Groundwater Impact Assessment

Upper Eastern View Formation (UEVF) Anglesea, Victoria

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Main Author(s)	C Smitt, Dr B Petrides, Dr R Fraser
Approved By	N Goulding
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Executive Summary

Alcoa are seeking to obtain approval from Southern Rural Water to reduce the existing Groundwater Licence (BEE029662), from 4000 ML/yr to 1,500 ML/yr (for 10 years) and amend its use to allow this groundwater to accelerate filling of the former Anglesea coal mine to help achieve the draft Mine Rehabilitation and Closure Plan (MRCP) objectives.

To ensure the reduced and amended allocation poses no unacceptable risks to the environment that may rely on groundwater, a groundwater impact assessment (GIA) has been completed in accordance with Section 51 and Section 59A of the *Water Act (1989)* and EPA Victoria Publication 688.1 (2022) Hydrogeological assessment guidelines for groundwater quality.

The GIA considers multiple sources of data and lines of evidence including:

- Review of multiple independent technical assessments conducted in the region relevant to potential groundwater impacts (**Section 2.3**);
- Detailed assessment of long-term water level, water quality, climate and surface water flow observation data from more than 130 groundwater monitoring points and available surface water flow sources (**Section 4**);
- Significantly improved Conceptual Hydro-geological Model for the Alcoa area of interest which has been subject to and endorsed by the regulator Inter Agency Group appointed independent Technical Review Panel (TRP); (**Section 6** and **Appendix A**);
- Predictive tools such as the updated 2024 Anglesea Groundwater Numerical Model, which has also been subject to and endorsed by the TRP comprised of independent experts from a wide range of fields including geology, hydrogeology, modelling, geochemistry, and ecology. The TRP was selected by an Inter Agency Group, representing the Water and Catchments Group of DEECA, Earth Resources Regulation, and Southern Rural Water (**Section 7** and **Appendix B**);
- Hydrogeological risk assessment including for proposed Alcoa groundwater extraction, including applying the relevant medium and high climate change models (**Section 8**);
- The results of a purpose designed groundwater pumping test completed in 2021 that was subject to significant regulatory oversight (**Appendix D** of **Appendix A**); and
- The feedback from on-going and recent community engagement processes and events (**Section 2.4**).

The GIA is based on long term water level, water quality, climate and surface water flow observation data that has formed a well-established and understood baseline of conditions across the catchment. This historical data also spans across numerous climatic and external groundwater stress periods that have operated at much greater stresses (i.e. higher groundwater extraction rates) than what is being proposed as part of the amended application. The hydrographic analysis (pre and post these stresses, including 9 years of continuous groundwater level observation data since Alcoa ceased UEVF extraction (2015)), show no observable or statistically significant trends which can be identified in the existing groundwater observation network for the shallow Alluvial Swamp Aquifer (ASA), indicating groundwater behaviours in these shallow aquifers have remained relatively consistent with seasonal variations, with climate (as indicated by rainfall) influencing its behaviour.

This is also supported by other observations as outlined in the hydrogeological conceptual model, such as:

- Groundwater mounding in the ASA following significant rainfall or flow events is not observed from daily monitoring groundwater data adjacent to the alluvial creek systems near the former power station, indicating in this area these leakage rates from the ASA to underlying aquifers is not a significant migration pathway.
- Isotope analysis of residual water pools in the ASA (or creek systems) supported evidence that these pools were not supported by groundwater; rather, they are surface water fed located in areas of low potential evapotranspiration.
- Groundwater level trends in the ASA are similar regardless of the underlying Upper Eastern View Formation (UEVF) potentiometric surface being higher or lower than the water table in the ASA.
- The Anglesea River has experienced low pH events prior to Alcoa activities at a sampling point located just upstream of the former Power Station with this area consistently recorded pH between 2.5 and 4 since 1967.
- Continuous pressure monitoring data from Vibrating Wire Piezometers (VWPs) from above the dewatered main coal seam (in the Demons Bluff Group) from 1999 to 2011 as well as those installed around the former power station from 2006 show no response to UEVF groundwater extraction.

From May to December 2021, Alcoa also conducted a groundwater pumping test as approved by Southern Rural Water (SRW) with close oversight by a cross regulator Technical Working Group (TWG) including SRW, ERR, EPA, DELWP and CCMA & Barwon Water. The purpose of the pumping test was to further assess potential risks associated with groundwater extraction and placement into the mine as part of the filling strategy. The ongoing results of the test, shared with regulators and community alike, importantly showed no adverse impact on groundwater dependent eco-systems including the Anglesea River.

In addition, the significant amount of available geological and hydraulic data and the responses to historical stresses has led to the development of a robust numerical model (2024 Anglesea Groundwater Model; also referenced herein as GHD 2024). The development of this model (including the hydrogeological conceptualisation) has been subject to and endorsed by a State appointed Technical Review Panel (TRP) comprised of independent experts from a wide range of scientific fields. This approach ensures that the model represents current best conceptual understanding, technical practice, and meets the model defined objectives (e.g. used to conservatively predict potential impacts such as lowering of water tables or impacts to stream flows as a result from extraction under certain climate models).

In using this model, and considering Alcoa's proposed amended groundwater entitlement, the 2024 Anglesea Groundwater Model predicts the following:

- The mine void can be filled decades faster than what it would naturally take, meaning the environmental and potential social and economic benefits of a rehabilitated safe and stable (steady state) landform can be realised much sooner.
- In the regions where Alcoa's pumping is modelled to have the greatest potential impact to the Alluvial Swamp Aquifer (ASA), that is the aquifer underlying the surface water marshlands, leakage rates as a result of the proposed groundwater entitlement are modelled to potentially increase by only:
    - 0.43 mm/yr along the ASA mid-section of Salt Creek; and
    - 0.75 mm/yr for along the ASA mid-section of the Anglesea River.

- Once the void is full of water, leakage from the shallow surrounding local aquifers into the void would cease meaning this recharge will remain in these aquifer systems for longer and not be lost to the mine void.
- Pit water migration was modelled by adding 300,000 particles in the waterbody and simulating movement across 150 model realisations, totalling more than 45 million particles. Of these, only 35 particles indicate a particle of water may extend past Alcoa's lease boundary. Furthermore, at the end of the model simulation, these particles are starting to turn back towards to mine water body
- Under a medium and high climate change scenario, the median water table drawdown at all observation bores within the ASA have modelled drawdown <0.1m resulting in the lowest consequence level of impact to GDEs as defined by the 2015 Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems.
- In areas where GDEs have no shallow alluvial observation bores, that is the marshlands in the alluvial valleys, under both climate change scenarios (high and medium), median drawdown is modelled to exceed 0.1m in only two small tributaries of the mid reaches of the Anglesea River. In this area, over the last 14 years, the potentiometric surface of the UEVF is higher than the water level in the ASA.
- Median drawdown for the alluvial swamps located along Salt Creek do not exceed 0.1m. This is an important observation as by reference it implies historical pumping and the reduction in surface water flow observed between the two periods, 2010 to 2023 and 1968 to 1981 are not strongly correlated.
- When considering model uncertainty and likelihood, e.g. the P10 uncertainty limit which takes into consideration 90% of the 150 model realisations, under a medium climate change scenario, the maximum potential drawdown at any shallow alluvial observation bore is 0.11m. This increases to 0.22m under a high climate change scenario. It is important to note that historical groundwater monitoring at this location shows no evidence of historical UEVF pumping related impacts (despite larger historical extraction rates). This modelled drawdown is also much less than the annual variability observed in groundwater levels.
- The modelling also predicts no reduction in annual no flow days at end of catchment gauging stations SV2 and AV2, and the seasonal variability of the ASA water table (WTOB1 and WTOB2) relative to the historical period do not result in any moderate or high consequence impacts or lead to an increased risk of acid generating events.

Despite the overall low risk and conservative approach (for example the numerical modelling takes into consideration a wide range of uncertainty by treating the P10 to P90 model outputs as the same likelihood to occur), as well as the effects of climate change, it is recognised that the ASA is a sensitive receptor, and that groundwater extraction does present a risk (albeit low as described above). Therefore, to monitor for potential risks, an adaptive monitoring and risk mitigation plan is proposed to form part of conditions imposed on any groundwater entitlement.

When cumulative impacts are considered (climate, Barwon Water potential Bulk Entitlement from LEVF, and Alcoa proposed amendment from UEVF), some increased risks to GDEs, surface water flows and potential acid generating events are forecast with these largely driven by climate impacts. While the licencing and approval of a LEVF BE is outside the control of Alcoa, it is nevertheless included for completeness in this GIA as directed by Southern Rural Water. For reference, the LEVF BE is currently going through a separate review by Barwon Water and Alcoa understands that it will be subject to approval by the Minister for Water under the Water Act 1989. Cumulative risks may also be managed via the inclusion in any entitlements (Barwon Water and Alcoa) appropriate adaptive monitoring and risk mitigation plans as described above.

Alcoa also recently conducted three open house style community engagement events seeking feedback on a potential Alcoa groundwater application and was provided with good support summarised as follows:

- 88 per cent of feedback received indicated that attendees felt they better understood the draft Anglesea Mine Rehabilitation and Closure Plan.
- 86 per cent of the feedback received indicated that attendees felt informed about what viable options there are to fill the mine pit.
- The majority of feedback (56 per cent) was assessed as being either neutral in tone or positive (32 per cent), with only 14 per cent assessed as negative.

On the basis of all of the above, Alcoa is now seeking a groundwater license amendment to enable the extraction of up to 1.5 gigalitres per year (GL/yr) for a period of 10 years (with appropriate conditions) to enable the accelerated filling of the mine pit consistent with the draft MRCP. As part of any amended groundwater licence, Alcoa proposes that one of the key conditions would include an updated adaptive management and monitoring plan, including trigger levels and actions, which must be provided to and accepted by SRW prior to any extraction occurring under this licence.

1 Introduction

Alcoa was licensed to extract 4,000 megalitres/year (ML/yr) from the Upper Eastern View Formation (UEVF) under Licence Entitlement ID BEE029662 up until 30 June 2024, however this licence does not permit the use of groundwater for the purpose of filling the former mine void.

Extensive investigations into possible options to fill the mine void as part of mine rehabilitation and closure planning has confirmed that only two options remain feasible, the use of UEVF groundwater (over 7-10 years) or via a natural fill (expected to take many decades). As such, Alcoa seeks to fill the mine void utilising groundwater from the UEVF. This "accelerated fill" strategy is consistent with the 'draft' Mine Rehabilitation and Closure Plan (MRCP) submitted to Earth Resources Regulator (ERR) in September 2017.

Left to fill naturally, it is estimated that the mine void will take many decades to fill. By accelerating the mine void filling, broader benefits can be realised sooner, such as:

- Completion of the Anglesea mine rehabilitation and closure and return of the Crown land area to the State and to the community in a timely fashion, and many decades quicker than otherwise achievable.
- Shallow groundwater systems in the vicinity of the mine void achieves steady state decades quicker than otherwise.
- Assists with geotechnical stability, which comprises a safe and stable landform (e.g., risk of floor heave is reduced).
- A large permanent water source is available to support the long-term Lower Anglesea River management strategy at the discretion of the State.
- An emergency supply of water which is of equivalent water quality, if not better than some existing surface water conditions, will be available to help mitigate bushfires.

Potential economic benefits including significant long term employment opportunities to the region could be realised as part of potential eco-tourism opportunities and projects. These types of projects would create significant sustainable community amenity and act as a catalyst for an estimated potential regional economic benefit of more than one billion dollars over a ten-year period (e.g. the Eden Project).

Alcoa is now seeking a groundwater license amendment to enable the extraction of up to 1.5 gigalitres per year (GL/yr) for a period of 10 years (with conditions) to enable the accelerated filling of the mine pit consistent with the draft MRCP. In the interests of exercising the precautionary principal, Alcoa is proposing a lower rate of extraction than compared to historical, recognising that some in the community have concerns with groundwater extraction, and to also to ensure that any risks to groundwater dependent ecosystems (GDEs) and the Anglesea River are minimised or avoided.

As part of the proposed license amendment, Alcoa proposes to adopt an adaptive management and monitoring plan that includes the establishment of agreed early intervention groundwater monitoring triggers, actions, contingencies and reporting – similar to that adopted for the 2021 Alcoa groundwater pumping test, and also used by Barwon Water.

1.1 Background

The former Anglesea Coal Mine (referred to as “the mine”) is located approximately 3 kilometres (km) northwest of the Anglesea township in Victoria. Adjacent to the mine is the former Anglesea Power Station (referred to as “the former power station”).

Alcoa were licensed to extract 4,000 ML/yr from the UEVF under Licence Entitlement BEE029662 (also referred to as a Groundwater Licence or a Take and Use Licence) until 30 June 2024. The purpose of use is permitted as industrial or commercial use, as well as industrial and stock but is subject to the groundwater being used on Allotment 64D of the former power station site only (Block 1-4 on **Figure 1-1**).

Filling the mine void with groundwater, which is not located on Allotment 64D, remains a key enabler for the draft MRCP as submitted to ERR in September 2017.

During the progressive rehabilitation works over the past nine years, the mine void water level has been slowly rising as forecasted largely as a result of natural groundwater recovery, direct rainfall, and local catchment runoff only with a small amount also added as part of the 2021 Alcoa groundwater pumping test. Using the latest predictions from the 2024 Anglesea groundwater numerical model (referred to herein as the Alcoa Groundwater Model; refer **Section 7**), it is estimated that allowing the mine void to naturally fill to a height of +4.0 metres Australian Height Datum (m AHD) will take many decades (refer to **Section 7** for further discussion on fill time uncertainty). The fill height of +4.0 m AHD has been defined in the draft MRCP as full, noting the mine void overflow to Marshy Creek is at an RL of approximately +10 m AHD (equivalent volume of more than 6 Gigalitres (GL)).

Alcoa submitted a Groundwater Impact Assessment (GIA) in September 2020 evaluating risks to both the environment and third-party users associated with a proposed 12-month groundwater pumping test of the UEVF aquifer. In October 2020, Southern Rural Water (SRW) issued an amended groundwater licence including an Addendum (LH1575619) to the Licence Entitlement BEE029662 and Licence to Operate Works WLE0351661.

The amended groundwater licence permitted a 12-month groundwater pumping test and extraction of up to 1.5 GL of groundwater from the UEVF ‘for the purposes of discharging groundwater to the mine void as part of the amended licence’.

Alcoa subsequently commenced a groundwater pumping test of the UEVF aquifer on 13 May 2021 to enable further investigations of groundwater use. The pumping test was paused on 8 December 2021 after a total of 671.9ML was extracted, representing approximately 44 percent of the licensed volume. The findings of the first 6-months were reviewed during this period, with data used to inform the development of the 2024 Anglesea Groundwater Model (refer **Section 7**) and also an updated UEVF Conceptual Hydrogeological Model (CHM).

It was subsequently determined by SRW, based on advice provided by an Inter-Agency Group (IAG – DEECA, SRW, ERR) selected Technical Review Panel (TRP) that the second 6-month period of the pumping test would not provide any additional information to further constrain data gaps and uncertainty to support the development of the CHM and Anglesea Groundwater Model, required for the potential future application for licence amendments.

The works to update the UEVF CHM for the Alcoa area of interest were completed by EHS Support for Alcoa during 2022, with independent peer review provided by the TRP, culminating in the update being approved by TRP on date 8 February 2024. The UEVF CHM is provided in **Appendix A**.

The works to update the 2013 Anglesea Groundwater Model were completed during 2022 and 2023 in conjunction with Barwon Water, with independent peer review provided by IAG/TRP, culminating in the updated 2024 Anglesea Groundwater Model being deemed '*fit for purpose for conducting predictive modelling to inform Barwon Water's Bulk Entitlement review process and Alcoa's mine rehabilitation strategy and groundwater assessment for a groundwater licence application'* by the IAG/TRP on February 8th, 2024 (**Appendix B**).

1.2 Purpose/Objective

The purpose of this report is to provide a groundwater impact assessment (GIA) to support a proposed amendment of Alcoa's groundwater licence (BEE029662), from 4000 ML/yr to 1,500 ML/yr (for 10 years).

The use of this groundwater is to enable faster filling of the mine pit void consistent with the Mine Rehabilitation and Closure Plan providing a long term safe, stable, and sustainable landform. The accelerated filling will create a water body in 7 to 10 years in contrast to natural filling which would take many decades.

The mine pit water body is not intended to provide environmental values such as direct contact recreational uses and flora/fauna habitat support which are not complimentary to the background surface waters and local catchment. The water body does however have the future potential to provide non- direct contact recreational aesthetic enjoyment such as visual appearance and bird watching from the surrounding Anglesea Heath.

This report has been developed in accordance with EPA Victoria Publication 688.1 Hydrogeological assessment guidelines for groundwater quality and Section 59A of the *Water Act* (1989) to provide a GIA to support an amendment to Alcoa's Licence Entitlement to Take and Use groundwater from the UEVF, seeking to permit use of this groundwater to accelerate filling of the mine void.

Furthermore, to align with the precautionary principal and to satisfy Section 40 of the Water Act 1989, the results presented in this application err on the side of conservatism as the numerical results which form the risk assessment have isolated Alcoa's pumping impact from other cumulative impact contributors such as Barwon Waters Bulk Entitlement and climatic factors, also presented in this application. By using this approach, the modelled outputs are more conservative (i.e. Alcoa's numerical impact is likely greater than may be realistically observed, thus satisfying Section 40 of the Water Act 1989). This is further discussed in **Section 0**.

Title Details

- 1 - TITLE Vol. 5944 Fol. 708 CA 63B1 PARISH JAN JUC TP397728Q COALMINE ROAD ANGLESEA VIC 3230
- 2 - TITLE Vol. 5944 Fol. 708 CA 64D PARISH JAN JUC TP397728Q COALMINE ROAD ANGLESEA VIC 3230
- 3 - TITLE Vol. 8876 Fol. 425 CA 66 PARISH JAN JUC TP776734J 205 COALMINE ROAD ANGLESEA VIC 3230
- 4 - TITLE Vol. 2047 Fol. 251 Lot 12 ON LP1981 (TP483388J) 75 CAMP ROAD ANGLESEA VIC 3230
- 5 - TITLE Vol. 5535 Fol. 856 Lot 13 ON LP1981 (TP483389G) 75 CAMP ROAD ANGLESEA VIC 3230
- 6 - TITLE Vol. 11005 Fol. 835 Lot 2 ON PS543785E 75 CAMP ROAD ANGLESEA VIC 3230
- 7 - TITLE Vol. 9532 Fol. 292 Lot 4 ON LP142943 75 CAMP ROAD ANGLESEA VIC 3230
- 8 - TITLE Vol. 9252 Fol. 185 Lot 1 ON TP193327W 60 GOLF LINKS ROAD ANGLESEA VIC 3230
- 9 - TITLE Vol. 8230 Fol. 618 Lot 1 ON TP408603H 60 GOLF LINKS ROAD ANGLESEA VIC 3230
- 10 - TITLE Vol. 8489 Fol. 766 Lot 2 ON LP61660 60 GOLF LINKS ROAD ANGLESEA VIC 3230
- A - LAND LEASED TO BMX CLUB PART TITLE Vol. 9532 Fol. 292 Lot 4 ON LP142943 75 CAMP ROAD ANGLESEA VIC 3230
- B - LAND LEASED FROM GOLF CLUB Part of Lot 1 on PS641442 and Reserve 1 on PS641442 GOLFLINKS ROAD ANGLESEA VIC 3230

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User Name: Danny.Barnes; Date and Time Printed: 19/06/24 2:57:06 PM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20240613_GroundwaterImpact Assessment\Figure1-1-AllotmentLocationsforWaterDischarge.mxd

Allotment Locations for Water Discharge

0 125 250 500 750 1,000 m

1 cm = 125 m [Page Size: A3]

LEGEND

- Parcel Boundary
- Watercourse
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

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Figure 1-1

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APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:12,500
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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2 Site Overview

2.1 Site Location

The former Anglesea Coal Mine is located approximately 3 km northwest of the Anglesea township in Victoria. Adjacent to the mine (to the west-northwest) is the former power station. The general site layout is shown in **Figure 2-1** and its regional location is shown **Figure 2-2**.

SALT CREEK
SALT CREEK
SALT CREEK
SALT CREEK
SALT CREEK
PROPOSED SALT CREEK ALIGNMENT
SALT CREEK
LOWER ANGLESEA RIVER
LOWER ANGLESEA RIVER
LOWER ANGLESEA RIVER

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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General Site Layout

0 125 250 500 750 1,000 m

1 cm = 115 m [Page Size: A3]

LEGEND

Monitoring Bore - Aquifer Monitored
- Demons Bluff Group - Alluvial Sand Aquifer
- Demons Bluff Group - Boonah Sands Aquifer
- UEVF
- UEVF (Basal Sands)
- UEVF (Upper Sands)
- UEVF/MEVF
- UEVF/LEVF
- LEVF
- Decommissioned

- Current Water Level (-19mAHD)
- -4mAHD
- 4mAHD
- Extent of Consolidated leached ash (CLA)
- Mine Sump
- APS Investigation Area
- Mine Infrastructure Area
- Ash/Water Reclamation Ponds
- Mine Water Reclamation Pond

- Wetland Dam
- Formerly Licensed Mixing Zone
- Former Power Station
- Surface Water Sample Location
- Watercourse
- Parcel Boundary
- Marshland
- AUS_AustralianStates_GA

Alcoa Anglesea Groundwater Impact Assessment

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Melbourne
Geelong

Figure 2-1

N

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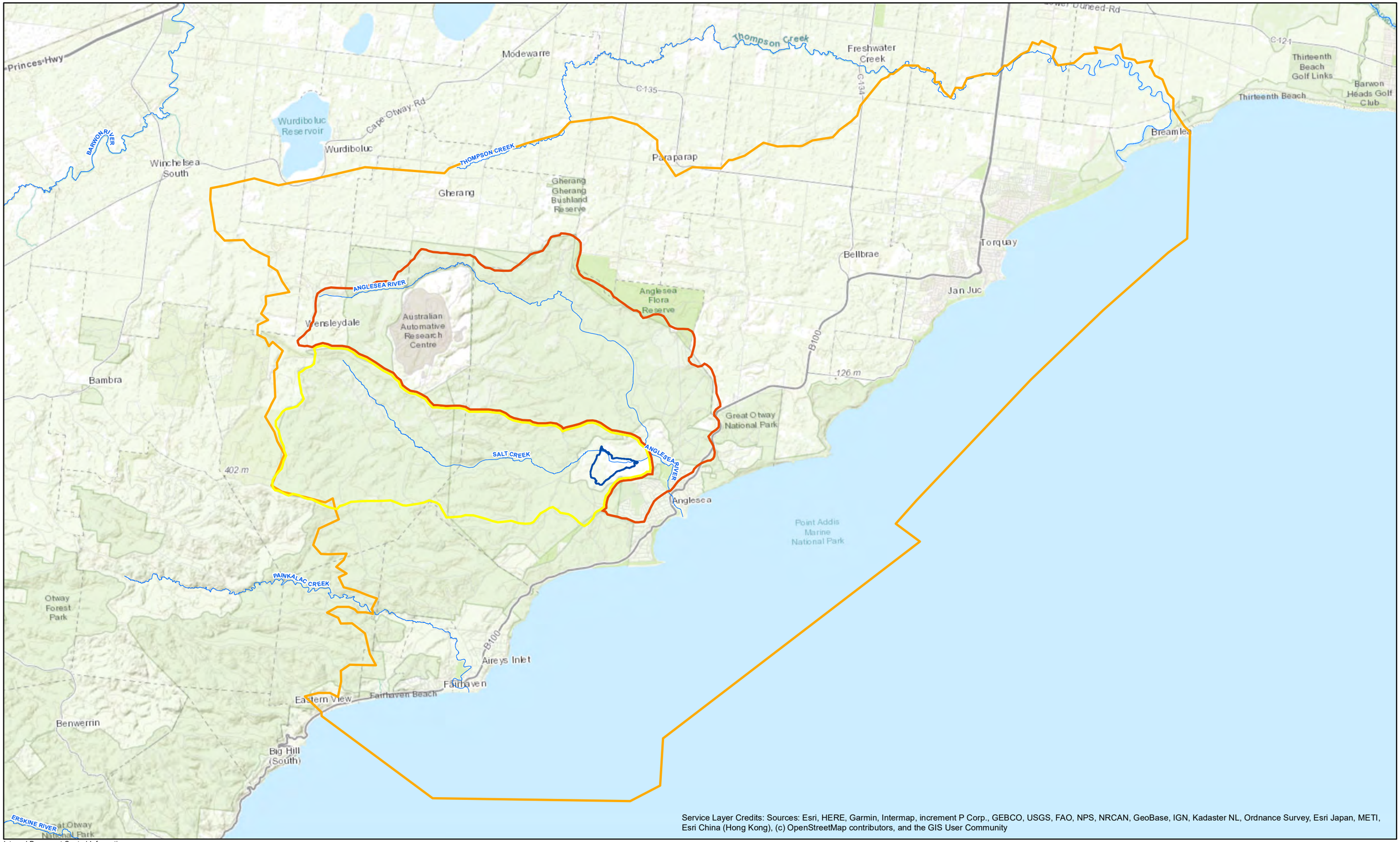

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Regional Site Location

0 1.25 2.5 5 7.5 10 Kilometers

1 cm = 1 km [Page Size: A3]

LEGEND

- Lake Boundary (+7mAHD)
- Anglesea River Catchment
- Watercourse
- Salt Creek Catchment
- Jan Juc GMA boundary

Alcoa Anglesea Groundwater Impact Assessment

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Figure 2-2

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MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:122,428
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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2.2 Site History

2.2.1 Pre 1960

Roche Brothers commenced open cut mining operations on the Anglesea coal deposit in the late 1950s. Around the same time, the concept for an aluminium smelter at Point Henry was developed (by Western Aluminium NL which became Alcoa of Australia (Alcoa) in 1961) about 7 km from Geelong, with feedstock alumina to be shipped from Western Australia.

The concept envisaged that the smelter would be supplied with approximately 70 percent (at that time) of the required electricity from a new generating station to be located at Anglesea and fuelled from the adjacent brown coal mine. Drilling was undertaken in 1960 in the Anglesea area which revealed a main coal seam mining area adjacent to the lower seam being operated by Roche Brothers. Assessments at the time showed a coal deposit of about 120 million tonnes, compared with approximately 30 million tonnes assessed by Roche Brothers.

2.2.2 1960-2016 (Mine Operation)

The mining rights were obtained by Alcoa from Roche Brothers at Anglesea, and on 22 November 1961 the *Mines (Aluminium) Agreement Ac*t was passed, providing Alcoa the rights to explore and mine over 7,350 hectares of leasehold land largely to the northwest of Anglesea, including the area being mined by Roche Brothers. Power station construction began in 1965 with the first power produced in March 1969.

The drilling program revealed that the original mining by Roche Brothers was in a lower seam to the west of the main upper seam. A new mine was resultingly opened adjacent to and expanding away from the power station site. Overburden removal was initially used for backfilling the old Roche Brothers open cut mine and to facilitate rehabilitation of the entire Roche Brothers site. **Figure 2-4** shows the progressing mining extents and **Figure 2-5** shows progressive backfilling extents.

Alcoa began to pump groundwater from the UEVF in 1969 to support the then newly constructed operation of the power station and mine. A series of boreholes from 1964 were drilled by Alcoa that were licensed to extract groundwater from the lower aquifers within the UEVF (**Figure 2-6**). These extraction bores extracted groundwater used for process and cooling water for the power station, with surplus (treated) process water directed to an Environment Protection Authority (EPA) licensed discharge point, providing baseflow and pH ~7-8 water to the Lower Anglesea River. Daily extraction rates from these bores were collectively around 4.5 ML/day. Prior to this licenced discharge, the pH of surface water upgradient of the former power station site has consistently remained acidic (**Figure 2-3**) due to natural catchment processes.

The historical groundwater extraction bore network at the time comprised bores WB9, WB10, WB13, WB14, WB15, WB16, and WB17 (**Figure 2-6**). Some of these bores (WB9, WB10, WB13, and WB17) have since been decommissioned (refer **Section 2.2.4.4**). In addition to the extraction bores, Alcoa undertook mine dewatering activities directly from the mine pit. The mine pit, which is excavated to a maximum depth of approximately -45 m AHD, was dewatered from a progressively moving sump positioned at the lowest part of the operational mine at an extraction rate ranging between 1 to 1.5 ML/day when pumping. This pumping was conducted intermittently, approximately 60 percent of the time (based on in-flows and rainfall).

The majority of groundwater extraction ceased in 2015 following the shutdown and closure of the Anglesea power station and mine on August 31st, 2015, with final extraction ceasing on March 1st 2016, after Alcoa provided ongoing support, such as maintenance of environmental flows, to the Anglesea River at the request of the State.

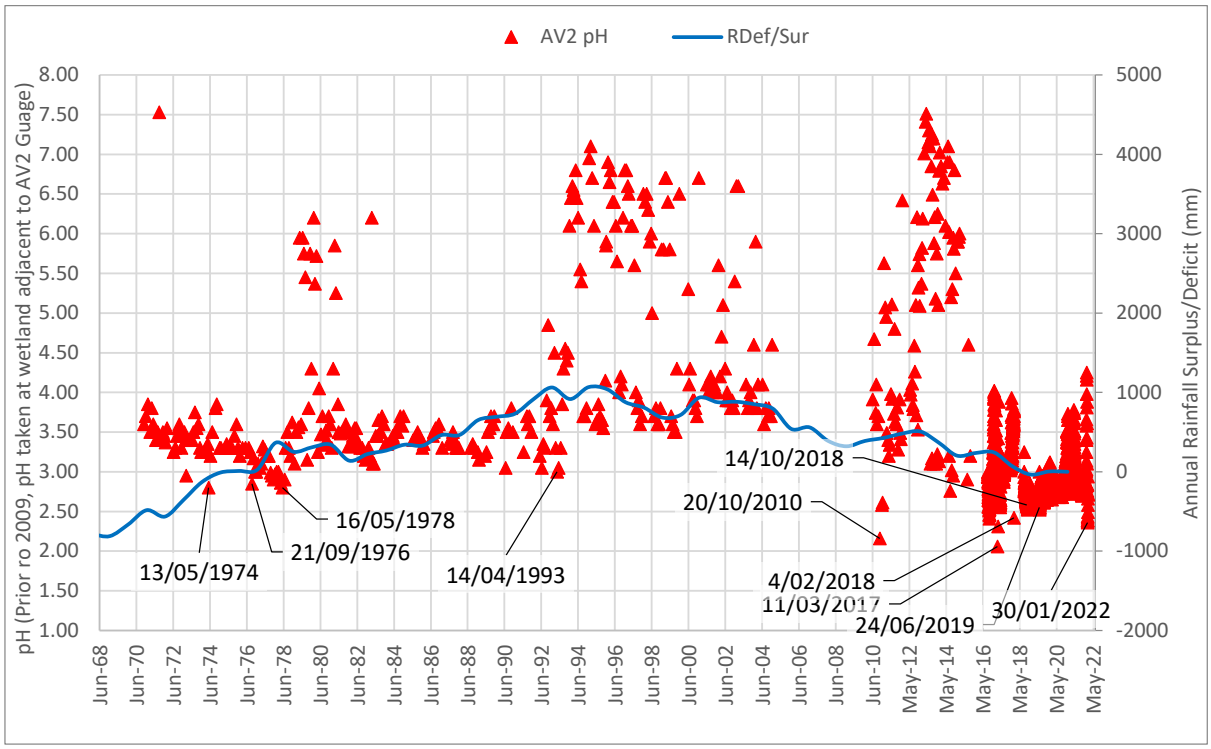


Figure 2-3 Historical pH Upgradient of the Former PowerStation

2.2.2.1 Historical Ash Management

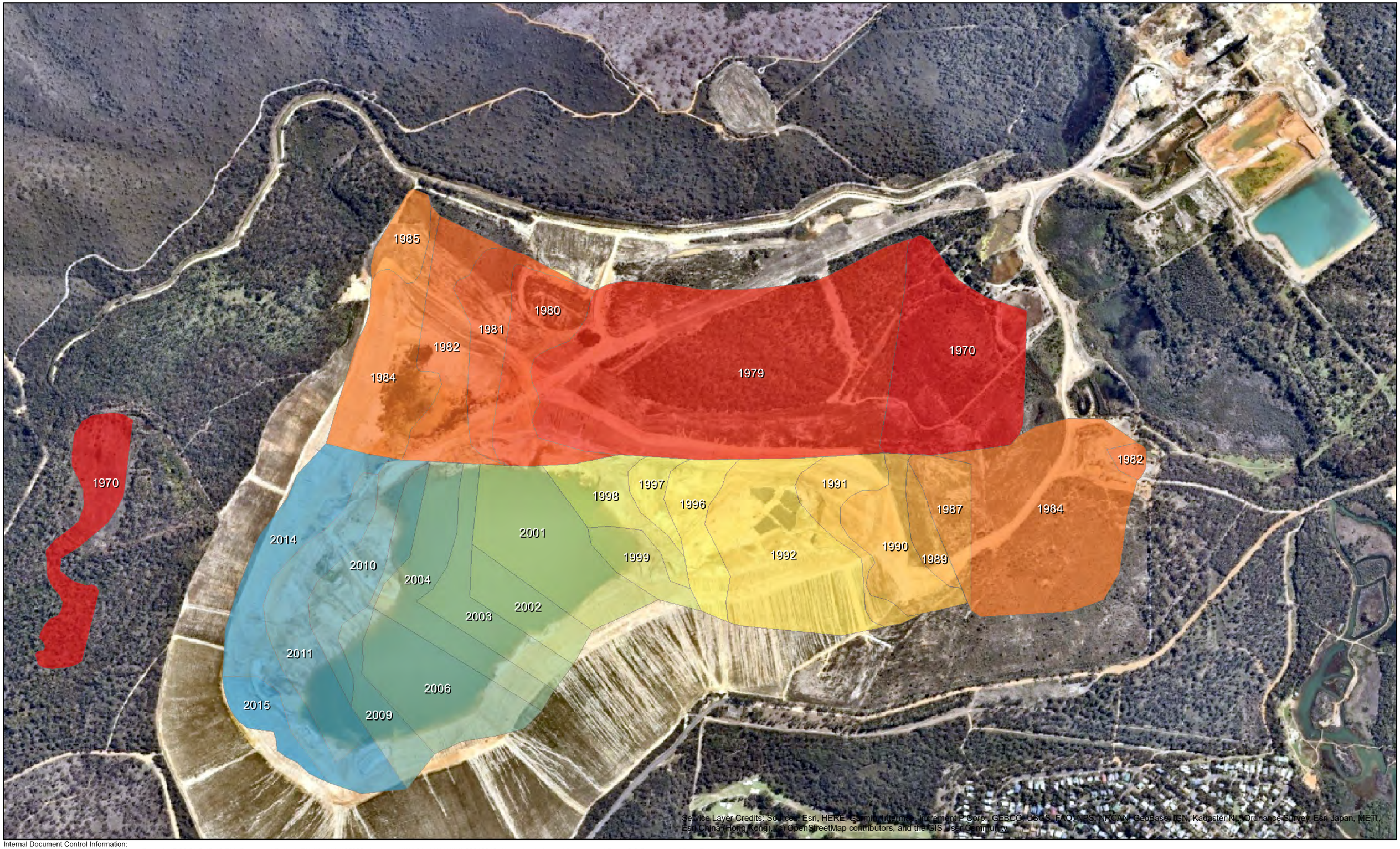
The former power station at Anglesea used coal from the former open cut brown coal mine (adjacent to the power station) to generate electricity for the aluminium smelting facility in Point Henry, Geelong. The power station started generating electricity in 1969 and closed in 2015. Approximately 1 million tonnes of brown coal was consumed by the power station each year (GHD, 2012). The ashing system was used to collect, convey, and dispose of the ash generated within the furnace and from the precipitators at the Alcoa Anglesea former power station. The coal at Anglesea contained on average between 2 to 4 percent ash, which is a by-product of the coal combustion process. Some of the ash was collected in the furnace bottom hopper, while the fly ash was entrained in the flue gases. The fly ash comprised a greater proportion of the total ash. The electrostatic precipitators collected the fly ash from the gas stream before the atmospheric dispersal of gases via the stack. The bottom ash from the furnace was sluiced away by water from the ash tank and the fly ash was removed by a pneumatic system. The combined furnace ash and fly ash was then transported by the water sluices through piping to the northern most Ash reclamation Pond shown on **Figure 2-1**.

Leached ash from this pond was periodically removed and dried. With the excavated leached ash was then deposited in the mine pit and incorporated into the general overburden backfill process as per the historical Mine Work Plan endorsed by ERR.

When the former Power Station was closed, the final dried leached ash was progressively tipped by truck and deposited in the consolidated leached ash (CLA) area within the south-eastern corner of the former coal mine, refer on **Figure 2-1**. This was permitted in accordance with the Mine Work Plan endorsed by Earth Resources Regulation (ERR) in September 2011.

The CLA material which has been encapsulated by at least 1m of rolled clay, will be inundated and submerged by the developing water body. To ensure Alcoa meets its general environmental duty (GED) by demonstrating that risks to the environment (including surface water and/or groundwater) remain low as far as reasonably practical in both the short and long term regardless of the water body fill strategy, a detailed technical review and risk assessment was undertaken. This review which been independently peer reviewed by BlueSphere is attached as **Appendix C** and demonstrates risks remain low.

Finally, when reviewing **Appendix C**, the reader should also review **Section 7.3.5**, which provides information about pit water and aquifer interaction.



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Progressive Mining Extents

0 100 200 400 600 800 Meters

1 cm = 80 m [Page Size: A3]

LEGEND

Year						
1970	1981	1987	1992	1999	2004	2011
1979	1982	1989	1996	2001	2006	2014
1980	1984	1990	1997	2002	2009	2015
	1985	1991	1998	2003	2010	

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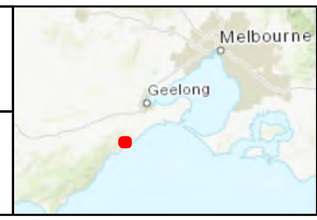

Figure 2-4

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APPROVED BY:	B. Petrides
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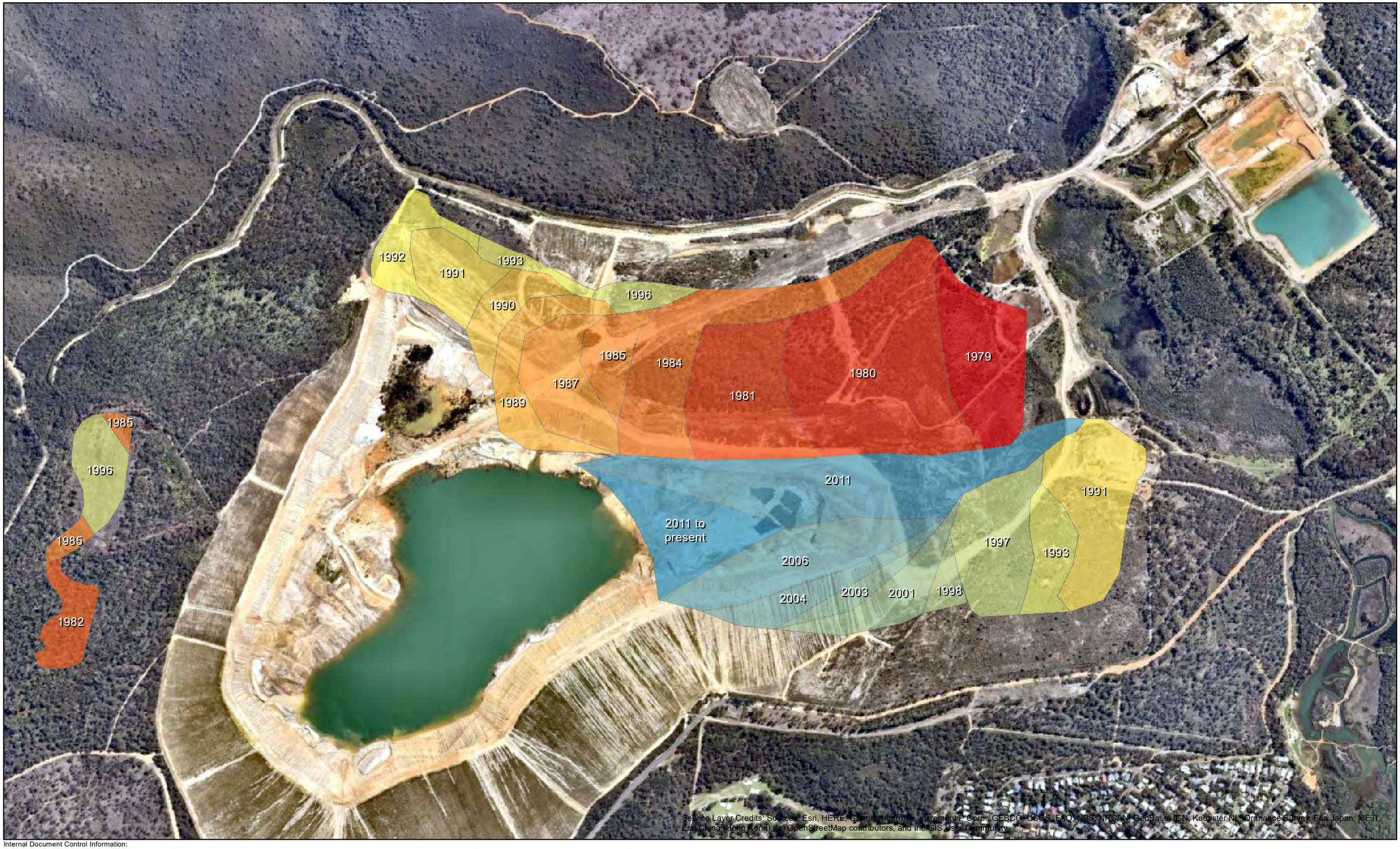

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Progressive Backfilling Extents

0 100 200 400 600 800 Meters

1 cm = 80 m [Page Size: A3]

LEGEND

Year					
1979	1982	1989	1993	2001	2011
1980	1984	1990	1996	2003	2011 to present
1981	1985	1991	1997	2004	
	1987	1992	1998	2006	

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Figure 2-**5**

N

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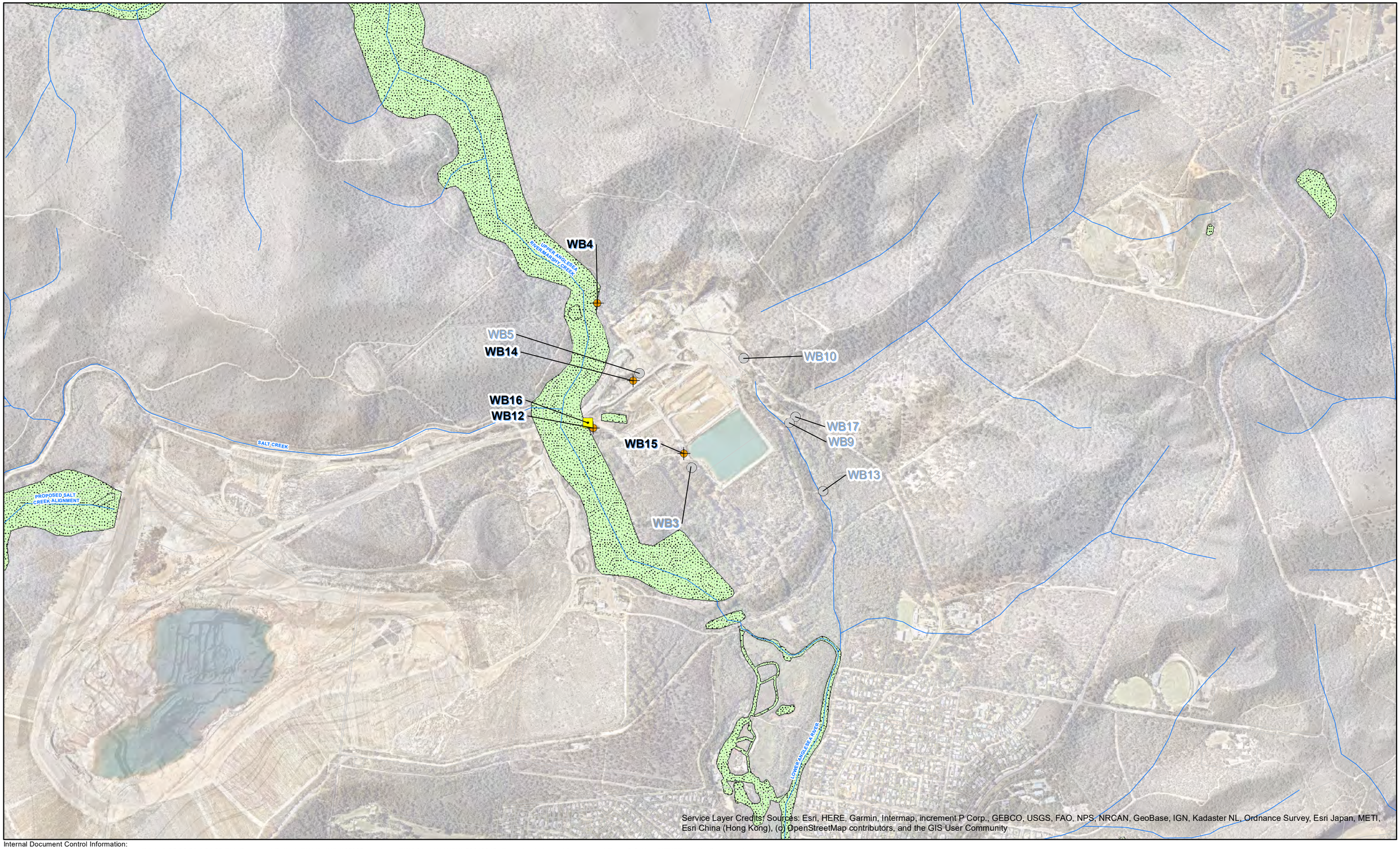

Internal Document Control Information:
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Alcoa UEVF Extraction Bores

0 125 250 500 750 1,000 Meters

1 cm = 125 m [Page Size: A3]

LEGEND

- Monitoring Bore
- Pumping Bore
- Decommissioned
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

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Figure 2-**6**

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APPROVED BY:	B. Petrides
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SCALE:	1:12,500
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2.2.3 Post-2008 – Barwon Water Groundwater Extraction

The Barwon Water Anglesea Borefield (referred to as the Anglesea Borefield) is used to extract groundwater from the Lower Eastern View Formation (LEVF) in the Jan Juc Groundwater Management Area and contains seven production bores that are licensed to extract a maximum of 40 ML/d, or 10,000 ML in any year, and 35,000 ML in any 5-year period. Five of the seven bores (GW1, GW 2, GW3, GW4, and GW5) are located proximal to the Anglesea mine (**Figure 2-8**).

Commissioning and testing of the bore field first commenced in October 2009 and ceased in June 2012, with a total of 7,617 ML pumped during that period. Due to low water storage levels, recommissioning of the bore field began in August 2019 to supplement the existing Greater Geelong water supply system. Between August 2019 and end of June 2020 a total of 2,177 ML was extracted from the Anglesea Borefield[1].

The Anglesea Borefield was moved into a standby maintenance mode from 1 July 2020, and has only been operated for maintenance purposes until 27 January 2022, when Barwon Water began a 6-month groundwater pumping test to inform a review of its bulk entitlement and environmental monitoring program.

A timeline of historical extraction for both the UEVF and LEVF is presented in **Figure 2-7**.

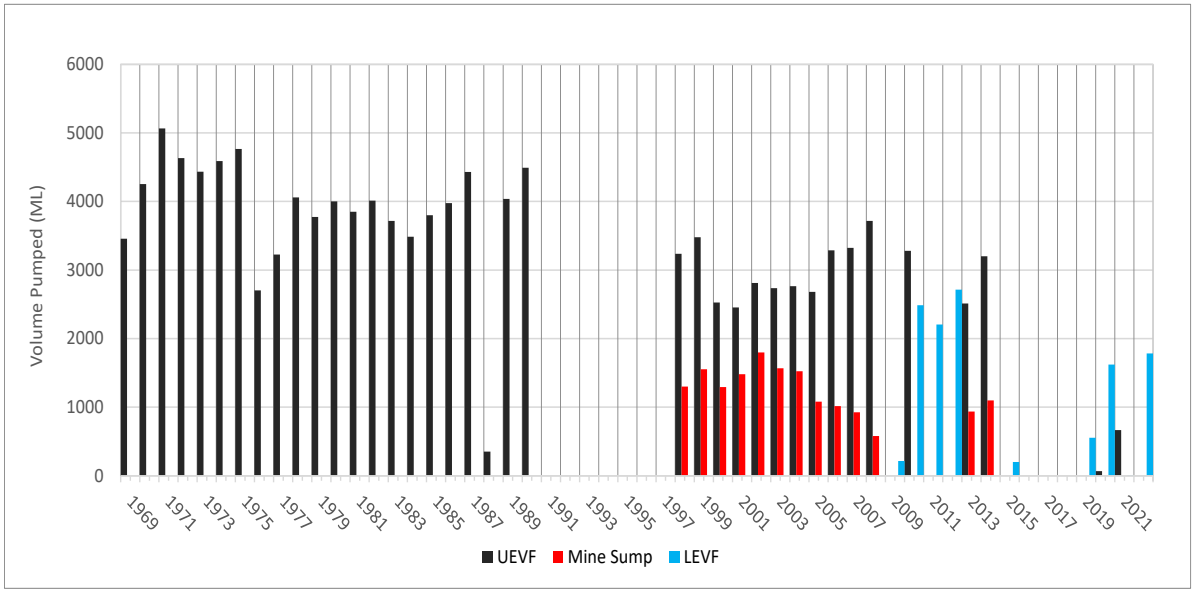
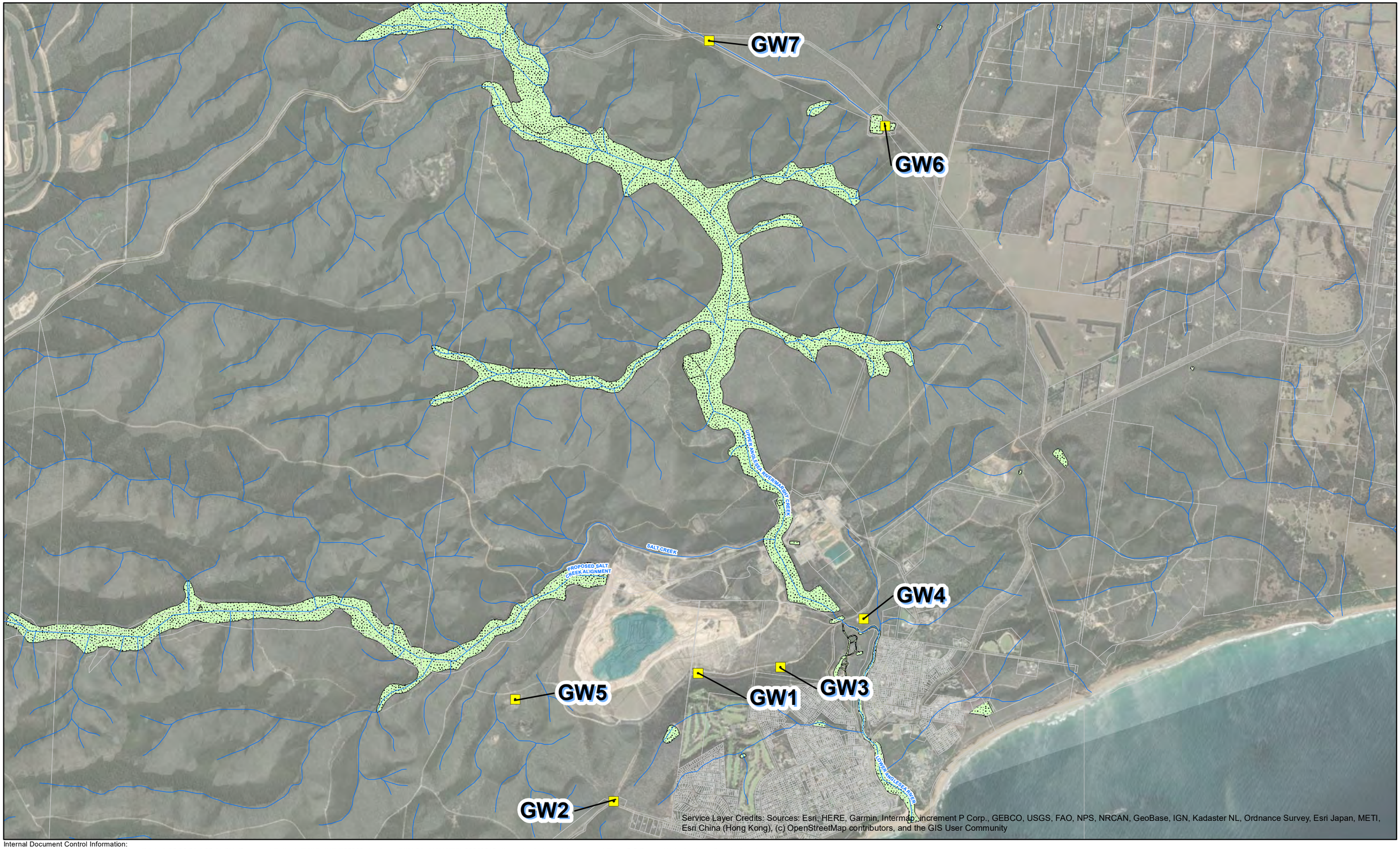


Figure Notes:
UEVF Data missing for 1991-1997, 2009 & 2011-2012
UEVF volumes prior to 1989 also include the mine sump volume

Figure 2-7 Timeline of Historical Groundwater Extraction (UEVF, Mine Sump, and LEVF)

[1] https://www.barwonwater.vic.gov.au/about-us/major-projects/anglesea-borefield



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Barwon Water Anglesea Borefield

0 0.25 0.5 1 1.5 2 Kilometers

1 cm = 331 m [Page Size: A3]

LEGEND

- Pumping Bore
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

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Figure 2-**8**

N

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2.2.4 Mine Rehabilitation Since 2015

Following the shutdown of the former power station and mine in August 2015, detailed planning for the final closure and rehabilitation of the mine commenced including detailed technical studies and community and regulator engagement. In September 2017 a draft MRCP was submitted to ERR proposing earthworks, revegetation, and the establishment of a water body. In March 2018 a Work Plan Variation - Progressive Rehabilitation was subsequently approved by ERR approving the earthworks and revegetation works.

Major earthworks were commenced in November 2018 and completed in June 2020, including the reprofiling of the west and south slopes of the mine, the installation of surface water catchment drains at strategic points around the mine, and the relocation of part of Coal Mine Road.

Revegetation works consisted of native heathy topsoil revegetation works in 2018 and 2019 on the north and west walls, and also the establishment of a large native grassland on the south wall which was completed in September 2020. Both the earthworks and revegetation works have entered a monitor and maintain phase with active monitoring programs in place.

2.2.4.1 Installation of Groundwater Observation Bores (2020 / 2021)

During 2020 and 2021, 16 groundwater observation bores were constructed around the periphery of the mine in addition to the 71 existing Alcoa installed bores. The rationale for the construction depth and location of these bores is discussed in **Table 2-1**. The construction details and bore logs are presented in **Appendix A**. The location of these bores is shown on **Figure 2-9** and **Figure 2-10**.

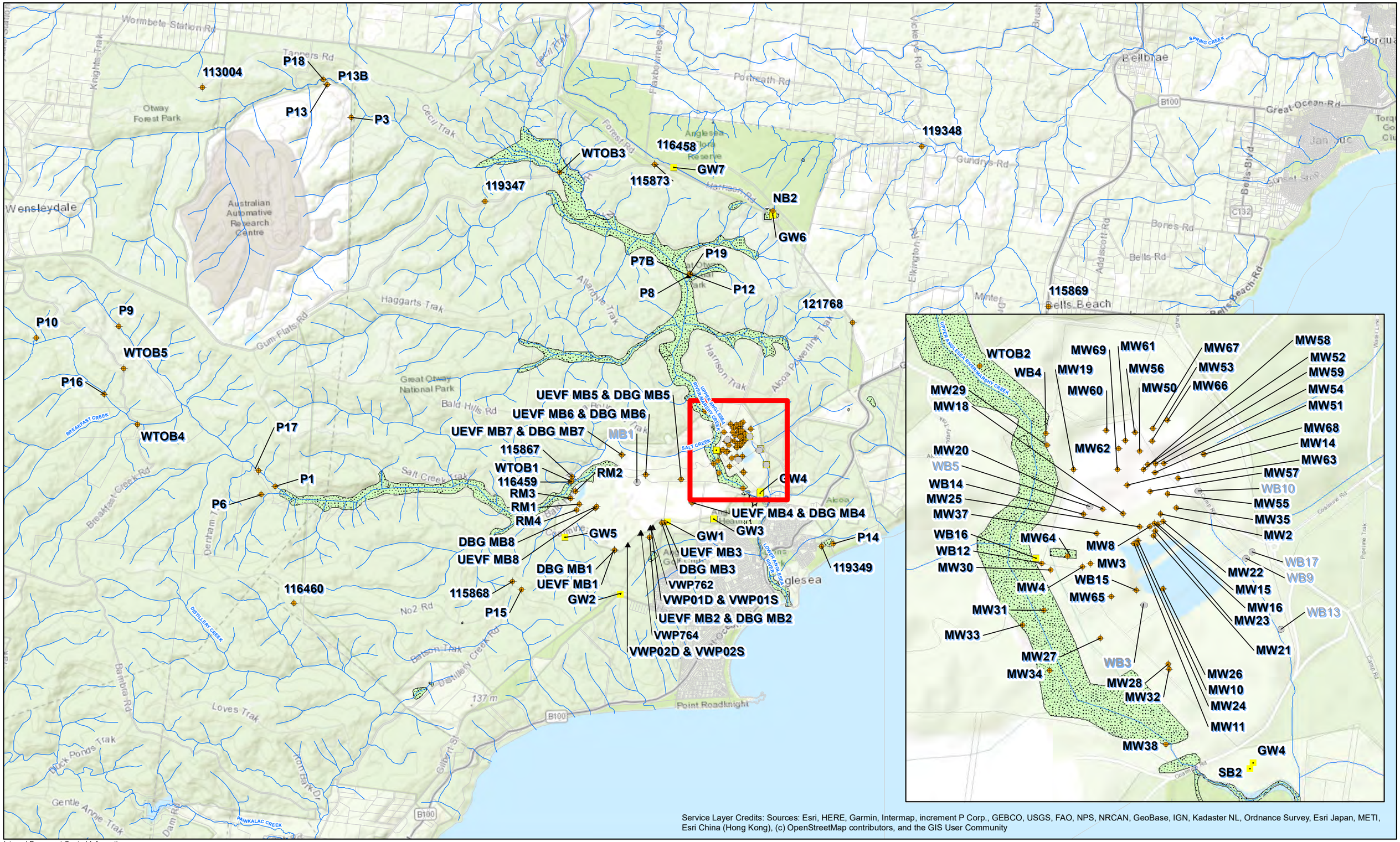
Table 2-1 Rationale for Construction of New Near Mine Void Bores

Bore ID	Rationale
UEVF MB 1	The purpose for construction of these bores is to: • Obtain a greater understanding of the lithology and groundwater levels in the upper section of the UEVF. • Confirm extensiveness of the basal clay which is assumed to overlie and confine these “upper sands”. • Act as monitoring bores to monitor for potential drawdown impacts arising from the pumping test undertaken in May 2021 which could then imply drawdown from the mine pit waterbody into formation.
UEVF MB 2	
UEVF MB 3	
UEVF MB 4	
UEVF MB 5	
UEVF MB 6	
UEVF MB 7	
UEVF MB 8	
DBG MB 1	The purpose for construction of these bores is to: • Obtain a greater understanding of the lithology and groundwater levels in the unconsolidated mine overburden, the natural DBG and the Boonah Sands surrounding the mine. • Act as monitoring bores to monitor for potential drawdown impacts arising from the pumping test and to obtain baseline data which can be used to monitor for pit water/aquifer when the waterbody reached such level that pit water may naturally migrate into the DBG.
DBG MB 2	
DBG MB 3	
DBG MB 4	
DBG MB 5	
DBG MB 6	
DBG MB 7	
DBG MB 8	

2.2.4.2 Catchment Drains

Important to the overall mine water balance are the installation of catchment drains to assist surface water runoff from the greater mine catchment area to be directed into the mine void without damaging the engineered slopes. Some of these drains are pictured on **Photo 2-1** and the overall layout of the drains and their supporting catchment is shown in **Figure 2-11**.

Photo 2-1 Images of the Installed Catchment Drains (Drain 4 (left); Drain 9 (right))



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Internal Document Control Information:
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Groundwater Observation and Extraction Bores

0 0.5 1 2 3 4 Kilometers

1 cm = 589 m [Page Size: A3]

LEGEND

Bore Type

- Monitoring Bore
- Pumping Bore
- Vibrating Wire Piezometer
- Unknown Well Type
- Decommissioned
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure 2-9

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:58,900
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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Alcoa Observation and Extraction Bores in the vicinity of the Mine Void

0 0.125 0.25 0.5 0.75 1 Kilometers

1 cm = 112 m [Page Size: A3]

LEGEND

Bore Type

- Monitoring Bore
- Pumping Bore
- Vibrating Wire Piezometer
- Unknown Well Type
- Decommissioned

- -4mAHD
- 4mAHD
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

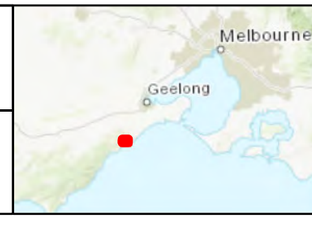

Figure 2-10

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:11,241
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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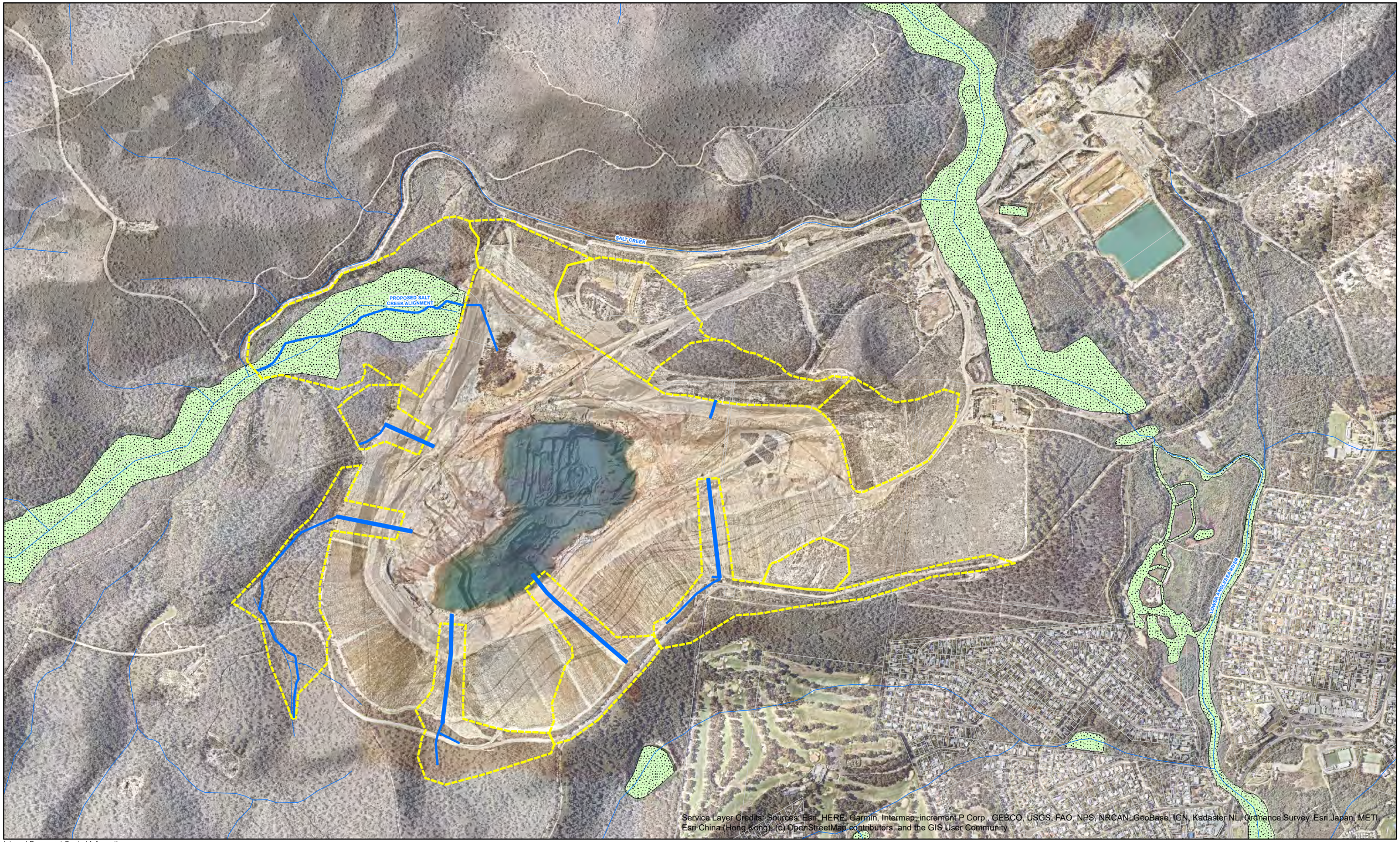

Internal Document Control Information:
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Location of the Catchment Drains

0 0.125 0.25 0.5 0.75 1 Kilometers

1 cm = 112 m [Page Size: A3]

LEGEND

- Drainage
- Catchments
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure 2-11

N

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:11,241
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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2.2.4.3 Subsidence Monitoring

From 1996 onwards the potential for subsidence has been monitored from prism and GPS pin monitoring from the south wall area of the mine; in summary, the movement that is observed during the 2000's is attributed specifically to 'relaxation' of the wall in response to actual mining operations. Relative levels typically have not otherwise moved significantly since monitoring began.

2.2.4.4 Decommissioning of Site Infrastructure

Between 1969 and 2015, Alcoa's groundwater extraction and monitoring used a series of 12 groundwater bores located across the former power station site (WB3, WB4, WB5, WB8, WB9, WB10, WB12, WB13, WB14, WB15, WB16, and WB17). During 2020 and 2021, these bores were subject to a borehole assessment program (BAP) which comprised geophysical logging (gamma and calliper) and downhole camera inspection to determine the bores condition and the reliability of the data during the pumping test. A summary of the results is presented in **Table 2-2** with the detailed results shown in **Appendix A**.

Table 2-2 Findings of Bore Assessment Program

Bore ID	BAP Assessment	Action
WB3	During the CCTV investigation the bore was confirmed to be full of sediment. The bore was cleaned out using mud rotary drilling techniques to a depth of 201 m, which is either the base of the bore or an obstruction. The drill rig could not progress past this depth. The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF and was therefore decommissioned. The bore was perforated at a depth of 195 m, 5 m above the UEVF/MEVF interface.	Decommissioned
WB4	This bore was repaired in 1977 by re-sleaving with an 8-inch casing. As part of the BAP, the drilling contractor advanced down through the bore annulus to 195m. A geophysics survey was completed, and the screened intervals were confirmed at 117 - 120 m, 161 - 164m, and 176 - 182m. It is likely that other screened intervals were installed but these could not be confirmed by the geophysics survey. A decision was made to re-sleave WB4. The re-drilling of the bore as part of the BAP was successful and lithological information and geophysical logs were reviewed to enable a suitable design. The following bore design summary is provided: • 50mm diameter screen and casing. • Screen intervals at 117-120m, 161-164m, 176-182m, 191-194m. The casing was perforated at 192.5m. • Fibre-glass casing was used from 0-117m. • Stainless steel screens and blank casing were used from 117-195m. • A sump was installed from 194-195m.	Repaired
WB5	Downhole camera confirmed that the casing had pulled apart at 86.5 m and the bore was full of sediment to 112.5m. The bore was cleaned out using mud rotary drilling techniques to attempt to reach the bottom of the bore and to confirm screen intervals. Based on the drillers observations and the geophysics survey responses, the casing was compromised at a number of depths; therefore, WB5 was confirmed to be unsuitable for monitoring or sampling purposes. The responses also indicated that the bore was only constructed to a shallow depth, around 151 m, when compared to the surrounding production bores. This bore was therefore only screened in the lower sands of the UEVF and was decommissioned appropriately.	Decommissioned
WB8	The driller confirmed that this bore had previously been decommissioned and grout was encountered at 50 m when cleaning out the bore. This bore was then decommissioned again using a grout/bentonite mix to the ground surface.	Decommissioned

Bore ID	BAP Assessment	Action
WB9	The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF/LEVF, and was therefore decommissioned. The bore was perforated at a depth of 162 m.	Decommissioned
WB10	The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF/LEVF, and was therefore decommissioned. The bore was perforated at a depth of 117 m.	Decommissioned
WB12	As part of the BAP, the drilling contractor had identified a number of integrity issues with this bore: • Damage to the casing at 90m and between 107m and 117m; • Significant debris throughout with a large obstruction at 193m; and Based on the downhole geophysical and camera survey, WB12 is screened entirely within the UEVF. Despite casing issues, this bore will be retained for observational purposes only.	Bore to be retained as an observation bore only
WB13	The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF/LEVF, and was therefore decommissioned. The bore was perforated at a depth of 160 m.	Decommissioned
WB14	Obstruction removed and bottom of bore confirmed at 214 m. Geophysics data confirmed that this bore is screened within the UEVF. The bore was found to be in good working order.	Retained
WB15	Obstruction removed and bottom of bore confirmed at 225 m. Geophysics data confirmed that this bore is screened within the UEVF. The bore was found to be in good working order.	Retained
WB16	WB16 is the pumping bore. Prior to undertaking the pumping test in May 2021, the bore was inspected by downhole geophysics and CCTV camera. The bore was found to be in good working order.	Retained
WB17	Obstruction pushed down to 177 m. The geophysics data confirmed that this bore was cross-screening the UEVF and MEVF; therefore, the bore was perforated at a depth of 167 m and was decommissioned.	Decommissioned

2.3 Previous Studies and Historical Evidence Defining Groundwater Extraction Risks

As with most major projects, there has been active community interest in the proposed activity with some attention based on the perception that historical groundwater extraction has led to an adverse impact on the lower Anglesea River estuary.

The main concern from some community members is that the Estuary water quality has become more frequently acidic from 2016 onwards, with the primary cause of this acidity being the more frequent drying out of the water table in the shallow alluvial creek systems (where the acidity is stored).

One community group hypothesises that historical groundwater extraction has primarily led to a large reduction in surface water flow for Salt Creek between 2010 to 2023 when compared to 1968 to 1982 flow. This has in turn lead to more frequent drying of the alluvial waterways which builds acidity, with this acidity released when the sediments are rewetted following a wet period.

Alcoa understands that the community members position is primarily formulated on the following observations:

1. Dewatering of a thin coal seam under the shallow waterways has increased its permeability, facilitating leakage from shallow aquifers to underlying aquifers.
2. Groundwater extraction has caused a “cone of depression” under the shallow alluvial systems (as shown by the declining groundwater pressure in SOB 116459); and to compensate, surface water must be leaking from above.

The above hypotheses and more have been tested throughout this GIA with the proposed activity informed by a number of investigations, with many significant scopes of work subject to independent peer review process. With respect to the above, this section summarises historical lines of evidence and their uncertainties as well as studies which led to an increased understanding of how and if groundwater extraction may impact surface water behaviours; refer **Table 2-3**.

Table 2-3 Key References or Lines of Evidence Used to Understand Catchment and Groundwater Behaviours to Stresses

Report or Line of Evidence	Evidence or Description of Catchment and Groundwater Behaviours to Stresses
Groundwater levels and quality Example Reports include: Groundwater Monitoring Reports (Coffey, 2006 to 2022) Anglesea Borefield Project Isotopic and Tracer Studies (GHD, 2011a) Quarterly Mine Water Body Monitoring 2020 to 2024)	Groundwater level and quality data has been collected across the catchment with some groundwater levels dating back to 1969. This includes: • Barwon Water groundwater level monitoring data at 32 observations points throughout the catchment. • The State Observation Bore Network (SOBN). Within the catchment there exists 12 active observation bores, with the primary purpose of the SOBN being to collect groundwater data for observational purposes. This data is used for research and other informative measures, and to improve the access and management of groundwater. • Alcoa Groundwater Bore Network. Alcoa have 80 active groundwater bores located across the former power station or the mine lease. Details and objectives of these bores are further discussed in Section 4. The location of the above bores is shown on **Figure 2-9**. For analysis of the above, key lines of evidence regarding surface water and groundwater behaviour are described in the following bullet points. Please refer to **Appendix A**, CHM report, that provides figures illustrating the relevant lines of evidence. • The "cone of depression" is observed in the lower section of the UEVF. The geological layers between mined main coal seam and the lower sands remain fully saturated, with some geological layering under the mine having hydraulic pressures higher than the shallow Alluvial water tables. • Groundwater mounding underlying or adjacent the ASA near the former PowerStation and UEVF pumping bores following significant rainfall or flow events is not observed from daily monitoring groundwater, indicating in this area these leakage rates from the ASA to underlying aquifers is not a significant migration pathway. • The direction of groundwater flow in the shallow aquifers is towards the mine void indicating the mine void and not UEVF groundwater extraction is influencing shallow water tables in the vicinity of the mine. • The direction of groundwater flow in the upper part of the UEVF is towards the historical sump pump location. • Continuous pressure monitoring data from Vibrating Wire Piezometers (VWPs) from above the main coal seam (in the Demons Bluff Group) from 1999 to 2011 as well as those installed around the former power station from 2006 show no response to drawdown from pumping in the lower sands of the UEVF; further, over the course of the UEVF pumping test in May 2021, no bore screened in aquifers above the UEVF lower sands showed any response to the pumping test. • Groundwater levels in the Alluvial Swamp Aquifer (ASA) responds closely to seasonal rainfall, declining when the proceeding months are low in rainfall and/or evapotranspiration is likely high. • Groundwater trends in the ASA behaves similarly regardless if the UEVF potentiometric surface or "cone of depression" is higher or lower than the watertable in the ASA. • In some areas, groundwater salinity in aquifers underlying and adjacent to the ASA are significantly higher, whilst in others it is significantly fresher than the median TDS at Salt Creek stream flow gauge SV2 (refer **Section 5.8** for a summary of catchment hydrology). • Surface water pH at or within the vicinity of Anglesea River (Marshy Creek) stream flow gauge AV2 has been consistently less than pH 4.0 since monitoring began in 1970; conversely, groundwater pH within the UEVF ranges 5.5 to 7.5 (mean 6.5).

Report or Line of Evidence	Evidence or Description of Catchment and Groundwater Behaviours to Stresses
	• Isotope analysis of residual water pools in the ASA indicated that these pools were not supported by groundwater; rather, these pools were located in areas of low potential evapotranspiration, GHD (2013).
Geology Controls Example References include: Barton, C. M. (1995). Hancock, (1967) Holdgate, et al., (2001) Mining One (2012 and 2017).	The following information summarises the geological lines of evidence that has been presented in past reports which suggests significant geological controls exist to govern surface water and groundwater interactions: • The Bells Beach anticline forces the UEVF to become quite shallow (<50 metres below ground level (m bgl) 7km north of the mine (under the mid reaches of Marshy Creek), whereas the Anglesea syncline forces the UEVF to become quite deep (>300m bgl) to the south and west of the mine (under Salt Creek). • When the first production bores were completed in the 1960's, the supervising hydrogeologist reported minor sands lenses were encountered between layers of clay and coal, with each sand lens recoding a rise in groundwater pressure as a result of "lithostatic pressure"; e.g., groundwater within these lenses are highly confined. • At a location just to the north of the former PowerStation, exploration undertaking in the late 1960's found slight artesian conditions were observed when drilling hit a sand lens at a depth of 138 mbgl. This is the top of the UEVF lower stands. Sand lenses above this were not artesian. • The installation of 8 UEVF observation bores surrounding the mine to depths of up to 150m as well as geophysical logging of Alcoa's existing deep production and observation bore network revealed the UEVF contains many aquifers (sand lenses) throughout its 250m sequence under the mine void. The deepest sand sequences were the target of Alcoa's UEVF extraction. • Above the lower sand lenses, a total cumulative thickness of over 100m of fully saturated low permeability clay and coal sequences separate the pumped section of the UEVF and the mine void. Laboratory permeability tests of these clay and coal sections indicate that permeability ranges from 3 x 10^{-9}m/sec to 7 x 10^{-10} m/sec. This is equivalent of the permeability of an engineered landfill liner. • A review of 22 exploration geological bore logs located either within or adjacent to the ASA (the peaty sediments confined within Salt Creek and Marshy Creek) have an average thickness of 27.7m (max = 86m; min = 2.4m) of either clay or silt (e.g., low permeability material) that separates the base of the ASA to the next most permeable layer underlying the surface water systems. • A review of all bore logs reveal the upper sands of the UEVF form a discontinuous permeable unit and are primarily found underneath the basal clay in the vicinity of the former mine and potentially extend towards the coast. These sands are likely recharged by rainfall where these sands are located near the surface. • There is a clay unit (referred to as the basal clay) underlying the mined coal seam which inhibits vertical groundwater movement. At the deepest part of the mine void, during the course of the coal mining, this underlying clay was likely extracted. A "sump pump" was historically installed in this location to keep the mine void dry; as a result, this sump pump was not only removing local catchment runoff and shallow groundwater ingress, but also dewatering the thin upper sand layers of the UEVF.
Climate	The following information suggests climatic conditions are the most important contributor to overall catchment surface water flow: • Using over 120 years of catchment specific data (e.g., climate data from a gridded point adjacent the mine from the SILO database [https://www.longpaddock.qld.gov.au/silo/]) it is clear the region has seen significant shifts in climate. Between the two periods of 14-year

Report or Line of Evidence	Evidence or Description of Catchment and Groundwater Behaviours to Stresses
	available surface water flow that are available for comparison (i.e., 1968 to 1981 and 2010 to 2023) there is vastly different rainfall statistics: o Total rainfall between 1968 to 1982 was 9,994 mm with an average of 714mm/yr. o Total rainfall between 2010 to 2023 was 8,515mm with an average of 608mm/yr. o The above means that during 2010 to 2023, the catchment received 1479mm less rainfall when compared to 1968 to 1982. Using a high level catchment yield calculator (refer Water Calculator (agriculture.vic.gov.au) this drop in rainfall represents a decline in more than 12,000[2] ML of surface water. • Four out of the top five driest five-year totals on record for the region have occurred since 1990, with the only other significant dry periods being the Federation drought at the start of last century as well as the severe drought between 1914 - 1918. • Zhang et al. (2016) investigated 222 high-quality stream gauging stations having 30 years or more continuous unregulated streamflow records from the Bureau of Meteorology's Hydrologic Reference Stations (HRS) dataset. The results found most of the stations in southeastern Australia spread across New South Wales and Victoria showed a significant decreasing trend in annual streamflow post 1997. • Using the HRS to analyse data closer to Anglesea in several gauges located away from waterways with upstream control structures, it is observed that significant declines in streamflow have also been observed since 1997 in nearby catchments. These observations are summarised below: o Stream flow at Werribee River at Ballan has seen a 65% decline since 1997 when compared to 1974 to 1996 (incl). This reduction increased to a 94% decline using data from cumulative dryer years (2006 to 2009). o Stream flow at Woady Yaloak River at Pittfield has seen a 77% decline since 1997 and this increased to a 94% decline using data from cumulative dryer years (2006 to 2009; 22% drier than 1900 to 1997). o Stream flow at Lerderderg River at U/S Goodman Ck Junction has seen a 65% decline since 1997 and this increased to a 95% decline using data from cumulative dryer years (2006 to 2009; 22% drier than 1900 to 1997). o Stream flow at Creswick Creek at Clunes has seen a 70% decline since 1997 and this increased to a 98% decline using data from cumulative dryer years (2006 to 2009; 22% drier than 1900 to 1997).

[2] Catchment Area = 11670 Ha; Catchment yield co-efficient of 7

2.4 Community Engagement

2.4.1 Introduction

Consultation and engagement with stakeholders are a priority in the development and approval process for the mine's rehabilitation and closure, the decommissioning and remediation of the power station site, and future land use planning.

The water filling strategy for the mine has been a key topic in Alcoa's community engagement activities and forums for many years.

Since 2015, Alcoa has been conducting broad engagement activities about the future of the Alcoa site to ensure community and key stakeholder feedback is well considered in Alcoa's decision making. Key activities have included the Alcoa Community Consultation Network (CCN) which was established in 2001, regular email updates to the large community database (950+ people), advertorials (Alcoa Community Update) in the Surf Coast Times newspaper, ongoing participation in the Anglesea River Advisory Committee, and updates provided via the online Anglesea Community Network bulletin (run by the community) to regularly cover the mine water filling strategy.

Since 2020 in particular and including the 2021 Groundwater Pumping Test, engagement has focussed on the potential use of groundwater from the Upper Eastern View Formation (UEVF) to help expedite the filling process.

To provide further information and opportunities for community feedback about the potential use of groundwater from the UEVF, Alcoa has produced a range of materials since this time, distributed widely via Alcoa's large community database and the various media described above.

Between May 2021 and September 2022, Alcoa provided monthly Groundwater Pumping Test Reports as updates to the community including key technical information, groundwater trends, and status of monitoring bore triggers and any associated investigations. These reports concluded 10 months after the actual pumping test itself was completed.

During the development of the updated Conceptual Hydro-geological Model for the Alcoa area of interest during 2022/2023 and the updated Anglesea Groundwater Numerical Model during 2023/2024, Alcoa continued to provide updates to the community using regular email updates to the large community database (950+ people), advertorials (Alcoa Community Update) in the Surf Coast Times, ongoing participation in the Anglesea River Advisory Committee, and updates provided via the online Anglesea Community Network bulletin.

During this period, Alcoa also made significant efforts to engage directly with the recently formed Friends of the Anglesea River community group who have expressed concerns related to the impact of Alcoa's historical groundwater extraction on Salt Creek surface water flows. This has included numerous face-to-face meetings and responding to many and varied questions during this time.

With the completion of the update to the Anglesea Groundwater Numerical Model early in 2024 allowing the progression of the final anticipated groundwater impact and risk assessment technical works, Alcoa undertook further engagement in the form of Open House events conducted from 23-25 May 2024, allowing for even greater community engagement on the topic of the water filling strategy.

The purpose of these three open house sessions in Anglesea, was to provide an opportunity for local community members to learn about the company's potential plans to fill the mine void with groundwater from the UEVF aquifer and hear the latest on rehabilitation of the former mine and power station sites.

- Thursday 23 May from 4:00pm to 6:00pm – 24 attendees.
- Friday 24 May from 10:00am to 12:00pm – 16 attendees.
- Saturday 25 May from 10:00am to 12:00pm – 62 attendees.

Alcoa provided detailed information boards related to various aspects of the water filling strategy to structure the information for the community, a copy of these boards is provided in the community engagement report referred to below.

The sessions were part of a comprehensive community engagement initiative, which leveraged a number of communication channels to generate community awareness and attendance. In total, 102 members of the local community dropped in to the sessions, seizing the opportunity to discuss the technical findings with Alcoa representatives and Alcoa's technical experts, demonstrating strong community interest.

The outcomes of this engagement are summarised below, with the Community Engagement Report made available to the community also attached as **Appendix H**.

In addition to the above, Alcoa has provided regular briefings to representatives of the local Traditional Owners – the Wadawurrung People. This has included technical briefings to their team related to surface and groundwater, site tours as 'walks on country' focussed on the mine rehabilitation and more specially the water related features of the area. The most recent briefing was provided during June 2024 providing a detailed overview of the groundwater investigations and outcome of these over approximately the last four years and Alcoa's intent to apply to SRW for an amended license. No objections or significant concerns were raised as part of this, or since with the information shared directly with the Traditional Owner team for further consideration.

2.4.2 Community Open House Engagement Objectives

The open house community engagement strategy encompassed two main objectives.

1. To provide the opportunity for local community members to learn about the potential plans to fill the mine void with groundwater from the UEVF aquifer and provide opportunities for feedback prior to any future application to Southern Rural Water.
2. To provide an update on the latest on rehabilitation of the former mine and power station sites including the opportunity to engage directly with Alcoa representatives and their technical experts.

2.4.3 Target Audience

A broad range of community and key stakeholders including Anglesea residents and homeowners, businesses, members of local community and interest groups and the general public.

2.4.4 Communication, Advertising, and Materials

While the subject of the mine void water filling strategy is well known to the Anglesea community having been covered on an ongoing basis since 2020 as described above, a multi-channel approach was adopted to inform the community and stakeholders about the open house sessions. Copies of the advertising collateral are provided in the attached Community Engagement Report.

Methods to advertise the open house sessions and the extent of each are shown in **Figure 2-12** and included:

- Direct email via Alcoa database to 979 direct community email addresses;
- Use of the Alcoa website www.alcoa.com.au/anglesea including featured FAQ's;
- Event listings via the Surf Coast Shire website event calendar;
- Advertorial and editorials in the Surf Coast Times and the Armstrong Creek Times newspapers;
- Multiple direct outreaches to community interest groups (including the Friends of the Anglesea River);
- Multiple direct outreaches to other key stakeholders including local and state government representatives, authorities, regulators, and ongoing engagement with the Wadawurrung local Traditional Owner representatives; and
- Use of a Facebook and Instagram campaign.

Figure 2-12 Summary of how the Sessions were Advertised

2.4.5 Summary of Open House Community Engagement Results

A total of 102 community members dropped in to one of three, 2-hour sessions hosted at the Anglesea Bowling Club, with many spending a significant period of time reading the information boards displayed around the room and conversing with Alcoa representatives and their technical experts.

Alcoa engaged independent communications agency, Keep Left, to capture community feedback throughout the sessions via a simple questionnaire - comprising three questions.

Prior to leaving the sessions, community members were invited to provide feedback, by completing the questionnaire themselves, or verbally while one of the two Keep Left representatives recorded the response. The questionnaire comprised three questions, and of the 102 attendees, more than half (65) chose to provide feedback.

The following data analysis aims to summarise the feedback provided, including categorisation of common themes and sentiment. A copy of all the completed feedback forms is provided within the attached Community Engagement Report.

Q1 Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- The vast majority (88 per cent) of attendees responded yes.
- Some respondents (9 per cent) didn't provide a clear response or made an alternative option, such as maybe - for the purpose of this analysis, these have been categorised as other.
- Only two attendees (3 per cent) responded no.

Q2 Has this session informed you about what viable options there are to fill the mine pit?

- The vast majority (86 per cent) of attendees responded yes.
- Seven respondents (11 per cent) responded no.
- While two were categorised as other.

Graphical presentation of results for Question 1 and 2 is shown in **Figure 2-13**.

Q3 Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- The nature of this question prompted respondents to say what additional information they would like regarding the mine water filling strategy and broader Anglesea Mine Rehabilitation and Closure Plan, whilst also providing opportunity for general comments or feedback.
- While some respondents directly answered this question by specifying the exact information that they would like, many others used the free text field as an opportunity to provide their views and opinions about the project.
- The majority of feedback was unsurprisingly related to the water filling strategy given this was the main topic of the open house sessions, however a number of other topics were raised as shown **Figure 2-14** .

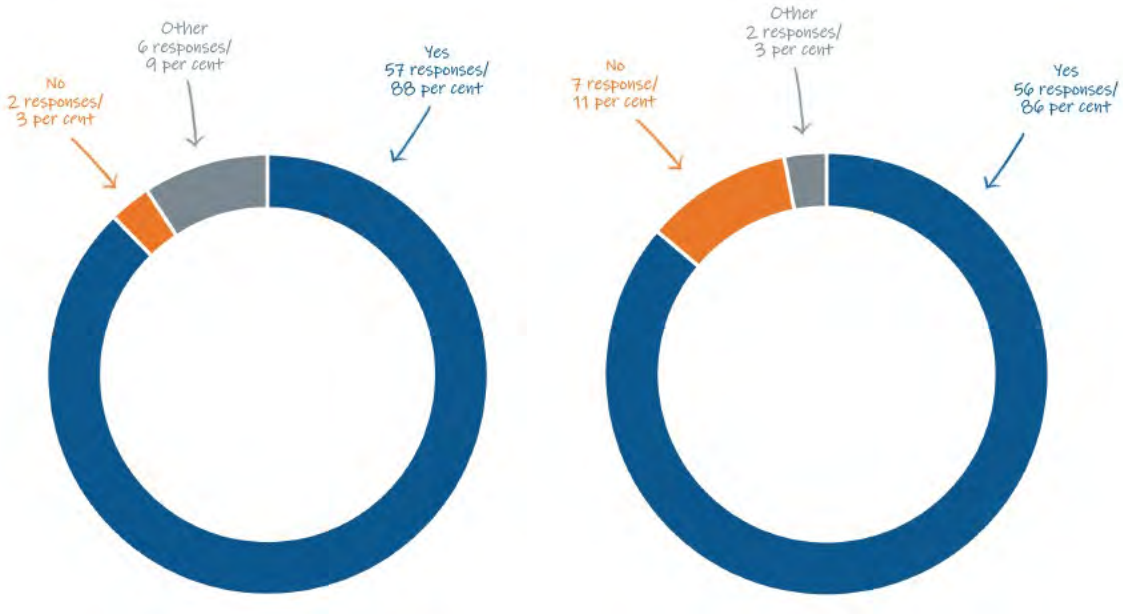


Figure 2-13 Question 1 Summary (left); Question 2 Summary (right)

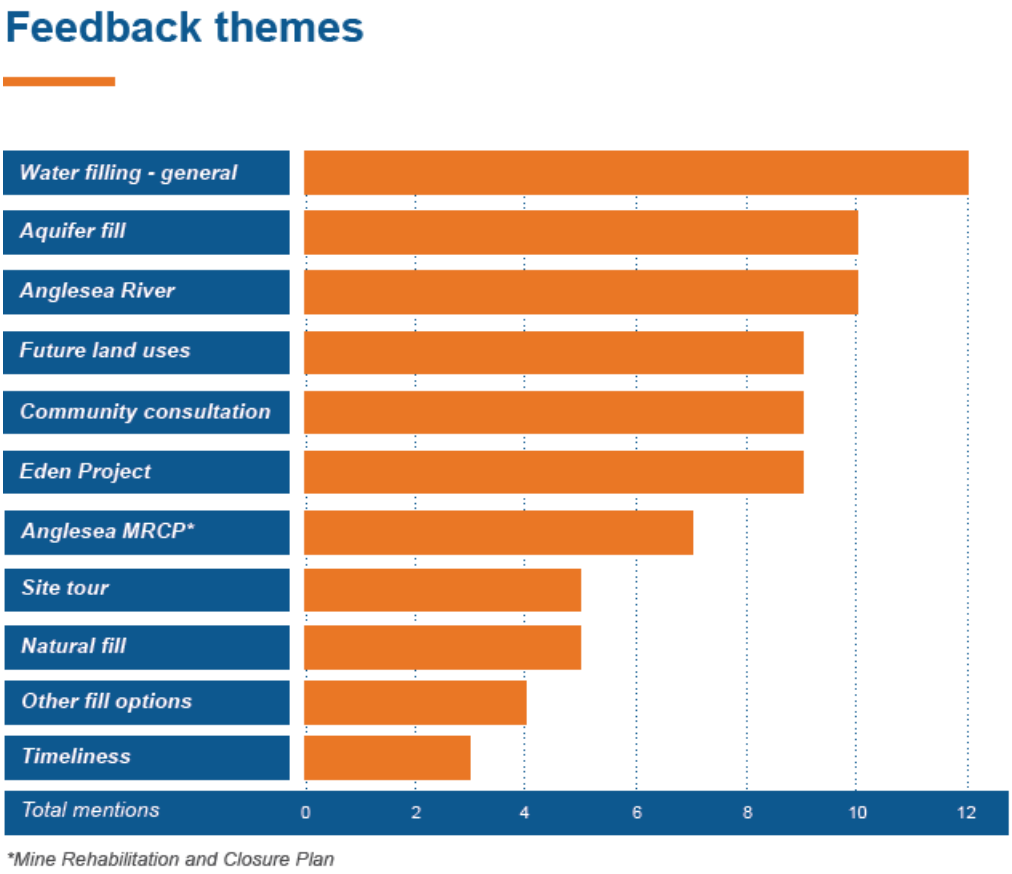


Figure 2-14 Question 3 – Feedback Themes

An analysis was also undertaken of the feedback provided in an attempt to determine the general community sentiment towards the proposed water filling strategy. This indicated that the majority of feedback (56 per cent) was assessed as being neutral in tone, just under a third (32 per cent) of respondent feedback was assessed as being positive in nature, and feedback from nine respondents (14 per cent) was assessed as being negative in nature.

2.4.6 Conclusion from Open House Community Engagement

Throughout the sessions, Alcoa representatives and technical experts engaged in numerous constructive conversations with individuals who showed genuine interest in the work being undertaken.

Many were equally as appreciative of the opportunity to be informed, with positive comments highlighting the sessions' informative nature, the professionalism of the presentation, and the accessibility of the representatives. This notion also aligns with the majority sentiment gleaned from the feedback forms and from the data analysed.

A summary of all the feedback collected during the open house sessions is detailed below:

- 88 per cent of feedback received indicated that attendees felt they better understood the draft Anglesea Mine Rehabilitation and Closure Plan.
- 86 per cent of the feedback received indicated that attendees felt informed about what viable options there are to fill the mine pit.
- The majority of feedback (56 per cent) was assessed as being either neutral in tone or positive (32 per cent), with only 14 per cent assessed as negative.

2.4.7 Ongoing Community Engagement Activities

Alcoa is committed to keeping the community informed about the proposed water filling strategy, including most recently (July 8, 2024) providing a copy of the Community Engagement Report to the Alcoa email database (950+), posting this on the Alcoa Anglesea website, and also sharing this directly via the online Anglesea Community Network.

Using these established engagement tools Alcoa will continue to seek feedback from interested community members and key stakeholders.

Alcoa will also continue to use these tools to continue to provide updates to the community about the status of the proposed groundwater license amendment once it is made to Southern Rural Water.

Ongoing feedback

Ongoing feedback and questions are always invited and responded to by Alcoa in all communication materials via emails to angleseaps@alcoa.com.

3 Relevant Regulatory Framework

3.1 Commonwealth Legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999 ('EPBC Act')

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places – which are defined in the EPBC Act as Matters of National Environmental Significance (MNES). The EPBC Act has the following objectives:

- Provide for the protection of the environment, especially matters of national environmental significance;
- Conserve Australian biodiversity;
- Provide a streamlined national environmental assessment and approvals process;
- Enhance the protection and management of important natural and cultural places;
- Control the international movement of plants and animals (wildlife), wildlife specimens, and products made or derived from wildlife;
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;
- Recognise the role of Indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and
- Promote the use of Indigenous peoples' knowledge of biodiversity with the involvement of, and in cooperation with, the owners of the knowledge.

The Australian Department of Sustainability and Environment, People and Communities (DSEWPAC, 2013) provides for protection of environmental matters on Commonwealth land.

Where a project or activity may negatively impact an MNES the activity should be referred to the Australian Government Minister for the Environment.

An EPBC Act self-assessment is a report prepared by project proponents which identifies MNES within the project area and the likelihood of the project impacting the MNES. If a self-assessment concludes that MNES will not be impacted, a referral to the Minister and formal assessment under the EPBC Act is not required.

As indicated by this groundwater impact assessment for the proposed extraction, risks of adverse impact to groundwater dependent eco-systems including the Anglesea River are low, and as such the likelihood of impacting any MNES is also low. On this basis it has been concluded by Alcoa that a referral to the Minister and formal assessment under the EPBC Act is not required.

3.2 State Legislation

3.2.1 Water Act 1989

In the context of groundwater, the Water Act principally deals with the sustainable, efficient, and equitable management and allocation of the resource. It also provides a means for the protection and enhancement of all elements of the terrestrial phase of the water cycle. Approvals are required under the Water Act for:

- Construction of bores for monitoring, dewatering, or aquifer recharge; and
- Extraction of groundwater, or aquifer reinjection/recharge.

The State assessment process will consider:

- The impact of the extraction on water availability within the area;
- Public and agency submissions;
- Water quality impacts;
- Existing water allocations;
- Natural processes and aquifers; and
- A requirement for approval of the licence will be to demonstrate no significant impact on the Section 79 Rehabilitation plan.

3.2.2 Mineral Resources (Sustainable Development) Act 1990

Mineral exploration, extraction, and the rehabilitation of mine sites is regulated by the Mineral Resources (Sustainable Development) Act 1990. This Act is overseen by Resources Victoria and the ERR unit, a part of the Department of Energy, Environment and Climate Action (DEECA)

A draft MRCP was developed in 2017 in compliance with Section 79 Rehabilitation plan. Key rehabilitation plan elements[3] include:

- The proposed post mining land use.
- Defined rehabilitation areas.
- Rehabilitation objectives.
- Rehabilitation criteria.
- Schedule for rehabilitation milestones.
- Rehabilitated land risk assessment.

3.2.3 Environmental Protection Act 2017

A key part of the Environment Protection Amendment Act is the general environmental duty (GED). This approach focuses on preventing waste and pollution impacts rather than managing those impacts after they have occurred. This duty requires people to undertake reasonably practicably steps to eliminate, or otherwise reduce risks of, harm to human health and the environment from pollution and waste. A breach of GED could lead to criminal or civil penalties. This concept is analogous to Victoria's existing Occupational Health and Safety laws.

[3] Microsoft Word - Preparation of rehabilitation plans - Guidelines for mining and prospecting projects February 2020.docx (earthresources.vic.gov.au)

3.2.4 Climate Change Act 2017

The Climate Change Act provides Victoria with a legislative foundation to manage climate change risks, maximise the opportunities from decisive action, and drive a transition to a climate resilient community and economy with net zero emissions by 2050.

3.2.5 Environment Effects Act 1978

The Environment Effects Act provides for assessment of proposed projects (works) that are capable of having a significant effect on the environment. The responsible Minister decides whether an Environment Effects Statement (EES) should be prepared. The EES process involves:

- Referral to the Minister for Planning;
- The Minister's decision on the need for an EES;
- Preparation of scoping requirements for the EES studies and reporting;
- Preparation of the EES report;
- Public review (exhibition and lodgement of submissions);
- Ministerial assessment of environmental effects; and
- Consideration of the assessment.

3.2.6 Catchment and Land Protection Act 1994

The Catchment and Land Protection Act 1994 establishes a series of reginal catchment strategies throughout Victoria. The Anglesea mine is located in the Corangamite catchment area. The Corangamite Regional Catchment Strategy outlines the catchment authorities vision for water, biodiversity, land, coast & marine, and communities within the catchment area. Under the Water Theme in the Corangamite Regional Catchment Strategy are four Sub-themes waterways, wetlands, estuaries, and groundwater.

Potential impacts on waterways, groundwater, or wetlands should have reference to the catchment strategy, and:

- Our Living Rivers of the Barwon, A Discussion Paper for the Future.
- Corangamite Natural Resource Plan for Climate Change.
- Corangamite Regional Floodplain Management Strategy, 2018-2028.
- Corangamite Waterway Strategy, 2014- 2022.
- Guidelines for assessing the impact of climate change on water availability in Victoria – 2020.
- Long Term Water Resource Assessment.
- Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan.
- Victorian Index of Stream Condition 2010.
- Western District Lakes Interim Ramsar Site Management Plan.

3.3 State and Local Planning Schemes

The State Planning Policy Framework (SPPF) is common to all Victorian planning schemes, and contains policies in relation to various policies, guidelines and standards. The SPPF has specific provisions relating to the environment, specifically the protection of catchments, waterways and groundwater. In terms of strategies within specific clauses:

- Clause 12.03-1S River corridors, waterways, lakes, and wetlands. To protect and enhance river corridors, waterways, lakes, and wetlands.

- Clause 13.01 – 1S Natural hazards and climate change. To minimise the impacts of natural hazards and adapt to the impacts of climate change through risk-based planning
- Clause 13.04-3S Salinity. To minimise the impact of salinity and rising watertables on land uses, buildings and infrastructure in rural and urban areas and areas of environmental significance and reduce salt load in rivers.
- Clause 14.02 – 1S Catchment planning and management. To assist the protection and restoration of catchments, water bodies, groundwater, and the marine environment.
- Clause 14.02-2S Water quality. To protect water quality
- Clause 19.03-3S Integrated water management. To sustainably manage water supply, water resources, wastewater, drainage and stormwater through an integrated water management approach.

The above clauses apply across the State, but each local council within the project area may have additional clauses in its local planning scheme relating to groundwater and sustainable environmental practices.

3.4 Policies, Guidelines, and Standards

3.4.1 National Guidelines and Policies

3.4.1.1 Groundwater Modelling Guidelines 2012

The objective of the guidelines is to promote a consistent and sound approach to the development of groundwater flow and solute transport models in Australia. Numerical groundwater modelling undertaken to assess impacts to groundwater has adopted these guidelines.

Note: These guidelines contain outdated approaches when it comes to aspects like model calibration as well as model classification. The traditional approach of developing a single calibrated model can give a false expectation that there is a single deterministic set of best parameters. Best practice now calls for derivatives of suites of plausible parameters that reflects the uncertain nature of the history-matching “calibration” process, which can be extended to predictive uncertainty analysis in an efficient manner. This probabilistic approach has become more widely applied in groundwater modelling since the publication of the guidelines in 2012.

3.4.1.2 Minimum Construction Requirements for Water Bores in Australia 2020 (Edition 4)

The guidelines outline the minimum requirements for constructing, maintaining, rehabilitating, and decommissioning water bores in Australia. They are used extensively by regulators and the drilling industry and provides a consistent standard reference across Australia for the licensing of bores and drillers. Investigations undertaken to characterise the groundwater environment of the project have adopted these guidelines.

3.4.1.3 NHMRC, NRMMC 2011 Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy

The guidelines are intended to provide a framework for good management of drinking water supplies that, if implemented, will assure safety at point of use. The ADWG have been developed after consideration of the best available scientific evidence. These guidelines have been applied to assess groundwater quality.

3.4.1.4 ANZG 2018 Australian and New Zealand Guidelines for fresh and marine water quality.

The guidelines outline the management framework recommended for applying the water quality guidelines to the natural and seminatural marine and freshwater resources in Australia and New Zealand. The guidelines provide a summary of the water quality objectives proposed to protect and manage the environmental values supported by the water resources, and advice on designing and implementing water quality monitoring and assessment programs.

3.4.1.5 NHMRC 2008 Guidelines for Managing Risks in Recreational Waters

The primary aim of these guidelines is to protect the health of humans from threats posed by the recreational use of coastal, estuarine and fresh waters. Threats may include natural hazards such as surf, rip currents and aquatic organisms, and those with an artificial aspect, such as discharges of wastewater. These guidelines have been applied to assess groundwater quality.

3.4.2 State Guidelines and Policies

3.4.2.1 Environment Reference Standard

The Environment Reference Standard (ERS) is part of the Environment Protection Act 2017 and commenced on 1 July 2021. The ERS identifies environmental values that the Victorian community want to achieve and maintain and provides a way to assess those environmental values in locations across Victoria.

The ERS is itself made up of many reference standards. These reference standards are in groups that cover four aspects of Victoria's environment:

- Ambient air;
- Ambient sound;
- Land; and
- Water (surface water and groundwater).

Each reference standard identifies an environmental value. Most reference standards also have indicators and objectives. These are how we assess if the environmental value is being achieved, maintained or threatened. An indicator is something we measure. An objective is the level of an indicator, or a way of using an indicator, to help us assess the environmental value.

3.4.2.2 Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems 2015

These guidelines are a supplement to a section of the Water Act 1989 where a groundwater Take and Use Licence application is made. It requires applications to undergo a risk assessment and referral process.

3.4.2.3 Aboriginal Water Program

The Aboriginal Water Program is a partnership between the DEECA and Traditional Owners and Aboriginal Victorians to manage our waterways and catchments across the State. Importantly, it is reconnecting communities to water for cultural, economic, customary and spiritual purposes.

3.4.3 Responsible Authority

Rural Water Corporations are responsible for issuing groundwater licences for any water other than mains supply (which is managed by urban water authorities). At Anglesea, Southern Rural Water is the Responsible Authority.

3.4.3.1 Groundwater Licensing

A licence to take and use groundwater may be issued by the Minister under Section 51 of the Water Act 1989. Approvals under the Water Act, such as for bore construction, groundwater extraction (dewatering) or artificial groundwater recharge may also be required by the project from the relevant water corporation, Southern Rural Water.

3.4.3.2 Discharge to Surface Water

Discharge of groundwater to surface systems would need to be assessed based on the EPA Victoria Publication 1287 (EPA Victoria, 2009), via a risk-based approach.

There are quality differences between the Upper Eastern View Formation (UEVF) groundwater and the existing surface water within the mine void. These are summarised in the **Table 3-1** and **Table 3-2.** Overall pH is lower in the water body and sulfate, calcium, aluminium and boron are more elevated compared to the UEVF groundwater. However, due to the elevated concentration of iron and reducing conditions of the UEVF groundwater, the pH of the UEVF groundwater is anticipated to be similar once the iron oxidises when discharged to the water body.

Table 3-1 Water Composition – Major Ions

Sample Location	Date	pH	Sodium mg/L	Potassi-m mg/L	Calcium mg/L	Magnesium mg/L	Chloride mg/L	Sulfate (as SO4) mg/L	Alkalinity (as CaCO3) mg/L
Water Body	9/11/22	3.6	250	19	87	82	427	626	<1
UEVF (WB12)	8/11/22	6.8	150	17	29	49	384	64	72

Table 3-2 Water Composition – Minor Ions

Sample Location	Date	Aluminium mg/L	Barium mg/L	Boron mg/L	Iron mg/L	Manganese mg/L	Zinc mg/L
Water Body	9/11/22	5.33	0.0509	1.23	2.59	0.555	0.582
UEVF (WB12)	8/11/22	0.0002	0.11	0.227	13.9	0.56	0.0116

Geochemical modelling has been used to simulate the addition of UEVF groundwater into the existing water body to achieve the final water elevation of 5.5 mAHD. The outcome of the modelling, refer to **Section 8.1.4** for more information, indicates no change in pH, minor increases in chloride and manganese and minor increases in other constituents of interest as provided in Table 3-3.

Therefore, the activity of discharging UEVF groundwater is not considered to be 'pollution' and neither is the existing water body considered to be 'polluted' as it is representative of the surrounding background catchment water quality.

Table 3-3 Comparison of one, four, and ten Year Fill Scenarios

Fill Scenario	pH	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate	Aluminium	Barium	Boron	Iron	Manganese	Zinc
	S.U.	*mg/L*											
Initial	3.60	250	19	87	82	373	627	5.34	0.05	1.23	2.59	0.56	0.58
Final 1yr	3.49	182	18	43	59	420	200	1.06	0.03	0.44	0[4]	0.60	0.14
Final 4yr	3.50	196	17	48	63	410	267	1.09	0.02	0.44	0	0.61	0.20
Final 10yr	3.54	241	16	61	77	413	441	1.23	0.01	0.48	0	0.70	0.34

[4] PHREEQC model precipitates iron (as iron mineral species) if oversaturated, in reality the mine water is supersaturated with iron

3.5 Summary

With reference to EPA Victoria Publication 1287 (EPA Victoria, 2009), specifically discharge of groundwater to surface systems, geochemical modelling indicates no change in pH, minor increases in chloride and manganese and minor increases in other constituents of interest, however the activity of discharging UEVF groundwater is not considered to be 'pollution' and neither is the existing water body considered to be 'polluted' as it is representative of (and still will be) the surrounding background catchment water quality

With reference to the EPBC Act and the requirement for a self-assessment referral, as part of the options assessed included within the draft MRCP and inclusive of the progressive rehabilitation works over the past nine years, and this GIA determining risks of adverse impact to GDE's including the Anglesea River are low, it was concluded that a self-assessment was not required due to the low risks (or ability to progressively manage) of any proposed works.

In compliance with Section 79 of the Sustainable Development Act 1990, a draft MRCP was developed and submitted to ERR in 2017. Within this Plan, it was presented that water is required to accelerate the filling of the mine void to achieve the MRCP objectives.

As such and in accordance with Section 51 of the Water Act 1989 which deals with sustainable, efficient, and equitable management and allocation of water resources, Alcoa are seeking to obtain approval from Southern Rural Water (the Responsible Authority) to reduce their existing Groundwater Licence (BEE029662), from 4000 ML/yr to 1,500 ML/yr and amend its use to allow this groundwater to accelerate filling of the former Anglesea coal mine to achieve the MRCP objectives.

To ensure the reduced and amended allocation poses no unacceptable risks to the environment that may rely on groundwater, an impact assessment (**this report and its supporting appendices**) has been developed in accordance with EPA Victoria Publication 688.1 Hydrogeological assessment guidelines for groundwater quality and Section 59A of the Water Act (1989).

This assessment also aligns with the precautionary principal and satisfies Section 40 of the Water Act 1989 as the results presented in this application err on the side of conservatism as the numerical results which form the risk assessment have isolated Alcoa's pumping impact from other cumulative impact contributors such as Barwon Waters Bulk Entitlement and climatic factors, also presented in this application. By using this approach, the modelled outputs are more conservative (i.e. Alcoa's modelled impact is likely greater than may be realistically observed, thus satisfying Section 40 of the Water Act 1989). This is further discussed in **Section 0**.

4 Datasets

This chapter sets out the list of all historical surface water data, groundwater data and climate data used to support this GIA, and broader work assessments completed to support the development of the MRCP. Where specific datasets are derived for a particular purpose, e.g., mine pit geochemical mixing, this data is presented in the relevant chapter.

Where appropriate this report also provides a compilation of all data and assesses this against the defined data quality objectives (DQOs). By undertaking this, potential data limitations or data uncertainties can be documented. Where limitations or uncertainties exist, the water management, monitoring, and contingency plan (refer **Section 10**) presents the approach for where, when, and how additional data and/or supplemental assessments or mitigation measures will be adopted.

4.1 Data Quality Objectives

In addition to the numerical groundwater model Quantities of Interest (refer **Section 7.2**), EHS Support developed the following DQOs with reference to relevant guidelines published (for example Australian and New Zealand Environment and Conservation Counsel, National Environment Protection Council, Australian Government Department of Agriculture and Water Resources, and Victorian requirements), which define minimum data requirements and quality control procedures.

The DQO process is used to establish performance or acceptance criteria and serves as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. The DQO process consists of seven iterative steps that are documented in **Figure 4-1**. While the interaction of these steps is portrayed in **Figure 4-1** in a sequential fashion, the iterative nature of the DQO process allows one or more of these steps to be revisited as more information on the problem is obtained.

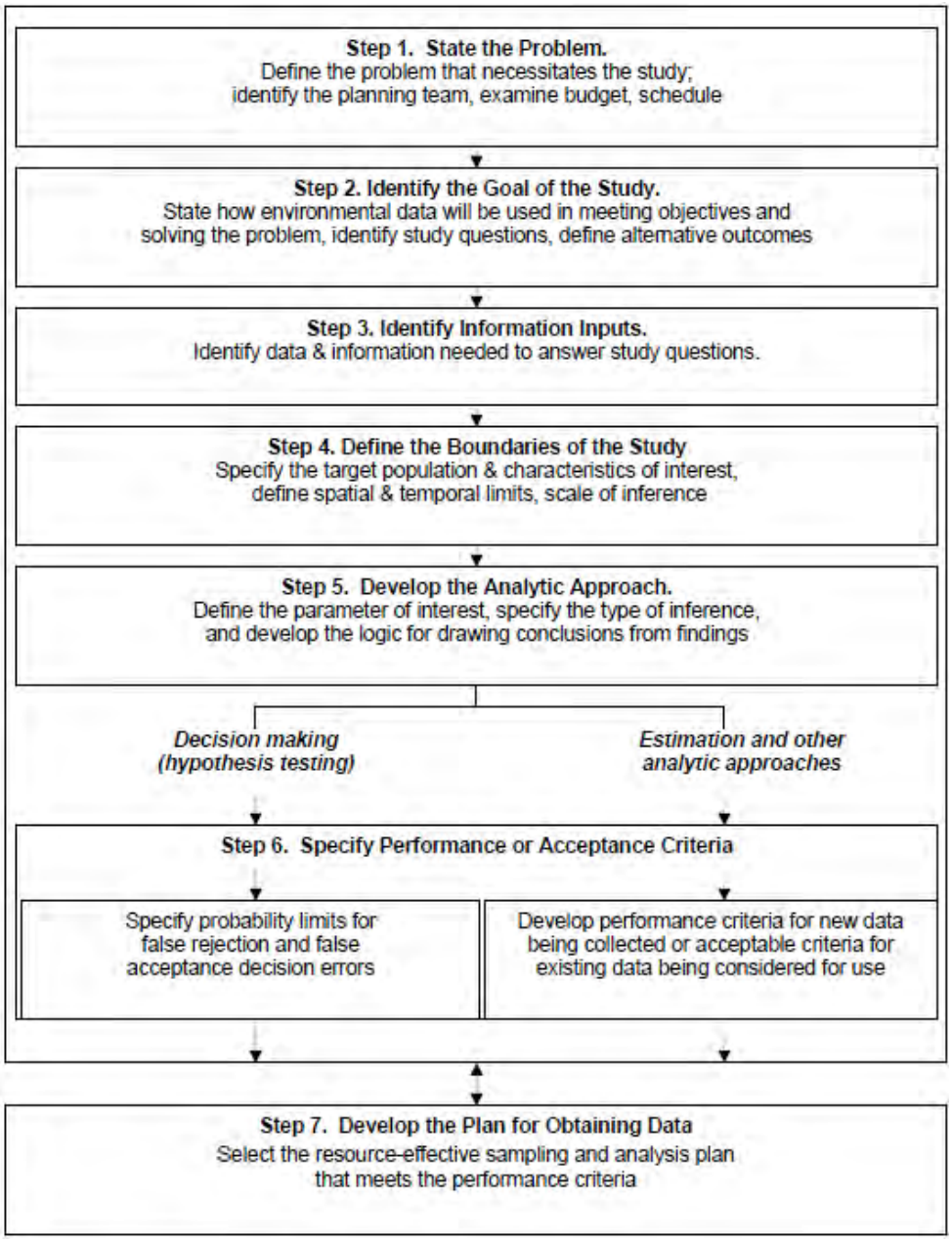


Figure 4-1 Data Quality Objective Process

Each step of the DQO process defines criteria that will be used to establish the final data collection design. The first five steps are primarily focused on identifying qualitative criteria, such as:

- The nature of the problem that has initiated the study and a conceptual model of the environmental hazard to be investigated;
- The decisions or estimates that need to be made and the order of priority for resolving them;
- The type of data needed; and
- An analytic approach or decision rule that defines the logic for how the data will be used to draw conclusions from the study findings.

A summary of the site wide DQOs is provided in **Table 4-1**.

Table 4-1 Summary of DQOs

DQO Step	DQO Overview
Step 1 – State the Problem	The Alcoa Anglesea Power Station and Coal Mine was permanently shut down on 31 August 2015. Alcoa is required to develop a MRCP and implement actions that establish a safe, stable, and sustainable landform. The MRCP comprises a final mine void waterbody surrounded by safe and stable batters and revegetated areas. The MRCP also depicts the preferred option to return a final mine void waterbody, this is now proposed to be achieved via groundwater pumping from the lower sands of the UEVF. The intent is to ensure that pumping of the UEVF does not result in potential unacceptable risk to the environment, such as impacts to GDEs, generation of acidic conditions, impacts to surface water quality and flows etc, a GIA is required.
Step 2 – Identify the Goal and Decisions	The goal of the GIA is to assess potential risks to the environment due to pumping of the UEVF aquifer to fill the mine void. Environmental data has been collected as part of the GIA to assess the following key decisions: • Will pumping of the EUVF result in impacts to GDE. o What aquifers support GDE at the site and in the surrounding area (i.e., ASA and DBG); o Is the UEVF hydraulically connected to GDE, or the aquifers which support them (i.e., ASA and DBG); o Will pumping of the UEVF result in a significant reduction in groundwater levels in the ASA and DBG; and • Will this reduction result in adverse impact to the GDE. • Will pumping of the UEVF result in a significant reduction in groundwater levels of the ASA and DBG resulting in the potential oxidation of Potentially acid sulphate soils (PASS) and generation and mobilisation of acidic conditions within the Anglesea River or its tributaries (and in turn impact ecological health and the broader environment). • Will pumping of the UEVF result in a reduction in surface water flows at Anglesea River and Salt Creek, and if so, will this reduction in flow impact ecological health either directly or indirectly (i.e. through acid generation). • Will the filling of the mine void with groundwater pumped from the UEVF compromise the water quality of surrounding shallow aquifers such as ASA and DBG, and in turn, impact on ecological health. • Are there any groundwater users of the UEVF (i.e., extractive uses such as drinking water, irrigation, stock watering, etc.) in the surrounding area, and if so, will these groundwater users be impacted by pumping of the UEVF.

DQO Step	DQO Overview
Step 3 – Identify Inputs to the Decision	Several previous and historical assessments and investigations have been completed at the site in order to assess potential impacts to the environment due to groundwater pumping of the UEVF. Data from these investigations provide inputs to make the above decisions, and includes (but not limited to): • Surface water data (flow pathways, historical and current flows, water quality, groundwater-surface water interactions, background water quality). • Mine void water data (water levels, evaporation rates, water quality, groundwater-surface water interactions, predicted future water quality). • Groundwater data (historical and current groundwater levels, continuous groundwater level monitoring, groundwater quality data [including quality data from various aquifers including UEVF, ASA and DBG], groundwater seasonal and temporal fluctuations, groundwater-surface water interactions, background groundwater quality). • Climatic data (historical and current rainfall, humidity, pressure, evaporation. etc.). • Publicly available data (i.e., surrounding groundwater users, SOBN historical data, general historical information, etc.). The inputs will be used to inform a hydrogeological risk assessment and help to make the defined decisions.
Step 4 – Define the Study Boundaries	The mine site boundary is shown on **Figure 2-1**; however, for the purpose of this GIA the site boundary also includes the Anglesea River and Salt Creek catchments and the extent of the LEVF, UEVF, ASA, and DBG aquifers which may be impacted by groundwater pumping based on measured and modelled drawdown. The GIA also assumes groundwater pumping will be conducted over a period of 10 years.
Step 5 – Develop a Analytical Approach (or Decision Rule)	The following decision rules have been established: • Groundwater data indicates that pumping of the UEVF does not result in a significant reduction in groundwater levels in shallow aquifers of the ASA or DBG, and in turn, is unlikely to impact on GDE (or vice versa). • Groundwater data indicates that pumping of the UEVF does not result in a significant reduction in groundwater levels in shallow aquifers of the ASA or DBG, and in turn, is unlikely to result in oxidation of PASS and generation and mobilisation of acidic conditions (or vice versa). • Groundwater data indicates that pumping of the UEVF does not result in a reduction in surface water flows, and in turn, is unlikely to impact ecological health either directly or indirectly (or vice versa). • Groundwater and surface water data indicates that the water quality of the UEVF once in the mine void is unlikely to impact surrounding shallow aquifers such as the ASA and DBG, and in turn, is unlikely to result in impacts to ecological health (or vice versa). • There are no groundwater extractive users in the surrounding area likely to be impacted by pumping of the UEVF (or vice versa).

DQO Step	DQO Overview
Step 6 - Specify Performance or Acceptance Criteria (Limits on Decision Errors)	Decision errors that may occur due to uncertainties or limitations include concluding that there is no impact when there in fact is. To prevent this, the following performance criteria will be adopted: • Adopting industry standard and best practice approaches to assess potential impacts. • Undertaking works in accordance with relevant National, State, and local legislation, regulations, standards, and guidelines, including, but not limited to: o ANZECC/ARMCANZ (2000). National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000; o ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. o Australian Government Department of Agriculture and Water Resources (2018). National Acid Sulfate Soils Guidance – Guidance for the dewatering of acid sulfate soils in shallow groundwater environments, 2018; o DELWP (2016). Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria, 2016; o Environment Protection Act 2017 o NEPC (2013). National Environment Protection (Assessment of Site Contamination) Measure, 2013. o Victoria Government (2021) Environment Reference Standard. Victoria Government Gazette No S245, 26 May 2021. Melbourne. Victoria. Australia • Establishing a detailed understanding of background aquifer and surface water conditions based on historical groundwater, surface water and climate data. • Implementing a Water Management Monitoring and Contingency Plan (WMMCP) (refer to **Section 10**) to ensure ongoing surveillance of potential impacts to the environment during pumping of the UEVF and filling of the mine void. • Implementation of robust QA/QC procedures and acceptance limits; and • Adopting the null hypnosis that potential impacts exist unless proven otherwise.
Step 7 – Optimise the Design for Obtaining Data	The GIA is based on historical and more recent assessments. A WMMCP (refer to **Section 10**) has also been proposed and has been optimized based on the information provided by the various supporting datasets and assessment.

4.2 Datasets

4.2.1 Surface Water

The main surface drainage features in the Anglesea area are described below and shown on **Figure 4-2**.

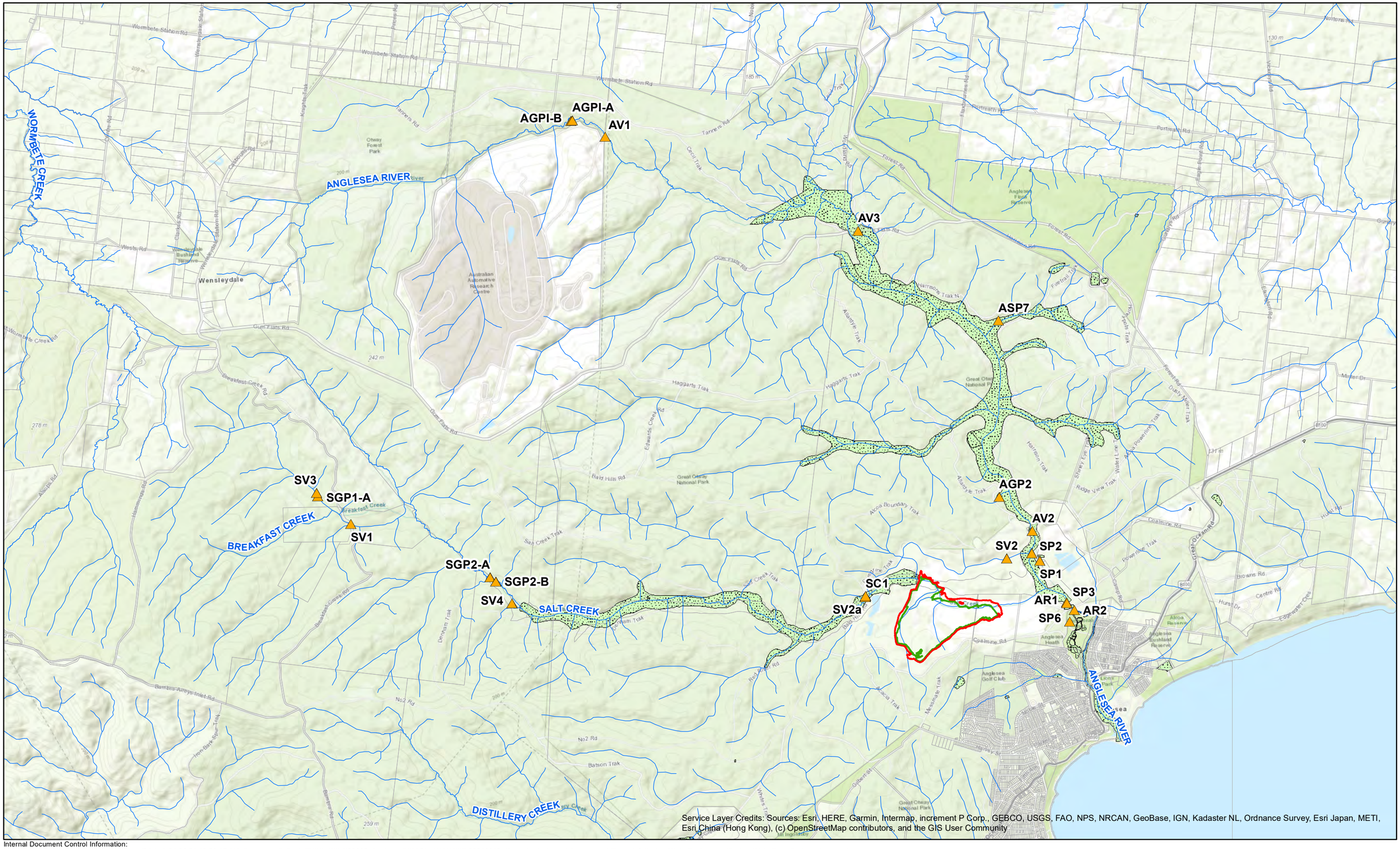
- Salt Creek and its associated swamps and tributaries (such as Breakfast Creek);
- Upper Anglesea River/Marshy Creek and its associated swamps and tributaries; and
- Lower Anglesea River.

With reference to the proposed activity, the overarching data objectives are as follows:

1. Obtain surface water flow data used for model history-matching (previously referred to as "calibration") and uncertainty analysis approaches applied with the numerical groundwater flow model;
2. Prediction of mine void water body quality; and
3. An assessment of groundwater/surface water interaction.

Over the last 20 years, the catchment hydrology has been extensively studied for a range of reasons. These have primarily focused on the catchment acid generating potential, as both the Anglesea River and Salt Creek and its tributaries experience frequent low pH water quality (pH 2-4) or acid flows due to naturally occurring conditions.

Key datasets were reviewed to gain an understanding of the background surface water conditions. A summary of the historical water quality results from Upper Anglesea River/Marshy Creek (AV2) and Salt Creek (SV2) are presented in **Table 4-2** and **Table 4-3**, respectively.



Internal Document Control Information:
User Name: Danny.Barnes; Date and Time Printed: 21/06/24 10:20:15 AM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20240613_GroundwaterImpact Assessment\Figure4-2-SurfaceWaterFeaturesandSurfaceWaterSamplingLocations.mxd

Surface Water Features and Surface Water Sampling Locations

0 0.5 1 2 3 4 Kilometers

1 cm = 1 km [Page Size: A3]

LEGEND

- Surface Water Sample Location
- -4mAHD Mine Contour
- 4mAHD Mine Contour
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure 4-2

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:50,000
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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Table 4-2 AV2 Water Quality Data Summary

Analyte	Count	Data Record		Max	Min	Average
pH	40	1/09/2000	23/09/2021	6.26	2.51	3.46
Flow (ML/d)	5157	2/09/2009	15/10/2023	25.42	0	1.50
TDS (mg/L)	9	26/07/2019	26/10/2022	4150	302	2413
EC (uS/cm)	36	16/01/2008	13/09/2019	7110	1320	2591
Chloride (mg/L)	10	1/09/2000	26/10/2022	1170	56	696.5
Sulphate (mg/L)	10	1/09/2000	26/10/2022	3440	61	1139
Nitrate as N (mg/L)	9	11/08/2016	26/10/2022	5.07	0.02	1.57
Calcium (mg/L)	10	1/09/2000	26/10/2022	154	3	57.7
Magnesium (mg/L)	10	1/09/2000	26/10/2022	173	5	77.5
Potassium (mg/L)	10	1/09/2000	26/10/2022	14	2	9.96
Sodium (mg/L)	10	1/09/2000	26/10/2022	614	32	329.5
Aluminium	53	1/09/2000	26/10/2022	254	0.53	40.4
Boron	51	23/07/2008	26/10/2022	1	0.018	0.25
Iron	53	1/09/2000	26/10/2022	160	0.127	14.65
Zinc	54	1/09/2000	26/10/2022	1.37	0.024	0.29

Table Notes:
Data Source: Barwon Water (sampled by Ventia) 2009 to 2016; Post 2016 Sampled by EHS Support

Table 4-3 SV2 Water Quality Data Summary

Analyte	Count	Data Record		Max	Min	Average
pH	10	1/09/2000	23/09/2021	6.28	3.24	3.90
Flow (ML/d)	8033	18/02/1975	15/10/2023	749.81	0	3.83
TDS (mg/L)	8	13/07/2016	23/09/2021	5660	193	1680
EC (uS/cm)	11	16/09/2010	13/09/2019	7600	193	1961
Chloride (mg/L)	10	1/09/2000	23/09/2021	1140	21	207.9
Sulphate (mg/L)	10	1/09/2000	23/09/2021	3080	23	902.6
Nitrate as N (mg/L)	9	13/07/2016	23/09/2021	10.8	0.1	3.31
Calcium (mg/L)	10	1/09/2000	23/09/2021	164	2	33.3
Magnesium (mg/L)	10	1/09/2000	23/09/2021	202	5	59.6
Potassium (mg/L)	10	1/09/2000	23/09/2021	15	1	6.50
Sodium (mg/L)	10	1/09/2000	23/09/2021	707	20	131.3
Aluminium (mg/L)	25	1/09/2000	23/09/2021	306	0.16	100.4
Boron (mg/L)	25	16/09/2010	23/09/2021	0.22	0.026	0.08
Iron (mg/L)	25	1/09/2000	23/09/2021	72.7	0.1	6.65
Zinc (mg/L)	26	1/09/2000	23/09/2021	3.5	0.006	1.44

Table Notes:
Data Source: Barwon Water (sampled by Ventia) 2009 to 2016; Post 2016 Sampled by EHS Support

4.2.2 Mine Water

With reference to the proposed activity, the overarching data objective is to assess background water quality to enable:

- Predicting the potential impacts of mine void water quality; and
- Bench-marking performance criteria.

The key data that were reviewed to gain an understanding of the background mine water conditions are presented in **Table 4-4**; note, prior to March 2016, analysis of the mine void water has most likely been from the mine reclamation pond and as such not included in **Table 4-4**. As demonstrated on **Figure 4-3**, this is not a direct sample of the pit water (sump) as the reclamation pond resides after the pit water is directly pumped out and into a small wetland prior to entering the reclamation pond. This wetland residence time is unknown and therefore this data must be treated with caution.

Post 2016 EHS Support has undertaken detailed water quality analysis of the mine void water (at the sump), however this period has been affected by authorised ash management activities (as seen in the large increase in pH) in the mine void and may not entirely be representative of background conditions. This is the data presented in **Table 4-4**.

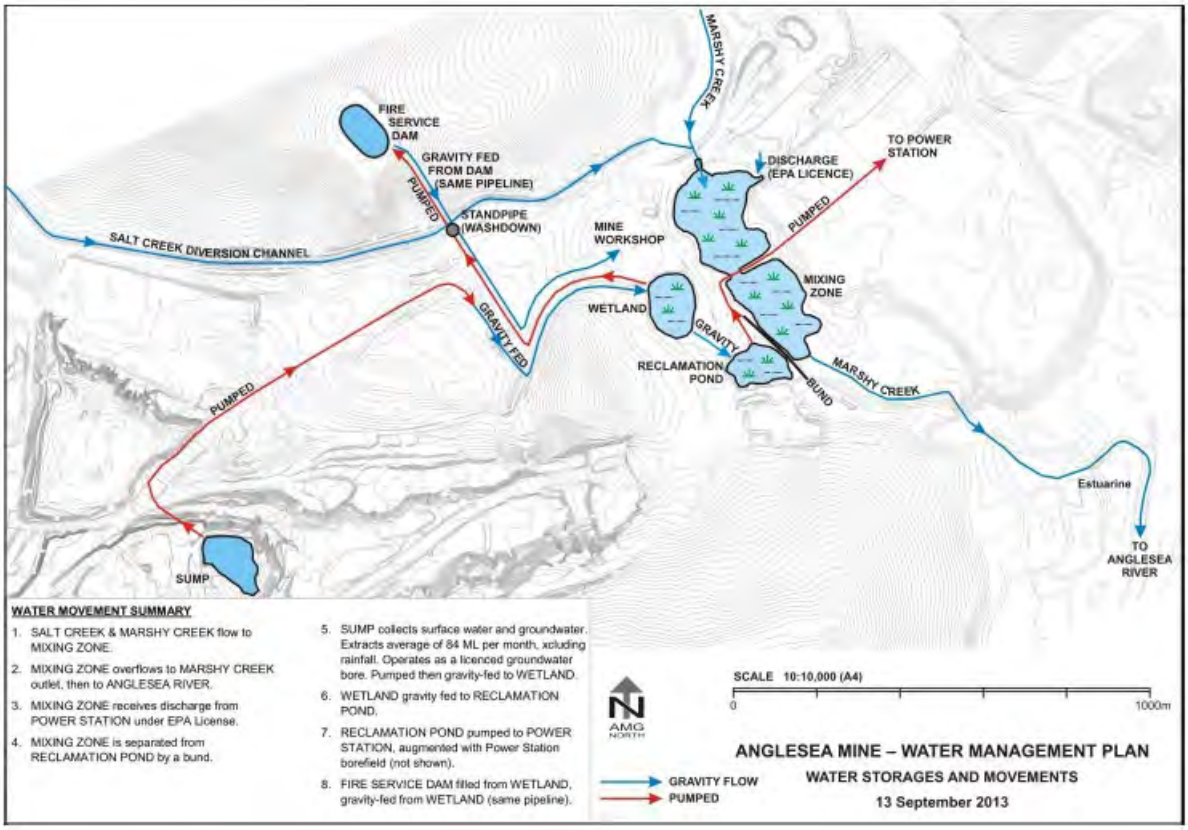

Figure 4-3 General Mine Location and Mine Water Sump Sampling Location

Table 4-4 Mine Water Data Summary – Post 2016

Analyte	Unit	Count	Min	Max	Mean
Acidity (as CaCO3)	mg/L	19	53	96	71
Alkalinity (total) as CaCO3	mg/L	3	1	11	2
Aluminium	mg/L	22	2.03	6.03	4.50
Arsenic	mg/L	1	0.002	0.002	0.002
Barium	mg/L	3	0.036	0.054	0.046
Beryllium	mg/L	1	0.00239	0.00239	0.00239
Boron	mg/L	18	0.958	3.93	1.501
Bromide	mg/L	20	0.26	1.05	0.77
Cadmium	mg/L	3	0.00066	0.09	0.00512
Calcium	mg/L	23	24	294	90
Chloride	mg/L	23	418	568	467
Chromium (III+VI)	mg/L	1	0.0053	0.0053	0.0053
Cobalt	mg/L	3	0.0111	0.101	0.0378
Copper	mg/L	2	0.0008	0.00651	0.0023
DOC	mg/L	7	1	2	2
Fluoride	mg/L	1	0.3	0.3	0.3
Iron	mg/L	22	0.18	11.6	1.71
Lead	mg/L	2	0.001	0.006	0.002
Magnesium	mg/L	23	24	114	81
Manganese	mg/L	5	0.134	0.690	0.394
Nickel	mg/L	3	0.007	0.090	0.028
Nitrate and Nitrite (as N)	mg/L	8	0.01	0.12	0.04
Nitrogen (Total Oxidised)	mg/L	13	0.1	0.5	0.2
pH (Lab)	pH_Units	22	2.87	6.8	3.63
Phosphorus (total)	mg/L	8	0.01	0.4	0.04
Potassium	mg/L	23	6	25	18
Selenium	mg/L	3	0.0009	0.0016	0.0012
Sodium	mg/L	23	96	389	258
Sulphate	mg/L	23	584	1180	712
TOC	mg/L	10	1	10	2
Total Dissolved Solids	mg/L	22	1500	2220	1689
Total Suspended Solids	mg/L	1	5	5	5
Vanadium	mg/L	1	0.0023	0.0023	0.0023
Zinc	mg/L	5	0.011	0.582	0.158

4.2.3 Groundwater

As noted in **Section 2.2.4.1**, Alcoa have implemented a groundwater monitoring network that includes 87 observation bores (**Figure 2-9**). With reference to the proposed activity, the overarching data objectives are:

- Obtain reliable groundwater level data used for model history-matching (previously referred to as "calibration") and uncertainty analysis approaches applied with the Anglesea groundwater numerical model;
- Assess background groundwater quality to understand the potential for groundwater mixing; and
- Understand surface water/groundwater interactions.

A comprehensive database of groundwater levels and groundwater quality exists. This information is summarised in the CHM report included as **Appendix A** and a summary of sentinel bores is presented in **Table 4-5**. Hydrographs of "**bolded**" bores are presented in **Appendix D.**

Table 4-5 Groundwater Level Data Summary

Bore	Aquifer Monitored	Groundwater Level Frequency	Water Quality (Y/N)	Frequency
DBG MB6	**Mine Overburden**	**10/12/2020 - 20/06/2024 Data Logger Measurements**	**Y**	**Quarterly**
UEVF MB1	**UEVF (Upper Sands)**	**10/12/2020 - 20/06/2024 Data Logger Measurements**	**Y**	**Quarterly**
UEVF MB2	**UEVF (Upper Sands)**	**11/05/2021 - 20/06/2024 Data Logger Measurements**	**Y**	**Quarterly**
UEVF MB3	**UEVF (Upper Sands)**	**23/04/2021 - 20/06/2024 Data Logger Measurements**	**Y**	**Quarterly**
UEVF MB4	**UEVF (Upper Sands)**	**10/12/2020 - 20/06/2024 Data Logger Measurements**	**Y**	**Quarterly**
UEVF MB5	**UEVF (Upper Sands)**	**10/12/2020 - 20/06/2024 Data Logger Measurements**	**Y**	**Quarterly**
UEVF MB6	**UEVF (Upper Sands)**	**10/12/2020 - Current Daily Logger Measurements**	**Y**	**Quarterly**
UEVF MB7	**UEVF (Upper Sands)**	**10/12/2020 - Current Daily Logger Measurements**	**Y**	**Quarterly**
UEVF MB8	**UEVF (Upper Sands)**	**11/05/2021 - Current Daily Logger Measurements**	**Y**	**Quarterly**
MW27	**Boonah Formation**	**13/03/2021 - Current Daily Logger Measurements**	**Y**	**Annually**
MW29	Boonah Formation	18/03/2021 Current Daily Logger Measurements	Y	Annually
MW32	Demons Bluff Group	18/03/2020 - Current Daily Logger Measurements	Y	Annually
MW33	**Boonah Formation**	**10/12/2020 - 20/06/2024 Daily Logger Measurements**	**Y**	**Annually**
MW64	**Boonah Formation**	**10/12/2020 20/06/2024 Daily Logger Measurements**	**Y**	**Annually**

Bore	Aquifer Monitored	Groundwater Level Frequency	Water Quality (Y/N)	Frequency
WB4	**UEVF (Lower Sands)**	**1975 - Nov 2008 Manual Gauging Measurements 4/11/2015- Current Daily Logger Measurements**	**N**	**-**
WB5	UEVF (Lower Sands)	1975 - May 2008 Manual Gauging Measurements 4/11/2015-18/10/2021 Daily Logger	N	-
WB10	UEVF (Lower Sands)	1969 - May 2015 Manual Gauging	Y	Annually
WB12	**UEVF (Lower Sands)**	**1975 - 27/11/2008 Manual Gauging 4/11/2015- Current Daily Logger**	**Y**	**Annually**
WB13	UEVF (Lower Sands)	1975 - May 2015 Manual Gauging Measurements 10/12/2020-20/05/2021 Daily Logger	Y	Annually
WB14	**UEVF (Lower Sands)**	**1979 - Dec 2012 Manual Gauging Measurements 10/12/2020-Current Data Daily Measurements**	**Y**	**Annually**
WB15	**UEVF (Lower Sands)**	**1982 - Dec 2012 Manual Gauging Measurements 10/12/2020- Current Daily Logger Measurements**	**Y**	**Annually**
WB16	**UEVF (Lower Sands)**	**1987 - August 2012 Manual Gauging Measurements 10/12/2020- Current Daily Logger**	**Y**	**Annually**
SOBN 116459	**UEVF (Lower Sands)**	**Nov 1993 - Feb 2021 Manual Gauging Measurements 18/03/2021- Current Daily Logger Measurements**	**N**	

4.2.4 Climate

With reference to the proposed activity and information presented in **Section 5**, the overarching data objectives were to assess climatic conditions (specifically rainfall and evaporation) across the site to:

- Obtain input parameters for numerical groundwater modelling;
- Understand water body evaporation rates; and
- Understand evapotranspiration.

Six meteorological weather stations exist across the site, with the closest weather stations to the site being Wensleydale 6km to the northwest and Aireys Inlet 6km to the southwest. The weather stations and the data considered in this study are presented in **Table 4-6** with all meteorological data derived from www.bom.gov.au.

Table 4-6 Key Meteorological Weather Stations

BOM Station Name	Station ID	From	To	Lat	Long	Temp	Rainfall	Evap
Aireys Inlet	90180	1994	Current	-38.458	144.0883	x	x	
Wensleydale (Anglesea (Vehicle Proving Ground)	87119	1965	Current	-38.368	144.0843		x	
Torquay Golf Club	87160	1974	2016	-38.340	144.3101		x	

BOM Station Name	Station ID	From	To	Lat	Long	Temp	Rainfall	Evap
Wurdiboluc Reservoir	87126	1969	2016	-38.282	144.0518		x	x
Buckley (Balliwindi)	87124	1968	Current	-38.250	144.0854		x	
Boonah	90187	2001	Current	-38.411	143.9771		x	

In addition to the above, catchment specific data has been obtained from the SILO database (https://www.longpaddock.qld.gov.au/silo/). SILO is a database of Australian climate data from 1889 and are constructed from observational records provided by the Bureau of Meteorology. SILO interpolates the raw data, using nearby BOM climate stations to derive datasets which are both spatially and temporally complete (more information can be found at (https://www.longpaddock.qld.gov.au/silo/about/overview/).

As observed in **Table 4-6**, continuous climate data does not exist at any one station spanning 1900 to current. The Australian climate change site networks (http://www.bom.gov.au/climate/change/hqsites/) doesn't have a station close to the mine; therefore a dataset was obtained from SILO (Point Patched Dataset (PPD) for the location shown on **Figure 4-5**. This location was chosen as it was close to the mine and equi-distance from coastal and higher relied stations and thus representative of the surface water catchments that feed Anglesea. **Figure 4-4** presents the side-by-side comparison of annual rainfall from Aireys Inlet, Wensleydale and the SILO (Point Patched Dataset (PPD) location shown on **Figure 4-5**.

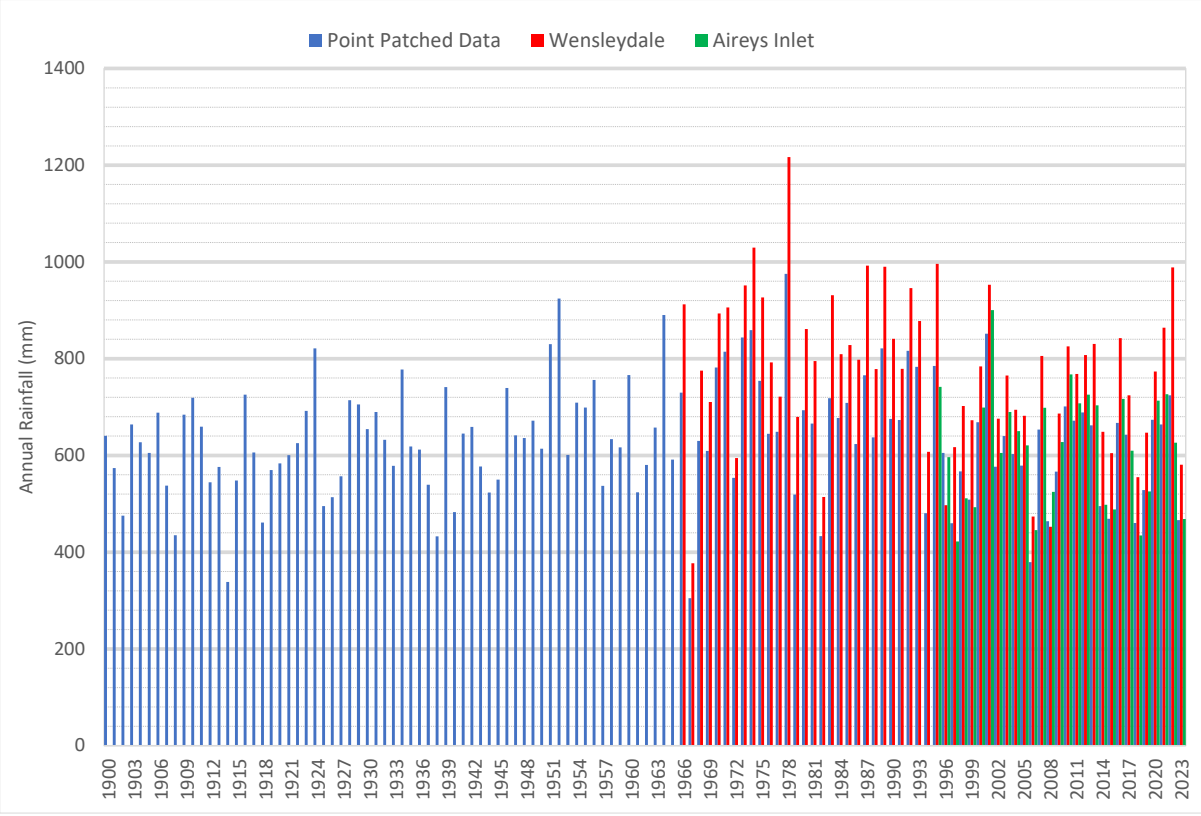

Figure 4-4 Side-by-Side Comparison of Annual Rainfall from Aireys Inlet, Wensleydale, and the SILO (Point Patched Dataset (PPD))

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Internal Document Control Information:
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SILO Patched Point Dataset (PPD) Location

0 0.375 0.75 1.5 2.25 3 Kilometers

1 cm = 0 km [Page Size: A3]

LEGEND

- SILO PPD Location
- Lake Boundary (+7mAHD)
- Watercourse

Alcoa Anglesea Groundwater Impact Assessment

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Figure 4-**5**

N

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:29,357
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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5 General Environment

5.1 Topography and Land use

The topography of the Anglesea area is presented in **Figure 5-1**. The land surface falls rapidly from 300 m AHD to 400 m AHD in the west to 0 m AHD along the coastal plains.

The topographically elevated areas to the west of Anglesea are dominated by forest. This primarily comprises native vegetation conservation areas, with smaller areas of production and plantation forestry (**Figure 5-1**). Across the flatter areas to the north and east, grazing pastures dominate. Urban land use is limited to small areas at the coastal towns. Several large and small marsh and wetland areas are found across the region. There are extensive swamp areas immediately northwest of Anglesea along the Anglesea River and Salt Creek (**Figure 5-1**).

5.2 Climate

The Anglesea area is characterised by relatively high rainfall in the topographically elevated areas to the west, with decreasing rainfall across the lower northern and eastern areas. The two closest rainfall gauges are located at Wensleydale (BOM ID 87119), approximately 6 km northwest of the mine (within Anglesea River Catchment), and Aireys Inlet (BOM ID 090180), approximately 6 km southwest of the mine along the coast.

Long-term average annual (LTA) rainfall at Wensleydale is 769 millimetres per year (mm/yr) based on data from 1935 to current. At Aireys Inlet, the LTA is 616 mm/yr based on data from 1994 to current. Yearly averages are presented on **Figure 5-2** along with rainfall surplus/deficit data from Wensleydale.

Since measurements began in 1965 at Wensleydale, rainfall data indicates a distinct wetting and drying phase. Using SILO, a longer-term record can also be derived beginning 1900, and this identifies a 3rd climatic phase (**Figure 5-3**). This climate signature shows:

- Between 1900 and 1950, the region exhibited a neutral to drying climate.
- Between 1950 and 1990, the region then experienced a strong wet period.
- Since 1990, a prolonged drying period is observed. The millennial drought (late 1996 to mid-2010) occurs in this period.
- Since 1990, 4 out of the top 5 driest 5-year totals on record for the region have occurred (**Figure 5-4**). The only other significant dry period being the drought during 1914-1918. This is an important consideration as recent surface water flows in Salt Creek (at monitoring point SV2) have been significantly lower than those recorded from 1969 to 1982; (refer to **Section 5.8** for more information on surface water flow data).

Seasonally rainfall is variable, with around 60 percent of total annual rainfall falling over the months of May through October. Heavier episodic rainfall (greater than 50 mm/day) generally occurs in Spring and Summer with almost 70 percent of these falls occurring in this period.

Mean annual potential evaporation (PE) does not vary significantly across the region, with an annual mean of 1,300 mm measured at Anglesea. Further information on evaporation (including lake evaporation) is discussed in **Section 5.2.1**.

5.2.1 Evaporation on Water Bodies

Typically, evaporation from surface water bodies (such as a lake), are calculated using Morton's Lake Coefficient or a Synthetic Class A Pan Coefficient. However, Morton's Lake Coefficient is for a shallow lake, and Synthetic Class A Pan Coefficient is for a shallow evaporation-pan. Therefore, to determine evaporation from a deeper lake (i.e., the mine void water body), both need to be converted by a coefficient to relate them to evaporation for a deep lake (greater than 1.0 m depth).

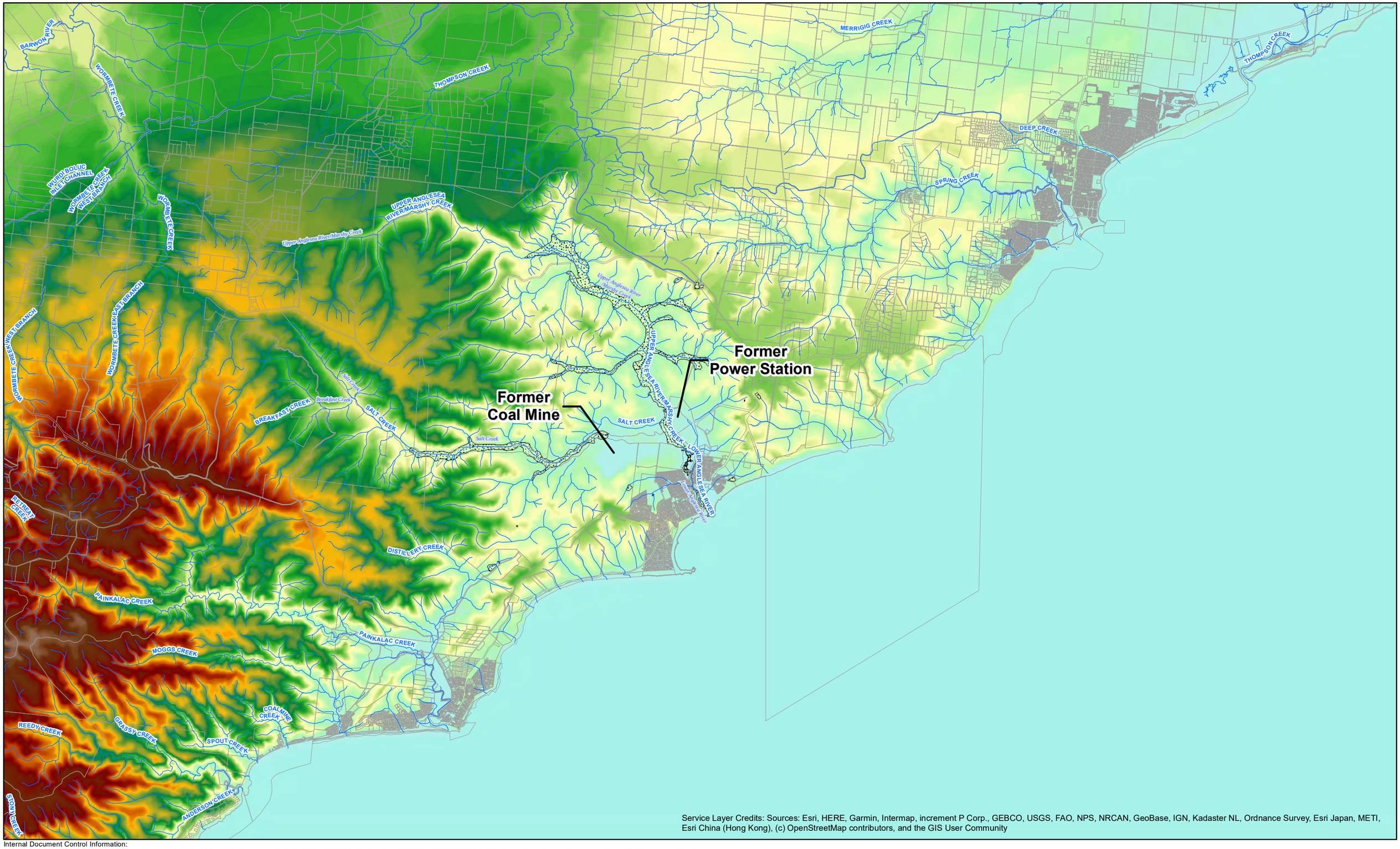
The standard conversion-factor for Pan to lake is generally 0.75 x Potential Evaporation (PE). For the mine void, PE was calculated using FAO56[5] and SILO Data Drill system6 for the site. The results indicated the ratio between the Synthetic Class A Pan Coefficient and FAO56 is 0.725; therefore, the unadjusted FAO56 is close to lake evaporation and its direct use without adjustment can therefore be used as the simplest estimate of lake evaporation.

McJannet et al. (2017, 2019) undertook a study whereby evaporation from a mine void lake using analytical, actual and modelling approaches were compared. The results found that aerodynamic modelling provided the closest match to actual floating pan evaporation, whilst applying the standard Class A pan measurements sometimes provided poor correlation, especially where shading from steep side walls and high evaporation rates are common (such as in northwestern Australia). As the former Anglesea mine, neither has steep sided walls or experiences very large seasonal fluctuations in temperature using the approach above is considered representative and no direct evaporation measurement is necessary.

Figure 5-3 shows a plot of PE (FAO56) and rainfall from SILO, as well as actual annual rainfall deficit for a site at the mine void (Lat. and Long. of -38.40^{o} 144.15^{o}, decimal degrees). This rainfall deficit was then used across the surface area of a full mine void (approximately 100 Ha at +5.5 m AHD) to determine likely actual evaporative losses as opposed to PE. On average, evaporative losses (rainfall deficit) per year were estimated at 311 mm/year or about 0.31 GL/yr of water at full storage (100 Ha x $1x10^{4}$ x 311mm/year x $1x10^{-9}$).

[5] http://www.fao.org/docrep/X0490E/X0490E00.htm

[6] http://www.longpaddock.qld.gov.au/silo/



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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User Name: Danny.Barnes; Date and Time Printed: 20/06/24 8:22:46 PM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20240613_GroundwaterImpact Assessment\Figure5-1-TopographicSetting.mxd

Topographic Setting

0 1 2 4 6 8 Kilometers

1 cm = 1 km [Page Size: A3]

LEGEND

- Watercourse
- Parcel Boundary
- Marshland

Elevation Values

High : 660

Low : -44

Alcoa Anglesea Groundwater Impact Assessment

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Figure 5-1

N

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:100,000
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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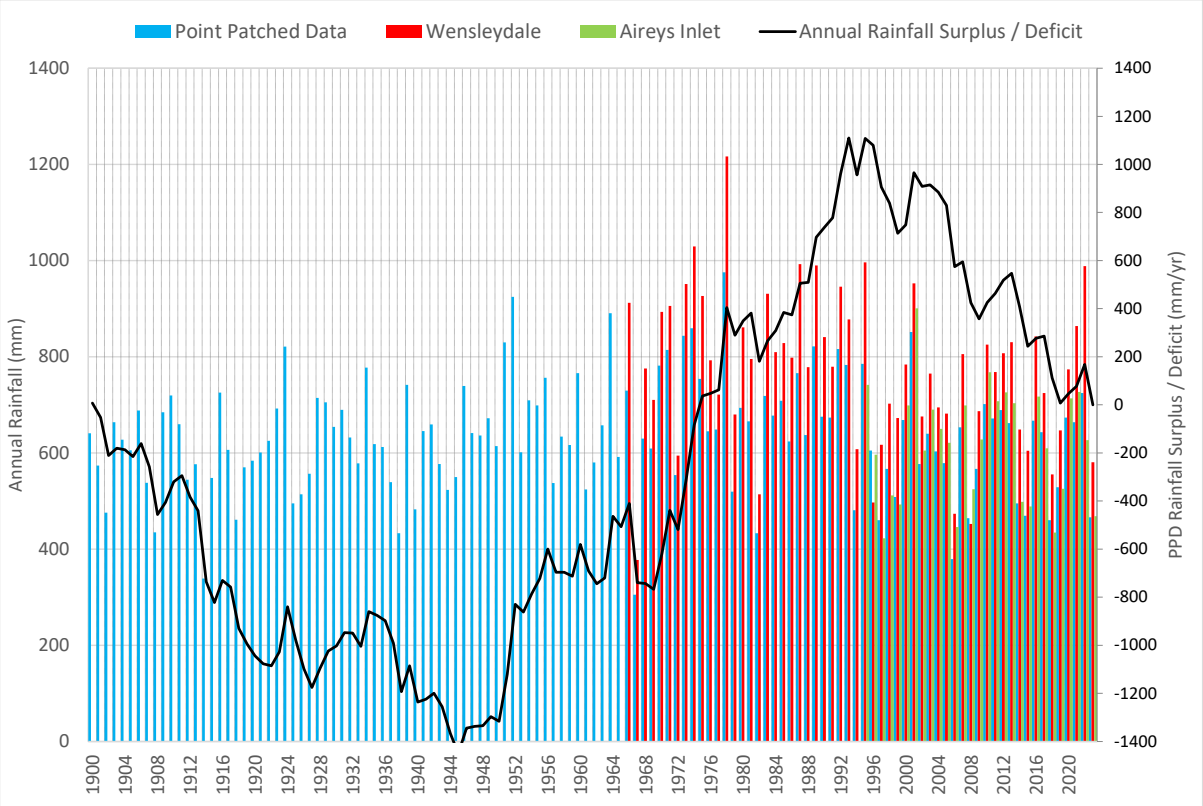

Figure 5-2 Rainfall Summaries

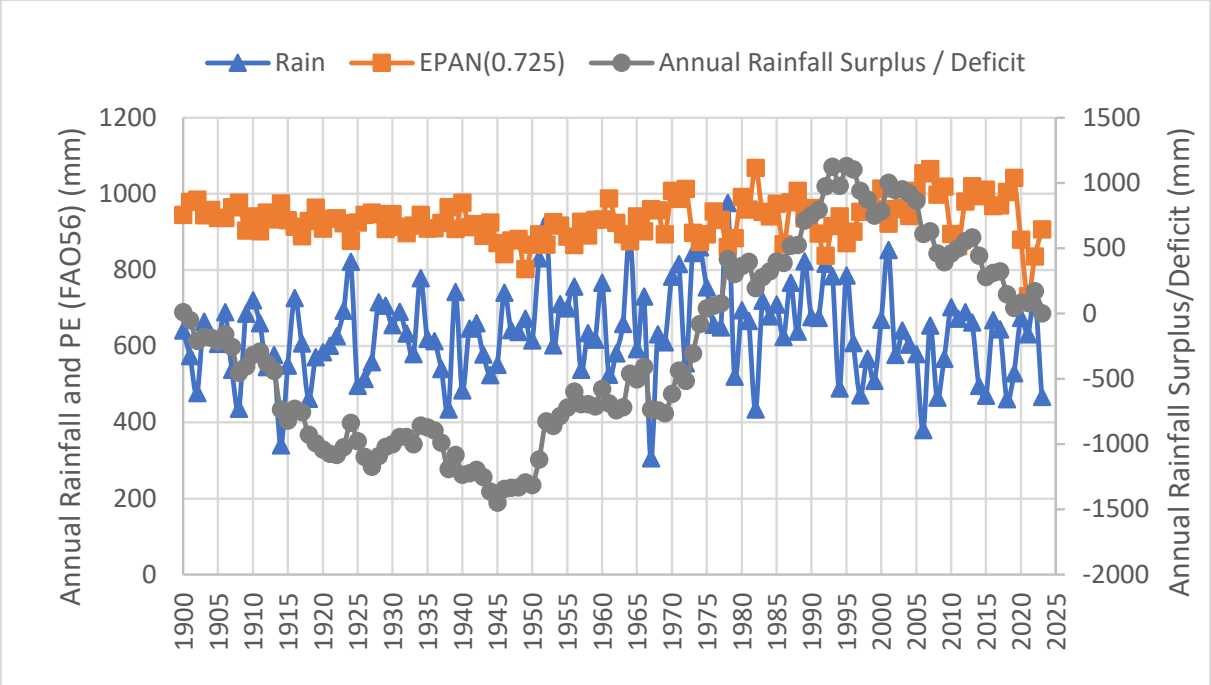

Figure 5-3 Annual Rainfall and PE (FAO56) for a Site at the Mine Void

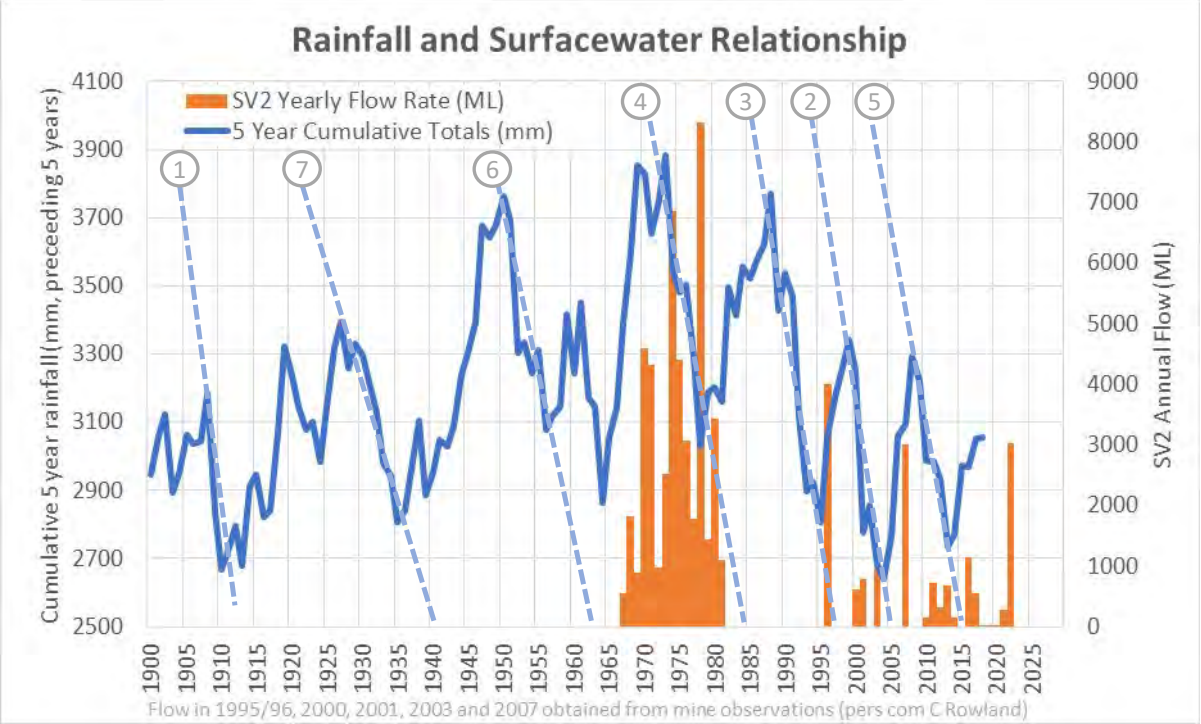

Figure 5-4 Rainfall and Surface water Relationship

5.3 Climate Change

As shown in **Figure 5-3** and discussed in **Section 5.2**, there is evidence of three strong climatic cycles over the last 120 years. Between 1900 and 1950, the region exhibited a drying climate, defined by average annual rainfall typically being lower than the LTA rainfall. Between 1950 and 1990, the region then experienced a strong wet period where above average rainfall fell for 27 out of 40 years. Recently, however, the rainfall surplus/deficit has again begun to fall with drier than average conditions dominating over the last 30 years. An important observation from **Figure 5-3** is the rate of decline (slope of the rainfall surplus/deficit) observed over the last 20 years is occurring 1.5 times faster than observed during the drying phase of 1900 to 1950.

As a result of this historical climate variability, the Victorian Government prepared a series of guidelines (Department of Environment, Land, Water and Planning [DELWP], 2016) outlining how the climate change projections can be applied for water resource planning in Victoria. These guidelines are based on 42 global climate models (GCM) and applied to generate climate change projections for Victoria's river basins for the years 2040 and 2065. With respect to this report, the Otway Coast basin is the relevant river basin.

A summary of the climate change projections for the Otway Coast basin are presented below for two projections: low (10th percentile) and high (90th percentile) impact on water availability from climate dependent sources. The results suggest:

- Average daily temperature is projected to increase by 1.0 °C by 2040 and 1.9 °C by 2065 relative to the current climate baseline.
- Potential evapotranspiration is projected to increase by 3.7 percent by the Year 2040, and 6.4 percent by 2065 relative to the current climate baseline.

- Average annual rainfall is projected to range from a decrease of 11.7 percent (high scenario) to an increase of 2.1 percent (low scenario) by the Year 2040, with a 3.6 percent decrease in rainfall for the medium climate change scenario. By 2065, rainfall is expected to range from 19 percent reduction (high scenario) to a 0.5 percent increase (low scenario). The median climate change scenario predicts a 5.8 percent relative reduction to the current climate baseline.
- Average annual runoff is projected to range from -25.3 percent to -6.6 (median = -15.8 percent) by the Year 2040. By 2065, annual runoff is projected to range from -41.9 percent to -4.7 percent (median = - 7.2 percent) relative to the current climate baseline.

With respect to sea level rise, future rises are projected for key areas in Victoria based on the 2015 national sea level projections (CSIRO and BoM, 2015). By the 2030s, sea level is projected to rise by around 12 cm (range of 7–18 cm) (relative to 1986–2005) under medium (RCP4.5) and high (RCP8.5) emissions scenarios. By the 2070s, the emissions scenario has greater impact, with increases of around 32 cm (range of 20–46 cm) under RCP 4.5, but up to 42 cm (range of 26–54 cm) under RCP 8.5.

In addition, the Victorian Governments Future Coasts Program7 is preparing policy of planning for not less than 0.8 m of sea level rise by 2100. Note: if this level of rise did occur it would only impact the estuary. The lowest point of Coal Mine Road which runs between the top of the estuary and the former mixing zone has an elevation of 5.0 mAHD.

5.4 Soils

Regionally, to the north and west of Anglesea, the soils are dominated by sandy uniform units formed on the Tertiary-aged sediments of the EVF. Further to the east, the dominant soil type changes to the more clay rich soils formed on the more recent Neogene-aged marls and non-calcareous sediments of the Jan Juc Formation and the DBG. In the topographically elevated and forested areas in the west, the soils are dominated by texture contrast soils formed on the Lower Cretaceous-aged sedimentary rocks of the Otway Group.

Locally, soils generally exhibit acid duplex profiles from three distinct profile types developed from differing parent materials. The three main characteristics of the vast majority of soils across the site are the distinct texture contrast between the light-textured sandy surface soil and the clay subsoil:

1. Sandy podzols and podsolic soils: These tend to be developed on older Tertiary sediments and therefore tend to be more prevalent on the lower sections of slopes. These highly leached acidic soils are characterised by sandy topsoils and low fertility with deficiencies in phosphorus, potassium, nitrogen, copper, zinc and molybdenum (Pitt, 1977).
2. Lateritic podsolic soils: These are generally developed on the plateau remnants of the Tertiary peneplain. The A horizons of these soils have a loamy texture with an organic aluminium (A1) and bleached A2 horizon, changing sharply to well-structured silty clay at a depth of approximately 40 cm. Ironstone blocks and nodules are ubiquitous at around a depth of 1 metre.
3. Acid peaty soils: These are developed in local creek beds and may be up to several metres in depth. Although nutrient levels are high, they are not freely available to plants due to a pH less than 4 (Kentish and Bourne, 1983).

[7] https://www.vgls.vic.gov.au/client/en_AU/search/asset/1013264/0

5.5 Catchment Acidity and Acid Sulphate Soils

Acidity in the Anglesea River catchment is a topic that has been researched extensively over the last 20 years and all studies to date acknowledge the catchments naturally high pyrite and sulphur content as the main source of acidity or acid drainage.

In the most recent study, Wong et al., (2020), investigated the distribution and characterisation of acid sulfate soils in the Salt Creek and Marshy Creek Swamplands. The study involved field sampling of 28 sites within the course of the Anglesea Swamplands and a further 25 sites along the marshlands associated with Salt Creek.

The study identified three modes of acidity at each site:

i) Potential sulfidic acidity, sourced from sulfidic sediments containing pyrite and monosulfides;
ii) Labile acidity, which is existing acidity and can be rapidly mobilised; and
iii) Retained acidity, which is existing latent acidity usually stored in minerals such as jarosite. In addition, acid neutralising capacity was also analysed, and net acidity determined.

The report found that both Salt Creek and Marshy Creek contain substantial volumes of acidity in a form that can be mobilised rapidly. Marshy Creek contains higher concentrations of labile acidity which can be transported readily in surface water and groundwater, whereas Salt Creek contains higher concentrations of retained acidity which can be slowly released over time.

Given it is known that the catchment is naturally acidic, the hydrogeological system contributes to acid generation and transport in 3 ways:

- Fluctuating watertables - falling watertables introduce air into moist pore spaces of the unsaturated zone.
- Dissolved oxygen can be transported to pyrite by groundwater recharge.
- Groundwater flow, specifically in the vadose zone, transports any acid generated.

These factors are schematically shown in **Figure 5-5**.

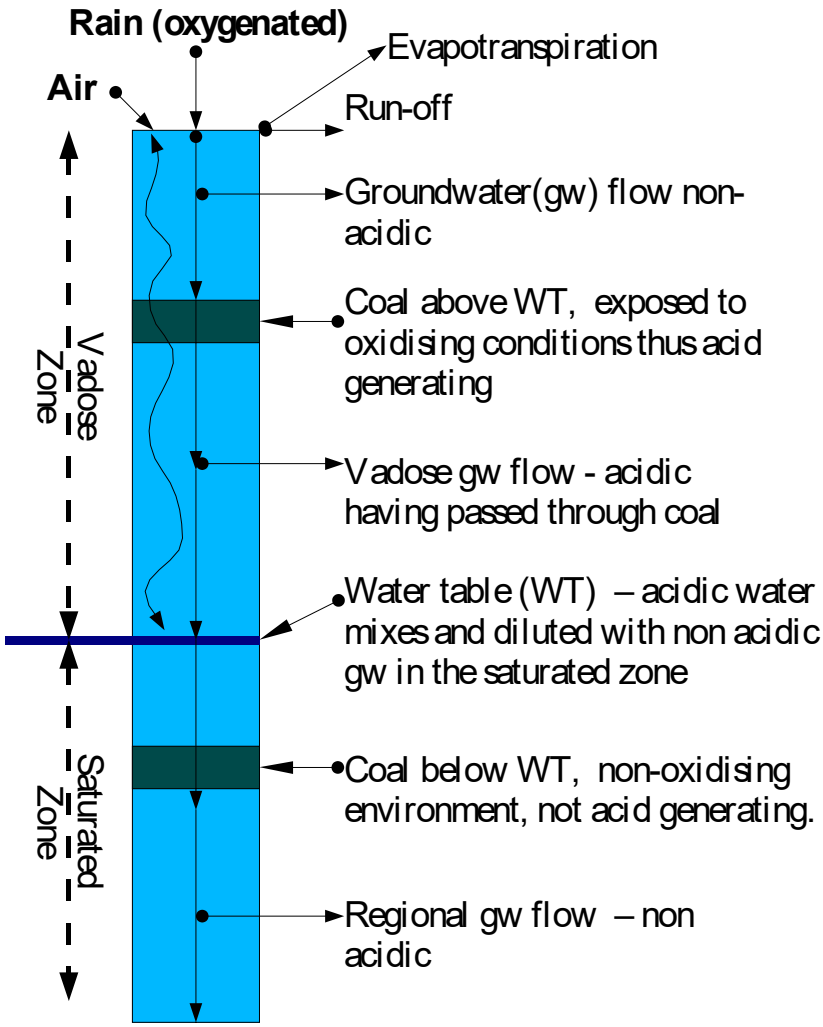

Figure 5-5 Model of Acid Generation and Transportation from Sulphide Containing Units of the Anglesea Geological Sequence (after Tutt 2008)

The key processes of the cycle which directly influence acid generation and transport in the Anglesea catchment are precipitation, infiltration, percolation and groundwater to lakes and streams (refer **Figure 5-6**).

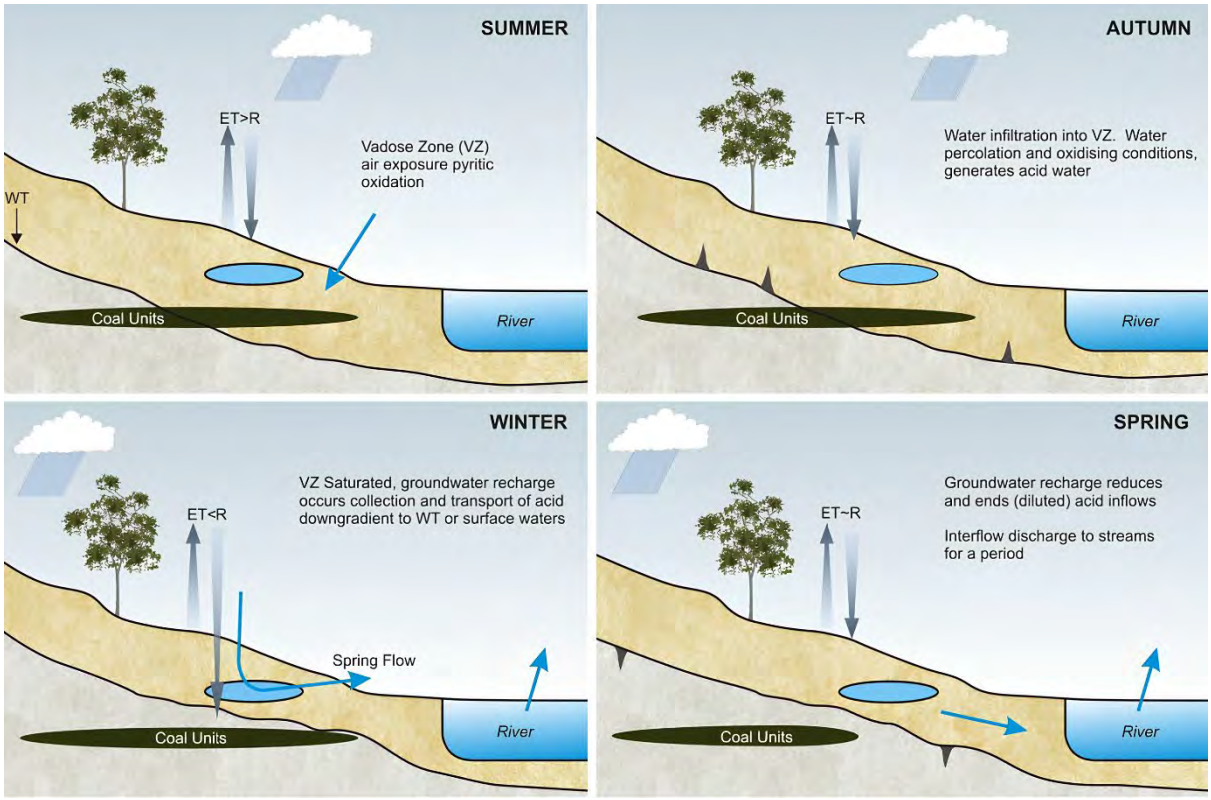

Figure 5-6 Modified Conceptual Model of Seasonal Acid Generation and Transportation Mechanisms (after Tutt 2008, reference GHD 2013)

As depicted in **Figure 5-6**, some acid generation and transportation should theoretically occur every year. Over winter and spring, water infiltrates and percolates into the vadose zone oxidising pyrite and transporting acidic water downgradient. This water can either discharge as a spring flow to the surface or mix with the existing groundwater within the shallow alluvial aquifer.

Seasonal rainfall therefore directly influences the rate of acid generation and transportation. Variation to normal weather patterns, including extended dry periods, which may drop the water table and affect acid generation and transportation, potentially creating scenarios such as:

- Low recharge to the shallow groundwater system causing reduced generation and transportation of acid in the systems and a potential build-up of acid in pore spaces.
- High recharge to the shallow groundwater system causing greater oxidation of pyrite plus increased transportation as percolating groundwater flushes pore water from the vadose zone.

In addition to Wong et al., (2020), other detailed studies that summarise the sources of acidity in the catchment are summarised in the CHM report in **Appendix A**.

5.6 Groundwater Users

The location of the groundwater users (such as private and commercial water bores) is shown on **Figure 5-7**. Groundwater bores within the local area have been determined through a search of the Victorian Water Measurement Information System (WMIS). The WMIS database was undertaken in 2024 to identify registered bores within a 10 km buffer of the mine void and within the Jan Juc GMA.

Figure 5-7 shows a high density of stock, domestic and irrigation bores located to the northeast of the Jan Juc GMA (north of Torquay); however, these bores are generally shallow and intersect the groundwater resources of the Beaumaris Sandstone (formerly known as the Moorabool Viaduct Sands) or the shallow sediments of the DBG. Of these bores, only two appear to be completed in the UEVF. Bore ID 68160 is completed to a depth of 278.9 m and located ~3 km southeast of the mine near the coast. Bore ID 68179 is completed to a depth of 28 m in coal and is approximately 8.5 km northeast of the mine. This bore sits within the Jan Juc syncline and due to the Bells Beach Anticline separating the UEVF at the mine and this bore, they are not connected.

Beginning 2007, Barwon Water installed seven production bores (GW1 to GW7) in the LEVF (refer **Section 2.2.3**).

Lastly, the Moriac Quarry has a licence to extract 250 ML/year. The quarry is located approximately 13 km north of the mine void with groundwater extracted from the LEVF (up-gradient of the site) and used for industrial sand washing purposes.

5.7 Potential Environmental Sensitive Receptors and Groundwater Dependant Ecosystems

Across the catchment there have been many studies that have assessed the nature and extent of GDEs that may occur within the catchment along with the aquatic ecology of the surface water systems. Many of these are summarised in **Figure 5-8** with the section below providing the most current understanding. Specifically, the following Environmental Sensitive Receptors (ESRs) and potential GDEs are discussed: summarised in GHD (2013) and the CHM report in **Appendix A**.

- Anglesea River and Salt Creek Permanent Pools.
- Anglesea River and Salt Creek Vegetated Marshlands.
- Anglesea River Estuary.

Additional information on the terrestrial and aquatic ecology of the catchment can be found by Ecology Australia (2007–2013) and GHD (2012–2016).

5.7.1 Anglesea River and Salt Creek Permanent Pools

As part of Barwon Waters Anglesea Borefield Project, a number of persistent pools in upper catchments of both water courses have been identified and include (**Figure 5-8**):

- Upper Anglesea Persistent pools (named AGP1-B, AGP2 and ASP7); and
- Salt Creek Persistent pools (SGP1-A and SGP2-B).

These pools (or potential GDEs) were identified as key asset points in the outcrop area associated with the LEVF, which had the potential to be significantly impacted by dewatering activities, as:

- They appeared to be permanent pools and therefore considered baseflow dependent.
- They are located in the interpreted LEVF outcrop area and hence likely to be in direct connection with the aquifer being pumped, also situated at the LEVF outcrop area closest to the Barwon Water borefield, and therefore impacts were possible in the short term.
- Southern Pygmy Perch was identified in the Salt Creek pools suggesting the pools may have a relatively high ecological value as habitats for these fish.

However, GHD (2011a) undertook a detailed investigation on these pools. These studies used stable oxygen isotopes, chlorofluorocarbons and radiocarbon to better understand surface water and groundwater interactions. The results, as well as yearly surface water quality monitoring from 2012 to 2019 confirmed that these pools, with the exception of SGP1-A, are not in direct connection with the underlying aquifer and not baseflow dependant, rather they are perched systems recharged by surface water flows.

5.7.2 Anglesea River and Salt Creek Vegetated Marshlands

Groundwater dependent ecosystems as defined by the Ministerial guidelines for groundwater licensing and the protection of high value groundwater dependent ecosystems (DELWP, 2015) means those ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals and ecological processes they support and the ecosystem services they provide. This definition has also been used in the recent Anglesea River and Estuary Environmental Flow Study (GHD, 2021).

Whilst there is always conjecture in determining the degree of groundwater reliance of certain GDEs (a process that often takes years and a high level of detailed studies to define), GHD (2021) presents that there are some vegetated communities in the swamplands within the Anglesea River and Salt Creek Catchment (defined in this report as the vegetation on top of the Alluvial Swamp Aquifer (ASA)) that rely on less than 10 percent groundwater contribution and therefore meet the definition of a GDE. These swamplands are typically found in the mid and upper reaches of Salt Creek and Marshy Creek and are shown on **Figure 5-8**

Importantly, no other GDEs or areas where they could exist were identified, and to date no other GDEs have been identified where they are in direct connection to the UEVF.

5.7.3 Anglesea River Estuary

The Anglesea River Estuary is an important environmental and community asset in the region. Multiple lines of evidence suggest that the estuary is hydraulically disconnected from the main aquifers within the UEVF and LEVF and include:

- Monitoring of shallow aquifers (DBG/ASA) in the vicinity of the former power station show no changes in water level despite climatic events and aquifer stresses.
- The top of the UEVF under the estuary occurs at a depth of 115 mbgl (refer bore log for P14, GHD, 2010).
- Underneath Marshy Creek adjacent to the former power station, ~30 m of coal, clay and silty clays separate the base of the Creek to the top the UEVF.
- Pre-development (Hancock, 1967) noted small artesian conditions near the former power station from a bore screened 138 mbgl. This indicates that the presence of clay layers between the surface and the water bearing zones are strongly confining.

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Internal Document Control Information:
User Name: Danny.Barnes; Date and Time Printed: 18/06/24 1:05:25 PM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20240613_GroundwaterImpact Assessment\Figure5-7-GroundwaterUsers.mxd

Groundwater Users

0 0.5 1 2 3 4 Kilometers

1 cm = 1 km [Page Size: A3]

LEGEND

- Stock and Domestic
- Surface Water
- Alluvial Swamp Aquifer
- Mine Overburden
- Boonah Formation
- Demons Bluff Formation
- Demons Bluff Formation / Boonah Formation
- UEVF (Intermediate Coal)
- UEVF (Lower Sands)
- UEVF (Upper Sands)
- LEVF
- Decommissioned
- Groundwater Bores (Unverified)
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure 5-7

N

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:59,911
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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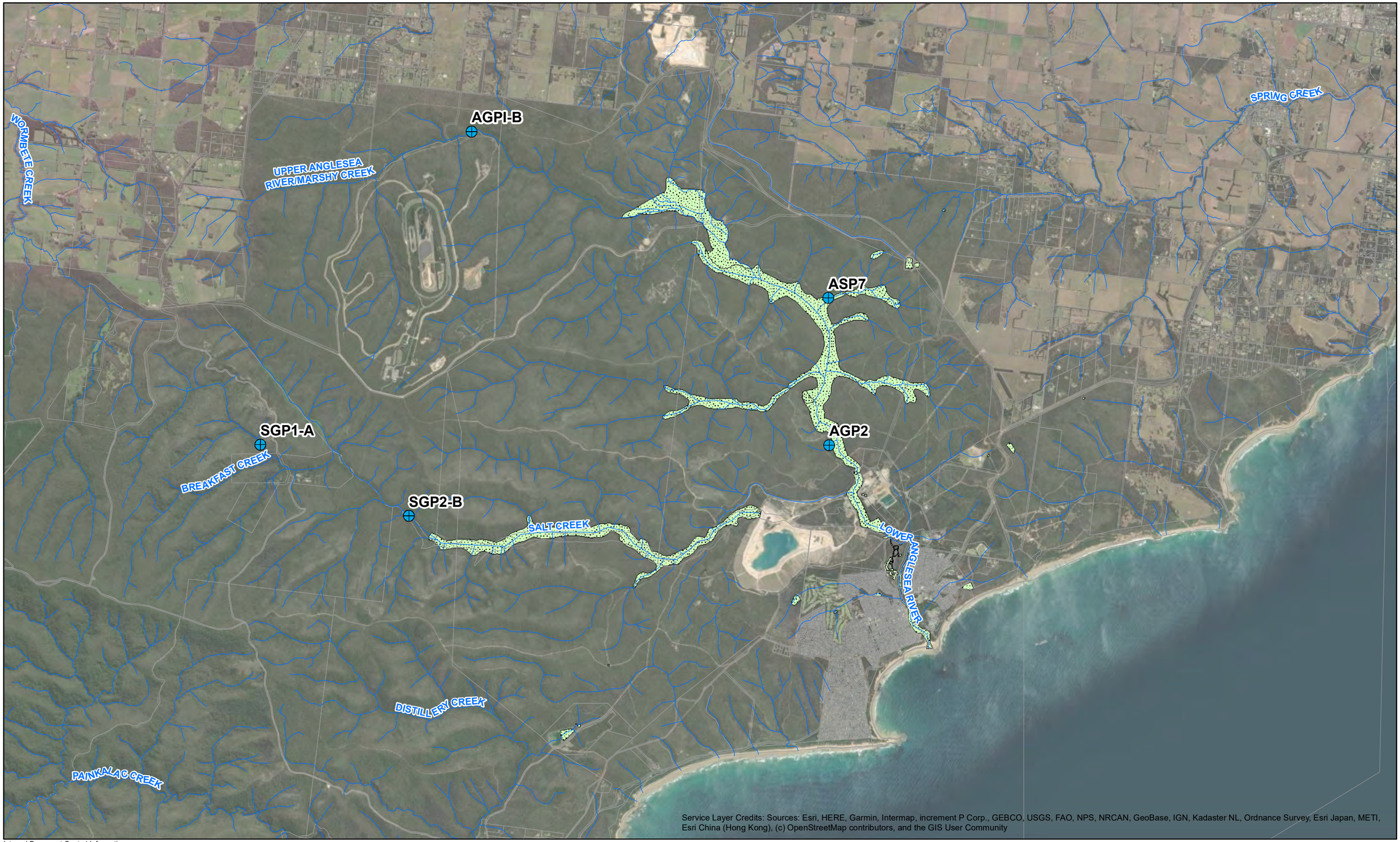

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User Name: Danny.Barnes; Date and Time Printed: 20/06/24 9:01:22 PM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20240613_GroundwaterImpact Assessment\Figure5-8-EnvironmentalSensitiveReceptors.mxd

Environmental Sensitive Receptors

0 0.5 1 2 3 4 Kilometers

1 cm = 1 km [Page Size: A3]

LEGEND

- Perminant Pools
- Marshland
- Watercourse
- Parcel Boundary

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure 5-8

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:59,911
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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5.8 Catchment Hydrology

The main surface drainage features in the Anglesea area are:

- Upper Anglesea River/Marshy Creek and associated swamps and tributaries.
- Lower Anglesea River (Estuary).
- Salt Creek and its associated swamps and tributaries (e.g., Breakfast Creek).

Figure 4-2 and **Figure 5-8** shows the location of surface water features and monitoring points discussed throughout this section.

5.8.1 Anglesea River

The total catchment extent is approximately 65 km^2. Swampy heath and heathy woodlands predominate in the catchment. The Anglesea River is described in three segments:

- Upper reaches of the Anglesea River (i.e., Marshy Creek).
- Swamps associated with the mid-reaches of Anglesea River/Marshy Creek.
- Lower Anglesea River.

Geographically, the Lower Anglesea River is defined to begin downstream of monitoring point SP6 at Coal Mine Road. The swamps are located between monitoring point SP6 and 1 km upstream of monitoring point AV3. The upper reaches are located above this point.

Table 5-1 discusses the Anglesea River inter-gauge flow differences and flow statistics are described in **Section 5.8.1.1**. Furthermore, it is noted that stream flow characteristics observed at the end of the catchment are considerably different between the 2 periods of 14-year available surface water flow data that are available for comparison i.e. 1968 to 1981 and 2010 to 2023. The difference (reduction) in observed flow and potential causes is discussed in **Section 5.8.3.**

5.8.1.1 Upper Anglesea River/Marshy Creek

The upper reaches of the Anglesea River/Marshy Creek are ephemeral; however, GHD (2013) reports that several non-groundwater fed, permanent pools exist across its reach (monitoring points AGP1-A, AGP1-B and AV1, **Figure 5-8**). These reaches drain the eastern flanks of the Otway Range, and much of the outcropping LEVF and MEVF from the west to the east near Gum Flats Road.

The ephemeral nature of flow within the Anglesea River catchment is evident in stream gauging data. Upstream monitoring point AV1 shows around 250 days per year (nearly 70 percent of the year) with no recordable flow. **Figure 5-9** shows flows since 2009 and **Figure 5-10** shows flows from 2019 to 2021.

5.8.1.2 Swamps

The swamp associated with Anglesea River/Marshy Creek is primarily located between AV3 and SP6 near the former power station. Within this stretch, surface water flow is ephemeral and usually dry during the summer; however, it has a number of wetlands that may be present year-round (GHD, 2013). During large first flush events of these swamps (i.e., first flows after a prolonged period of no flow), significant volumes of low pH water can be flushed into the estuary (Lower Anglesea River), which cause metals precipitation and, in some cases, fish kills. Historical data shows that the estuary exhibits low pH (<5) in two out of every three years.

At monitoring point AV2, which is located just upstream of the former power station, data indicates that there are on average 134 days per year (37 percent of the year) that show no recordable flow for the period 2009 to 2021. Note, AV2 was installed in 2009, much later than gauging station SV2 on Salt Creek.

For periods where baseflow is sustained for longer periods than average, **Figure 5-10** presents typical flow duration curves using runoff events from 2019 to 2021 from AV2 (lower catchment) and AV1 (upper catchment). This shows discharge in AV2 runs for a longer period of time than in the upper catchment (**Table 5-1**).

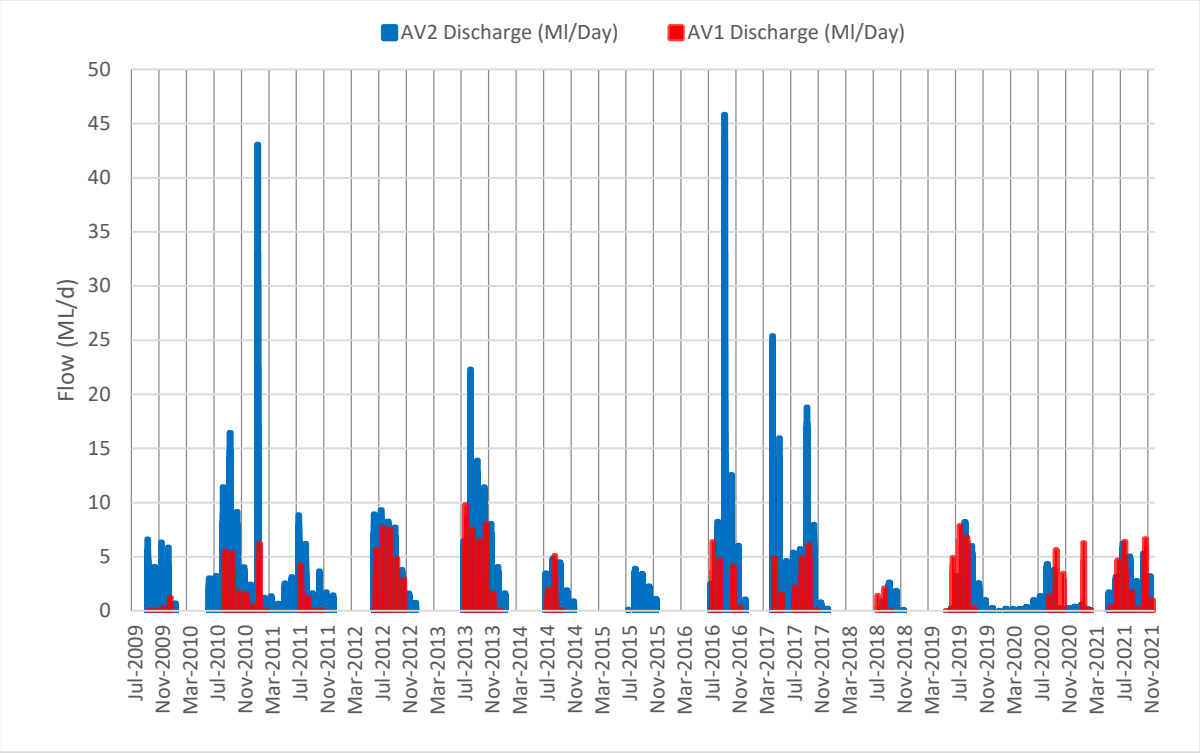


Figure 5-9 Total flow (by month) for the Anglesea River (AV1 & AV2) from 2009 to 2021

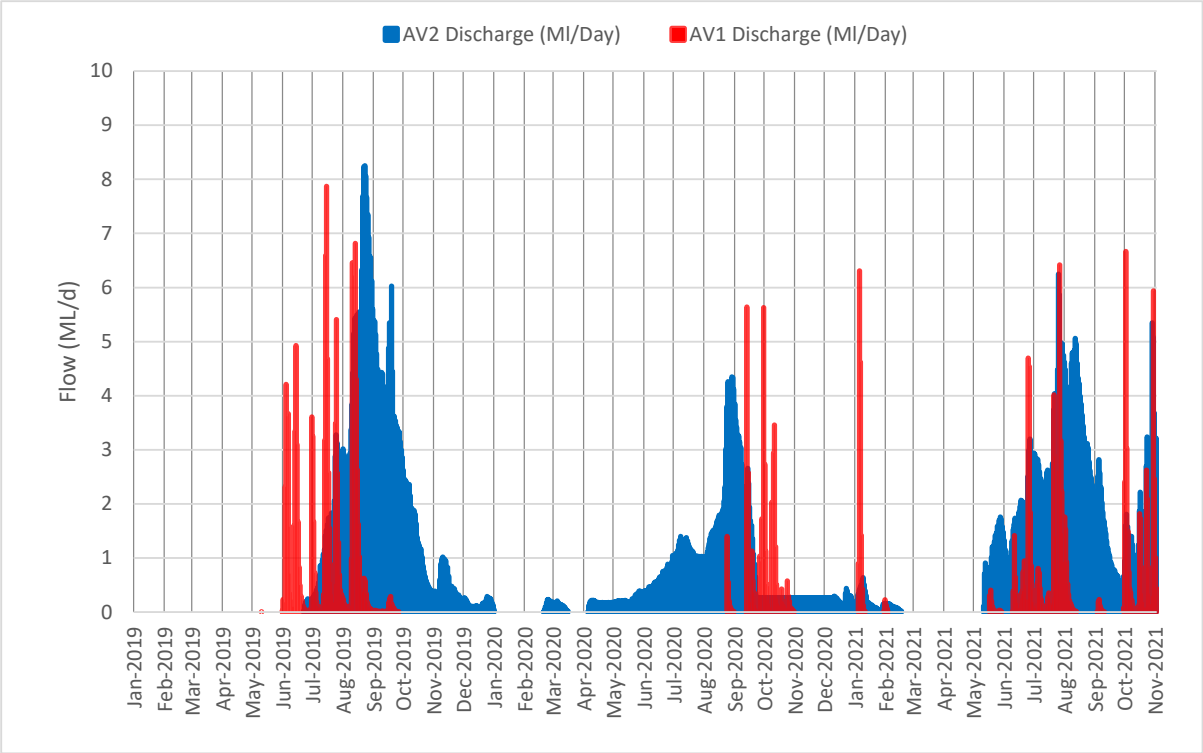


Figure 5-10 AV1 vs AV2 Baseflow Comparison 2019 to 2021

Table 5-1 Anglesea River Inter-Gauge Flow Differences

Monitoring Point	Comparison
Between monitoring points AV1 and AV2	Gaining conditions (i.e., where surface water flow gains occur as water travels downstream) are identified throughout the data record for these monitoring points. These stream gains are due to continued runoff and drainage of the catchment downstream of the upstream monitoring point. Again, this is as expected due to the increasing catchment size and runoff potential moving downstream. Short-term losing stream conditions were identified following prolonged dry periods. In these cases, rainfall recorded in the upstream monitoring point (AV1) probably infiltrated relatively dry ground and was subsequently attenuated in the swamp prior to reaching AV2.

5.8.1.3 Lower Anglesea River

At the lower reaches of the Anglesea River catchment in the region of the site and downstream, flows had previously been artificially supported by a 3-5 ML/day of approximately pH 7-8 water discharges from Alcoa's power station (EPA License EM32162), refer **Figure 2-3**. In addition to this discharge, the lower reaches of the Anglesea River received periodic baseflow (as throughflow) from the ASA formed in the permeable alluvial sediments deposited along the creek valley. The effect of Alcoa's alkaline buffering capacity, effectively masking the ongoing naturally occurring issues within the ephemeral river system for the majority of the last 50 years, along with peak flows from Salt Creek and Upper Anglesea River on the pH of the Estuary is clear on **Figure 2-3**.

5.8.2 Salt Creek

The total catchment area of Salt Creek is approximately 48.7 km^2 and primarily resides within Anglesea Heath, containing significant quantities of heathy woodland and swampy heath with peaty soils. For the purposes of this report, Salt Creek is described in two segments: Upper Salt Creek and Lower Salt Creek, **Figure 4-2**.

Geographically, Upper Salt Creek is defined as the reach above the marshland (near monitoring point SV4) with the lower reaches being defined from this point to monitoring point SV2 along the diversion channel. Flows occurring in the lower reaches have been modified over time as the mine footprint developed. A portion of the Salt Creek catchment has been modified in the 1960's whereby surface water in this location now runs into the mine void as opposed to Salt Creek or the diversion channel. The physical size of the mine void today, plus its local drainage area represents approximately 8% of the Salt Creek catchment, however the actual impact on the historical flows to Salt Creek would be dependent on the original topography and any additional catchment introduced by the diversion channel.

Monitoring point locations are shown in **Figure 5-7**. **Table 5-2** discusses inter-gauge flow differences across Salt Creek and flow history is shown in **Figure 5-11** (since 2009) and **Figure 5-12** (total period).

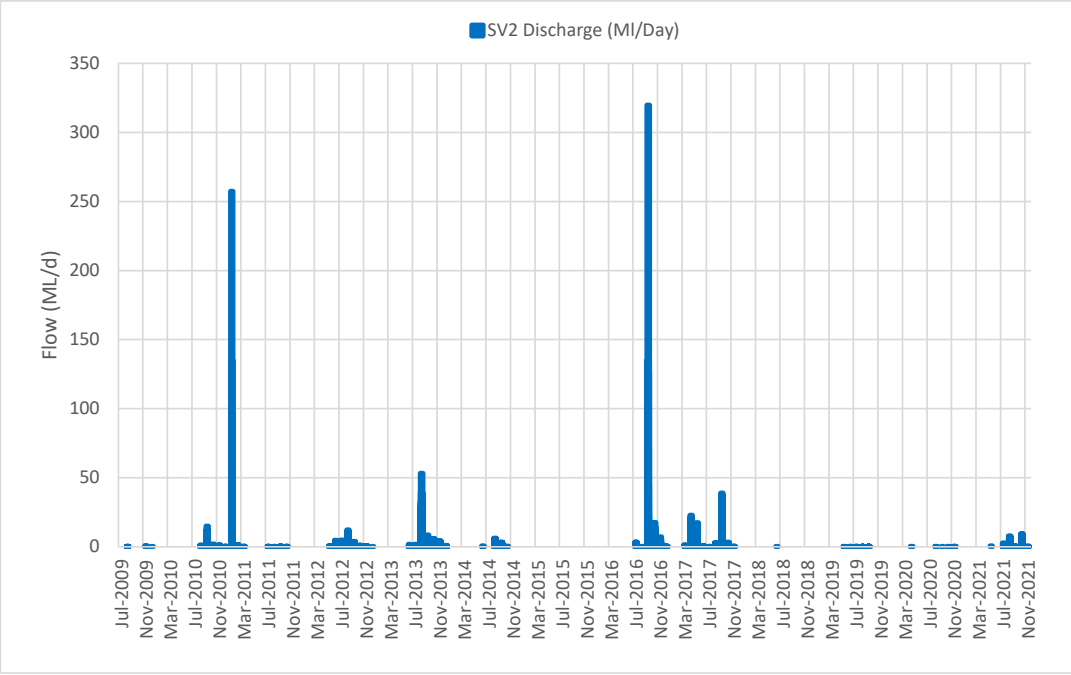


Figure 5-11 Total Flow (by month) for Salt Creek from 2009 to 2021

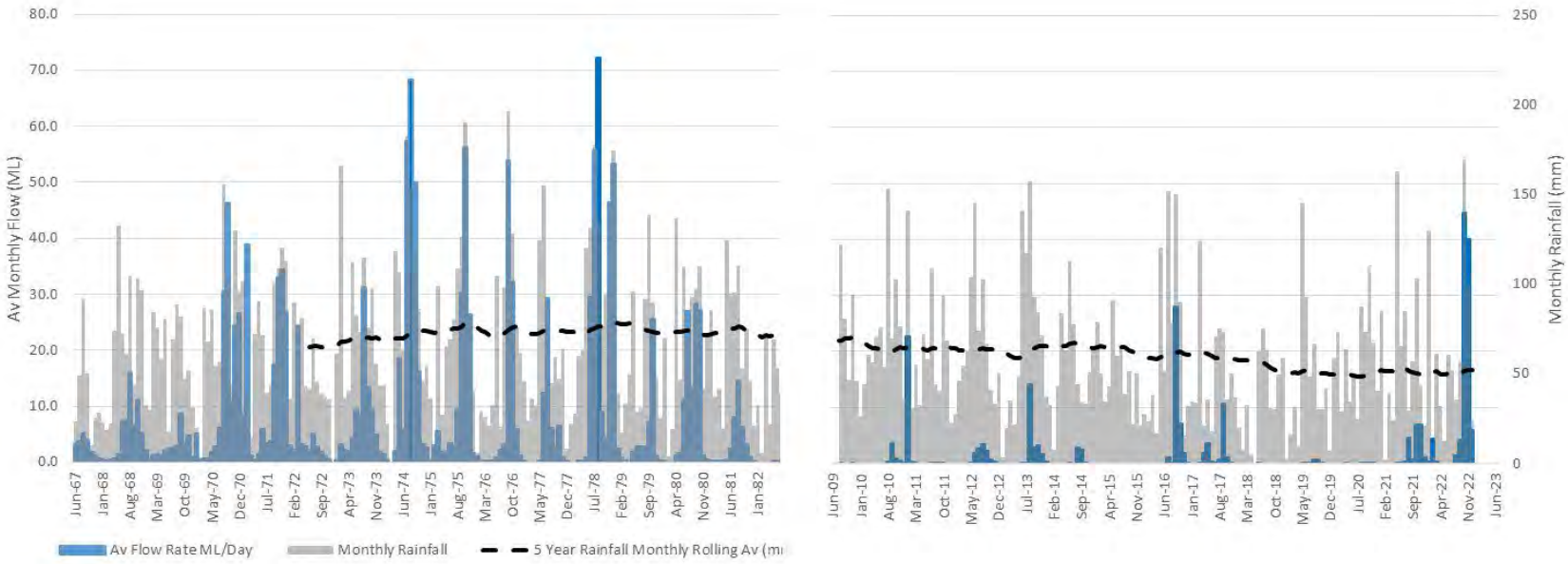


Figure 5-12 SV2 Historical Flow

Table 5-2 Salt Creek Inter-Gauge Flow Differences

Monitoring Point	Flow Description
Between monitoring points SV3 and SV1	• These monitoring points show primarily gaining stream conditions, often following large rainfall events. This is where surface water gains occur as water travels downstream, due to continued runoff and drainage of the catchment downstream of the upstream monitoring point (SV3). This is as expected given that catchment size increases in the downstream direction. Also, the likely addition of groundwater from perched watertables would contribute to gaining stream conditions. • Losing stream conditions occur temporarily, often at the commencement of the wetter winter period. This is possibly due to increased infiltration rates to relatively dry and unsaturated sub-surface soils.
Between monitoring points SV1 and SV4	• Short-term surface water flow losses were identified at downstream monitoring points, primarily due to rainfall runoff and infiltration subsequent to significant rainfall events. • Longer term surface water flow gains occur at SV4 (upstream of the swamp). Flow at this monitoring point continues subsequent to rain events and subsequent to flow upstream. This shows the increase in catchment size and as such, runoff potential, available to the downstream monitoring point (SV4). • A period of no flow was identified between January and April 2012.
Between monitoring points SV4 and SV2	• These monitoring points, situated upstream and downstream of the main swamp, predominantly show minor flow differences. They frequently show losing stream conditions, whereby surface water is attenuated by the swamp, either through evapotranspiration or infiltration. This results in less net flow passing through the down-swamp monitoring point (SV2). • Gaining stream conditions occur periodically during significant rain events, whereby there is more surface water flow at the down-swamp monitoring point compared with the up-swamp monitoring point. This results in cyclical flushing of the swamp and prolonged flow to the downstream monitoring point (SV2) compared with the up-swamp Anglesea River Catchment.

5.8.2.1 Upper Salt Creek

Upper Salt Creek, above the Breakfast Creek confluence (near SV1), is ephemeral; however, Breakfast Creek itself (a tributary to Salt Creek) appears to be the only section within the Anglesea River/Salt Creek catchment that appears to be perennial (GHD, 2013). This is supported by subsequent surface water monitoring reported by GHD (2016b).

Between SV1 and SV4, where the LEVF outcrops, baseflow is ephemeral with permanent pools of water (monitoring points SGP2-B and SV4). Mostly year around, these upper reaches appear to be mainly losing surface water reaches. **Figure 5-13** shows the flow differences in 2013 from upper catchment monitoring points (SV1 to SV3) to the lower reach (SV2).

5.8.2.2 Lower Salt Creek

Lower Salt Creek and its associated swamp (between SV4 and SV2) reports historical spring surface water flows with dry periods occurring at most other times of each summer (**Figure 5-12** and **Figure 5-13**). In this location, the Creek is confined to a more incised channel and is also inferred to be a potential losing stretch of surface water (GHD, 2013).

The lowest monitoring location in Salt Creek is along the diversion channel (monitoring point SV2), which generally only records flows during the winter months when high intensity and large duration rainfall events occur.

Total stream flow data at SV2 (Lower Salt Creek) ranges from 1967 to 1982 and 2009 to 2021 and is presented in **Figure 5-12**. This shows an average stream flow of 2,300 ML/year, ranging from years of no flow (e.g. 2015) to 9,000 ML/year (1978). In the latter period, flows are significantly lower than those observed in 1967 to 1982. **Section 5.8.3** explores the observed flow reduction further.

At SV2, daily flow exceeding 1 ML/day occurs approximately 35 percent of the time and completely dry conditions occur for approximately 50 percent of the time based on existing gauge records.

Lastly, it should be noted that only anecdotal data for flow exists between the period of 1983 and 2009, these are noted on **Figure 5-14**. Whilst no measured flow data exists between this period, a significant rainfall event (November 1995 of approximately 200 mm over 2 days), led to the overtopping of the Salt Creek diversion channel embankment and a volume of water estimated between approximately 3 and 4 GL entering the mine void (pers. com C. Rolland, 2016, former Alcoa Mine Manager).

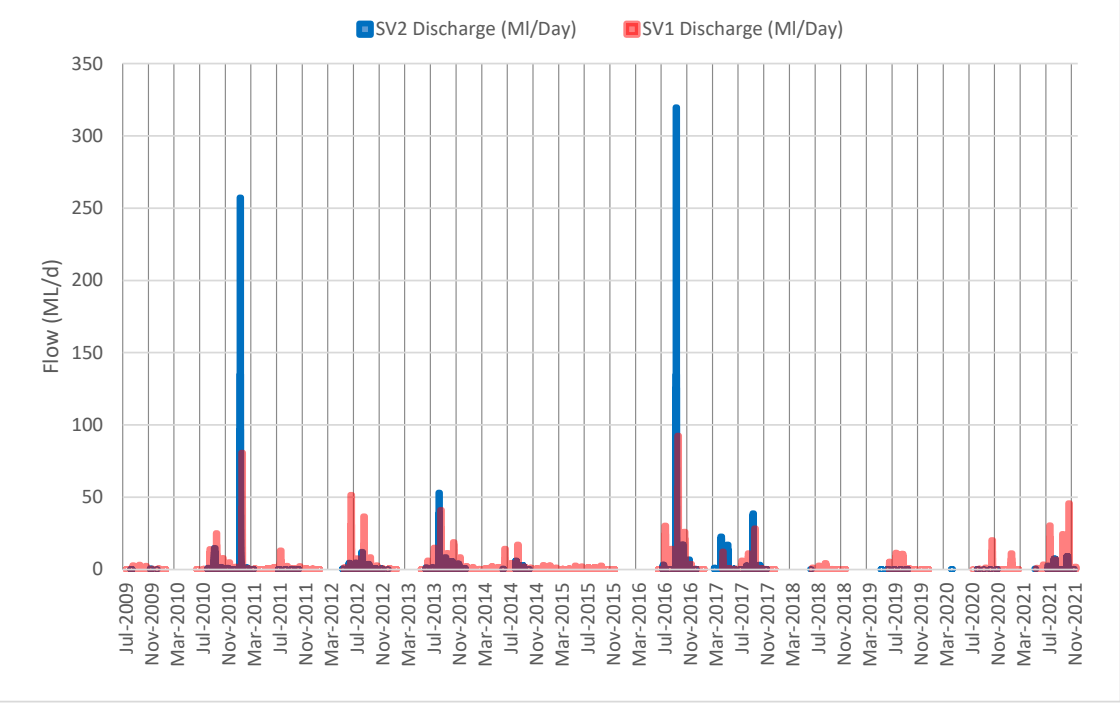


Figure 5-13 Upper Salt Creek Flow (SV1) vs Lower Salt Creek Flow (SV2)

5.8.3 Reduction in Surface Water Flows

Stream flows within the catchment have significantly declined since monitoring began in 1967, refer **Figure 5-14**. Numerous theories have postulated causes for this from the impact of climate change (such as decreased rainfall and increase in evapotranspiration) to an increase in water loss to underlying aquifers. This section explores these questions and outlines the most probably cause.

Firstly, the relationship between rainfall and runoff is not linear. Using over 120 years of catchment specific data, e.g. climate data from a gridded point adjacent the mine from the SILO database it is clear the region has seen significant shifts in climate. Between the 2 periods of 14-year available surface water flow that are available for comparison i.e. 2010 to 2023 and 1968 to 1981 there are vastly different rainfall statistics.

- Total rainfall between 1968 to 1982 was 9,994 mm an average of 714mm/yr.
- Total rainfall between 2010 to 2023 was 8,515mm with an average of 608mm/yr.

This means that during 2010 to 2023, the catchment received 1479 mm less rainfall when compared to 1968 to 1982. Using a high-level catchment yield calculator, this drop in rainfall represents a decline in more than 12,000[8] ML of surface water.

Furthermore, Chiew and Prossor (2011) suggest annual variations in rainfall are typically amplified as two- to three-times larger variations to annual runoff. So, a 10 percent reduction in rainfall typically leads to a 20 to 30% reduction in runoff. However, this rule of thumb does not always hold true especially in catchments dominated by large elevation differences and steep slopes (such as the Otway's). In fact, a study undertaken by (Potter and Chiew, 2011) in the Campaspe region of Victoria found that observed reduction in annual runoff during 1997–2008 was 59 percent lower compared to its long-term average despite rainfall only falling by 15 percent during this period.

For Salt Creek, a 16 percent reduction of rainfall (2010 to current c.f 1968 to 1981) has led to an 89 percent reduction in flow. Whilst this does seem severe and may indicate that additional water must also be losing from the catchment, it may not be unexpected considering the results from the Campaspe trial (Pott and Chew, 2011) and the fact that the majority of Salt Creek is located within a high relief catchment.

An additional study undertaken by (Saft *et al.,* 2015) looked at data from 228 catchments from south-eastern Australia (East Coast and Murray-Darling Basin water divisions) that are unregulated, relatively unimpaired, not nested, and with catchment areas between 50 and 2000 km^2. The study aimed to address whether annual rainfall-runoff relationships are significantly different during extended dry periods, compared with the historical norm and if so what catchment and climate characteristics cause these changes.

[8] Catchment Area = 11670 Ha; Catchment yield co-efficient of 7

The results found 79 percent of all catchments experienced a downward shift in the best-fit rainfall-runoff relationship during extended dry periods. This means that a persistent drought results in lowered runoff generation rates for similar rainfall amounts. Thus, in a sequence of years with reduced rainfall we would expect not only lower runoff due to the lower rainfall, but also less runoff than would be expected from the historical functional dependency of runoff on rainfall.

To relate the above with Salt Creek, and in recognition that following the millennial drought, multiyear rainfall from Wensleydale in 2005/06 was the 4th driest 2-year cumulative period on record (from 122 years); 2015/2016 was the 5th driest and 2018/19 was the 8th driest on record. In addition, the cumulative 5-year period 2005 to 2009 and 2014 to 2018 represent the two driest 5-year cumulative rainfall totals on record being 24 percent and 21 percent drier than each cumulative 5-year average between 1968 to 1981.

Therefore, if a 15 percent reduction in annual rainfall causes a 59 percent reduction in surface water flow in the Campaspe region of Victoria, it is entirely possible that >20 percent reduction in rainfall can lead to almost a 90 percent reduction in flow for a catchment with the relief characteristic of Salt Creek.

Notwithstanding the above, the purpose of this GIA, the data analysis, the groundwater pumping test, and the updated groundwater numerical model is to determine the risk of adverse impact associated with Alcoa groundwater extraction based on the best available data and science.

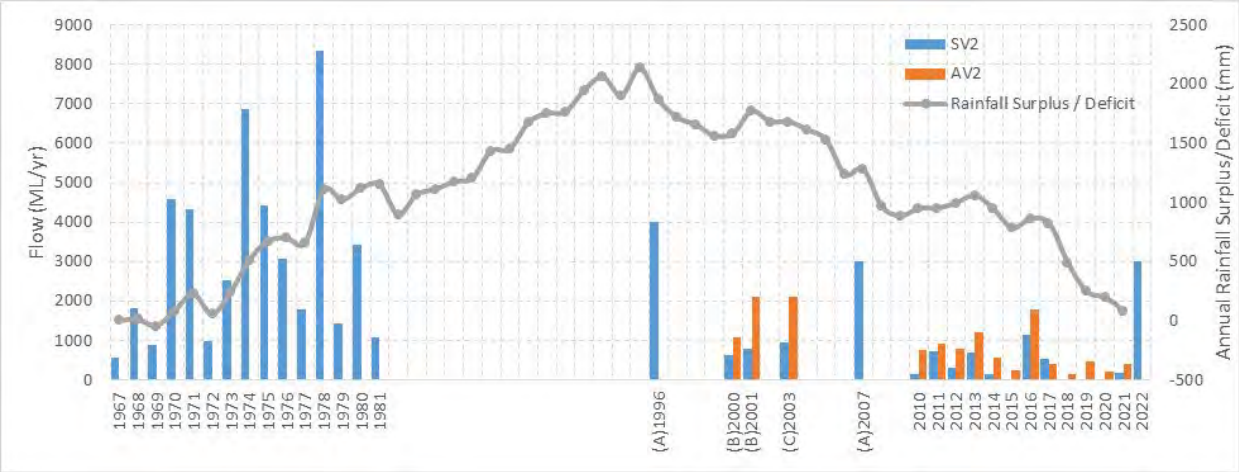


Table Notes:

A = pers. com C. Rolland (2016), former Alcoa Mine Manager

B = Pope (2010)

C = Thorp (2003)

Figure 5-14 SV2 and AV2 Historical Flow

6 Conceptual Hydrogeological Model Overview

EHS Support developed a comprehensive Conceptual Hydrogeological Model, which has been reviewed and endorsed by the State appointed independent TRP and is provided in **Appendix A.** The following sections provide a focussed summary of the conceptual hydrogeological (and hydrological) conditions, relevant to the GIA.

In addition, continuous level loggers (data from some presented in **Appendix D**) and water quality are reported on a quarterly basis (example report presented in **Appendix G**). Observations that may lead to a potential change or increase understanding of hydrogeological processes are summarised in **Section 6.6**.

6.1 Climate

The Anglesea area is characterised by relatively high rainfall in the topographically elevated areas to the west, with decreasing rainfall across the lower northern and eastern areas. Long term average annual rainfall at the two closest rainfall gauging stations to the former mine range from 616 to 769 mm/year. Mean annual potential evaporation exceeds rainfall and has been measured at approximately 1,300 mm/year. Within the mine void, evaporative losses per year are estimated at 311 mm/year.

Over the last 120 years there have been three distinct climatic phases. Between 1900 and 1950, the region exhibited a drying climate, defined by average annual rainfall typically being lower than the LTA rainfall. Between 1950 and 1990, the region then experienced a strong wet period where above average rainfall fell for 27 out of 40 years. Recently, however, the rainfall surplus/deficit has again begun to fall with drier than average conditions dominating over the last 30 years.

Future median climate projections, relative to the current climate baseline, estimate that daily temperatures will increase, potential evapotranspiration will increase, and average annual rainfall and runoff will decrease.

6.2 Surface Water

The three main surface drainage features in the Anglesea area include Salt Creek and its associated swamps and tributaries, Upper Anglesea River/Marshy Creek and associated swamps and tributaries and the Lower Anglesea River. These waterways are ephemeral in natural, however, there are several non-groundwater fed, permanent pools that exist across its reach. These are recharged by overland/surface runoff and located in densely vegetated parts of the Alluvial Swamp system. Since surface water monitoring began in 1967, Salt Creek has experienced a significant decline is annual flow. This decline is primarily related to climate as outlined within this document.

At the lower reaches of the Anglesea River catchment in the region of the site and downstream, flows had previously been artificially supported by a 3-5 ML/day of approximately pH 7 water discharges from Alcoa's power station (EPA License EM32162). This ceased in 2016.

The surface water that flows in the catchment is retarded in Alluvial Swamps located in the mid and upper parts of the catchment. These alluvial swamps store and use (via evapotranspiration) significant volumes of water. The water that is stored in these systems is referred to as groundwater of the alluvial swamp aquifer (ASA). When the ASA storage is fully saturated and / or runoff exceeds the ASA's storage capacity, surface water flows begin.

The pH in the upper region of the Salt Creek catchment is generally around 5-7 and decreases to 3.5 to 4 in the mid to lower reaches due to a greater component of ASS which is readily oxidised. As with Salt Creek, acidity increases downstream in the Upper Anglesea River/Marshy Creek where the mid and lower reaches of the catchment contain more ASS which is readily oxidised. A similar trend is observed in electrical conductivity, where fresher water is reported in the upper catchments of Salt Creek and Anglesea River/Marshy Creek. In both sub catchments, the larger variation in EC seen in the downstream part of the catchment is likely due to surface water flows being retarded in the Alluvial Aquifer and allowing evapotranspiration to concentrate salts.

6.3 Catchment Acidity

Studies of acidity in the Anglesea River catchment have acknowledged the catchments naturally high pyrite and sulphur content as the main source of acidity or acid drainage. An acid sulfate soil assessment undertaken within the Anglesea swamp by Fiona Glover and Assoc Prof. John Webb (Report on Anglesea River Acid Sulfate Soil[9]) identified both potential PASS and AASS were present within the sediments. Wong et al., (2020), also found the catchment to contain high sulfur reserves from pyritic shales and siltstones, coal seams, tea tree swamps. The ASA also contains naturally occurring sulphide-bearing sediments, peat and coal. As the water level fluctuates in the ASA these sediments are exposed to air and oxidised in the vadose zone. This happens over and over again resulting in a build-up of leachable acid and metals. When the ASA becomes fully saturated (usually after a significant wet period), these oxidised sediments are mobilised resulting is low pH (acidic) water.

The Upper Anglesea River has experienced low pH events prior to Alcoa activities. A sampling point located at AV2 has consistently recorded pH between 2.5 and 4 since 1967. The Anglesea River estuary had previously been artificially supported by a 3-5 ML/day of approximately pH 7 water discharged from Alcoa's power station (EPA License EM32162) effectively masking any upstream low pH events. This discharge ceased in 2016. This along with the introduction of Cooroogarah Park (circa 1983) and the management of the estuary mouth have contributed to the variability in water quality seen in the Estuary over time.

A good statistical correlation exists between rainfall surplus and deficit trends and catchment acidity (pH) indicating that climate (rainfall) and catchment pH have some dependency. 12 km further south at Airies Inlet, Distillery Creek (a tributary of Painkalac Creek) has also reported frequent low pH conditions (Surf Coast Shire, 2006). Therefore, climatic drivers as opposed to anthropogenic factors (such as groundwater pumping) are understood to be the main reason for the low pH conditions experienced within the catchment.

[9] Download Thesis (hdp-au-prod-app-barwonwater-yoursay-files.s3.ap-southeast-2.amazonaws.com)

6.4 Surface Water and Groundwater Interactions

Previously geological and hydrogeological evidence has indicated that the swamps and marshlands that make up the shallow unconfined ASA acts like a perched water system, that is water in the ASA finds it very difficult to interact (leak or receive baseflow) with underlying aquifers. This conceptualisation is supported by a number of lines of evidence which are summarised below:

- A review of all available exploration geological bore logs (22 logs) that were located either within or adjacent to the ASA shows that an average thickness of 27.7m (max = 86m; min = 2.4m) of either clay or silt (e.g. low permeability material) that separates the base of the alluvial / swamp sediments in which surface water flows to the next most permeable layer underlying the surface water systems.
- Laboratory testing of some of these low permeability materials indicated that the average vertical hydraulic conductivity was 0.0002 m/d with an average porosity of 41 percent. To put this in context, assuming a minimum thickness of 2.4m existed between the base of the swamp sediments and the next most permeable formation, surface water would need to be present for 5.6 years for water to leak though this barrier. As we know, the surface water ways are ephemeral, and this driving head of water is rarely there for more than a few months at a time.
- Throughout the marshland areas several permanent water pools have been mapped (AGP1-B, AGP2 and ASP7). Stable and radioactive isotopes obtained within these pools indicate that they are not in direct connection with the underlying aquifers and therefore not baseflow dependant. At these locations there is an upward gradient. If the gradient was to reverse, as the impermeable base of the ASA inhibits baseflow, there is no reason to suggest it won't do the same and inhibit leakage.
- All ASA monitoring bores have shown a stable trend over the last 10 years with no impact seen in either system despite Alcoa extraction up to 2016, more recent aquifer pumping tests undertaken by Alcoa, and also aquifer pumping tests undertaken by Barwon Water between 2009 and 2012.
- Most large rainfall events exceeding 40mm have resulted in an immediate increase in groundwater levels within most ASA monitoring locations. This indicates that direct rainfall recharge is the dominant driver of recharge to the ASA. Within the ASA, the steepest decline of groundwater levels occurs over spring and summer when episodic rainfall events are absent (such as spring and summer of 2011/12; 2013/14; 2015/16; and 2019/2020). This similar correlation is not commonly observed in unconfined aquifers surrounding the ASA such as the outcropping UEVF, DBG and Boonah Formation. As evapotranspiration is highest during spring and summer, this suggests that evapotranspiration and throughflow is the most likely cause of water loss from the ASA.

6.5 Hydrogeology

A complex series of aquifers and aquitards exist beneath the coal mine and former power station. A summary from the shallowest to deepest is provided below.

In addition to the hydrogeological units described below, the mine void acts as a hydrogeological control; for the local catchment, the mine void acts as a groundwater sink. Prior to the exposed coal being covered, seepage faces after heavy rain were observed near the main coal and basal clay interface leading into the mine void. As coal is unsaturated, its anticipated that its permeability has increased and within the vicinity of the mine, groundwater that would normally be held in the Boonah Formation, now has an easier migration path. This flux will continue to be high until the main coal seam becomes saturated.

The Alluvial Swamp Aquifer (ASA) is the shallowest and described as unconfined comprising alluvial sediments and organic clay and peaty mix. This aquifer exists within Marshy Creek and Salt Creek and appears to be disconnected from the underlying sediments of the DBG, Boonah Formation and the UEVF by clay located at its base. Hydrographic analysis as well as water chemistry using stable and radioactive isotopes also suggest limited potential for surface water and groundwater interactions to occur. A review of the aerial imagery along with ecological reports (Ecology Australia 2007, 2011, 2012, 2013a,b) indicates swamp vegetation and associated ecology has persisted and suggests that the ASA has remained saturated over the long term.

The Demons Bluff Formation consists of siltstone, clay, sandstone and minor coal seams. At the former power station site, the DBG is extends from the surface to ~10 mbgl and thickens and dips towards the southeast. The Boonah Formation underlies the DBG, is ~25m thick and consists of clean sandstone with minor shale, clay and coal. The mine void acts as a groundwater sink and most observation bores screened in the DBG surrounding the mine are unsaturated. In the vicinity of the mine, the only monitoring bore that was saturated was DBG MB06 with an average TDS of 2,770 mg/L. This bore is installed within the backfilled overburden material and as such is not representative of the native aquifer. Permeability tests undertaken within this formation are highly variable with an average horizontal hydraulic conductivity (0.1 m/d, from slug tests) and vertical hydraulic conductivity of $1x10^{-4}$ m/d, from laboratory analysis). The recharge potential of outcropping sediments is low as evidenced by a lack of watertable response after heavy rainfall.

Underlying the DBG is the UEVF which is represented by multiple aquifers occurring as sand lenses separated by aquitards (clay and coal). In the upper half, there is significantly more clay and coal, whilst more permeable sand lenses exist near the base. These basal sand lenses were the target of Alcoa's historical extraction. Pre mine levels suggested the potentiometric surface (groundwater pressure) for the UEVF lower sands found >180mbgl at the mine was ~4m AHD. This means that is a bore were to be drilled to >180m at this location, the standing water level in that bore would rise to 4m AHD or near ground surface. Individual sand sequences above this within the UEVF showed slightly lower potentiometric surfaces the shallower the sand lenses occurred. Vertical permeability testing of these clays and coal indicated an average vertical hydraulic conductivity of $1x10^{-4}$ m/d. Analysis of the pumping test Stage 1 results suggest the horizontal hydraulic conductivity is 1.3 m/d and a storativity of $4x10^{-4}$. Groundwater quality is variable within shallower sand sequences with the TDS within the upper sands is variable ranging from 168 mg/L (UEVF MW07) to 3,470 mg/L (UEVF MW04) with a median

concentration of 889 mg/L. This provides evidence that these lenses may be discontinuous or impacted by the mine void. In the lower sands, during the groundwater pumping test pH ranged from 6.3 to 6.7 with a mean of 6.5. The TDS ranged from 741 to 1,660 mg/L which is consistent with historical ranges reported prior to May 2021, of between 830 to 1,313 mg/L.

The MEVF underlies the UEVF and generally consists of 30-40m of mudstone and siltstone, but also has minor sand and gravel lenses as well as thin brown coal layers. It has been previously modelled as a leaky aquitard as depressurisation impacts have been observed in some deep Alcoa UEVF observation bores whilst pumping has been occurring from nearby the LEVF extraction bores. However, a recent bore assessment program involving down hole camera and wireline logging was undertaken by Alcoa to identify bores with potential integrity issues or those that may cross screen aquifers. In 2021, several at-risk bores were identified and decommissioned. Since the restarting of the LEVF extraction by Barwon Water in early 2022, no impacts have been recorded in the Alcoa UEVF deep observation bores indicating that potential cross aquifer interactions have been mitigated (refer to **Section 7** for further discussion on cumulative pumping risks).

The LEVF underlies the MEVF and forms a confined to semi-confined aquifer (in the upper parts of the catchment) across the region and consists of unconsolidated micaceous silts, carbonaceous clays, silty clays, thin brown coal seams and fine to coarse-grained sands and gravels. Below the coal mine site, the LEVF is up 200 m thick where aquifer material occurs within geological synclines. Geologically, this unit represents the Pebble Point Formation and, prior to Barwon Water groundwater extraction in the area, was artesian at the site. Groundwater TDS in the LEVF is fresher than that observed in the UEVF. GHD (2013) reported that groundwater salinity had been measured between approximately 500 to 900 mg/L TDS. The aquifer parameter data suggests hydraulic conductivities of up to 2.77 m/day can occur in individual sand horizons.

6.6 Observation from the Ongoing Quarterly Monitoring

As part of the current site reporting objectives, continuous groundwater level and water quality are reported on a quarterly basis. This was initiated for the UEVF groundwater pumping test which commenced on 13 May 2021, and was completed on 8 December 2021. The November 2024 Quarterly report is attached as **Appendix G**. Key observations noted from this report include:

- Groundwater pressure for the upper part of the UEVF aquifer (approximately 40m to 140m depth) show no impact of pumping (**Figure 6-1**). This increase in trend in this part of the aquifer is attributed to the long-term pumping of the sump which intersected the upper sand lens.
- The rate of recovery observed in UEVF MB1, UEVF MB 2 and UEVF MB 5 (downgradient of the waterbody and closest to the historical sump location) show a partial response to pit waterbody level fluctuations (**Figure 6-1**). This does not imply a direct connection, rather as the pit waterbody fills, the aquifer is compressed, and the rate of recovery varies slightly due to compressibility and storativity characteristics of the aquifer.
- Groundwater levels in the shallower aquifer generally show gradual to stable trends over the cooler months (March to October) and declines over the warmer months (associated with higher evapotranspiration) or when there has been low rainfall in the preceding months (**Figure 6-1**). This continues to support rainfall and evapotranspiration as the key drivers for groundwater behaviours in this area.

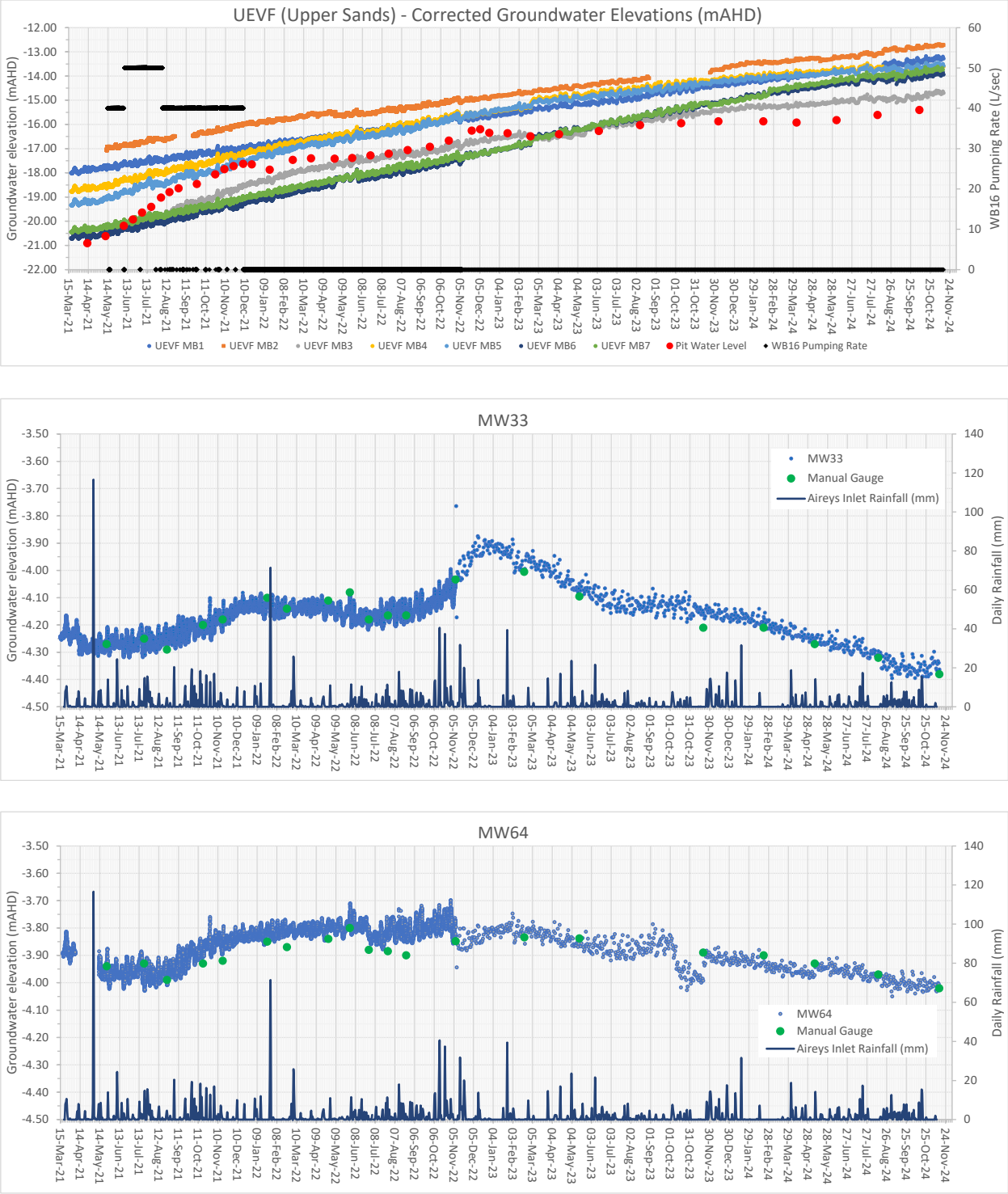


Figure 6-1 Selected Hydrographs from the Continuous Water Level Monitoring

7 Numerical Groundwater Flow Model

The updated Anglesea Groundwater Model - Numerical Model Development and Calibration Report is provided in full as **Appendix E**. A summary of the findings is provided below.

7.1 Overview

Barwon Water investigated and developed the Anglesea bore field, an urban groundwater supply, between 2007 and 2010 in response to severe water shortages at that time. Development of the bore field was supported by a series of field and desktop investigations, including the original 2009 numerical groundwater model developed by GHD, that evaluated potential bore field impacts. Following this, a Bulk Entitlement (BE) for bore field operation was issued by the Victorian Government in June 2009 based on those preliminary investigations. In 2013, the 2009 numerical groundwater model was updated following a series of pumping tests undertaken by Barwon Water between 2011 and 2012. A five-yearly review of data and modelling is required under the BE following bore field operation, which occurred in late 2019, and is again under review in 2024; Barwon Water rely on the most updated numerical groundwater model, currently referred to as the 2024 Anglesea groundwater model, for bore field sustainability and impact assessments.

In 2020 Southern Rural Water (SRW) approved a 12-month UEVF groundwater pumping test for Alcoa to assess the sustainability and effects of groundwater abstraction for filling of the mine void over a proposed period of approximately 10 years. Hydrogeological data from this pumping test along with refinement of geological layers from recent drilling near the mine supported further development and calibration of the 2024 Anglesea groundwater model. Note that Barwon Water and Alcoa both use the same calibrated 2024 Anglesea groundwater model for supporting groundwater licence requirements.

The 2024 Anglesea groundwater model has been subject to rigorous independent peer review by a regulator appointed Technical Review Panel has two main objectives:

- Support Barwon Water's Anglesea bore field planning, management and approvals works under the BE process, specifically:
  - Barwon Water are required to periodically update their Anglesea groundwater model that underpins the Anglesea bore field BE and use it to re-assess aspects of bore field sustainability, details of which are outlined in the main body of this GIA report.
- It is intended that GHD, with subconsultant Groundwater Logic, will develop and apply predictive model scenarios for Barwon Water's BE review purposes, using the developed history-matched models documented in **Appendix E**.
- Support Alcoa/EHS Support for Alcoa's mine closure and rehabilitation planning and management works, specifically:
  - Support Alcoa's license application to SRW for potential long-term groundwater abstraction for filling of the mine void. Specific issues to be addressed using the 2024 Anglesea groundwater model are outlined in the main body of this GIA report.
- It is intended that Alcoa/EHS Support will develop and apply predictive model scenarios for Alcoa's purposes, using history-matched models (refer **Appendix E**).

The 2024 Anglesea groundwater model is based in a minor sense on the earlier modelling of GHD (2013) but is a wholly new model using a new numerical code, layer structure, and parameterisation schemes, and modern methods of history matching to historical observation data. It was built and operates in a stochastic framework that recognises input observation data and model parameter uncertainties.

The intent of using this approach is that the recognised input uncertainties are carried through to their effects on model forecasts and their uncertainty, and therefore their effects on water management decision-making.

The model simulates flux-conserved groundwater and surface water flow and interactions between the two systems. It also simulates the post-Alcoa coal mine closure mine void water body balance, including its interaction with groundwater and other surface water systems. The model history-matching process therefore uses a range of surface water and groundwater data of wide-ranging types, including mine void water levels, to inform (constrain) model parameters. It also uses derivative observations such as water table depth-frequency curves, flow-frequency curves, pumping-induced drawdown trends, and vertical hydraulic gradients.

The intent of employing these wide-ranging observation types is, to the extent possible, to minimise related model forecast uncertainties such as the uncertainty in potential effects from groundwater use on the shallow water table (in swamps), surface water systems, and acid generation risks.

Two-hundred and sixty-three history matched model realisations, each with widely varying parameters, were selected from an ensemble of five hundred. For predictive scenario modelling purposes, a smaller, more manageable number of model realisations was selected for application in that case (e.g., the top 150 models of higher history match quality).

History match quality across these models is generally good, for groundwater levels in deeper bores, water table depths in shallow bores, mine void water body levels, and surface water flows. There are however of course exceptions to this which are discussed in the main body of this GIA report. Several points for further investigation and analysis, aimed at improving history-match quality at specific sites in specific ways, are also identified and discussed.

The model developed and framework used provide a sound basis for ongoing use of the 2024 Anglesea groundwater model in the context of rigorous model forecast and uncertainty assessment.

7.2 Predictive Model Scenarios/Quantities of Interest

Both the updated Alcoa Conceptual Hydrogeological Model (**Appendix A**) and the updated Anglesea groundwater model have been independently peer reviewed by the regulator appointed Technical Review Panel (TRP) to ensure that the model represents current best conceptual understanding, technical practice, and meets the model defined objectives (refer **Appendix E**). This has ensured a comprehensive and robust basis for predictive scenario assessment as part of this GIA.

The modelled scenario and historical climatic data (and climate change projections) along with the Quantities of Interest (QoIs) for assessing any potential impacts or defining other investigations that may be required are discussed in the sections below. It should be noted in the QoIs (refer **Table 7-6**)

drawdown and absolute heads will be extracted as this will enable a comparison between the potential impact as a result from extraction under a certain climate reference period to that of the calibrated observations.

7.2.1 Climate Change

The Guidelines for Assessing the Impact of Climate Change on Water Availability in Victoria DELWP (2020) were used to identify an approach for applying climate change scenarios for temperature, potential evapotranspiration, rainfall, runoff and groundwater recharge to be used across Victoria for assessing the impact of climate change on water availability.

7.2.2 Reference Period

The reference period outlined in DELWP (2020), i.e., Reference Period 1 – post-1975 to 2023, will be used to inform future projections whilst considering potential future climate change effects. The use of a post-1997 reference period was considered however due to significant model run time and the statistical similarities of annual rainfall from the SILO (Point Patched Dataset (PPD) location shown on **Figure 4-5** between post-1975 and post-1997 to 2023s, refer below for rainfall, this second reference period was not warranted.

- Rainfall post 1975 = 643 mm/yr
- Rainfall post 1997 = 622 mm/yr

Note: whilst the rainfall observations from the two periods above are relatively similar, observations between the two periods that contain surface water flow data (that is 1968 to 1982 and 2010 to 2023) are significantly different, refer **Table 2-3.**

7.2.2.1 Applying Climate Change Projections

Whilst it is anticipated that any groundwater application will just be for the period required to fill the mine void, the models' predictive capability will begin January 2023 (year 1) and will run until February 2066 (year 44) which will be decades longer than any potential groundwater application. Monthly stress periods will be incorporated up until February 2040. Between March 2040 and 2066, stress periods will reduce to seasonal, being 4 stress periods per year (March to May, June to August, September to November, and December to February).

Simulations involved using a climate projection obtained from the Stochastic Climate Library (SCL) tool within the stochastic weather library[10] for the climate reference station within and adjacent the model domain. Whilst each predictive groundwater scenario contains 150 unique projections (to bound uncertainty), one realisation from the SCL was applied, rather than 150 unique realisations for each of the 150 history-matched groundwater models. This approach removes "noise" from the model outputs so that the effects from any proposed pumping can be more readily discerned from randomness in

[10] https://toolkit.ewater.org.au/Tools/SCL

climatic inputs. To ensure this stochastically generated dataset was appropriate, a scenario without any climate change applied to the climate reference period (1975 - 2023) was used to check that the simulated average annual recharge map derived from the SCL outputs was sufficiently like that from the average rate mapping from the history-matched models over this same period. This is how the single SCL realisation was chosen, i.e., the one (of 150) that most closely resembled historical annual average recharge across the model domain.

The projections based upon data obtained from the post-1975 reference period and projected changes between 1995 and the year of interest were scaled according to the RCP8.5 (conservative) global climate model (GCM); that is, the 10, 50, and 90 percentile forecasts for the stochastic dataset for rainfall and evaporation were scaled down by the amounts for the climate projection scenarios (medium, high) as shown in **Table 7-1** and would be applied directly to the climate sequence obtained from the method above. Forecasting projections based on post-1997 reference period used the 10, 50, and 90 percentile forecasts for the stochastic dataset for rainfall and evaporation.

Note: The DELWP (2020) guidelines recommends analysis of the low, medium and high scenarios, projected from the post-1975 reference period. The low climate change scenario was excluded from this assessment as this would have resulted in even lower potential risks and as the risk assessment is designed to be conservative, the use of a low climate change scenario was excluded.

Table 7-1 Projected Change in Average Annual Rainfall, Runoff, and Potential Evapotranspiration Relative to 1995 % for the Otway Coast as Presented in DELWP (2020b)

	Rainfall (RCP8.5)			Runoff (RCP8.5)			Evapotranspiration (RCP8.5)		
Projection	**2020**	**2040**	**2065**	**2020**	**2040**	**2065**	**2020**	**2040**	**2065**
Medium	-2.0%	-3.6%	-5.8%	-4.0%	-7.2%	-15.8%	2.0%	3.7%	6.4%
High	-6.5%	-11.7%	-19.0%	-14.1%	-25.3%	-41.9%	2.9%	5.3%	9.5%

Table Notes:
These are applicable to post 1975 reference period.

7.2.3 Defining Surface Water and Groundwater Historical Reference Period

While the project site contains a comprehensive set of climate data, and despite 27 years of daily surface water data, there is a gap for Salt Creek flow data between 1982 to 2009. Between 1967 and 1982 surface water data at SV2 was collected during the wettest period on record for the catchment, and then from 2010 to current, which is representative of some of the driest conditions observed (refer **Figure 5-4**). Historical trends and relationships between surface water flow and rainfall have resultingly been difficult to establish.

To maintain the use of the precautionary principal, the surface water conditions (monthly flow and no flow days) experienced between the period January 2010 to 2023 will therefore be used as "the historical reference period", as any adverse impact beyond this as a result from a proposed groundwater license application will clearly be unacceptable. Flow statistics are presented in **Table 7-2** to **Table 7-4**.

It is worth noting however that ultimately, in practice, comparison between model forecast conditions with historical conditions is done using modelled equivalents of the historical data – noting that the model is history-matched to the data most strongly over the 2010-2023 period of data availability.

Table 7-2 Annual Surface Water Flow Statistics – February 1975 to December 2023

	Rainfall (Wensleydale, mm/yr)	Annual Rainfall Surplus / Deficit (mm vs 1975-82 Av)	TOTAL SV2 Flow (ML)	MEDIAN SV2 Flow (ML)	Number of SV2 No Flow Days	% No Flow Days		TOTAL AV2 Flow (ML)	MEDIAN AV2 Flow (ML)	Number of AV2 No Flow Days	% No Flow Days
1975[1]	926.6	130	4292	3.2	0	0					
1976	792.5	-4.1	3077	1.255	38	10					
1977	721.4	-75.2	1791	0.61	151	41					
1978	1216.7	420.1	8330	4.44	122	33					
1979	679.8	-116.8	1462	1.5	65	18					
1980	861.3	64.7	3419	1.205	103	28					
1981	795.3	-1.3	1113	0.84	114	31					
1982[1]	514.1	-282.5	145	0.07	129	39					
2010	825.4	28.8	161	0	245	67		764.75	1	137	38
2011	768.4	-28.2	719	0	290	79		606.21	1	16	4
2012	807.4	10.8	336	0	194	53		795.97	0	183	50
2013	830.4	33.8	697	0	202	55		1215.22	0	199	55
2014	648.8	-147.8	161	0	310	85		357.74	0	222	61
2015	604.6	-192	0	0	365	100		249.42	0	256	70
2016	842.4	45.8	1146	0	251	69		415.45	0	254	69
2017	724.4	-72.2	551	0	221	61		1154.83	2	115	32
2018	555.2	-241.4	0	0	363	99		83.78	0	277	76
2019	646.8	-149.8	0	0	282	77		398.44	0	173	47
2020	773.5	-23.1	0	0	338	92		186.61	0	150	41
2021	864	67.4	288	0	203	56		598.86	1	85	23
2022	988.5	191.9	3020	0.25	177	48		569.16	0	84	23
2023	580.8	-215.8	34	0	242	84		19.35	0	179	62
Av. 1967 -1982	**796.6 (mm/yr)**		**3141 (ML/yr)**		**90 (days/yr)**	**25 (%/yr)**					
Av. 2010 -2023	**747.2 (mm/yr)**		**508 (ML/yr)**		**265 (days/yr)**	**72 (%/yr)**		**569 (ML/yr)**		**165 (days/yr)**	**45 (%/yr)**
Av. 1975 -2023	**767.4 (mm/yr)**		**1487 (ML/yr)**		**200 (days/yr)**	**56 (%/yr)**		**Refer above. Gauge Operational from 2009.**			

1 Incomplete Flow data year

Table 7-3 Surface Water Flow Statistics – 18 February 1975 to 31 December 2023

18 February 1975 to Current	TOTAL SV2 Flow (ML)	MEDIAN SV2 Flow (ML)	Total Number of SV2 Days	Number of SV2 No Flow Days	Number of SV2 NA Days	Number of Years with SV2 Data	% No Flow Days		TOTAL AV2 Flow (ML)	MEDIAN AV2 Flow (ML)	Total Number of AV2 Days	Number of AV2 No Flow Days	Number of AV2 NA Days	Number of Years with AV2 Data	% No Flow Days
Jan	837	0	1488	512	837	21	79		Refer Table 7-4. Guage Operational 2009 onwards.						
Feb	182	0	1367	491	763	22	81								
Mar	195	0	1519	578	837	22	85								
Apr	151	0	1470	575	810	22	87								
May	334	0	1519	461	837	22	68								
Jun	1977	0	1470	339	810	22	51								
Jul	4106	0.055	1519	328	835	23	48								
Aug	4644	0.7	1519	269	806	23	38								
Sep	5826	2.12	1470	173	780	23	25								
Oct	6659	1.28	1503	212	806	23	30								
Nov	3899	0.78	1440	228	781	22	35								
Dec	1932	0	1488	385	837	21	59								

Table 7-4 Surface Water Flow Statistics – 1 January 2010 to 31 December 2023

3 September 2009 to Current	TOTAL SV2 Flow (ML)	MEDIAN SV2 Flow (ML)	Total Number of SV2 Days	Number of SV2 No Flow Days	Number of SV2 NA Days	Number of Years with SV2 Data	% No Flow Days		TOTAL AV2 Flow (ML)	MEDIAN AV2 Flow (ML)	Total Number of AV2 Days	Number of AV2 No Flow Days	Number of AV2 NA Days	Number of Years with AV2 Data	% No Flow Days
Jan	714	0	434	396	0	14	91		155	0	434	318	0	14	73
Feb	121	0	395	348	0	14	88		34	0	395	314	0	14	79
Mar	12	0	434	412	0	14	95		19	0	434	357	0	14	82
Apr	56	0	420	407	0	14	97		133	0	420	346	0	14	82
May	119	0	434	389	0	14	90		290	0	434	289	0	14	67
Jun	97	0	420	333	0	14	79		427	0	420	216	0	14	51
Jul	138	0	434	326	0	14	75		884	1.24	434	117	0	14	27
Aug	852	0	434	244	0	14	56		1846	3.8	434	24	0	14	6
Sep	1657	0.615	448	171	0	15	38		1849	3.31	448	15	0	15	3
Oct	1813	0.26	449	212	0	15	47		1028	1.6	449	60	0	15	13
Nov	1372	0	420	228	0	14	54		756	0.65	420	101	0	14	24
Dec	161	0	434	334	0	14	77		308	0.04	434	173	0	14	40

7.2.4 Predictive Groundwater Modelling Scenarios

Table 7-5 outlines the scenarios undertaken. The outcomes of the scenario modelling have informed the broader groundwater impact and risk assessments associated with the Alcoa groundwater license application; note, Barwon Water have a current licensed Bulk Entitlement, and are also currently in the process of reviewing their future Bulk Entitlement. Barwon Water have informed Alcoa that for their assessment a Bulk Entitlement of 7GL per year for 5 years, every 5 years should be considered appropriate.

Note: To satisfy Section 40 of the Water Act 1989, from the scenarios modelled, the results presented in this application have isolated Alcoa's pumping impact from other cumulative impact contributors such as Barwon Waters Bulk Entitlement and climatic factors, also presented in this application. Specifically the results shown for Alcoa's pumping only impact presented in the following sections of this assessment, were determined numerically by the difference between Scenario 2 and Scenario 3.

Fundamental to each scenario are the Quantities of Interest (QOIs). The QOIs form a key prediction or model outcome from a specified model scenario, with a predefined spatial and temporal setting, that is relevant to assessing the likelihood and consequence of a causal pathway element representing a hazard. These are presented in **Table 7-6**. Fundamental to these QOIs are the following terminology definitions:

- "Drawdown" refers to the magnitude of change in groundwater level in response to a given development scenario, as measured relative to the case without the development change (i.e., the "baseline" or "null" scenario, which is that without the groundwater pumping that is tested in the development scenario).
- "Absolute head" is used herein to refer to observed and/or modelled groundwater levels and/or depths (i.e., not change in groundwater levels). Absolute head is used in the QOI definitions to present the modelled drawdown (scenario difference) in a more physically meaningful context. In this case, we assess whether modelled drawdown induces a decline in groundwater levels below the observed and/or modelled historical range (from the historical comparison period described earlier); this will differ across the various climatic model inputs (rainfall, evaporation, and hence recharge and runoff; see the above section on "Applying climate change projections").

Table 7-5 Model Scenarios

Scenario	Climate Scenario	High Level Rationale
Scenario 1		
No Groundwater Extraction ("baseline Scenario 1" or "null" scenario)	Reference Period 1 - Medium[1]	Estimate the natural recovery of the mine void over time with only natural groundwater inflow, and rainfall (overland flow and direct) to counter evaporation.
	Reference Period 1 - High[1]	
Scenario 2		
Baseline Scenario 2 Bulk Entitlement Operation for LEVF. The BE has been defined by Barwon Water	Reference Period 1 - Medium[1]	Modelled results (drawdown and absolute heads) to assess potential impacts for existing Barwon Water BE from the LEVF.
	Reference Period 1 - High[1]	
Scenario 3		
Groundwater extraction from WB16 at 1500ML/yr for 10 years Bulk Entitlement Operation for LEVF[2].	Reference Period 1 - Medium [1]	Modelled results (drawdown and absolute heads) to estimate the potential cumulative impacts resulting from dual operation of UEVF and LEVF extraction.
	Reference Period 1 - High[1]	
Scenario 4		
Mine void fills in 12 months	Reference Period 1 - Medium [1]	Estimate the movement of mine void water into the surrounding aquifers as a result of a Catastrophic Flood Filling event which will cause the mine void to fill up within 12 months.

Table Notes:

1 Applied to the post-1975 reference period.

2 Barwon Water pumping @ 7GL/year for 5 years, then off for 5 years. This cycle will be repeated once, totalling a model run for 20 years, after which, no further pumping assumed.

Table 7-6 Quantities of Interest

Quantities of Interest	Where and How It Will Be Defined or Measured
1 Drawdown at High Value Groundwater Dependent Ecosystems and within the mapped marshlands of the ASA. High Value GDEs is represented by the mapped marshy sediments founds in the alluvial channels located across the catchment and shown on **Figure 4-2** and **Figure 5-8**.	Risks (consequence and likelihood) to high value GDEs was assessed using the framework outlined in the Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems (DELWP 2015) as well as likelihood of exceedance as presented in Peeters LJM and Middlemis H 2023[1] (table 4, pg. 42). Consequence was determined by the modelled median prediction (P50) whilst the method presented in Peeters LJM and Middlemis H., 2023[1] was used to determine the likelihood. Of these 150 realisations, the median value (e.g., P50) represented the consequence of the impact, whilst the P10 and P90 outputs represented the bounds of probability (or likelihood). Both drawdown and historical dry season water table depth were used to assess risk by adopting these consequence criteria: • Minor consequence if median modelled drawdown or change in historical dry season water table depth is <0.1m; • Moderate consequence if modelled drawdown change in historical dry season water table depth is > 0.1 m but < 2m; and • Significant (high) consequence if modelled drawdown change in historical dry season water table depth is > 2 m. Note: Drawdown of 0.1m is the lowest resolution the numerical model is designed for, refer, Table 5-3 of GHD Rev 7. The rationale for using seasonal variability in addition to drawdown is that reductions in seasonal water table depth range may pose risks to GDEs – i.e., some species may require periodic root zone saturation, flushing, or moisture access via capillary action from the water table. This metric however must be interpreted in the context of drawdown because absolute watertable depths arguably matter more to GDEs than seasonal variability – if a GDE cannot access the water table because it has been lowered below the root zone throughout the year (due to climatic factors), then seasonal watertable fluctuations below the root zone throughout the year would have no bearing on GDE health or risks because the water table that the GDE typically seasonally accesses is no longer accessible; for reference, "Seasonal watertable depth range" here means the difference between the 95th percentile and 5th percentile exceedance values as measured over the time periods assessed. These percentile values represent percentages of time over which watertable depth values are exceeded – i.e., the 5th percentile reflects the deepest groundwater depth values that are exceeded only 5% of the time (typically occurring in summer), whilst the 95th percentile represents the shallowest water table depth values that are exceeded over 95% of time (typically occurring in winter and spring). This range metric represents typical seasonal watertable range or variability. Differences in this modelled seasonal range metric between the model with WB16 pumping and the case without pumping, along with differences from historical 2010-2023 conditions are presented. This is termed change in historical dry season water table depth.
2 Increase in future acid generating events at SV2 and AV2 as a result of increased flow cessation days.	The natural or artificial lowering of water tables, below those typically experienced under natural conditions along with the frequency and seasonal fluctuations, can lead to acidification of soil and groundwater in areas where these sub-surface environments contain appreciable amounts of sulfide minerals (Shand et al, 2018). To assess the risks of acid generating events, a similar approach to protect high value GDEs was used; that is, using the groundwater model to establish consequence limits for the altering of the seasonal variability of the water table as well as the flow characteristics of the surface water systems. Specifically: • Minor consequence if the seasonal variability of the ASA water table (WTOB1 and WTOB2) is no more than 0.1m greater than the historical range (2010 to 2023) caused by Alcoa's simulated pumping AND other effects such as climate and other groundwater users, OR there is no reduction in annual zero-flow days relative to the 2010-23 historical period. • Moderate consequence if the seasonal variability of the ASA water table (WTOB1 and WTOB2) is greater than 0.1m and less than 1m greater than the historical range (2010 to 2023) caused by Alcoa's simulated pumping AND other effects such as climate and other groundwater users, OR there is between zero and 10% reduction in mean annual zero-flow days relative to the 2010-23 historical period. • Significant consequence if the seasonal variability of the ASA water table (WTOB1 and WTOB2) is more than 1m greater than the historical range (2010 to 2023) caused by Alcoa's simulated pumping AND other effects such as climate and other groundwater users, OR there is greater than 10% reduction in zero-flow days relative to the 2010-23 historical period. As outlined in QOI 1, the method presented in Peeters LJM and Middlemis H., 2023[1] was used to determine the likelihood by using the P10 and P90 outputs as the bounds of probability (or likelihood). Note: As mentioned above 0.1m drawdown is the lowest resolution the numerical model is designed for, refer, Table 5-3 of GHD Rev 7. This combined with natural water level fluctuations within the ASA which on a daily timescale can often exceed 0.1m (**Figure 6-1),** and >2.5m annually **(Appendix D),** means acid generating processes at a scale finer than 0.1m cannot be numerically assessed. As a result and to add an extra layer of conservatism to the assessment, seasonal variability of the water table as well as the flow characteristics of the surface water systems has also been incorporated in this process. This combined with the fact that the modelled Alcoa results in this GIA are conservative in nature, satisfies Section 40 of the Water Act 1989
3 Reduction in surface water flows from Marshy Creek and Salt Creek flows into the Anglesea River Estuary.	Water quality aside (assessed in QOI 1 and 2), flows from Salt Creek and Marshy Creek are important to maintain stage heights in the Anglesea River Estuary. To ensure the model predictions and resulting risk adequately considers potential changes to surface water flows, the absolute flow rate difference as a percentage against flow from the baseline period was used to inform the risk of modifying catchment inflows to the Anglesea River Estuary. Specifically, a moderate or higher consequence is identified when: • Low consequence. o No reduction in zero flow days from the historical period 2010-2023. o Where AV2 and SV2 mean annual absolute flow rate difference measured against the baseline period is less than 5%. • Moderate consequence: o Between zero and 10% reduction in mean annual zero-flow days relative to the 2010-23 historical period, OR

Quantities of Interest	Where and How It Will Be Defined or Measured
	o Where AV2 and SV2 mean annual absolute flow rate difference measured against the baseline period is greater than 5% but less than 20%, as a result of the pumping (in isolation from climate and other groundwater users) AND where the mean annual absolute flow rate measured against the historical period (2010 – 2023) has a difference greater than 5% but less than 20%, as a result of the "cumulative" pumping and climatic factors. • Significant (high) consequence: o Greater than 10% reduction in zero-flow days relative to the 2010-23 historical period; OR o Where AV2 and SV2 mean` annual absolute flow rate difference measured against the baseline period is greater than 20%, as a result of the pumping (in isolation from climate and other groundwater users) AND where the mean annual absolute flow rate measured against the historical period (2010 – 2023) has a difference greater than 20%, as a result of the "cumulative" pumping and climatic factors. Measured at AV2 and SV2. As outlined in QOI 1, the method presented in Peeters LJM and Middlemis H., 2023[1] was used to determine the likelihood by using the P10 and P90 outputs as the bounds of probability (or likelihood).
4 Migration of mine void water beyond the licenced mine lease area and into the underlying UEVF Upper Sands as part of any proposed future extraction from the UEVF.	As the mine void fills, there is potential for pit (surface) water to infiltrate into the unsaturated mine sediments surrounding the mine, which may in turn create conditions where water rock geochemical interactions can occur. To assess this water particle migration was undertaken. To capture the most conservative scenario (e.g., the case that provided the greatest potential mine void water to migrate into the surrounding environment, the mine void is assumed to be filled in 12 months). If as a result of this activity there is more than a 10% (P10) chance of a particle of water (determined by Mod-Path3DU or flux source tracing e.g., FlowSource code (Foley and Black, 2013)) migrating from the mine void to nodal points placed at the boundary of the mine lease area as well as in the top of the UEVF Upper Sands over the modelled extraction period, a mass balance of acid-generating materials within the pit overburden/backfill material vs. natural DBG may be undertaken.

7.3 Results

For a complete list of modelled results, refer to **Appendix F**.

7.3.1 Mine Void Water Body Recovery Profile

The mine void water level stage height was modelled under the various scenarios presented in **Table 7-5** to better understand the recovery profile of the mine void water body, which is presented in **Figure 7-1**. Firstly, it should be noted that the applied evaporation rate for the developing water body is based on the historical (post-Alcoa closure 2016 to 2023) rate of mine void water body recovery. This means that as the mine void fills, evaporation is likely underestimated at later times and hence and especially for the no pumping scenario, modelled fill times will be underestimated (modelled to fill quicker). Therefore, for this scenario (i.e., no pumping scenario), and due to this uncertainty, the modelled P5 uncertainty bounds have been presented. This uncertainty is not considered critical for the proposed groundwater amendment, more for the final MRCP, and as such it is proposed that in future iterations of the model, this will be addressed.

The current uncertain result indicated that for the scenario of left to fill naturally, under a medium climate change scenario, the mine void water body would fill in approximately three decades (26 years). However, and as discussed above, this time is estimated to be quicker due to the uncertainty surrounding modelled open waterbody evaporation. Once a steady state profile is achieved, the modelled water level would fluctuate by up to +2 m annually, although smaller variations of about 0.5m (volume equivalent of ~500 ML) annually are more frequent.

For the scenario where groundwater is extracted from the UEVF at a rate of 1.5 GL/yr for 10 years, (Alcoa only Pumping, **Figure 7-1**), and the basis of the proposed license amendment, the mine void water body fills in just under 10 years. Full is defined by water level >+4.0m AHD as per the current mine earthworks design. Once the UEVF extraction ceases, a small amount of mine void water appears to infiltrate into the remaining unsaturated surrounding sediments to fill pore spaces before slowly reaching the maximum model height of 5.67m AHD. After this point, water is removed from the model. As presented in **Section 7.3.5**, particles of water that move from the mine void water body back into the aquifer, never migrate beyond the mine lease boundary.

For the cumulative scenario (UEVF at a rate of 1.5 GL/yr for 10 years, plus the operation the LEVF Bulk Entitlement), the mine void water level is modelled to take significantly longer. The reasons for this additional time will be explored further by Alcoa in conjunction with Barwon Water, with this potential issue being important to understand for the final MRCP, but not considered critical for the proposed groundwater amendment application.

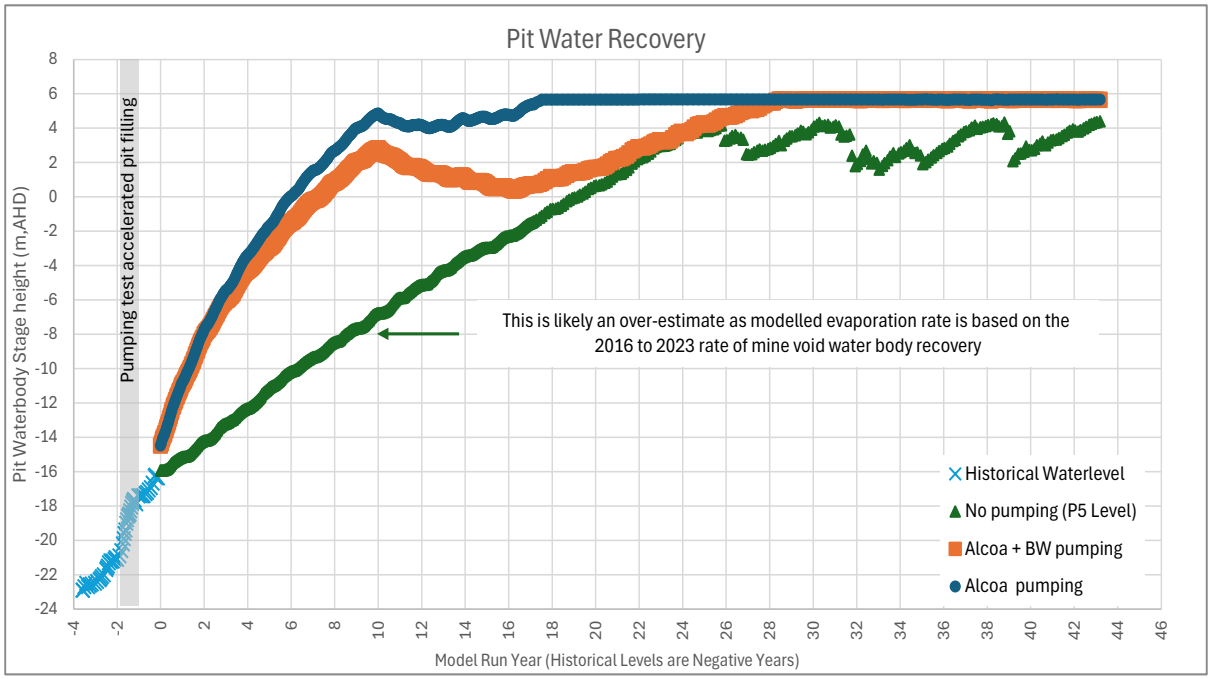


Figure 7-1 Modelled Pit Water Body Behaviour

7.3.2 Drawdown at High Value Groundwater Dependent Ecosystems

7.3.2.1 Median Climate Change

The modelled change in water table depth caused by Alcoa simulated pumping in isolation of all other effects is presented and discussed below, specifically:

- **Table 7-7** presents the modelled P10, P50 and P90 maximum drawdown within the modelled dataset at all ASA observation bores. Graphically, these are shown in **Appendix F**.
- **Figure 7-2** to **Figure 7-4** present modelled water table depth changes at observation bores located within the ASA caused by Alcoa's simulated pumping in isolation of all other effects such as climate and other groundwater users (i.e., "drawdown"). Error bars show model uncertainty over the 10th to 90th percentile range. Negative y-axis values indicate lower (deeper) water table levels than the baseline model (e.g., no pumping), while positive y-axis values indicate higher values.
- **Figure 7-5** presents the maximum annual average drawdown over any decadal or longer forecast period measured across the P10, P50, and P90 modelled water table drawdown across defined zones of Potential Acid Sulphate Soils (ASS/PASS) within the ASA and swamplands.
    - The maps in the left column of **Figure 7-5** represent the modelled water table drawdown due to Alcoa pumping, averaged across each zone. The value that is averaged is actually the maximum annual average drawdown over any decadal or longer forecast period.
    - The maps in the right column of **Figure 7-5** represent the modelled water table depth difference from historical (2010-2023) conditions, accounting for the effects of climate and all groundwater users.
    - The upper and lower row of maps present the upper (90th percentile) and lower (10th percentile) model uncertainty limits.
    - The three colours used to symbolise each map are classed according to the consequence thresholds defined in **Section 7.2**, – i.e., high, moderate, and low consequence.
- **Figure 7-6** presents modelled water table depth changes at bores WTOB1 (lower Salt Creek swamplands; left half of the chart) and WTOB2 (lower Anglesea River swamplands; right half of the chart).
    - The blue data series markers represent the modelled change in water table depth caused by Alcoa's simulated pumping in isolation of all other effects such as climate and other groundwater users. Drawdown here is measured as the maximum annual average drawdown over any decadal or longer forecast period (periods are shown along the x-axis).
    - The red data series markers on the other hand show the difference in water table depths between the forecast model and the historical model over the 2010-2023 period, accounting for the effects of climate and all groundwater pumping. This metric is often termed "cumulative drawdown", as it includes the cumulative effect of Alcoa's pumping along with climatic effects and the effects of other groundwater users. The red data series represent changes in dry (summer) period water table depths relative to historical (2010-2023) conditions, as measured at the higher (deeper) 10th percentile depth exceedance value over each of the time-period blocks shown along the x-axis; this figure represents risks to the typical seasonal low point on the water table hydrograph, which is presumably important to GDEs that require seasonal water table access when there is little to no rainfall.

  - Both the red and blue data series need to be interpreted in the context of one another – a model that simulates "drawdown" when measured as a difference between a model with groundwater pumping and another without pumping does not mean that groundwater levels will be lower than they were historically. This is particularly important in this case, because of the long history of groundwater usage and mine dewatering by Alcoa between 1968 and 2016. Under these conditions the groundwater system is in the process of a long-term recovery in pressure, hence future "drawdown", at least around the Alcoa mine site, is likely to delay groundwater pressure recovery rather than lower groundwater pressure. Note this is pressure within the lower sands of the UEVF and is not reflected within surface aquifers.
  - Error bars show model uncertainty over the 10th to 90th percentile range. Negative y-axis values indicate lower (deeper) water table levels than either the model without Alcoa pumping (blue data series) or the historical period (red data series), while positive y-axis values indicate higher values.
- **Figure 7-7** presents modelled seasonal water table depth range changes for Salt Creek swamplands (WTOB1) and Anglesea River swamplands (WTOB2). These also form a GDE risk metric; therefore, consequence thresholds are shown behind this plot. "Seasonal water table depth range" here means the difference between the 95th percentile and 5th percentile exceedance values, as measured over the time periods shown along the x-axis on **Figure 7-7**. These percentile values represent percentages of time over which water table depth values are exceeded – i.e., the 5th percentile reflects the deepest groundwater depth values that are exceeded only 5 percent of the time (typically occurring in summer), whilst the 95th percentile represents the shallowest water table depth values that are exceeded over 95 percent of time (typically occurring in winter and spring). This range metric represents typical seasonal water table range or variability. Differences in this modelled seasonal range metric between the model with Alcoa pumping and the case without pumping (blue data series), along with differences from historical 2010-2023 conditions (red data series), are presented in this plot. Other details follow:
  - The marker symbols (data series) plotted are presented for observation bore WTOB1 in the left half, and for observation bore WTOB2 in the right half.
  - Each marker is labelled along the x-axis by a model time-period over which the water table depth range statistics are taken. A variety of these periods is presented to show that modelled changes in water table depth seasonality, and changes that are due to Alcoa pumping, can vary over time.
  - Each marker has error bars shown, which represent the lower (10th percentile) to upper (90th percentile) model uncertainty limits as measured across the 150 model realisations.

The results listed in **Table 7-7** and presented in **Figure 7-2** to **Figure 7-5** (as well as **Appendix F**) show that of the 44 years modelled, the median (P50) drawdown for all observation bores within the ASA and marshlands have modelled potential drawdown <0.1m. This results in a low consequence of impact as defined by the Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems (DELWP 2015).

When considering uncertainty (used in the assessment of Risk, **Section 7.3.6**), the P10 limit (e.g. takes into consideration 90% of model realisations) suggests at WTOB2 (**Figure 7-2**) and P7/P7B a maximum potential drawdown of 0.11m is forecast. As the median drawdown here is much lower than this, it would indicate very few of the 150-model realization indicate this 1cm exceedance. It is important to note that historical groundwater monitoring at this location shows no evidence of historical pumping related impacts (refer **Table 2-3**, and **Section 2.3**).

In addition to the above, **Figure 7-5** suggests the only areas simulated to experience drawdown from the proposed Alcoa only pumping scenario to water table levels below historically observed depths are two small tributaries in the middle Anglesea swamplands and the upper-mid sections of the Anglesea river swamplands (see the circled areas in **Figure 7-5**). Most other areas of the ASA and swamplands are simulated to experience similar or slightly shallower water table depths than historical conditions (blue areas on the right column of maps in **Figure 7-5**), despite drawdown from Alcoa pumping (orange areas on the left column maps).

With respect to cumulative impacts, **Figure 7-6** shows that the modelling indicates a high likelihood of low consequence to water table drawdown from Alcoa pumping for bores WTOB1 and WTOB2 (blue data series). When these (low) risks are considered with reference to water table change from historical (2010-2023) conditions (red data series), there is also generally low (to no) consequence because water table levels, particularly at bore WTOB2, are for the most part higher (i.e., shallower) over the forecast model period than those over the historical period.

Regarding modelled seasonal water table depth range (**Figure 7-7**), the modelling shows that the simulated Alcoa groundwater pumping has caused insignificant to no reduction in the seasonal water table depth range over the forecast model period (blue data series; low consequence) at both WTOB1 and WTOB2. Even at the 90th percentile model uncertainty limit, the error bars indicate that this metric never breaches the moderate consequence threshold for either bore. **Figure 7-7** also shows that when forecast seasonal water table depth ranges are compared with those from the historical (2010-2023) period (red symbols), they are always higher (greater seasonal variability) than in the historical period for bore WTOB2, despite the insignificant potential water table depth changes arising from Alcoa's pumping. WTOB1 shows modelled water table depths that are at times deeper than those in the historical 2010-2023 period, though this is not due to drawdown from Alcoa's proposed pumping schedule.

Table 7-7 Modelled Maximum Drawdown Over a 10 Year Period (Medium Climate Change) from the Alcoa Only Pumping scenario at all ASA Observation Bores

Bore ID	Drawdown (m, P90 Max)	Drawdown (m, P50 Max)	Drawdown (m, P10 Max)
P1	0.00	-0.02	-0.06
P13B	-0.02	-0.04	-0.07
P16	0.00	0.00	-0.01
P17	0.00	-0.01	-0.03
P18	-0.01	-0.02	-0.04
P7	-0.04	-0.07	-0.12
P7B	-0.04	-0.07	-0.12
P8	-0.02	-0.04	-0.07
WTOB1	0.00	0.00	-0.02
WTOB2	-0.03	-0.06	-0.11

Modelled hydrographs located in **Appendix F**.

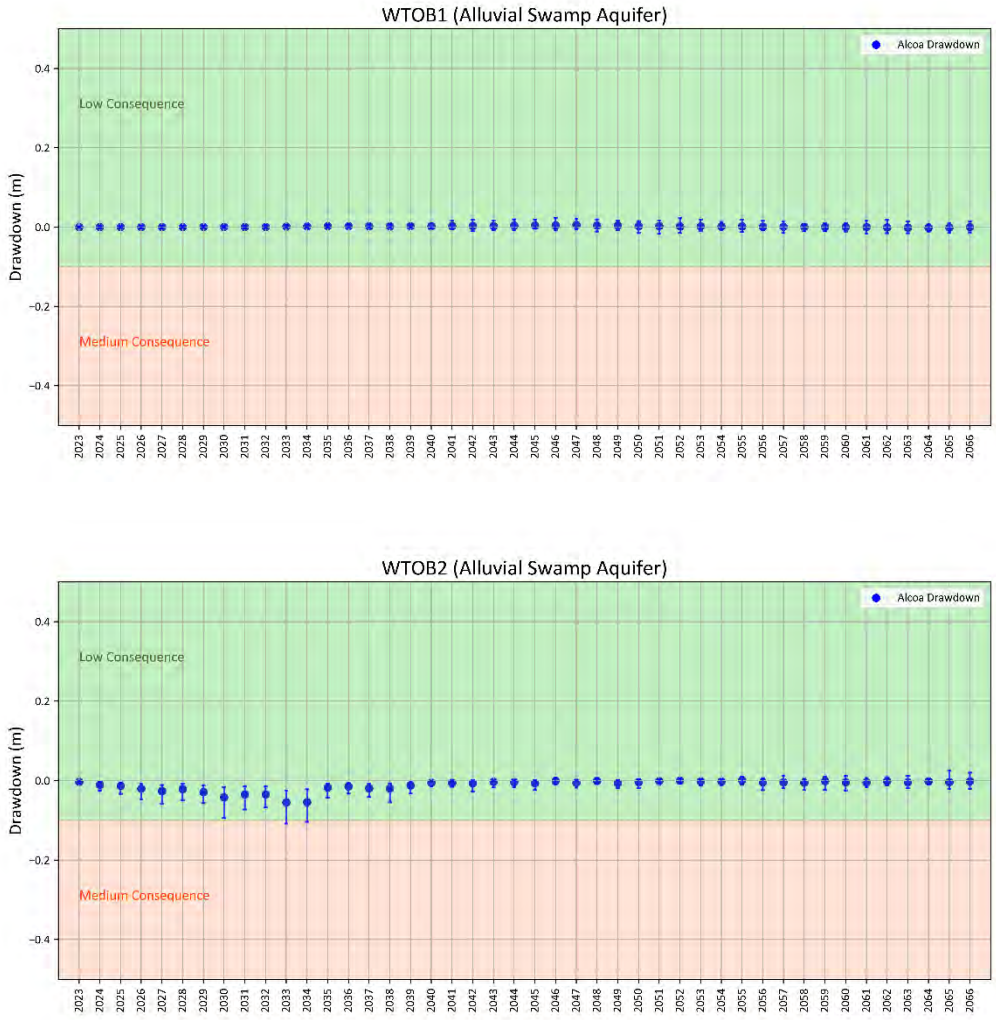


Figure 7-2 Drawdown at WTOB1 and WTOB2 (Lower Reaches of Marshy and Salt Creek) for Alcoa Only Pumping

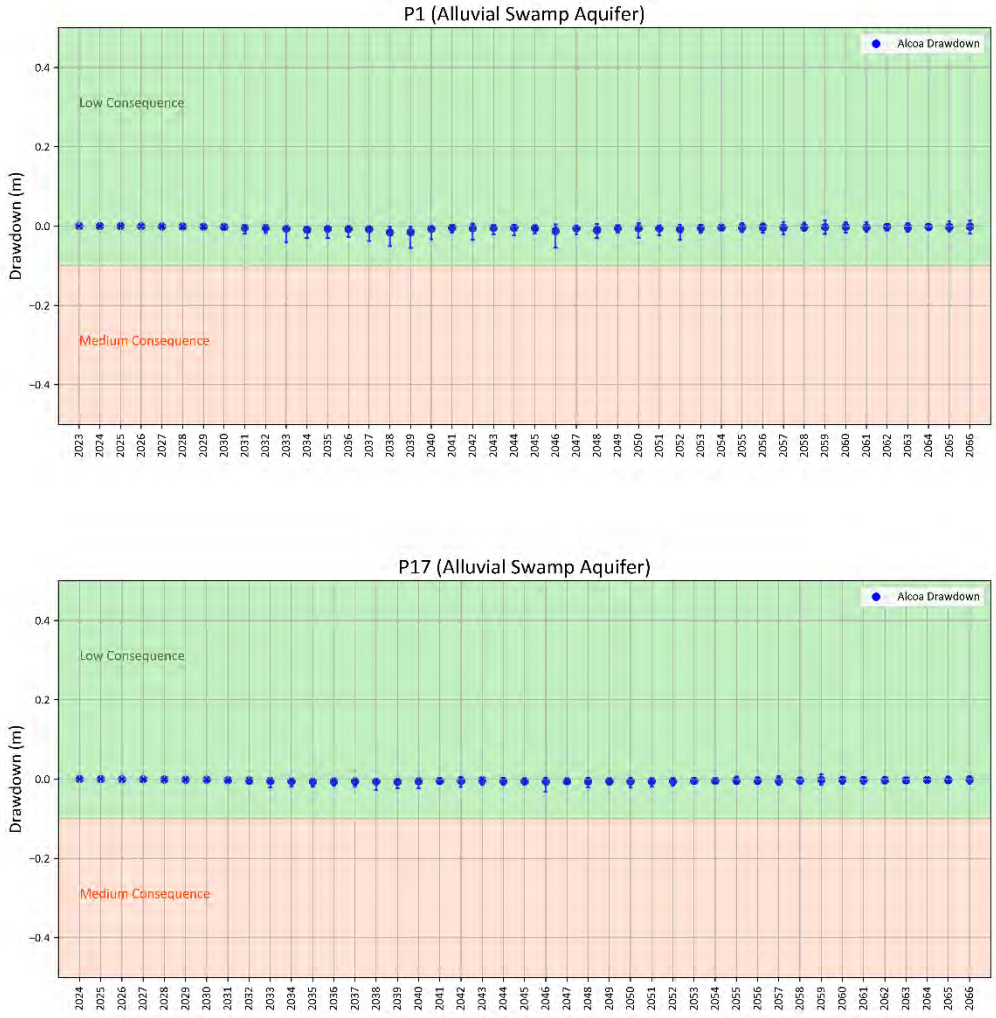


Figure 7-3 Drawdown at P1 and P17 (Mid to Upper Reaches of Salt Creek) for Alcoa Only Pumping

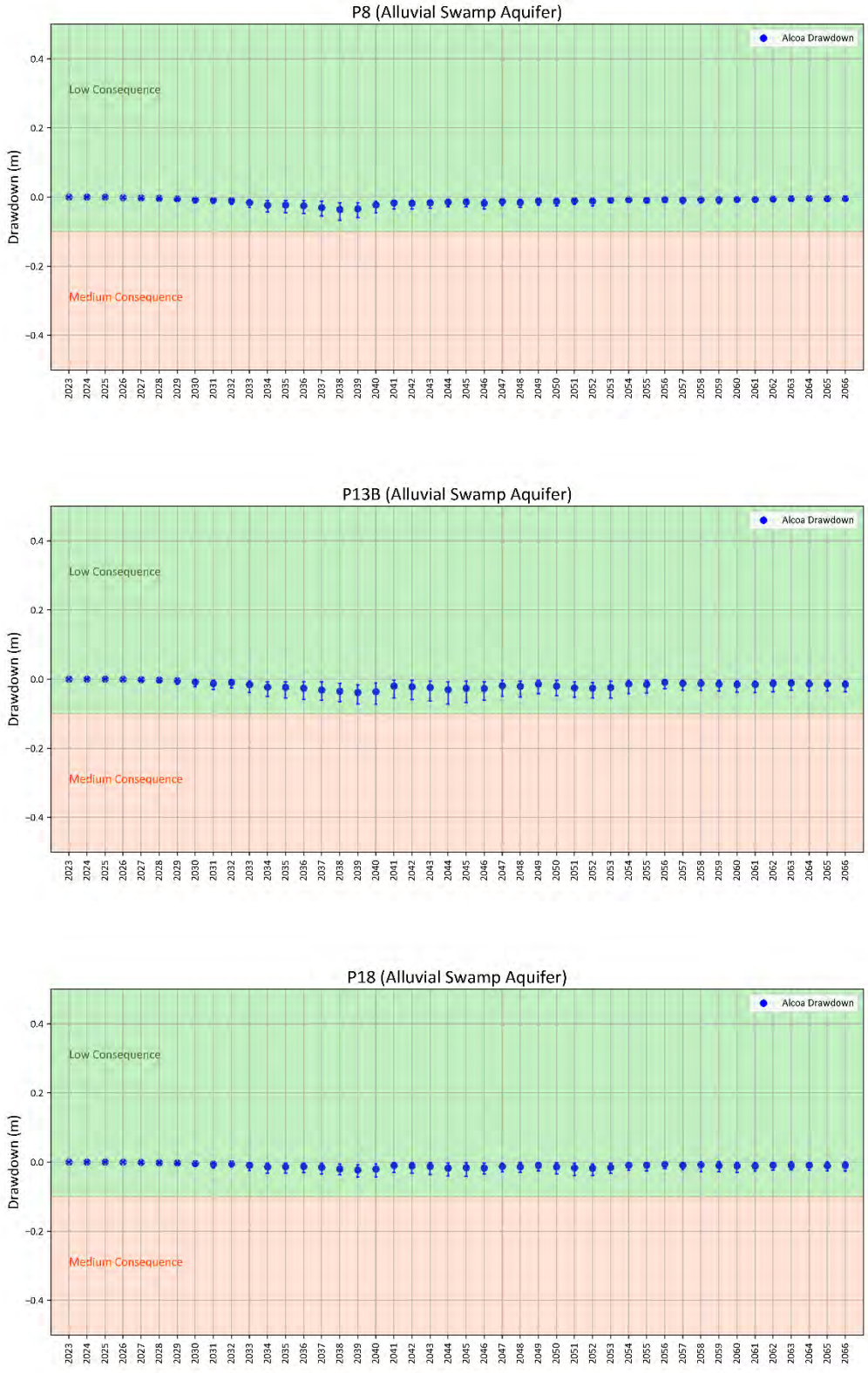


Figure 7-4 Drawdown at P8, P13B, and P18 (Mid to Upper Reaches of Marshy Creek) for Alcoa Only Pumping

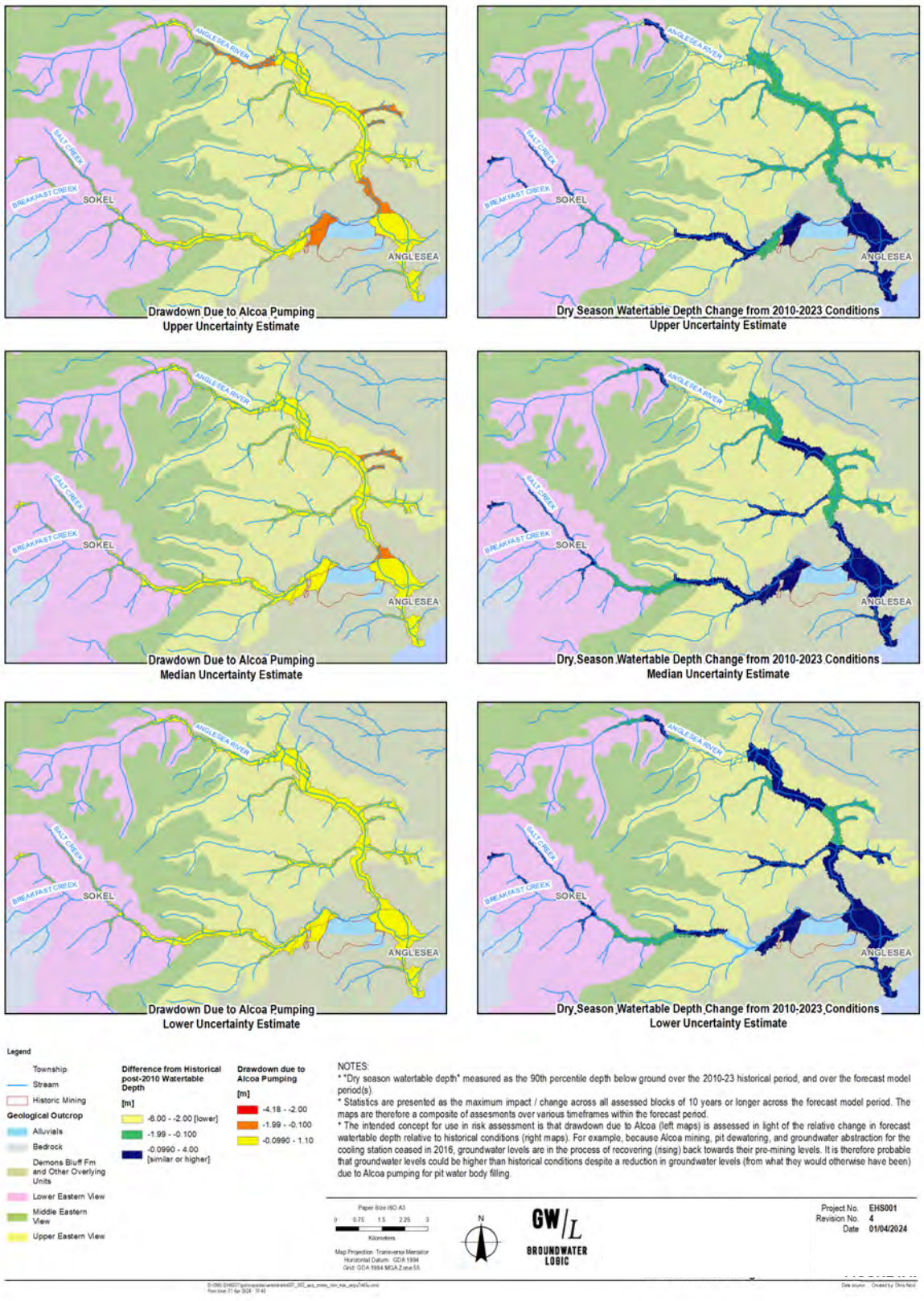


Figure 7-5 Modelled P10, P50, and P90 of Maximum Drawdown (Median Climate Change)

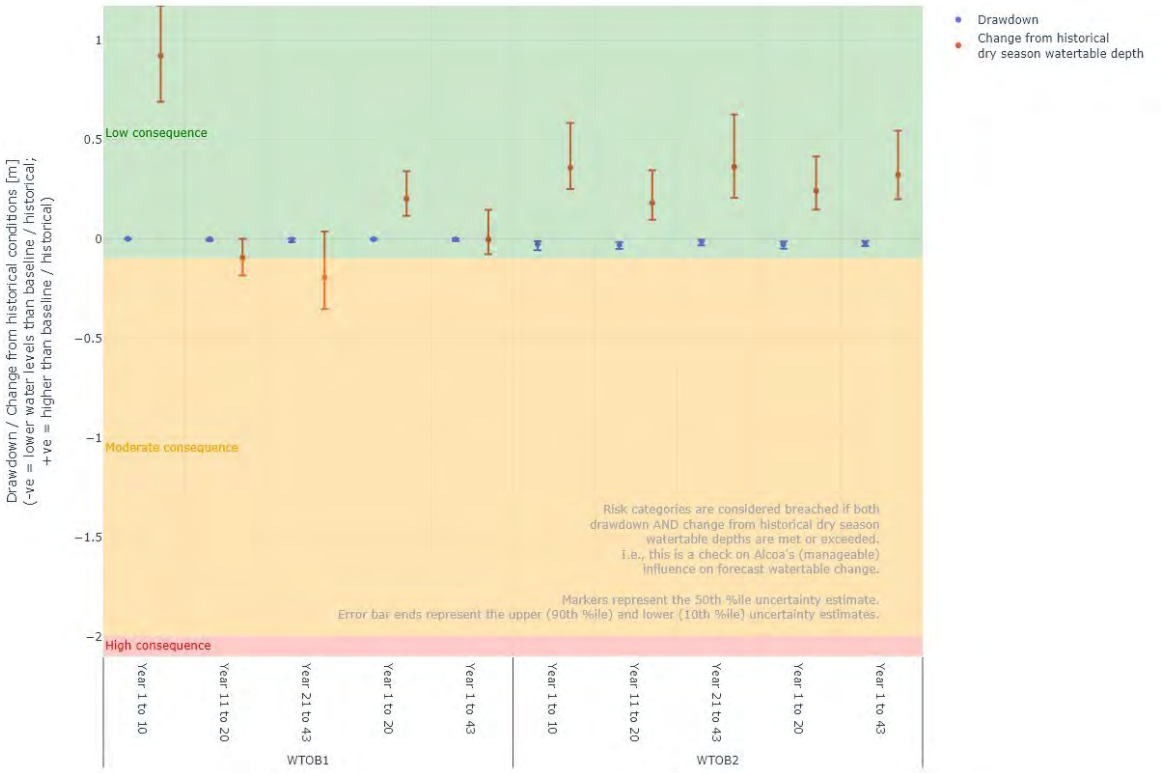


Figure 7-6 WTOB1 and WTOB2 Modelled Watertable Depth GDE Risk Metrics and Consequence Thresholds

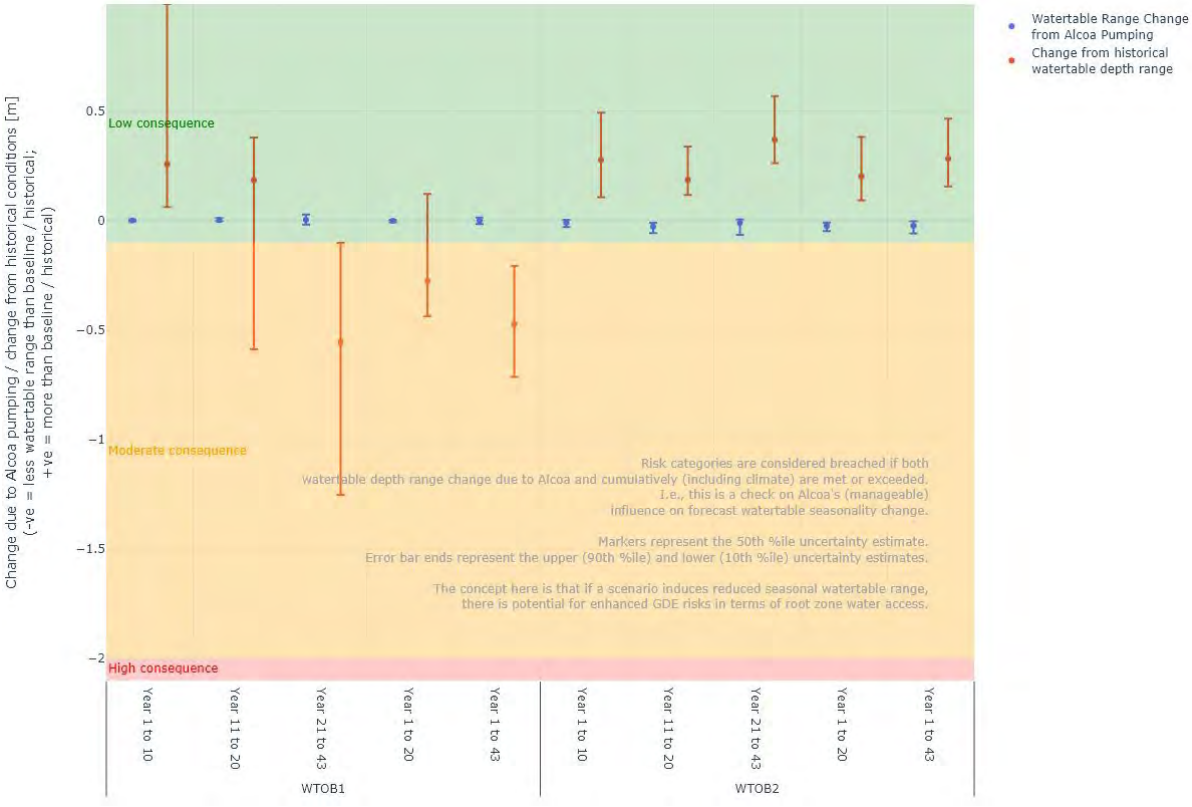


Figure 7-7 Modelled Watertable Seasonal Range GDE Risk Metrics and Consequence Thresholds

7.3.2.2 High Climate Change

The modelled change in watertable depth caused either by Alcoa simulated pumping in isolation of all other effects as well as accounting for the effects of climate and all groundwater pumping users is presented and discussed below, specifically:

- **Table 7-8** presents the mmodelled P10, P50 and P90 maximum drawdown within the modelled dataset at all ASA observation bores. Graphically, these are shown in **Appendix F**.
- **Figure 7-8** to **Figure 7-10** present modelled water table depth changes at observation bores located within the ASA caused by Alcoa's simulated pumping in isolation of all other effects such as climate and other groundwater users (i.e., "drawdown"). Error bars show model uncertainty over the 10th to 90th percentile range. Negative y-axis values indicate lower (deeper) water table levels than the baseline model (e.g., no pumping), while positive y-axis values indicate higher values.
- **Figure 7-11** presents the maximum annual average drawdown over any decadal or longer forecast period measured across the P10, P50, and P90 modelled water table drawdown across defined zones of ASS/PASS within the ASA and swamplands.
    - The maps in the left column of **Figure 7-11** represent the modelled water table drawdown due to Alcoa pumping, averaged across each zone. The value that is averaged is actually the maximum annual average drawdown over any decadal or longer forecast period.
    - The maps in the right column of **Figure 7-11** represent the modelled water table depth difference from historical (2010-2023) conditions, accounting for the effects of climate and all groundwater users.
    - The upper and lower row of maps present the upper (90th percentile) and lower (10th percentile) model uncertainty limits.
    - The three colours used to symbolise each map are classed according to the consequence thresholds defined in **Section 7.2**, i.e., high, moderate, and low consequence.
- **Figure 7-12** presents modelled water table depth changes at bores WTOB1 (lower Salt Creek swamplands; left half of the chart) and WTOB2 (lower Anglesea River swamplands; right half of the chart).
    - The blue data series markers represent the modelled change in water table depth caused by Alcoa's simulated pumping in isolation of all other effects such as climate and other groundwater users (i.e., "drawdown"). Drawdown here is measured as the maximum annual average drawdown over any decadal or longer forecast period (periods are shown along the x-axis).
    - The red data series markers on the other hand show the difference in water table depths between the forecast model and the historical model over the 2010-2023 period, accounting for the effects of climate and all groundwater pumping. This metric is often termed "cumulative drawdown", as it includes the cumulative effect of Alcoa's pumping along with climatic effects and the effects of other groundwater users. The red data series represent changes in dry (summer) period water table depths relative to historical (2010-2023) conditions, as measured at the higher (deeper) 10th percentile depth exceedance value over each of the time-period blocks shown along the x-axis; this figure represents risks to the typical seasonal low point on the water table hydrograph, which is presumably important to GDEs that require seasonal water table access when there is little to no rainfall.
- Both the red and blue data series need to be interpreted in the context of one another – a model that simulates "drawdown" when measured as a difference between a model with Alcoa pumping and another without pumping does not mean that groundwater levels will be lower than they were historically. This is particularly important in this case, because of the long history of groundwater usage and mine dewatering by Alcoa between 1968 and 2016.

Under these conditions the groundwater system is in the process of a long-term recovery in pressure, therefore future "drawdown", at least around the Alcoa mine site, is likely to delay groundwater pressure recovery rather than lower groundwater pressure.

- Error bars show model uncertainty over the 10th to 90th percentile range. Negative y-axis values indicate lower (deeper) water table levels than either the model without Alcoa pumping (blue data series) or the historical period (red data series), while positive y-axis values indicate higher values.

The results listed in **Table 7-8** and presented in **Figure 7-8** to **Figure 7-10** (as well as **Appendix F**) show that in all model predictions, the median (P50) drawdown predictions are all <0.1m across the ASA and marshlands. There are minor exceedances when the upper uncertainty level is considered, which are:

- Minor drawdown exceedances are observed at observation bore WTOB2 (**Figure 7-8**, mid reaches of Marshy Creek) in 9 out of 44 years modelled. Maximum drawdown modelled is 0.22m.
- Minor drawdown exceedances are observed at observation bore P1 (**Figure 7-9**, upper reaches of Salt Creek) 25 years into the model timeline. Note: There are no mapped GDE's at this location.
- Minor drawdown exceedances are observed at observation bore P8 (**Figure 7-10**, mid reaches of Marshy Creek) in 2 out of 44 years modelled.
- Minor drawdown exceedances are observed at observation bore P13B (**Figure 7-10**, upper reaches of Marshy Creek) in 9 out of 44 years modelled. Note: There are no mapped GDE's at this location.

With respect to **Figure 7-11**, this also confirms drawdown along Salt Creek remains a low consequence whilst confirming the results above; i.e., under a high climate change scenario the Lower-mid Anglesea River swamp and two small tributaries upstream of Salt Creek confluence (circled in **Figure 7-11**) are modelled to experience moderate consequence drawdown levels (due to Alcoa pumping alone).

With respect to cumulative impacts, **Figure 7-12** shows that the modelling indicates a high likelihood of low consequence to water table drawdown from Alcoa pumping for bores WTOB 1 and WTOB2 (blue data series).

Table 7-8 Modelled Maximum Drawdown Over a 10 Year Period (High Climate Change) from the Alcoa Only Pumping scenario at all ASA Observation Bores

Bore ID	Drawdown (m, P90 Max)	Drawdown (m, P50 Max)	Drawdown (m, P10 Max)
P1	-0.21	-0.05	-0.01
P13B	-0.13	-0.07	-0.03
P16	-0.01	0.00	0.00
P17	-0.10	-0.03	0.00
P18	-0.07	-0.04	-0.02
P7	-0.15	-0.08	-0.05
P7B	-0.15	-0.08	-0.05
P8	-0.13	-0.07	-0.03
WTOB1	-0.03	0.00	0.00
WTOB2	-0.22	-0.10	-0.04

Modelled hydrographs are located in **Appendix F**.

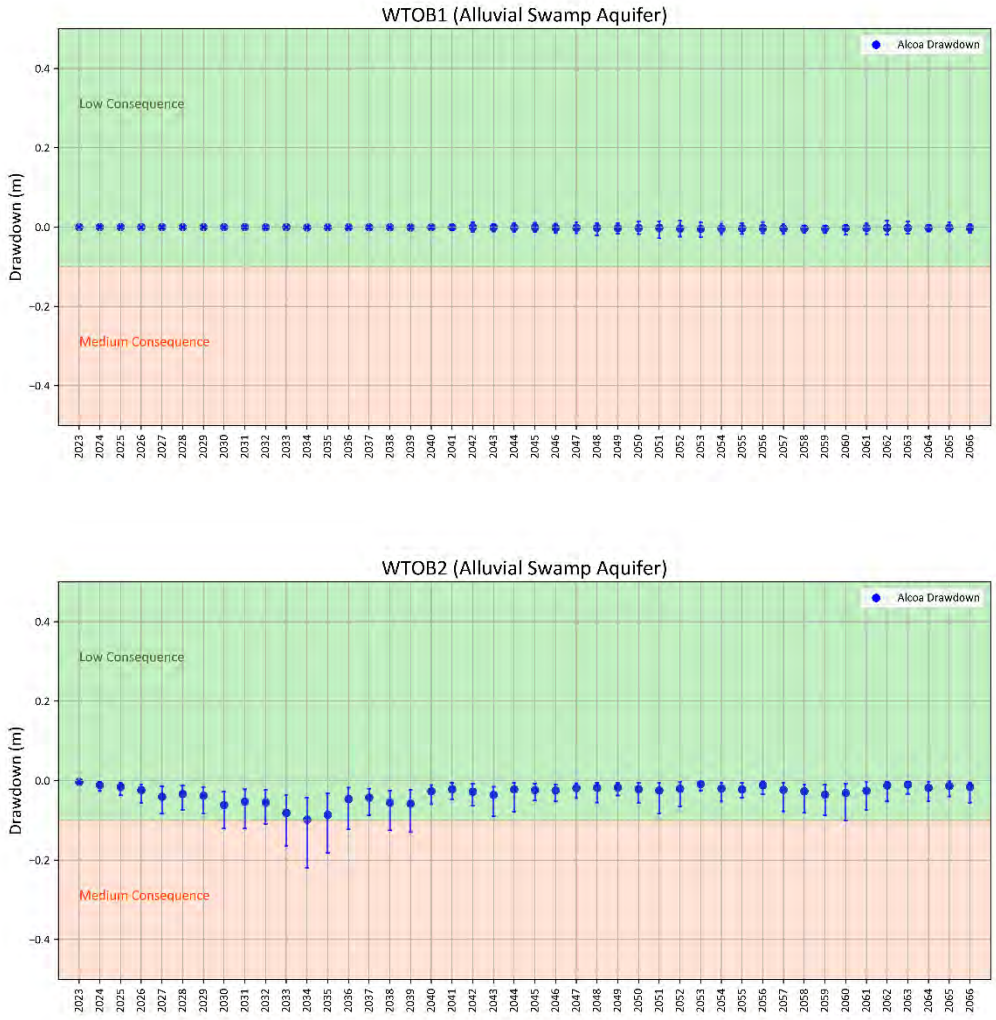


Figure 7-8 Drawdown at WTOB1 and WTOB2 (Lower Reaches of Marshy and Salt Creek) for Alcoa Only Pumping

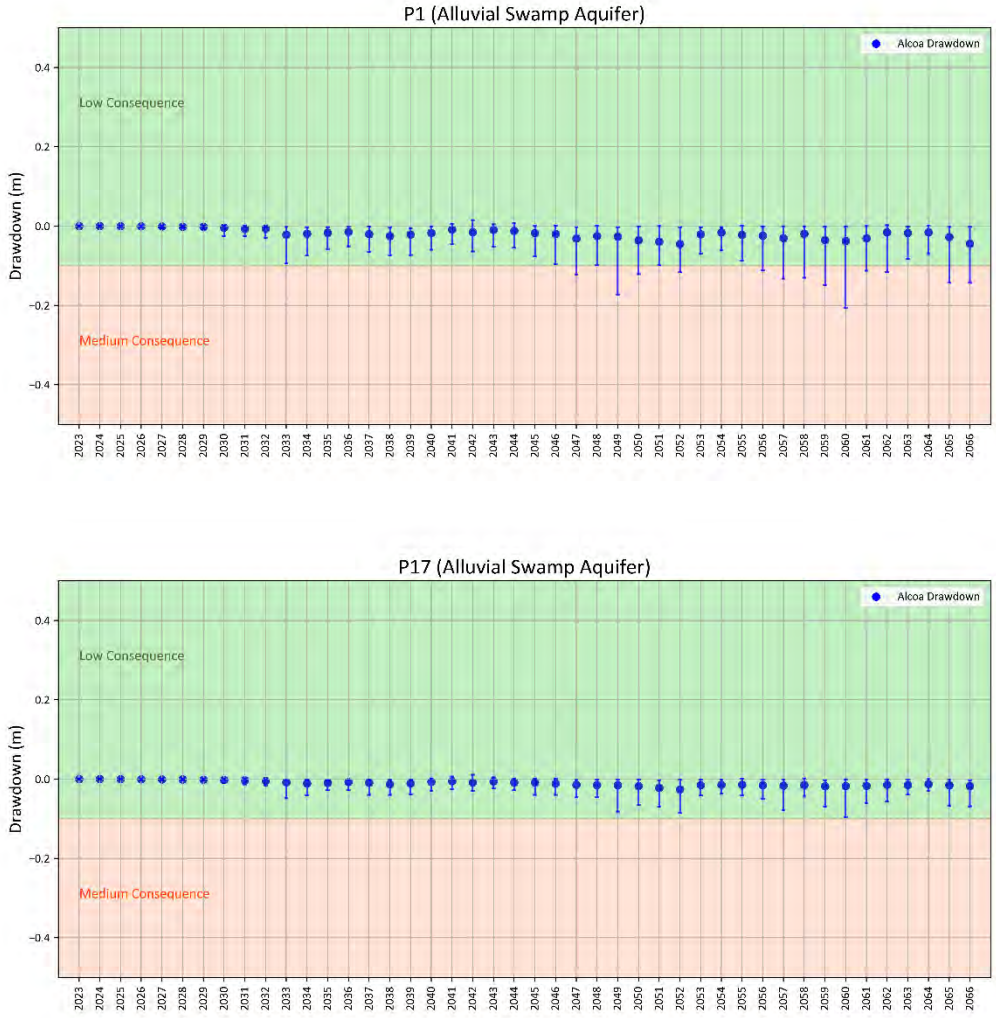


Figure 7-9 Drawdown at P1 and P17 (Mid to Upper Reaches of Salt Creek) for Alcoa Only Pumping

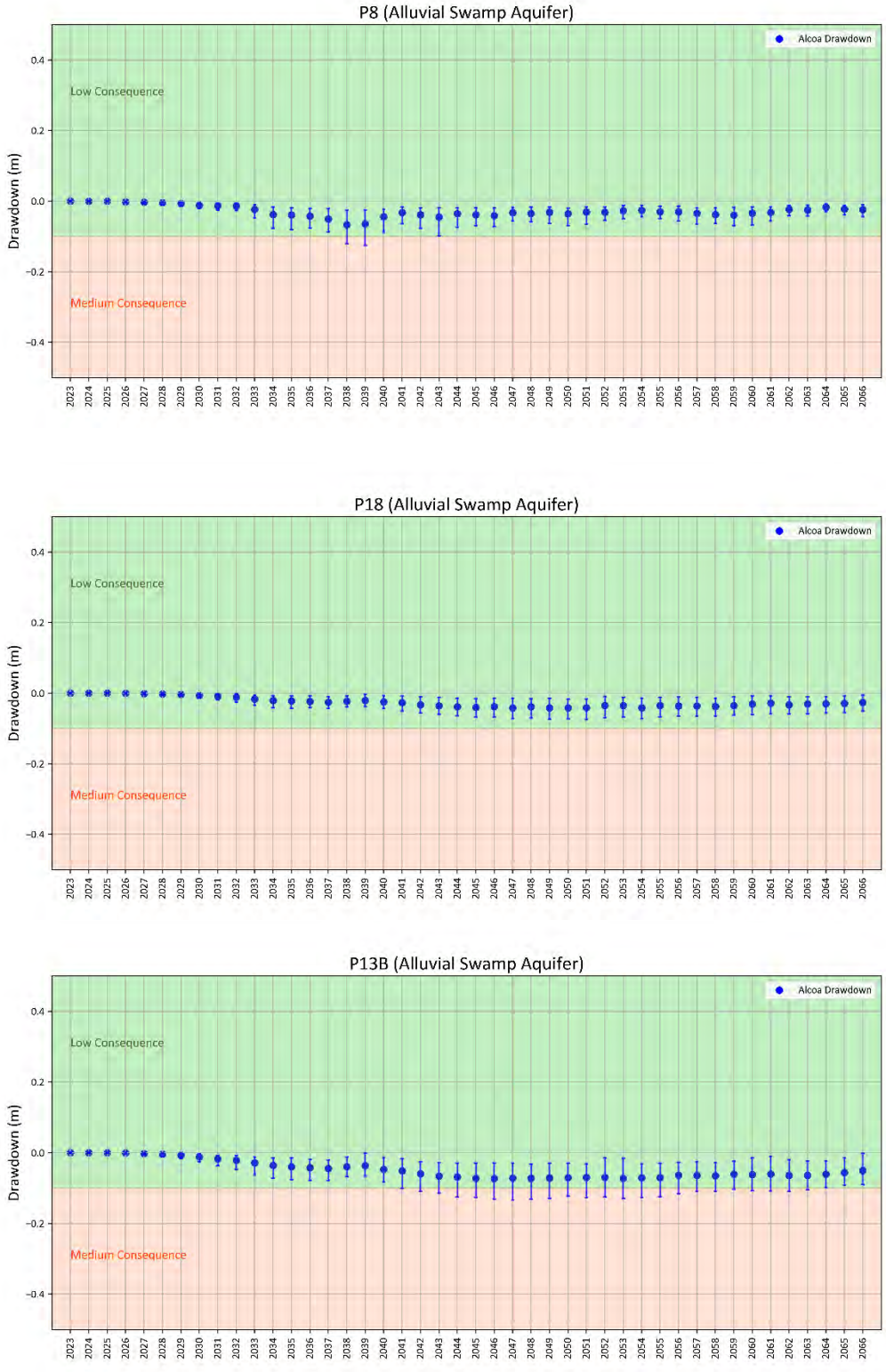


Figure 7-10 Drawdown at P8, P13B, and P18 (Mid to Upper Reaches of Marshy Creek) for Alcoa Only Pumping

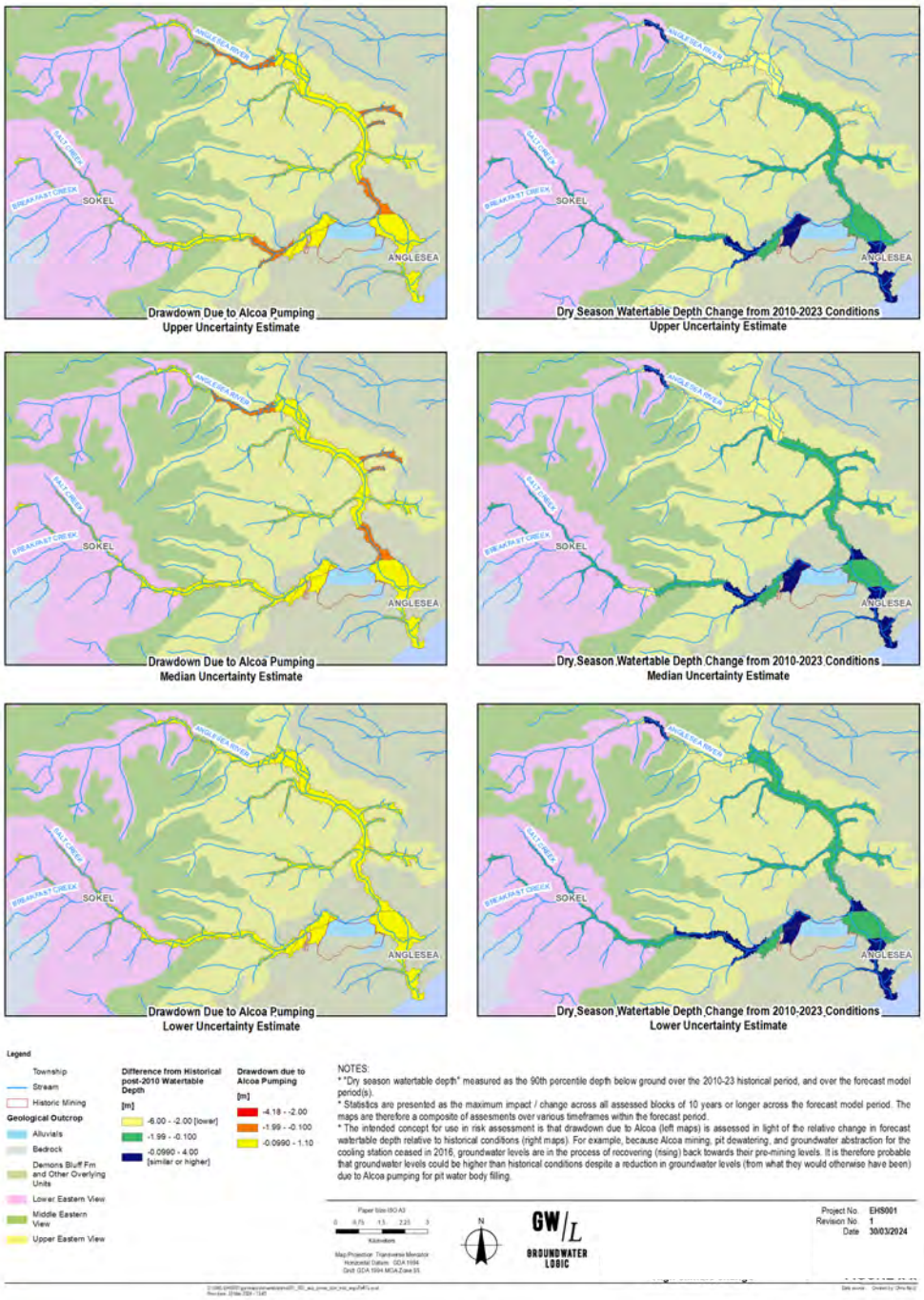


Figure 7-11 Modelled P10, P50, and P90 of Maximum Drawdown (High Climate Change)

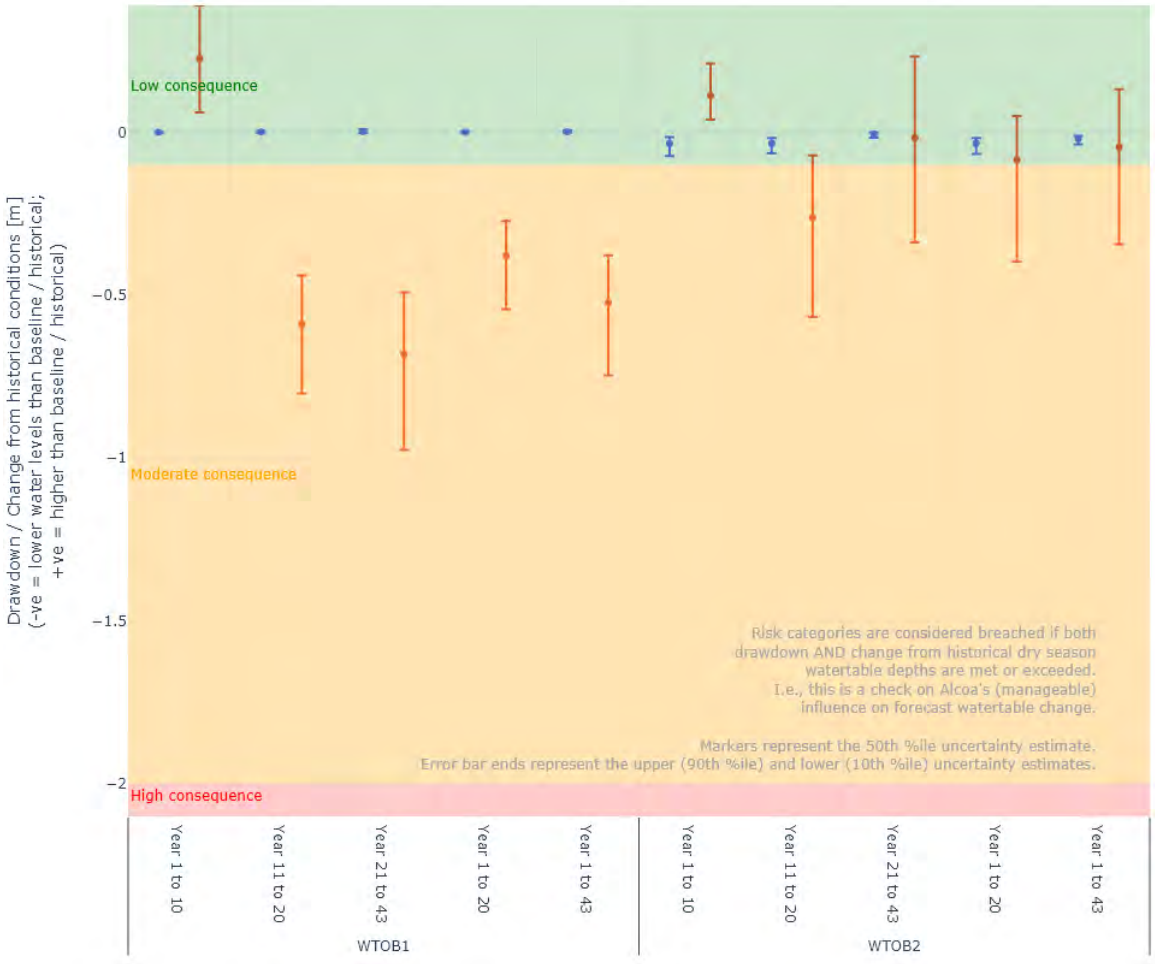


Figure 7-12 Modelled Watertable Depth GDE Risk Metrics and Consequence Thresholds

7.3.3 Modelled Future Acid Generating Events

7.3.3.1 Median Climate Change

As presented in **Table 7-6**, water table depth, its variability, and changes to stream flow zero-flow days is used to inform the risk of increasing acid generating events.

Figure 7-13 presents the seasonal variability of the ASA water table (WTOB1 and WTOB2) relative to the 2010-2023 historical period, as per below:

- Seasonal water table depth range metrics are shown to the right, recalling that more than 0.1m change greater (lower water table) than the historical range (2010 to 2023) results in moderate or high consequence.
- Blue markers show the range change due to Alcoa pumping, as measured against the “no Alcoa pumping” case.
- Red markers show the cumulative range change, due to all factors including pumping, climate, and post-mining recovery. These are measured as change from the historical 2010-2023 period.

Figure 7-14 presents the percent change in annual zero-flow days relative to the 2010-2023 historical period, as per below:

- The percent change in annual zero-flow days metrics are shown to the right. Recalling any change greater than 0 percent (dryer) than the historical range (2010 to 2023) results in moderate or high consequence.
- Blue markers show the range change due to Alcoa pumping, as measured against the “no Alcoa pumping” case.
- Red markers show the cumulative range change, due to all factors including pumping, climate, and post-mining recovery. These are measured as change from the historical 2010-2023 period.

The results from **Figure 7-13** indicate that all model estimates fall within the low consequence band in terms of Alcoa’s component of drawdown (blue markers). In cumulative terms, either climate or potential cumulative impacts associated with the BE causes a risk of seasonal water table variability range both higher and lower than historical conditions, however Alcoa’s proposed pumping is not forecast to appreciably influence this.

The results from **Figure 7-14** suggest forecast zero flow days at SV2 and AV2 are generally the same as or fewer than over the historical 2010-2023 period, at the P10 and P50 uncertainty limits; most model estimates fall into the low consequence band, although in years 11-20 are modelled to fall into the moderate consequence band (at SV2 and AV2). At the upper end (lower likelihood uncertainty estimate - P90) however, the modelling estimates that zero flow days, as compared to the 2010-2023 historical period, could at times fall into the high consequence band at AV2, primarily in years 11-20, under the cumulative scenario.

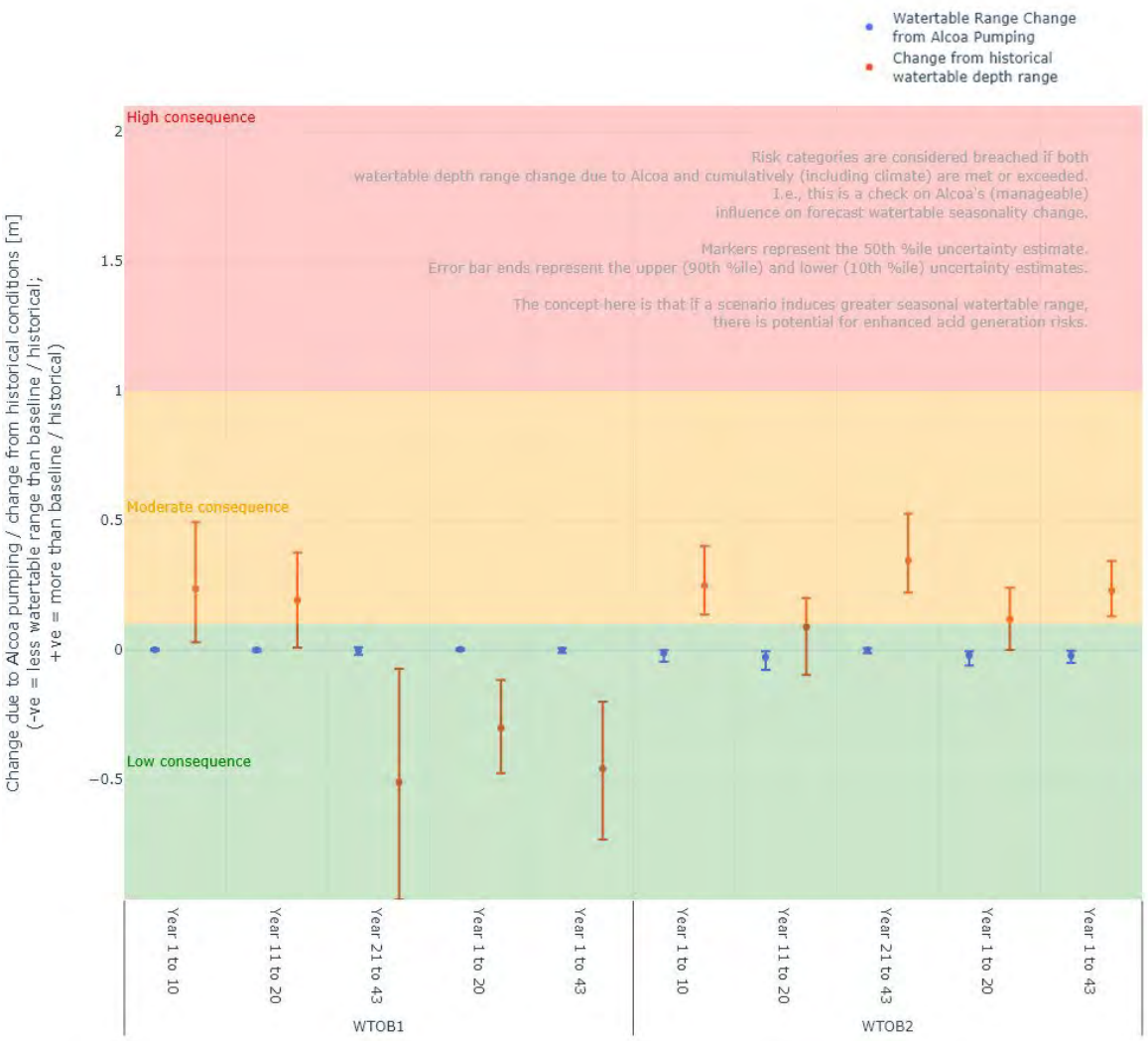


Figure 7-13 Median Climate Change – Seasonal Variability of the ASA Watertable (WTOB1 and WTOB2) Relative to the 2010-2023 Historical Period

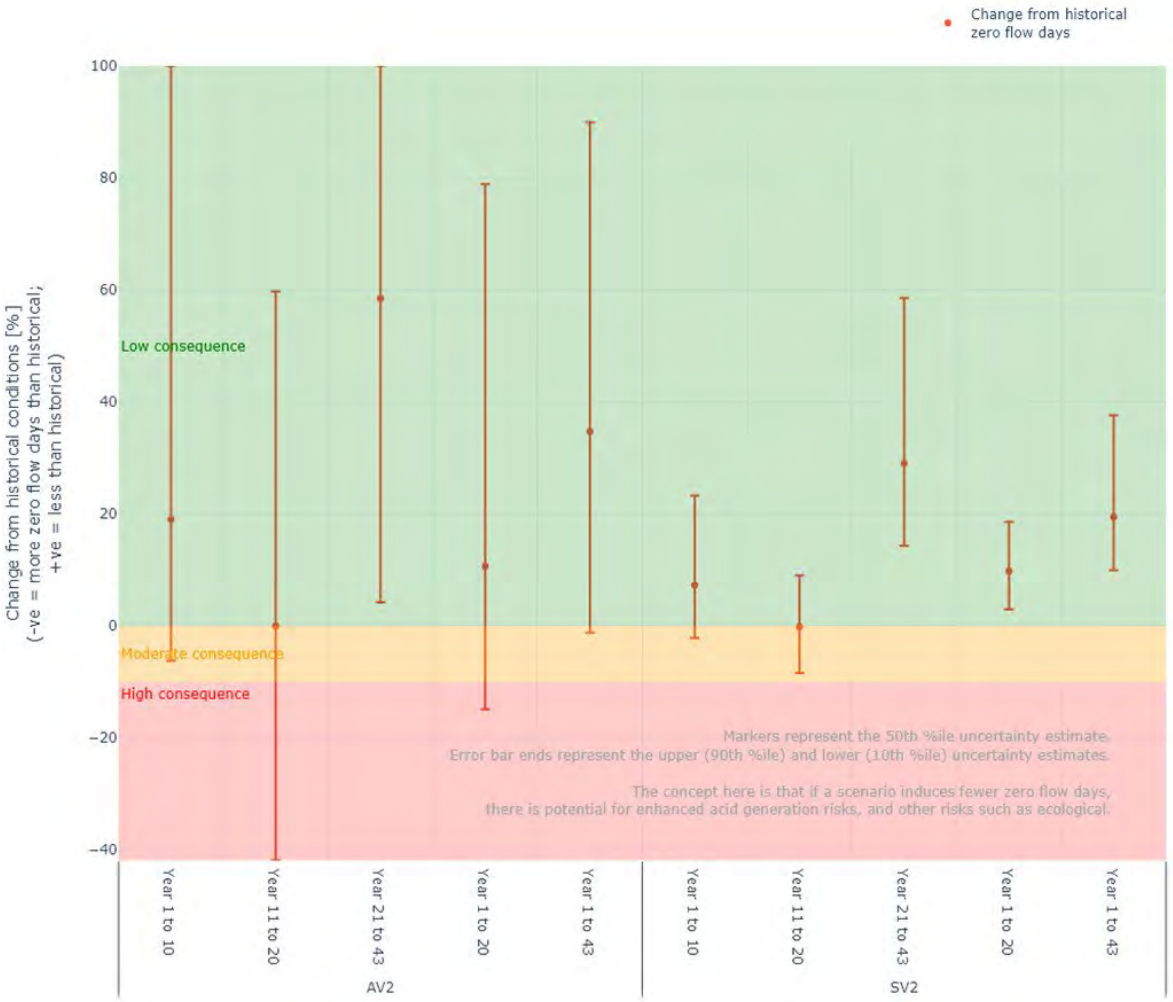


Figure 7-14 Median Climate Change – Percent Change in Annual Zero-flow Days Relative to the 2010-2023 Historical Period

7.3.3.2 High Climate Change

As resented in **Table 7-6**, water table depth, its variability, and changes to stream flow zero-flow days is used to inform the risk of increasing acid generating events.

Figure 7-15 presents the seasonal variability of the ASA water table (WTOB1 and WTOB2) relative to the 2010-2023 historical period, as per below:

- Seasonal water table depth range metrics are shown to the right. Recalling more than 0.1m change greater (lower water table) than the historical range (2010 to 2023) results in moderate or high consequence.
- Blue markers show the range change due to Alcoa pumping, as measured against the “no Alcoa pumping” case.
- Red markers show the cumulative range change, due to all factors including pumping, climate, and post-mining recovery. These are measured as change from the historical 2010-23 period.

Figure 7-16 presents the percent change in annual zero-flow days relative to the 2010-23 historical period, as per below:

- The percent change in annual zero-flow days metrics are shown to the right. Recalling any change greater than 0 percent (dryer) than the historical range (2010 to 2023) results in moderate or high consequence.
- Blue markers show the range change due to Alcoa pumping, as measured against the “no Alcoa pumping” case.
- Red markers show the cumulative range change, due to all factors including pumping, climate, and post-mining recovery. These are measured as change from the historical 2010-2023 period.

The results from **Figure 7-15** indicate that all model estimates fall within the low consequence band in terms of Alcoa’s component of drawdown (blue markers). In cumulative terms, risk of seasonal water table variability range both higher and lower than historical conditions, however Alcoa’s proposed pumping is not forecast to appreciably influence this.

The results from **Figure 7-16** suggest forecast zero flow days at SV2 and AV2 fall into the high consequence band, except at AV2 at the upper uncertainty interval at times, when zero flow days are like or fewer than over the historical period. AV2 also exhibits a much greater range of (and uncertainty in) potential zero flow periods than does SV2, likely due to SV2 being closer to the significant historical stresses of the Alcoa mine. Model parameters relating to its behaviour are therefore more informed by mine void management and progression than those in the AV2 catchment; either way, the modelling indicated climate, rather than Alcoa pumping, has the biggest impact on flow and seasonal water table fluctuations.

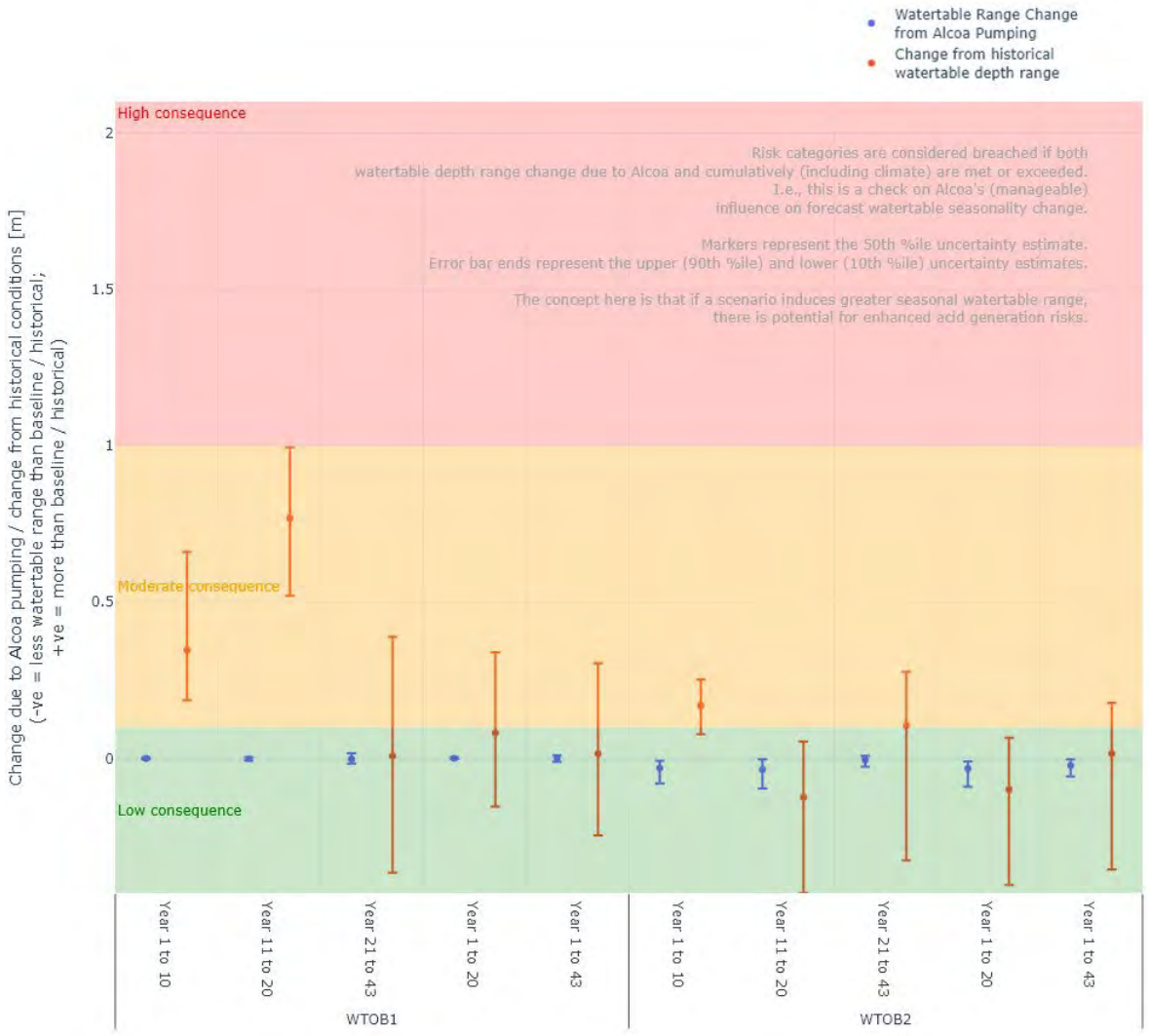


Figure 7-15 High Climate Change – Seasonal Variability of the ASA Watertable (WTOB1 and WTOB2) Relative to the 2010-2023 Historical Period

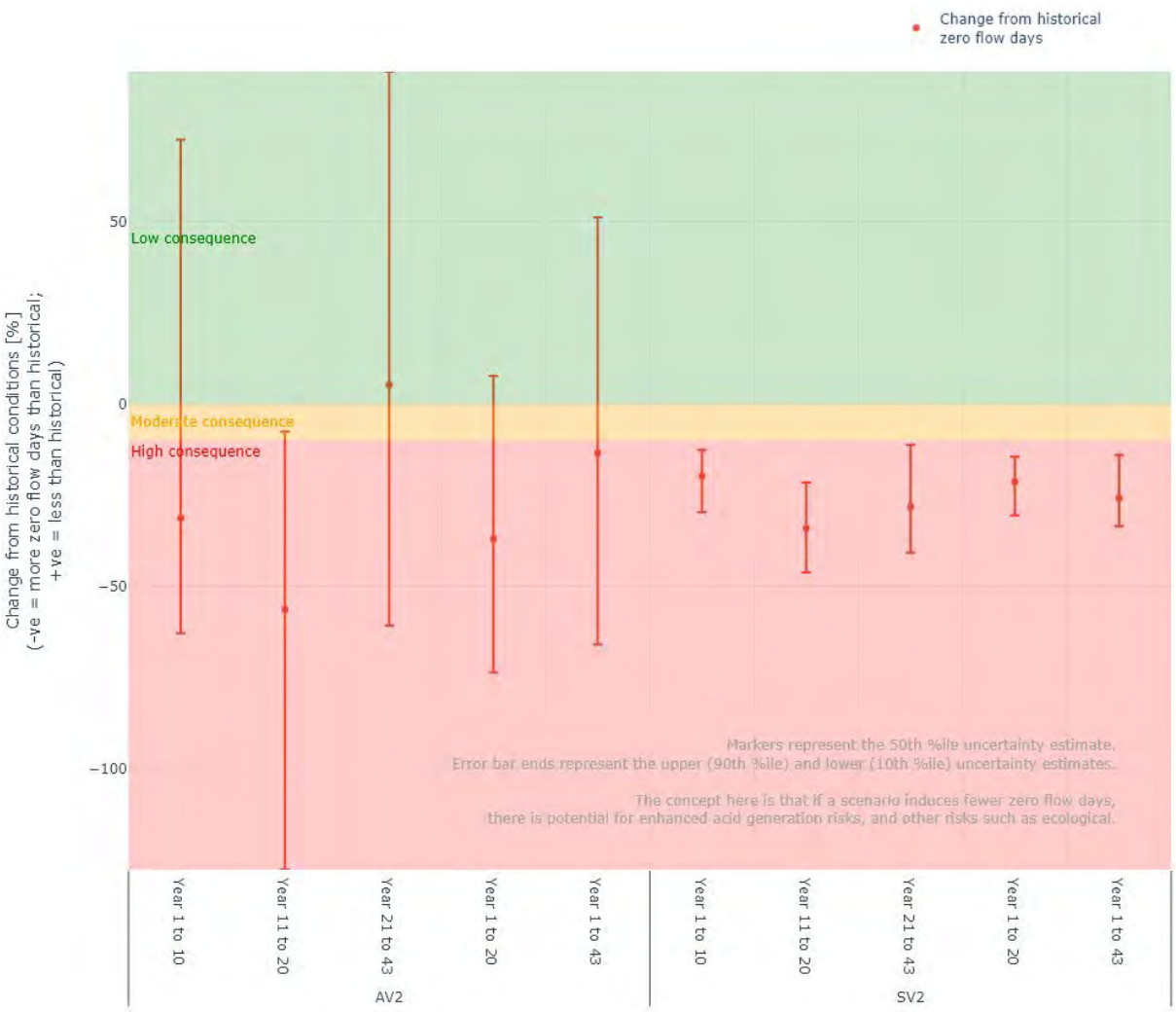


Figure 7-16 High Climate Change – Percent Change in Annual Zero-flow Days Relative to the 2010-2023 Historical Period

7.3.4 Reduction in Surface Water Flows

As presented in **Table 7-6**, the absolute flow rate difference as a percentage against flow from the baseline period was used to inform the risk of modifying catchment inflows to the Anglesea River Estuary from Marshy Creek and Salt Creek; specifically, a moderate or higher consequence is identified when:

- The mean annual absolute flow rate difference measured at AV2 and SV2 against the baseline period is greater than greater than 5 percent as a result of the pumping (in isolation from climate and other groundwater users); and/or
- The mean annual absolute flow rate measured at AV2 and SV2 against the historical period (2010 – 2023) has a difference greater than 5 percent as a result of the “cumulative” pumping and climatic factors.

The above is shown in **Figure 7-17** (medium climate) and **Figure 7-19** (high climate change), as per below:

- The mean annual absolute flow rate difference measured at AV2 and SV2 as a percentage are shown to the right.
- Blue markers show the change due to Alcoa pumping, as measured against the "no Alcoa pumping" case.
- Red markers show the cumulative range change, due to all factors including pumping, climate, and post-mining recovery. These are measured as change from the historical 2010-2023 period.

7.3.4.1 Median Climate Change

The results indicate that for the Alcoa pumping only scenario:

- Forecast annual flows at SV2 are expected to be generally higher than historical rates indicating groundwater extraction has inconsequential impact on flows within the Salt Creek catchment;
- Modelling suggests that Alcoa's pumping at AV2 may contribute only a minor (<5 percent) portion of flow reduction over the historical 2010-2023 period.

For the cumulative impact scenario:

- There is a large degree of uncertainty at both AV2 and SV2 in modelled estimates indicating climatic factors and variability control flow behaviour.
- Modelling generally suggests that flows will be higher at SV2 when compared to the historical period, while AV2 is modelled to be generally less than that over the historical 2010-2023 period by up to 50 percent.

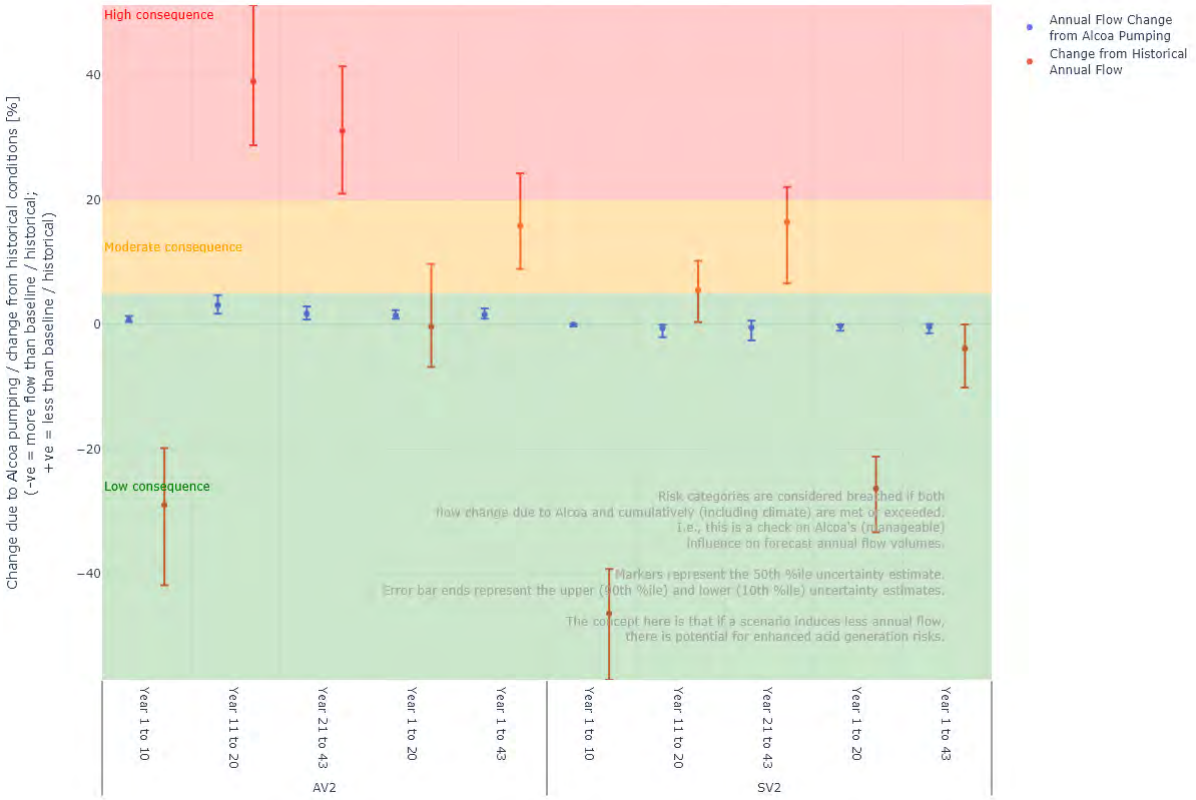


Figure 7-17 Median Climate Scenario – Salt Creek (SV2) and Anglesea River (AV2) Modelled Seasonal Flow Range Acid Generation Risk Metrics and Consequence Thresholds

Figure 7-18 Forecast Annual Flow Timeseries for SV2 and AV2

7.3.4.2 High Climate Change

The results indicate that for the Alcoa pumping only scenario:

- Forecast annual flow flows at SV2 are expected to be generally higher than historical rates, indicating groundwater extraction has inconsequential impact on flows within the salt creek catchment;
- Modelling suggests that Alcoa's pumping at AV2 may contribute minor consequence flow, except during years 11-20, when consequence on these terms may extend into the moderate range.

For the cumulative impact scenario:

- There is a large degree of uncertainty in modelled estimates at both AV2 and SV2, indicating climatic factors and variability control flow behaviour; however, under this climate regime (19 percent further decline in average annual rainfall), modelling suggests that both AV2 and SV2 flows will be significantly lower compared to the historical period.

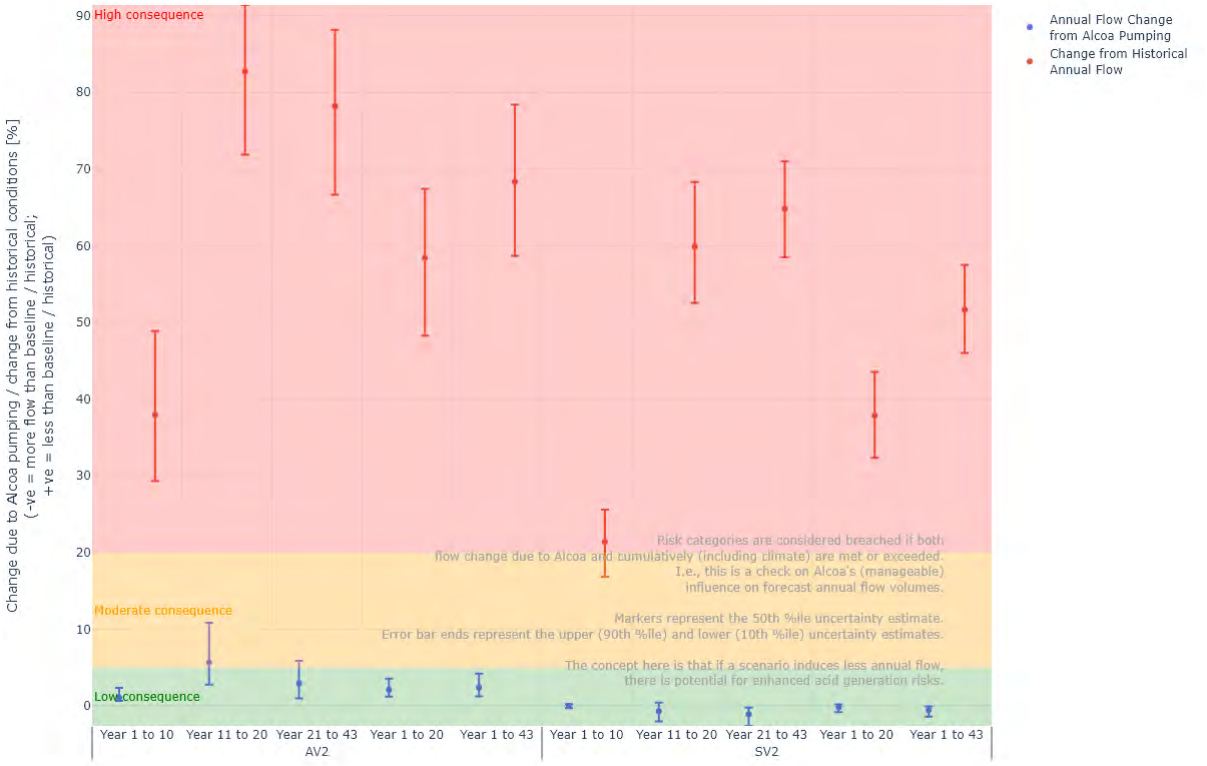


Figure 7-19 High Climate Scenario – Salt Creek (SV2) and Anglesea River (AV2) Modelled Seasonal Flow Range Acid Generation Risk Metrics and Consequence Thresholds

7.3.5 Pit Water Migration

As presented in **Table 7-6**, migration of pit water beyond the specified mine lease area into surrounding aquifers has been assessed. This was achieved using Scenario 1 (medium climate) from **Table 7-5** and assuming base realisation and a rapid pit fill scenario, i.e., the mine void fills within 12 months. By assuming such a rapid fill, this provided the greatest outward hydraulic gradient from which the pit water can migrate into the unsaturated material surrounding the mine.

The results (refer **Figure 7-20**) show that despite the rapid one-year fast fill scenario modelled, 98 percent of the model realisations (147 of 150) indicate that all particles migrating from the boundary of the mine void into the surrounding formation remain within the specified mine lease boundary within the simulation period (to 2066). All water particles are also simulated to discharge back into the mine void, confirming it acts as a groundwater sink for aquifers that intersect the mine in the long term. This is common in Australian post mine closures, as evaporation from the mine void generally exceeds the rate of discharge into it from both surface and groundwater.

Of the three model realisations that represent groundwater migration from edge of the water body across the Alcoa lease boundary (refer **Figure 7-21**), within these three realisations, it is only predicted to occur in 35 particles. That means that of the 300,000 particles simulated across 150 model realisations, totalling more than 45 million particles, only 35 particles indicate a level of cross lease migration risk. Furthermore, at the end of the model simulation (after 44 years), these particles are starting to turn back towards to mine water body.

The geochemical implication of mixing UEVF groundwater with mine void water is discussed in the hydrogeological risk assessment; refer **Section 8.1.4**.

Note: the intent is not to fill over 12 months (which was the conservative case modelled here), and therefore the risk of particle travel is actually much lower than shown in **Figure 7-20** and **Figure 7-21**.

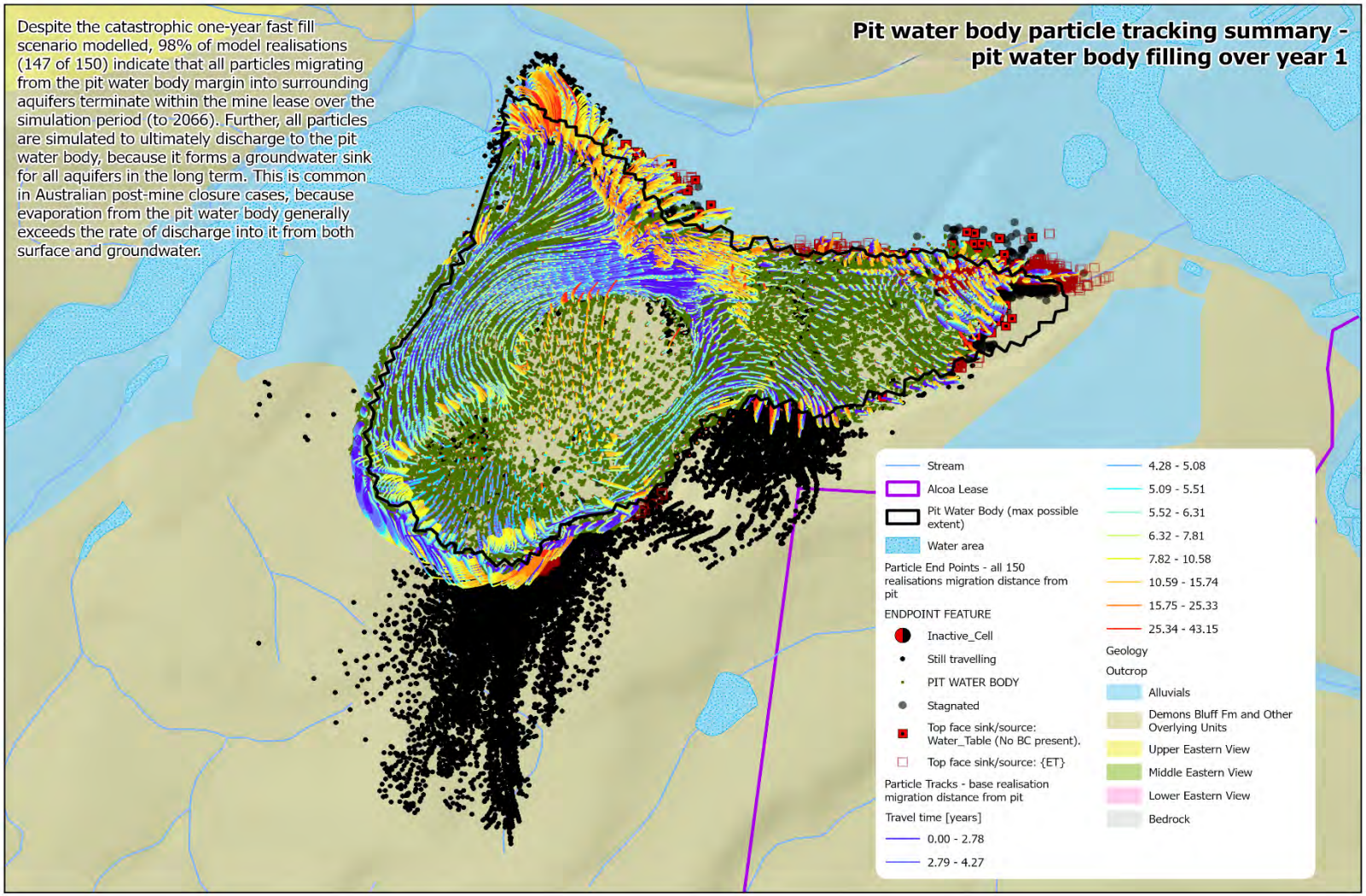


Figure 7-20 Mine Void Water Body Particle Tracking (1 year fill scenario)

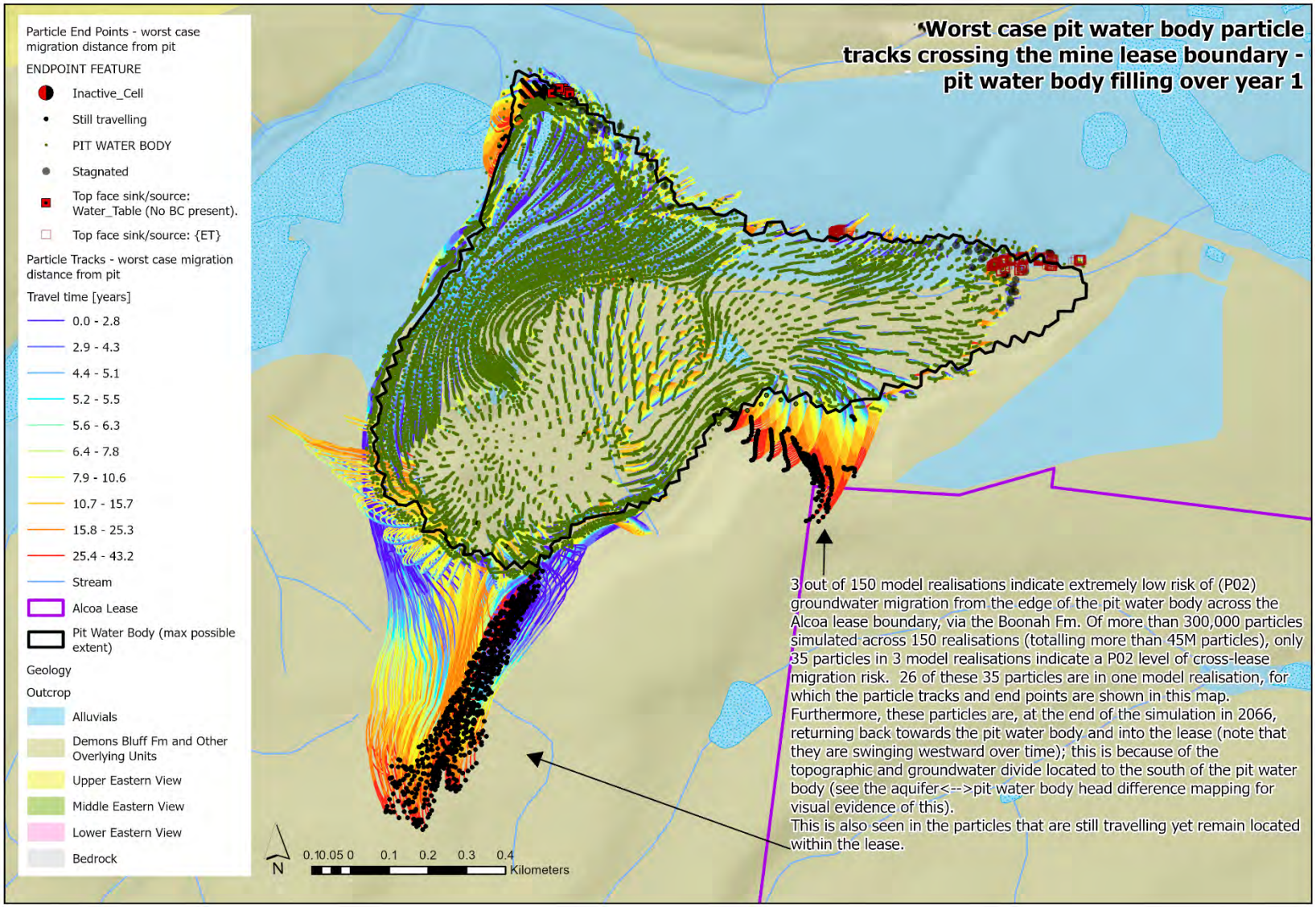


Figure 7-21 Mine Void Water Body Particle Tracking (Worst Case Scenario)

7.3.6 Modelled Water Budgets

A summary of the zone / model layer water budgets for key areas (**Figure 7-22**) has been provided in the sections below with all zone budgets outputs presented in **Appendix F4** to **Appendix F6**.

These results will help quantify the potential degree of leakage to and from the ASA, historically and also under various modelled scenarios as well as also determine where most of the water that enters the model, moves to.

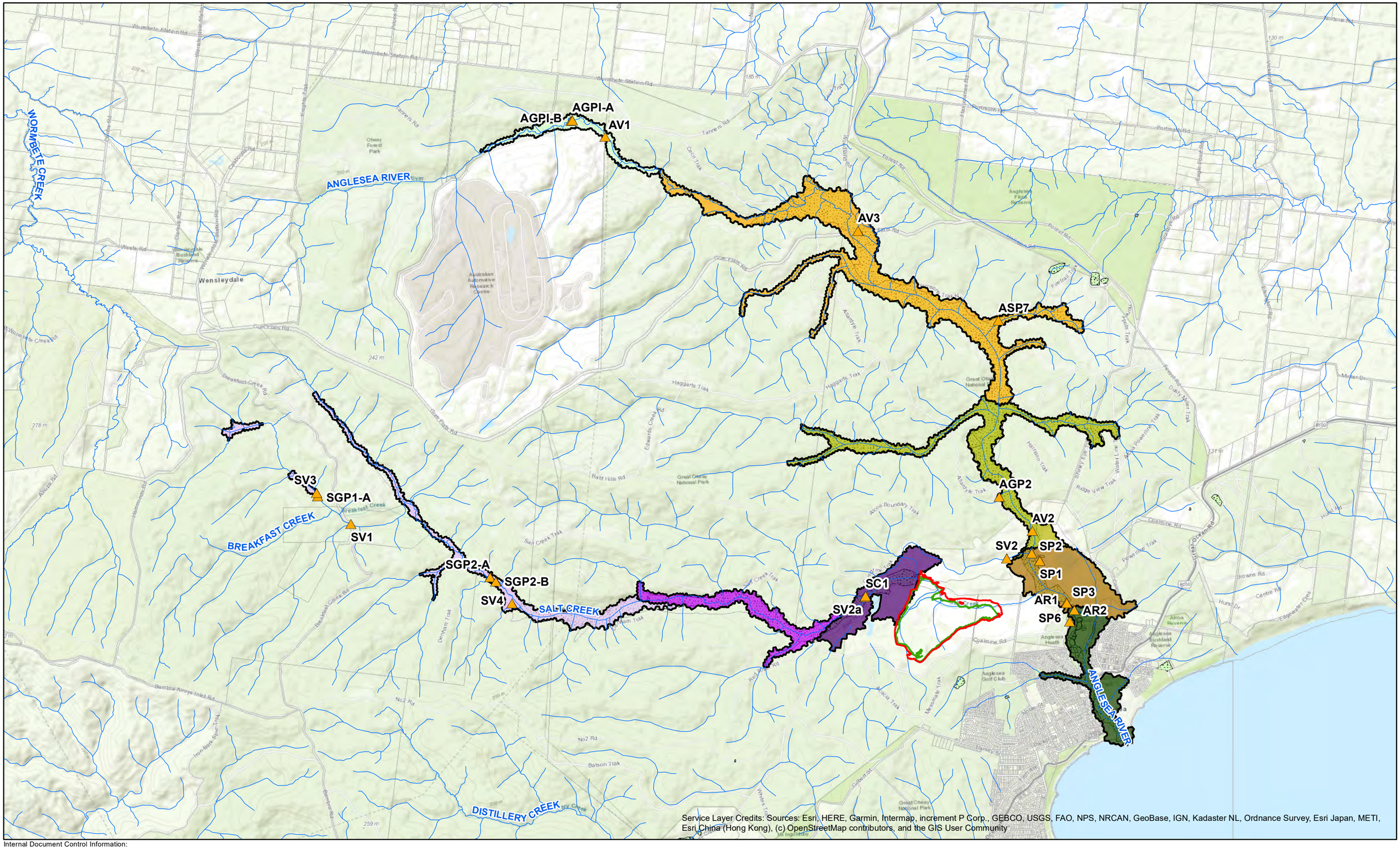
These results were obtained by running 3 scenarios (refer below) defined within the Zone Budget feature within the groundwater model.

- **Scenario 1** = Angv7tr12u - Alcoa and Barwon Water Historical Use 1968 to 2022.
- **Scenario 2** = Angv7tr44u - Medium climate change; Barwon Water pumping 7GL/year for 5 years, then off for 5 years; No Alcoa pumping.
- **Scenario 3** =Angv7tr46u - Medium climate change; Barwon Water pumping 7GL/year for 5 years, then off for 5 years; Alcoa pumping from WB16 @ 1.5GL/year for 10 years. Discharge into the pit water body.

The zones that the water budgets were applicable to are presented in **Figure 7-22;** and listed below;

- Anglesea Estuary.
- Anglesea River ds Salt Creek.
- Anglesea River (lower-mid)
- Anglesea River (mid).
- Anglesea River (upper).
- Salt Creek (lower).
- Salt Creek (mid).
- Salt Creek (upper).

A summary of Alcoa potential influence on recharge to underlying formations is discussed in **Section 7.3.7**.



Internal Document Control Information:
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Groundwater Model Zone Budgets

0 0.5 1 2 3 4 Kilometers

1 cm = 1 km [Page Size: A3]

LEGEND

- Surface Water Sample Location
- -4mAHD
- 4mAHD
- Watercourse
- Parcel Boundary
- Marshland

Groundwater Model Zones

- Anglesea Estuary
- Anglesea River ds Salt Creek
- Anglesea River (lower-mid)
- Anglesea River (mid)
- Anglesea River (upper)
- Salt Creek (lower)
- Salt Creek (mid)
- Salt Creek (upper)

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure **7-22**

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:50,000
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

N

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7.3.6.1 Scenario 1: Alcoa and Barwon Water Historical Use 1968 to 2022

Water balance flow components for all layers as a whole within the model domain is presented in **Figure 7-23**. To help quantify risk associated with the proposed application mean ASA leakage to the various underlying hydrogeological units (HGUs) for specified stream reaches is also presented, refer **Figure 7-24** (Anglesea River reaches) and **Figure 7-25** (Salt Creek stream reaches).

The results presented in **Figure 7-23** indicate the greatest losses of groundwater that enter the model are via groundwater evapotranspiration and aquifer storage (filling up aquifer pore spaces). An interesting observation between the two periods modelled (1968-2000) and (2001-2022) is in the later period, recharge entering the model has declined 46%. This corresponds to the notable reduction in average annual rainfall in the latter period, refer **Table 2-3.**

For historical modelled leakage from and to the ASA along the Anglesea River, the results, refer **Figure 7-24** and **Figure 7-26**, indicate that near the former mine and power station, leakage from the ASA to the underlying Demon Bluff Formation (DBF) occurs at a rate up to 0.014 ML/day/km^2. This increases to 0.048 ML/day/km^2 in the lower to mid sections of the Anglesea River where the intermediate sections of the UEVF underly the ASA. In the mid and upper reaches of the catchment, the ASA has a net gain of groundwater.

The higher modelled leakage from the ASA in the mid part of the Anglesea River catchment is attributed to increase in vertical hydraulic conductivity for the underlying formation. Refer Figure 4-24, p.g 101 from GHD (2024), which shows that the vertical hydraulic conductivity of the UEVF Intermediate in this location is orders of magnitude greater than the demon bluff group located further down the catchment. Note that, if historical groundwater pumping were to significantly induce greater leakage over time from the ASA, potentially greater leakage rates would be seen in the zone Anglesea River lower-mid zone which is closer to the former Power Station, however this is not observed. Further, **Figure 7-35**, **Section 7.3.7** presents Alcoa's modelled potential influence on leakage to the ASA under Alcoa's proposed groundwater amendment and in this location, there is no distinguishable impact.

For historical modelled leakage from and to the ASA along Salt Creek, the results, refer **Figure 7-25**,and **Figure 7-27**, indicate in the lower part of Salt Creek, leakage from the ASA to the Boonah Formation is approximately 0.04 ML/day/km^2. This increases considerably immediately upgradient to 0.4 ML/day/km^2. In the mid and upper reaches of the catchment, the ASA has a net gain of groundwater.

Conceptually, this increase in leakage is unlikely attributed significantly to historical pumping as the lower section of the UEVF in this location is relatively deep (>300m bgl) with thick sequences of confining geology separating the ASA and the Lower UEVF compared to other areas adjacent the pumping centre which have lower leakage rates. During early model run times (e.g. 1968 to 1975 and before groundwater extraction form the lower UEVF may have formed a cone of depression, modelled leakage or recharge in this zone is similar if not more than modelled leakage 2005 onwards, refer **Figure 7-25**. Simply put, higher historical leakage may have been due to greater surface water in the system available for recharge.

Finally, **Figure 7-28** presents a time series of modelled historical ASA leakage in the lower zone of Salt Creek. Evident on this graph, is an increase in leakage from the early 1980's. To further understand what may be causing this level of leakage, **Figure 2-4** which presents the progressive mining operations, shows between 1980 and 1985 the northwest corner of the mine and closest to the original part of Salt Creek were progressively mined. This may have provided a higher degree of potential connectivity between the ASA and the mine void in this location. However, its also important to note that in this location, ASA monitoring bores WTOB1 and WTOB2 show no trend in watertable elevation since monitoring began in 2009.

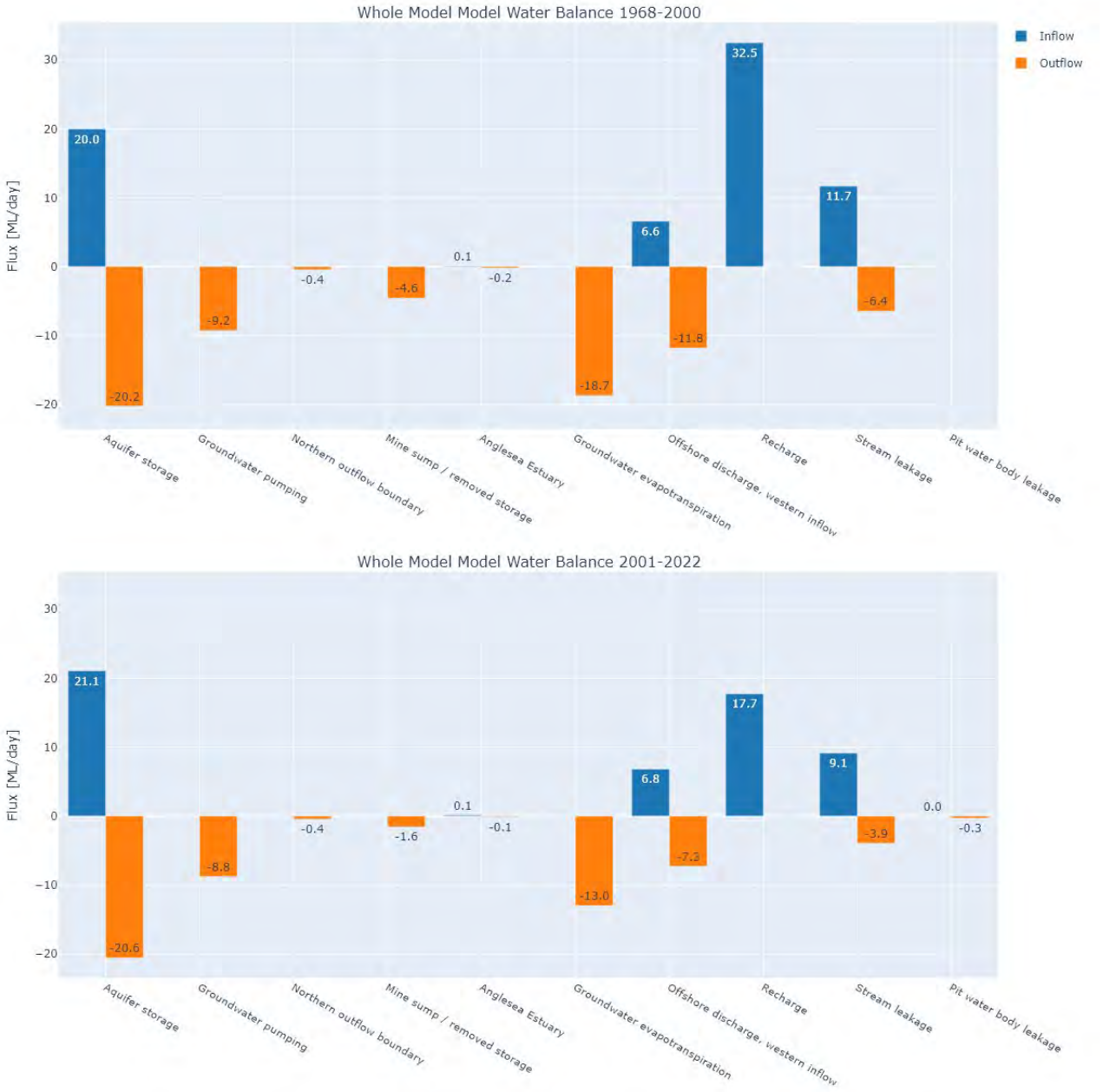


Figure 7-23 Scenario 1: Water balance flow components for all layers (Anglesea and Jan Juc syncline)

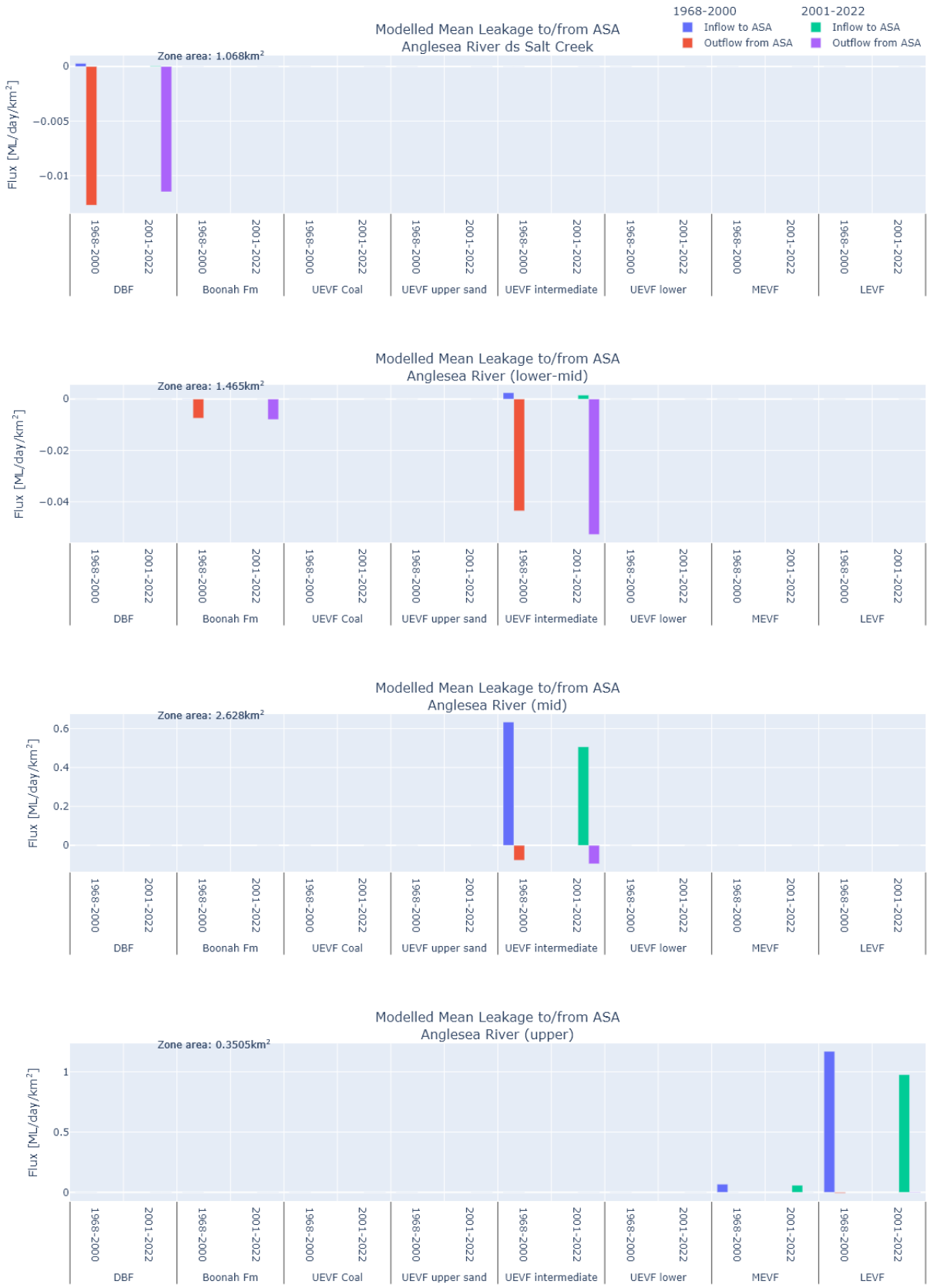


Figure 7-24 Mean ASA leakage to the various underlying aquifers along the Anglesea River

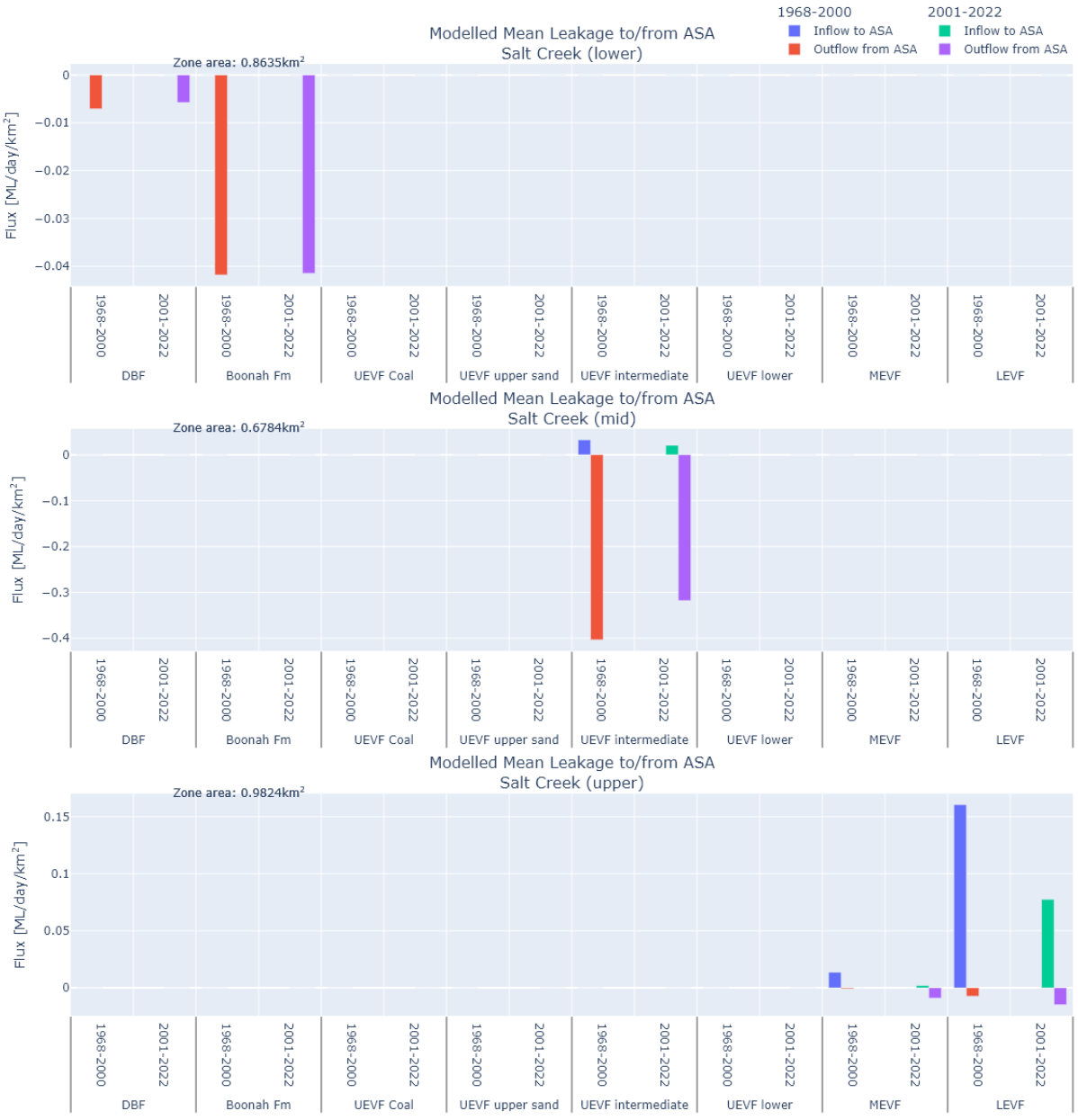


Figure 7-25 Mean ASA leakage to the various underlying aquifers along Salt Creek

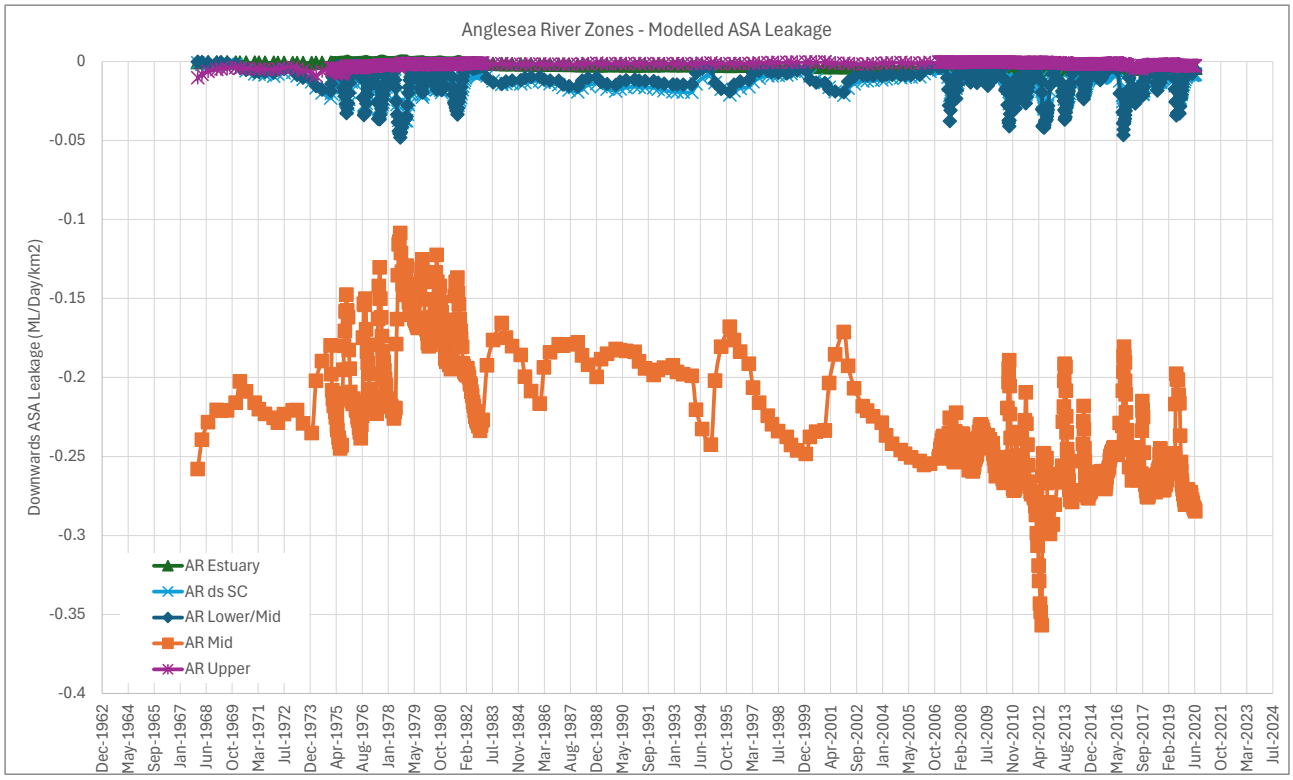


Figure 7-26 Modelled Historical ASA Leakage to Underlying Units Along the Anglesea River

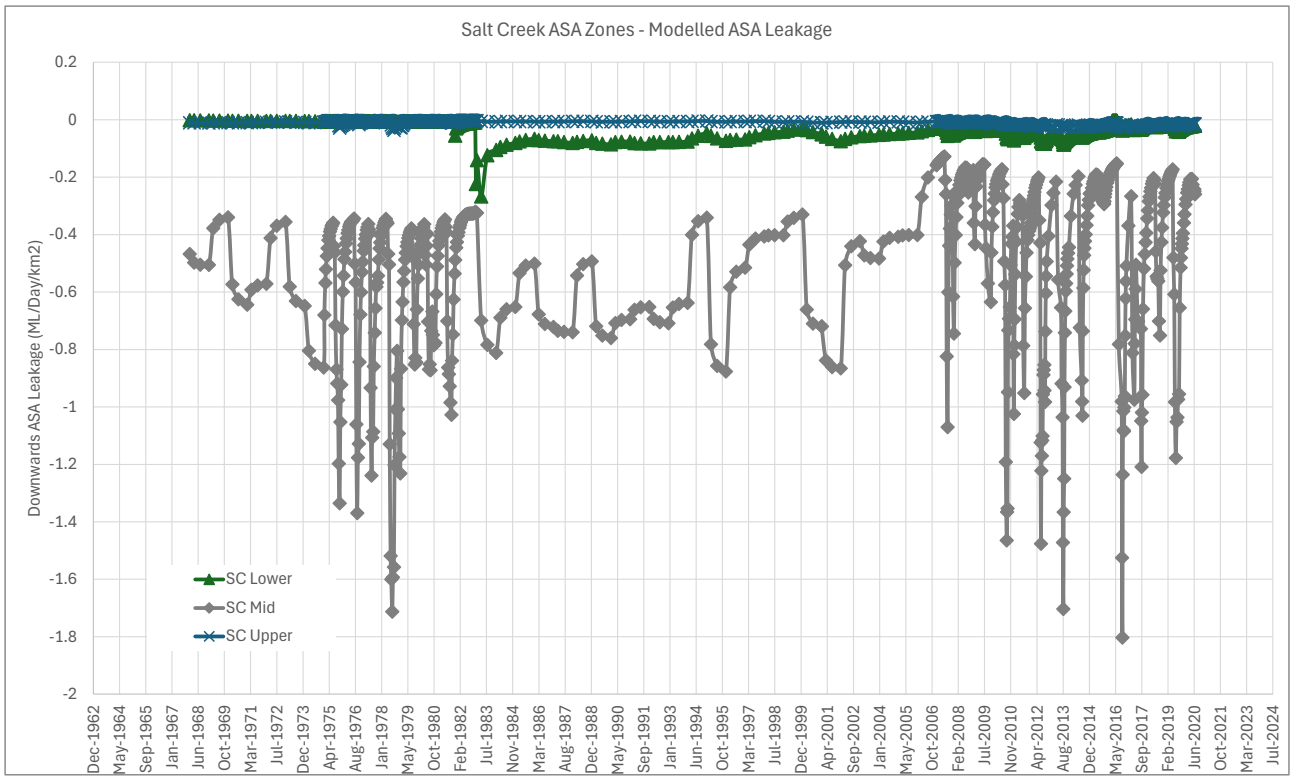


Figure 7-27 Modelled Historical ASA Leakage to Underlying Units Along Salt Creek

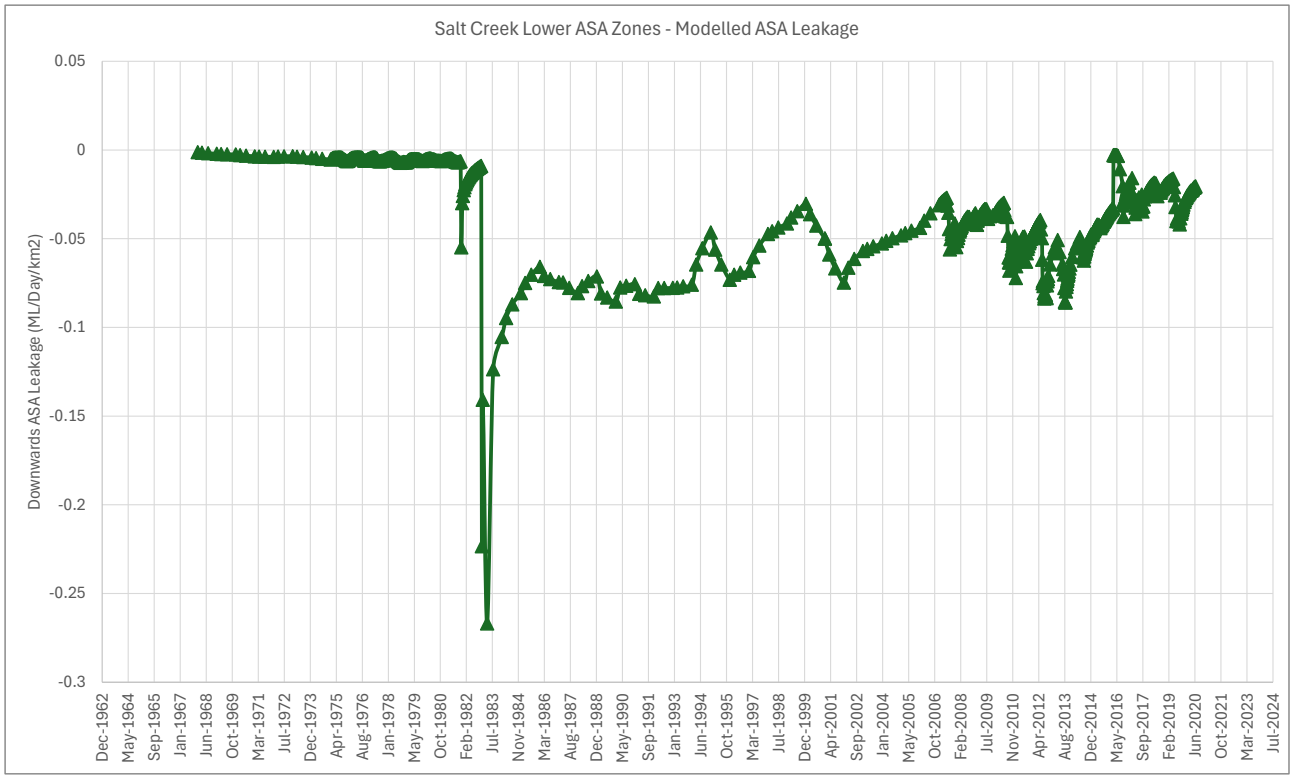


Figure 7-28 Modelled Historical ASA Leakage in the Lower Zone of Salt Creek

7.3.6.2 Scenario 2: Medium climate change; Barwon Water pumping 7GL/year for 5 years, then off for 5 years; No Alcoa pumping.

Water balance flow components for all layers as a whole within the model domain is presented in **Figure 7-29**. To help quantify risk associated with the proposed application mean ASA leakage to the various underlying hydrogeological units (HGUs) for specified stream reaches is also presented, refer **Figure 7-30** (Anglesea River reaches) and **Figure 7-31** (Salt Creek stream reaches).

As with modelled historical water balance outputs (refer **Section 7.3.6.1**), the results presented in **Figure 7-29** indicate the greatest losses of groundwater that enter the model are via groundwater evapotranspiration and aquifer storage, albeit these fluxes are slightly lower than those historically modelled. Mean ASA leakage per km^2 to the underlying geology is presented in **Figure 7-24** (Anglesea River) and **Figure 7-25** (Salt Creek).

For modelled leakage from and to the ASA along the Anglesea River, the results indicate that near the former mine and power station, leakage from the ASA to the underlying Demon Bluff Formation (DBF) occurs at a rate up to 0.014 ML/day/km^2 with the highest leakage to occur in the early time (2023-2033) before reducing to 0.005 ML/day/km^2 from2033 – 2066. This increases to up to 0.07 ML/day/km^2 in the lower to mid sections of the Anglesea River where the intermediate sections of the UEVF underly the ASA. In the mid and upper reaches of the catchment, the ASA has a net gain of groundwater, however this net gain has reduced from 0.4 to 0.08 ML/day/km^2 when compared to 1968 to 2022.

For leakage from and to the ASA along Salt Creek, the results indicate in the lower part of Salt Creek, leakage from the ASA to the Boonah Formation is approximately 0.035 ML/day/km^2. This increases immediately upgradient up to 0.38 ML/day/km^2 which is similar to modelled historical leakage from 1968 to 2022 (Scenario 1). In the mid and upper reaches of the catchment, the ASA has a net gain of groundwater, similar to modelled historical leakage from 1968 to 2022 (Scenario 1).

Appendix F5 presents all timeseries ASA leakage plots along the various zones.

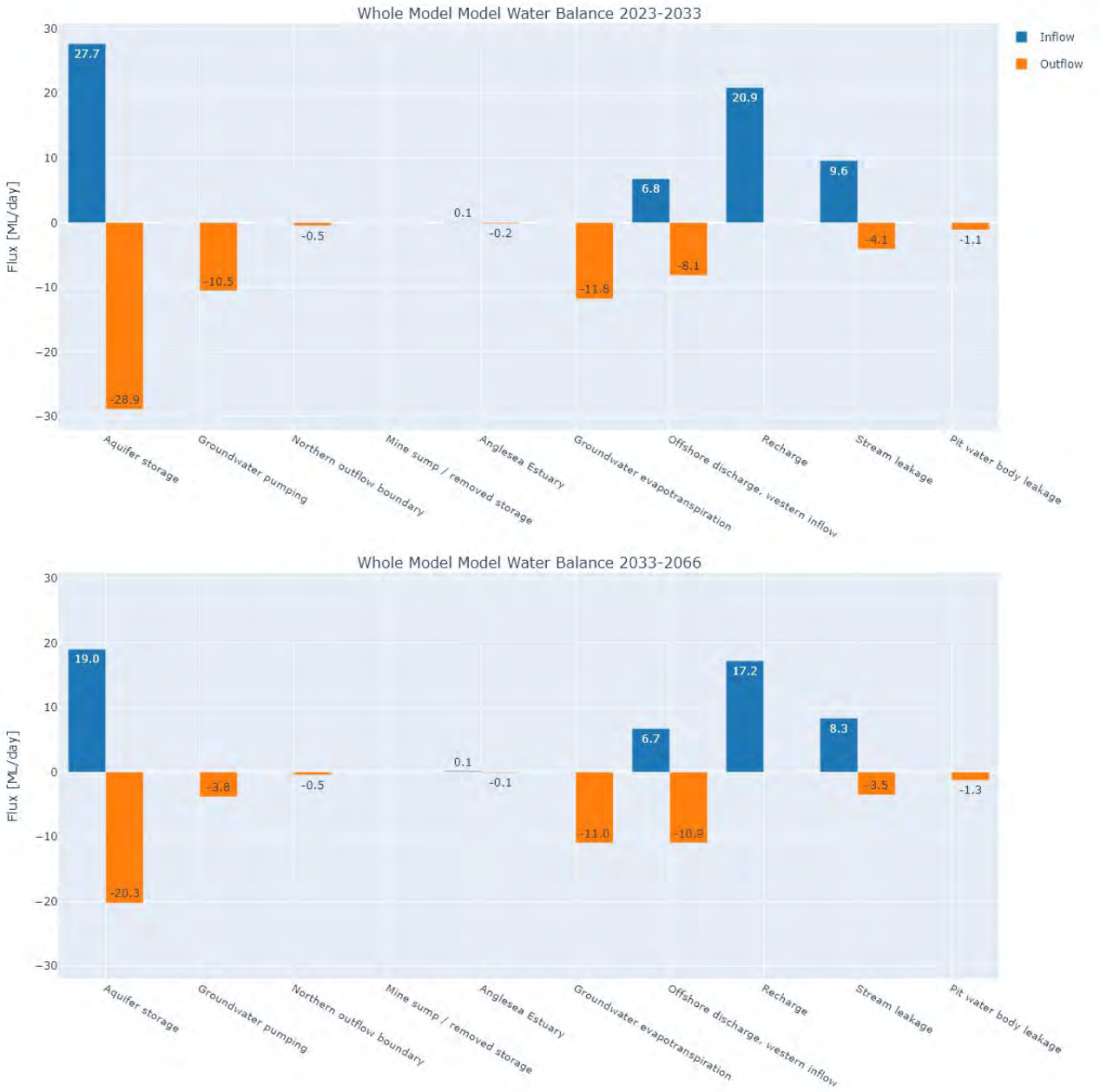


Figure 7-29 Scenario 2: Water balance flow components for all layers (Anglesea and Jan Juc syncline)

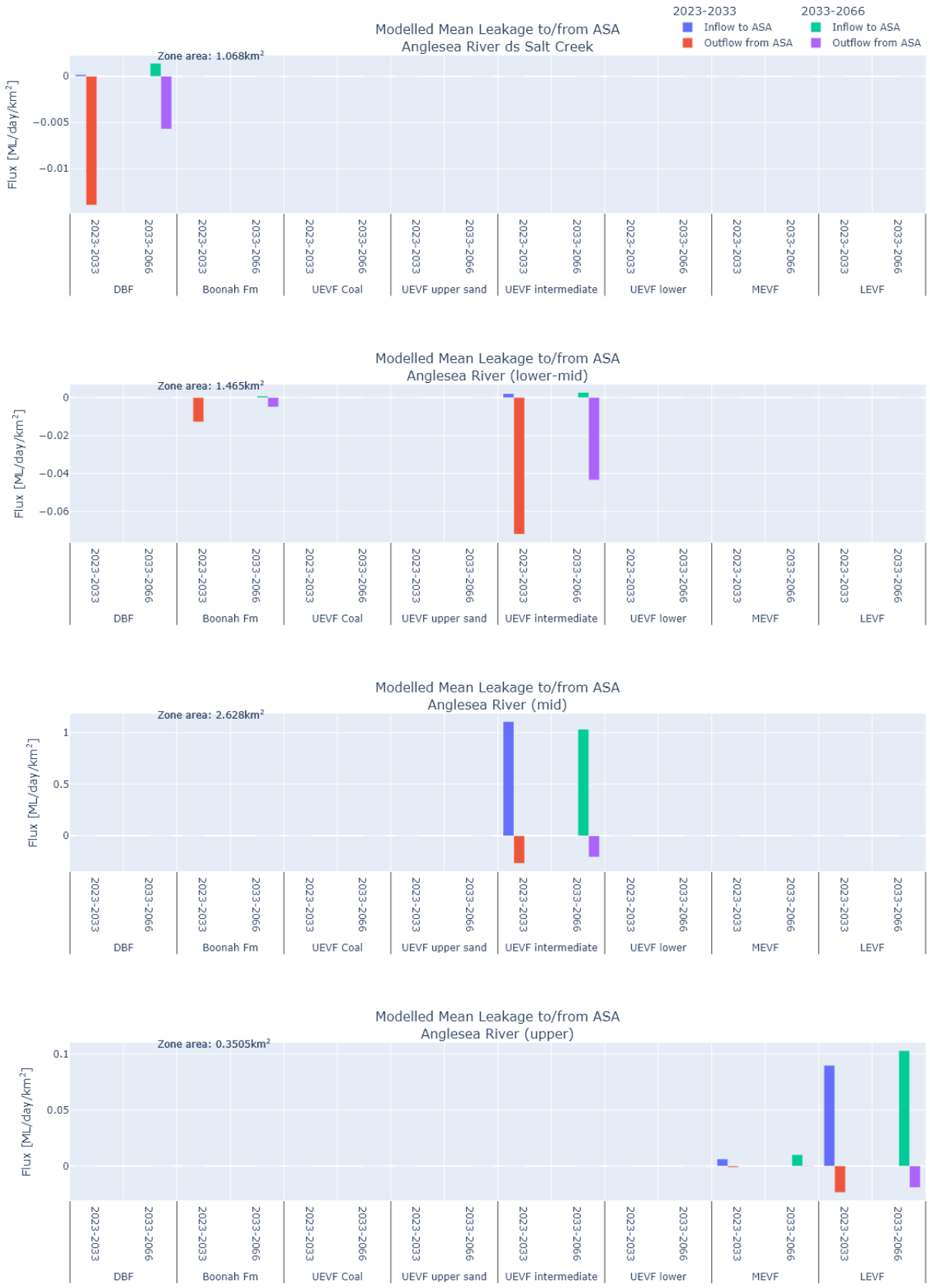


Figure 7-30 Mean ASA leakage to the various underlying aquifers along the Anglesea River

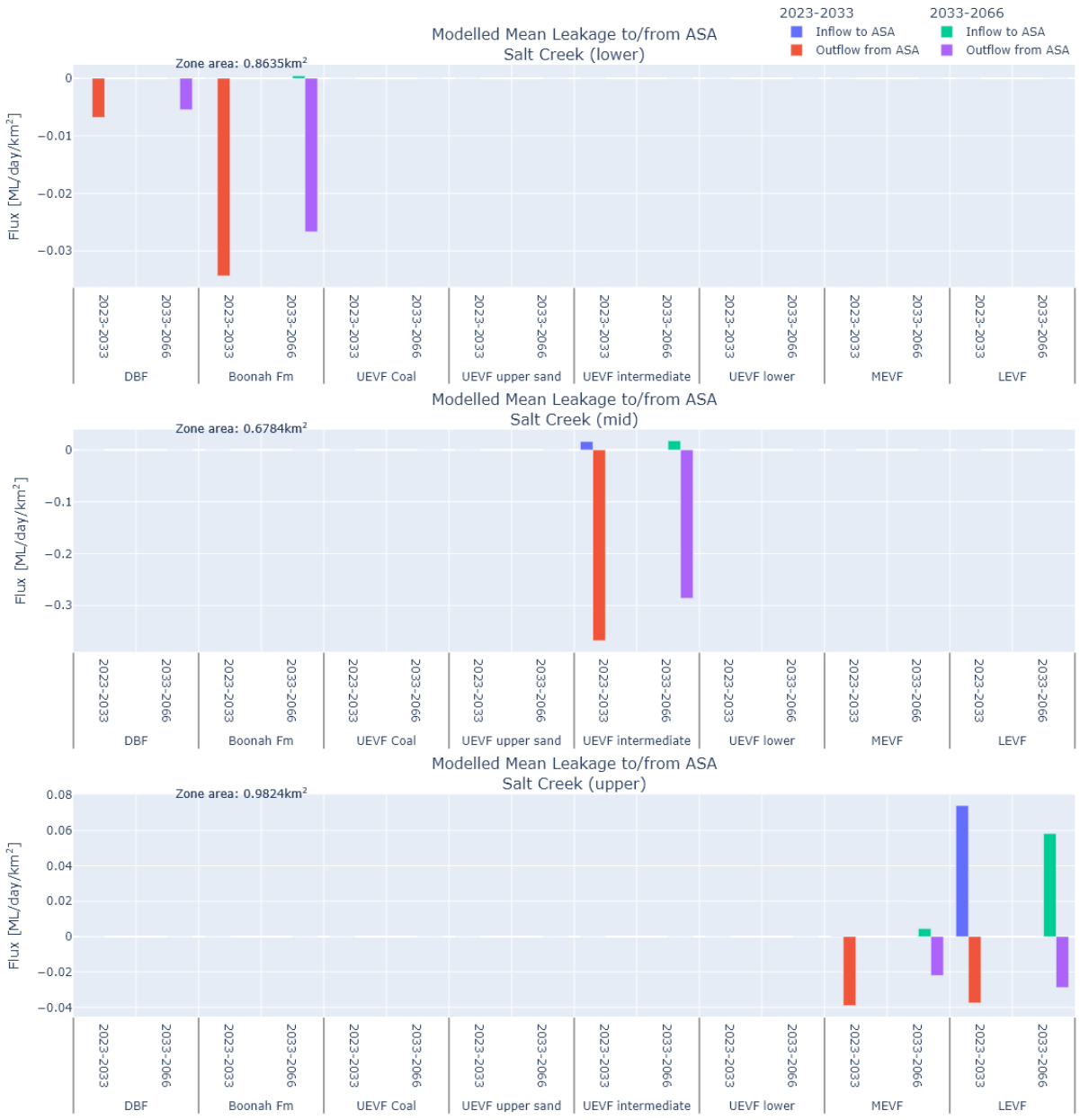


Figure 7-31 Mean ASA leakage to the various underlying aquifers along Salt Creek

7.3.6.3 Scenario 3: Medium climate change; Barwon Water pumping 7GL/year for 5 years, then off for 5 years; Alcoa pumping from WB16 @ 1.5GL/year for 10 years. Discharge into the pit water body.

Water balance flow components for all layers as a whole within the model domain is presented in **Figure 7-32**. To help quantify risk associated with the proposed application mean ASA leakage to the various underlying hydrogeological units (HGUs) for specified stream reaches is also presented, refer **Figure 7-33** (Anglesea River reaches) and **Figure 7-34** (Salt Creek stream reaches).

As with modelled historical water balance outputs (refer **Section 7.3.6.1**), the results presented in **Figure 7-32** indicate the greatest losses of groundwater that enter the model are via groundwater evapotranspiration and aquifer storage. Interestingly, stream leakage between this scenario and scenario 2, predict the same amount of stream leakage. Mean ASA leakage per km^2 to the underlying geology is presented in **Figure 7-32** (Anglesea River) and **Figure 7-34** (Salt Creek).

For modelled leakage from and to the ASA along the Anglesea River, the results indicate that near the former mine and power station, leakage from the ASA to the underlying Demon Bluff Formation (DBF) occurs at a rate up to 0.014 ML/day/km^2 with the highest leakage to occur in the early time (2023-2033) before reducing to 0.006 ML/day/km^2 from2033 – 2066. This increases to up to 0.08 ML/day/km^2 in the lower to mid sections of the Anglesea River where the intermediate sections of the UEVF underly the ASA. In the mid and upper reaches of the catchment, the ASA has a net gain of groundwater, however this net gain has reduced from 1.5 to 1 ML/day/km^2 in the mid part of the catchment and 0.35 to 0.07 ML/day/km^2 in the upper part of the catchment when compared to 1968 to 2022.

For modelled leakage from and to the ASA along Salt Creek, the results indicate in the lower part of Salt Creek, leakage from the ASA to the Boonah Formation is approximately 0.035 ML/day/km^2. This remains relatively unchanged from Scenario 2. This leakage increases immediately upgradient up to 0.38 ML/day/km^2 which is similar to the leakage modelled in Scenario 2. In the mid and upper reaches of the catchment, the ASA has a net gain of groundwater, similar to modelled leakage in Scenario 2.

Appendix F5 presents all timeseries ASA leakage plots along the various zones.

Note: **Section 7.3.7** analyses the difference between Scenario 2 and Scenario 3. This is modelled Alcoa potential influence on leakage from the ASA.

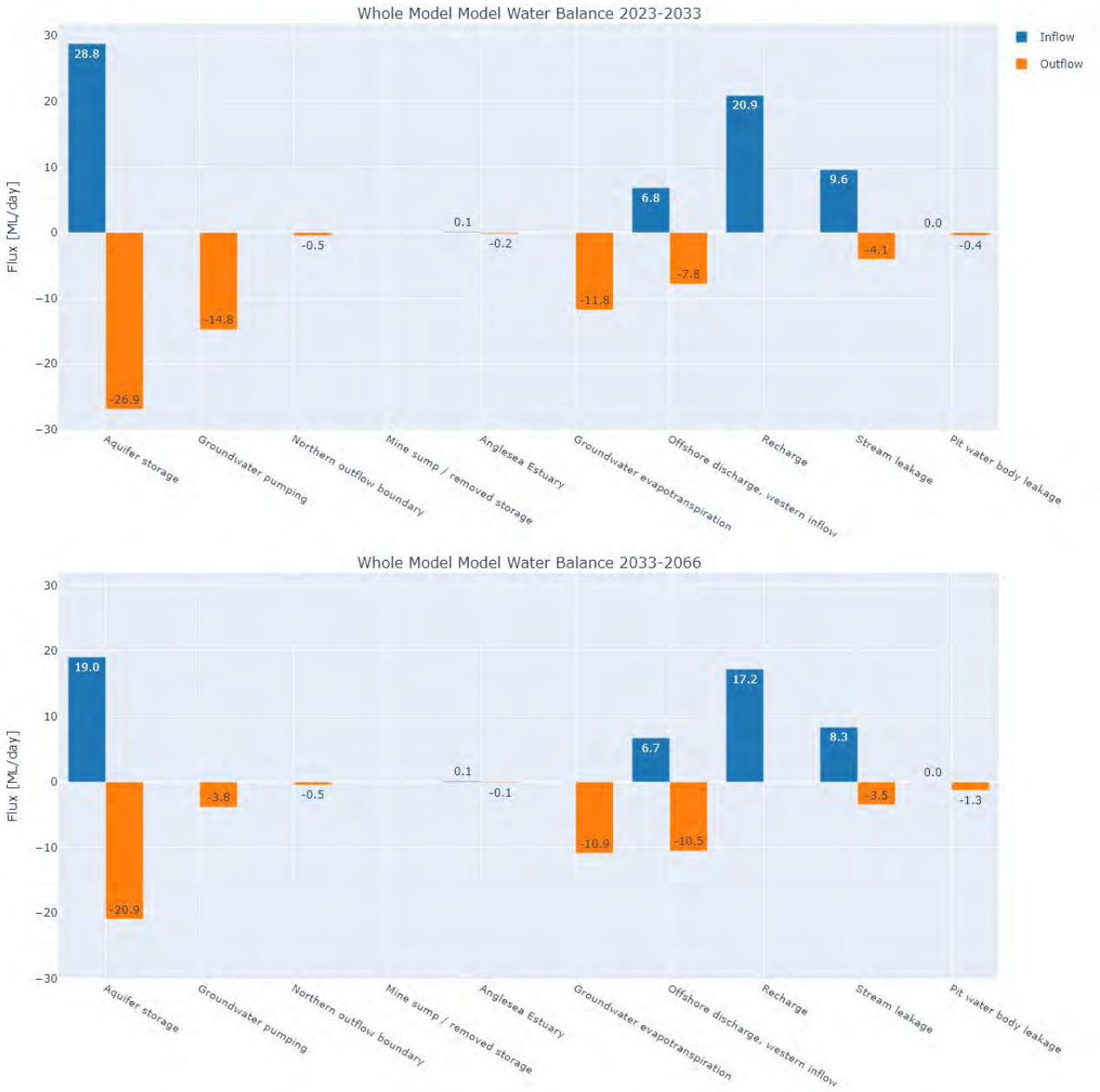


Figure 7-32 Scenario 3: Water balance flow components for all layers (Anglesea and Jan Juc syncline)

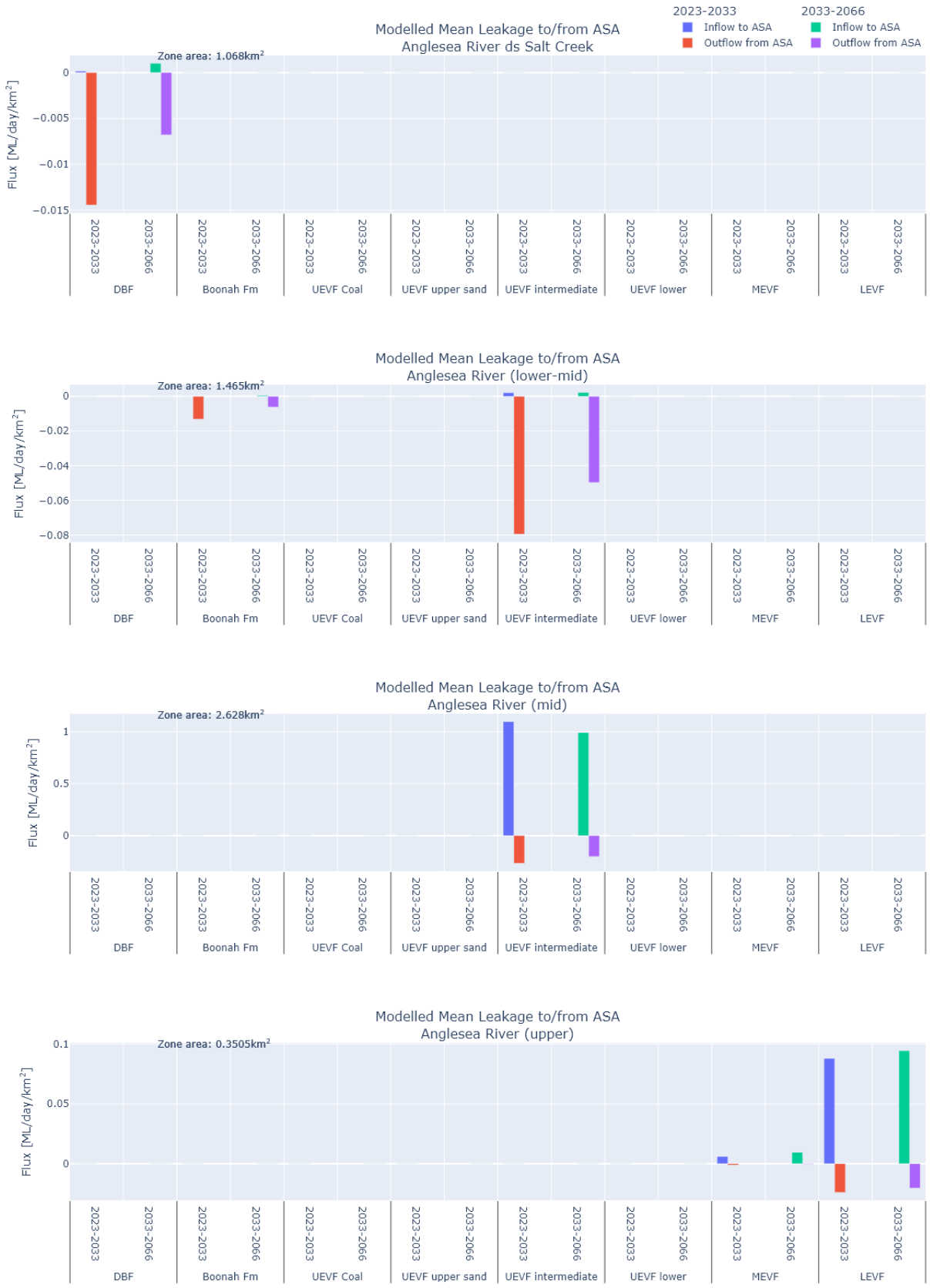


Figure 7-33 Mean ASA leakage to the various underlying aquifers along the Anglesea River

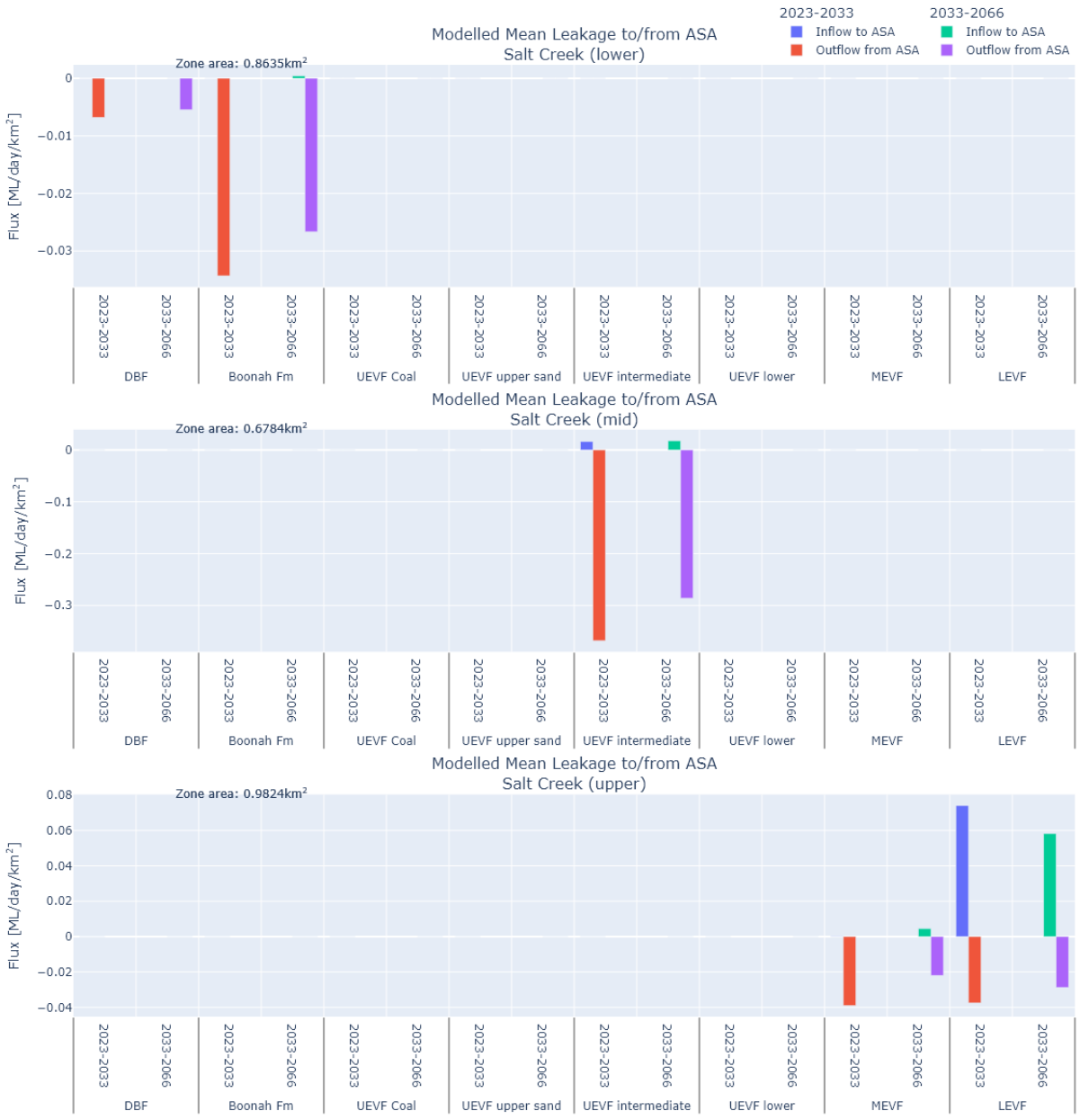


Figure 7-34 Mean ASA leakage to the various underlying aquifers along Salt Creek

7.3.7 Alcoa Potential Influence on Recharge

To analyse the impact that Alcoa's potential groundwater entitlement may have on leakage rates from the ASA to underlying formations, the difference between two forward looking scenarios (Angv7tr44u [scenario 2] and Angv7tr46u [Scenario 3]) were obtained. These are presented in **Figure 7-35**, and **Figure 7-37** to **Figure 7-41** (Anglesea River ASA zones) and **Figure 7-36** and **Figure 7-42** to **Figure 7-44** (Salt Creek ASA Zones)

For the ASA alignment within the Anglesea River catchment, the results indicate that the largest rate of leakage (potentially attributable to Alcoa pumping) from the ASA to the underlying formation occurs in the zone immediately upgradient of the former PowerStation, (refer **Figure 7-23)**. In this location median leakage between forecast Year 1 and Year 50 is 0.0008 ML/day/km^2 with a maximum leakage of 0.0068 ML/day/km^2, refer **Figure 7-35.**

To put this into context, a median increase in leakage of 0.0008 ML/day/km^2 as a result of Alcoa potential groundwater entitlement is approximately 0.30ML/yr (across the whole zone) or 0.0003% of Alcoa proposed annual entitlement (1500 ML/yr). In hydrogeological recharge terms since 1 m equals 1000 mm, 1 mm of rain is 1 litre per square metre and as the area of this zone is 1,464,576 m^2, 0.0008 ML/day/km^2 represents approximately 0.43 mm/yr (or approximately 0.9% of the modelled recharge rate), refer **Table 7-9**.

For the ASA alignment within the Salt Creek catchment, the results indicate that the largest rate of leakage (potentially attributable to Alcoa pumping) from the ASA to the UEVF Intermediate sediments occurs in the mid part of catchment. In this location (refer **Figure 7-23)** the median leakage between forecast Year 1 and Year 50 is 0.001 ML/day/km^2 with a maximum leakage of 0.04 ML/day/km^2. Refer **Figure 7-36.** Similar to the assessment above, as the area of this zone is 679,422 m^2, 0.003 ML/day/km^2 represents approximately 0.75 mm/yr (or approximately 1.25% of the modelled recharge rate), refer **Table 7-9**.

Table 7-9 Alcoa Modelled Recharge Impacts to the ASA

Parameter	Unit	ASA Mid Salt Creek	ASA Mid Anglesea River
Modelled Mean Leakage	ML/day/km2	0.0008	0.001
	L/day/km2	800	1000
	L/yr/km2	292000	365000
	mm/yr/km2	292000[1]	365000[1]
Area	km2	0.68	1.46
	m2	679422	1464576
Mean Modelled Recharge	mm/yr	50[2]	20[2]
Recharge Rate Equivalent	mm/yr	0.43	0.75
% of Calibrated Recharge Rate	%	0.86	1.25

[1]A rainfall of 1 mm supplies 0.001 m^3, or 1 litre of water to each square metre of the land.
[2] Data from Figure 6-31, p.g 165 from GHD (2024),

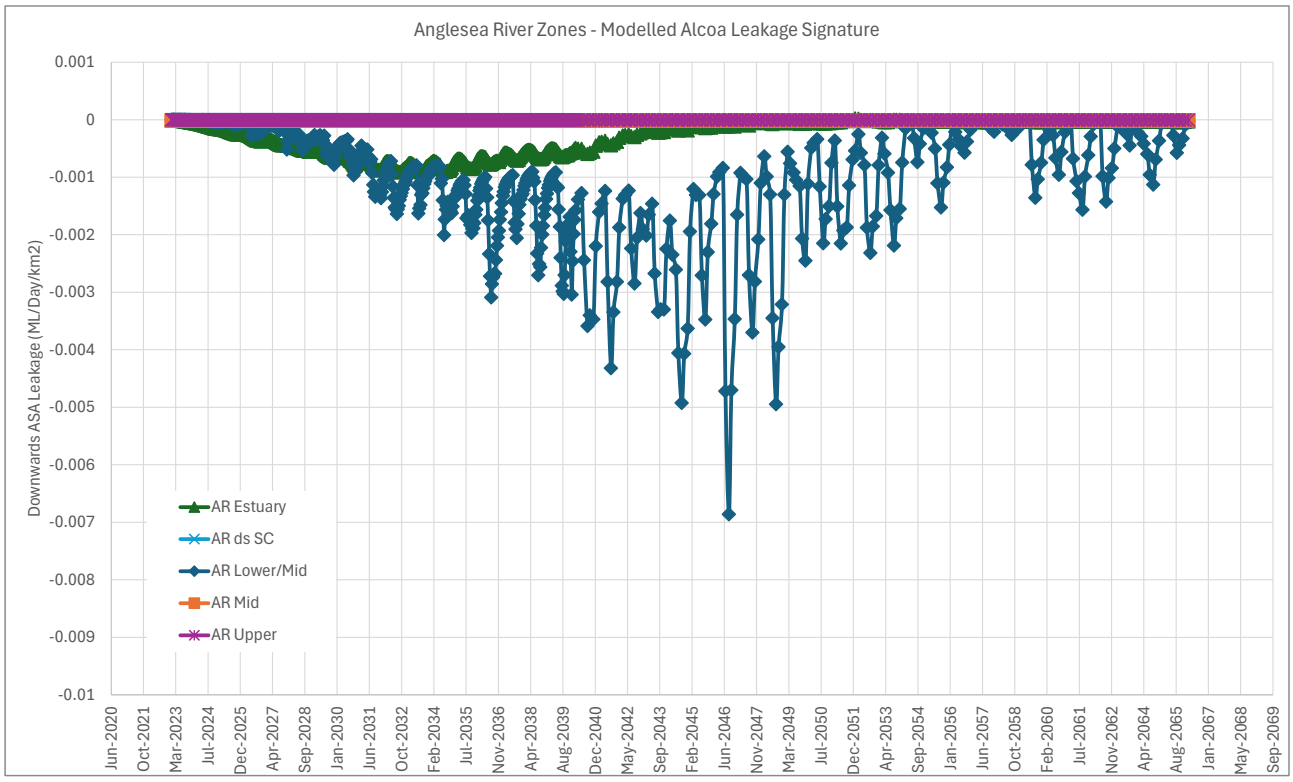


Figure 7-35 Anglesea River ASA Zones - Modelled Alcoa Induced Leakage, refer Figure 7-23 for zone locations.

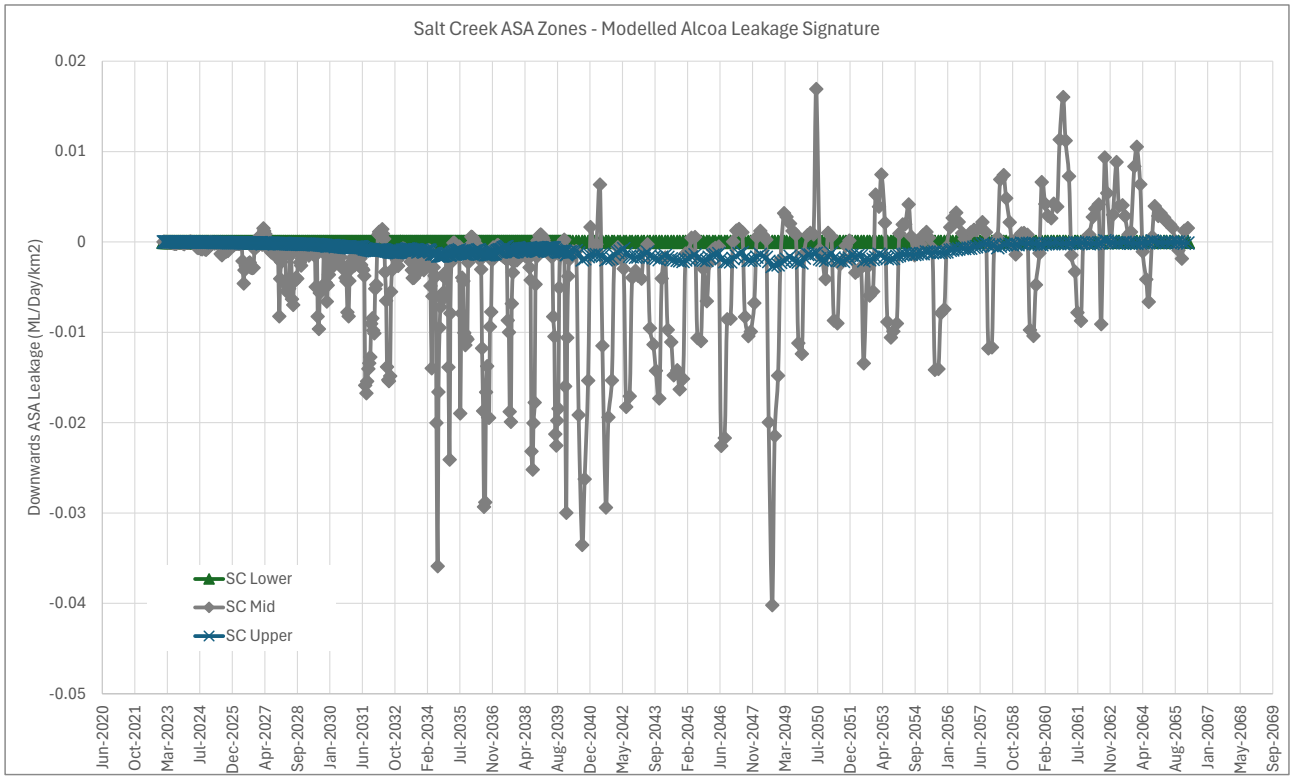


Figure 7-36 Salt Creek ASA Zones - Modelled Alcoa Induced Leakage, refer Figure 7-23 for zone locations.

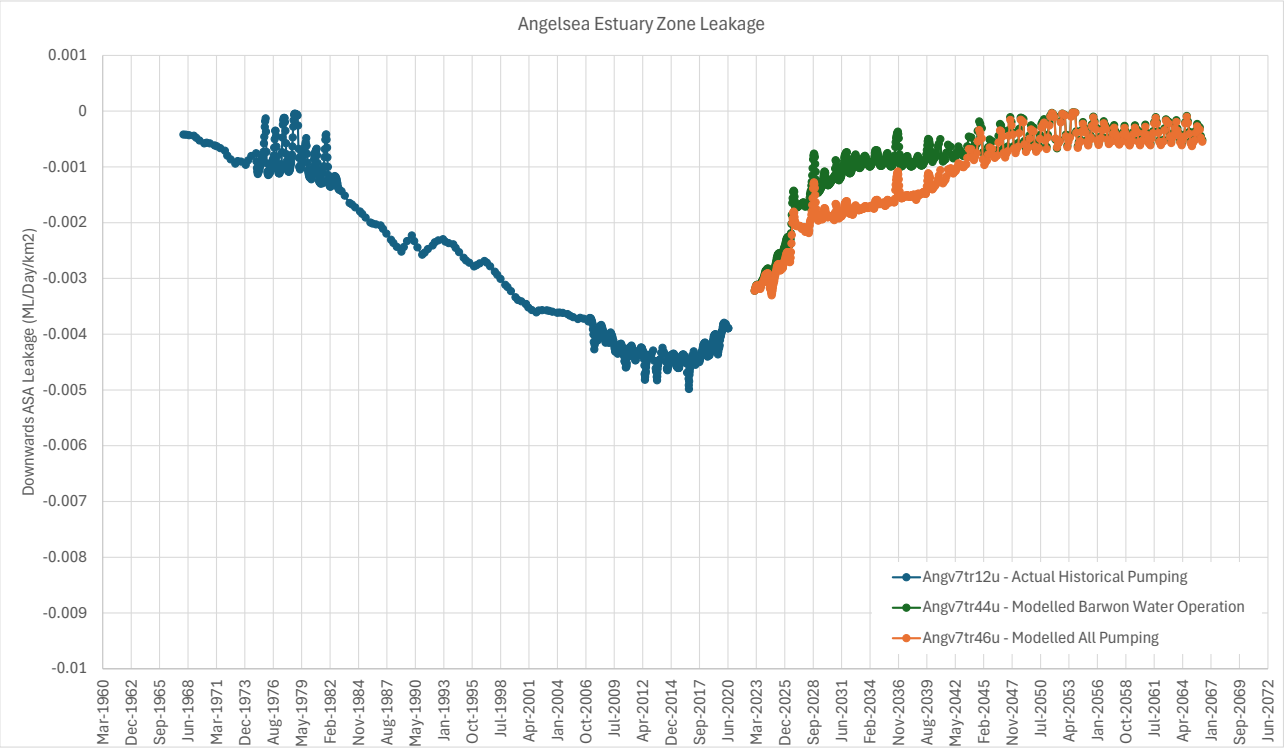


Figure 7-37 Anglesea River Estuary ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

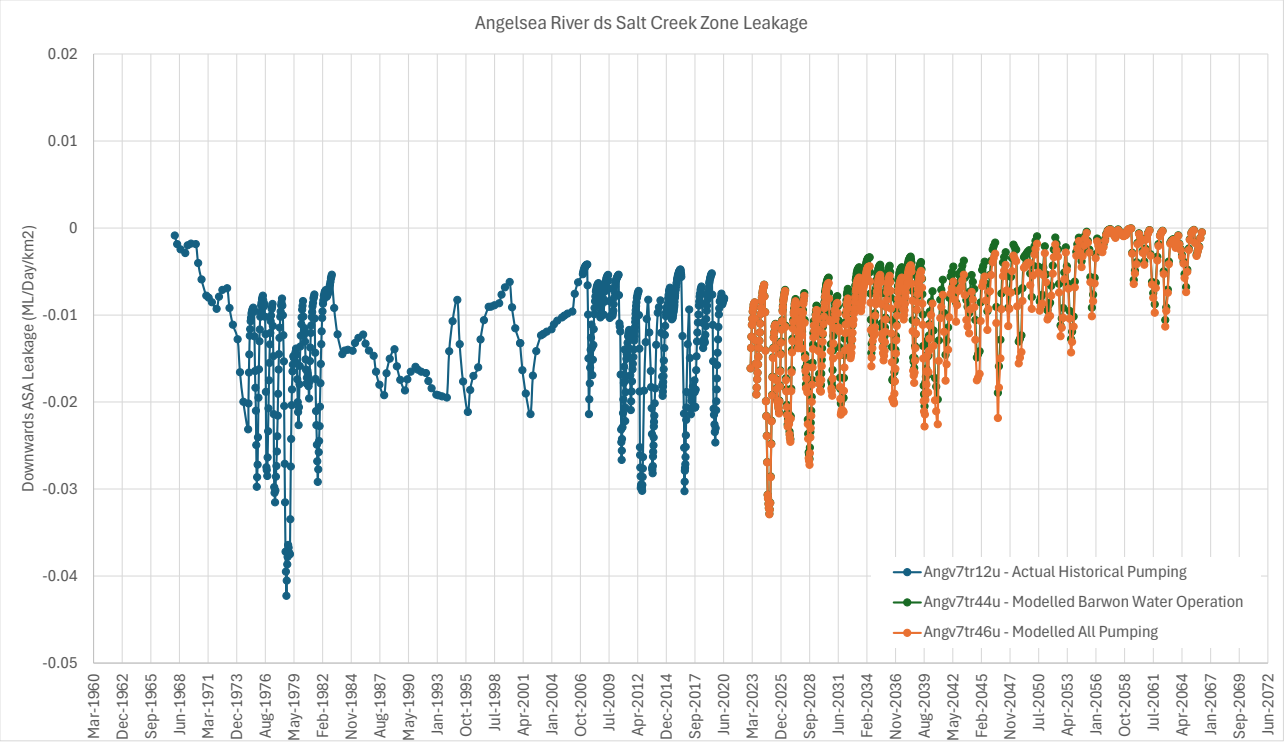


Figure 7-38 Anglesea River ds Salt Creek ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

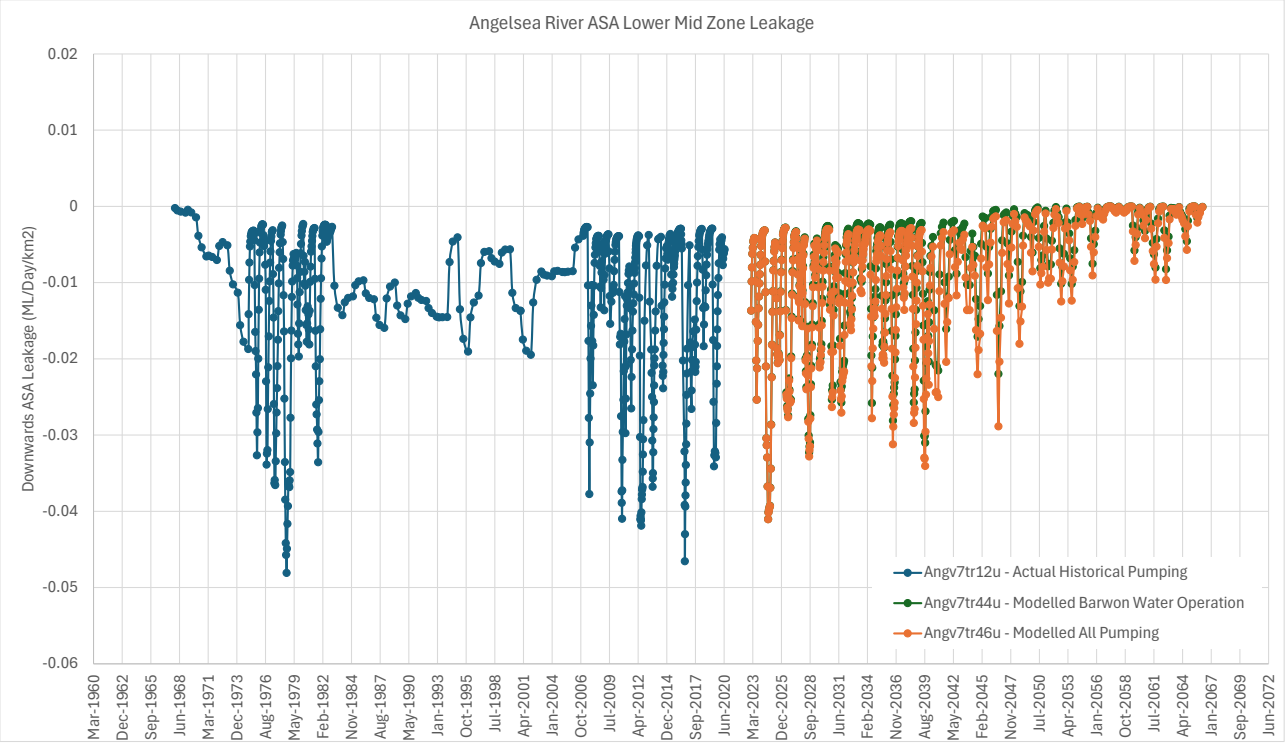


Figure 7-39 Anglesea River Low/Mid ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

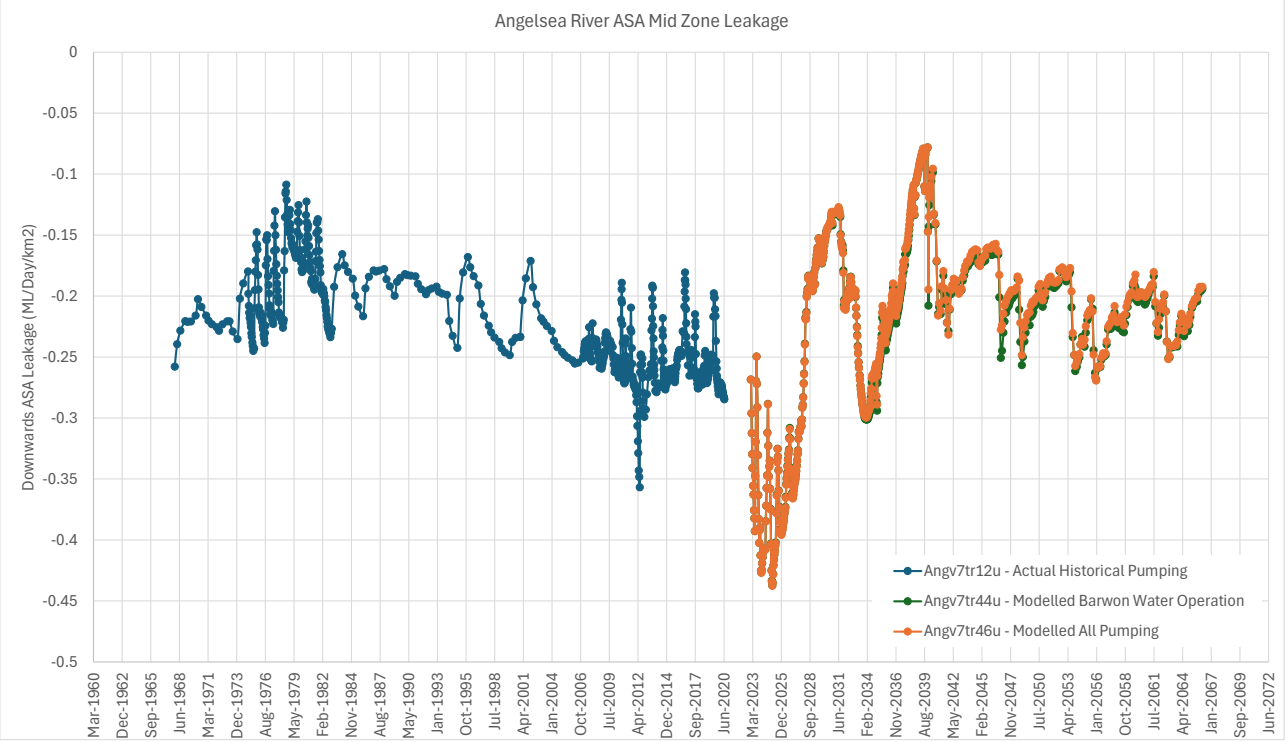


Figure 7-40 Anglesea River Mid ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

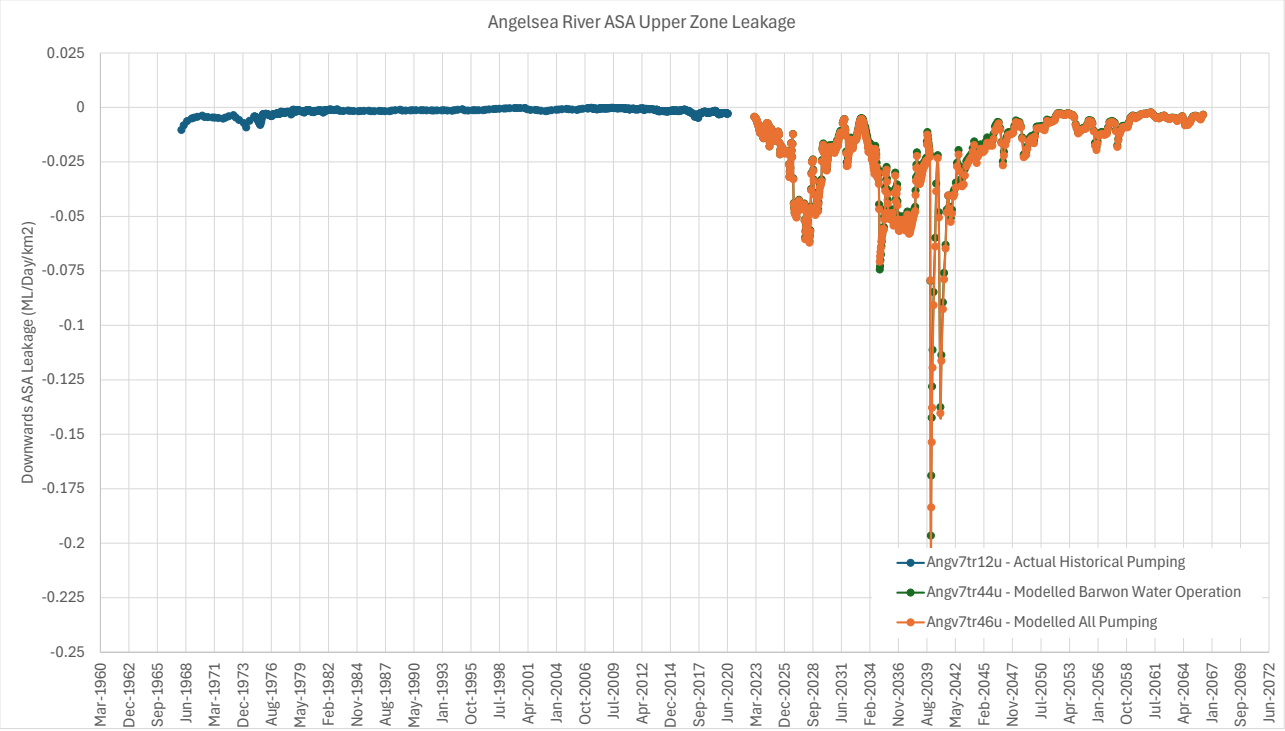


Figure 7-41 Anglesea River Upper ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

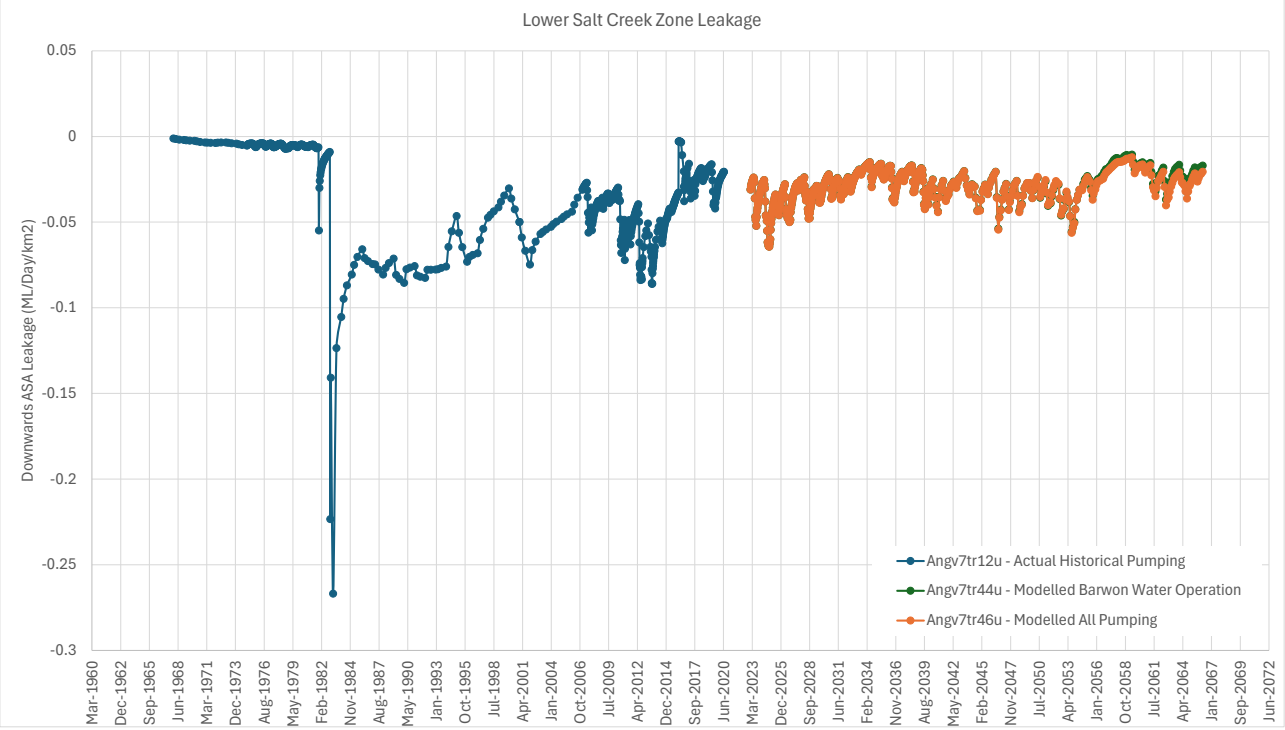


Figure 7-42 Salt Creek Lower ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

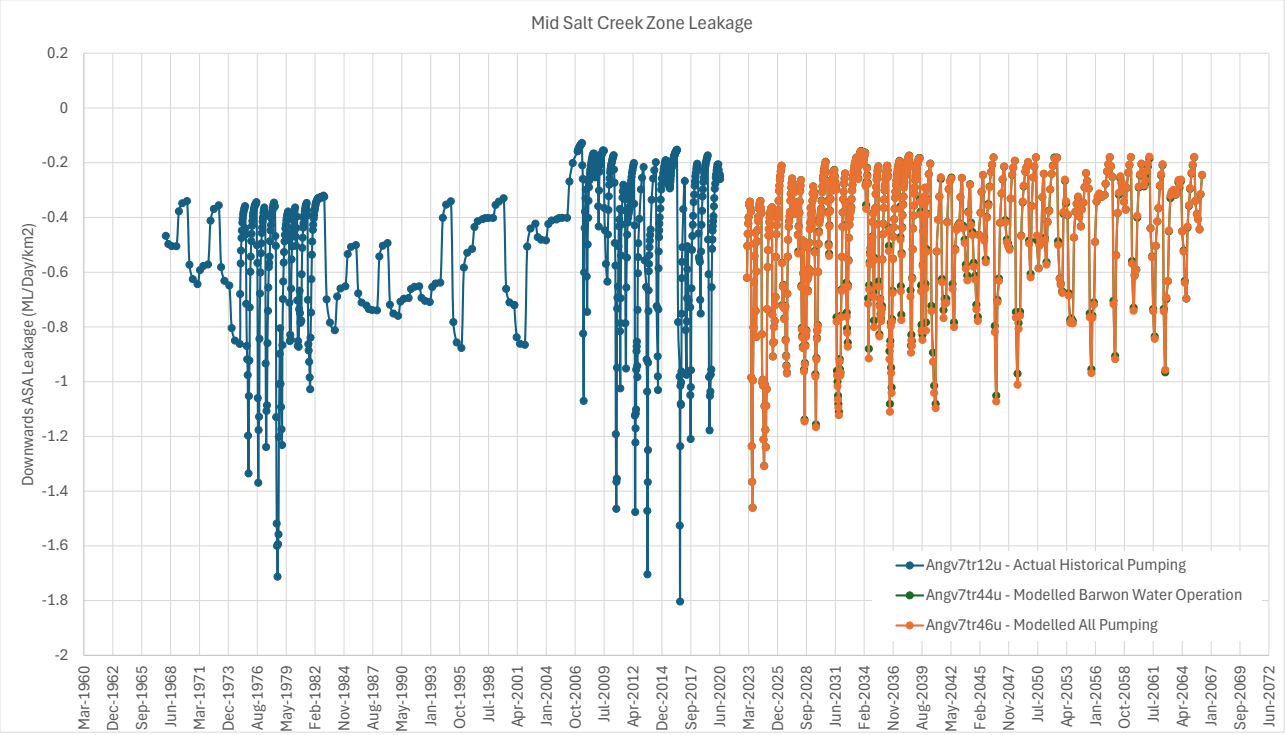


Figure 7-43 Salt Creek Mid ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

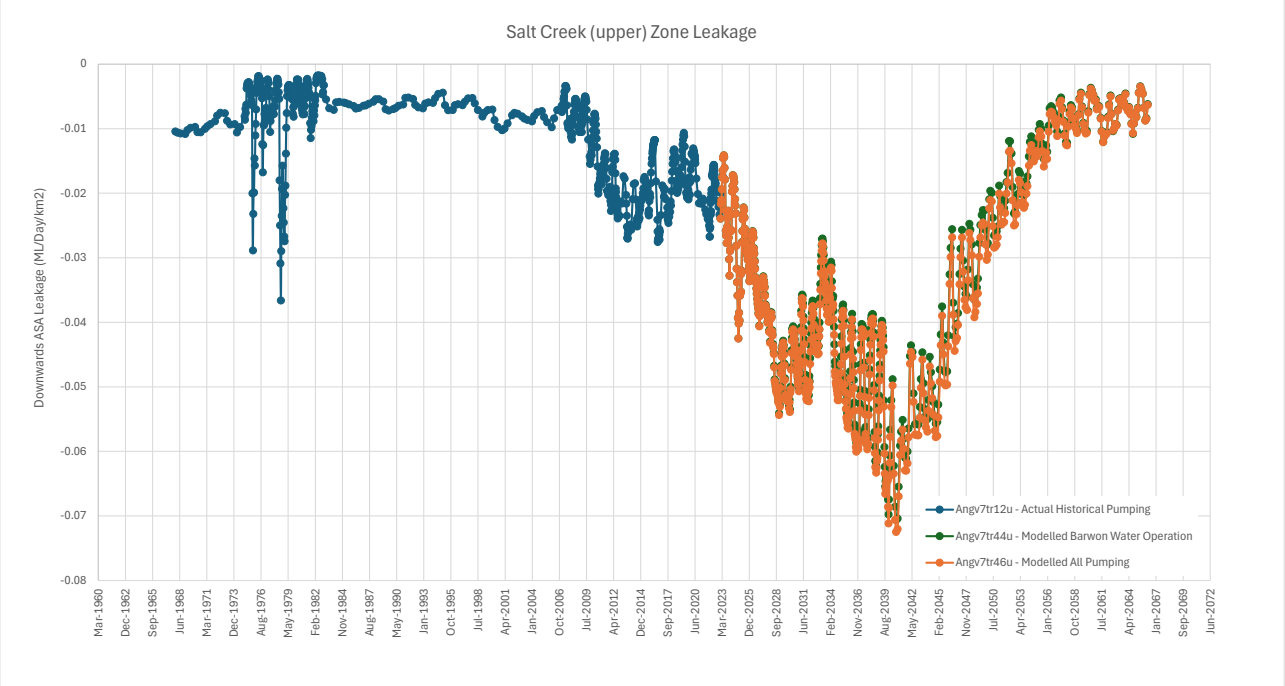


Figure 7-44 Salt Creek Upper ASA Zone Modelled Leakage, refer Figure 7-23 for zone locations.

8 Hydrogeological Risk Assessment

The risks presented in this section account for both the potential impacts resulting from Alcoa proposed UEVF groundwater use and for completeness, the cumulative impacts which may arise if the proposed Buk Entitlement of the LEVF is exercised in addition to Alcoa's proposed extraction. Whilst the operation and permitting of any LEVF extraction is beyond the control of Alcoa, it included as a reference scenario as required by Southern Rural Water.

In addition, it should be noted that risks presented within this assessment are without the mitigating factors that would be found within a Water Management and Monitoring Plan (refer **Section 10**). When these are implemented, this would only further reduced and potential risks associated with the application.

As discussed in **Section 7** (**Table 7-6**), risk is defined by consequence and likelihood. The consequence was determined by the modelled median prediction (P50) from the 150 unique realisations from the modelled scenario whilst the method presented in Peeters & Middlemis (2023[1]) determined the likelihood. The decision to adopt Peeters & Middlemis (2023) is because the Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems (DELWP 2015) provide no guidance on definition for likelihood (e.g., unlikely, possible, certain). This method also advances the best practice Australian Groundwater Modelling Guidelines ('AGMG'; Barnett et al., 2012) and have been adopted by the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining, IESC (2023). This approach will achieve this as the numerical model will produce 150 realisations (predictions) for each climate scenario. Of these 150 realisations, the P10 and P90 outputs will represent the bounds of probability (or likelihood).

Based on the Peeters & Middlemis (2023), the probability of an outcome is as follows:

- Less than 10th percentile indicates it is very likely the outcome is larger than this value.
- 10th–33rd indicates it is likely that the outcome is larger than this value.
- 33rd–67th indicate it is as likely as not that the outcome is larger or smaller than this value.
- 67th–90th indicates it is unlikely that the outcome is larger than this value.
- Greater than 90th percentile indicates it is very unlikely the outcome is larger than this value.

For example, if 100 model simulations were run, and 80 simulations lie within the 10 - 90 percent categories, then 20 simulations predicted outcomes outside the criteria range selected. In this way likelihood is based on a quantitative assessment of the available data produced by the model.

Within this GIA, and to err on the side of conservatism and commensurate with the historical data and calibration (history matching), the above probabilities have been further condensed as follows:

- Less than 10th percentile indicates the outcome is very likely larger than this value.
- **10th–90th percentile indicates the result is as likely as not that the outcome is larger or smaller than this value.**
- Greater than 90th percentile indicates it is very unlikely the is larger than this value.

As presented in **Section 7.3**, the results show error bars representing model uncertainty over the 10th to 90th percentile range. An example risk matrix is presented in **Table 8-1**.

Table 8-1 Risk Assessment Matrix

		Consequence		
		Minor	**Moderate**	**Significant**
Likelihood / Probability	**Very unlikely (n ≤ P10)**	Low	Low	High
	as likely as not (P10 > n < P90)	Low	Medium	High
	Very likely (n ≥ P90)	Medium	High	High

The above risk assessment process uses a similar framework outlined in Victorian Governments Preparation of Work Plans and Work Plan Variations, Guidelines for Mining Projects, December 2020 (version 1.3), referenced here after as ERR (2020). However, the major difference is the risk matrix presented in **Table 8-1** is more conservative based on **BOTH** the likelihood or probability of an impact happening when compared to the process shown in ERR (2020).

For example, **Table 8-2** presents the likelihood definitions within ERR (2020), **Table 8-3** (consequences), and **Table 8-4** overall risk. As a numerical model output is based on a quantitative series of probabilities (in this case the probability of a result occulting from 150 model realisations), it was determined that if the result fell outside of the top and bottom tenth percentile, the event was 'as likely as not' of occurring. This would capture the majority of the "unlikely" events presented in **Table 8-2.**

Table 8-2 Likelihood Definitions (adapted from ERR 2020)

Severity	**Description**	**Probability of event occurring**
Almost certain	The risk event is expected to occur in most circumstances.	90 – 100%
Likely	The risk event will probably occur in most circumstances	70 – 90%
Possible	The risk event might occur at some time	30 – 70%
Unlikely	The risk event could occur at some time	5 – 30%
Rare	Highly unlikely, but the risk event may occur in exceptional circumstances.	0 – 5%

Table 8-3 Consequence Definitions (adapted from ERR 2020)

	Consequences Level				
	Insignificant	**Minor**	**Moderate**	**Major**	**Critical**
Consequences for the environment	Impacts are barely recognised and/or quickly recovered from. No specific remediation required. **Example:** **Hazard event with minimal environmental impact and no noticeable effect beyond the immediate occurrence or expression of the hazard**	Hazard is perceived but has minor and typically temporary effects. Some remediation may be required. **Example:** **Minor contamination of natural waterway or wetland occurs, but water quality remains within applicable EPA or ANZECC guidelines for existing beneficial uses.** **Water extraction or diversion reduces surface water flows or groundwater available for environmental uses, but with no detectable effect on dependent species or ecosystems and carried out within terms of water licence.**	Hazard has moderate, noticeable impact, in terms of severity, duration and/ or frequency of occurrence. Moderate treatment or Remediation effort may be required. Hazard event would be the subject of limited community concern. **Example: Localised contamination of surface water/groundwater aquifer leading to disruption of beneficial for weeks to months.**	Hazard has major impact, in terms of severity, duration and/ or frequency of occurrence. Treatment or remediation effort is required. Some effects may be irreversible. Remediation of environmental contamination would require significant Private and public resources. Hazard event would be the subject of widespread community concern. **Example: Contamination of surface water/ groundwater aquifer leading to disruption of beneficial uses for up to one year**	Hazard has critical impact, in terms of severity and/ or duration. Treatment or remediation effort is required, although some effects may be irreversible. Remediation of environmental contamination would require significant Private and public resources. Hazard event would be the subject of widespread community outrage. **Example: Contamination of surface water/ groundwater aquifer leading to disruption of beneficial uses for more than year**

Table 8-4 Risk Matrix (adapted from ERR 2020)

		Consequence				
		Insignificant	Minor	Moderate	Major	Critical
Likelihood	Almost Certain	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High

8.1 Impact Assessment

Note: Due to significant model run time, and as presented in **Section 7.2.4** and **Table 7-5,** there is no singular model scenario whereby Alcoa proposed pumping activity was undertaken in isolation and as a single run. As such and to satisfy Section 40 of the Water Act 1989, from the scenarios modelled, the results presented in this application have isolated Alcoa's pumping impact from other cumulative impact contributors such as Barwon Waters Bulk Entitlement and climatic factors, also presented in this application.

This was achieved by developing a script that numerically subtracted outputs Scenario 2 (Barwon Water only pumping) from Scenario 3 (Alcoa + Barwon Water pumping). By using this approach, the modelled outputs are more conservative (thus satisfying Section 40 of the Water Act 1989) as this potentially results in larger Alcoa impacts, than if modelled as a single scenario. This is because it takes Alcoa pumping impact under conditions in which the aquifer is more stressed, as Barwon Water is also pumping in both scenarios.

8.1.1 Risks to Groundwater Dependant Ecosystems

As discussed above, risk is defined as consequence multiplied by likelihood (or probability) of exceedance (**Table 8-5**).

The consequence of an impact to GDEs in this GIA has been defined using the Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems (DELWP 2015). The consequence descriptors are below and presented in **Table 8-5**.

- **Minor Consequence**, where:
  - The modelled change in watertable depth (mean annual average drawdown) is caused by simulated pumping in isolation of all other effects across the mapped marshlands of the ASA (including locations WTOB1 or WTOB2) is less than 0.1m.
- **Moderate Consequence**, where:
  - The modelled change in watertable depth (mean annual average drawdown) is caused by simulated pumping in isolation of all other effects such as climate and other groundwater users across the mapped marshlands of the ASA (including locations WTOB1 or WTOB2) is greater than 0.1 m but less than 2m; and/or
  - The “cumulative” drawdown (mean annual average drawdown), accounting for the effects all groundwater pumping across the mapped marshlands of the ASA (including locations WTOB1 or WTOB2), is greater than 0.1 m but less than 2m.
- **Significant (High) Consequence**, where:
  - The modelled change in watertable depth (mean annual average drawdown) is caused by simulated pumping in isolation of all other effects across the mapped marshlands of the ASA (including locations WTOB1 or WTOB2) is greater than 2 m; and/or
- The “cumulative” drawdown (mean annual average drawdown), accounting for the effects of climate and all groundwater pumping across the mapped marshlands of the ASA (including locations WTOB1 or WTOB2), is greater than 2.0m.

The likelihood (probability of exceedance) descriptors are presented in **Table 8-5** and are in reference to the consequence; for example, if the P50 drawdown is 0.08m, but the P10 to P90 range varied from 0.00 to 0.15m, as the consequence threshold from minor to moderate (being 0.1m) is breached within the P90 criteria then the likelihood of modelled drawdown being 0.15 is regarded “as likely as not“ to occur and the risk would therefore be “medium”.

Table 8-5 Risks Matrix (Groundwater Dependant Ecosystems)

		Consequence		
		Minor (<0.1m drawdown)	**Moderate (0.1-2m drawdown)**	**Significant (>2m drawdown)**
Probability of Exceedance	**Very unlikely (n ≤ P10)**	Low	Low	High
	as likely as not (P10 > n < P90)	Low	Medium	High
	Very likely (n ≥ P90)	Medium	High	High

Table Notes:
This risk metrics is more conservative than traditional ones used in ERR 2020 where very unlikely and Significant would only be a “medium” risk. It is only high here due to (>2m drawdown) consequence.

Table 8-6 Risks Assessment for GDEs

Time	Climate Scenario	Location of Receptor at Risk	Potential Risk Pathway	Change from Historical Reference Period (Alcoa Pumping)[1]			Comment / Contingency Requirement	Change from Historical Reference Period (Cumulative Pumping)[2]		
				Maximum (worst case) Consequence	Likelihood / Probability	Risk Rating		Maximum (worst case) Consequence	Likelihood / Probability	Cumulative Risk Rating
Years 1-10	Medium	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low	At least 90% of the 150 model runs demonstrate drawdown is less than 0.1m at this location as a result of the proposed pumping activity.	Minor	As likely as not	Low
Years 11-20	Medium	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 21-43	Medium	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-20	Medium	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Minor	As likely as not	Low
Years 1-43	Medium	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Minor	As likely as not	Low
Years 1-10	Medium	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low	The overall risk rating of "medium" is due to the lowest drawdown uncertainty limit (P10) having a maximum potential drawdown of 0.11m. As the median drawdown (P50) here is much lower than this, it would indicate very few of the 150-model realization indicate this 1cm exceedance. Note: Historical groundwater monitoring at this location shows no evidence of historical pumping related impacts (refer **Table 2-3**, and **Section 2.3**), despite past pumping being at much higher rates.	Minor	As likely as not	Low
Years 11-20	Medium	WTOB2	Drawdown of the ASA	Moderate	As likely as not	Medium		As likely as not	Medium	Medium
Years 21-43	Medium	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low		Minor	As likely as not	Low
Years 1-20	Medium	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low		Minor	As likely as not	Low
Years 1-43	Medium	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low		Minor	As likely as not	Low
Years 1-44	Medium	ASA - Lower Anglesea River	Drawdown of the ASA	Minor	As likely as not	Low	Modelling indicates parts of the mid Anglesea River may experience maximum annual change (drawdown) assessed across 10-year blocks to marginally exceed 0.1m as a result of the proposed pumping activity. However, the model also predicts water levels in these areas are likely to be higher (shallower) than observed across the historical (2010-2023) period negating the drawdown impacts. Nevertheless, It will therefore be proposed that observation bores P8 (ASA) and WTOB2 (ASA) and UEVF MB07 (UEVF) will be used within a trigger and contingency plan network to monitor water level behaviours within Mid Anglesea River, refer **Section 10**. Note: The modelling predicts a maximum drawdown of only 4cm (in 90% of the models for all physical monitoring bores in the ASA.	Minor	As likely as not	Low
Years 1-44	Medium	ASA - Mid Anglesea River	Drawdown of the ASA	Moderate	As likely as not	Medium		Moderate	As likely as not	Medium
Years 1-44	Medium	ASA - Upper Anglesea River	Drawdown of the ASA	Moderate	As likely as not	Medium		Moderate	As likely as not	Medium
Years 1-44	Medium	ASA - Lower Salt Creek	Drawdown of the ASA	Moderate	As likely as not	Medium	At the lowest drawdown uncertainty limit (P10), a small area adjacent the mine is modelled to have drawdown >0.1m. However also within this this location is monitoring bore WTOB1 and the maximum P10 drawdown is here is modelled to be 2cm	Moderate	As likely as not	Medium

Time	Climate Scenario	Location of Receptor at Risk	Potential Risk Pathway	Change from Historical Reference Period (Alcoa Pumping)[1]			Comment / Contingency Requirement	Change from Historical Reference Period (Cumulative Pumping)[2]		
				Maximum (worst case) Consequence	Likelihood / Probability	Risk Rating		Maximum (worst case) Consequence	Likelihood / Probability	Cumulative Risk Rating
Years 1-44	Medium	ASA - Mid Salt Creek	Drawdown of the ASA	Minor	As likely as not	Low	(refer **Table 7-7).** Therefore, if there is an exceedance in this area, its spatial area is small and likely to only just exceed 0.1m. If only median drawdown was considered (P50), all areas in this location have a modelled drawdown <0.1m**.**	Minor	As likely as not	Medium
Years 1-10	High	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low	At least 90% of the 150 model runs demonstrate drawdown is less than 0.1m at this location as a result of the proposed pumping activity.	Minor	As likely as not	Low
Years 11-20	High	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 21-43	High	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-20	High	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-43	High	WTOB1	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-10	High	WTOB2	Drawdown of the ASA	Minor	As likely as not	Medium	The overall risk rating of "medium" is due to the lowest drawdown uncertainty limit (P10) having a maximum potential drawdown of 0.22m. As the median drawdown (P50) here is much lower than this, it would indicate very few of the 150-model realization indicate this exceedance. Note: The level (variability) in uncertainty under high climate change is much greater than medium climate change. Historical groundwater monitoring at this location shows no evidence of historical pumping related impacts (refer **Table 2-3**, and **Section 2.3**), despite past pumping being at much higher rates.	Moderate	As likely as not	Medium
Years 11-20	High	WTOB2	Drawdown of the ASA	Minor	As likely as not	Medium		Moderate	As likely as not	Medium
Years 21-43	High	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-20	High	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-43	High	WTOB2	Drawdown of the ASA	Minor	As likely as not	Low		Moderate	As likely as not	Medium
Years 1-44	High	ASA - Lower Anglesea River	Drawdown of the ASA	Minor	As likely as not	Low	Under severe climate change, modelling indicates parts of the mid Anglesea River may experience maximum annual change (drawdown) assessed across 10 year blocks to marginally exceed 0.1m as a result of the proposed pumping activity. It will therefore be proposed that observation bores P8 (ASA) and WTOB2 (ASA) and UEVF MB07 (UEVF) will be used within a trigger and contingency plan network to monitor water kevel behaviours within Mid Anglesea River, refer **Section 10**.	Moderate	As likely as not	Medium
Years 1-44	High	ASA - Mid Anglesea River	Drawdown of the ASA	Moderate	As likely as not	Medium		Moderate	As likely as not	Medium
Years 1-44	High	ASA - Upper Anglesea River	Drawdown of the ASA	Moderate	As likely as not	Medium		Moderate	As likely as not	Medium
Years 1-44	High	ASA - Lower Salt Creek	Drawdown of the ASA	Minor	As likely as not	Low	The majority of model estimates indicates that across the Salt Creek catchment, drawdown of the ASA water table does not exceed 0.1m as a result of the proposed pumping. Lower Salt Creek was moderate Alcoa impact above under median climate change? Note: Under a median climate change, a mall section of lower salt creek near the mine void indicated a moat risk (exceedance of 0.1m drawdown) this is not seen here	Moderate	As likely as not	Medium
Years 1-44	High	ASA - Mid Salt Creek	Drawdown of the ASA	Moderate	As likely as not	Medium		Moderate	As likely as not	Medium

[1]Risk determined from modelling - subtracting Scenario 2 (Barwon Water only pumping) from Scenario 3 (Alcoa + Barwon Water pumping) model outputs**.**

[2]Risk determined from Scenario 3 model outputs (Alcoa + Barwon Water pumping plus climate change)

8.1.2 Risks of Acid Generating Events

The natural or artificial lowering of water tables, below those typically experienced under natural conditions with seasonal fluctuations, can lead to acidification of soil and groundwater in areas where these sub-surface environments contain appreciable amounts of sulfide minerals (Shand et al, 2018). To assess the risks of acid generating events the following criteria will therefore be used:

- **Minor Consequence**, where:
  - The seasonal variability of the ASA water table (WTOB1 and WTOB2) is no more than 0.1m greater than the historical range (2010 to 2023) caused by Alcoa's simulated pumping in isolation of all other effects, such as climate and other groundwater users;
  - The seasonal variability of the ASA water table (WTOB1 and WTOB2) is no more than 0.1m greater than the historical range (2010 to 2023) caused by cumulative pumping and other effects such as climate; and/or
  - No reduction observed in annual zero-flow days relative to the 2010-23 historical period.
- **Moderate Consequence**, where:
  - The seasonal variability of the ASA water table (WTOB1 and WTOB2) is between 0.1 and 0.5m greater than the historical range (2010 to 2023) caused by Alcoa's simulated pumping in isolation of all other effects, such as climate and other groundwater users;
  - The seasonal variability of the ASA water table (WTOB1 and WTOB2) is no more than 0.5m greater than the historical range (2010 to 2023) caused by cumulative pumping and other effects, such as climate; and/or
  - Between zero and 10 percent reduction observed in mean annual zero-flow days relative to the 2010-23 historical period.
- **Significant (High) Consequence**, where:
  - The seasonal variability of the ASA water table (WTOB1 and WTOB2) is more than 0.5m greater than the historical range (2010 to 2023 caused by Alcoa's simulated pumping in isolation of all other effects, such as climate and other groundwater users);
  - The seasonal variability of the ASA water table (WTOB1 and WTOB2) is more than 0.5m greater than the historical range (2010 to 2023 caused by cumulative pumping and other effects, such as climate; and/or
  - Greater than 10 percent reduction observed in zero-flow days relative to the 2010-23 historical period.

The resulting risk matrix is shown in **Table 8-7**.

Table 8-7 Risks Matrix (Acid Generating Events)[11]

		Consequence		
		Minor	**Moderate**	**Significant**
Probability of exceedance	**Very unlikely (n ≤ P10)**	Low	Low	Medium
	as likely as not (P10 > n < P90)	Low	Medium	High
	Very likely (n ≥ P90)	Medium	High	High

[11] Note the risk categories are slightly different to the matrix used to assess impacts to GDEs, which is based on the DELWP 2015 Guidelines. The consequence descriptors in the above table are more conservative i.e. have a lower range, thus the significance of the consequence is reduced.

Table 8-8 Risks Assessment for Acid Generating Events

Time	Climate Scenario	Location of Receptor at Risk	Increase in Seasonal Variability of Watertable Fluctuation (Alcoa Pumping)[1]			Comment / Contingency Requirement	Increase in Seasonal Variability of Watertable Fluctuation (Cumulative Pumping)[2]			Change in Zero Flow Days (Cumulative Pumping)[2]		
			Maximum Consequence	Likelihood / Probability	Alcoa Only Risk Rating		Maximum Consequence	Likelihood/ Probability	Risk Rating	Maximum Consequence	Likelihood/ Probability	Cumulative Risk Rating
Years 1-10	Medium	SV2 / WTOB1	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Moderate	As likely as not	Medium	Moderate	As likely as not	Medium
Years 11-20	Medium	SV2 / WTOB1	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Moderate	As likely as not	Medium
Years 21-43	Medium	SV2 / WTOB1	Minor	As likely as not	Low		Minor	As likely as not	Low	Minor	As likely as not	Low
Years 1-20	Medium	SV2 / WTOB1	Minor	As likely as not	Low		Minor	As likely as not	Low	Minor	As likely as not	Low
Years 1-43	Medium	SV2 / WTOB1	Minor	As likely as not	Low	With reference to watertable variability, external factors outside the control of Alcoa are responsible for a moderate consequence forecast to occur between years 1 and 20.	Minor	As likely as not	Low	Minor	As likely as not	Low
Years 1-10	Medium	AV2 / WTOB2	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Moderate	As likely as not	Medium	Moderate	As likely as not	Medium
Years 11-20	Medium	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 21-43	Medium	AV2 / WTOB2	Minor	As likely as not	Low		Minor	As likely as not	Low	Minor	As likely as not	Low
Years 1-20	Medium	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Moderate	As likely as not	Medium
Years 1-43	Medium	AV2 / WTOB2	Minor	As likely as not	Low	With reference to watertable variability, external factors outside the control of Alcoa are responsible for a moderate consequence metrics to be met.	Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 1-10	High	SV2 / WTOB1	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Moderate	As likely as not	Medium	Moderate	As likely as not	Medium
Years 11-20	High	SV2 / WTOB1	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 21-43	High	SV2 / WTOB1	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 1-20	High	SV2 / WTOB1	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 1-43	High	SV2 / WTOB1	Minor	As likely as not	Low	With reference to watertable variability, external factors outside the control of Alcoa are responsible for a moderate consequence forecast to occur between years 1 and 20.	Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 1-10	High	AV2 / WTOB2	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 11-20	High	AV2 / WTOB2	Minor	As likely as not	Low		Minor	As likely as not	Low	Significant	As likely as not	High
Years 21-43	High	AV2 / WTOB2	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 1-20	High	AV2 / WTOB2	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Significant	As likely as not	High
Years 1-43	High	AV2 / WTOB2	Minor	As likely as not	Low	With reference to water table variability, external factors outside the control of Alcoa are responsible for a moderate consequence metrics to be met.	Moderate	As likely as not	Medium	Significant	As likely as not	High

[1]Risk determined from modelling subtracting Scenario 2 (Barwon Water only pumping) from Scenario 3 (Alcoa + Barwon Water pumping) model outputs.

[2]Risk determined from Scenario 3 model outputs (Alcoa + Barwon Water pumping plus climate change)

8.1.3 Reduction in Surface Water Flows

Changes to stream flow dynamics have also been used to inform the risk of increasing acid generating events; specifically, the following criteria has been used:

- **Minor Consequence**, where:
  - No reduction observed in annual zero-flow days relative to the 2010-23 historical period;
- The mean annual absolute flow rate difference measured against the baseline period is less than 5 percent as a result of Alcoa pumping (in isolation from climate and other groundwater users), measured at AV2 and SV2; and/or
  - The mean annual absolute flow rate measured against the historical period (2010 – 2023) has a difference less than 5 percent as a result of the "cumulative" pumping and climatic factors, measured at AV2 and SV2.
- **Moderate Consequence**, where:
  - Between zero and 10 percent reduction observed in mean annual zero-flow days relative to the 2010-23 historical period;
- The mean annual absolute flow rate difference measured against the baseline period is greater than 5 percent but less than 20 percent as a result of Alcoa pumping (in isolation from climate and other groundwater users), measured at AV2 and SV2; and/or
  - The mean annual absolute flow rate measured against the historical period (2010 – 2023) has a difference greater than 5 percent but less than 20 percent as a result of the "cumulative" pumping and climatic factors, measured at AV2 and SV2.
- **Significant (High) Consequence**, where:
  - Greater than 10 percent reduction observed in zero-flow days relative to the 2010-23 historical period;
  - The mean annual absolute flow rate difference measured against the baseline period is greater than 20 percent as a result of Alcoa pumping (in isolation from climate and other groundwater users), measured at AV2 and SV2; and/or
  - The mean annual absolute flow rate measured against the historical period (2010 – 2023) has a difference greater than 20 percent as a result of the "cumulative" pumping and climatic factors, measured at AV2 and SV2,

The resulting risk matrix is shown in **Table 8-9**.

Table 8-9 Risks Matrix (Surface Water Flows)[12]

		Consequence		
		Minor	**Moderate**	**Significant**
Probability of Exceedance	**Very unlikely (n ≤ P10)**	Low	Low	Medium
	as likely as not (P10 > n < P90)	Low	Medium	High
	Very likely (n ≥ P90)	Medium	High	High

[12] Note the risk categories are slightly different to the matrix used to assess impacts to GDEs, which is based on the DELWP 2015 Guidelines. The consequence descriptors in the above table are more conservative i.e. have a lower range, thus the significance of the consequence is reduced

Table 8-10 Risks Assessment for the Reduction in Surface Water Flows

Time	Climate Scenario	Location of Receptor at Risk	Reduction in Surface Water Flow (Alcoa Pumping)[1]			Comment / Contingency Requirement	Reduction in Surface Water Flow (Cumulative Pumping)[2]			Change in Zero Flow Days (Cumulative Pumping)[2]		
			Maximum (worst case) Consequence	Likelihood / Probability	Alcoa only Risk Rating		Maximum (worst case) Consequence	Likelihood / Probability	Risk Rating	Maximum (worst case) Consequence	Likelihood / Probability	Cumulative Risk Rating
Years 1-10	Medium	SV2 / WTOB1	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Moderate	As likely as not	Low	Moderate	As likely as not	Medium
Years 11-20	Medium	SV2 / WTOB1	Minor	As likely as not	Low		Moderate	As likely as not	Medium	Moderate	As likely as not	Medium
Years 21-43	Medium	SV2 / WTOB1	Minor	As likely as not	Low		Moderate	As likely as not	High	Minor	As likely as not	Low
Years 1-20	Medium	SV2 / WTOB1	Minor	As likely as not	Low		Minor	As likely as not	Low	Minor	As likely as not	Low
Years 1-43	Medium	SV2 / WTOB1	Minor	As likely as not	Low	With reference to watertable variability, external factors outside the control of Alcoa are responsible for a moderate consequence forecast to occur between years 1 and 20.	Minor	As likely as not	Low	Minor	As likely as not	Low
Years 1-10	Medium	AV2 / WTOB2	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Minor	As likely as not	Low	Moderate	As likely as not	Medium
Years 11-20	Medium	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 21-43	Medium	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Minor	As likely as not	Low
Years 1-20	Medium	AV2 / WTOB2	Minor	As likely as not	Low		Minor	As likely as not	Medium	Moderate	As likely as not	Medium
Years 1-43	Medium	AV2 / WTOB2	Minor	As likely as not	Low	With reference to water table variability, external factors outside the control of Alcoa are responsible for a moderate consequence metrics to be met.	Moderate	As likely as not	High	Significant	As likely as not	High
Years 1-10	High	SV2 / WTOB1	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Significant	As likely as not	High	Moderate	As likely as not	Medium
Years 11-20	High	SV2 / WTOB1	Moderate	As likely as not	Medium		Significant	As likely as not	High	Significant	As likely as not	High
Years 21-43	High	SV2 / WTOB1	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 1-20	High	SV2 / WTOB1	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 1-43	High	SV2 / WTOB1	Minor	As likely as not	Low	With reference to water table variability, external factors outside the control of Alcoa are responsible for a moderate consequence forecast to occur between years 1 and 20.	Significant	As likely as not	High	Significant	As likely as not	High
Years 1-10	High	AV2 / WTOB2	Minor	As likely as not	Low	Generally, and on the basis of the uncertainty analysis, there will be a decrease in zero flow days (more flowing days) compared to 2010 to 2023. However, and despite the median (P50) indicating more flowing days, there is a wide range of uncertainty with this metric and on occasion (defined by outputs within the P50 to P10 uncertainty band) the moderate or significant consequence metrics are met.	Significant	As likely as not	High	Significant	As likely as not	High
Years 11-20	High	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 21-43	High	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 1-20	High	AV2 / WTOB2	Minor	As likely as not	Low		Significant	As likely as not	High	Significant	As likely as not	High
Years 1-43	High	AV2 / WTOB2	Minor	As likely as not	Low	With reference to water table variability, external factors outside the control of Alcoa are responsible for a moderate consequence metrics to be met.	Significant	As likely as not	High	Significant	As likely as not	High

[1]Risk determined from modelling subtracting Scenario 2 (Barwon Water only pumping) from Scenario 3 (Alcoa + Barwon Water pumping) model outputs.

[2]Risk determined from Scenario 3 model outputs (Alcoa + Barwon Water pumping plus climate change)

8.1.4 Pit Water Quality

The quality of water used to fill the mine void will potentially influence the chemistry of the developing water body. PHREEQC is a geochemical modelling program which can be used to assess the effects of mixing varying volumes of different quality water sources in conjunction with evaporation to estimate how the future water body quality will evolve.

The following sections provide a summary of the geochemical modelling approach used to develop a PHREEQC model coupled with outputs from the 2024 Anglesea groundwater model (**Section 7**). Volumetric outputs obtained from the numerical model (**Table 8-11**) and surface water and groundwater quality inputs were used to assess water body quality recovery under a 12-month UEVF fill scenario using groundwater abstracted from the UEVF. This scenario was selected as it represents using UEVF water as the largest proportion of water used to fill the water body and therefore has the greatest potential for geochemical reactivity to occur between the two water types.

The data covered a time frame of 12 months and a final water body elevation of 5.5 mAHD. The data was provided as 2 weekly timesteps for a total of 24 timesteps during the augmentation period.

Note: this high level mine pit water quality assessment is provided for the purpose of assessing the potential impact of 'the use' of water under any amended Alcoa license, the final and long-term water quality for the mine water body will be further assessed as part of the final Mine Rehabilitation and Closure Plan (and following a confirmed water body filling strategy).

Table 8-11 Water Volume Inputs and Outputs Over 12 Months

Water Balance Data		Volumes (ML)
Natural Inputs		
1	Leakage from ASA	<1[13]
2	Natural groundwater inflow into the waterbody (from DBG)	455
3	Natural groundwater inflow into the waterbody (from UEVF)	626
4	Rainfall input to water body	301
5	Side wall run-off into water body	2.5
Natural Inputs Total		1,384.5
Augmented (modelling purposes only) UEVF Groundwater		17,464
Natural Outputs		
6	Evaporation output from water body	422
7	Pit water loss back into DBG	36

[13] During the augmentation period, groundwater contribution from the alluvial swamp aquifer (ASA) was negligible (less than $2x10^{-4}$ ML per timestep or 0.0048 ML annually) and was discounted from the water balance calculations.

The geochemical modelling of the interaction of the existing water body and UEVF groundwater (as summarised in Table 3-3) included speciation and acid-base reactions. It was not kinetically constrained i.e. reactions were immediate and completed to equilibrium.

The water body that has developed within the pit void is a combination of rainwater and groundwater. A proportion of the rainfall has interacted with the sidewalls before infiltrating the side walls or discharging to the water body as run-off. Recovering groundwater levels have also contributed to the water body. Both rainfall and groundwater have interacted with the unconsolidated backfill material. The groundwater is likely to be in chemical equilibrium with the surrounding material, however, the redox potential and conversion of reduced iron species to oxidised (ferrous) species is the main source of acidity. Other metal species which contribute to the acidity balance are aluminium, manganese and iron. There is a significant temporal record of pH within the water body and based on the stability of pH over the decades it is not anticipated that there will be any significant changes to the current chemistry of the water as it naturally develops.

8.1.4.1 Water Quality Inputs

Water quality data was used from a single groundwater and surface water monitoring event in early November 2022 as it is the most recent data captured using the broad analytical suite and samples from both the UEVF and DBG aquifers. The largest contributors to the developing water body (the waterbody itself and the UEVF), under an augmentation scenario, also have stable geochemistry profiles over time.

Major and selected minor ions were used to characterise the water inputs. The major ions were used to ensure an acceptable ionic balance and the minor ions for the acid producing and buffering characteristics (**Table 8-12** and **Table 8-13**).

Table 8-12 Water Composition – Major Ions

Sample Location	Date	pH	Sodium mg/L	Potassium mg/L	Calcium mg/L	Magnesium mg/L	Chloride mg/L	Sulfate (as SO4) mg/L	Alkalinity (as CaCO3) mg/L
Water Body	9/11/2022	3.60	250	19	87	82	427	626	<1
DBG (DBG MB4)	9/11/2022	6.51	383	11	94	119	430	922	68
UEVF (WB12)	8/11/2022	6.82	150	17	29	49	384	64	72
Rainfall	*Note 1*	5.47	2.46	0.37	1.2	0.5	4.43	ND	*Note 2*

Table Notes:
ND – non-detectable
Note 1 – Rainfall composition based on 28 stations over 36 stations in south-east Australia (Carroll, 1962)
Note 2 – alkalinity calculated based on equilibrium with atmospheric $CO_{2(g)}$

Table 8-13 Water Composition – Minor Ions

Sample Location	Date	Aluminium mg/L	Barium mg/L	Boron mg/L	Iron mg/L	Manganese mg/L	Zinc mg/L
Water Body	9/11/2022	5.33	0.0509	1.23	2.59	0.555	0.582
DBG (DBG MB4)	9/11/2022	0.154	0.0798	0.336	11.4	1.03	0.695
UEVF (WB12)	8/11/2022	0.0002	0.11	0.227	13.9	0.56	0.0116
Rainfall	*Note 1*	ND	ND	ND	ND	ND	ND

Table Notes:
ND – non-detectable
Note 1 – Rainfall composition based on 28 stations over 36 stations in south-east Australia (Carroll, 1962)

8.1.4.2 PHREEQC Model Development

The geochemical conceptual model for the water body development was based on an assumed input of water at each timestep of water quality derived from the DBG, UEVF, and rainfall and the ratios (or volumes) from the 2024 Anglesea groundwater model. Water (as H_2O) was removed at each timestep as evaporation. Solution composition was equilibrated with mineral species and atmospheric gasses at each timestep. Oversaturated (SI>0) mineral phases were removed (precipitated) from the solution. At the end of each timestep a proportion (as a ratio for the next timestep simulation) of the final solution composition was used to form the water body component of the next timestep. In total 24 timesteps (representative of 1 year) were simulated. The Minteq version 4 database was used for all simulations.

8.1.4.3 PHREEQC Outputs

The water body quality development over the 24 timesteps (indicative time period only represented from 1 January 2023 to 1 January 2024) has been plotted in **Figure 8-1** (major ions) and **Figure 8-2** (minor ions) below. As the volume of the water body increases with the addition of groundwater and surface water, fluctuations in major and minor ion chemistry are observed.

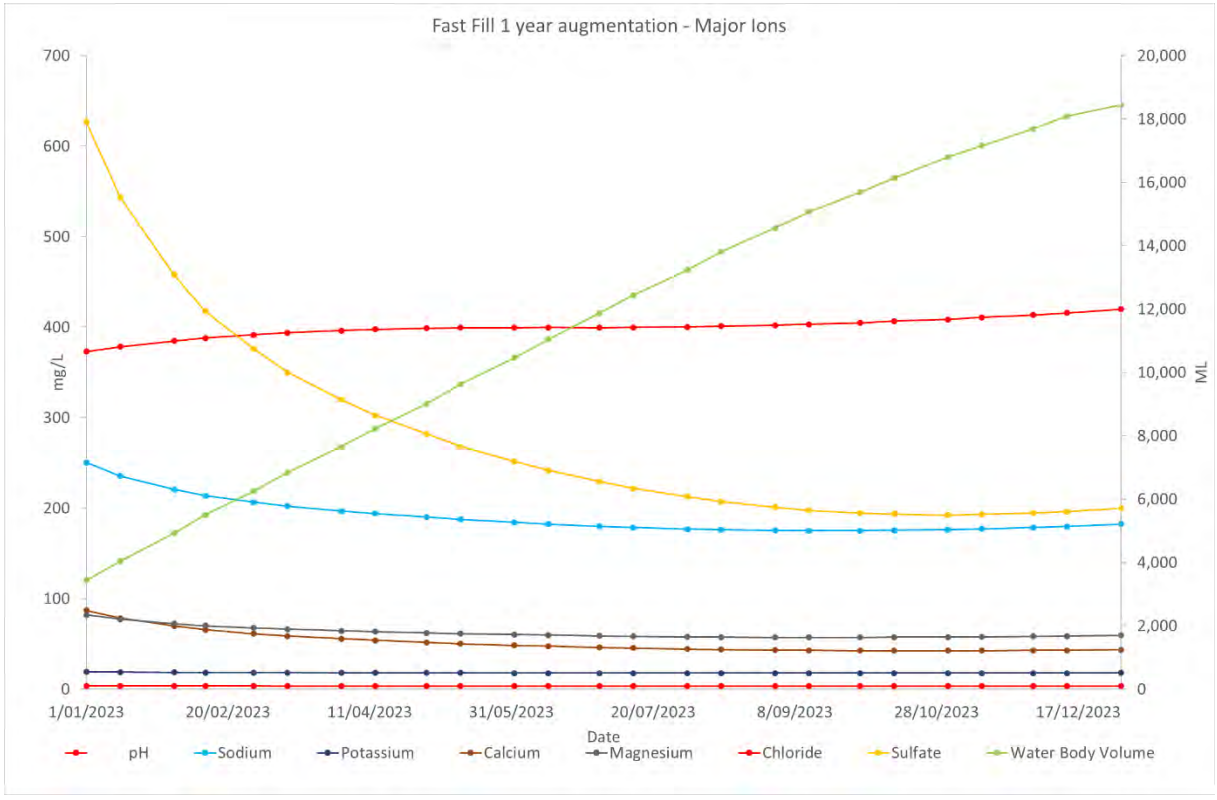


Figure 8-1 Fast Fill 1 Year – Major Ions

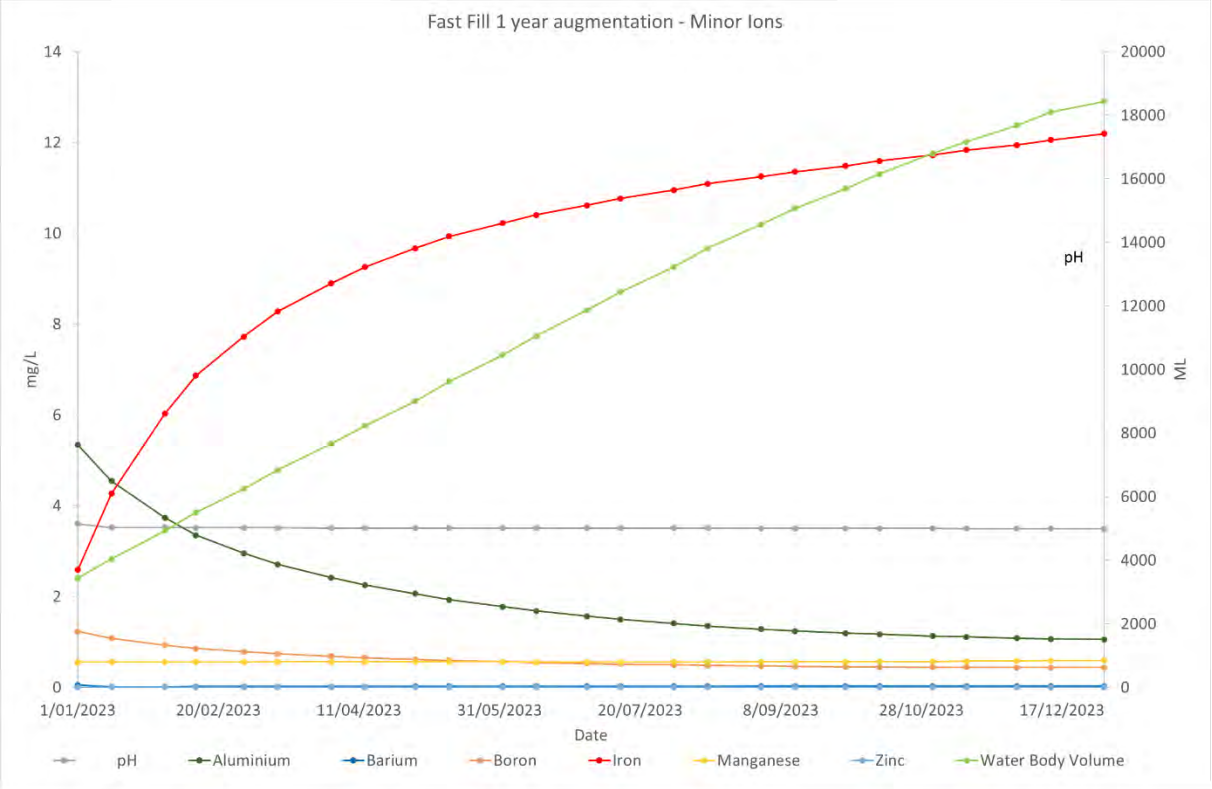


Figure 8-2 Fast Fill 1 Year – Minor Ions

8.1.4.4 Additional Scenarios

In addition to the 12 months scenario, 4- and 10-year fill scenarios were also simulated using an extrapolation of the original numerical model data (**Table 8-14**). This assumption will underestimate the natural inflow contributions, particularly from the UEVF; however, the augmentation volume has compensated for this shortfall. Rainfall contribution will increase over time and sidewall runoff will decrease; however, these are proportionally minor volumes compared to augmentation. Evaporation will also increase over time, so evapo-concentration is underestimated.

8.1.4.5 Model Simulation Conclusion

Although the pH of the UEVF water is only slightly acidic (pH 6.82), the potential acidity loading is high based on the concentration of iron (and to a lesser extent aluminium, manganese, and zinc). The overall increase in iron concentration at the end of the augmentation period is sufficient to maintain the acidic nature of the water body with a slight decrease in the pH from 3.6 to pH 3.5.

The final water body quality is improved with lower concentrations of aluminium (5.34 mg/L to 1.06 mg/L), barium (0.05 mg/L to 0.03 mg/L), boron (1.23 mg/L to 0.44 mg/L), zinc (0.58 mg/L to 0.14 mg/L) and major ions (sodium, potassium, calcium, magnesium, and sulfate). The decrease in metal and major ion species is due to dilution (lower concentrations in UEVF groundwater), although precipitation of mineral phases (iron minerals including ferrihydrite) could potentially affect metal concentrations (via co-precipitation) in the long term. There are also increases in the concentrations of chloride (373 mg/L to 420 mg/L), iron (2.59 to 12.19 mg/L), and manganese (0.56 mg/L to 0.60 mg/L).

Table 8-14 Comparison of One, Four, and Ten Year Fill Scenarios

Fill Scenario	pH	Na	K	Ca	Mg	Cl	SO_4^2	Al	Ba	B	Fe	Mn	Zn
	S.U.	mg/L											
Initial	3.60	250	19	87	82	373	627	5.34	0.05	1.23	2.59	0.56	0.58
Final 1yr	3.49	182	18	43	59	420	200	1.06	0.03	0.44	0*	0.60	0.14
Final 4yr	3.50	196	17	48	63	410	267	1.09	0.02	0.44	0	0.61	0.20
Delta (yr 1)	*0.01*	*14*	*-1*	*5*	*4*	*-10*	*67*	*0.03*	*-0.01*	*0*		*0.01*	*0.06*
Final 10yr	3.54	241	16	61	77	413	441	1.23	0.01	0.48	0	0.70	0.34
Delta (yr 1)	*0.05*	*59*	*-2*	*18*	*18*	*-7*	*241*	*0.17*	*-0.02*	*0.04*		*0.1*	*0.2*

*PHREEQC model precipitates iron (as iron mineral species) if oversaturated, in reality the mine water is supersaturated with iron

9 Conclusions

Rehabilitation of the former Anglesea coal mine is regulated by the *Mineral Resources (Sustainable Development) Act 1990*. This Act is overseen by Resources Victoria and the ERR unit, now a part of DEECA. In compliance with Section 79 of the *Sustainable Development Act 1990*, a draft MRCP was developed and submitted to ERR in 2017. Within this Plan, it was presented that water is required to accelerate the filling of the mine void to help achieve the MRCP objectives in a timely manner.

Since then, additional studies and rehabilitation objectives (e.g., earthworks and revegetation) have been separately completed, with a defined and approved water filling strategy now the outstanding item inhibiting the finalisation of the MRCP. These additional studies have also confirmed that sustainable UEVF groundwater extraction is the only feasible option to accelerate the filling of the mine void. Left to fill naturally, the mine void would take many decades to fill.

As such and in accordance with Section 51 of the *Water Act 1989* which deals with sustainable, efficient, and equitable management and allocation of the water resources, Alcoa are seeking to obtain approval from Southern Rural Water (the Responsible Authority) to amend the existing Groundwater Licence (BEE029662), from 4000 ML/yr to 1,500 ML/yr (for 10 years) and amend its use to allow this groundwater to accelerate filling of the former Anglesea coal mine to help achieve the MRCP objectives.

To ensure the reduced and amended allocation poses no unacceptable risks or adverse impacts to the environment that may rely on groundwater, a groundwater impact assessment has been developed in accordance with EPA Victoria Publication 688.1 Hydrogeological assessment guidelines for groundwater quality and Section 59A of the *Water Act (1989)*.

The key findings from this GIA are summarised below and are based on:

- Multiple independent technical assessments conducted in the region relevant to potential groundwater impacts (**Section 2.3**);
- Detailed assessment of long term water level, water quality, climate and surface water flow observation data from more than 130 groundwater monitoring point and available surface water flow sources (**Section 4**);
- Significantly improved Conceptual Hydro-geological Model for the Alcoa area of interest that which has been subject to and endorsed by the regulator Inter Agency Group appointed independent TRP; (**Section 6** and **Appendix A**);
- Predictive tools such as the updated 2024 Anglesea Groundwater Numerical Model, which has also been subject to and endorsed by the TRP comprised of independent experts from a wide range of fields including geology, hydrogeology, modelling, geochemistry, and ecology. The TRP was selected by an Inter Agency Group, representing the Water and Catchments Group of DEECA, Earth Resources Regulation, and Southern Rural Water (**Section 7** and **Appendix B**);
- Hydrogeological risk assessment including for proposed Alcoa groundwater extraction, including applying the relevant medium and high climate change models (**Section 8**);
- The results of a purpose designed groundwater pumping test completed in 2021 that was subject to significant regulatory oversight (Appendix D of **Appendix A**); and
- The feedback from on-going and recent community engagement processes and events (**Section 2.4**).

9.1 Key Findings

General Findings (including consideration from ongoing monitoring post pumping test):

- In the Anglesea River and Salt Creek valleys, younger alluvial deposits overlie the regional aquifer-systems and are referred to as the Alluvial Swamp Aquifer (ASA). The ASA supports the dense swampland vegetation as well as comprising naturally occurring sulphide-bearing sediments, peat and coal. As the groundwater level fluctuates in the ASA, mostly driven by climatic variations, these sediments are exposed to air and oxidised in the vadose zone. This happens over and over again, resulting in a build-up of leachable acid and metals. When the ASA becomes fully saturated (usually after a significant wet period), these oxidised sediments are mobilised resulting is low pH (acidic) water.
- Despite the ASA in the lower reaches of the Anglesea Catchment having consistently recorded pH between 2.5 and 4 since 1967, the Anglesea River estuary had previously been artificially supported by a 3-5 ML/day of approximately pH 7 water discharged from Alcoa's power station (EPA License EM32162). This activity, which ceased in 2016 has historically buffered upgradient low pH conditions.
- A well established and understood baseline of groundwater elevation data exists across the site. This data also spans across numerous external groundwater stress periods that have operated at much greater stresses (i.e., groundwater extraction rates) than what is being proposed as part of this amended application. As a result of these stresses, no observable or statistically significant trends can be identified in the existing groundwater observation network for the ASA. Simply, groundwater behaviours in these shallow aquifers have remained relatively consistent with seasonal variations, with climate (e.g., rainfall) influencing its behaviour.
- At the deepest part of the mine void, during the course of the coal mining, a clay unit (referred to as the basal clay) underlying the mined coal seam which inhibits vertical groundwater movement was likely extracted and a "sump pump" installed in this location to keep the mine void dry; as a result, this sump pump was not only removing local catchment runoff and shallow groundwater ingress, but also likely dewatering the thin upper sand layers of the UEVF.

Numerical Model Findings

- Progressive mining operations between 1980 and 1985 in the northwest corner of the mine and closest to the original part of Salt Creek may have increased connectivity between the surrounding aquifers in this location and the mine void. Conversely, modelling also predicts that once the mine is full of water in this region, leakage from theses surrounding near void shallow aquifers into the void would cease meaning post rehabilitation, any groundwater that may have been lost to the mine void, can stay in the groundwater system.
- In the regions of the ASA where water balance modelling predicts Alcoa's pumping may have the largest impact, the potential increase in leakage from the ASA is calculated as:
  - 0.43 mm/yr (0.86% of the calibrated recharge rate) for the mid-section of Salt Creek.
  - 0.75 mm/yr (1.25% of the calibrated recharge rate) for the mid-section of Anglesea River.
- The formation of pit water body poses no adverse risks from a pit water quality perspective with minimal change to the existing pH of 3.6, and the final water body quality having modelled lower concentrations of aluminium, barium, boron, zinc and major ions (sodium,

potassium, calcium, magnesium, and sulfate). Only minor increases chloride, iron, and manganese are modelled.

- Using groundwater to accelerate the filling of the water body poses no adverse risks to surrounding groundwater quality with only 35 particles (out of 45 million modelled) potentially progressing a distance into the aquifer extending beyond the mine lease boundary. The mine water body has been modelled to act as a groundwater sink.
- Under a medium climate change scenario and using the top 150 groundwater model solutions from the 2024 Anglesea Groundwater model, and as a result of simulated Alcoa groundwater pumping only, the following conclusions are made:
  - The median (P50) drawdown at all observation bores within the ASA have modelled drawdown <0.1m resulting in a low consequence of impact to GDEs as defined by the 2015 Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems.
  - When considering uncertainty, e.g. the P10 limit which takes into consideration 90 percent of model realisations), WTOB2 and P7/P7B are modelled to have a maximum potential drawdown of 0.11m. As the median drawdown here is much lower than this, it would indicate very few of the 150-model realization indicate this 1cm exceedance. It is important to note that historical groundwater monitoring at this location shows no evidence of historical pumping related impacts.
  - At both WTOB1 and WTOB2 there is insignificant to no reduction in the seasonal water table depth (P10-P90) range over the forecast model period.
  - Forecast zero flow days at SV2 and AV2 (using models within P10 - P90) are generally the same as or fewer (meaning more flow days) than over the historical 2010-2023 period.
  - Modelled annual flows at SV2 (using models within P10 - P90) are expected to be generally higher than historical rates indicating groundwater extraction has an inconsequential impact on flows within the Salt Creek catchment.
  - Modelled annual flows at AV2 (using models within P10 - P90) suggest a possible minor (<5 percent) portion of flow reduction over the historical 2010-2023 period.
  - For locations in the ASA that do not have a physical observation point (such as a groundwater observation bore), the only areas simulated to experience modelled drawdown from the proposed pumping activity where water table levels are below historically observed depths, are two small tributaries in the middle Anglesea swamplands and the upper-mid sections of the Anglesea River swamplands. Most of the other areas of the ASA and swamplands are simulated to experience similar or slightly shallower (higher) water table depths than historical conditions.
  - A water balance undertaken as part of QOI #4, estimated groundwater contribution from the alluvial swamp aquifer (ASA) was negligible (0.0048 ML annually) supporting historical conceptualisation that baseflow either to or from the ASA into groundwater is insignificant.
- Under a high climate change scenario and using the top 150 model solutions from the 2024 Anglesea Groundwater model, as a result of simulated Alcoa groundwater pumping only:
  - The median (P50) drawdown at all observation bores within the ASA have modelled drawdown <0.1m resulting in a low consequence of impact to GDE as defined by the 2015 Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems.
  - When considering uncertainty, e.g., the P10 limit which takes into consideration 90 percent of model realisations), the largest drawdown is modelled to be 0.22m (WTOB2). It is important to note that historical groundwater monitoring at this location shows no evidence of historical pumping related impacts.

- At both WTOB1 and WTOB2 there is insignificant to no reduction in the seasonal water table depth (P10-P90) range over the forecast model period.
- Forecast zero flow days at SV2 and AV2 (using models within P10 - P90) are generally the same as or fewer (meaning more flow days) than over the historical 2010-2023 period.
- Modelled annual flows at SV2 (using models within P10 - P90) are expected to be generally higher than historical rates indicating groundwater extraction has in consequential impact on flows within the Salt Creek catchment.
- Modelled annual flows at AV2 (using models within P10 – P90) suggest a possible minor (<5 percent) portion of flow reduction over the historical 2010-2023 period.
- For locations in the ASA that do not have a physical observation point (such as a groundwater observation bore), the only areas simulated to experience drawdown from the proposed pumping activity water table levels below historically observed depths are two small tributaries in the middle Anglesea swamplands and the upper-mid sections of the Anglesea river swamplands. Most other areas of the ASA and swamplands are simulated to experience similar or slightly shallower (higher) water table depths than historical conditions.

When cumulative impacts are considered (climate, Barwon Water LEVF, Alcoa UEVF), some increased risks to GDEs, surface water flows and potential acid generating events are observed. While the licencing and approval of a LEVF BE is outside the control of Alcoa and the Responsible Authority being Southern Rural Water (SRW), it is nevertheless included for completeness in this GIA. For reference, the LEVF BE it is currently going through a separate review by Barwon Water and Alcoa understands that it will be subject to approval by the Minister for Water under the *Water Act 1989*. Cumulative risks may also be managed via the inclusion in any entitlements (Barwon Water and Alcoa) appropriate adaptive monitoring and risk mitigation plans as described below.

Considerate of all of the above, this GIA is also based on multiple lines of evidence to inform risk, such as:

- Groundwater mounding in the ASA following significant rainfall or flow events is not observed from daily monitoring groundwater data adjacent to the alluvial creek systems near the former power station, indicating in this area these leakage rates from the ASA to underlying aquifers is not a significant migration pathway.
- Isotope analysis of residual water pools in the ASA (or creek systems) indicated that these pools were not supported by groundwater; rather, they are surface water fed located in areas of low potential evapotranspiration.
- Groundwater levels for all monitored locations in the ASA responds closely to seasonal rainfall, declining when the proceeding months are low in rainfall and/or evapotranspiration is likely high.
- Groundwater level trends in the ASA are similar regardless of if the underlying UEVF potentiometric surface is higher or lower than the water table in the ASA.
- Continuous pressure monitoring data from Vibrating Wire Piezometers (VWPs) from above the main coal seam (in the Demons Bluff Group) from 1999 to 2011 as well as those installed around the former power station from 2006 show no response to UEVF groundwater extraction.
- The Alcoa groundwater pumping test conducted during 2021 with close oversight from the regulator and Technical Working Group identified no adverse impacts on groundwater dependent eco-systems including the Anglesea River.

Therefore, and in recognition of all the lines of evidence, an amended groundwater entitlement of 1,500 ML/yr for 10 years to accelerate the filling of the former Anglesea mine void poses low risk of adverse environmental impact to groundwater dependent ecosystems (including the Anglesea River).

Recognising however that the ASA (GDE's and Anglesea River) are sensitive receptors, and that groundwater extraction does present a risk (albeit low as described throughout), it is proposed to adopt an adaptive water management and monitoring program as a key ongoing monitoring, reporting and control measure.

10 Monitoring, Risk Mitigation, and Contingency Plan

This section has been prepared to address the proposed adaptive water management and monitoring program requirements for the period of the amended license entitlement application.

It is proposed that as part of any amended groundwater licence, one of the key conditions would include an updated adaptive management and monitoring plan, including trigger levels and actions which must be provided to SRW and accepted by SRW prior to any extraction occurring under this licence. The development of the trigger levels and action plans will also be considerate of the identified potential beneficial uses of the site.

In the event that an amended license was approved and provided to Alcoa, then Alcoa proposes that it would be required to prepare a detailed adaptive water management and monitoring plan including clearly identified monitoring locations, triggers, actions and contingency plans and seek approval from Southern Rural Water prior to the commencement of any future extraction. Alcoa anticipates this would be similar to the process that preceded the 2021 Alcoa groundwater pumping test. As a pre-cursor to this Alcoa offers the following for future consideration only.

10.1 Potential Risks and Mitigation Measures

As outlined in **Section 8**, as a result of the proposed groundwater licence entitlement and under a median climate change scenario, there are very few risks of moderate or higher consequence to either GDEs or surface water flow dynamics (including the generation of acidic events). This is also supported by long term groundwater elevation behaviour in the shallow (unconfined) and ASA at key parts of the catchment. For example:

- Isotope analysis of residual water pools in the ASA (or creek systems) indicated that these pools were not supported by groundwater; rather, they are surface water fed located in areas of low potential evapotranspiration.
- Groundwater levels for all monitored locations in the ASA responds closely to seasonal rainfall, declining when the proceeding months are low in rainfall and/or evapotranspiration is likely high.
- Groundwater level trends in the ASA are similar regardless if the UEVF potentiometric surface is higher or lower than the water table in the ASA.
- Continuous pressure monitoring data from Vibrating Wire Piezometers (VWPs) from above the main coal seam (in the Demons Bluff Group) from 1999 to 2011 as well as those installed around the former power station from 2006 show no response to UEVF groundwater extraction.

Despite this, the numerical modelling suggests that under future modelled median climate change conditions, as a result of the proposed extraction, the ASA located in the mid part of the Anglesea River has a slightly elevated risk profile (i.e., the low risk [inclusive of P10-P90 uncertainty]) drawdown threshold is exceeded (i.e., 0.1m drawdown).

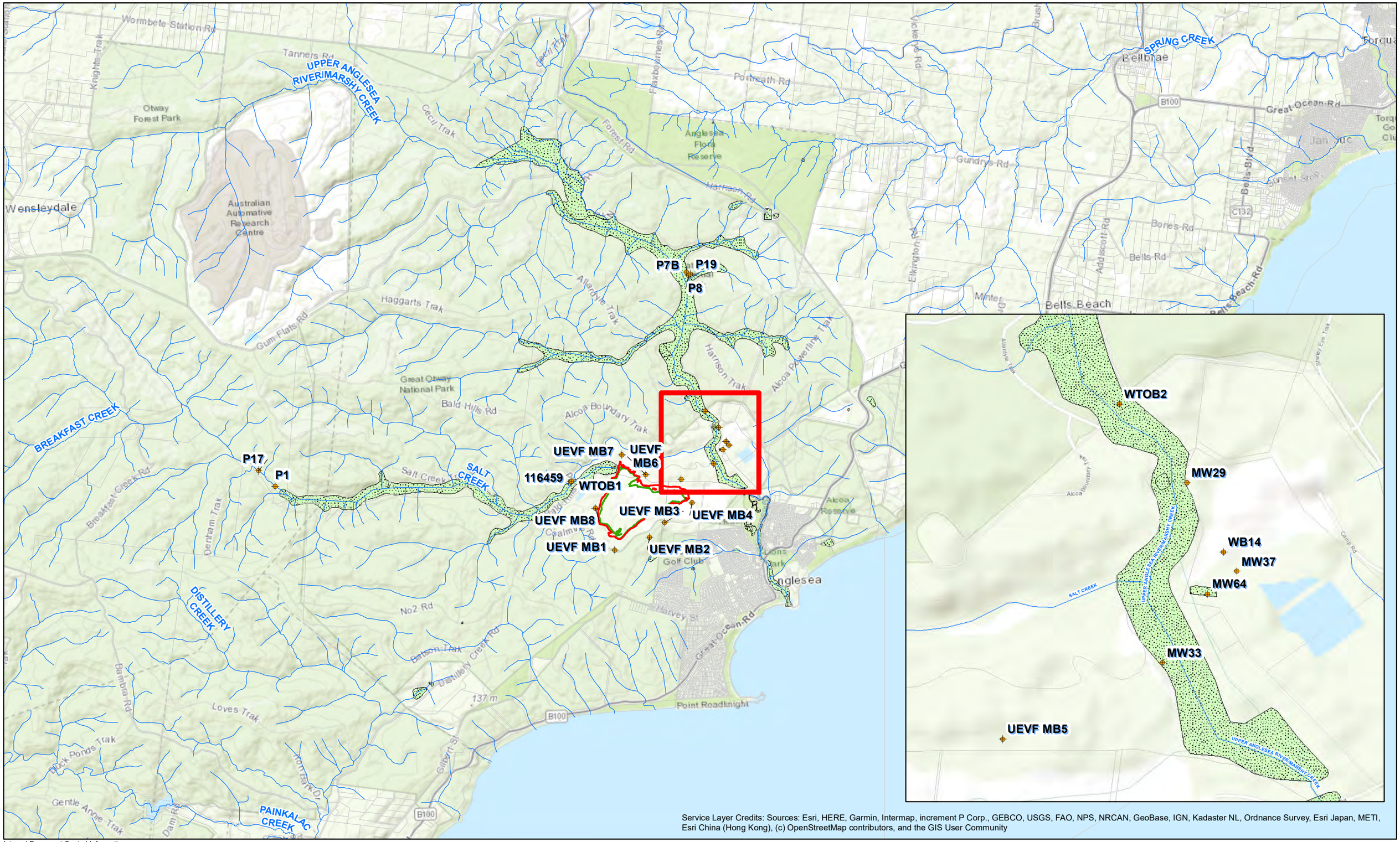
To monitor this potential risk, it is proposed that continuous (daily; via pressure transducers with data logging capability such as a Solonist Levelogger) groundwater level and pressure monitoring be undertaken in key observation bores that were defined for the 12-month pumping test undertaken in 2021. In addition, it is proposed that monitoring bores including Barwon Water bores P7B, P8, P12, P17 and P19 are also to be included. These are shown on **Figure 10-1** and **Table 10-1**.

Table 10-1 Monitoring Bore Network Construction Details and Modelled Drawdown

Bore ID	Aquifer Monitored	Easting	Northing	Screen interval (mbgs)	Well depth (mbgs)	Catchment Reach
UEVF WB14	UEVF (Lower Sands)	253671	5747343	155.9 - 213.7	218.8	Mine Lease
SOB 116459**	UEVF (Lower Sands)	250982	5746639	243 - 246	253	Lower Salt Creek
UEVF MB1	UEVF (Upper Sands)	251737.19	574557.26	92 –- 98	100	Mine Lease
UEVF MB2	UEVF (Upper Sands)	252342.02	5745681.11	122 –- 128	130	Mine Lease
UEVF MB3	UEVF (Upper Sands)	252550.24	5745921.9	139.3 - 145.3	150	Mine Lease
UEVF MB4	UEVF (Upper Sands)	253081.748	5746278.973	71 –- 77	79	Mine Lease
UEVF MB5	UEVF (Upper Sands)	252891.1525	5746682.701	59 – 65	66	Mine Lease
UEVF MB6	UEVF (Upper Sands)	252278.4	5746761.66	69 - 75	77	Mine Lease
UEVF MB7	UEVF (Upper Sands)	251862.3155	5747106.234	42 – 51.6	52.6	Mine Lease
UEVF MB8	UEVF Coal	251272.17	5746026.56	81 – 84	85	Mine Lease
MW29	DBG	253437.8	5747391.8	6-12	12	Mine Lease
MW37	DBG	253717.9	5747275.4	3 – 6	6.6	Mine Lease
MW33	DBG	253551.7	5746791.7	8 – 14	14	Mine Lease
MW64	DBG	253614.43	5747194.65	7 – 13	13	Mine Lease
WTOB1	ASA	250991	5746647	1.7 – 13.7	13.7	Lower Salt Creek
WTOB2	ASA	253304	5747866	1.6 – 6.6	6.6	Lower Anglesea River
P1	ASA	245855.0	5746562.4	0.5 – 5.9	5.9	Mid Salt Creek
P7B	ASA	252943	5750691	2 – 3.3	3.3	Mid Anglesea River
P8	ASA	253020	5750213	0.3 – 3.6	3.6	Mid Anglesea River
P17	ASA	245564.6	5746834	0.3 – 5.4	5.4	Mid Salt Creek
P19	UEVF (Lower Sands)	253035	5750242	19 – 22	22	Mid Anglesea River

Table Notes:

*DEECA have removed this bore from the State Observation Bore Network due to integrity issues and will likely be decommissioned. However, until such time, this bore will be retained as it contains significant historical data and despite its history of casing integrity issues, there is value in maintaining this data to assist only with decision-making processes.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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User Name: Danny.Barnes; Date and Time Printed: 20/06/24 10:17:30 PM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20240613_GroundwaterImpact Assessment\Figure10-1-ProposedGroundwaterMonitoringNetwork.mxd

Proposed Groundwater (Automatic Logger) Monitoring Network

0 0.5 1 2 3 4 Kilometers

1 cm = 589 m [Page Size: A3]

LEGEND

- Monitoring Bore
- -4mAHD
- 4mAHD
- Watercourse
- Parcel Boundary
- Marshland

Alcoa Anglesea Groundwater Impact Assessment

EHS Support

Figure 10-1

N

CREATED BY:	D. Barnes
APPROVED BY:	B. Petrides
PROJECT REF. NO:	PTY.04649
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA2020 MGA Zone 55
SCALE:	1:58,900
AERIAL IMAGE SOURCE:	Nearmap Pty Ltd

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10.2 Groundwater Monitoring, Trigger Levels, and Contingency Measures

As discussed in **Section 10.1**, the ASA located in the mid part of the Anglesea River has a slightly elevated risk profile. Fortunately, in this location there are a series of nested groundwater observation bores that contain greater than 10 years of high frequency data (included in the proposed observation bore network detailed in **Table 10-1**). This data also spans numerous external groundwater stress periods that have operated at **much greater stresses** (i.e., groundwater extraction rates) than what is being proposed as part of the entitlement application; such as:

- LEVF extraction during 2011 and 2012; 2022.
- UEVF extraction 1969 to 2015; 2021.

Therefore, it is proposed to incorporate these bores into a management and monitoring contingency framework.

Typically, and as part of a monitoring contingency and response plan, water triggers are developed. These triggers are designed to prompt investigations, implement further monitoring or undertake mitigation actions. However, across the catchment, the established and extensive groundwater baseline conditions indicate that the above historical stresses have not caused an observable change in groundwater level trends in the shallow ASA monitoring bores. Furthermore, the numerical modelling predicts potential drawdown impacts within the ASA monitoring locations are considerably less than the natural annual groundwater level variability of the ASA. As such the development of trigger levels based on common approaches such as those using the 20 percentile would be inconsequential. For example, assume a trigger level (based on exceedance of the 20 percentile) was applied to P19 (screened in the UEVF, underlying the ASA) in the mid part of the Anglesea river catchment. As observed in **Figure 10-2 (orange line)**, this is exceeded almost annually and typically in summer, regardless of whether or not there has been groundwater extraction or not.

It is therefore proposed to develop an upper tolerance limit (UTL) using ProUCL software published by the United States Environmental Protection Agency (USEPA), (USEPA, 2015a), (USEPA, 2015b). There exists more than a sufficient dataset to undertake this methodology with the calculation of an UTL, based on the 95 percent upper confidence limit (UCL) for water levels in each proposed observation bore network detailed in **Table 10-1**.

For the calculated UTL triggers, the following contingency steps should be undertaken upon the first or subsequent exceedance of a trigger level:

- In the event of the first trigger level exceedance:
  - Review the data and quality assurance/quality control (QA/QC) to determine whether the result is valid. This should include consideration of:
    - Monitoring Equipment failure or transcription errors.
    - Historical data and data from other bores (i.e., Does the data make sense in the context of historical data or data from other site monitoring bores that are screened in the same formation? Is the result a clear outlier?).
    - Are water quality parameters exhibiting a change.
    - Validity of the trigger level (e.g., Have the trigger levels been based on a sufficient number of representative results? Is further monitoring data required to establish more representative trigger levels?)
  - If the result is potentially not valid, confirm the result through an additional monitoring event (ideally taken within a period of 3 months).
  - If result is valid or subsequent analysis confirms the exceedance, increase the frequency or monitoring from quarterly to monthly.

  - Note: It is proposed to undertake quarterly download and reporting of the data which is logged on a daily timestep (for water level). If an exceedance is observed, download of daily data would happen monthly.
  - Continue monthly water level monitoring until four consecutive results below the trigger level have been obtained.
- In the event of a second consecutive trigger level exceedance:
  - conduct further comparative assessment of climate and water level behaviours to determine whether the result is indicative of groundwater pumping. The assessment should be documented in an internal technical memorandum, which at a minimum should include the following elements:
    - Review and comparison with local trends in groundwater concentrations for other site monitoring bores (including background monitoring bores) and assessment of whether the result is attributed to broader site-wide or regional trends as compared to localised conditions.
    - Review of other factors, as applicable, including potential bore integrity issues (e.g., casing damage, surface water infiltration) or climatic factors.
    - Comparative assessment of other groundwater constituents (e.g., metals concentrations) may also be warranted.
  - If further review determines that the result is likely due to naturally occurring conditions, groundwater trigger levels should be reviewed and updated (based on historical and recent results) using references such as DES guideline *Using monitoring data to assess groundwater quality and potential environmental impacts* (DES, 2021).
  - Monthly reporting should continue until four consecutive results below the trigger level have been obtained.
  - If the further review conducted at this stage determines that the result is likely due to groundwater pumping (i.e., there are clear indications of drawdown), this is classed as a trigger event and an investigation must be undertaken with the results of the investigation submitted to SRW within a practicable timeframe (e.g., within 6 weeks following the notice of a second consecutive trigger level exceedance).
- A third consecutive trigger level exceedance is classed as a trigger event.

A trigger event will result in the cessation of pumping until an investigation is completed.

As mentioned above (and where no triggers are breached), groundwater levels from these bores listed in **Table 10-1** will be reported quarterly (from the dedicated pressure transducers) and verified where possible by manual gauging prior to each groundwater monitoring event. This data will then lead to the development of a factual quarterly report. A bi-annual report (every 2 years) will be produced which will provide further comment on any observed trends or outliers. With respect to water quality, the current quarterly Mine Water Body sampling program will be maintained during the period of the entitlement, unless otherwise agreed with the regulator. Reporting from the period of March to May 2024 is presented in **Appendix G**. This data will be evaluated, and a summary provided in the quarterly report as indicated above.

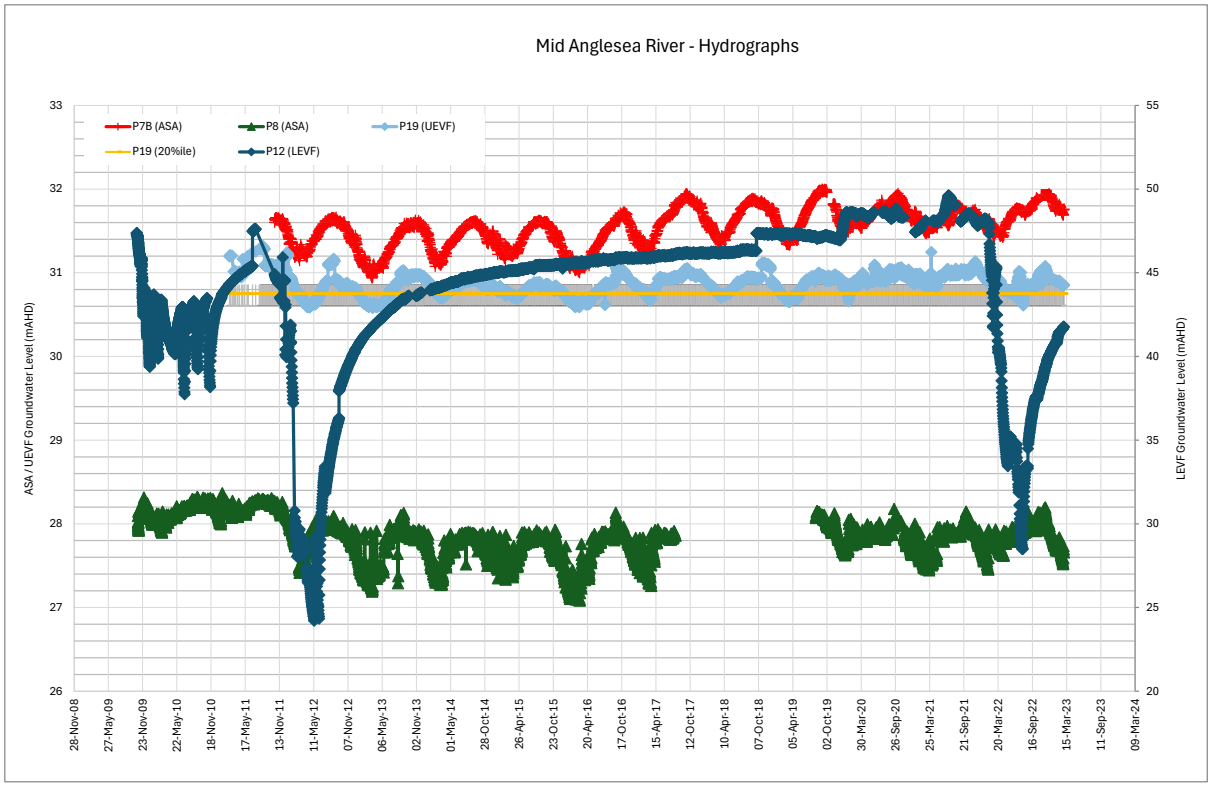

Figure 10-2 Trigger Example

11 Limitations

EHS Support Pty Ltd (“EHS Support”) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Alcoa of Australia and only those third parties who have been authorised in writing by EHS Support to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The methodology adopted and sources of information used by EHS Support are outlined in this report. EHS Support has made no independent verification of this information beyond the agreed scope of works and EHS Support assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to EHS Support was false.

This report was prepared between March 2024 and March 2025 and is based on the conditions encountered and information reviewed at the time of preparation. EHS Support disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full, including appendices. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, EHS Support must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore, this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

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Appendix A Conceptual Hydrogeological Model

Conceptual Hydrogeological Model

Former Alcoa Anglesea Power Station and Coal Mine

Prepared for:

Alcoa of Australia

Prepared by:

EHS Support

September 2022

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List of Acronyms

AASS	Actual Acid Sulfate Soil
ABP	Anglesea Borefield Project
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AOI	Area of Interest
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999
BE	Bulk Entitlement
BW	Barwon Water
CHM	conceptual geological and hydrogeological model
cm	centimetre
CSM	conceptual Site Model
DBF	Demon Bluff Formation
DELWP	Department of Environment, Land, Water and Planning
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
EC	electrical conductivity
EPA	Environmental Protection Agency
ERR	Earth Resources Regulator
ERS	Environment Reference Standard
ESR	Environmental Sensitive Receptors
EVF	Eastern View Formation
GCM	global climate models
GDE	groundwater dependent ecosystem
GED	general environmental duty
GEDIS	Geological Exploration and Development Information System
GIA	Groundwater Impact Assessment
GL	gigalitres
GMA	Groundwater Management Area
Ha	hectare
km	kilometres
LOR	limit of reporting
LTA	long-term average annual
m	metres
MAP	Monitoring and Assessment Program
MEVF	Middle Eastern View Formation
ML	megalitres
mm	millimetres
MRCP	Mine Rehabilitation and Closure Plan

NHMRC	National Health and Medical Research Council
NRMMC	National Resource Management Ministerial Council
PAN	Pollution Abatement Notice
PASS	Potential Acid Sulfate Soil
PE	potential evaporation
PWT	perched water table
RORB	runoff routing model
SEPPs	State Environment Protection Policies
SOB	State Observation Bore
SRW	Southern Rural Water
UEVF	Upper Eastern View Formation
WMC	Western Mining Corporation
WMIS	Water Measurement
yr	year
µS/cm	microsiemens/centimetre

1 Introduction

1.1 Purpose of this Report

This report serves multiple purposes, these are:

- To provide hydrogeological and conceptual data to support a potential groundwater licence application for extraction of groundwater from a bore screened in the Upper Eastern View Formation (UEVF) located at the former Alcoa Power Station and Coal mine.
- To provide input into a risk assessment that will be used to inform water related closure criteria related to Alcoa mine closure and rehabilitation plan (MCRP).
- To provide site specific hydrogeological and other data specific to Alcoa's area of interest (AOI) (refer **Section 5.2.1**) to support the refinement of the Anglesea groundwater model (refer GHD 2022 and section below). Note: to gain greater detailed understanding of the whole catchments hydrogeological understanding is it strongly recommended to read GHD 2013a,b, GHD 2015 and GHD 2020.
  For reference, the Anglesea groundwater model was initially developed by GHD Pty Ltd in 2009 and revised in 2013. The model is a single catchment wide (Jan Juc Groundwater Management Area) numerical groundwater model that was used to determine potential impacts from Barwon Waters Bulk Entitlement from the Lower Eastern View Formation (LEVF). An agreement between Barwon Water and Alcoa was made whereby this updated calibrated model will be provided to Alcoa to allow predictive management scenarios to be undertaken associated with potential extraction of groundwater from the Upper Eastern View Formation (UEVF). As such, the data contained within this report is not intended to cover the whole numerical model domain as Alcoa's interests and potential impacts only cover a small part of the overall catchment. This report does however direct the reader to other studies where a significant amount of data has been collected and presented in support of the model development.

1.2 Background

The former Anglesea Coal Mine (referred to as "the mine") is located approximately 3 kilometres (km) northwest of the Anglesea township in Victoria. Adjacent to the mine is the former Anglesea Power Station (referred to as "the former power station"). The general site layout is shown in **Figure 1-1** and its regional location is shown on **Figure 1-2**.

Alcoa is licensed to extract 4,000 megalitres/year (ML/yr; approximately 11 ML/day) from the Upper Eastern View Formation (UEVF) under Licence Entitlement BEE029662 (also referred to as a Groundwater Licence or a Take and Use Licence) until 30 June 2024 (**Appendix A**). The purpose of use is permitted as industrial or commercial use, as well as industrial and stock but is subject to the groundwater being used on Allotment 64D of the former power station site only (Block 1-4 on **Figure 1-3**).

Filling the mine pit void, which is not located on Allotment 64D, with water remains a key enabler for the draft *Anglesea Mine Rehabilitation and Closure Plan* (MRCP) as submitted to Earth Resources Regulator (ERR) in September 2017.

During the progressive rehabilitation works over the past five years, the mine pit void water level has been slowly rising as forecasted, as a result of natural groundwater recovery, direct rainfall and local catchment runoff only. It is estimated that allowing the mine pit void to naturally fill would take between 50 and 100 years with a final steady state waterbody surface estimated between -4 and +4 metres Australian Height Datum (m AHD) (EHS Support, 2017).

In September 2020, Alcoa submitted a Groundwater Impact Assessment (GIA) evaluating risks to both the environment and third-party users associated with a proposed 12-month groundwater pumping test of the UEVF aquifer. In October 2020, Southern Rural Water (SRW) issued an amended groundwater licence including an Addendum (LH1575619) to the Licence Entitlement BEE029662 and Licence to Operate Works WLE0351661. These three documents are provided in **Appendix B**.

The amended groundwater licence permits the 12-month groundwater pumping test and specifically the extraction of up to 1.5 gigalitres (GL) of water '*for the purposes of discharging groundwater to the mine pit as part of the amended licence'* (**Appendix B**). A condition of the amended groundwater license was that *'An updated monitoring plan, including trigger levels and actions must be provided to SRW and accepted by SRW prior to any extraction occurring under this licence.*' A copy of the Monitoring Plan and Trigger Levels Report is provided in Appendix C.

Alcoa subsequently commenced a groundwater pumping test of the UEVF aquifer on 13 May 2021 to enable further investigation of groundwater use and commence the initial mine pit void filling process. The pumping test was paused on December 8, 2021 after a total of 671.9ML was extracted, representing approximately 44% of the licensed volume. During this period, the findings of the first 6-Months were reviewed.

On September 20, 2022, Southern Rural Water (SRW) refused the application made to undertake the second 6-month period primarily due to "***the aquifer having recovered back to pre-trial levels***" and their view that "***further pumping would likely yield similar results***." Further, SRW sought advice from the independent technical panel (ITP), appointed to review the development and calibration of the Anglesea groundwater model, and they advised "**additional information from the second 6- month period would be of limited benefit because there is sufficient data to have developed and appropriately calibrated a groundwater model that can inform any potential future application for licence amendments**". Further information regarding SRW decision is here: https://www.srw.com.au/news-media/alcoas-groundwater-licence-application-refused

Importantly though, the data gathered during the pumping test has not identified any adverse impacts on groundwater dependent ecosystems, including the Anglesea River.

Therefore, this document outlines the findings from the first six months of the groundwater pumping test **Appendix D** and presents a revised Conceptual Site Model (CSM). The data collated and analysed will be used to refine and re-calibrate an existing regional numerical Anglesea groundwater flow model (in conjunction with Barwon Water) to enable predictions of potential impacts to the environment.

Dependent on the outcomes of the data analysis from the first six months of the groundwater pumping test, and the outputs of the updated Anglesea Groundwater Model, Alcoa is seeking to determine if a sustainable groundwater extraction rate can be achieved and if so proposes to then seek a groundwater license amendment from SRW to support the filling of the mine void.

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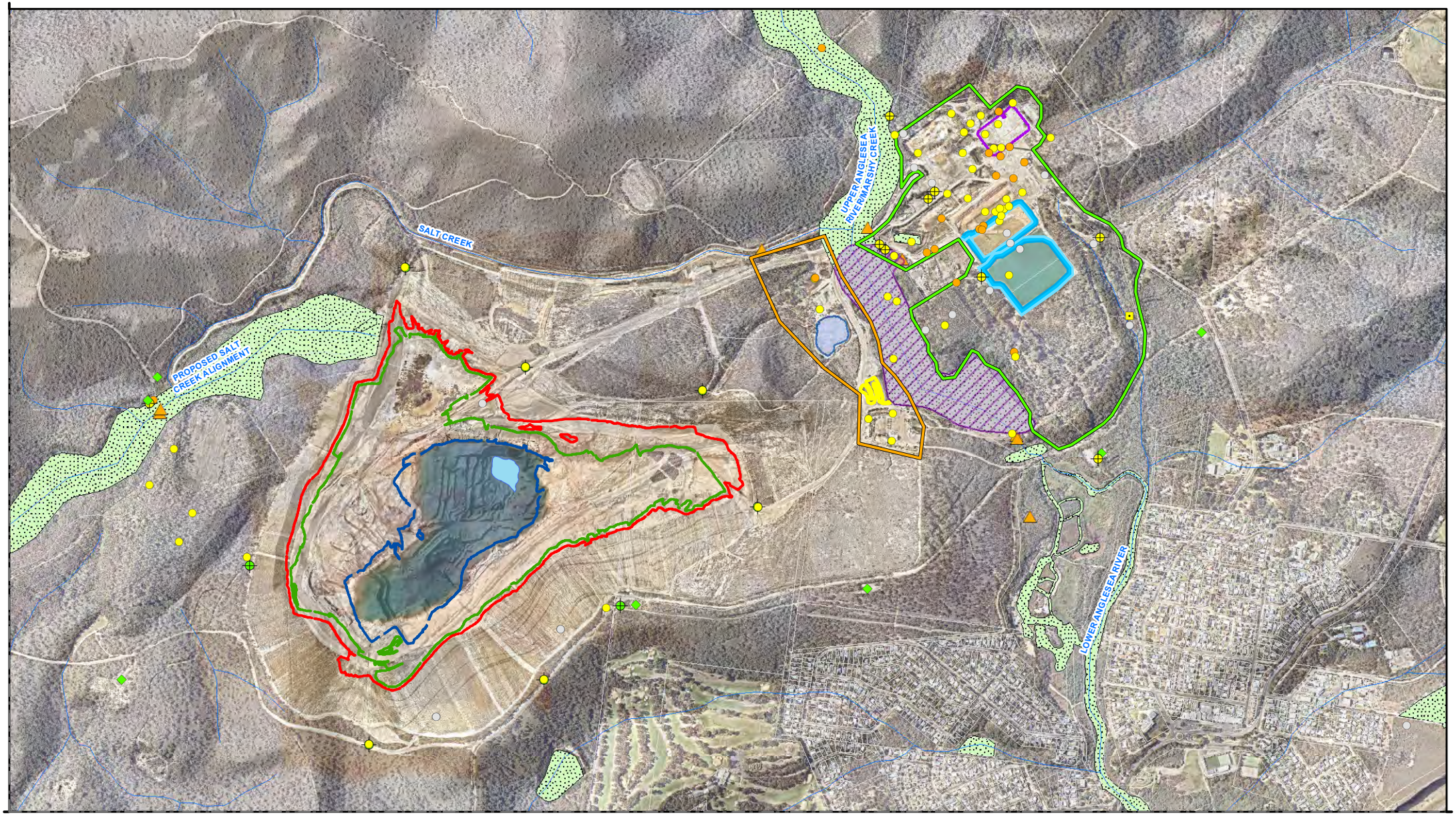

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 1-1 Local Site Location.mxd

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Figure 1-1 Local Site Location

Monitoring Bore - Aquifer Monitored
- Demons Bluff Group - Perched Aquifer (Alluvial)
- Demons Bluff Group - Boonah Sands Aquifer
- UEVF
- UEVF (Basal Sands)
- UEVF (Upper Sands)
- UEVF/MEVF
- UEVF/LEVF
- LEVF
- Decommissioned
- Surface Water Sample Location
- Current Water Level (-20mAHD)
- -4mAHD
- 4mAHD
- Mine Sump
- APS Investigation Area
- Mine Infrastructure Area
- Ash/Water Reclamation Ponds
- Mine Water Reclamation Pond
- Wetland Dam
- Formerly Licensed Mixing Zone
- Former Power Station
- Watercourse
- Parcel Boundary
- Marshland

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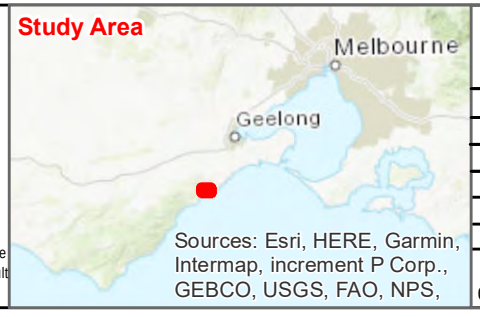

Alcoa Anglesea Hydrogeological Investigation

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Kilometers

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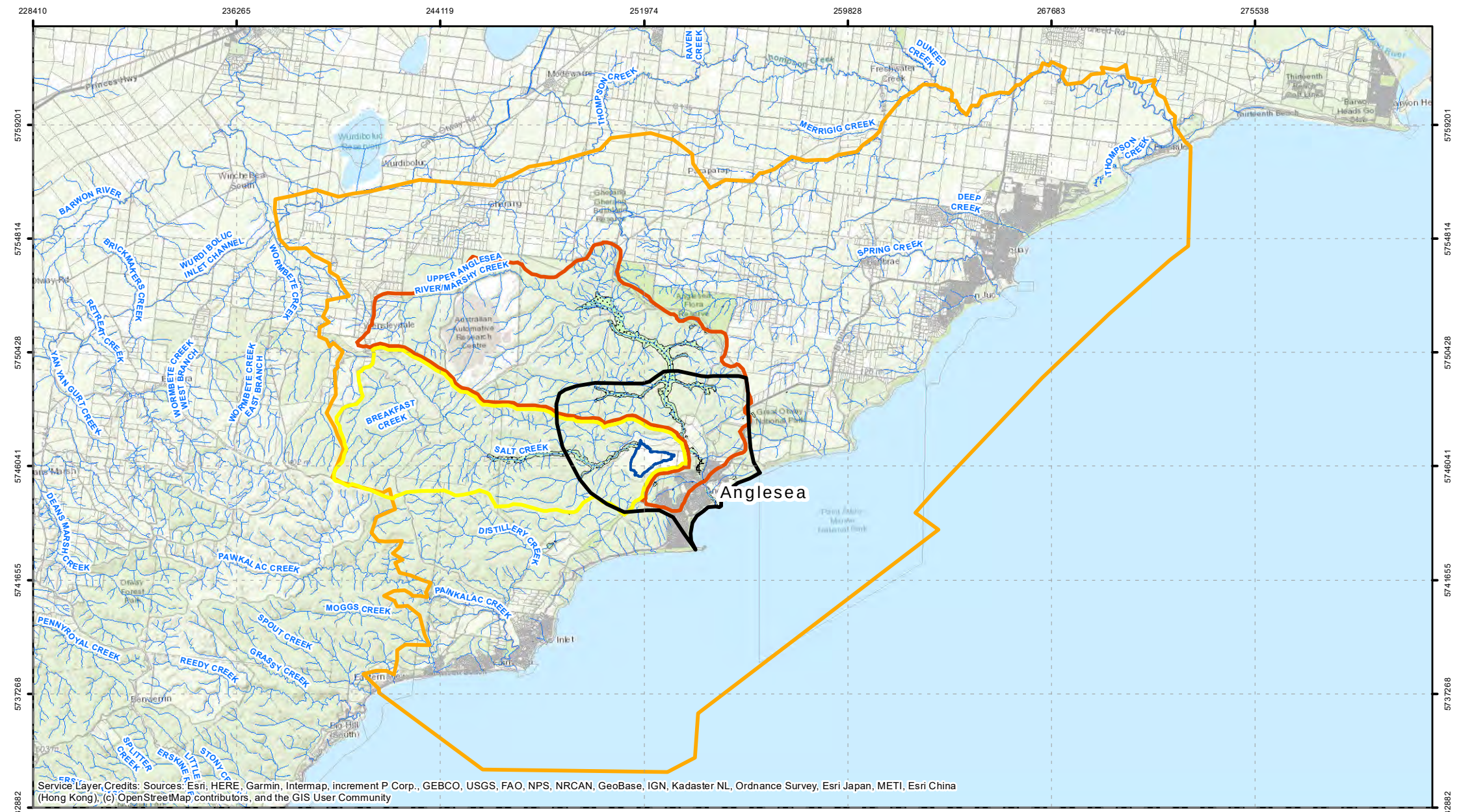

J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 1-2 Regional Site Location.mxd

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Figure 1-2 Regional Site Location

- Lake Boundary (+7mAHD)
- Alcoa AOI
- Salt Creek Catchment
- Anglesea River Catchment
- Jan Juc GMA boundary
- Watercourse
- Parcel Boundary
- Marshland

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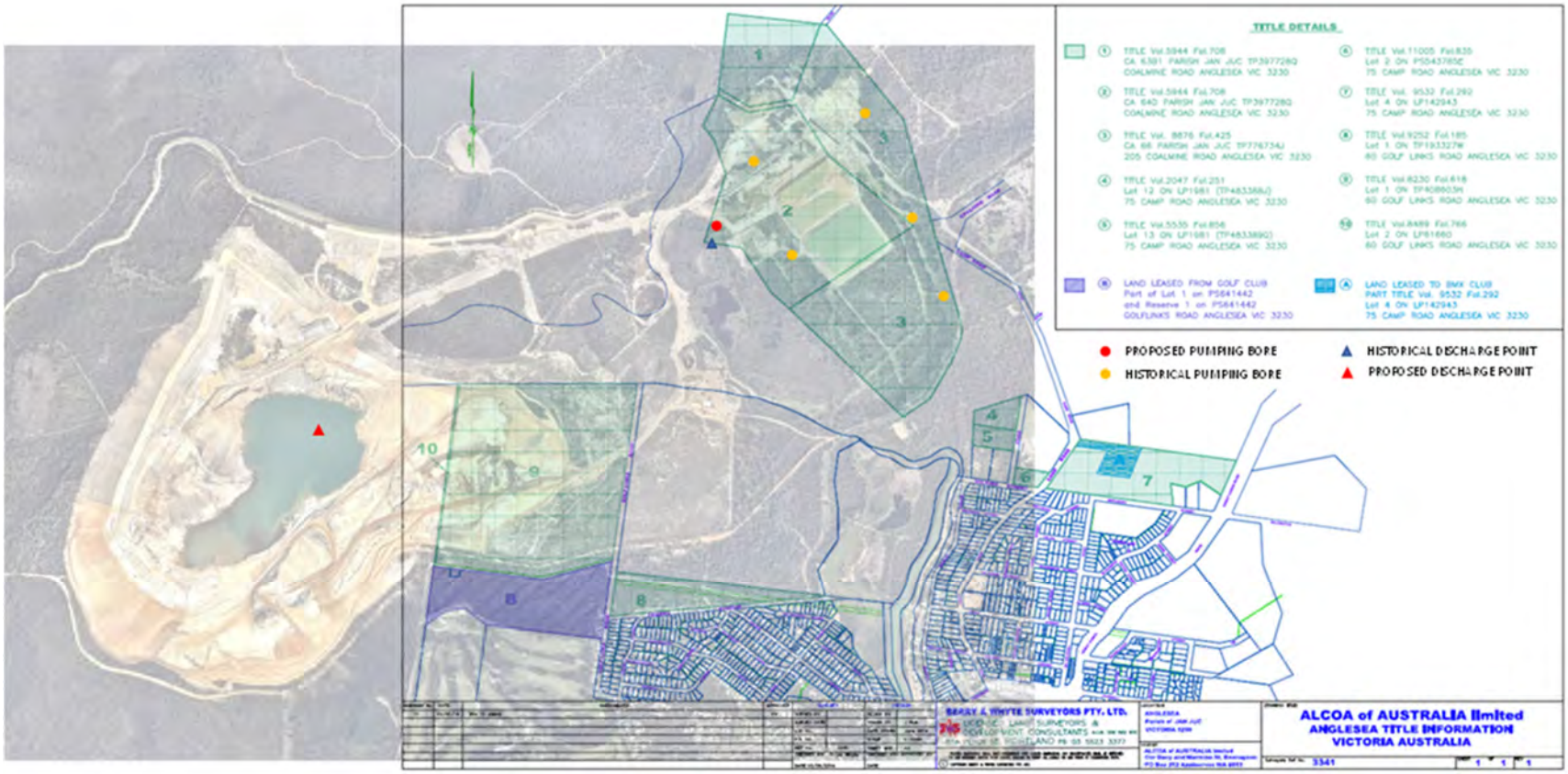

Figure 1-3 Allotment Locations for Water Discharge

2 Historical Investigations and Activities

2.1 Pre-1960

Roche Brothers commenced open cut mining operations on the Anglesea coal deposit in the late 1950s. Around the same time the concept for an aluminium smelter at Point Henry was developed (by Western Aluminium NL which became Alcoa of Australia in 1961), about 7 km from Geelong with feedstock alumina to be shipped from Western Australia.

The concept envisaged that the smelter would be supplied with approximately 70% (at that time) of the required electricity from a new generating station to be located at Anglesea and fuelled from the adjacent brown coal mine. In 1960, drilling was undertaken in the Anglesea area and revealed a main coal seam mining area adjacent to the lower seam being operated by Roche Brothers. Assessments at the time showed a coal deposit of about 120 million tonnes, compared with approximately 30 million tonnes assessed by Roche Brothers.

2.2 1960-2016 (Mine Operation)

2.2.1 Mine Development Timeline

The mining rights were obtained by Alcoa of Australia (Alcoa) from Roche Brothers at Anglesea, and on 22 November 1961 the Mines (Aluminium) Agreement Act was passed providing Alcoa the rights to explore and mine over 7,350 hectares of leasehold land largely to the northwest of Anglesea, including the area being mined by Roche Brothers. Power Station construction began in 1965 with the first power produced in March 1969.

The drilling program revealed that the original mining by Roche Brothers was in a lower seam to the west of the main upper seam. As a result, a new mine was opened adjacent to and expanding away from the power station site. Overburden removal was initially used for backfilling the old Roche Brothers open cut mine and to facilitate rehabilitation of the entire Roche Brothers site. **Figure 2-3** shows the progressing mining extents and **Figure 2-4** shows progressive backfilling extents.

In 1969, Alcoa began to pump groundwater from the UEVF to support the operation of the power station and mine. A series of boreholes from 1964 were drilled by Alcoa that were licensed to extract groundwater from the lower aquifers within the Upper Eastern View Formation (UEVF). These extraction bores extracted groundwater used for process and cooling water for the power station, with surplus (treated) process water directed to an Environmental Protection Agency (EPA) licensed discharge and providing baseflow and Alkaline pH water; pH ~7-8, to the Lower Anglesea River. Daily extraction rates from these bores were around 4.5 ML/day with higher extraction rates measured historically. This is presented on **Figure 2-1** and clearly shows the alkaline buffering capacity the Alcoa discharge baseflow had on the pH of the Estuary. Prior to this discharge, these was evidence that these surface water systems periodically turned acidic, **Figure 2-1**.

The historical groundwater extraction bore network at the time comprised of bores WB9, WB10, WB13, WB14, WB15, WB16 and WB17 (**Figure 2-2**). Some of these bores (WB9, WB10, WB13 and WB17) have since been decommissioned (refer **Section2.3.4**). In addition to the extraction bores, Alcoa undertook mine dewatering activities directly from the mine pit. The mine pit, which is excavated to a maximum depth of approximately -45 m AHD, was dewatered from a progressively

moving sump positioned at the lowest part of the operational mine at an extraction rate ranging between 1 to 1.5 ML/day when pumping. This pumping was conducted intermittently, approximately 60 percent of the time (based on in-flows and rainfall).

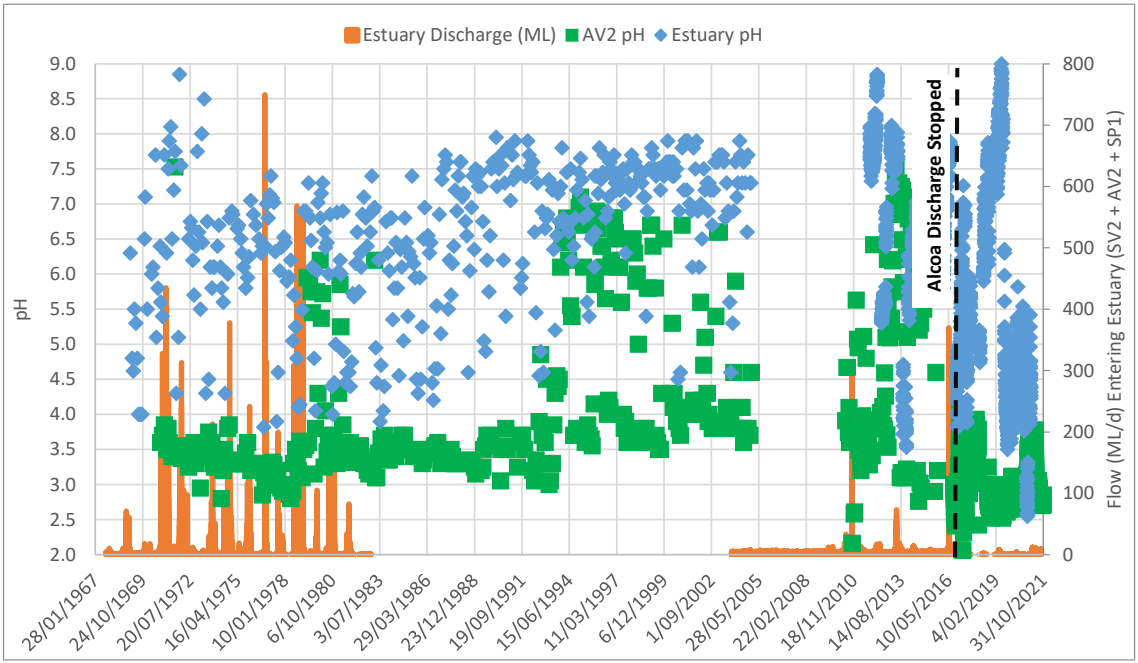

Figure 2-1 Historical Surface Water Flows into the Anglesea River Estuary

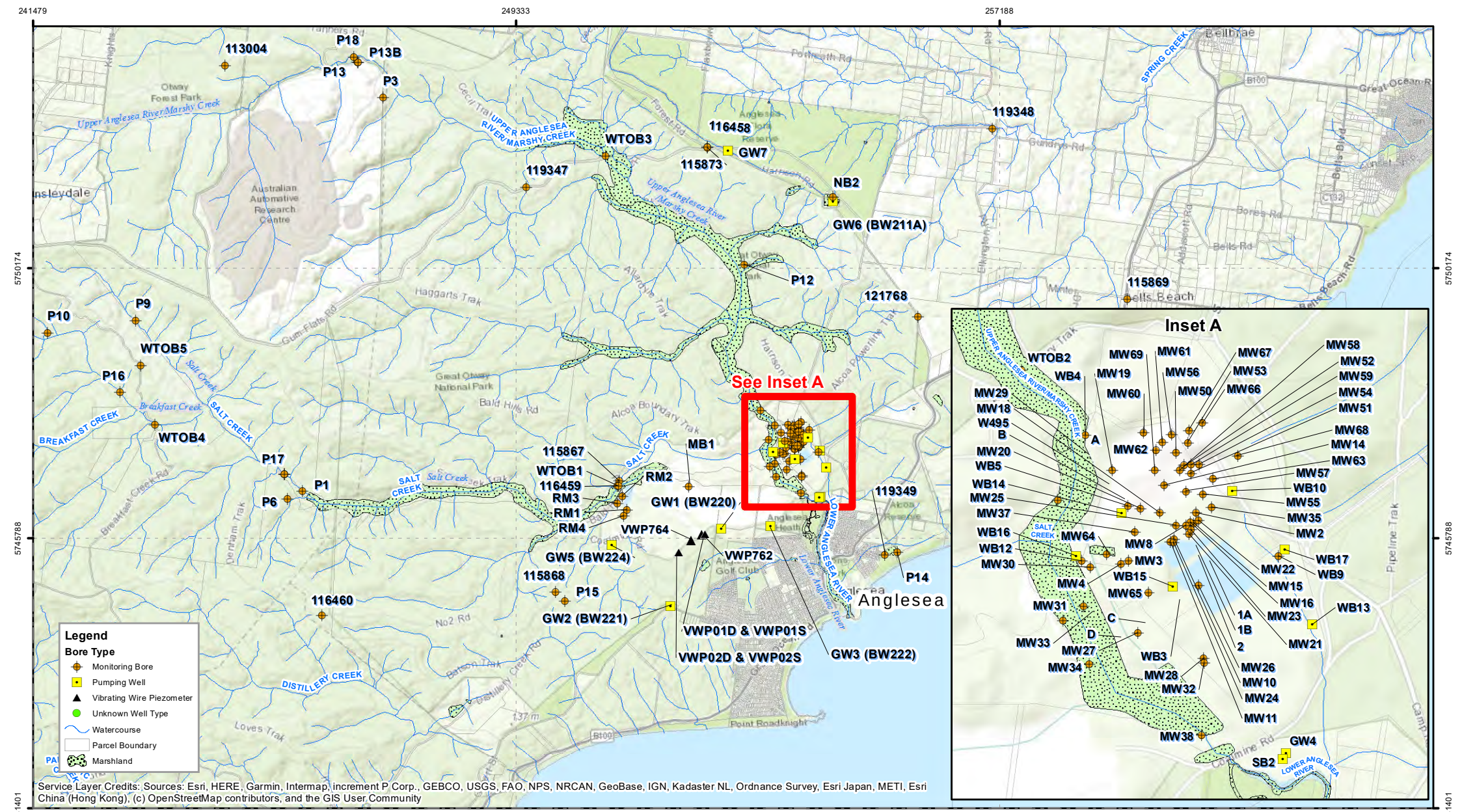

Figure 2-2

Monitoring Well and Pumping Bore Network

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Hydrogeological Investigation

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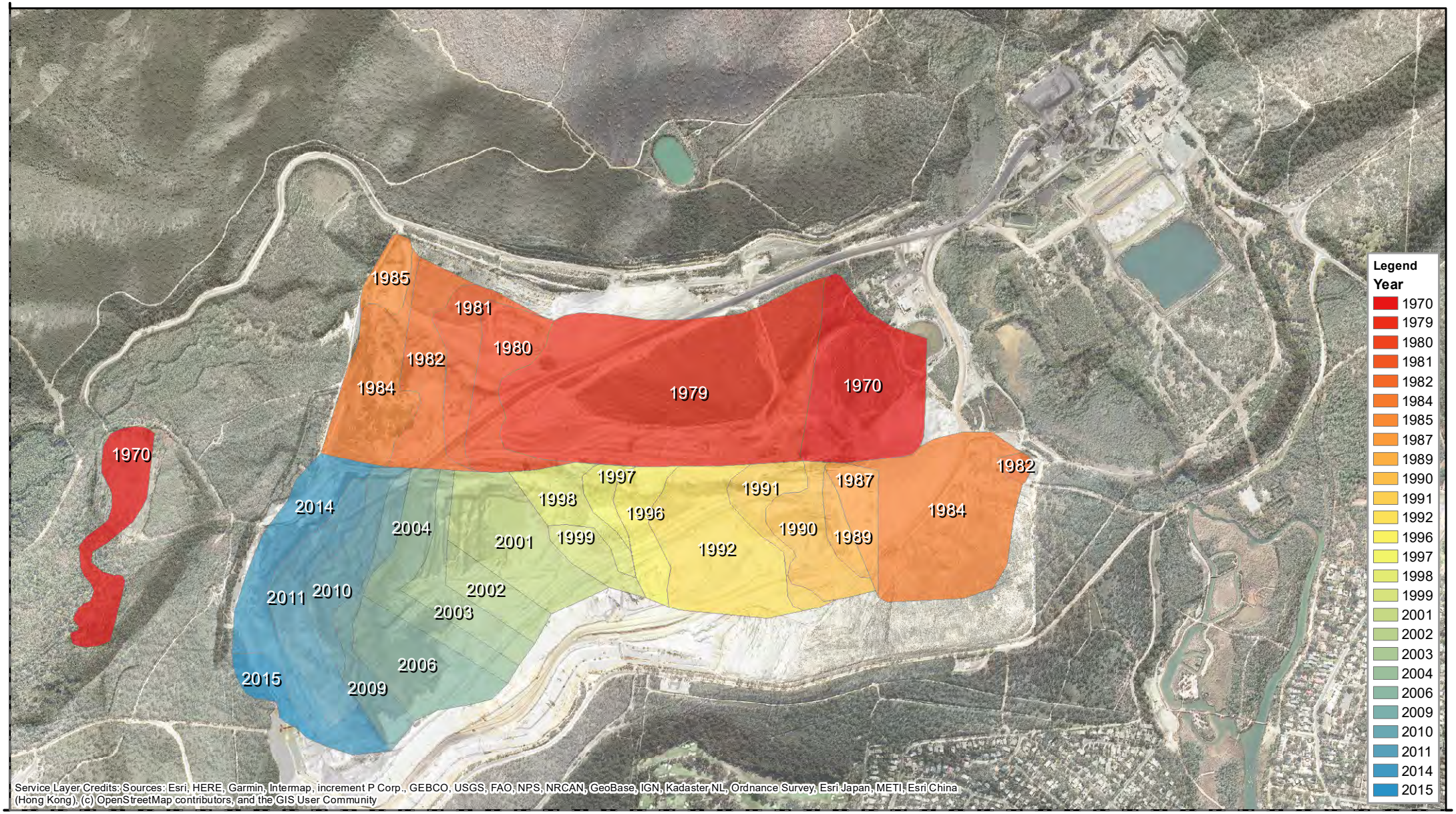

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 2-3 Historic Mine Extent.mxd

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Figure 2-3
Historic Mine Extent

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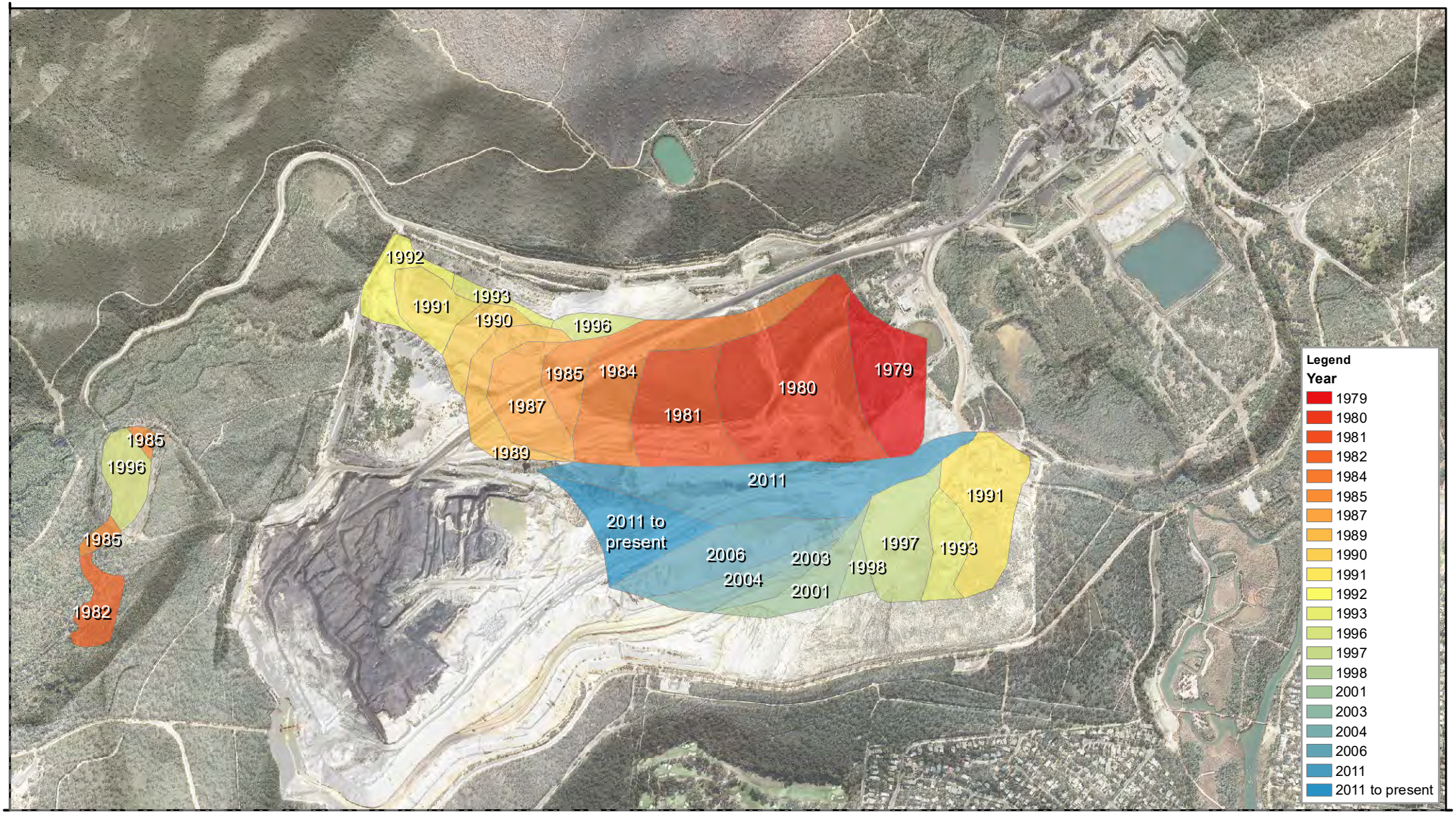

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 2-4 Historic Mine Backfill.mxd

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Figure 2-4
Historic Mine Backfill

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2.2.2 *Post-2008 – Barwon Water Groundwater Extraction*

The Anglesea Borefield is used to extract groundwater from the Lower Eastern View Formation (LEVF) in the Jan Juc Groundwater Management Area and contains seven production bores that are licensed to extract a maximum of 40 ML/d, or 10,000 ML in any year, and 35,000 ML in any 5-year period. Five of the seven bores (GW1, GW 2, GW3, GW4 and GW5) are located proximal to the mine (**Figure 2-2**).

Commissioning and testing of the borefield first commenced in October 2009 and ceased in June 2012, with a total of 7,617 ML pumped during that period. Due to low water storage levels, recommissioning of the borefield began in August 2019 to supplement the existing Greater Geelong water supply system. Between August 2019 and end of June 2020 a total of 2,177.3 ML was extracted from the Anglesea Borefield.

The Anglesea borefield was moved into a standby maintenance mode from 1 July 2020 and has only been operated for maintenance purposes until January 27, 2022 when Barwon Water began their 6 - month groundwater pumping test to inform a review of its bulk entitlement and environmental monitoring program.

A timeline of historical extraction for both the UEVF and LEVF is presented in **Figure 2-5**.

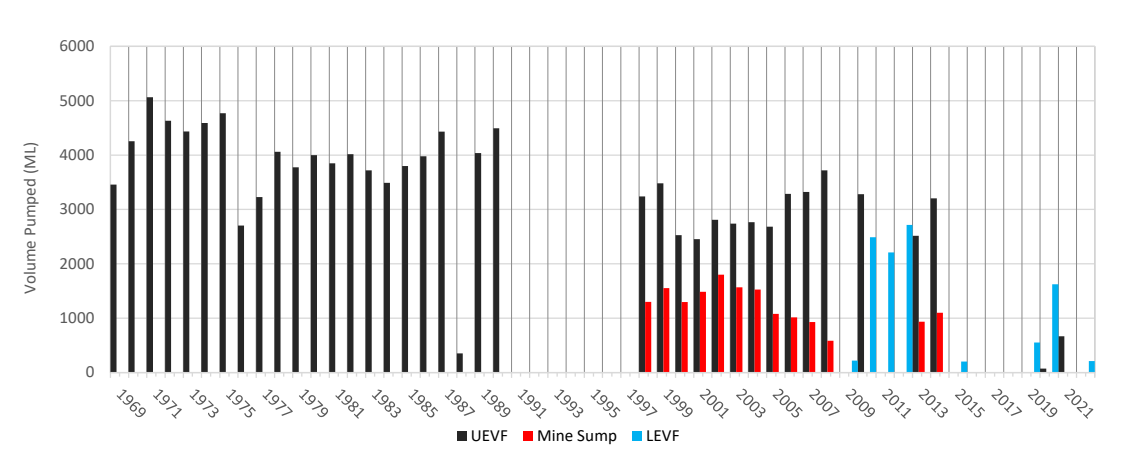

Figure Notes:

UEVF Data missing for 1991-1997, 2009 & 2011-2012
UEVF volumes prior to 1989 also include the mine sump volume
LEVF 2021 Data – Up to and including February 2022

Figure 2-5 Timeline of Historical Groundwater Extraction (UEVF, Mine Sump and LEVF)

2.3 Mine Rehabilitation Since 2015

Following the shutdown of the Anglesea Power Station and Mine in August 2015, detailed planning for the final closure and rehabilitation of the mine commenced including detailed technical studies and community and regulator engagement. In 2016 Guiding Principals were published after extensive consultation with the community, with these then used as an input into the development of the closure plan.

In September 2017 a draft Mine Closure and Rehabilitation Plan (MCRP) was submitted to Earth Resources Regulation (ERR) proposing earthworks, revegetation and the establishment of a water body. Subsequent to this, in March 2018 a Work Plan Variation – Progressive Rehabilitation was approved by ERR approving the earthworks and revegetation works.

Major earthworks were commenced in November 2018 and completed in June 2020, including the reprofiling of the west and south slopes of the mine, the installation of surface water catchment drains at strategic points around the mine, and the relocation of part of Coalmine Road.

Revegetation works consisted of native heathy topsoil revegetation works in 2018 and 2019 on the north and west walls, and also the establishment of a large native grassland on the south wall which was completed in September 2020. Both the earthworks and revegetation works have entered a monitor and maintain phase with active monitoring programs in place.

2.3.1 Installation of Groundwater Monitoring Bores (2020 / 2021)

Within the catchment there exists over 110 dedicated groundwater monitoring bores belonging to either Alcoa (71 bores), Barwon Water (32 bores) and the State Government SOBN (14 bores). These bores are shown in **Figure 2-2**. Many of these bores have been installed for a variety of reasons. These reasons (i.e. their purpose) along with basic construction details is presented **Appendix E**

During 2020 and 2021, 16 groundwater observation bores were constructed around the periphery of the mine. These are in addition to the 71 bores listed above. The location of these bores are shown in **Figure 2-7**. The rational for the construction depth and location of these bores is discussed in **Table 2-1**. Their construction details is presented **Appendix E** and bore logs presented in **Appendix F.**

Table 2-1 Rationale for Construction of New Near Mine Void Bores

Bore ID	Targeted Lithology	Rationale
UEVF MB 1	The upper sands of the UEVF, refer **Section 5.2.2.2.3**	The purpose for construction of these bores is to: • Obtain a greater understanding of the lithology and water levels in the upper section of the UEVF. • Confirm extensiveness of the basal clay which is assumed to overlie and confine theses “upper sands”. • To act as monitoring bores to monitor for potential drawdown impacts arising from the pumping test which could then imply drawdown from the mine pit waterbody into formation.
UEVF MB 2		
UEVF MB 3		
UEVF MB 4		
UEVF MB 5		
UEVF MB 6		
UEVF MB 7		
UEVF MB 8		
DBG MB 8	The permeable zones (Boonah Sands) in the DBG and located above the main coal, refer **Section 5.2.2.1.**	The purpose for construction of these bores is to: • Obtain a greater understanding of the lithology and water levels in the DBG surrounding the mine. • To act as monitoring bores to monitor for potential drawdown impacts arising from the pumping test and to obtain baseline data which can be used to monitor for pit water / aquifer when the waterbody reached such level that pit water may naturally migrate into the DBG.
DBG MB 1		
DBG MB 2		
DBG MB 3		
DBG MB 4		
DBG MB 5		
DBG MB 6		
DBG MB 7		
DBG MB 9		

2.3.2 Catchment Drains

Important to the overall mine water balance are the installation of catchment drains to assist surface water runoff from the greater mine lease area to be directed into the mine void. Some of these drains are pictured on **Photo 1** and the overall layout of the drains and their supporting catchment is shown in **Figure 2-6**. The estimated volume of runoff these drains are likely to provide is discussed in **Section 5.6**.

Photo 1 Images of the Installed Catchment Drains (Drain 4 (left); Drain 9 (right))

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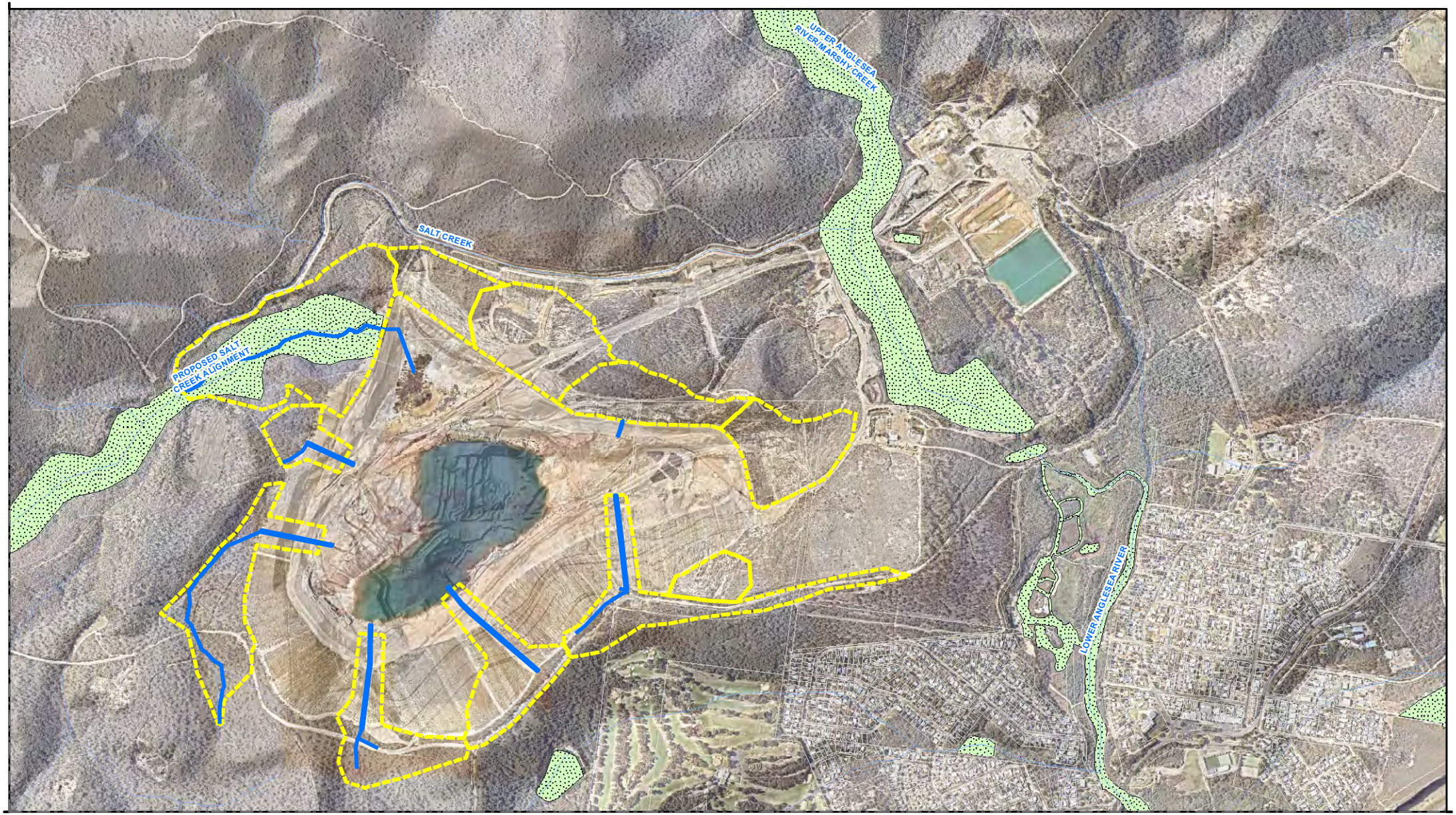

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Figure 2-6 Catchments and Drainage

- Drainage
- Catchments
- Watercourse
- Parcel Boundary
- Marshland

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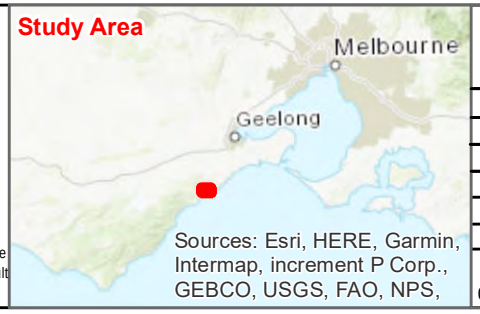

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-2 Location of Proposed New Groundwater Observations Bores.mxd

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Figure 2-7

Location of New Groundwater Observation Bores

Legend

- Groundwater Bore – DBG
- Groundwater Bore – UEVF
- Surface Water (Gauge)
- Surface Water (Pit)
- Monitoring Bore
- Pumping Well
- Lake Boundary (+7mAHD)
- Watercourse
- Proposed Road
- Existing Road
- Marshland

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Study Area

Water Monitoring, Management and Contingency Plan

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MAP PROJECTION:	GDA94
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2.3.3 Subsidence Monitoring

From 1996 until current subsidence has been monitored from prism and GPS pin monitoring from the south wall area of the mine (**Appendix I**). In summary, the movement that is observed during the 2000's is attributed specially to 'relaxation' of the wall in response to actual mining. Apart from this, RL's typically have not moved significantly since monitoring began.

2.3.4 Decommissioning of Site Infrastructure

Between 1969 and 2015, Alcoa's groundwater extraction and monitoring used a series 12 groundwater bores (WB3-5, WB8-10, and WB12-17) located across the former Power Station site. During 2020 and 2021 these bores were subject to a borehole assessment program (BAP) which comprised geophysical logging (gamma and calliper) and downhole camera inspection to determine the bores condition and the reliability of the data during the pumping test. The results of the BAP are presented in **Table 2-2**.

Table 2-2 Findings of Bore Assessment Program

Bore ID	Bore Construction Log available	Pump in bore	Screened intervals (mbgs)	Obstructions (mbgs)	BAP Assessment
WB3	No	No	No bore construction log available and screen intervals could not be confirmed with CCTV	126m Unknown blockage	During the CCTV investigation the bore was confirmed to be full of sediment. The bore was cleaned out using mud rotary drilling techniques to a depth of 201 m, which is either the base of the bore or an obstruction. The drill rig could not progress past this depth. The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF, therefore it was decommissioned. The bore was perforated at a depth of 195 m, approximately 5 m above the UEVF/MEVF interface.
WB4	No	No	Bore was re-sleaved	84.1 - Bore has been bridged, a lot of sediment sitting on top of the bridge	In 1977, this bore was repaired by re-sleaving with an 8-inch casing. As part of the BAP, the drilling contractor advanced down through the bore annulus to 195m. A geophysics survey was completed and the screened intervals were confirmed at 117-120 m, 161-164m, 176-182m. It is likely that other screened intervals were installed but these could not be confirmed by the geophysics survey. A decision was made to re-sleave WB4. The re-drilling of the bore as part of the BAP was successful and lithological information and geophysical logs were reviewed to enable a suitable design. The following bore design summary is provided: • 50mm diameter screen and casing • Screen intervals at 117-120m, 161-164m, 176-182m, 191-194m. The casing was perforated at 192.5m • Fibre-glass casing was used from 0-117m • Stainless steel screens and blank casing were used from 117-195m • A sump was installed from 194-195m.

Bore ID	Bore Construction Log available	Pump in bore	Screened intervals (mbgs)	Obstructions (mbgs)	BAP Assessment
WB5	No	No	110.3 - 112.5 Additional screened intervals not encountered due to obstruction	112.5 - Appears to be cabling associated with a pump	Downhole camera confirmed that the casing had pulled apart at 86.5 m and the bore was full of sediment to 112.5m. The bore was cleaned out using mud rotary drilling techniques to attempt to reach the bottom of the bore and to confirm screen intervals. Based on the drillers observations, and the geophysics survey responses, the casing was compromised at a number of depths and therefore WB5 was confirmed to be unsuitable for monitoring or sampling purposes. The responses also indicated that the bore was only constructed to a shallow depth, around 151 m, when compared to the surrounding production bores. Therefore this bore was only screened in the lower sands of the UEVF and was decommissioned appropriately.
WB8	No	No	No bore construction log available and screen intervals could not be confirmed with CCTV	47.5 - Appears to be rusted metal	The driller confirmed that this bore had previously been decommissioned and grout was encountered at 50 m when cleaning out the bore. This bore was then decommissioned again using a grout/bentonite mix to the ground surface.
WB9	Yes	No	126.2 - 129.2 146 - 149 155 - 161 172 - 175 181.1 - 182.6 Obstruction at 188.1	188.1	The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF/LEVF, therefore it was decommissioned. The bore was perforated at a depth of 162 m.

Bore ID	Bore Construction Log available	Pump in bore	Screened intervals (mbgs)	Obstructions (mbgs)	BAP Assessment
WB10	Yes	Yes	109.1 - 112.1 124.1 - 127.1 131.0 - 133.5 138.6 - 141.6 159.5 - 161.1 172.9 - 174.4 187.5 - 191.8 197.8 - 199.3 207.8 - 211.4	None	The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF/LEVF, therefore it was decommissioned. The bore was perforated at a depth of 117 m.
WB12	Yes	No	147.2 – 157.0 174.3 – 178.9 184.4 – 187.5 200.3 – 205.1 219.8 – 221.3	108.1 - Unknown 151 - Obstruction identified during second CCTV camera 194 - Driller pushed obstruction to depth	As part of the BAP, the drilling contractor has identified a number of integrity issues with this bore: • Collapsed casing at 90m; • Damage to the casing (large holes) between 107m and 117m. • Significant debris throughout with a large obstruction at 193m. • Screens blocked by silt / sediment and likely iron bacteria. At this stage WB12 forms part of the monitoring network. Following pump shut down and the collection of recovery data, further analysis will be undertaken to assess the response in WB12. Depending on the outcomes of the data analysis, WB12 may be: • Rectified by re-sleaving the casing issues, removing the obstruction at depth and cleaning the screened intervals; or • Decommissioned. Note any decommissioning will not be undertaken whilst the pump test is active.

Bore ID	Bore Construction Log available	Pump in bore	Screened intervals (mbgs)	Obstructions (mbgs)	BAP Assessment
WB13	Yes	Yes	165.05 – 168.25 175.25 – 178.45 187.0 – 190.2 199.05 – 200.71 213.44 – 216.62 227.59 – 232.29	145 - Appears to be lines/chords. They were removed	The geophysics data confirmed that this bore was likely cross-screening the UEVF and MEVF/LEVF, therefore it was decommissioned. The bore was perforated at a depth of 160 m.
WB14	Yes	Yes	155.9 – 158.9 183.0 – 168.5 183.0 – 183.0 187.4 – 190.4 194.8 – 196.8 211.7 – 213.7	138.7 - Appears to be a metallic object and cabling	Obstruction removed and bottom of bore confirmed at 214 m. Geophysics data confirmed that this bore is screened within the UEVF. The bore was found to be in good working order.
WB15	Yes	Yes	186.8 – 190.8 197.8 – 200.8 210.8 – 214.8 220.4 – 222.4 227.0 - 230.0 244.5 – 247.5	79.0 - Potentially pump cabling. Obstruction removed 4 September 2020	Obstruction removed and bottom of bore confirmed at 225 m. Geophysics data confirmed that this bore is screened within the UEVF. The bore was found to be in good working order.

Bore ID	Bore Construction Log available	Pump in bore	Screened intervals (mbgs)	Obstructions (mbgs)	BAP Assessment
WB16	Yes	No	173.7 - 177.7 183.7 - 189.7 199.2 - 203.2 208.3 - 211.3 216.8 - 220.3	None	WB16 is the pumping bore. Prior to undertaking the plumping test, the bore was inspected by downhole geophysics and CCTV camera. The bore was found to be in good working order.
WB17	Yes	Yes	120.6 – 127 133 – 137.2 144.2 – 147.2 155.2 – 158.2 169.2-174.2 178.2 – 182.4 185.6 – 189.6	171 - Not confirmed	Obstruction pushed down to 177 m. The geophysics data confirmed that this bore was cross-screening the UEVF and MEVF, therefore the bore was perforated at a depth of 167 m and it was decommissioned.

2.4 Summary of Lessons Learnt from Post 2015 MRCP Activities

The following lesson learnt presents information that either confirms or suggests material departures from hydrogeological assumptions and conclusion derived from pre 2015 investigations. A high-level summary of these learnings is presented in the sections below. All learnings have been used to inform the development of the updated conceptual hydrogeological understandings (summarised in **Section 6**) as well as the draft Anglesea Numerical Model (GHD 2022 Draft).

2.4.1 Learnings from Installation of New Observation Bores

As shown in **Figure 2-7,** 8 nested pairs of bores have been installed in to the shallow DBG and the upper sands of the UEVF around the periphery of the mine. Geological core has been retained from several bores (UEVF MB 7 and UEVF MB 8) and 5 core sections within UEVF MB 7 were subject to laboratory permeability tests. Key learnings are presented below.

- The majority of the DBG bores are dry indicating that near the mine void, these units discharge water into the mine void keeping the local DBG unsaturated.

  This observation matches previous conceptualization and assumptions.

- In bore log UEVF MB08 on the western margin of the mine, the UEVF Upper Sands were not encountered. Numerous other exploration bores in this location also identified no sand units below the main coal seam. This suggests the upper sands of the UEVF form a discontinuous permeable unit and are primarily found underneath the basal clay in the vicinity of the former mine and potentially extend towards the coast. The upper sands do not outcrop or extend in any great distance west and north of the mine, rather they pinch out within the subsurface.

  This observation is a departure from earlier assumptions where these upper sands were assumed to be regionally extensive.

- A clay unit (basal clay) exists below main coal seam however may have been excavated near the vicinity of the mine sump and at UEVF MB 6. At these locations the mining of coal may have thinned the basal clay to a minimal thickness causing some degree of connectivity to the UEVF upper sand lens and the mine water body. Further evidence of this is groundwater elevations from data loggers installed in Bores UEVF MB01-07 show increasing trends. This could be in response to cessation of the sump pump which was historically operated to keep the sump dry. Groundwater contours shown on **Figure 5-59** also show that groundwater is migrating to the sump location. Water quality is also variable across these upper sand locations however no spatial correlations can be concluded. For example, the water quality in UEVF MB07 ranges 170 to 200 mg/L TDS which is significantly fresher than all surface water systems and other UEVF MB bores. This suggests that this sand lens is recharged where the sand outcrops and is not influenced by the alluvial swamp aquifer (ASA) or surface water. Interestingly, the hydrographic response in this bore shows no evidence of delayed recharge to rainfall and has similar trends to the other UEVF Upper sand bores.

  This is a departure from earlier assumptions where it was assumed the basal clay underlie the main coal seam and varied in thickness between 1-4m.

- Laboratory permeability tests of clay and coal sections within UEVF MB 7 indicate that permeability ranges from 7E-10 m/sec at 33mbgl to 3E-9m/sec at 55mbgl to 2E-9m/sec at 70.5mbgl and 1E-10 m/sec at 140mbgl.

  This is a minor departure from earlier assumptions. Whilst it was assumed these coal and clay lenses were relatively impermeable, these permeabilities are 1-2 orders of magnitude lower that initially conceptualized.

- A total cumulative thickness of over 100m of low permeability clay and coal sequences separate the upper sands and lower sands of the UEVF.

  This is a departure of past conceptualisations where the total thickness of the UEVF was treated as a bulk aquifer (with an even distribution of sand, clay and coal seams distributed throughout its thickness).

2.4.2 Learnings from the 6-Month Pumping Test

A 6-Month groundwater pumping test commenced on 13 May 2021 and ceased on 8 December 2021. The objective of the pumping test was to establish various aquifer parameters to support a revision to the Anglesea Groundwater Model (Refer GHD 2022) and determine additional information to support a potential licence amendment for the UEVF.

A total of 671.9ML was extracted during the test and monthly reviews were conducted with the Co-regulator Technical Working Group (inclusive of Alcoa, Southern Rural Water, DELWP, EPA Victoria, Earth Resources Regulation, Barwon Water and Corangamite Catchment Management Authority).

Appendix D presents the in-depth findings from the Pumping test however the following observations can be made:

- Prior to the pumping test being undertaken, analytical solutions indicated that at a pumping rate of 50 L/sec, drawdown impacts >0.2m after 6 months would radially extend ~3km from the dewatering bore. During the test, SOB 116459 which is located 2,986m from WB16 appeared to show a minor impact on the groundwater trend (0.2m over 3 months) once the pumping rate was increased from 40 L/sec to 50 L/sec. Once the pumping rate was reduced to 40 L/sec, groundwater levels within this bore stabilized, refer **Figure 5-61**.

  This observation matches previous assumptions and indicates that the preliminary hydrogeological parameters and assumptions used in the initial setup on the analytical model (and earlier numerical models) are reasonable. Furthermore, the relative instantaneous response of groundwater levels to changes in the pumping rate at this distance indicate that the lower sands of the UEVF are consistent with low storativity. Again, previous assumption of low aquifer storativity are supported by this observation.

- As discussed in **Section 2.4.1** the upper half of the UEVF contains predominantly thick sequences of low permeability clay and coal.

  This understanding is a departure of past conceptualisations where the total thickness of the UEVF was treated as a bulk aquifer (with an even distribution of sand, clay and coal seams distributed throughout its thickness). In addition to the drilling and geophysical logging of observation and production bores, during the pumping test, groundwater pressure in all monitoring bores in the mid and upper section of the UEVF within close

proximity to the pumping bore demonstrated no impact from pumping. The lower section of the UEVF where the pumping well was screened exhibited drawdowns up to 65m.

2.4.3 Other Learnings

Other learnings that can be noted are:

- Near the mine void, a low permeability clay separating the water within the ASA and underlying groundwater systems is mapped in all bores/exploration holes that are/were located in the ASA. Episodic or delayed responses to rainfall are not observed in the UEVF upper sands indicating leakage is minimal. The water table within the ASA at WTOB2 remains relatively stable with declines only observed in dry summers, refer **Figure 5-72**.

  This observation matches previous conceptualization and assumptions whereby the ASA is considered to behave like a perched system with assumed limited connectivity to underlying aquifer systems, having an aquitard (low permeable layer) separating the water within the ASA and underlying groundwater systems.

- Permeability tests from 29 sites located in the mine void representative of the reworked and backfilled BDG at depth between 0.5m and 8m show Kv (min = 6.9E-6m/d, max = 6.05E-3 and mean = 8.6E-5m/d). Further information on these results is presented in EHS Support 2022a (Draft).

  This is somewhat of a departure from initial assumptions. Whilst the DBG was considered to consist of low to moderate permeability, these permeabilities are several orders of magnitude lower that initially conceptualized. The long lasting pooling of water after rainfall on the DBG, refer Section 5.4.2.3 and Figure 5-49 is also an indication of the formations low infiltration potential.

- Since the decommissioning of several older Alcoa production bores which may have cross screened UEVF and MEVF/LEVF formations (refer **Section 2.3.4**), recent groundwater level data post bore decommissioning show no response from LEVF pumping in the UEVF lower sands, refer to **Figure 2-8**. Prior to bore decommissioning when the LEVF was pumped from GW1-5, minor impacts on the UEVF were observed in the UEVF (refer Bore WB5 response). Post decommissioning, these impacts are not replicated.

  This is somewhat of a departure from initial assumptions the Middle Eastern View Formation (MEVF) was thought to be a leaky aquitard due to the minor drawdown impact in UEVF bores during historical LEVF pumping. Whilst is it likely that the MEVF contains areas where it is leakier that others, it is likely that in the Alcoa AOI, the MEVF is potentially tighter than initially conceptualised.

- A review of all available exploration geological bore logs (22 logs) that were located either within or adjacent to the ASA shows that an average thickness of 27.7m (max = 86m; min = 2.4m) of either clay or silt (e.g. low permeability material) that separates the base of the alluvial / swamp sediments in which surface water flows to the next most permeable layer underlying the surface water systems.

  This observation matches previous conceptualization and assumptions that the swamps and marshlands that make up the ASA act like a Perched Water Table (PWT).

- A review of all ASA monitoring bores have shown a stable trend over the last 10 years with despite Alcoa extraction up to 2016 and more recent aquifer tests, and also aquifer tests undertaken by Barwon Water between 2009 and 2012 and again recently in 2022.

  This observation matches previous conceptualization and assumptions that the swamps and marshlands that make up the ASA act like a Perched Water Table (PWT).

- A review of the impact of episodic rainfall events on groundwater levels within the ASA and underlying BDG and UEVF show that for most large rainfall events exceeding 40mm, an immediate increase in groundwater levels at most ASA monitoring locations was observed. For nested sites or where bores are close together, for the corresponding rainfall event no increase or only very minor and delayed responses was observed in underlying BDG or UEVF monitoring points. This indicates that direct rainfall recharge is the dominant driver of recharge to the ASA.

  This observation matches previous conceptualization and assumptions that the swamps and marshlands that make up the ASA act like a Perched Water Table (PWT).

- Within the ASA, the steepest decline of groundwater levels occurs over spring and summer when episodic rainfall events are absent (such as spring and summer of 2011/12; 2013/14; 2015/16; and 2019/2020). This similar correlation is not commonly observed in unconfined aquifers surrounding the ASA such as the outcropping UEVF and BF.

  This observation matches previous conceptualization and assumptions that evapotranspiration (during dry spring and summers) is a key cause of water loss from the ASA.

- It is estimated that allowing the mine pit void to naturally fill would take between 50 and 100 years.

  This estimation will be impacted by the installation of catchment drains (may fill quicker) to assist surface water runoff from the greater mine lease area to be directed into the mine void, Figure 2-6. However, under certain climate change scenarios, this time frame could take longer.

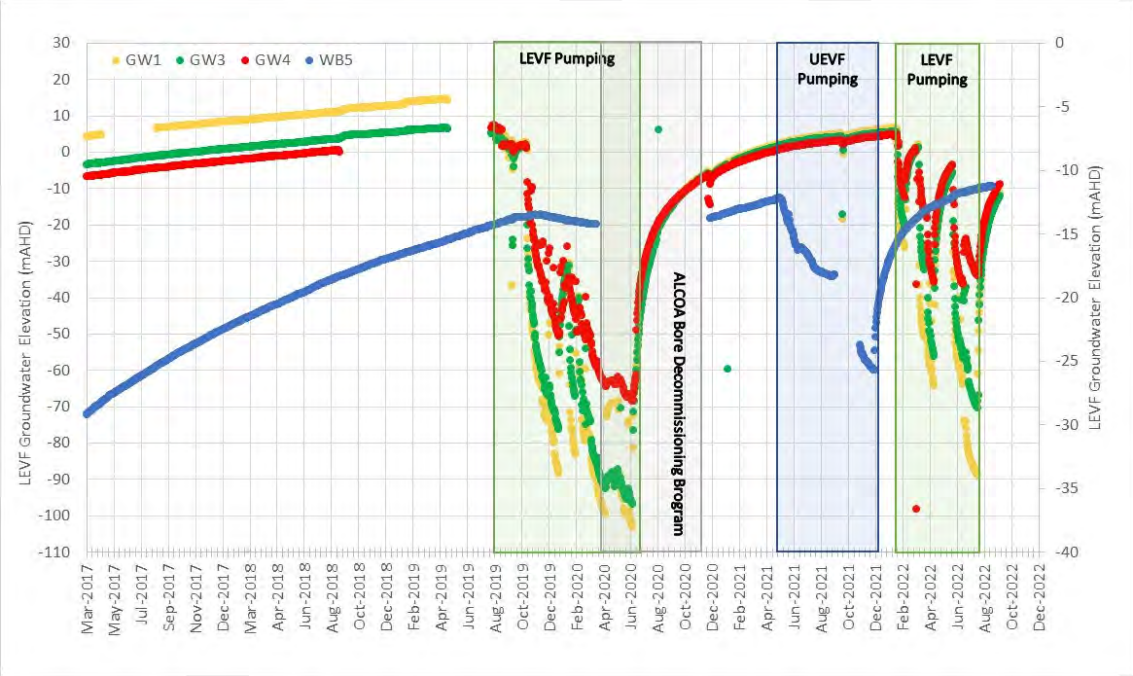


Figure 2-8 Groundwater Elevations Before and After the Assessment Program

2.5 Summary of Groundwater Investigations

As discussed in **Section 1.1** data presented within this report is not intended to cover the whole catchment as Alcoa's area of interest (AOI, refer **Section 5.2.1**) only cover a small part of the overall catchment. There has however been a plethora of existing environmental investigations and impact assessments undertaken over the last 60 years to characterise groundwater behaviour both within Alcoa's AOI and more broadly across the greater catchment and groundwater management area. The main investigations that have significantly advanced the understanding of the hydrogeological conditions are summarised in **Table 2-3**. These reports and data, where available, have been used to assist in building this conceptual hydrogeological model (CHM) and the development of the original numerical groundwater (GHD 2013) flow model used to assess groundwater extraction-related risks.

The detailed findings (such as aquifer permeability data) where necessary from each of these investigations are summarised within **Section 5** (Conceptual Geological and Hydrogeological Model).

2.6 Summary of Surface Water and Catchment Investigations

In addition to groundwater data, numerous investigations have been conducted detailing surface water and catchment conditions. Those considered as key references in assisting the understanding of environmental conditions surrounding the mine (as well as in the broader catchment) are presented in **Table 2-4**.

In addition to the studies listed in **Table 2-4**, a number of research projects were completed on the surface water chemistry in the Anglesea catchment including, 'The cause(s) of the acidification of the Anglesea River, Victoria' (Hermon, 2002), and 'Trace element distribution and speciation in the Anglesea River' (Meyrick, 1999). Both investigations focused on aluminium (Al), iron (Fe), manganese (Mn) and zinc (Zn) concentrations, and Hermon (2002) focused especially on pH values. Hermon (2002) concluded that an acid sulfate mechanism is naturally operating within the Anglesea catchment. This conclusion has been supported by numerous other investigations (Maher, 2011 and GHD, 2013a).

The geology of the area has been extensively investigated. Recent research includes, 'Geology of coal bearing Palaeogene Sediments, Onshore Torquay Basin, Victoria' (Holdgate, *et al.,* 2001) and 'Local Geology and the Eastern View Coal Measures, Anglesea, Victoria' (Smith, 1998).

Table 2-3 Key References Used to Develop the CHM

Report	Description	Relevance to Alcoa's AOI
The Hydrogeology of the Anglesea Area (Hancock, 1967)	This report presents an early discussion of the hydrogeology and geomorphology of the Anglesea region. The initial findings of site conditions are also discussed and provided valuable insight to the hydrogeological conditions pre mining.	Directly relevant to Alcoa's AOI
The Impact of Groundwater pumping at the Alcoa Coal Mine at Anglesea on Regional Aquifers (SKM, 1998)	This report presents groundwater monitoring information and other hydrogeological information relevant to Alcoa pumping and its potential effects on the surrounding area.	Directly relevant to Alcoa's AOI
Groundwater Extraction Assessment (SKM, 2007)	The purpose of this study was to provide further preliminary results for the impacts assessment and identify areas for further investigations. The scope of work involved the following tasks: • Develop a strategy for liaison with SRW and Department of Sustainability and Environment (DSE); • Obtain available information from Alcoa and the Department of Primary Industries (DPI); • Undertake a detailed hydrogeological assessment to develop a conceptual model; • Formulate and calibrate a three-dimensional finite difference numerical model using MODFLOW 2000 to predict the groundwater response to future changes in mine dewatering; • Develop a two-dimensional finite element FEFLOW model to assess the movement of salt water near the coast under additional pumping stresses; and • Make recommendations for areas requiring additional hydrogeological information.	Directly relevant to Alcoa's AOI
Holdgate (2001, 2002 and 2009)	These reports contain a stratigraphic evolution of the Boonah Formation and how this unit was re-assigned from the Eastern View Formation (EVF) to the DBF.	Directly relevant to Alcoa's AOI
Anglesea / Barwon Water Bore Field Project (GHD, 2008, 2013)	This report presents numerical modelling simulations and hydrogeological conceptualisation associated with the Barwon Water Bulk Entitlement from the Victorian Government in 2009 to install and operate the 7,000 ML/year (19.2 ML/day) borefield. The later report (2013) provides updates to the conceptual hydrogeological model as well as numerical model.	Alcoa's AOI plus the broader catchment

Report	Description	Relevance to Alcoa's AOI
Anglesea Borefield Project Isotopic and Tracer Studies (GHD, 2011a)	This report details the scope, methodology and results of detailed environmental tracer and groundwater dating studies conducted in the Anglesea Borefield project area. The key objectives of the environmental tracer and dating studies were to: • Provide a better understanding of potential interactions between groundwater and surface water in key asset point areas (located within what are referred to as the Northern and Southern Lower Eastern View Formation [LEVF] Outcrop Areas); and • Provide a better understanding of groundwater residence times, and therefore allowing better numerical model conceptualisation and calibration.	Alcoa's AOI plus the broader catchment
Anglesea Borefield Surface Water Quality Results (GHD, 2011c to 2016 and 2019).t	These reports detail the results of the annual Surface Water Quality monitoring requirements as listed under the Barwon Waters Bulk Entitlement and associated Monitoring and Assessment Program (MAP). Note: Only raw data from 2019 has been sighted and used in this report.	Alcoa's AOI plus the broader catchment
Jan Juc Groundwater Management Area Groundwater Resource Appraisal (GHD, 2019)	This report was commissioned by DELWP with the scope to complete a review of the Sustainable Yield of the Upper Eastern View Formation (UEVF) aquifer within the Jan Juc Groundwater Management Area (GMA).	Alcoa's AOI plus the broader catchment
Groundwater Monitoring Reports (Coffey, 2006 to 2015)	This series of reports presents groundwater monitoring works at the former power station to assess potential groundwater impacts, and if so, compare groundwater results to ecological and health-based investigation levels, and assess the potential impact to receptors based on the groundwater quality.	Directly relevant to Alcoa's AOI
7-Day Constant Rate Pumping Test (EHS Support, 2020)	EHS Support completed a pumping test investigation, including a step drawdown test and 7-day constant rate pumping test, to refine aquifer hydraulic parameters of the UEVF.	Directly relevant to Alcoa's AOI

Report	Description	Relevance to Alcoa's AOI
6-month UEVF Pumping Test (**Appendix D** of this report)	A long-term pumping test was undertaken on the UEVF Lower Sands aquifer (13 May 2021 to 8 December 2021) with the following objectives: • Obtain additional hydrogeological data (such as storativity and transmissivity) that can be used to develop a robust and peer-reviewed conceptual and numerical groundwater flow model that will determine if the use of longer term UEVF groundwater is a practical and an environmentally sustainable water management strategy to fill the mine pit void as part of the MRCP. • Address data gaps identified in the draft MRCP.	Directly relevant to Alcoa's AOI

Table 2-4 Key References Used to Develop an Understanding of Catchment Conditions

Report	Description	Relevance to Alcoa's AOI
A Hydrogeochemical Assessment of Trace Element Concentrations at the Alcoa Power Station (Beattie, 2003)	This report was for the fulfilment of an honours degree and contained an environmental assessment of the site. The assessment included a lithology, hydrology and geochemical evaluation of trace element concentrations in the shallow aquifer.	Directly relevant to Alcoa's AOI
Anglesea Borefield Project Groundwater Investigations: Terrestrial Flora and Fauna (Ecology Australia, 2007)	This is a report conducted for Barwon Water and presents an investigation of the potential dewatering impacts on terrestrial flora and fauna arising from the proposed Barwon Water Bulk Entitlement groundwater extraction.	Alcoa's AOI plus the broader catchment

Report	Description	Relevance to Alcoa's AOI
Anglesea Borefield Flora and Fauna Monitoring (Ecology Australia 2008 - 2013)	These reports present extensive flora, fauna and aquatic ecological surveys that were undertaken in the study area to identify significant species and establish baseline conditions as part Barwon Waters Bulk Entitlement impact assessment.	Alcoa's AOI plus the broader catchment
Anglesea River Water Quality Review. Independent Review (Maher, 2011)	This report was undertaken in response to growing community concerns about the health of the Anglesea River. This report deals with the request in April 2011 from the Minister for Environment and Climate Change, to conduct an independent investigation with the following terms of reference: • Review the history of acid events in the Anglesea estuary. • Identify the sources of acidic water and metals in the estuary. • Investigate the role of specific factors that are of concern to the community, such as, the role of land use in the catchment, licensed discharge into the river and water extraction. • Review options for remediation of poor-quality water originating from the catchment.	Alcoa's AOI plus the broader catchment
Barwon Water – Report for Anglesea Borefield Project (June, 2011)	This assessment evaluated the degree of groundwater surface water interaction at the Salt Creek and Anglesea River pools. Initial numerical modelling indicated that the upper reaches of the Anglesea River and Salt Creek may be baseflow dependent.	Alcoa's AOI plus the broader catchment
Anglesea Power Station 53V Audit (GHD, 2012)	This report was triggered by the issuing of a Pollution Abatement Notice (PAN) after high levels of boron were discovered downstream of the former power station.	Directly relevant to Alcoa's AOI
Anglesea River Estuary Flow Assessment Final Approved Report (GHD, 2016)	The Anglesea River Estuary Flow Report Assessment provides an assessment of the changes to the physical character and ecological, social and economic values resulting from changes to the mine and power station discharge, and a high-level scoping of options to manage the predicted changes.	Alcoa's AOI plus the broader catchment
Anglesea Estuary Water Balance Scenarios (GHD, 2017)	Anglesea River scenario modelling to understand the effect of Salt Creek diversion on maintaining the minimum stage height requirements and flows for the maintenance of beneficial uses in the Anglesea River estuary.	Alcoa's AOI plus the broader catchment

Report	Description	Relevance to Alcoa's AOI
Anglesea River and Estuary Environmental Flow Study (GHD, 2021)	The study aimed to determine the environmental flow requirements for waterways in the catchment and estuary of the Anglesea River. This study involved field assessments and developing water balance, hydrodynamic and geochemical models. This report also quantifies the catchment groundwater dependence ecosystems	Alcoa's AOI plus the broader catchment
Anglesea Borefield Bulk Entitlement Aquatic Monitoring (GHD, 2011b to 2016)	These reports detail the results of the annual aquatic ecological monitoring requirements as listed under the Barwon Waters Bulk Entitlement and associated Monitoring and Assessment Program (MAP)	Alcoa's AOI plus the broader catchment
Anglesea Acid Sulfate Soil Assessment (Wong et al. and Monash University, 2021)	A study carried out on behalf of Monash University to better understand Acidity in the Anglesea River catchment	Alcoa's AOI plus the broader catchment
Anglesea Borefield Surface Water Quality Results (GHD, 2011c to 2016 and 2019).t	These reports detail the results of the annual Surface Water Quality monitoring requirements as listed under the Barwon Waters Bulk Entitlement and associated MAP.	Alcoa's AOI plus the broader catchment

Report	Description	Relevance to Alcoa's AOI
Review of Numerical Model Outputs and Assessment of the Implications on Potential Acid Generation Process (GHD, 2013a)	The scope of this assessment is limited to a review of previous documentation, the findings of the updated numerical modelling report and monitoring data collected as part of ongoing MAP established for the Bulk Entitlement (BE). The scope of works comprised of the following tasks: • Review of background information (including GHD, 2012b) and develop simple conceptual models for key components of the catchment where there may be a potential for further acid generation to occur; • Review the updated hydrological model report (GHD, 2013b), particularly relating to effects of pumping on drawdowns and cease to flow events and provide an opinion on whether the acid generation potential is likely to be increased due to Barwon Water extraction (for both climate scenarios); • Review the significant first flush predictions to assess whether significant first flush events that may affect the Anglesea Estuary are likely to change frequency during BW extraction in comparison to baseline conditions; • Develop threat descriptor tables for potential acid generation and assign threat scores to different areas of the catchment, as part of the Ecological Risk Assessment process being undertaken as part of evaluating impacts from groundwater extraction; and • Complete a short report (this document) detailing conceptual models, assumptions, the reasoning behind threat descriptors and threat scores and conclusions on whether there is likely to be a potential impact on acid generation in the Anglesea catchments under BW pumping, under the different median and dry climate model scenarios.	Alcoa's AOI plus the broader catchment

2.7 Data Sets

2.7.1 Surface water

2.7.1.1 Flow

Total stream flow data available at monitoring point SV2 (Lower Salt Creek) ranges from 1967 to 1982 and 2009 to current. Flow records at monitoring point AV2 (Marshy Creek) ranges from 2009 to current. At SV2, flow data recorded since 2009 shows that there has been significantly less flow in Salt Creek when compared to the 1967 to 1982 time period. Due to the vastly different flow and climatic conditions in each period and the 27-year data gap between each period, there is uncertainty to apportion the cause(s) of the recent flow decline. However, evidence suggest the decline correlates well to climate. This is discussed further in **Section 3.3** and **Section 3.8**.

Temporal rainfall and runoff flow gauge data is insufficient to determine the rainfall-based flow for high and medium frequency events (greater than 1 in 50-year event). Estimates extrapolated beyond that are considered unreliable and cannot be established using the accepted flood frequency analysis techniques. As such, a runoff routing model (RORB) for Salt Creek was developed to allow reliable estimation of rare and extreme events. RORB is a runoff and streamflow routing program that is used to calculate flood hydrographs. The model uses available rainfall records in the catchment, estimates losses and calculates runoff.

In most cases since 2012, Barwon Water have monitored stage heights at locations further up the catchment. There locations (**Figure 4-2**) are AV1, SV1, AV3, SV3, AV4 and SV4 (all V-notch weirs); AGP1-A, AGP1- B, SGP1-A, SGP2-A, SGP1-B (all permanent water holes) and ASP7 and AGP2 (wetlands).

2.7.1.2 Water Quality

Due to ythe ephemeral nature of the of Salt Creek, a limited data set of comprehensive water quality parameters exist. Additional monitoring has been completed and will continue at varying stages of future flows (pre-during and post peak) to assist with further characterisation of the surface water beyond that of major ions and physio-chemical parameters.

While water quality data was collected from the mine pit void prior to 2016, there remains uncertainty around how and where these mine pit void samples were taken.

As above, Barwon Water have monitored (usually quarterly), water quality at locations AV1, SV1, AV3, SV3, AV4 and SV4 (all V-notch weirs); AGP1-A, AGP1-B, SGP1-A, SGP2-A, SGP1-B (all permanent water holes) and ASP7 and AGP2 (wetlands). **Figure 4-2** shows monitoring locations. This data is also summarised in annual groundwater quality for the Barwon Waters Anglesea Borefield project (refer GHD 2017 for latest summary).

2.7.2 Groundwater

2.7.2.1 Hydro-Stratigraphy

The region around the coal mine contains detailed information that has allowed for a comprehensive understanding of the sub-surface stratigraphy. Furthermore, the hydraulic behaviour/parameters of each major aquifer (LEVF and UEVF) are generally well understood. Whilst the hydraulic properties of the Middle Eastern View Formation (MEVF) aquitard are unknown, concurrent aquifer pumping have occurred in bores screened above and below the MEVF. This has enabled some estimation on its competence as an aquitard. Furthermore, during the installation of the Anglesea borefield, core was obtained of the shale and siltstone of the MEVF.

2.7.2.2 Groundwater Level

Groundwater level data has been collected across the catchment with some groundwater levels dating back to 1969. **Appendix E** provides a summary of the amount of groundwater data that has been collected over time as well as a brief comment on the data reliability.

2.7.2.3 Groundwater Quality

Across the mine and power station site, groundwater quality sampling has been sporadic and governed by individual project timelines. Physio-chemical parameters such as pH and total dissolved solids (TDS) have been sampled relatively frequently, with some datasets extending back to 1970.

Transient groundwater quality defined by analytical suites containing organics, nutrients, metals and major and minor ions are limited; however, through the development of Barwon Waters Anglesea borefield and sporadic sampling of Alcoa's observation bores, sufficient water quality data exist to classify water types and perform data analysis involving geochemical mixing.

As above, Barwon Water have monitored (usually quarterly), water quality at locations of bores listed in **Appendix E** that form part of their Anglesea forefield monitor network.

2.7.3 Climate

Six meteorological weather stations exist near the site with the closest weather stations to the site being Wensleydale, approximately 6 km to the northwest and Aireys Inlet, approximately 9 km to the southwest. The weather stations and the data considered in this study are presented in **Table 2-5**[1].

Table 2-5 Climate Data Summary

BOM Station Name	Station ID	Year From	Year To	Lat.	Long.	Temp	Wind Speed	Rainfall	Evap.
Aireys Inlet	90180	1994	2022	-38.458	144.0883	x	x	x	
Wensleydale Anglesea (Vehicle Proving Ground)	87119	1965	2020	-38.368	144.0843			x	
Torquay Golf Club	87160	1974	2016	-38.340	144.3101			x	

[1] All meteorological data is derived from www.bom.gov.au.

BOM Station Name	Station ID	Year From	Year To	Lat.	Long.	Temp	Wind Speed	Rainfall	Evap.
Wurdiboluc Reservoir	87126	1969	2016	-38.282	144.0518			x	x
Buckley (Balliwindi)	87124	1968	2022	-38.250	144.0854			x	
Boonah	90187	2001	2022	-38.411	143.9771			x	

The data listed in **Table 2-5** are considered appropriate for the required use with the exception of hydrodynamic modelling. For this activity site-specific climatic conditions of wind, temperature and solar radiation are required and is a consideration for the long-term MRCP.

3 Environmental Setting

3.1 Topography and Land use

The topography of the Anglesea area is presented in **Figure 3-1**. The land surface falls rapidly from 300 m AHD to 400 m AHD in the west to 0 m AHD along the coastal plains.

The topographically elevated areas to the west of Anglesea are dominated by forest. This primarily comprises native vegetation conservation areas, with smaller areas of production and plantation forestry (**Figure 3-1**). Across the flatter areas to the north and east, grazing pastures dominate. Urban land use is limited to small areas at the coastal towns. Several large and small marsh and wetland areas are found across the region. There are extensive swamp areas immediately northwest of Anglesea along the Anglesea River and Salt Creek (**Figure 3-1**).

3.2 Climate

The Anglesea area is characterised by relatively high rainfall in the topographically elevated areas to the west, with decreasing rainfall across the lower northern and eastern areas. The two closest rainfall gauges are located at Wensleydale (BOM ID 87119), approximately 6 km northwest of the mine (within Anglesea River Catchment), and Aireys Inlet (BOM ID 090180), approximately 9 km southeast of the mine along the coast.

Long-term average annual (LTA) rainfall at Wensleydale is 769 millimetres per year (mm/yr) based on data from 1935 to current. At Aireys Inlet, the LTA is 616 mm/yr based on data from 1994 to current. Yearly averages are presented on **Figure 3-2** along with rainfall surplus/deficit data from Wensleydale.

Since measurements began in 1965 at Wensleydale, rainfall data indicates a distinct wetting and drying phase. Using SILO Data Drill system[2] for the site, a longer-term record can also be derived beginning 1900, and this identifies a 3rd climatic phase, (**Figure 3-3**). This climate signature shows:

- Between 1900 and 1950, the region exhibited a drying climate, defined by average annual rainfall typically being lower that the LTA rainfall.
- Between 1950 and 1990, the region then experienced a strong wet period where above average rainfall fell for 27 out of 40 years.
- Since 1990, a prolonged drying period is being observed. The millennial drought (late 1996 to mid-2010) occurs in this period and more recently the 5-year rainfall totals of 2004 to 2009 and 2014 to 2018 comprise the 2 driest 5-year totals on record for the region. This is an important consideration as recent surface water flows in Salt Creek (at monitoring point SV2) have been significantly lower than those recorded from 1969 to 1982; (refer to **Section 3.8** for more information on surface water flow data).

Seasonally rainfall is variable, with around 60 percent of total annual rainfall falling over the months of May through October. Heavier episodic rainfall (greater than 50 mm/day) generally occurs in Spring and Summer with almost 70 percent of these falls occurring in this period.

[2] http://www.longpaddock.qld.gov.au/silo/

Mean annual potential evaporation (PE) does not vary significantly across the region, with an annual mean of 1,300 mm measured at Anglesea. Further information on evaporation (including lake evaporation) is discussed in **Section 3.2.1**.

3.2.1 Evaporation on Water Bodies

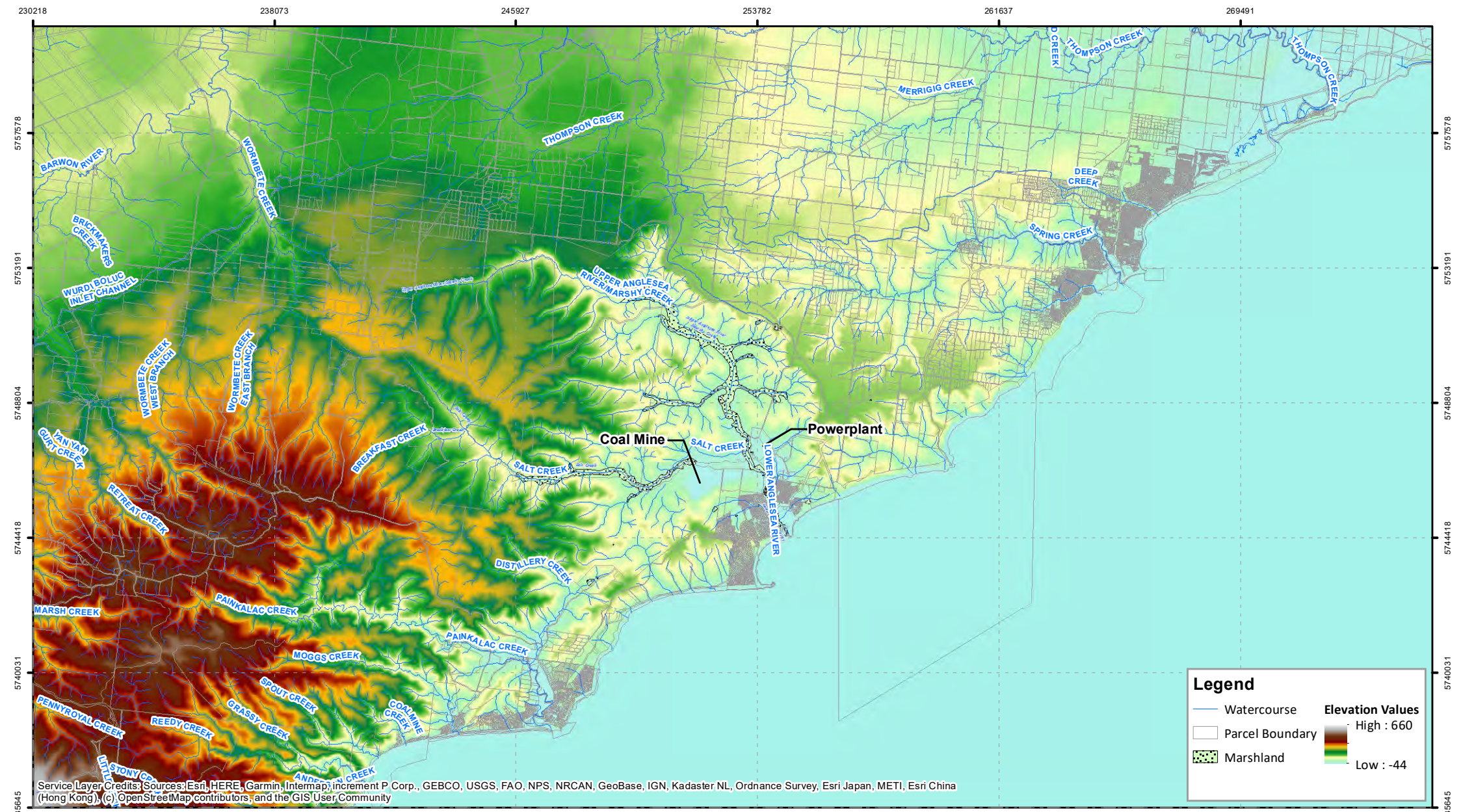
Typically, evaporation from surface water bodies (such as a lake), are calculated using Morton's Lake Co-Efficient or a Synthetic Class A Pan Co-Efficient. However, Morton's Lake Co-Efficient is for a shallow lake, and Synthetic Class A Pan Co-Efficient is for a shallow evaporation-pan. Therefore, to determine evaporation from a deeper lake (i.e., the mine pit void water body), both need to be converted by a co-efficient to relate them to evaporation for a deep lake (greater than 1.0 m depth).

The standard conversion-factor for PAN to lake is generally 0.75 x PE. For the mine pit void, PE was calculated using FAO56[3] and SILO Data Drill system[4] for the site. The results indicated the ratio between the Synthetic Class A Pan Co-Efficient and FAO56 is 0.725; therefore, the unadjusted FAO56 is close to lake evaporation and its direct use without adjustment can therefore be used as the simplest estimate of lake evaporation.

McJannet *et al.,* (2017) undertook a study whereby evaporation from a mine void lake using analytical, actual and modelling approaches were compared. The results found that aerodynamic modelling provided the closest match to actual floating pan evaporation, whilst applying the standard Class A pan measurements sometimes provided poor correlation, especially where shading from steep side walls and high evaporation rates are common (such as in North Western Australia). As the former Anglesea mine, neither has steep sided walls or experiences very large seasonal fluctuations in temperature. As such, using the approach above is considered representative and no direct evaporation measurement is necessary.

Figure 3-3 shows a plot of PE (FAO56) and rainfall from SILO, as well as actual annual rainfall deficit for a site at the mine pit void for a point at the mine pit void (Lat. and Long. of -38.40^{o} 144.15^{o}, decimal degrees). This rainfall deficit was then used across the surface area of a full pit void (approximately 100 Ha at +5.5 m AHD) to determine likely actual evaporative losses as opposed to PE. On average, evaporative losses (rainfall deficit) per year were estimated at 311 mm/year or about 0.31 GL/yr of water at full storage (100 Ha x $1x10^{4}$ x 311mm/year x $1x10^{-9}$).

[3] http://www.fao.org/docrep/X0490E/X0490E00.htm
[4] http://www.longpaddock.qld.gov.au/silo/



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 3-1 Topographic Setting.mxd

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Figure 3-1
Topographic Setting

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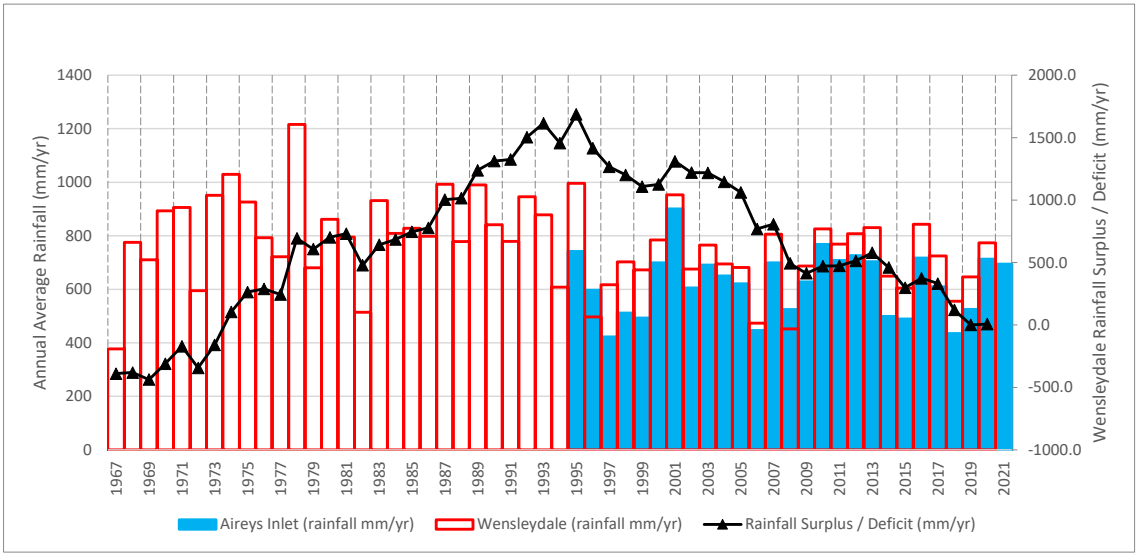


Figure 3-2 Rainfall Summaries

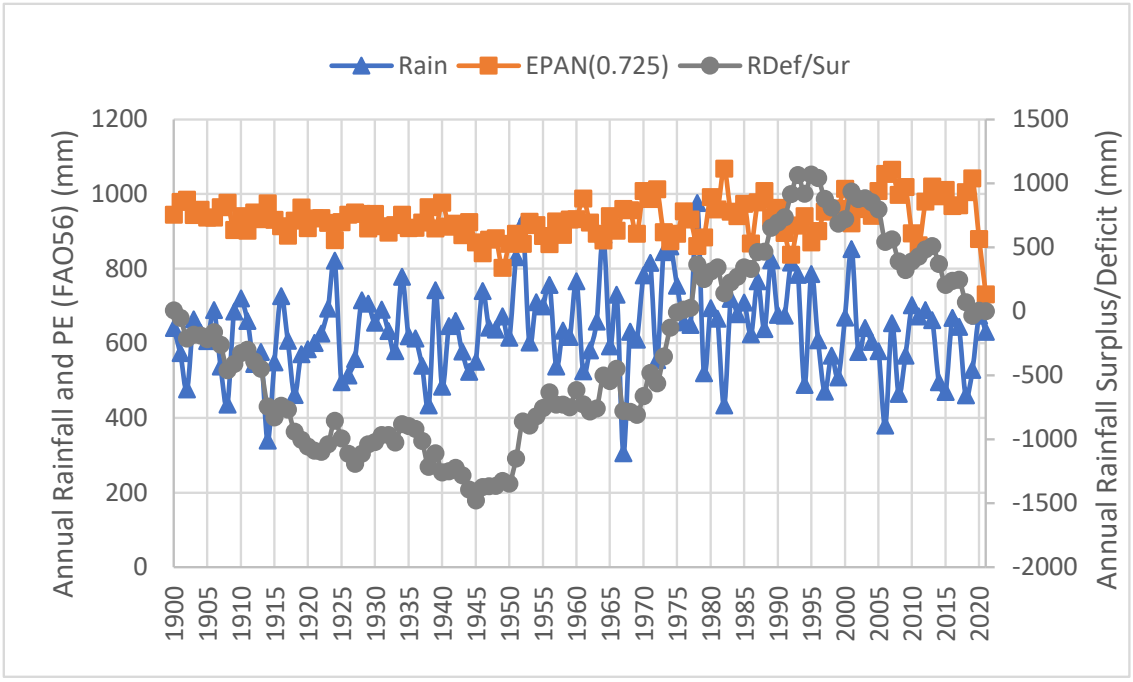


Figure 3-3 Annual Rainfall and PE (FAO56) for a Site at the Mine Pit Void

3.3 Climate Change

As shown in **Figure 3-3** and discussed in **Section 3.2**, there is evidence of three strong climatic cycles over the last 120 years. Between 1900 and 1950, the region exhibited a drying climate, defined by average annual rainfall typically being lower that the LTA rainfall. Between 1950 and 1990, the region then experienced a strong wet period where above average rainfall fell for 27 out of 40 years. Recently, however, the rainfall surplus/deficit has again begun to fall with drier than average conditions dominating over the last 30 years. An important observation from **Figure 3-3** is the rate of decline (slope of the rainfall surplus/deficit) observed over the last 20 years is occurring 1.5 times faster than observed during the drying phase of 1900 to 1950.

As a result of this historical climate variability, the Victorian Government prepared a series of guidelines (Department of Environment, Land, Water and Planning [DELWP], 2016) outlining how the climate change projections can be applied for water resource planning in Victoria. These guidelines are based on 42 global climate models (GCM) and applied to generate climate change projections for Victoria's river basins for the years 2040 and 2065. With respect to this report, the Otway Coast basin is the relevant river basin.

A summary of the climate change projections for the Otway Coast basin are presented below for two projections: low (10^{th} percentile) and high (90^{th} percentile) impact on water availability from climate dependent sources. The results suggest:

- Average daily temperature is projected to increase by 1.0 ^{o}C by 2040 and 1.9 ^{o}C by 2065 relative to the current climate baseline.
- Potential evapotranspiration is projected to increase by 3.7 percent by the Year 2040, and 6.4 percent by 2065 relative to the current climate baseline.
- Average annual rainfall is projected to range from a decrease of 11.7 percent (high scenario) to an increase of 2.1 percent (low scenario) by the Year 2040, with a 3.6 percent decrease in rainfall for the medium climate change scenario. By 2065, rainfall is expected to range from 19 percent reduction (high scenario) to a 0.5 percent increase (low scenario). The median climate change scenario predicts a 5.8 percent relative reduction to the current climate baseline.
- Average annual runoff is projected to range from -25.3% to -6.6 (median = -15.8%) by the Year 2040. By 2065, annual runoff is projected to range from -41.9% to -4.7% (median = - 7.2%) relative to the current climate baseline.

With respect to sea level rise, future rises are projected for key areas in Victoria are based on the 2015 national sea level projections (CSIRO and BoM, 2015). By the 2030s, sea level is projected to rise by around 12 cm (7–18 cm) (relative to 1986–2005) under medium (RCP4.5) and high (RCP8.5) emissions scenarios. By the 2070s, the emissions scenario has greater impact, with increases of around 32 cm (20–46 cm) under RCP 4.5, but up to 42 cm (26–54 cm) under RCP 8.5.

In addition, the Victorian Governments Future Coasts Program[5] is preparing policy of planning for not less than 0.8 m of sea level rise by 2100. Note: if this level of rise did occur it would only impact the estuary. The lowest point of coal mine road which runs between the top of the estuary and the former mixing zone (**Figure 1-1**) has an elevation of 5.0mAHD.

[5] https://www.vgls.vic.gov.au/client/en_AU/search/asset/1013264/0

3.4 Soils

Regionally, to the north and west of Anglesea, the soils are dominated by sandy uniform units formed on the Tertiary-aged sediments of the Eastern View Formation (EVF). Further to the east, the dominant soil type changes to the more clay rich soils formed on the more recent Neogene-aged marls and non-calcareous sediments of the Jan Juc Formation and the Demon Bluff Formation (DBF). In the topographically elevated and forested areas in the west, the soils are dominated by texture contrast soils formed on the Lower Cretaceous-aged sedimentary rocks of the Otway Group.

Locally, soils generally exhibit acid duplex profiles from three distinct profile types developed from differing parent materials. The three main characteristics of the vast majority of soils across the site are the distinct texture contrast between the light-textured sandy surface soil and the clay subsoil:

1. Sandy podzols and podsolic soils: These tend to be developed on older Tertiary sediments and therefore tend to be more prevalent on the lower sections of slopes. These highly leached acidic soils are characterised by sandy topsoils and low fertility with deficiencies in phosphorus, potassium, nitrogen, copper, zinc and molybdenum (Pitt, 1977).
2. Lateritic podsolic soils: These are generally developed on the plateau remnants of the Tertiary peneplain. The A horizons of these soils have a loamy texture with an organic aluminium (A1) and bleached A2 horizon, changing sharply to well-structured silty clay at a depth of approximately 40 centimetres (cm). Ironstone blocks and nodules are ubiquitous at around a depth of 1 metre.
3. Acid peaty soils: These are developed in local creek beds and may be up to several metres in depth. Although nutrient levels are high, they are not freely available to plants due to a pH less than 4 (Kentish and Bourne, 1983).

3.5 Catchment Acidity and Acid Sulphate Soils

Acidity in the Anglesea River catchment is a topic that has been researched extensively over the last 20 years and all studies to date acknowledge the catchments naturally high pyrite and sulphur content as the main source of acidity or acid drainage.

In the most recent study, Wong *et al.,* (2020), investigated the distribution and characterisation of acid sulfate soils in the Salt Creek and Marshy Creek Swamplands. The study involved field sampling of 28 sites within the course of the Anglesea Swamplands and a further 25 sites along the marshlands associated with Salt Creek.

The study identified three modes of acidity at each site:

i) potential sulfidic acidity, sourced from sulfidic sediments containing pyrite and monosulfides;
ii) labile acidity, which is existing acidity and can be rapidly mobilised; and
iii) retained acidity, which is existing latent acidity usually stored in minerals such as jarosite. In addition, acid neutralising capacity was also analysed and net acidity determined.

The report found that both Salt Creek and Marshy Creek contain substantial volumes of acidity in a form that can be mobilised rapidly. Marshy Creek contains higher concentrations of labile acidity which can be transported readily in surface water and groundwater, whereas Salt Creek contains higher concentrations of retained acidity which can be slowly released over time.

Given it is known that the catchment is naturally acidic, the hydrogeological system contributes to acid generation and transport in 3 ways:

- fluctuating water tables - dropping water tables introduce air into moist pore spaces of the unsaturated zone.
- dissolved oxygen can be transported to pyrite by groundwater recharge.
- groundwater flow, specifically in the vadose zone, transports any acid generated.

These factors are schematically shown in **Figure 3-4**.

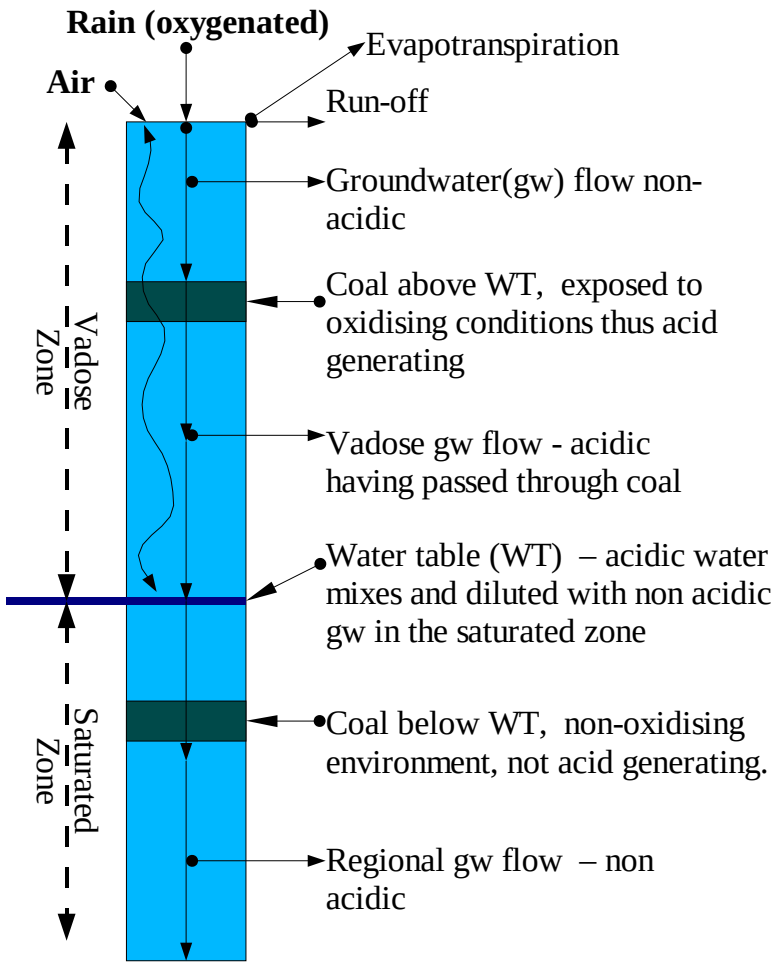


Figure 3-4 Model of Acid Generation and Transportation from Sulphide Containing Units of the Anglesea Geological Sequence (after Tutt 2008)

The key processes of the cycle which directly influence acid generation and transport in the Anglesea catchment are precipitation, infiltration, percolation and groundwater to lakes and streams, refer **Figure 3-5**.

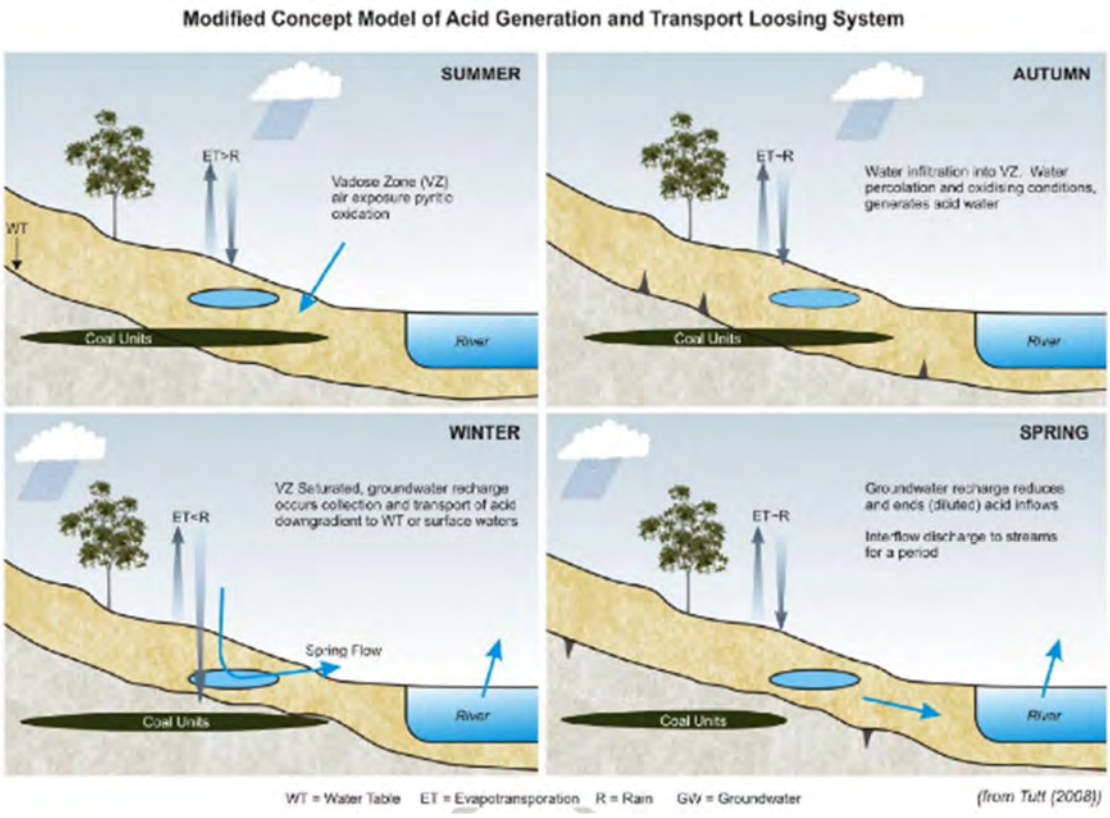


Figure 3-5 Modified Conceptual Model of Seasonal Acid Generation and Transportation Mechanisms (after Tutt 2008, reference GHD 2013)

As depicted in **Figure 3-5**, some acid generation and transportation should theoretically occur every year. Over winter and spring, water infiltrates and percolates into the vadose zone oxidising pyrite and transporting acidic water down gradient. This water can either discharge as a spring flow to the surface or mix with the existing groundwater within the shallow alluvial aquifer.

Seasonal rainfall therefore directly influences the rate of acid generation and transportation. Variation to normal weather patterns, including extended dry periods, which may drop the water table and affect acid generation and transportation, potentially creating scenarios such as:

- low groundwater recharge causing reduced generation and transportation of acid in the systems and a potential build-up of acid in pore spaces.
- high groundwater recharge causing greater oxidation of pyrite plus increased transportation as percolating groundwater flushes pore water from the vadose zone.

In addition to Wong *et al.,* (2020), other detailed studies that summarise the sources of acidity in the catchment are summarised in **Table 2-4.**

Section 5.6 presents a more detailed conceptualisation of the acid generation and transportation processes. This section along with the hydrogeological conceptualisation (including aquifer interconnectivity and an analysis of groundwater and surface water data over a logger dataset), presented within this report addresses many of the recommendations in Wong *et al.,* (2020).

3.6 Groundwater Users

The location of the groundwater users (such as private and commercial water bores) are shown on **Figure 3-6**. Groundwater bores within the local area have been determined through a search of the Victorian Water Measurement Information System (WMIS), refer **Figure 3-6**. The WMIS database was undertaken in October 2021 to identify registered bores within a 10 km buffer of the mine pit void and within the Jan Juc GMA.

Figure 3-6 shows a high density of stock, domestic and irrigation bores are located to the northeast of the Jan Juc GMA (north of Torquay); however, these bores are generally shallow and intersect the groundwater resources of the Beaumaris Sandstone (formerly known as the Moorabool Viaduct Sands) or the shallow sediments of the Demon Bluff Formation (DBF). Of these bores, only two appear to be completed in the UEVF. Bore ID 68160 is completed to a depth of 278.9 m and located ~3 km southeast of the mine near the coast. Bore ID 68179 is completed to a depth of 28 m in coal and is approximately 8.5 km northeast of the mine. This bore sits within the Jan Juc syncline and due to the Bells Beach Anticline separating the UEVF at the mine and this bore, they are not connected.

Beginning 2007, Barwon Water installed seven production bores (GW1 to GW7) in the LEVF, refer **Section 2.2.2**.

Lastly, the Moriac Quarry has a licence to extract 250 ML/year. The quarry is located approximately 13 km north of the mine pit void with groundwater extracted from the LEVF (up-gradient of the site) and used for industrial sand washing purposes.

3.7 Potential Environmental Sensitive Receptors and Groundwater Dependant Ecosystems

Across the catchment there have been many studies that have assessed the nature and extent of GDEs that may occur within the catchment along with the aquatic ecology of the surface water systems. Many of these are summarised in **Table 2-3** with the section below providing the most current understanding. Specifically, the following Environmental Sensitive Receptors (ESRs) and potential GDEs are discussed:

- Anglesea River and Salt Creek Permanent Pools.
- Anglesea River and Salt Creek Vegetated Marshlands.
- Anglesea River Estuary.

Additional information on the terrestrial and aquatic ecology of the catchment can be found by Ecology Australia (2007–2013) and GHD (2012–2016).

3.7.1 Anglesea River and Salt Creek Permanent Pools

As part of Barwon Waters Anglesea Borefield Project (ABP), a number of persistent pools in upper catchments of both water courses (**Figure 3-6**):

- Upper Anglesea Persistent pools (named AGP1-B, AGP2 and ASP7); and,
- Salt Creek Persistent pool (SGP1-a and SGP2-B).

These pools (or potential GDEs) were identified as key asset points in the outcrop area associated with the LEVF, which had the potential to be significantly impacted by dewatering activities, as:

- They appeared to be permanent pools and therefore considered baseflow dependent.

- They are located in the interpreted LEVF outcrop area and hence likely to be in direct connection with the aquifer being pumped, also situated at the LEVF outcrop area closest to the Barwon Water borefield, and therefore impacts were possible in the short term.
- Southern Pygmy Perch was identified in the Salt Creek pools suggesting the pools may have a relatively high ecological value as habitats for these fish.

However, GHD 2011, undertook a detailed investigation on these pools. These studies used stable oxygen isotopes, chlorofluorocarbons and radiocarbon for better understand surface water and groundwater interactions. The results, as well as yearly surface water quality monitoring from 2012 to 2019 confirmed that these pools, with the exception of SGP1-A, are not in direct connection with the underlying aquifer and not baseflow dependant, rather they are perched systems recharged by surface water flows.

3.7.2 Anglesea River and Salt Creek Vegetated Marshlands

Groundwater dependent ecosystems as defined by the Ministerial guidelines for groundwater licensing and the protection of high value groundwater dependent ecosystems (DELWP, 2015) means those ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals and ecological processes they support and the ecosystem services they provide. This definition has also been used in the recent Anglesea River and Estuary Environmental Flow Study (GHD, 2021).

Whilst there is always conjecture in determining the degree of groundwater reliance of certain GDEs (a process that often takes years and a high level of detailed studies to define), GHD (2021) presents that there are some vegetated communities in the swamplands within the Anglesea River and Salt Creek Catchment (defined in this report as the vegetation on top of the Alluvial Swamp Aquifer (ASA)) that rely on less than 10 percent groundwater contribution and therefore meet the definition of a GDE. These swamplands are typically found in the mid and upper reaches of Salt Creek and Marshy Creek and are shown on **Figure 3-6**.

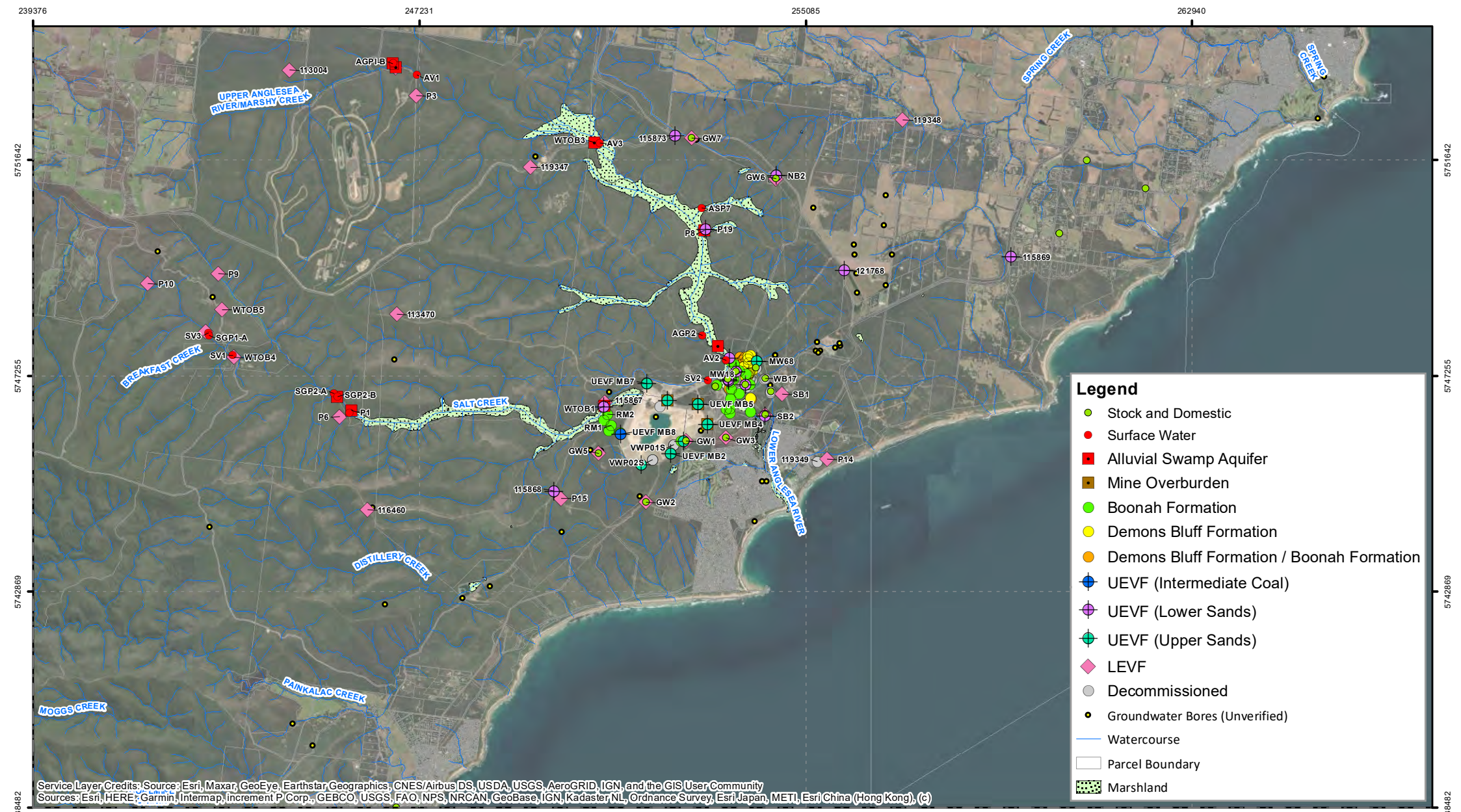
Importantly, no other GDEs or areas where they could exist were identified, and to date no other GDEs have been identified where they are in direct connection to the UEVF.

3.7.3 Anglesea River Estuary

The Anglesea River Estuary is an important environmental and community asset in the region. Multiple lines of evidence suggest that the estuary is hydraulically disconnected from the main aquifers within the UEVF and LEVF:

- Monitoring of shallow aquifers (DBG/ASA) in the vicinity of the former power station show no changes in water level despite climatic events and aquifer stresses.
- The top of the UEVF under the estuary occurs at a depth of 115 metres below ground level (mbgl) (refer bore log for P14, GHD, 2010).
- Underneath Marshy Creek adjacent to the former power station, ~30 m of coal, clay and silty clays separate the base of the Creek to the top the UEVF.
- Pre-development (Hancock, 1967) noted small artesian conditions near the former power station site from a bore screened 138 mbgl. This indicates that the presence of clay layers between the surface and the water bearing zones are strongly confining.

Refer **Section 5.5** for further information on potential surface water and groundwater interactions and **Section 3.7** for a discussion of groundwater dependant ecosystems.



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 3-6 Groundwater Users, Environmental Sensitive Receptors and Gauge Locations.mxd

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Figure 3-6

Groundwater Users, Environmental Sensitive Receptors and Gauge Locations

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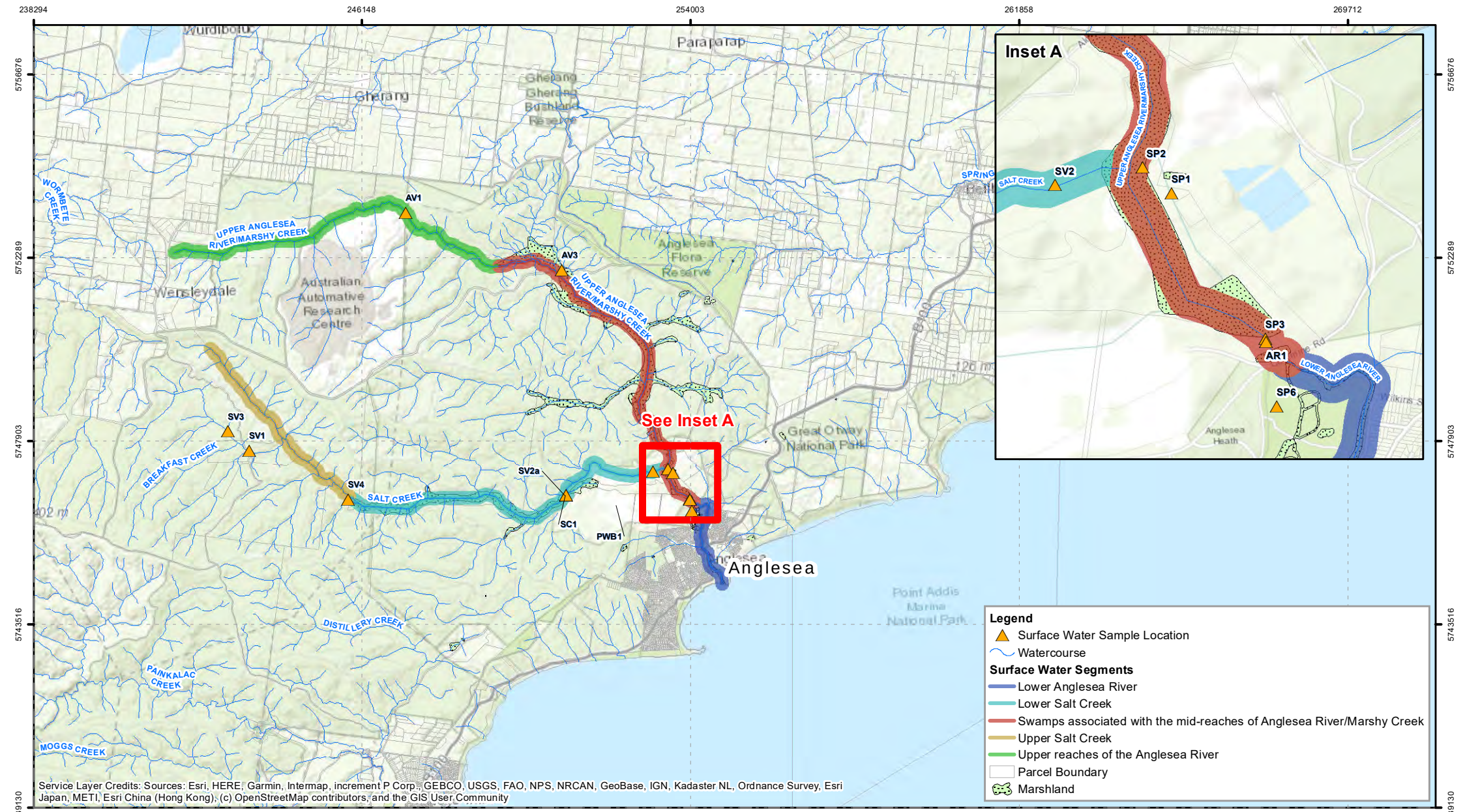
3.8 Catchment Hydrology

The main surface drainage features in the Anglesea area are:

- Salt Creek and its associated swamps and tributaries (e.g., Breakfast Creek).
- Upper Anglesea River/Marshy Creek and associated swamps and tributaries.
- Lower Anglesea River (Estuary).

Surface water features including monitoring points (i.e., gauging stations) are show on **Figure 3-6**. Surface water segments are shown in **Figure 3-7**.



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 3-7 Surface Water Segments.mxd

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Figure 3-7
Surface Water Segments

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(January to April 2020)

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3.8.1 Anglesea River

The Anglesea River is described in three segments (**Figure 3-7**):

- Upper reaches of the Anglesea River (i.e., Marshy Creek).
- Swamps associated with the mid-reaches of Anglesea River/Marshy Creek.
- Lower Anglesea River.

Geographically, the Lower Anglesea River is defined to begin downstream of monitoring point SP6 at Coal Mine Road. The swamps are located between monitoring point SP6 and 1 km upstream of monitoring point AV3. The upper reaches are located above this point. **Figure 3-6** shows the location of surface water features and monitoring points. The total catchment extent is approximately 65 km^2. Swampy heath and heathy woodlands predominate in the catchment. **Table 3-1** discusses the Anglesea River inter-gauge flow differences. Flow statistics described in **Section 3.8.1.1** to **Section 3.8.1.3**.

3.8.1.1 Upper Anglesea River/Marshy Creek

The upper reaches of the Anglesea River/Marshy Creek are ephemeral; however, GHD (2013) reports that several non-groundwater fed, permanent pools exist across its reach (monitoring points AGP1- A, AGP1-B and AV1, **Figure 3-6**). These reaches drain the eastern flanks of the Otway Range, and much of the outcropping LEVF and MEVF from the west to the east near Gum Flats Road.

The ephemeral nature of flow within the Anglesea River catchment is evident in stream gauging data. Upstream monitoring point AV1 shows around 250 days per year (nearly 70 percent of the year) with no recordable flow. **Figure 3-8** shows flows since 2009 and **Figure 3-9** for historical flow during 2010.

3.8.1.2 Swamps

The swamp associated with Anglesea River/Marshy Creek is primarily located between AV3 and SP6 near the former power station. Within this stretch, surface water flow is ephemeral and usually dry during the summer; however, it has a number of wetlands that may be present year-round (GHD, 2013). During large first flush events of these swamps (i.e., first flows after a prolonged period of no flow), significant volumes of low pH water can be flushed into the estuary (Lower Anglesea River), which cause low pH, metals precipitation and, in some cases, fish kills. Historical data shows that the estuary exhibits low pH (<5) in two out of every three years.

At monitoring point AV2, which is located just upstream of the former power station (**Figure 3-6**), data indicates that there are on average 134 days per year (37 percent of the year) that show no recordable flow for the period 2009 to 2021.

For periods where baseflow is sustained for longer periods than average, **Figure 3-9** presents typical flow duration curves using a runoff event in 2010 from AV2 (lower catchment) and AV1 (upper catchment). This shows discharge in AV2 runs for a longer period of time than in the upper catchment (**Table 3-1**).

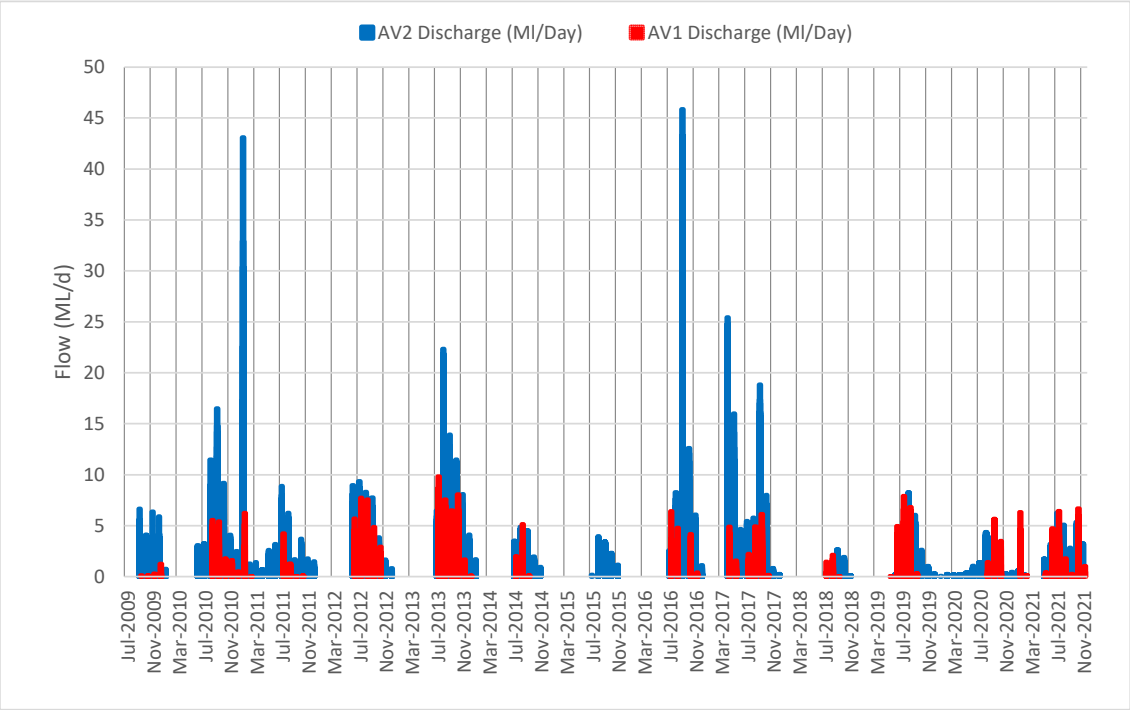


Figure 3-8 Total flow (by month) for the Anglesea River (AV1 & AV2) from 2009 to 2021

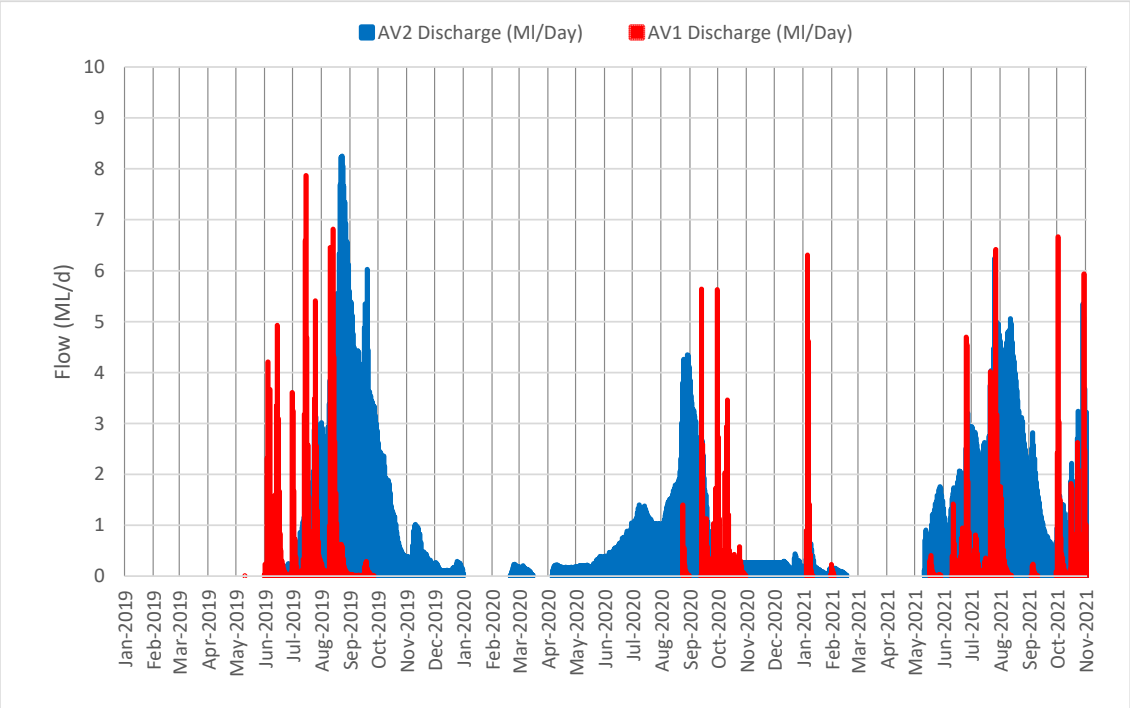


Figure 3-9 AV1 vs AV2 Baseflow Comparison 2019 to 2021

Table 3-1 Anglesea River Inter-Gauge Flow Differences

Monitoring Point	Comparison
Between monitoring points AV1 and AV2	Gaining conditions (i.e., where surface water flow gains occur as water travels downstream) are identified throughout the data record for these monitoring points. These stream gains are due to continued runoff and drainage of the catchment downstream of the upstream monitoring point. Again, this is as expected due to the increasing catchment size and runoff potential moving downstream. Short-term losing stream conditions were identified following prolonged dry periods. In these cases, rainfall recorded in the upstream monitoring point (AV1) probably infiltrated relatively dry ground and was subsequently attenuated in the swamp prior to reaching AV2.

3.8.1.3 Lower Anglesea River

At the lower reaches of the Anglesea River catchment in the region of the site and downstream, flows had previously been artificially supported by a 3-5 ML/day of approximately pH 7-8 water discharges from Alcoa's power station (EPA License EM32162), refer **Figure 2-1**. In addition to this discharge, the lower reaches of the Anglesea River received periodic baseflow (as throughflow) from the ASA formed in the permeable alluvial sediments deposited along the creek valley. The effect of Alcoa's alkaline buffering capacity along with peak flows from Salt creek and Upper Anglesea River on the pH of the Estuary is clear on **Figure 2-1**.

3.8.2 Salt Creek

The total catchment area of Salt Creek is approximately 48.7 km^2 and primarily resides within Anglesea Heath, containing significant quantities of heathy woodland and swampy heath with peaty soils. For the purposes of this report, Salt Creek is described in two segments: Upper Salt Creek and Lower Salt Creek, **Figure 3-7**.

Geographically, Upper Salt Creek is defined as the reach above the marshland (near monitoring point SV4) with the lower reaches being defined from this point to monitoring point SV2 along the diversion channel. Flows occurring in the lower reaches have been modified over time as the mine footprint developed. A portion of the Salt Creek catchment has been modified whereby surface water in this location now runs into the pit void as opposed to Salt Creek or the diversion channel. The physical size of the mine void today, plus its local drainage area represents approximately 8% of the salt creek catchment, however the actual impact on the historical flows to Salt Creek would be dependent on the original topography and any additional catchment introduced by the diversion channel.

Monitoring point locations are shown in **Figure 3-6**. **Table 3-2** discusses inter-gauge flow differences across Salt Creek and flow history is shown in **Figure 3-10** (since 2009) and **Figure 3-12** (total period).

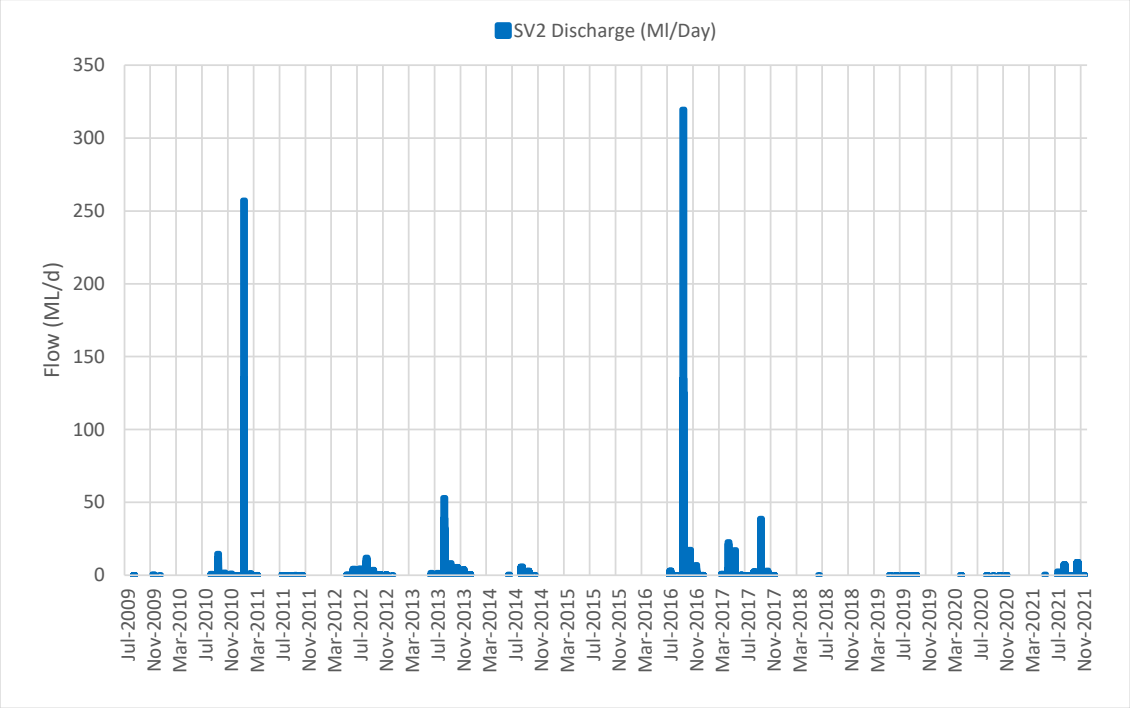


Figure 3-10 Total Flow (by month) for Salt Creek from 2009 to 2021

Table 3-2 Salt Creek Inter-Gauge Flow Differences

Monitoring Point	Flow Description
Between monitoring points SV3 and SV1	• These monitoring points show primarily gaining stream conditions, often following large rainfall events. This is where surface water gains occur as water travels downstream, due to continued runoff and drainage of the catchment downstream of the upstream monitoring point (SV3). This is as expected given that catchment size increases in the downstream direction. Also, the likely addition of groundwater from perched water tables would contribute to gaining stream conditions. • Losing stream conditions occur temporarily, often at the commencement of the wetter winter period. This is possibly due to increased infiltration rates to relatively dry and unsaturated sub-surface soils.
Between monitoring points SV1 and SV4	• Short-term surface water flow losses were identified at downstream monitoring points, primarily due to rainfall runoff and infiltration subsequent to significant rainfall events. • Longer term surface water flow gains occur at SV4 (upstream of the swamp). Flow at this monitoring point continues subsequent to rain events and subsequent to flow upstream. This shows the increase in catchment size and as such, runoff potential, available to the downstream monitoring point (SV4). • A period of no flow was identified between January and April 2012.

Monitoring Point	Flow Description
Between monitoring points SV4 and SV2	• These monitoring points, situated upstream and downstream of the main swamp, predominantly show minor flow differences. They frequently show losing stream conditions, whereby surface water is attenuated by the swamp, either through evapotranspiration or infiltration. This results in less net flow passing through the down-swamp monitoring point (SV2). • Gaining stream conditions occur periodically during significant rain events, whereby there is more surface water flow at the down-swamp monitoring point compared with the up-swamp monitoring point. This results in cyclical flushing of the swamp and prolonged flow to the downstream monitoring point (SV2) compared with the up-swamp Anglesea River Catchment.

3.8.2.1 Upper Salt Creek

Upper Salt Creek, above the Breakfast Creek confluence (near SV1), is ephemeral; however, Breakfast Creek itself (a tributary to Salt Creek) appears to be the only section within the Anglesea River/Salt Creek catchment that appears to be perennial (GHD, 2013). This is supported by subsequent surface water monitoring reported by GHD (2016b).

Between SV1 and SV4, where the LEVF outcrops, baseflow is ephemeral with permanent pools of water (monitoring points SGP2-B and SV4). Mostly year around, these upper reaches appear to be mainly losing surface water reaches. **Figure 3-11** shows the flow differences in 2013 from upper catchment monitoring points (SV1 to SV3) to the lower reach (SV2).

3.8.2.2 Lower Salt Creek

Lower Salt Creek and its associated swamp (between SV4 and SV2) reports historical spring surface water flows with dry periods occurring at most other times of each summer (**Figure 3-11** and **Figure 3-12**). In this location, the Creek is confined to a more incised channel and is also inferred to be a potential losing stretch of surface water (GHD, 2013).

The lowest monitoring location in Salt Creek is along the diversion channel (monitoring point SV2), which generally only records flows during the winter months when high intensity and large duration rainfall events occur.

Total stream flow data at SV2 (Lower Salt Creek) ranges from 1967 to 1982 and 2009 to 2021 and is presented in **Figure 3-12**. This shows an average stream flow of 2,300 ML/year, ranging from years of no flow (2015) to 9,000 ML/year (1978). In the latter period, flows are significantly lower than those observed in 1967 to 1982. **Section 3.8.3** explores the observed flow reduction further.

At SV2, daily flow exceeding 1 ML/day occurs approximately 35 percent of the time and completely dry conditions occur for approximately 50 percent of the time based on existing gauge records.

Lastly, it should be noted that only anectodical data for flow exists between the period of 1983 and 2009. Whilst no measured flow data exists between this period, a significant rainfall event (approximately 200 mm over 2 days), led to the overtopping of the Salt Creek diversion channel embankment and a volume of water estimated between approximately 3 and 4 GL entering the mine void (pers. com C. Rolland, 2016, former Alcoa Mine Manager).

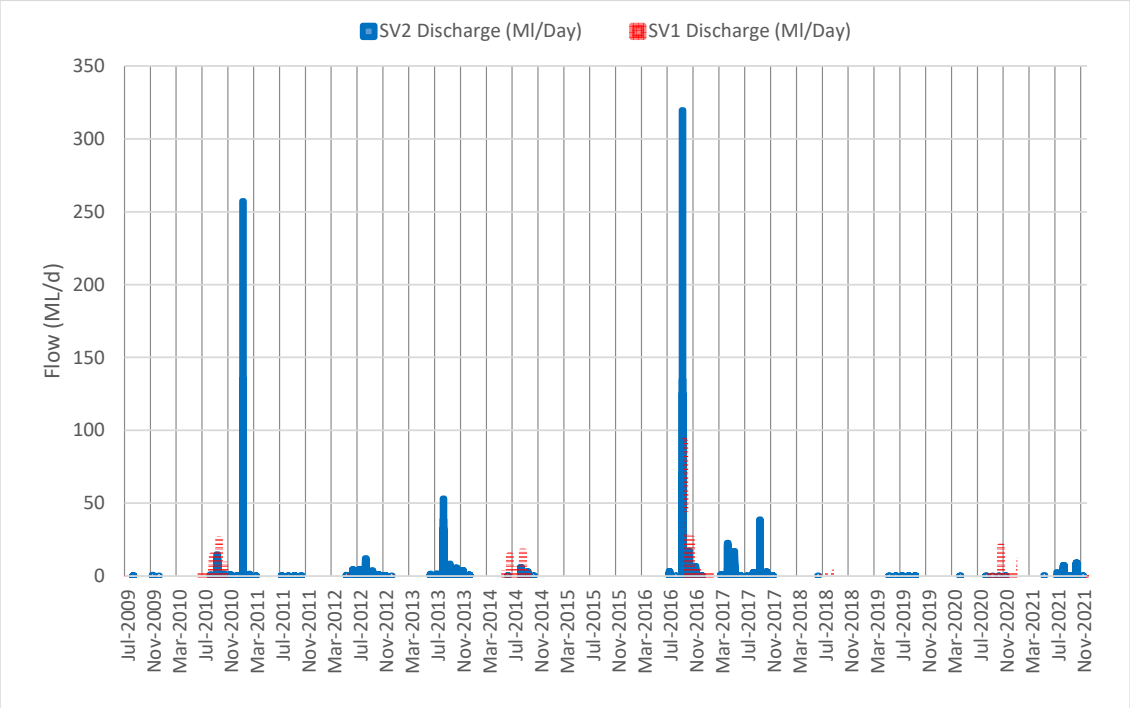


Figure 3-11 Upper Salt Creek Flow (SV1) vs Lower Salt Creek Flow (SV2)

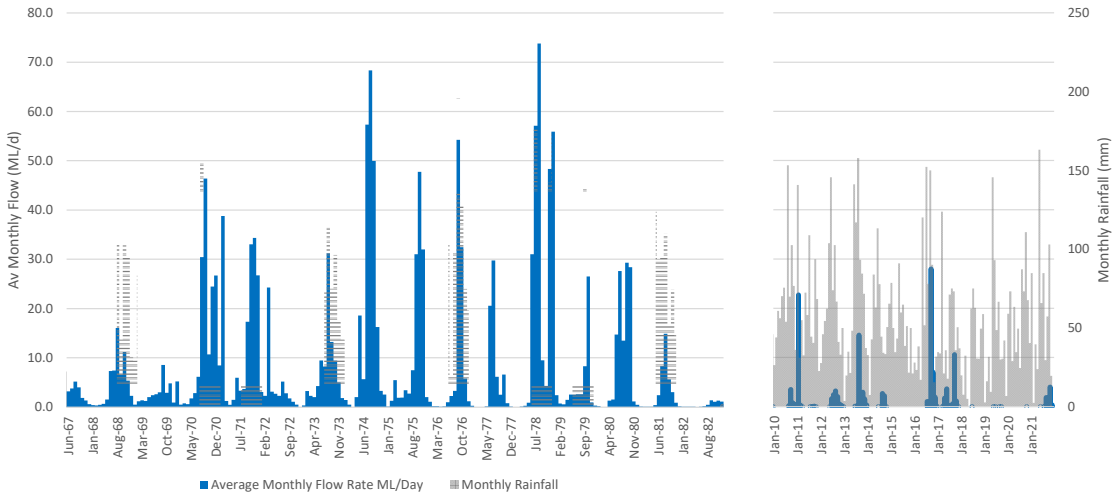


Figure 3-12 SV2 Historical Flow

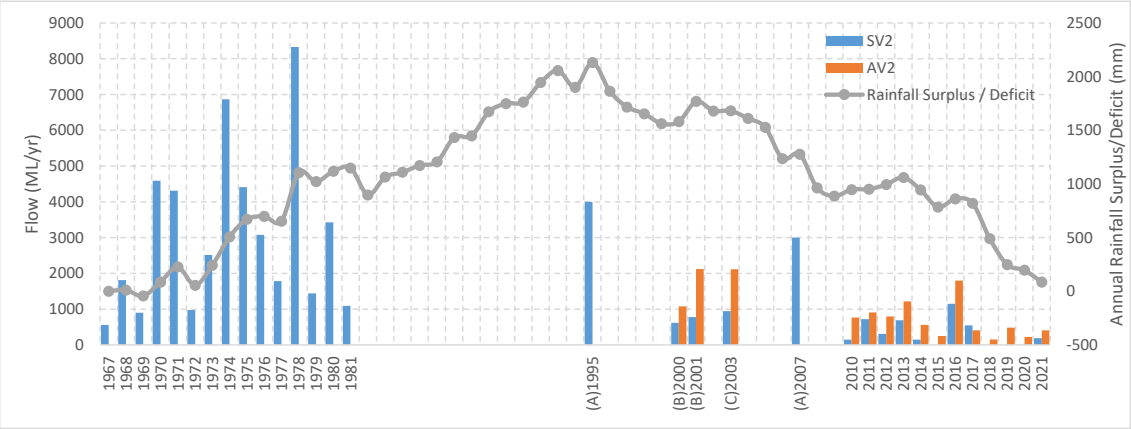


Figure 3-13 SV2 and AV2 Historical Flow

Notes:
A = pers. com C. Rolland (2016), former Alcoa Mine Manager
B = Pope (2010)
C = Thorp (2003)

3.8.3 Reduction in Surface Water Flows

Stream flows within the catchment have significantly declined since monitoring began in 1967. Numerous theories have postulated causes for this from the impact of climate change (such as decreased rainfall and increase in evapotranspiration) to an increase in water loss to underlying aquifers. This section explores these questions and outlines the most probably cause.

Firstly, the relationship between rainfall and runoff is not linear. (CSIRO, 2011) suggest annual variations in rainfall are typically amplified as two- to three-times larger variations to annual runoff. So a 10% reduction in rainfall typically leads to a 20 to 30% reduction in runoff. However, this rule of thumb does not always hold true especially in catchments dominated by large elevation differences and steel slopes (such as the Otway's). In fact, a study undertaken by (Pott and Chew, 2011) in the Campaspe region of Victoria found that observed reduction in annual runoff during 1997–2008 was 59% lower compared to its long-term average despite rainfall only falling by 15% during this period.

For Salt Creek, this reduction is even higher with a 16% reduction of rainfall (2010 to current c.f 1968 to 1981) leading to a 89% reduction in flow. Whilst this does seem severe and fingers point to additional water must also be losing from the catchment, its not that unexpected considering the results from the Campaspe trial (Pott and Chew, 2011) and the fact that the majority of Salt Creek is located within a high relief catchment and the last stretch of the catchment has been modified by mining with surface water runoff being diverted into the mine void (approx 8%).

Furthermore, an additional study undertaken by (Saft *et al.,* 2015) looked at data from 228 catchments from south-eastern Australia (East Coast and Murray-Darling Basin water divisions) that are unregulated, relatively unimpaired, not nested, and with catchment areas between 50 and 2000 km^2. The study aimed to address whether annual rainfall-runoff relationships are significantly different during extended dry periods, compared with the historical norm and if so what catchment and climate characteristics cause these changes.

The results found 79% of all catchments experienced a downward shift in the best-fit rainfall-runoff relationship during extended dry periods. This means that a persistent drought results in lowered runoff generation rates for similar rainfall amounts. Thus, in a sequence of years with reduced rainfall we would expect not only lower runoff due to the lower rainfall, but also less runoff than would be expected from the historical functional dependency of runoff on rainfall.

To relate the above with Salt Creek, and in recognition that following the millennial drought multiyear rainfall from Wensleydale in 2005/06 was the 4th driest 2-year cumulative period on record (from 122 years); 2015/2016 was the 5th driest and 2018/19 was the 8th driest on record. In addition, the cumulative 5-year period 2005 to 2009 and 2014 to 2018 represent to 2 driest 5-year cumulative rainfall totals on record being 24% and 21% drier than each cumulative 5-year average between 1968 to 1981.

Therefore, if a 15% reduction in annual rainfall causes a 59% reduction in surface water flow in the Campaspe region of Victoria, it is entirely possible that >20% reduction in rainfall can lead to almost a 90% reduction in flow for a catchment with the relief characteristic of Salt Creek.

4 Protected Environmental Values and Water Quality Summary

4.1 Environment Protection Act 2017

The *Environment Protection Act 1970* was superseded by the *Environment Protection Act 2017* ("new Act"), which came into force on 1 July 2021. The general environmental duty (GED) is at the centre of the new Act and it applies to all Victorians. The GED requires that the entity engaging in an activity must reduce the risk of harm:

- To human health and the environment.
- From pollution or waste.

Subordinate legislation is the group of tools that support the new Act, which include Regulations and the Environment Reference Standard (ERS). Under the new Act, State Environment Protection Policies (SEPPs) are replaced by ERS. The ERS includes the SEPP (Waters), which presented the framework for the protection and management of water quality in Victoria, covering surface waters, estuarine and marine water and groundwater. The purpose of the ERS is to support the protection of human health and the environment from pollution and waste by providing benchmarks to be used to assess and report on environmental conditions in the whole or any part of Victoria.

4.1.1 Environmental Values and Adopted Assessment Criteria

The environmental values of waters (both surface water and groundwater) are defined in Table 5.1 of Part 5, Division 1 of the ERS, with the first column listing the environmental value and the second column describing what the purpose or intent of that use is. These are summarised in **Table 4-1**.

Table 4-1 Environmental Values of Waters

Environmental value	Description of Environmental Value
Water dependent ecosystems and species	Water quality that is suitable to protect the integrity and biodiversity of water dependent ecosystems. This integrity and biodiversity includes – • the integrity of riparian vegetation as it contributes to the health of water dependent ecosystems and bank stability. • groundwater quality that does not adversely affect surface water ecosystems. • groundwater quality that does not adversely affect natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis to maintain their communities of organisms, ecological processes and ecosystem services. This includes wetlands, rivers and streams reliant on groundwater baseflow, some terrestrial vegetation and some estuarine and near-shore marine systems, stygofauna and troglofaunal. • maintenance of fish passage.
Human consumption after appropriate treatment	Surface water quality that is suitable for use by drinking water suppliers for delivery, after appropriate treatment, to consumers of drinking water. Surface water quality that is suitable for use by the Wonthaggi desalinisation plant.
Potable water supply	Groundwater quality that is suitable for raw or potable water supply
Potable mineral water supply	Groundwater quality that is suitable for drinking and, in its natural state, contains soluble minerals and natural gases causing effervescence

Environmental value	Description of Environmental Value
Agriculture and irrigation	Water quality that is suitable for agricultural activities such as stock watering and irrigation, as well as a range of other uses such as the irrigation of domestic gardens, commercial agriculture, parks and golf courses
Human consumption of aquatic foods	Surface water quality that is suitable to support the availability and safe human consumption of fish and any other aquatic plant, algae or invertebrate from natural populations, commercial and recreational catch
Aquaculture	Surface water quality that is suitable for the production of fish and any other aquatic plant, algae or invertebrate for human consumption via aquaculture
Industrial and commercial use	Water quality that is suitable for industrial and commercial use
Water-based recreation	Water quality that is suitable for primary contact recreation (for example swimming, diving, water skiing, caving and spas), secondary contact recreation (for example boating and fishing) and for aesthetic enjoyment
Traditional Owner cultural values	Water quality that protects the cultural values of Traditional Owners, having recognised primary responsibility for protecting the values of water for cultural needs, to ensure that Traditional Owner cultural practices can continue. Values may include traditional aquaculture, fishing, harvesting, cultivation of freshwater and marine foods, fish, grasses, medicines and filtration of water holes.
Navigation and shipping	Surface water quality that is suitable for the transportation of passengers and cargo by ship and for harbour facilities
Buildings and structures	Groundwater quality that is not corrosive to buildings, structures, property and materials
Geothermal properties	Groundwater quality that will not affect the natural thermal capacity (including temperature) of the groundwater

Applicable protected environmental values for surface water and each groundwater segment (**Section 4.1.2**) were selected based on the protected environmental values specified in the ERS for the Inland segment Central Foothills and Coastal Plains and the Marine segment of Central Bass.

The National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM) (NEPC, 2013) and ERS references those guidelines for the risk-based assessment of water quality depending on the different environmental values to be protected:

- National Health and Medical Research Council (NHMRC)/National Resource Management Ministerial Council (NRMMC) (2011) Australian Drinking Water Guidelines 6 Version 3.4 Updated October 2017.
- Australian and New Zealand Environment and Conservation Council (ANZECC)/ Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality:
  - Aquatic ecosystems
- ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality:
  - Agriculture and Irrigation.
    - Stock watering.
    - Irrigation.
- Primary Contact Recreation[1]

- ANZECC/ARMCANZ (1992) Australian and New Zealand Guidelines for Fresh and Marine Water Quality:
  - Industrial Water use.
- NHMRC (2008) Guidelines for Managing Risks in Recreational Water for primary contact for bathing and swimming.

The naturally occurring acidity of surface water within the catchment and elevated concentrations of metals (aluminium, iron, manganese, nickel and zinc) exceeds applicable criteria and naturally precludes these environmental values. The naturally poor water quality has caused periodic significant fish kills documented in 2000, 2007 and in spring 2010 to early 2011 (Maher, 2011) and more recently. Furthermore, Maher (2011) noted that the water in the Anglesea River, its tributaries and its estuary, frequently becomes acidic (i.e., pH less than 2.5), for short periods following extended dry periods. Normally, background pH in both systems is between 3.0 and 4.5.

Therefore, and as discussed in the ERS[6], an environmental value may not apply to groundwater or surface water if the background water quality exceeds the relevant objective, and as a result, the environmental value cannot be achieved or maintained.

4.1.2 Relevant Groundwater Segment and Environmental Values

The ERS sets out the environmental values of groundwater to be protected. The ERS classifies groundwater into seven segments on the basis of background TDS levels. Each segment has defined environmental values for protection, and the ERS specifies that all of these environmental values must be protected. Environmental values of groundwater are considered to be precluded when relevant groundwater quality objectives for those environmental values have been exceeded.

The ERS outlines the applicable and protected environmental values of groundwater as detailed in **Table 4-2**. The adopted segment classification for the UEVF based on the ERS is highlighted.

Table 4-2 Protected Environmental Values for Groundwater

Environmental Value	Segment (TDS mg/L)						
	A1 0-600	A2 601-1,200	B 1,201-3,100	C 3,101-5,400	D 5,401-7,100	E 7,101-10,000	F >10,001
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓	-	-	-	-	-	-
Potable water supply (acceptable)	-	✓		-	-	-	-
Potable mineral water supply	✓	✓	✓	✓	-	-	-
Agriculture and irrigation (irrigation)	✓	✓	✓	-	-	-	-
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	-

[6] Division 2 – Groundwater, Section 15 2(c) page 19; Division 3 – Surface water, Section 18 (3) page 25

Environmental Value	Segment (TDS mg/L)						
	A1 0-600	A2 601-1,200	B 1,201-3,100	C 3,101-5,400	D 5,401-7,100	E 7,101-10,000	F >10,001
Industrial and commercial	✓	✓	✓	✓	✓	-	-
Water based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

mg/L = milligrams per litre
TDS = total dissolved solids

4.2 Water Quality Summary

4.2.1 Mine Pit Water Quality

Surface water has collected within the low point of the mine pit and consists of rainwater runoff and groundwater recharge from the UEVF and the overlying DBF sediments. **Table 4-3** presents a summary of analytical water quality data from annual sampling conducted from 1999 to 2020, and monthly sampling from May 2021 to July 2022 during the groundwater pumping test and recovery period.

Between July 1999 and July 2022, analysis of the mine pit water has reported limited variability of the majority of analytes measured above the limit of reporting (LOR). As shown on a piper diagram, (**Figure 4-1**), the majority of the water samples plot as a sodium chloride (NaCl) water type. The dominance of this water type is most likely related to the depositional environment of the Eastern View Formation (sub-littoral) and the geochemical influence on the younger aquifer sediments of the Demons Bluff and Boonah Formations. The mine water body is also characterised by a sulfate signature which is likely influenced through run-off from the overburden material (reworked Demons Bluff and Boonah Formations) which is present surrounding the mine void.

TDS are observed to vary between 1,200 and 2,200 mg/L and this appears to be influenced by increases in major ions particularly sulfate. These variations may be related to the differing chemistry of groundwater and mine pit void runoff that contribute to the pit water body. Although runoff is considered to comprise a small component of the water body volume, the sample location could be locally influenced by runoff to a greater extent than groundwater discharging to the water body. The magnitude and trend for sulfate and calcium appear to be similar, suggesting they are derived from similar sources. Historically, the water body has reported a sodium chloride water type; however, the sample events in 2017 and 2020 recorded higher concentrations of sulfate and calcium and a water type, sodium sulfate. The same observation is made for minor metal ions such as aluminium and boron. Concentrations of total iron appear to correlate with pH. Total iron concentrations increase when pH decreases, which is likely to be attributed to increased concentrations of soluble ferrous iron as pH drops.

The natural background surface water quality in the area is characteristic of the low pH, elevated aluminium, boron and other trace metals as reported within the mine pit void. This is further discussed in **Section 4.2.2**.

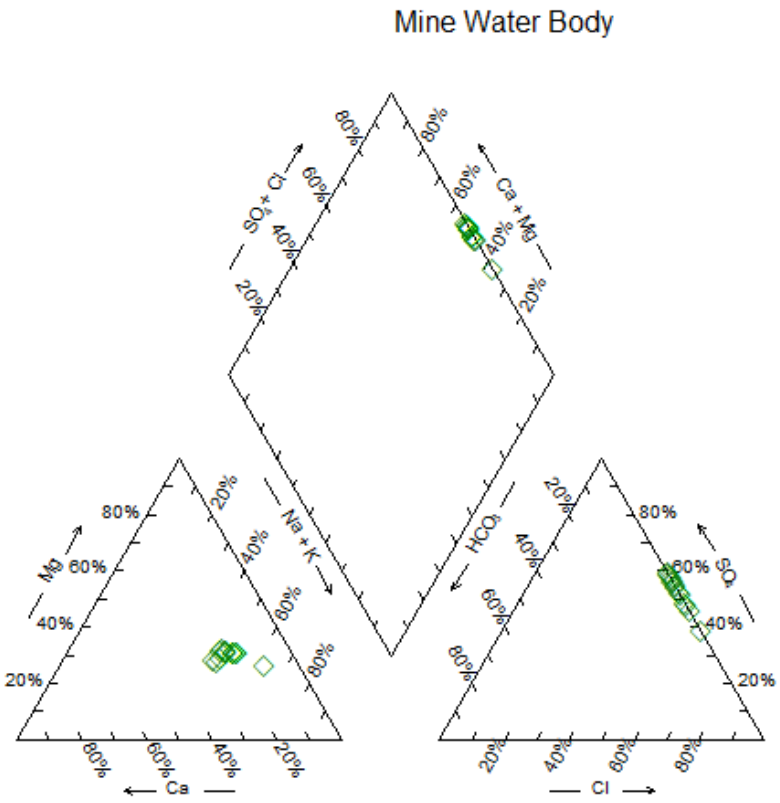


Figure 4-1 Mine Water Piper Diagram

Table 4-3 Mine Pit Water Quality Summary

Analyte	Units	Pre-Pumping Test (1999 – 2020)					During Pumping Test (May 2021 – July 2022)				
		Mean	Median	Low	High	90th percentile	Mean	Median	Low	High	90th percentile
pH		3.35	3.35	2.8	4.28	3.55	3.55	3.53	3.36	3.72	3.64
TDS	mg/L	1562	1510	1200	2200	2052	1732	1715	1520	2020	1992
Aluminium	mg/L	1.28	1.40	0.48	5.56	2.30	4.58	4.14	3.33	6.46	6.40
Boron	mg/L	0.98	1.05	0.03	3.65	2.27	1.57	1.57	1.09	2.21	2.12
Iron	mg/L	4.67	6.75	0.30	14.0	11.9	6.91	8.43	1.32	14.6	13.65
Zinc	mg/L	0.18	0.20	0.10	0.52	0.33					

mg/L = milligrams per litre
NR = Not Recorded
TDS = total dissolved solids

4.2.2 Catchment Surface Water Quality

This section provides a discussion on historical onsite surface water quality and surface water quality from upstream areas across the catchment. Surface water monitoring locations are shown on **Figure 4-2**.

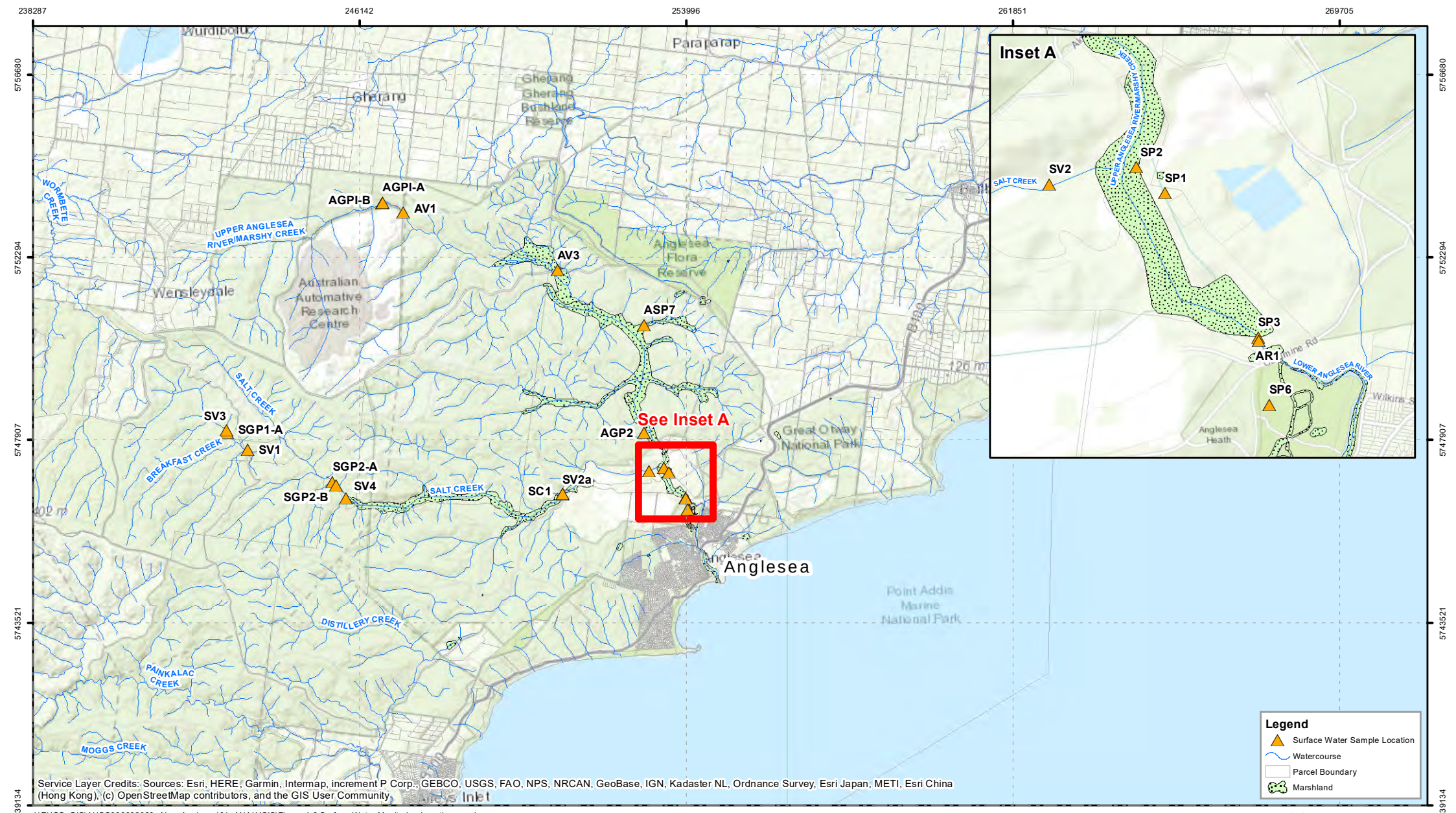
4.2.2.1 Onsite (Former Power Station) Surface Water Quality Summary

The surface water interaction between natural, but highly modified, and managed surface water flows generated on-site was investigated in detail for the *2012 53V Audit Report* (GHD, 2012). It should be noted that the surface water quality data collected and reviewed as part of the audit was during operations of the power station. To provide context to the historical sampling, the components of flow at each sampling point are consolidated into a flow diagram (**Figure 4-3**), refer to Figure 4-3 GHD (2012) for an understanding of coal mine to power station water budgets. This is important to understand as the majority of data points used to undertake the technical assessments (i.e., groundwater and surface water modelling), only incorporated data points upstream of the mixing zone (SV1-4) and (AV1-3).

A limited dataset for Salt Creek (2010 and 2011) and Marshy Creek (2008 to 2011) was reviewed as part of the audit. The analytical schedule included field parameters (temperature), inorganics (colour, turbidity, total solids, total suspended solids, pH and electrical conductivity [EC]), iron and trace metals (aluminium, boron, nickel and zinc). Detailed flow data was also available for these two surface water systems at three locations upstream of the former power station (2009 to 2012).

Based on the assessment presented in the following sections, natural (geo-genic) sources of low pH and aluminium, boron and zinc constituents have been identified in surface water flowing onto the site. **Table 4-4** presents a summary of analytical water quality data from upstream monitoring points AV2 (Upper Anglesea River) and SV2 (Salt Creek). This up-catchment surface water then mixed (historically) with the treated wastewater discharges from the power station (Ash Pond 2), providing a subsequent ameliorating effect on pH (discharges were more alkaline in nature).

The characteristics of each of the identified surface water areas are described in **Section 4.2.2.2** onwards.



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 4-2 Surface Water Monitoring Locations.mxd

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Figure 4-2

Surface Water Monitoring Locations

Alcoa Anglesea Hydrogeological Investigation

DATE:	30/03/2022
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	02
MAP PROJECTION:	GDA94
SCALE:	1:117,863

N

Kilometers

0 1.5 3 6

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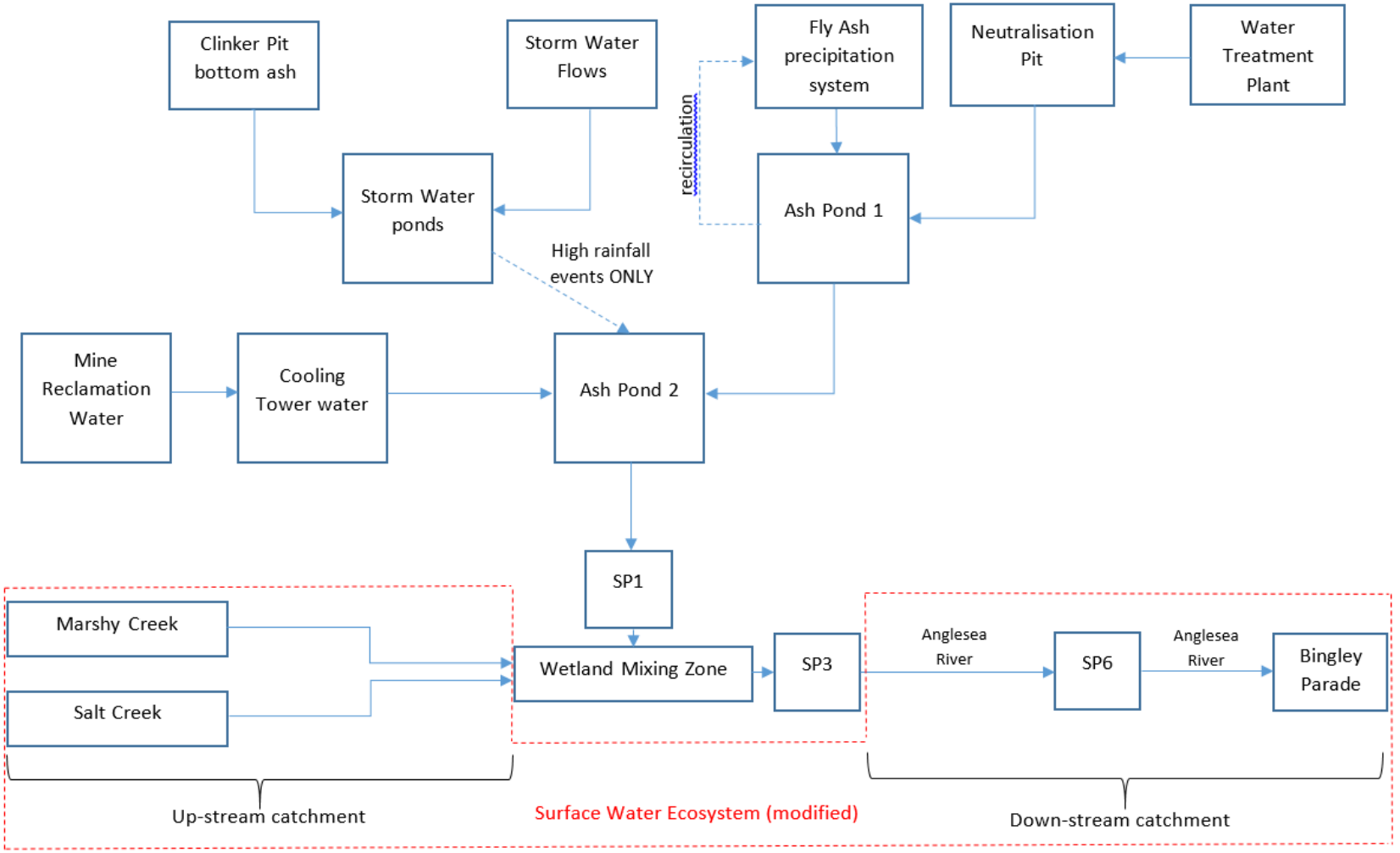

Figure 4-3 Surface Water Flow Diagram

4.2.2.2 Upper Anglesea River/Marshy Creek

Upper Anglesea River/Marshy Creek is located upstream of the former power station (upstream of monitoring point AV2) and as such the environmental values are not affected by the discharges from the site (**Section 3.2.3** for more information on licensed water discharges at monitoring point SP3).

Aluminium, boron, iron and zinc (**Figure 4-4**) within Upper Anglesea River/Marshy Creek upstream of the site permitted discharges were generally elevated. Between 2008 and 2021 the following concentration ranges were reported at AV2:

- Aluminium – 0.53 to 254 mg/L
- Boron – less than 0.05 to 1 mg/L
- Iron – 0.66 to 160 mg/L
- Zinc – less than 0.005 to 1.37 mg/L

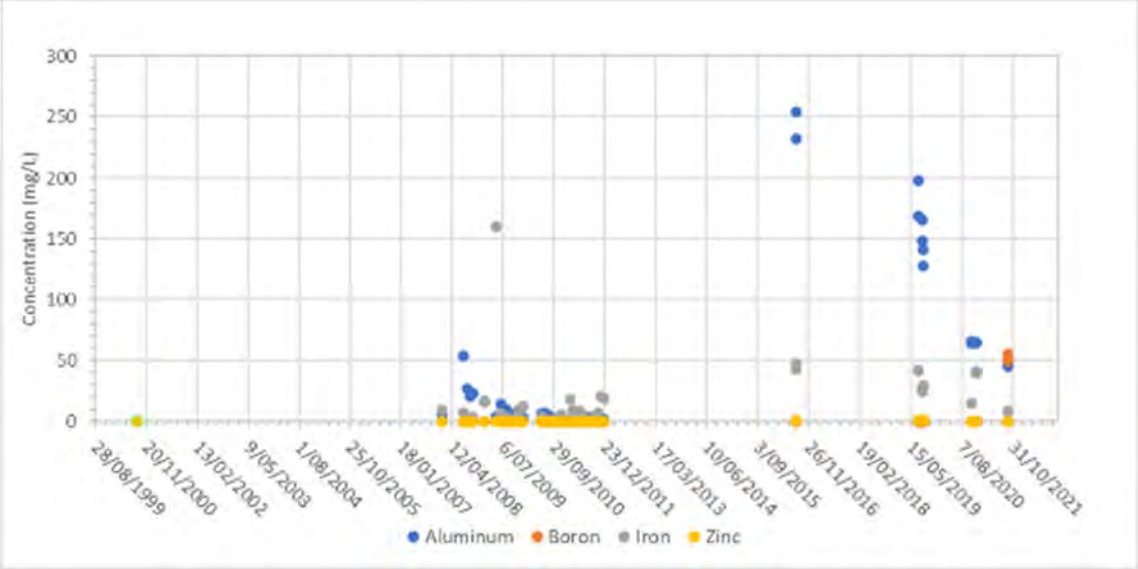

Figure 4-4 Upper Anglesea River/Marshy Creek (AV2) Trace Metal Water Quality

As shown in **Figure 4-5**, since 2009 the pH at AV2 is usually less than pH 3 (net acidic) whilst at AV1, is generally pH >5. Longer term pH data at or near location at AV2 is shown in **Figure 5-81** and also shows pH generally ranging between 3 and 4 since 1969.

The EC in Upper Anglesea River/Marshy Creek at AV1 generally ranges between 500-1,000 microSiemens/centimetre [µS/cm]) and is lower than EC measured downstream at AV2 which ranges between (2,000 and 7,000 µS/cm).

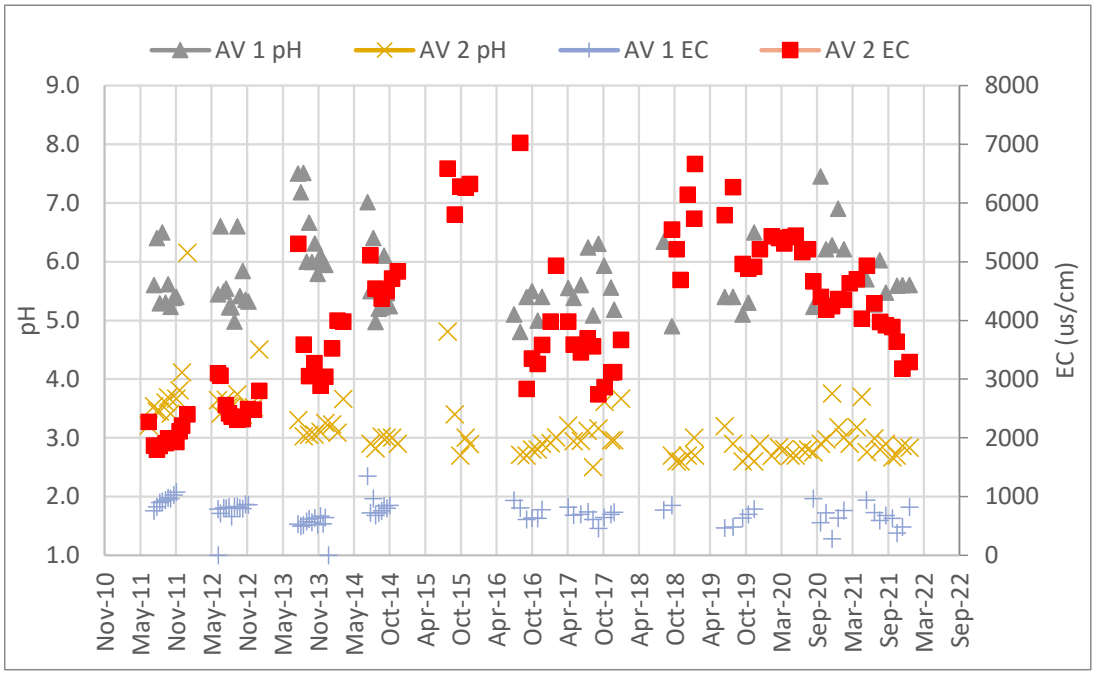

Figure 4-5 AV1 and AV2 Historical EC and pH

4.2.2.3 Salt Creek

Salt Creek is also located upstream of the former power station and as such the environmental values are not affected by the permitted discharges from the site. Aluminium, boron, iron and zinc are generally observed (**Figure 4-6**) to be elevated. Between 2010 and 2021 the following concentration ranges were reported at SV2, which is the closest upstream monitoring point on Salt Creek, to the mine:

- Aluminium – 0.16 to 306 mg/L
- Boron – less than 0.026 to 0.50 mg/L
- Iron – 0.1 to 72.7 mg/L
- Zinc – 0.006 to 3.5 mg/L

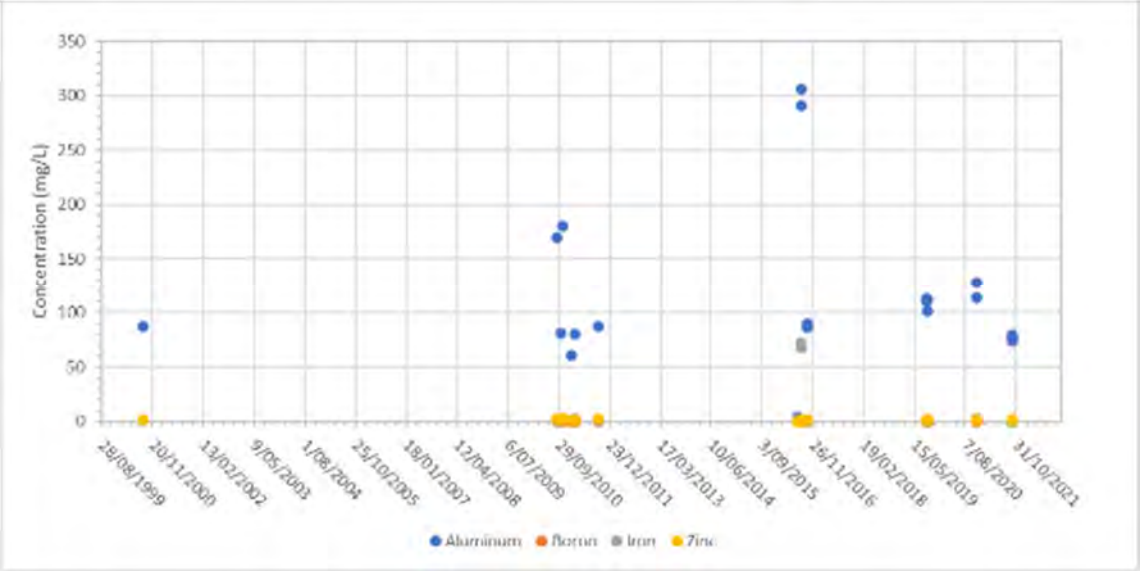

Figure 4-6 Salt Creek (SV2) Trace Metal Quality

The pH at SV2 is slightly higher than at AV2 ranging between pH 3.5 and 4. Further up the Salt Creek catchment at SV1, the pH is higher ranging between pH 5 to 7. EC at the lower end of Salt Creek at SV2 generally ranges between 250 and 2000 µS/cm), whilst in the upper part this range is more constrained varying from 250 and 2000 µS/cm. The larger variation in EC seen in the downstream part of the catchment is likely due to surface water flows being retarded in the Alluvial Aquifer and allowing evapotranspiration to concentrate salts.

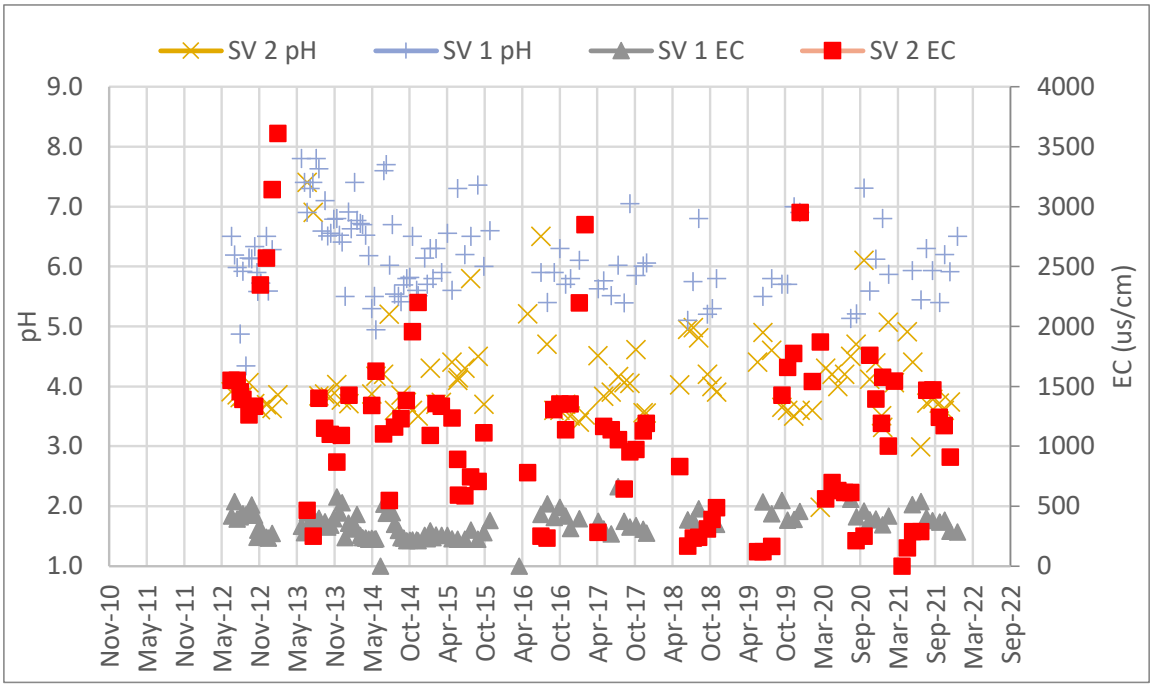

Figure 4-7 SV1 and SV2 Historical EC and pH

Table 4-4 Upstream Surface Water Quality Summary

Analyte	Units	Upper Anglesea River/Marshy Creek (AV2) (1999 – 2021)[7]					Salt Creek (SV2) (1999 – 2021)				
		Mean	Median	Low	High	90th percentile	Mean	Median	Low	High	90th percentile
pH (1970 to 1999)		3.5	3.4	2.8	7.5	4.15					
pH		3.08	2.97	2.50	6.15	3.67	4.05	3.87	1.98	7.40	4.98
TDS	mg/L	2,390	2,468	1,116	4,970	3,596	578	715	74	5,660	1,367
Aluminium	mg/L	10.8	6.2	0.53	254	151.6	47.1	87	0.16	306	176
Boron	mg/L	0.12	0.09	0.05	1	0.6	0.06	0.05	0.03	0.5	0.15
Iron	mg/L	7.11	7.5	0.66	160	41.28	1.28	0.86	0.1	72.7	2.62
Zinc	mg/L	0.12	0.1	0.01	1.37	0.79	0.79	1.49	0.01	3.5	2.13

mg/L = milligrams per litre
TDS = total dissolved solids

[7] Unless date period noted elsewhere

4.2.3 Groundwater Quality

Groundwater quality (water types) for all systems is presented on a Piper plot. Within a Piper plot the two ternary cation and anion plots are projected onto the diamond plot. The diamond plot is a matrix transformation which can be used to determine varying water types. Compositionally, the majority of the groundwater samples plot as a sodium chloride (NaCl) water type (**Figure 4-8**). The dominance of this water type is most likely related to the depositional environment of the EVF (sub-littoral) and the geochemical influence on the younger aquifer sediments of the DBF and Boonah Formations. These younger sediments also indicate a sulfate influence which could be related to the oxidation and dissolution of sulfide minerals.

The salinity signatures for the Demons Bluff and Boonah Formations are not as pronounced and sulfate is more dominant. This could be potentially related to the evolution of the catchment groundwater geochemical facies along a theoretical flowline.

Groundwater within all aquifers above the LEVF is classified as Segment B, in accordance with the ERS. This is in agreement with previous classifications (Coffey, 2015; GHD, 2013). The groundwater within the LEVF is classified as Segment A2 (refer to Section 4.1 for classification of segments).

It should be noted that the TDS obtained from the historical Alcoa extraction bores shown on **Figure 4-9** generally suggest the UEVF groundwater that were reported to be within Segment A2, however and as discussed in **Section 2.3.4, Table 2-2**, many of these bores were potentially crossed screened and the water quality may have been impacted by the lower TDS groundwater of the LEVF.

The UEVF groundwater (**Table 4-5, Figure 4-9** and **Figure 4-10**) does not report significant actual acidity (median concentration of 5.8); however, groundwater may contain potential acidity. The UEVF groundwater is anoxic and in the presence of oxygen, acidity may be generated from the oxidation of ferrous iron to ferric iron. Aluminium and manganese are also reported, which could potentially produce acidity; however, zinc concentrations are below the laboratory LOR for these sample results. Providing the UEVF groundwater remains reducing, it is not considered to be a source of acidity. The reported pH does vary between UEVF locations, and it is not known whether these pH values are representative of in-situ pH or if the method of sampling has resulted in oxidation and an increase in acidity (i.e., lowering the pH).

Figure 4-10 presents the same dataset as **Figure 4-9** however as discussed in **Section 2.3.4, Table 2-2**, several older bores were decommissioned as they were likely cross screened across aquifers. Those bores are removed in **Figure 4-10.**

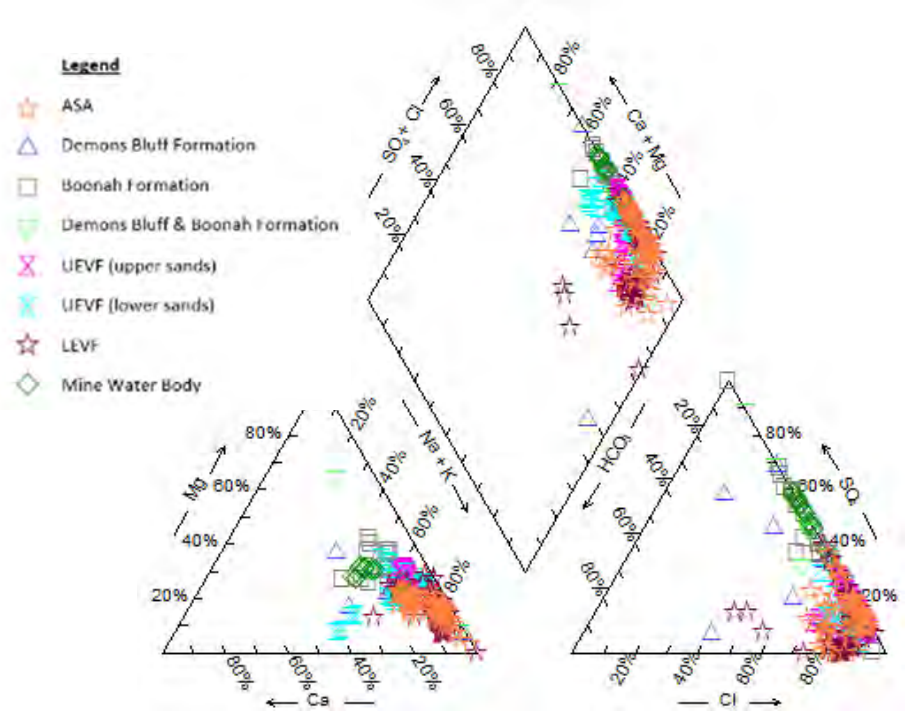

Figure 4-8 Groundwater Piper Diagram

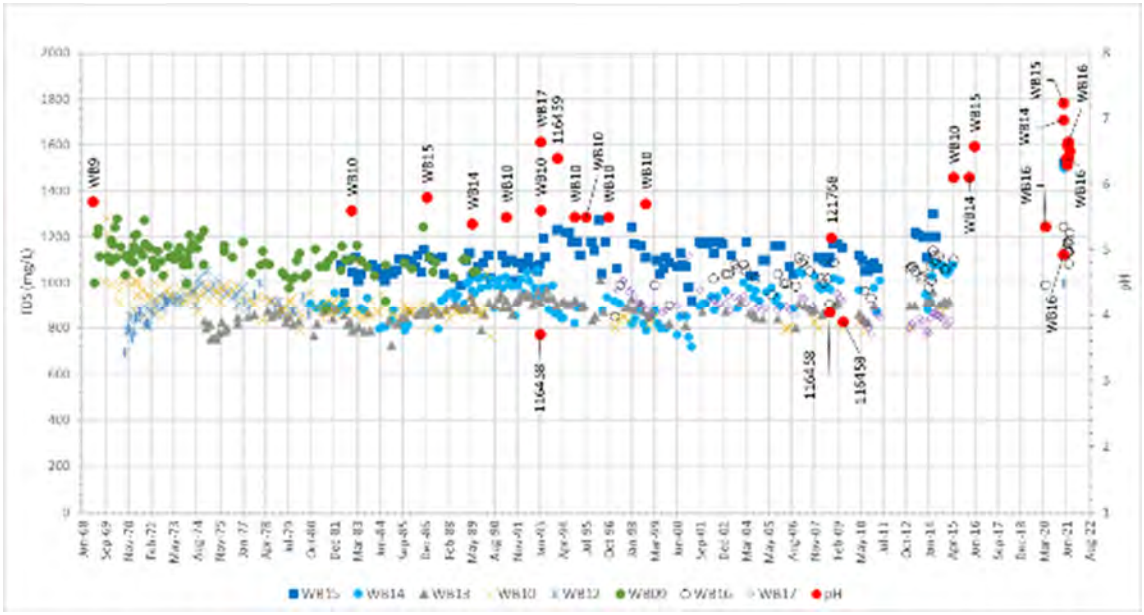

Figure 4-9 Long-Term Historical UEVF (Lower Sands) TDS and pH Trend

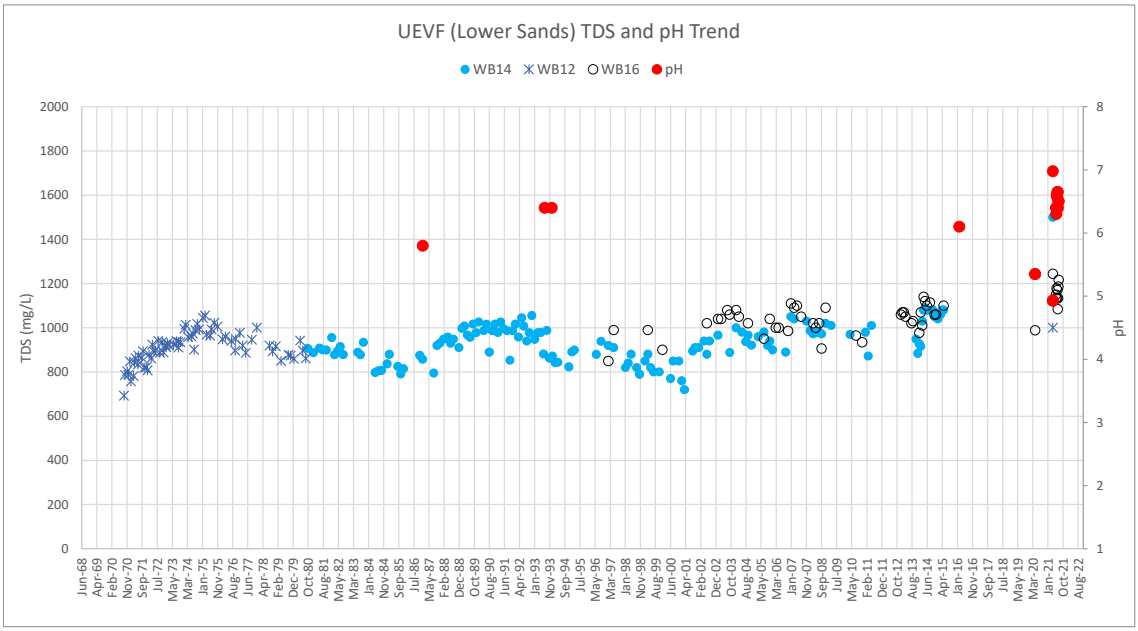

Figure 4-10 UEVF (Lower Sands) TDS and pH Trend with Decommissioned Bores Removed

4.2.3.1 Mixing Zone and underneath the Former Power Station

Water chemistry results from the mixing zone are detailed in EHS Support, 2021, Detailed Site Investigation, Alcoa Anglesea Power Station (April 2021) and EHS Support, 2021, Supplemental Surface Water, Soil and Groundwater Investigation Works, Alcoa Anglesea Power Station (April 2021). These reports were submitted and verified by the EPA appointed Environmental Auditor, Darryl Strudwick, on 29 April 2021, to fulfil obligations of Clean Up Notice (CUN 90011694). The mixing zone is disconnected from the underlying aquifers at the site; the groundwater elevations are significantly below the stream invert elevation and the groundwater level response in shallow wells during rainfall events is negligible.

In summary the results are:

- This area is highly disturbed.
- The TDS of this shallow aquifer (either the DBF or Boonah Formation) is generally consistent with Segment B groundwater (1,201-3,100 mg/L).
- Leakage from the former ash ponds, with a historic TDS of around 5,400mg/L has likely formed an artificial perched water table (PWTa) in the DBF.
- Major ion analysis shows that the Marshy Creek solid and aqueous samples are sodium sulfate in nature and appear to be in major ion equilibrium. The Mixing Zone (shallow and deep samples) are characterised as calcium sulfate.
- Ion exchange between sodium and calcium has occurred due to an influx of fresher (lower TDS) water into the Mixing Zone catchment which likely occurred during Alcoa licence discharge at SP1.

Table 4-5 UEVF Groundwater Quality Summary

Analyte	Units	Pre-Pumping Test (1999 – 2020)	During Groundwater Pumping Test (May 2021 – current)				
		Concentration range*	Mean	Median	Low	High	90th percentile
pH		3.7 – 7.2	6.5	6.5	6.3	6.7	6.6
TDS	mg/L	830 - 1313	1193	1260	741	1660	1520
Aluminium	mg/L	0.005 – 0.02	0.006	0.03	0.0008	0.03	0.02
Boron	mg/L	0.04 – 0.14	0.066	0.050	0.035	0.339	0.246
Iron	mg/L	4.2 – 63.2	16.88	19.95	0.02	63.4	60.06

mg/L = milligrams per litre
NR = Not Recorded
TDS = total dissolved solids
Water quality data from other production bores have been omitted from the statistical analysis due to bore integrity issues and have now been decommissioned. This bores WB3, WB5, WB8, WB9, WB10, WB13, and WB17
* Limited data record from 1999 to 2020 didn't allow for statistical analysis. Therefore, a concentration range is provided.

Table 4-6 LEVF Groundwater Quality Summary

Analyte	Units	(2019 Sampling, P3. P6, P9, P12, P13, P16, WTOB4 and WTOB5)		
		Median	Low	High
pH		6.23	4.59	6.92
TDS	mg/L	622	219	1200
Aluminium	mg/L	<0.005	<0.005	0.11
Boron	mg/L	#N/A	#N/A	#N/A
Iron	mg/L	13	9.8	14

5 Conceptual Geological and Hydrogeological Model

A conceptual geological and hydrogeological model (CHM) was developed using both regional and site-specific investigation data. This model builds on the previous CHM used for the development of the initial numerical groundwater flow model, specifically, the CHM defined in (GHD, 2013) and (EHS Support, 2018, 2020). The CHM forms the building block for ongoing technical support and delivery of project deliverables for Alcoa to meet the requirements set out within the MCRP as well as support the development of the updated regional numerical groundwater flow model (GHD, 2021a).

There has been a significant amount of independent work undertaken over the last 60 years to characterise groundwater behaviour. The main investigations which have significantly advanced the understanding of the hydrogeological conditions are summarised in **Table 2-3**. These reports and where available, the data, have been used to assist in building this CHM and develop the numerical groundwater flow model used to assess groundwater related risks.

5.1 Regional Geology

Regionally the site is located in the Torquay Sub-basin (**Figure 5-1**), which was isolated from the Otway Basin when the mid-Cretaceous Otway Ranges were uplifted in response to the break-up between Australia and Antarctica (Trupp *et al.,* 1994).

The Torquay Sub-basin is a northeast trending, rift depocentre that occupies largely offshore areas along the Victorian coast in the north-eastern part of the Otway Basin. It was initiated in the Early Cretaceous as a result of rifting along the southern Australian margin that culminated in the break-up of Australia and Antarctica. There are two main fault-bounded structural elements within the sub-basin, the Basin Deep ("Nerita Trough" or "Nerita Deep") and Snail Terrace. The lower part of the basin-fill comprises rift-related, fluvio-lacustrine sediments of the Lower Cretaceous Otway Group (Crayfish and Eumeralla super-sequences). The upper Torquay Sub-basin comprises Upper Cretaceous to Eocene, coal-prone fluvio-lacustrine sediments of the EVF, Eocene to Oligocene siliciclastic sediments of the DBF, and Oligocene to Miocene marine carbonates of the Torquay Group.

The mining has exposed, over a strike length of 2 km, a 20 to 35 m-thick coal seam at the base, and up to 80 m of overburden sandstone, siltstone, carbonaceous shale and minor coal. These exposures reveal the relationship between the Eocene upper units of the Eastern View Formation, the overlying Boonah Formation, and the lower units of the Salt Creek and Anglesea Formations of the DBF. The relationship between the EVF exposed in the Anglesea coal mine and the deeper stratigraphy was re-interpreted using deep aquifer drilling and age dating in the area (Holdgate *et al.,* 2002). The mine exposures also provide a record of the Boonah Formation, the Salt Creek Formation, and the lower beds of the Anglesea Formation not seen in coastal outcrops. All coal and oil exploration, groundwater and stratigraphic drilling results have been compiled. From this, the onshore basin can be structurally divided from south to north into the southeast-plunging Anglesea Syncline, the east-pitching Bald Hills Anticline, the east plunging Bells Beach Syncline. (Holdgate *et al.,* 2002).

North to south and west to east conceptual cross-sections are displayed on **Figure 5-3** and **Figure 5-4** respectively. These cross-sections (**Figure 5-2** for location) illustrate the extent of formation outcrop, deposition, and the structural controls on the geological layering. **Figure 5-5** shows a southwest–

northeast regional cross-section through the Tertiary deposits of the Anglesea area, showing stratigraphic correlations, geophysical logs, palynological ages, sequence boundaries and structures.

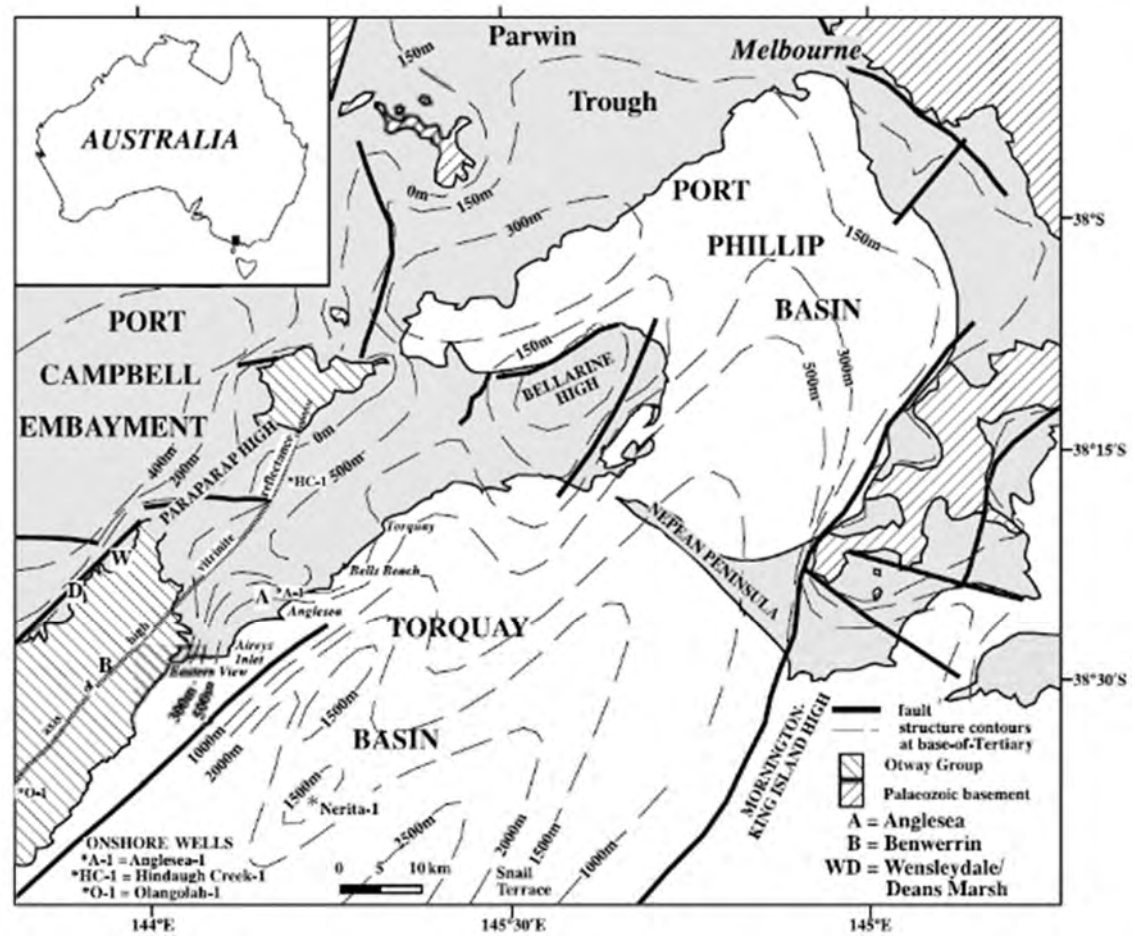

Figure 5-1 Location and Structural Map of the Central Coastal Basins of Victoria Including the Torquay Basin

Note: The main basement and Otway Group outcrops and generalised structure contours on base-of-Tertiary are also shown
Source: adapted from Abele et al., 1988

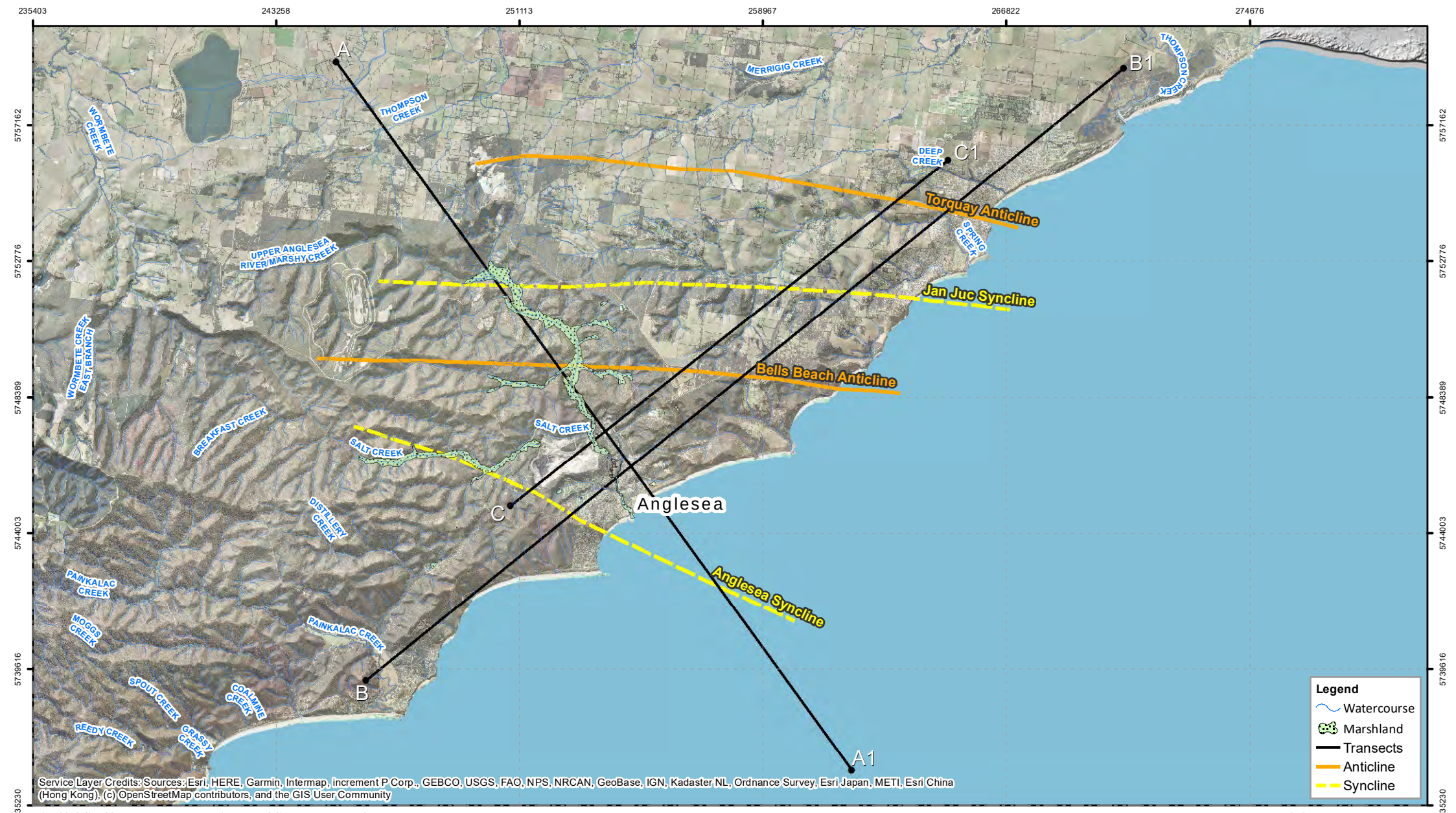

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Figure 5-2

Regional Geology Transect Loactions

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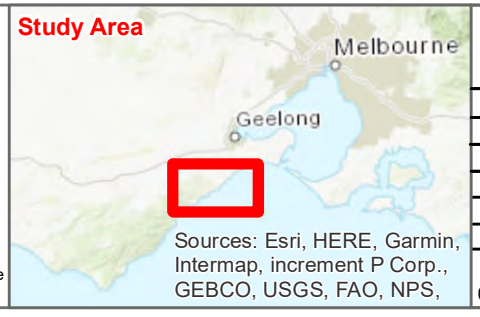

Alcoa Anglesea Hydrogeological Investigation

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CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:158,209

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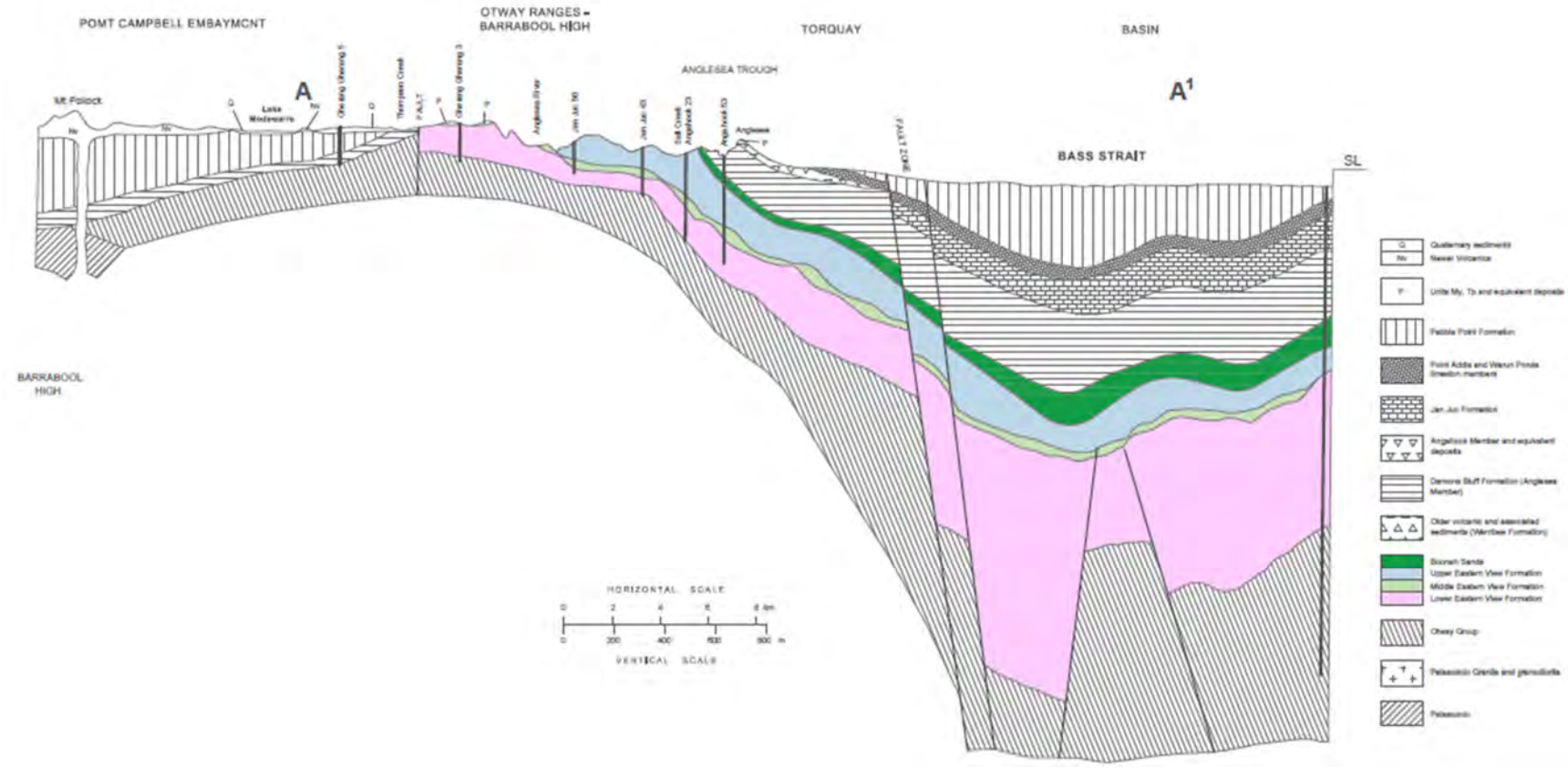

Figure 5-3 North-South Conceptual Cross-Section

Source: modified from Reeckmann et al., 1988

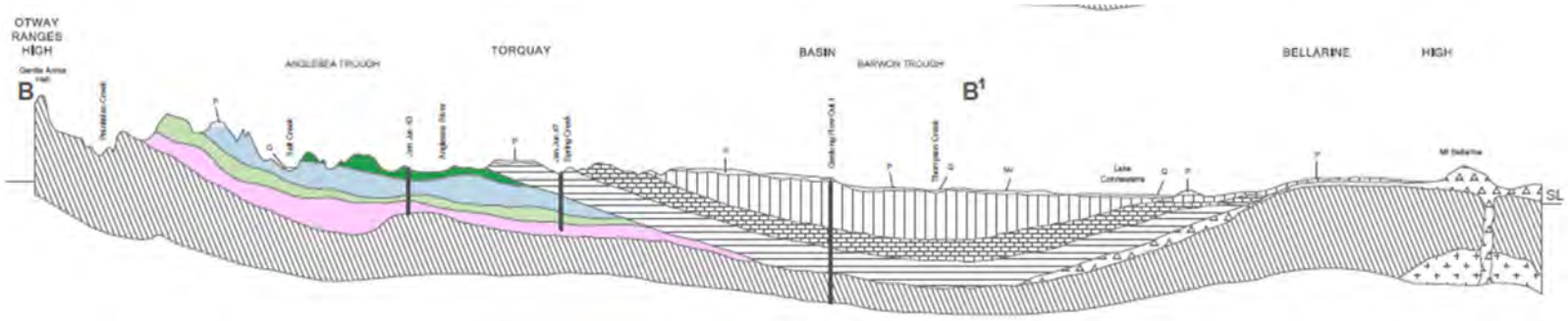

Figure 5-4 West to East Conceptual Cross-Section

Source: modified from Reeckmann et al., 1988

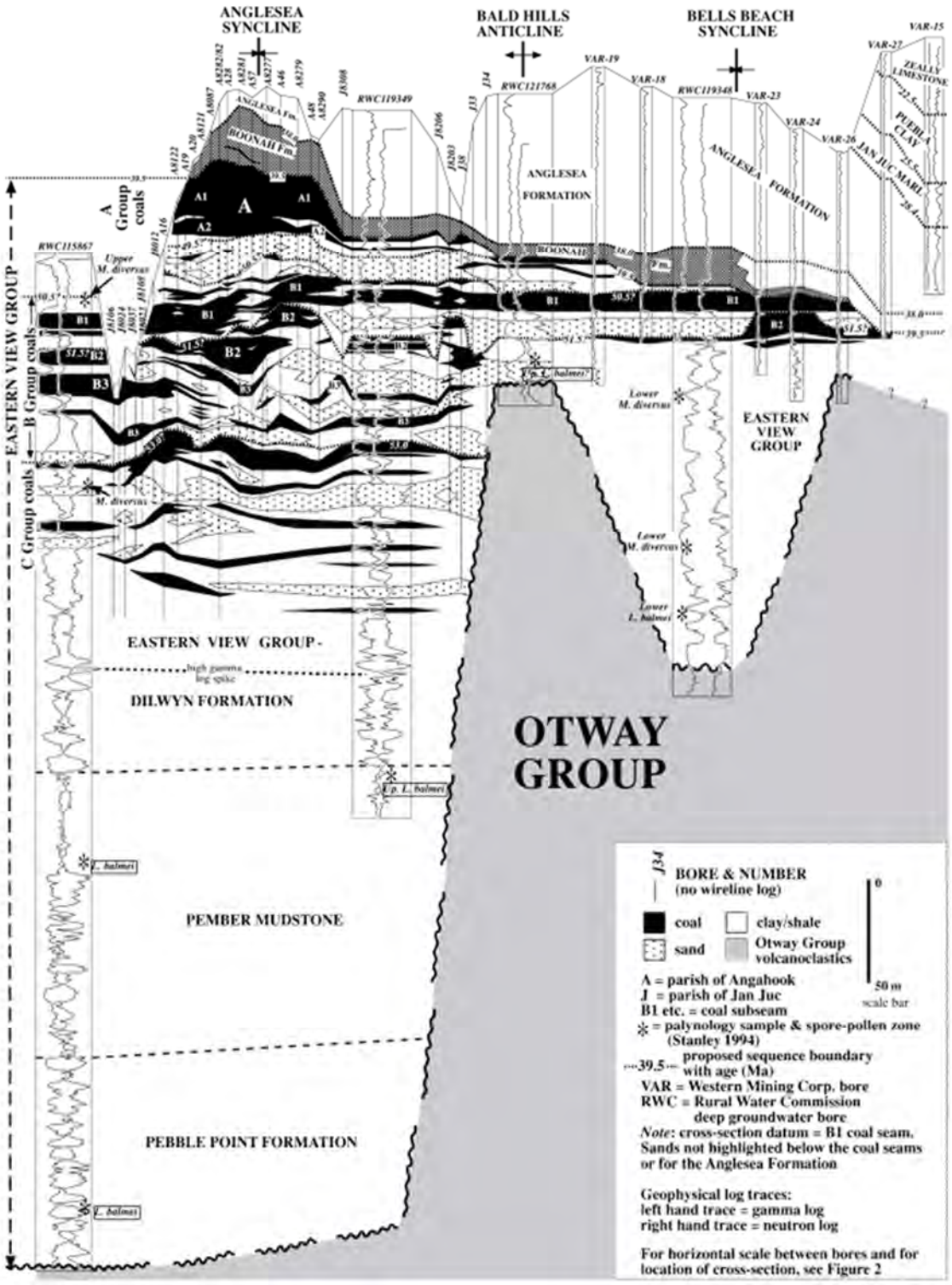

Figure 5-5 Southwest–Northeast Regional Cross-Section through the Tertiary Deposits of the Anglesea Area (Cross Section C-C' on Figure 5-2).

Note: showing stratigraphic correlations, geophysical logs, palynological ages, sequence boundaries and structures
Source: after Holdgate et al., 2001.

5.1.1 The Boonah Formation

As shown on the stratigraphic sequence in **Figure 5-7**, the Boonah Formation is listed as a member of the Demon Bluff Group (DBG). This has not always been the case. From 1955 to 1994, the Boonah Formation was included within the Eastern View coal measures (Raggatt and Crespin, 1955) and later the EVF (Abele, 1968). This extent is shown in the Geological Survey of Victoria Anglesea 1:63,000 geological map sheet (GSV, 1967).

In (Holdgate *et al.,* 2002), the Boonah Formation was re-assigned from the EVF to the DBG. This has resulted in the DBG extending further inland, where it outcrops across the mine lease area and includes part of Anglesea River, Salt Creek and the Salt Creek diversion channel. This outcropping area is estimated and presented on **Figure 5-6** with the outcrop defined after reviewing the lithological data from bores recorded in the Geological Exploration and Development Information System (GEDIS).

As the Boonah Formation is an important geological unit within the Alcoa mine lease area, the Boonah Formation will be separated out from both the DBF and the UEVF for the purposes of numerical groundwater model development.

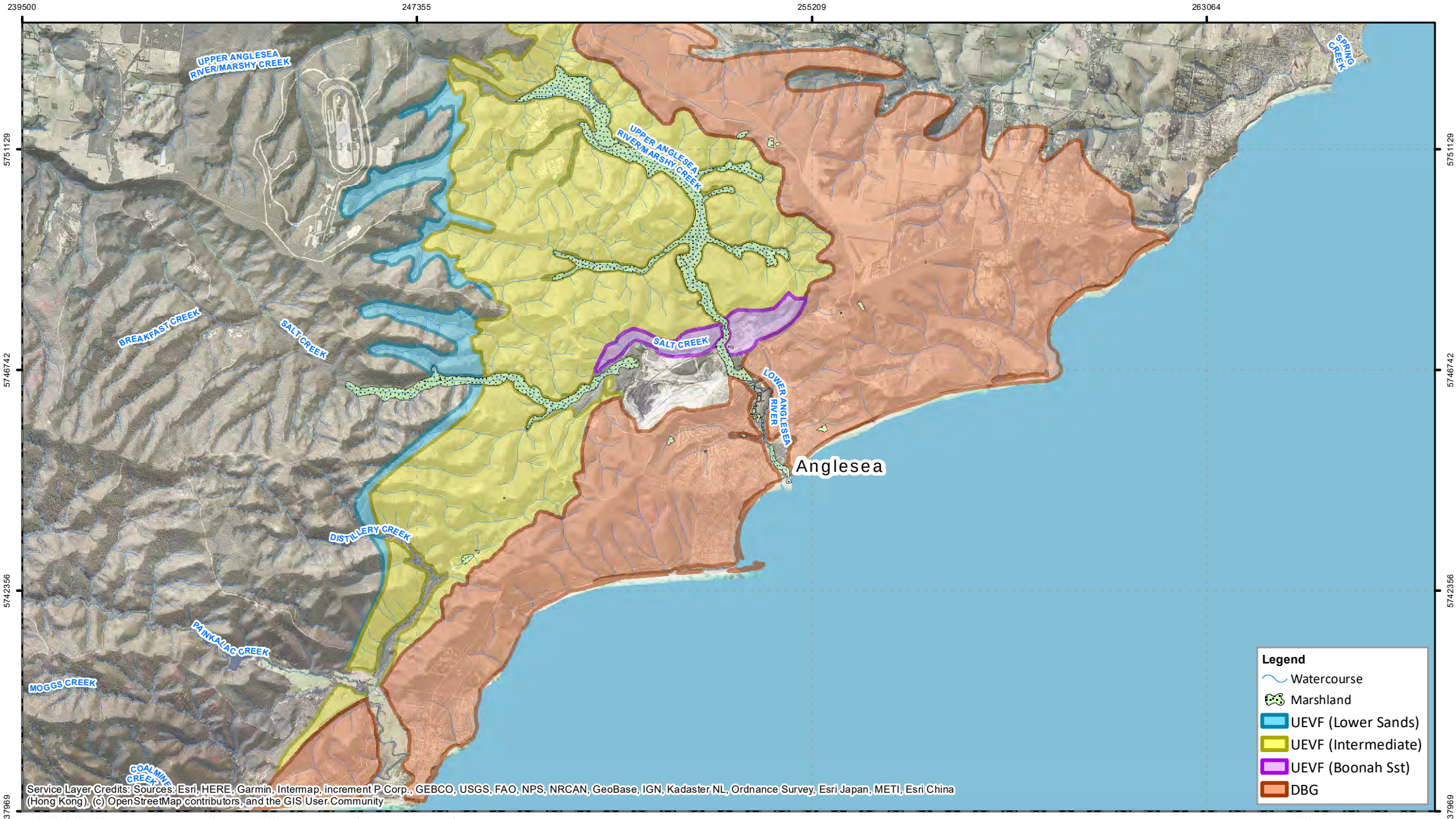

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Figure 5-6
Regional Geology

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Alcoa Anglesea Hydrogeological Investigation

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REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:98,797

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Kilometers

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5.1.2 Jan Juc Groundwater Management Area

The Alcoa and Barwon Water borefields are located within the Jan Juc GMA. The Jan Juc GMA incorporates the north-western onshore section of the Torquay Basin. Within this portion of the basin, there are two distinct synclines, the Anglesea Syncline and the Bells Beach Syncline, where the sedimentary sequences are up to approximately 500 m and 350 m thick respectively. Separating the two synclines is a bedrock high referred to as the Bald Hill Anticline or the Bells Beach Anticline.

A summary of the main geological units in the region, from youngest to oldest, in the GMA, is shown in **Table 5-1** and on **Figure 5-7**. The Alcoa borefield targets the permeable sand lenses of the lower part of the UEVF, while the Barwon Water borefields target the permeable sand lenses of the LEVF. A series of regional north to south and west to east cross-sections illustrate the stratigraphic sequence relationships. The cross-section locations are shown on **Figure 5-8** and the cross-sections are presented on **Figure 5-9** to **Figure 5-15**. In addition to the investigation and observation bores drilled by Alcoa and Barwon Water, these cross-sections were developed using publicly available data, and were obtained from the following sources:

- GeoVic layers (earthresources.vic.gov.au).
- Discover and access Victorian Government open data | Data Vic.
- Visualising Victoria's Groundwater (vvg.org.au).
- Geological Exploration and Development Information System (GEDIS) (vvg.org.au).

Table 5-1 Geological Units Across the Jan Juc GMA

Period	Geological Unit	Description	Approximate Thickness
Quaternary	Swamp and Alluvial Sediments	Alluvium consisting of sand, silt, clay and gravel deposited along the local river valleys and swamp deposits such as peat in the main swamplands.	Generally, 10 -30 m thick. Present along the creek lines (i.e., Painkalac Creek, Salt Creek, Spring Creek and Anglesea River), and thickest in the Salt Creek Swamp and Anglesea Swamp.
	Colluvium	Sand, silts and clays	Also present along some creek lines.
Tertiary	Moorabool Viaduct Sands	Sand, ferruginous sand, limestone and gravel, and was deposited in a marine environment	Also present along some creek lines.
	Torquay Group (including Jan Juc and Puebla Formation):	limestone, marl, calcareous and clayey silt, deposited in a marine environment	This unit is mainly present to the northeast of the Torquay Basin and overlies the Demons Bluff Formation.
	DBF	Marine deposit of fine-grained micaceous and carbonaceous silts and silty clays.	Along the coastal stretch between Aireys Inlet and Anglesea and stretches inland towards the Bells Beach anticline.

Period	Geological Unit	Description	Approximate Thickness
	Boonah Formation	As discussed in **Section 5.1.1** The Boonah Formation has historically been reported to be a member of both the UEVF (upper most unit) and the DBF (lower most unit). The formation consists of 1-3 m thick- coarse-grained sand-channel units with interbedded minor clay, shale and carbonaceous siltstone.	In the Anglesea coal mine, the Boonah Sands Formation is up to 32 m thick with the permeable sections extending laterally up to 50 m (e.g., representative of disconnected "shoe-string sands").
	EVF	Deposited in a non-marine lacustrine or deltaic environment and subdivided into three distinct units	Unit up to 250 m thick in Anglesea Syncline. Coals from this unit were formerly mined by Alcoa (generally <50 m thick).
	UEVF	Clay, silty clay, silt and fine to medium grained sand sequences with minor fine gravel lenses. Brown coal seams are common in the top of the sequence.	
	MEVF	Clay, silty clay, shale and mudstone.	In the order of 50-60m deep in the Anglesea Syncline and 25-50 m thick in the Jan Juc syncline
	LEVF	Micaceous silts, carbonaceous clays, silty clays, thin brown coal and fine to coarse grained sands and gravels.	The average thickness of the unit is almost 450 m along the Anglesea Syncline and 100 m along the Jan Juc Syncline
Lower Cretaceous	Otway Group	Inter-bedded sandstones and laminated grey siltstone and mudstone	The bedrock outcrops on the western side of the GMA, and along the Breakfast Creek Tributary gully.

DBF = Demons Bluff Formation
EVF = Eastern View Formation
GMA = Groundwater Management Area
LEVF = Lower Eastern View Formation
m = metre
MEVF = Middle Eastern View Formation
UEVF = Upper Eastern View Formation

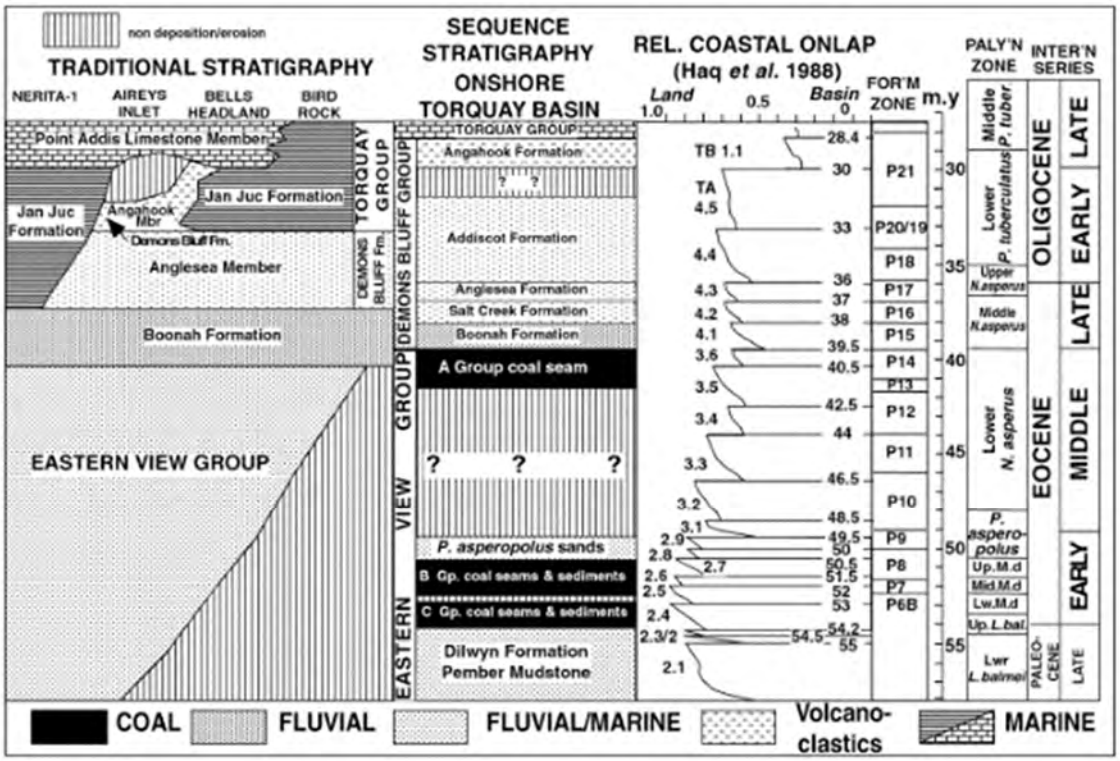
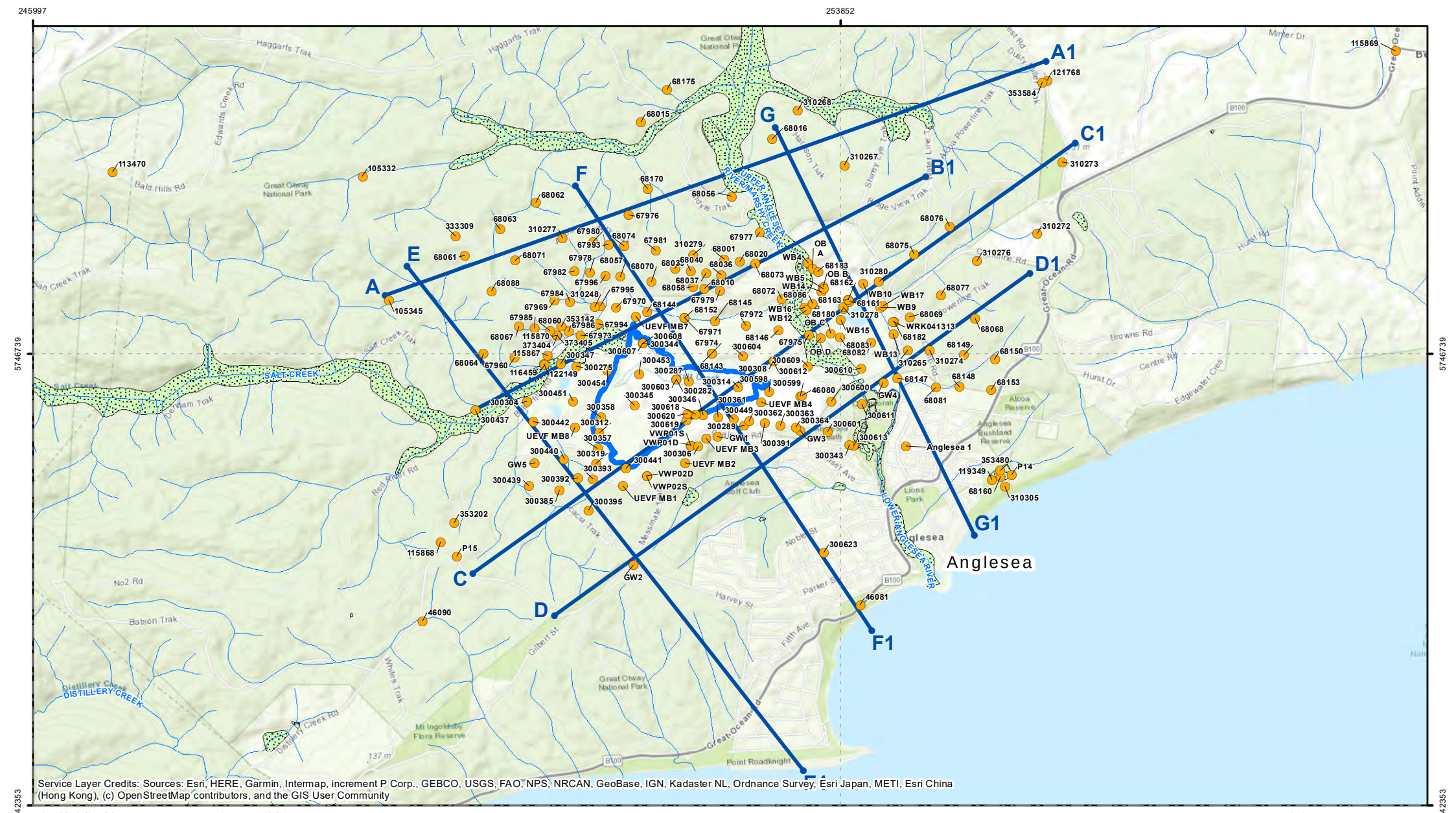


Figure 5-7 Stratigraphic Sequence of the Onshore Torquay Basin

Source: Holdgate et al., 2002



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-8 Well Depth Transects.mxd

Printed 30/03/22 2:08:25 PM by Danny.Barnes

Figure 5-8 - Well Depth >100m

Well Depth >100m
Well Depth >100m
Transects
Pit Lake Boundary (+7mAHD)
Watercourse
Marshland

ALCOA

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

DATE:	30/03/2022
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:47,690

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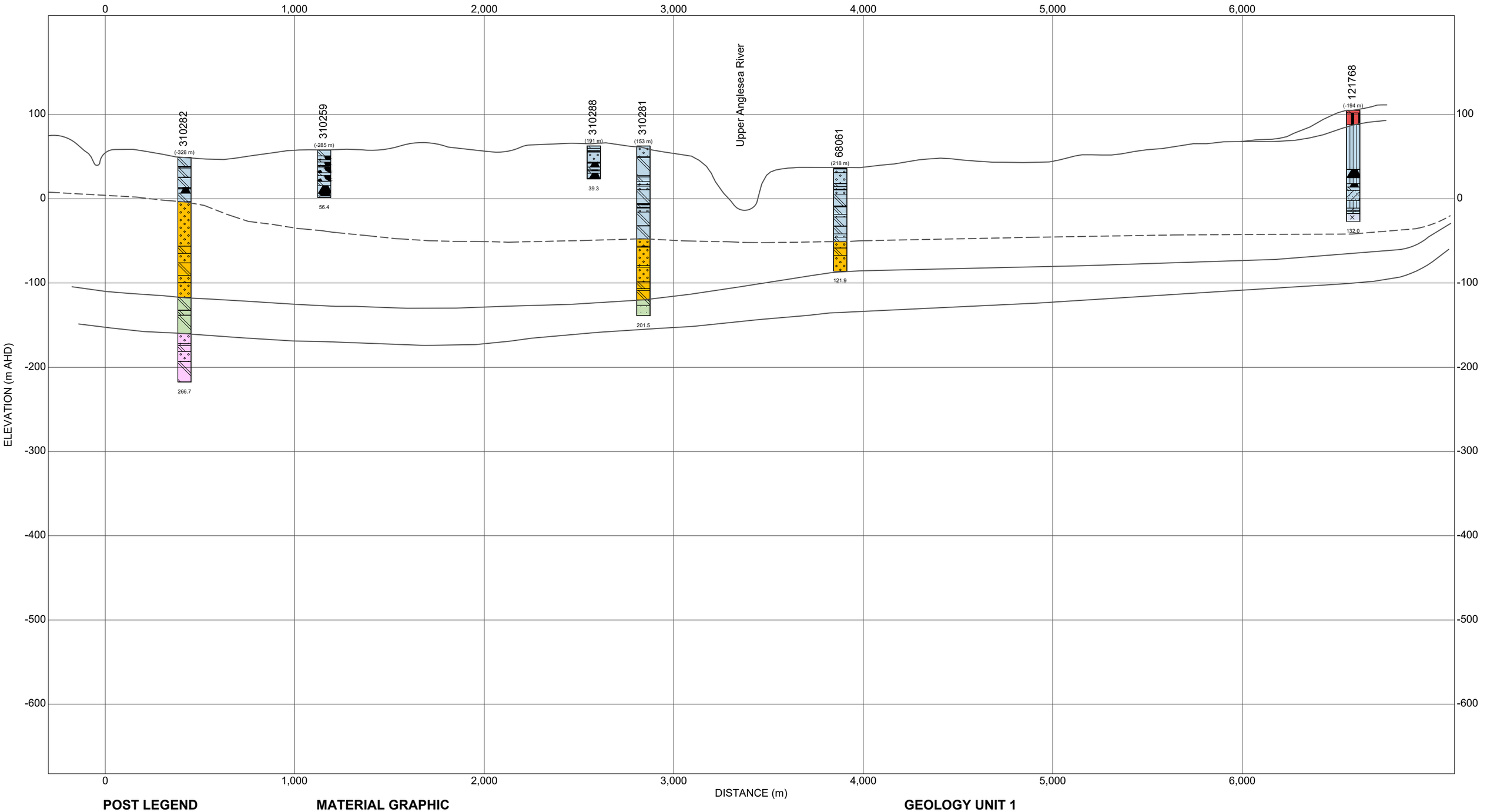

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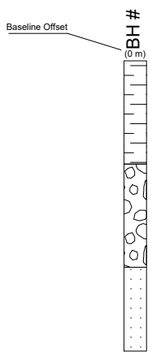


MATERIAL GRAPHIC

- Topsoil
- USCS Well-graded Gravel
- USCS Clayey Gravel
- FERRICRETE
- USCS Well-graded Sand
- USCS Elastic Silt
- USCS Low Plasticity Gravelly Clay
- USCS Low to High Plasticity Clay
- USCS Silt
- Siltstone
- Coal
- USCS Clayey Sand
- Sandstone

H 1:20000

0 200 400 600 800 1000m

V 1:4500

0 50 100 150 200 250m

Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

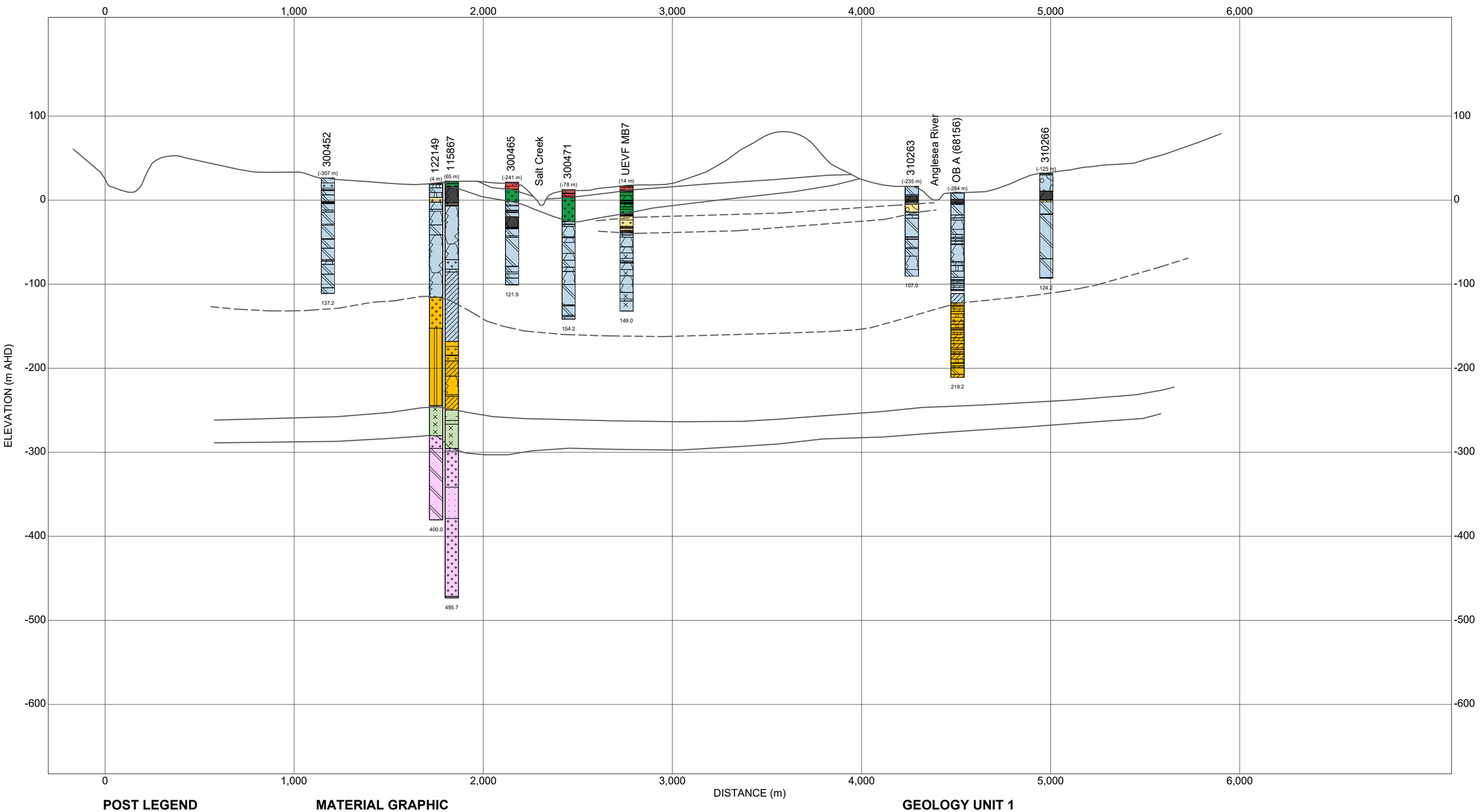
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - A

DRAWN		DATE	28/10/2021
CHECKED		DATE	28/10/2021
SCALE	H 1:20000 V 1:4500		A3
PROJECT No	AUS##C03093_2020	FIGURE No	5-9



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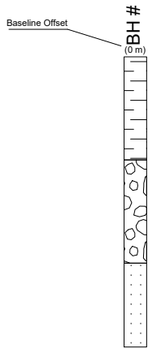


MATERIAL GRAPHIC

- Topsoil
- USCS Low to High Plasticity Clay
- Siltstone
- FERRICRETE
- USCS Low Plasticity Sandy Clay
- Sandstone
- USCS Silt
- USCS Clayey Sand
- USCS Well-graded Sand
- USCS Well-graded Gravel
- USCS Elastic Silt
- USCS Sandy Silt
- Coal
- MUDSTONE
- Limestone
- USCS Low Plasticity Clay

H 1:20000
0 200 400 600 800 1000m
V 1:4500
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

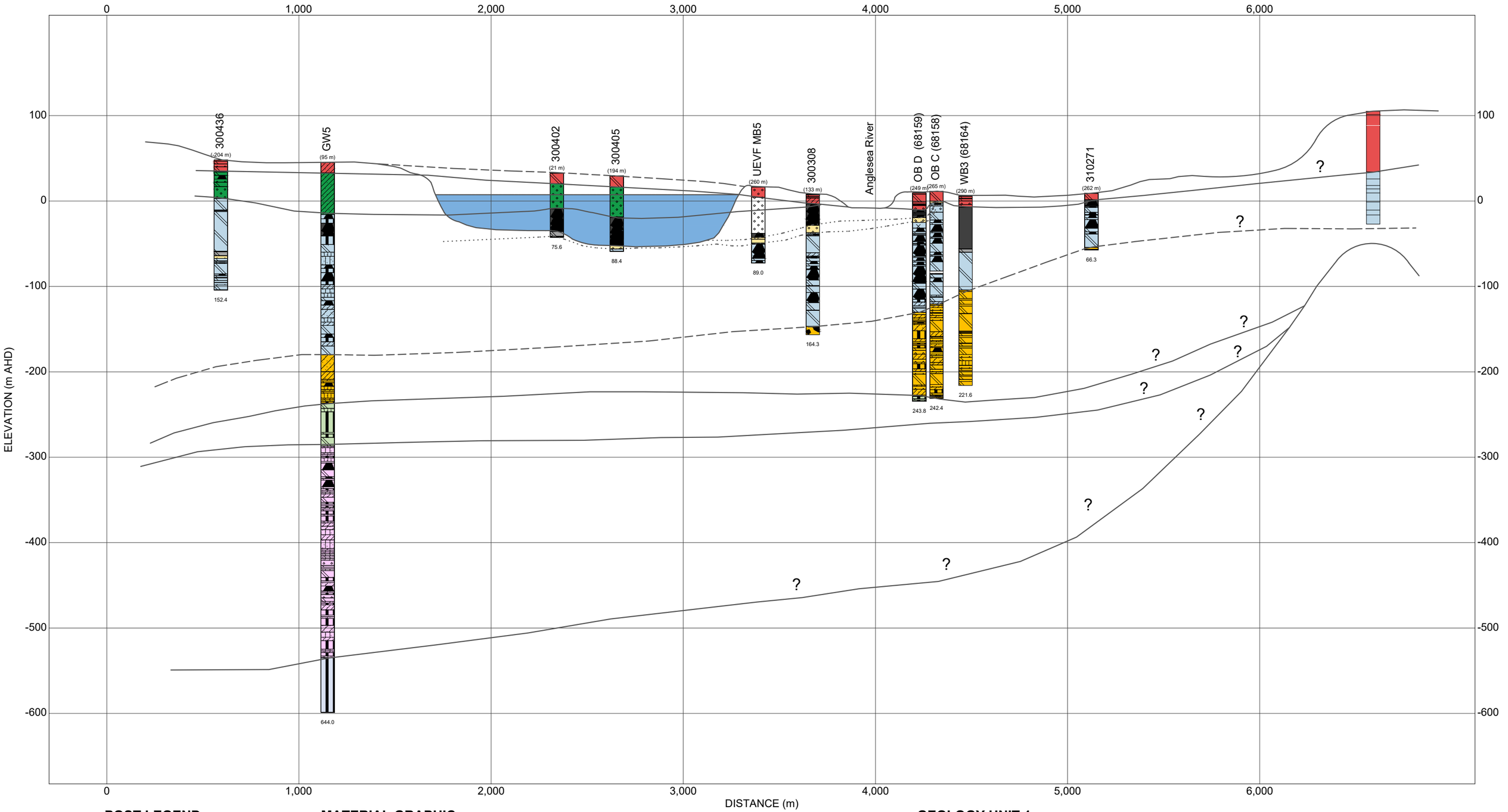
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - B

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:4500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-10	



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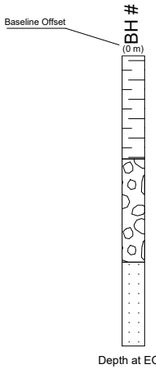


MATERIAL GRAPHIC

- USCS Elastic Silt
- Coal
- FERRICRETE
- USCS Clayey Sand
- USCS Low to High Plasticity Clay
- USCS Well-graded Gravel
- Siltstone
- USCS Silt
- USCS Low Plasticity Sandy Clay
- Topsoil
- USCS Sandy Silt
- USCS Well-graded Sand
- Sandstone
- USCS Silty Sand

H 1:20000
0 200 400 600 800 1000m
V 1:4500
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

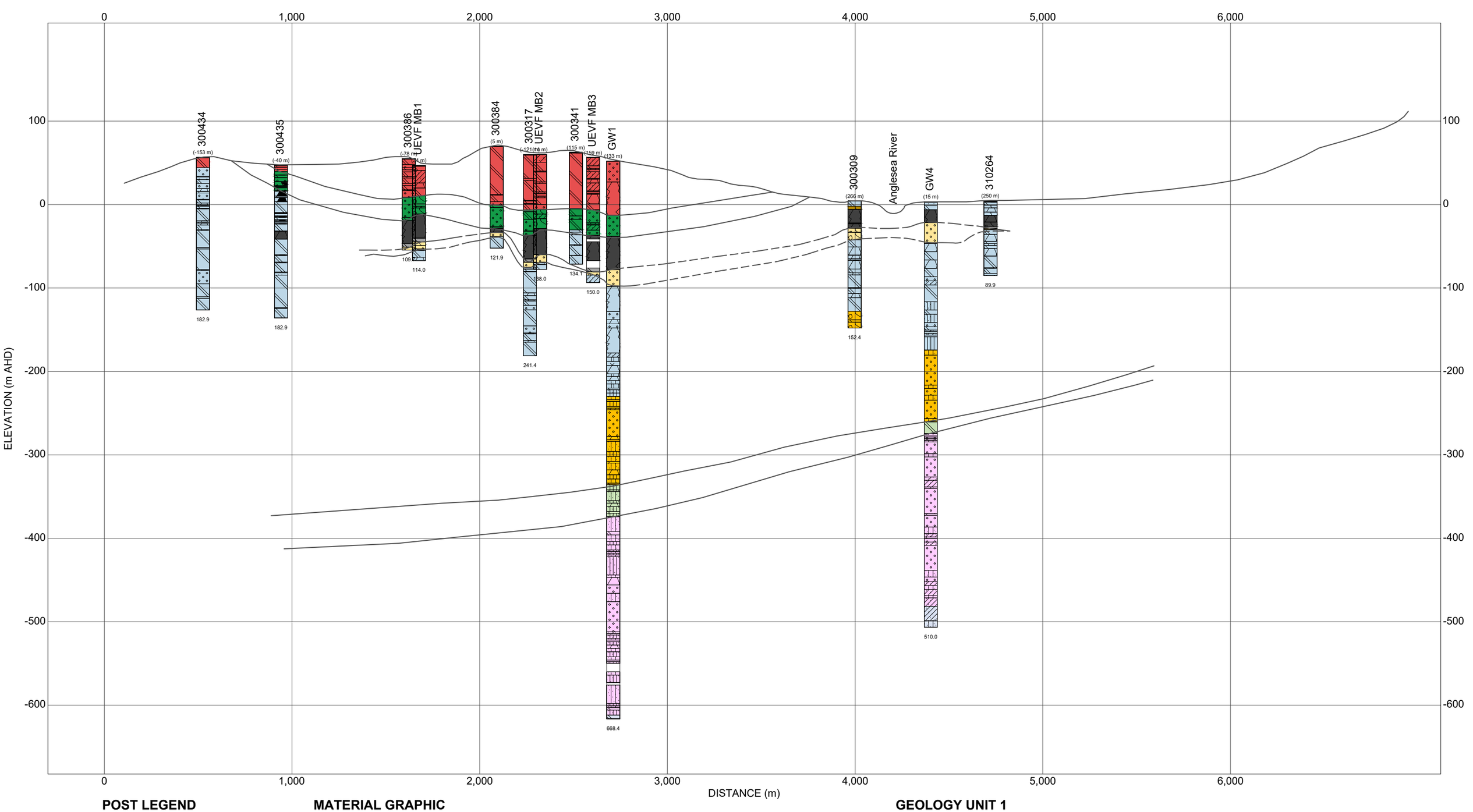
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - C

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:4500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-11	



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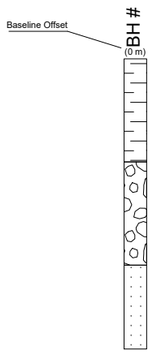


MATERIAL GRAPHIC

- Topsoil
- USCS Well-graded Sand
- USCS Low Plasticity Sandy Clay
- USCS Silt
- USCS Low to High Plasticity Clay
- Siltstone
- USCS Elastic Silt
- USCS Clayey Sand
- USCS Well-graded Gravel
- FERRICRETE
- USCS Silty Sand
- USCS Low Plasticity Gravelly Clay
- Coal
- Sandstone
- USCS Sandy Silt

GEOLOGY UNIT 1

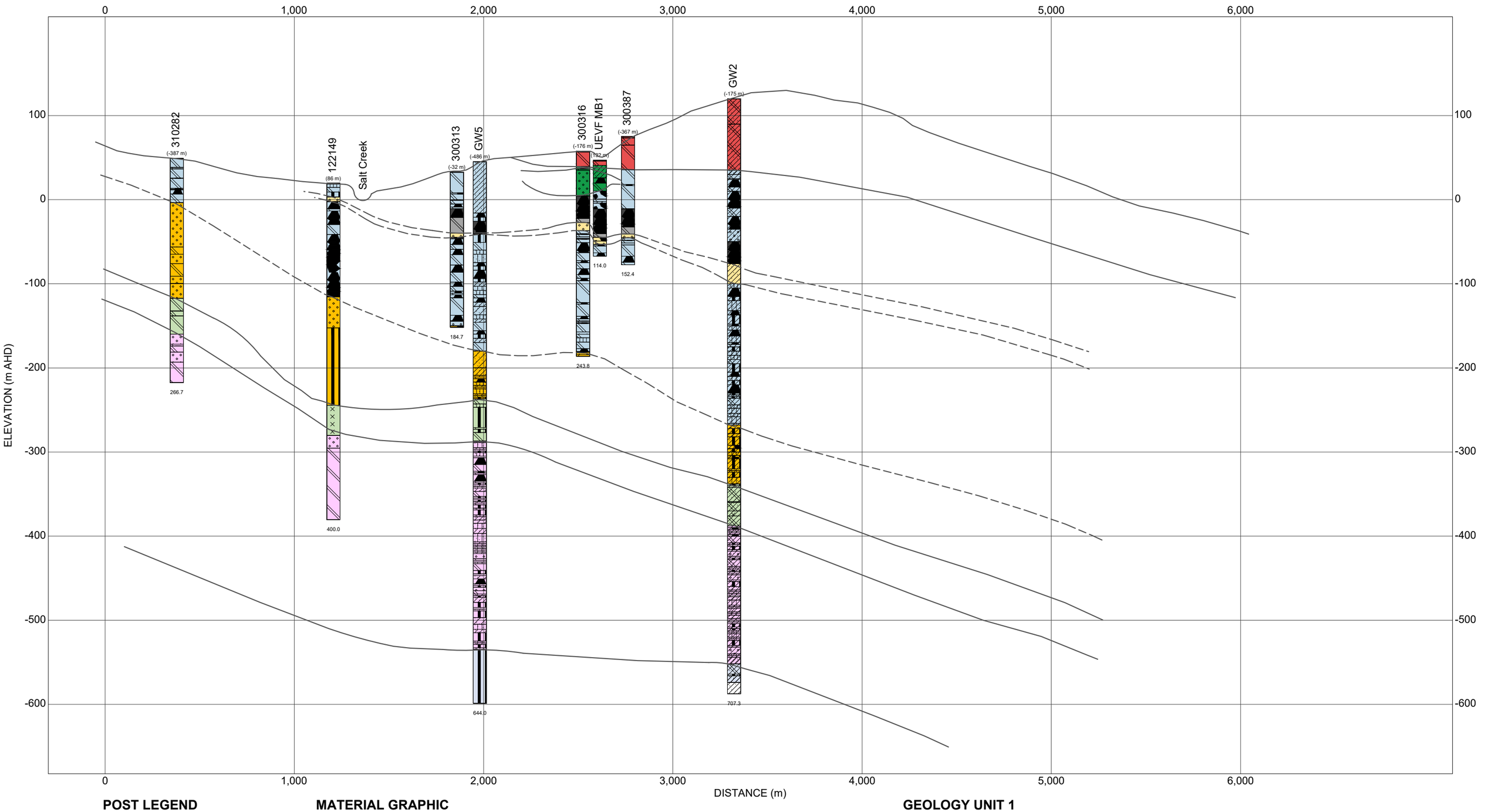
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

H 1:20000
0 200 400 600 800 1000m
V 1:4500
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support™

TITLE
Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - D

DRAWN	DATE 28/10/2021
CHECKED	DATE 28/10/2021
SCALE H 1:20000 V 1:4500	A3
PROJECT No AUS##C03093_2020	FIGURE No 5-12



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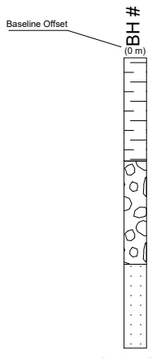


MATERIAL GRAPHIC

- USCS Low to High Plasticity Clay
- Coal
- Limestone
- USCS Sandy Silt
- USCS Silt
- Siltstone
- FERRICRETE
- USCS Silty Sand
- USCS Elastic Silt
- Topsoil
- USCS Low Plasticity Sandy Clay
- USCS Clayey Sand
- USCS Well-graded Sand
- USCS Well-graded Gravel
- USCS Low Plasticity Gravelly Clay

H 1:20000

0 200 400 600 800 1000m

V 1:4500

0 50 100 150 200 250m

Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

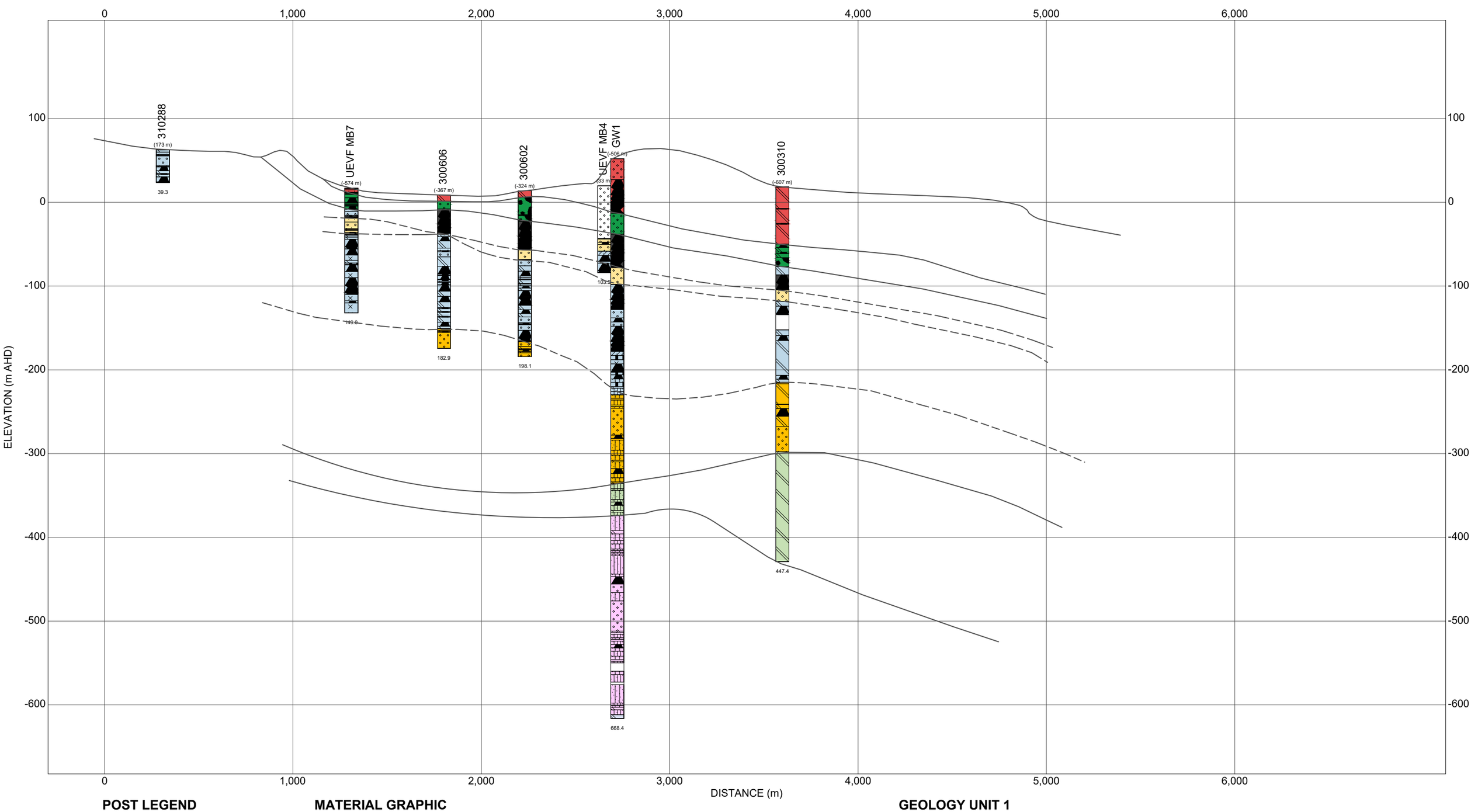
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - E

DRAWN		DATE	28/10/2021
CHECKED		DATE	28/10/2021
SCALE	H 1:20000 V 1:4500		A3
PROJECT No	AUS##C03093_2020	FIGURE No	5-13



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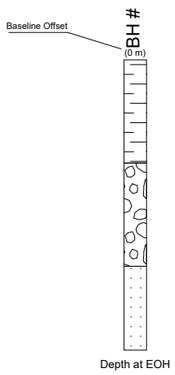


MATERIAL GRAPHIC

- USCS Well-graded Sand
- Sandstone
- Siltstone
- USCS Clayey Sand
- USCS Low to High Plasticity Clay
- FERRICRETE
- USCS Silty Sand
- USCS Low Plasticity Clay
- Coal
- USCS Low Plasticity Sandy Clay
- USCS Sandy Silt
- USCS Well-graded Gravel
- USCS Elastic Silt
- USCS Silt

H 1:20000
0 200 400 600 800 1000m
V 1:4500
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

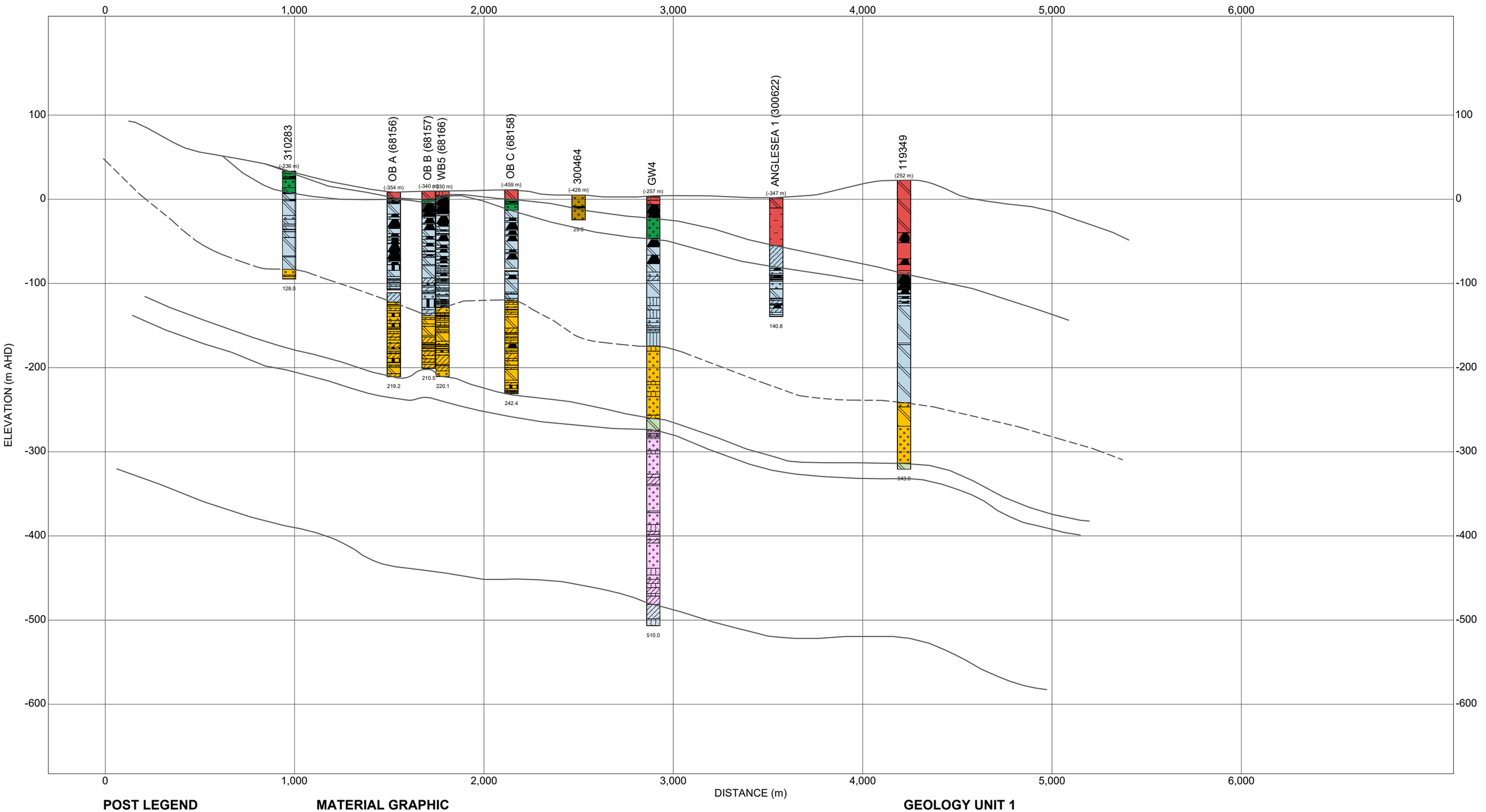
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - F

DRAWN		DATE	28/10/2021
CHECKED		DATE	28/10/2021
SCALE	H 1:20000 V 1:4500		A3
PROJECT No	AUS##C03093_2020	FIGURE No	5-14



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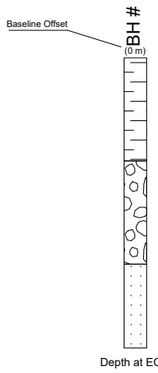


MATERIAL GRAPHIC

- USCS Low to High Plasticity Clay
- USCS Well-graded Gravel
- Sandstone
- USCS Silt
- Coal
- FERRICRETE
- USCS Silty Sand
- USCS Elastic Silt
- USCS Well-graded Sand
- MUDSTONE
- USCS Sandy Silt
- Topsoil
- USCS Low Plasticity Sandy Clay
- USCS Clayey Sand

GEOLOGY UNIT 1

- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

H 1:20000

0 200 400 600 800 1000m

V 1:4500

0 50 100 150 200 250m

Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - G

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:4500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-15	

5.2 Local (Alcoa Area of Interest) Geology

5.2.1 Area of Interest Overview

The Alcoa Area of Interest (AOI) is a region within the broader catchment and numerical groundwater model domain (GHD, 2021a) that has been broadly defined by geological characteristics as well a conservative analytical radius of influence (defined by the Hantush-Jacob equation) associated with pumping bore on the former Alcoa Power station site at a rate of 40 l/s. The adopted hydrogeological parameters have been derived from the pumping test **Appendix D**.

The Hantush-Jacob solution is defined as:

$$s = \left(\frac{Q}{4\pi T}\right) w(u, \frac{r}{B}); \quad u = \left[\frac{(r^2 S)}{(4Tt)}\right]; \quad B = \sqrt{\left[\frac{Tb'}{K'}\right]} \tag{3}$$

Where s is drawdown [m], b' is aquitard thickness [m], K' is vertical hydraulic conductivity of the aquitard [m/d], Q is pumping rate [l/s], r is radial distance from pumping well to observation well [m], S is storativity [-], t is elapsed time since start of pumping [days] and T is transmissivity [m²/d].

Time-drawdown calculations using Hantush-Jacob equation

Aquifer parameters		
T	32	m2/d
S	0.0004	
B	997.3	m
Pumping rate		
Q	40	l/s

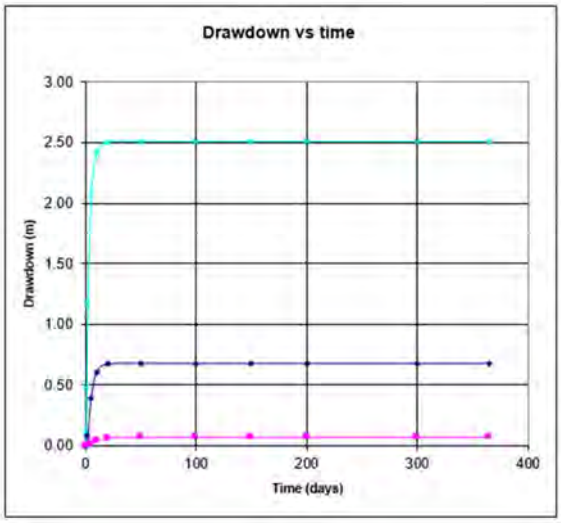
B	997.3	m
b'	4	m
K'	3.70E-04	m/d

Radius (m)	1000	2000	4800
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.1	0.000	-	-
0.5	0.105	0.000	-
1	0.485	0.006	-
2	1.165	0.081	0.000
5	2.071	0.395	0.008
10	2.420	0.608	0.041
20	2.502	0.672	0.063
50	2.507	0.676	0.066
100	2.507	0.676	0.066
150	2.507	0.676	0.066
200	2.507	0.676	0.066
300	2.507	0.676	0.066
365	2.507	0.676	0.066

Distance-drawdown calculations using Hantush-Jacob equation

Aquifer parameters		
T	32	m2/d
S	0.0004	
B	997.3	m
Pumping rate		
Q	40	l/s

	1 day	30 Days	365 Days
Time (days)	1	30	365
Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.1	52.438	55.742	55.743
1	38.671	41.976	41.976
5	29.049	32.354	32.354
10	24.906	28.210	28.211
20	20.764	24.068	24.069
40	16.630	19.932	19.932
100	11.207	14.494	14.495
220	6.699	9.921	9.921
440	3.169	6.156	6.157
880	0.742	2.986	2.987
1500	0.067	1.271	1.272
3000	0.000	0.205	0.206
6000	-	0.007	0.007



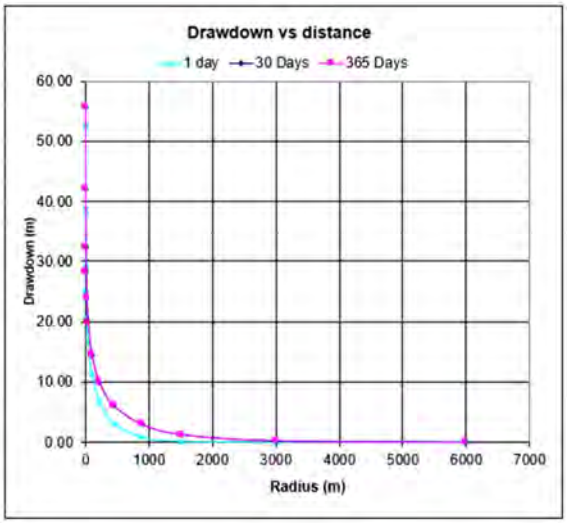


Figure 5-16 Analytical Drawdown Results

The results (**Figure 5-16)** suggest a 3km radius of impact. The AOI also takes into consideration the geological features of the northern boundary (basement high) located approximately 4 km from the pumping bore (WB16). Edwards Creek, a tributary of the Upper Anglesea River, is also located at the northern edge of the AOI. The western boundary is located approximately 4km from WB16. This location is close to Scrubby Hill and where the Bells Beach Anticline causes the entire EVF sequence to thin. The southern margin is defined by the coast, located approximately 3km from WB16. The western extent is defined at the contact boundary between the UEVF and MEVF. This location is also west of the Anglesea syncline, which is approximately 6 km from WB16.

Beyond the extents listed above, based on geology (the maximum rate that bore WB16 can efficiently pump (e.g. ~40 l/s) and empirical groundwater equations, it is unlikely that any proposed groundwater pumping activities will have (or can have) an impact on groundwater systems or other environmental assets.

The key features (**Figure 1-1** and **Figure 2-2**) within the AOI include:

- The mine pit void.
- The former power station monitoring and pumping bores (including WB16).
- The Anglesea River estuary and lower marshlands associated with the Anglesea River.
- Salt Creek diversion and a portion of the Salt Creek marshland.
- Barwon Water southern borefield (GW1 to GW5).
- The township of Anglesea.

5.2.2 AOI Geology

This section discusses in greater detail the local geology/stratigraphy in the Alcoa AOI. **Figure 5-17** shows the upper 50 m beneath the mine to better understand the location of each unit. The deeper stratigraphy immediately below and surrounding the mine within the Alcoa AOI is shown in cross sections on **Figure 5-18** to **Figure 5-23**.

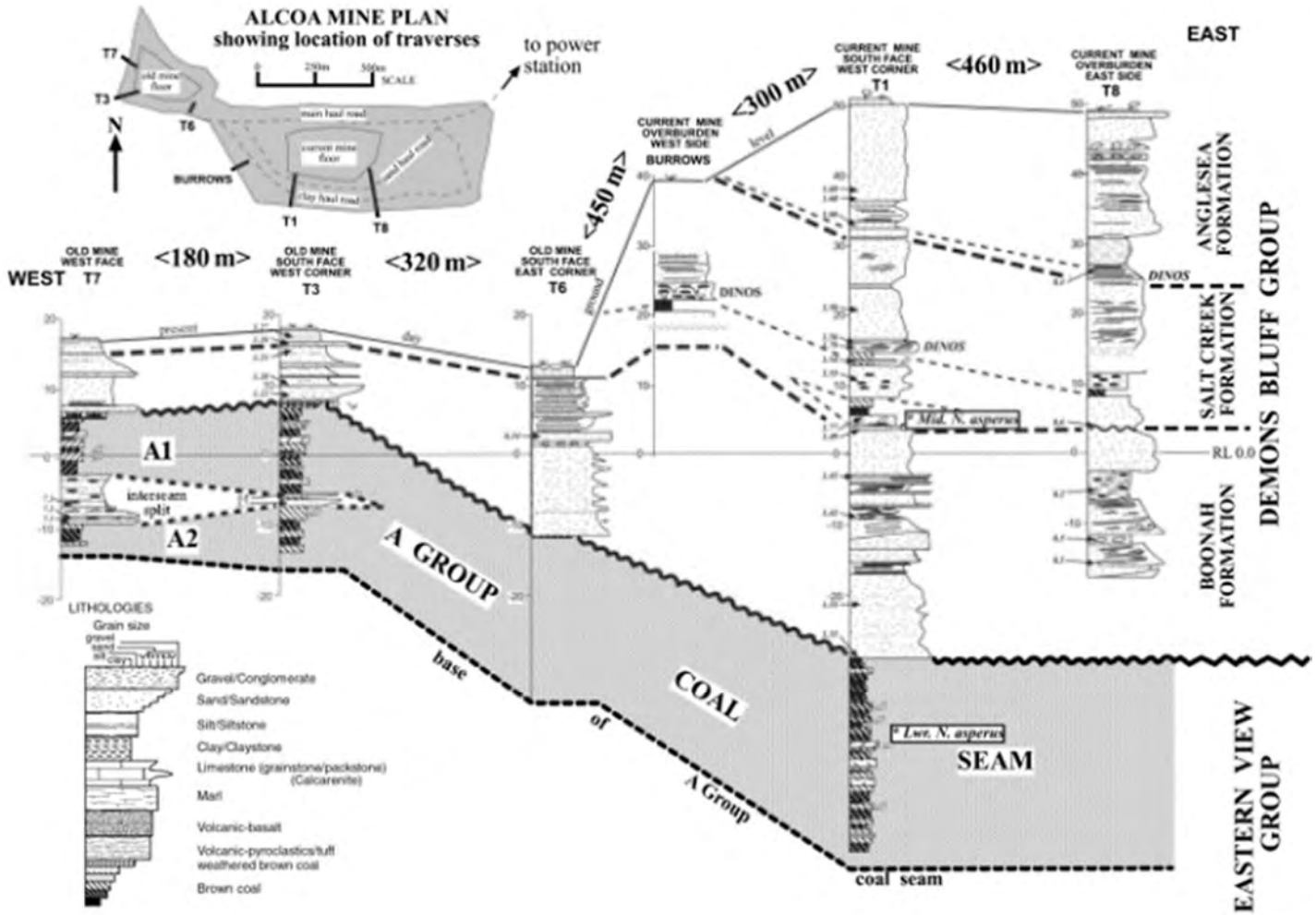
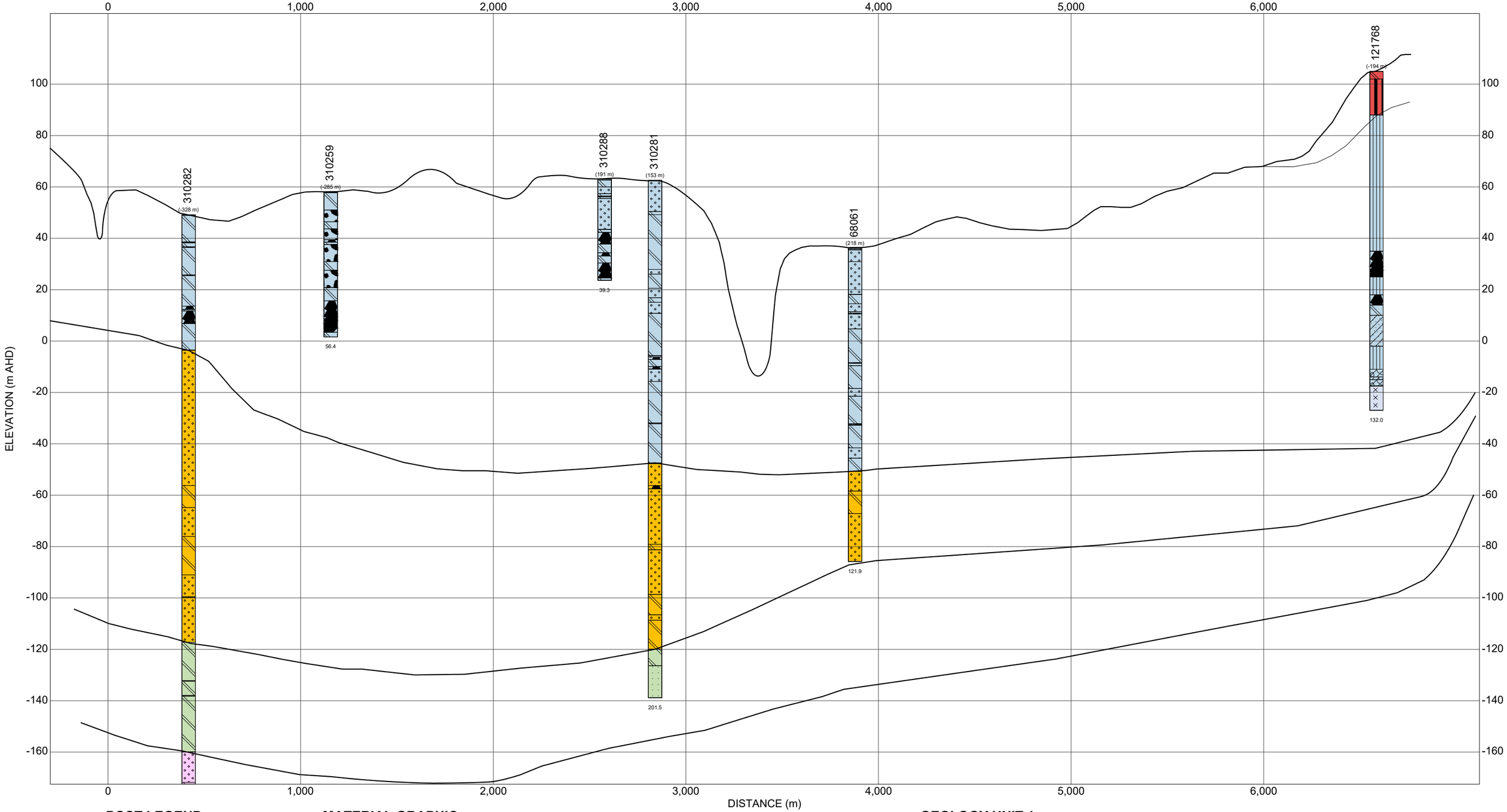


Figure 5-17 Detailed Lithostratigraphic Logs of Measured Sections Across the Anglesea Coal Mine Showing the Proposed Formation Boundaries

Source: after Holdgate et al., 2002.



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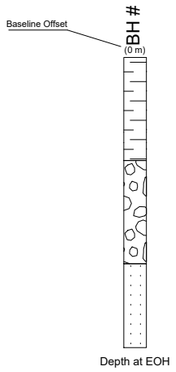


MATERIAL GRAPHIC

- Topsoil
- USCS Well-graded Gravel
- USCS Clayey Gravel
- FERRICRETE
- USCS Well-graded Sand
- USCS Elastic Silt
- USCS Low Plasticity Gravelly Clay
- USCS Low to High Plasticity Clay
- USCS Silt
- Siltstone
- Coal
- USCS Clayey Sand
- Sandstone

H 1:20000

0 200 400 600 800 1000m

V 1:1500

0 15 30 45 60 75m

Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

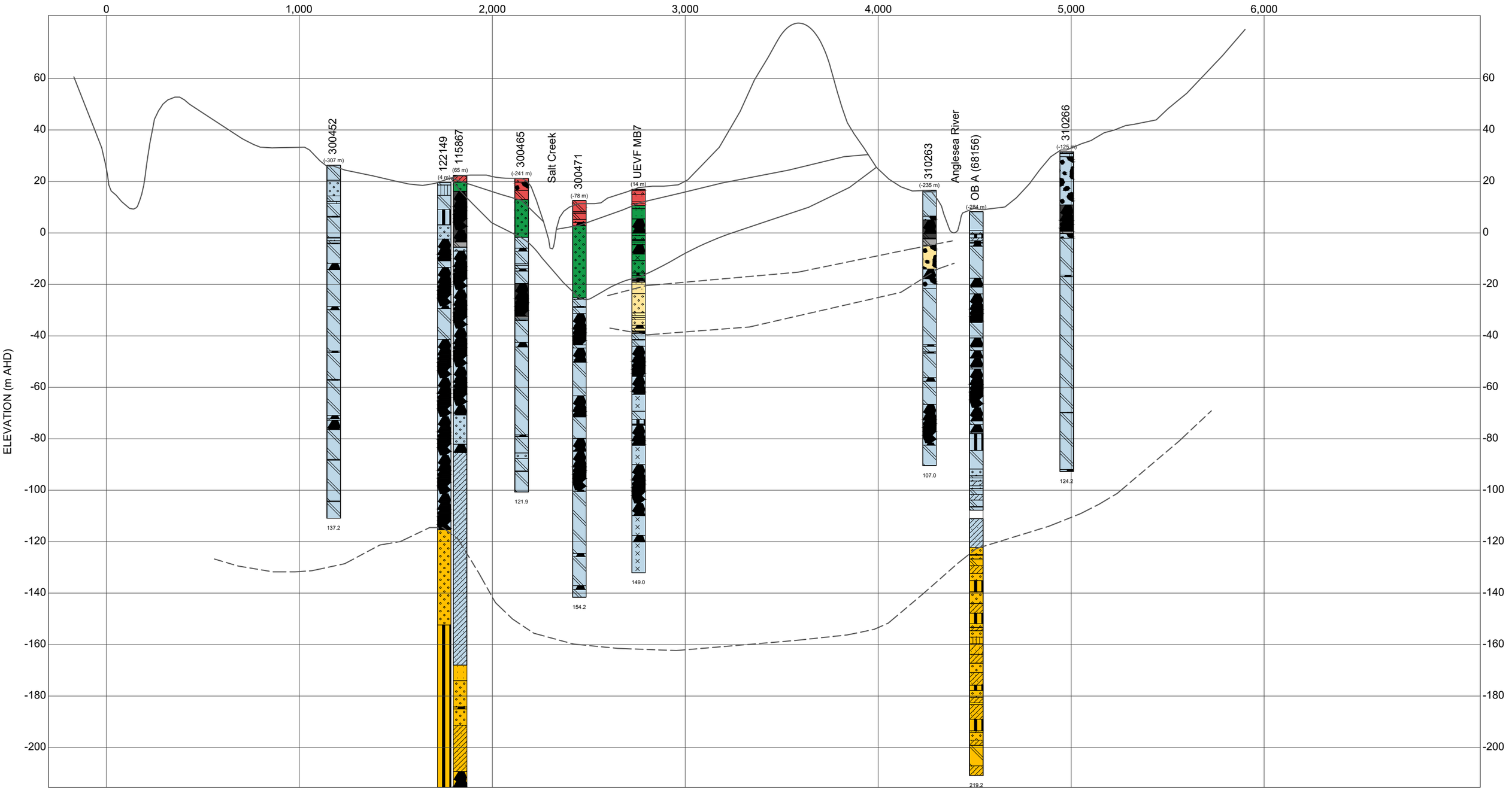
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - A

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:1500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-18	



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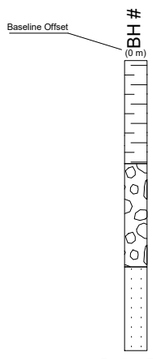


MATERIAL GRAPHIC

- Topsoil
- USCS Low to High Plasticity Clay
- USCS Elastic Silt
- USCS Clayey Sand
- USCS Low Plasticity Sandy Clay
- Sandstone
- Siltstone
- USCS Sandy Silt
- USCS Well-graded Sand
- USCS Well-graded Gravel
- Limestone
- USCS Low Plasticity Clay
- Coal
- USCS Silt
- FERRICRETE

H 1:20000
0 200 400 600 800 1000m
V 1:1500
0 15 30 45 60 75m
Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

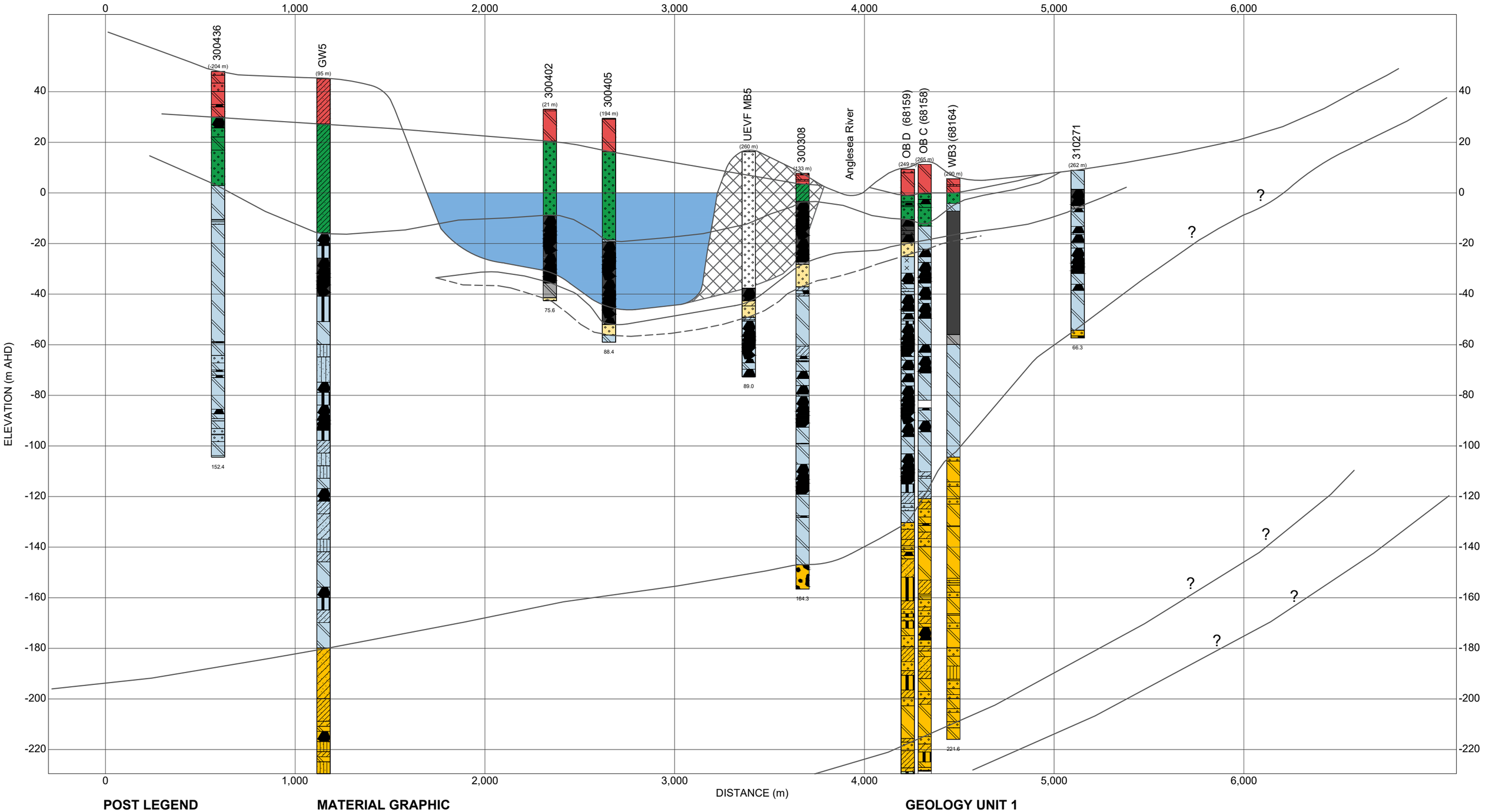
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - B

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:1500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-19	



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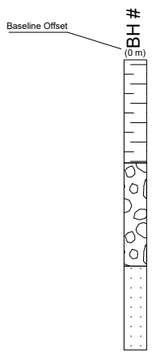


MATERIAL GRAPHIC

- USCS Elastic Silt
- Coal
- FERRICRETE
- USCS Clayey Sand
- USCS Low to High Plasticity Clay
- USCS Well-graded Gravel
- Siltstone
- USCS Silt
- USCS Low Plasticity Sandy Clay
- Topsoil
- USCS Sandy Silt
- Mined (Now Overburden)
- USCS Well-graded Sand
- Sandstone
- USCS Silty Sand

H 1:20000

0 200 400 600 800 1000m

V 1:1500

0 15 30 45 60 75m

Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

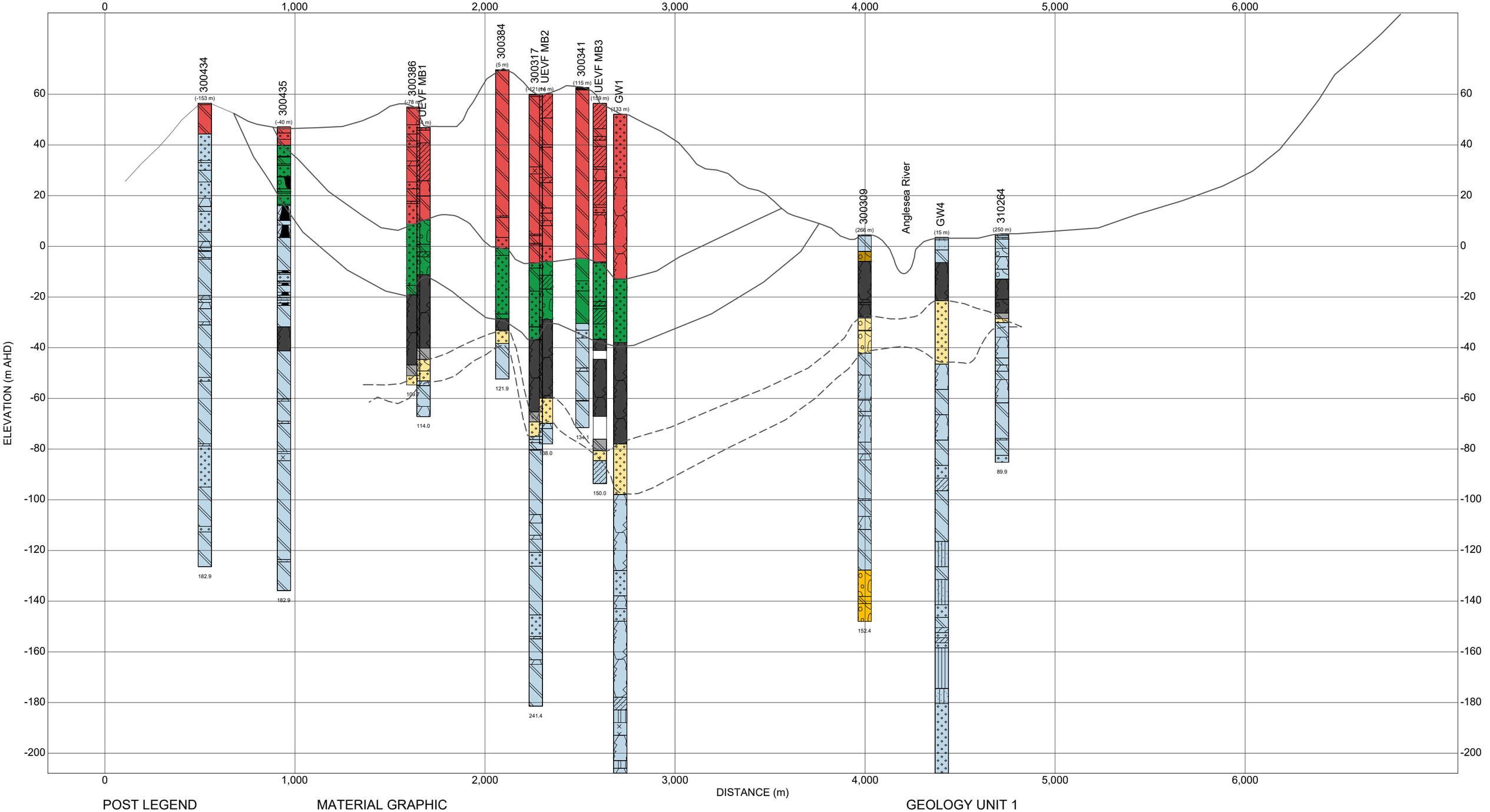
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support™

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - C

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:1500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-20	



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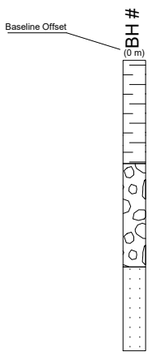


MATERIAL GRAPHIC

- Topsoil
- USCS Well-graded Sand
- USCS Low Plasticity Sandy Clay
- USCS Clayey Sand
- USCS Low to High Plasticity Clay
- Siltstone
- USCS Elastic Silt
- USCS Silt
- USCS Well-graded Gravel
- FERRICRETE
- USCS Silty Sand
- USCS Low Plasticity Gravelly Clay
- Coal
- Sandstone
- USCS Sandy Silt

1:20000

0 200 400 600 800 1000m

V 1:1500

0 15 30 45 60 75m

Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

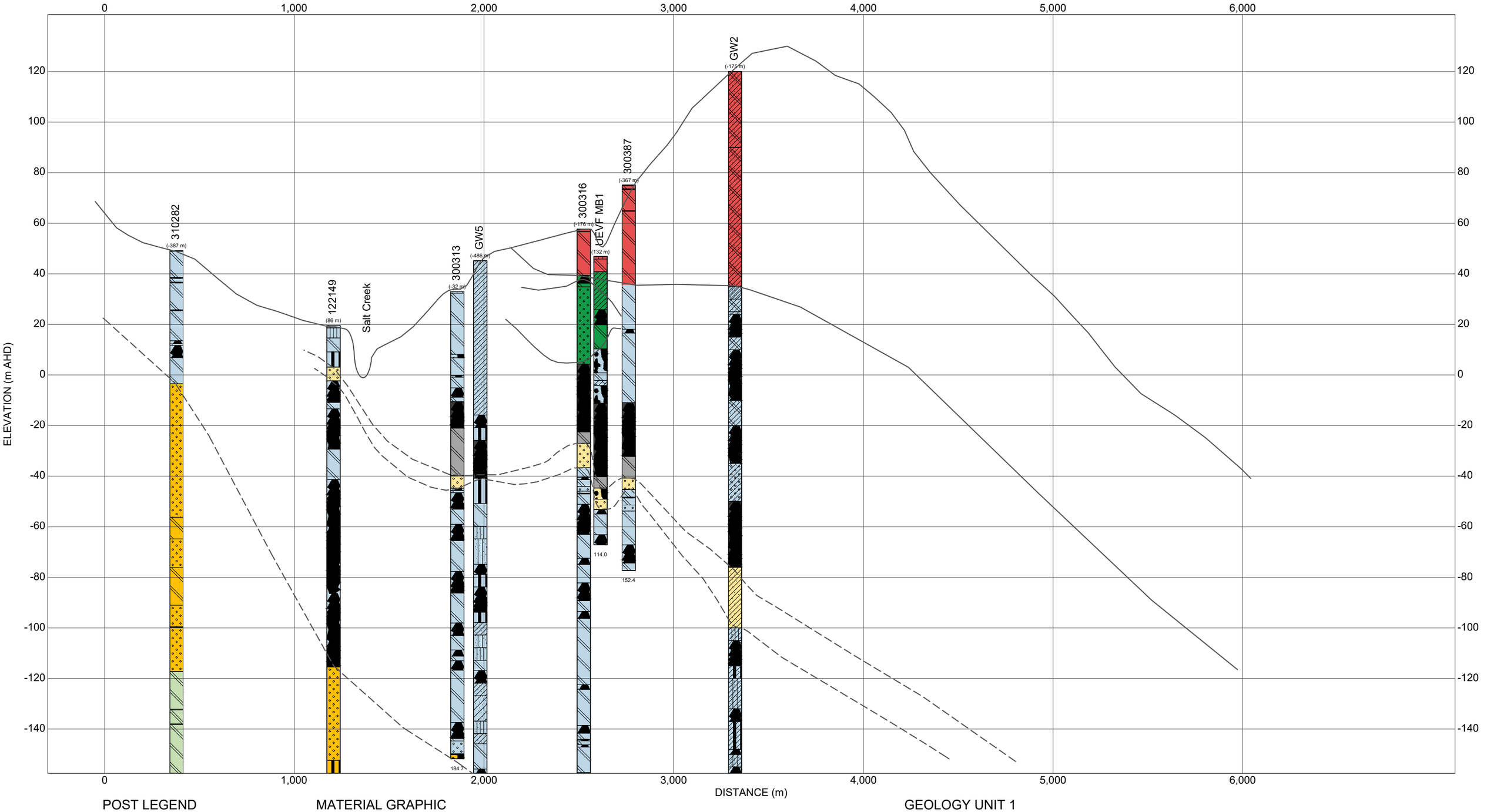
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - D

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:1500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-21	



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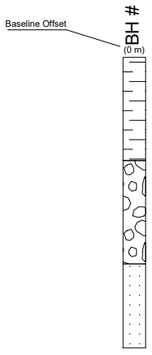

MATERIAL GRAPHIC

- USCS Low to High Plasticity Clay
- Coal
- FERRICRETE
- USCS Sandy Silt
- USCS Silt
- Topsoil
- Siltstone
- USCS Silty Sand
- USCS Elastic Silt
- USCS Well-graded Gravel
- USCS Low Plasticity Sandy Clay
- USCS Clayey Sand
- USCS Well-graded Sand
- Limestone
- USCS Low Plasticity Gravelly Clay

GEOLOGY UNIT 1

- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

H 1:20000
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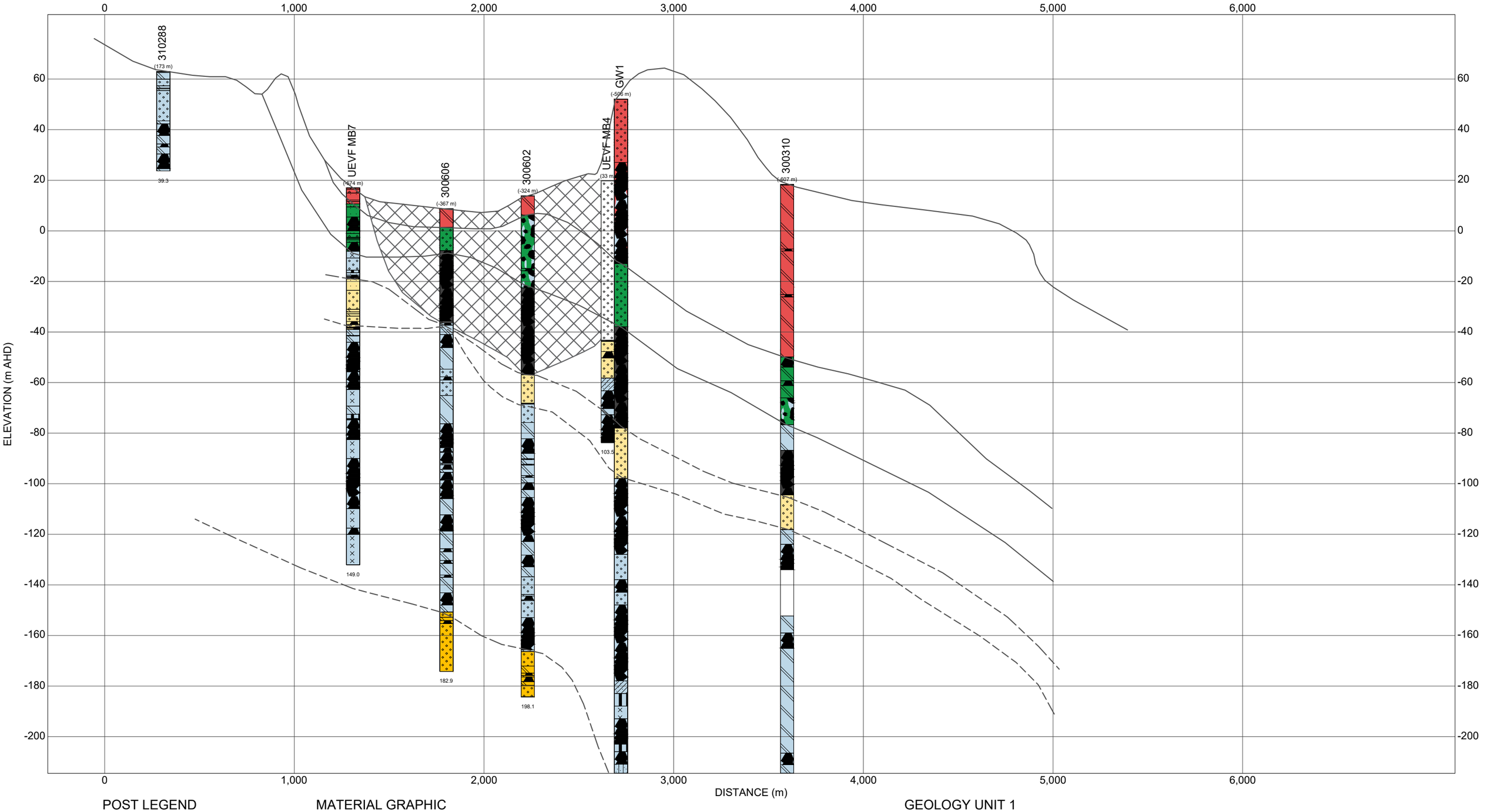
V 1:1500
0 15 30 45 60 75m
Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - E

DRAWN	DATE 28/10/2021
CHECKED	DATE 28/10/2021
SCALE H 1:20000 V 1:1500	A3
PROJECT No AUS##C03093_2020	FIGURE No 5-22



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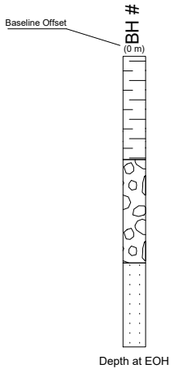


MATERIAL GRAPHIC

- USCS Well-graded Sand
- FERRICRETE
- USCS Silty Sand
- USCS Low to High Plasticity Clay
- USCS Low Plasticity Sandy Clay
- USCS Low Plasticity Clay
- Coal
- USCS Elastic Silt
- Sandstone
- USCS Well-graded Gravel
- Siltstone
- Mined (Now Overburden)

H 1:20000

0 200 400 600 800 1000m

V 1:1500

0 15 30 45 60 75m

Coord.System: MGA94 Zone 55 Height Datum: AHD

GEOLOGY UNIT 1

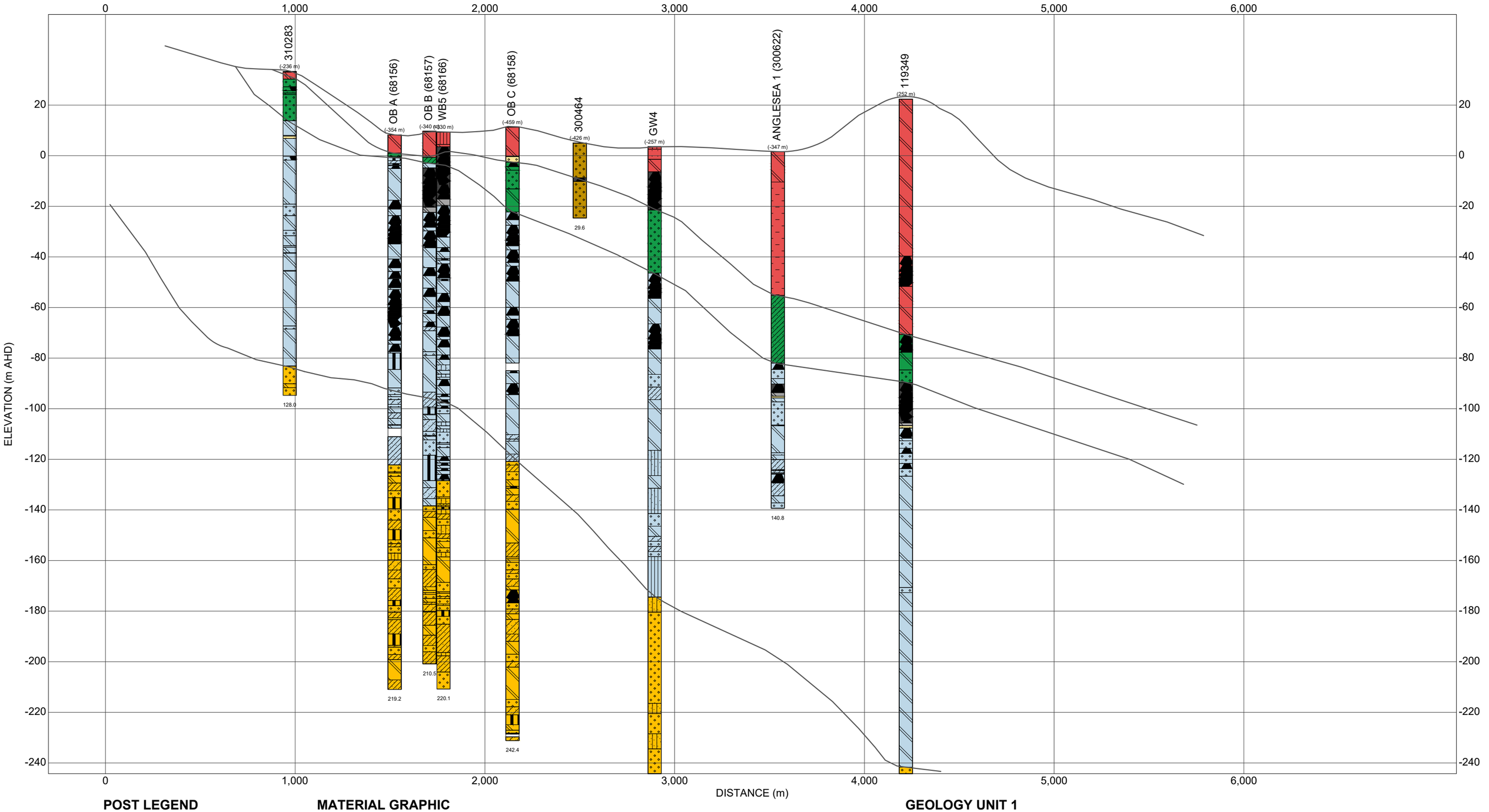
- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - F

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:1500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-23	



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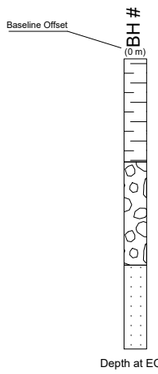

MATERIAL GRAPHIC

- USCS Low to High Plasticity Clay
- USCS Well-graded Gravel
- Sandstone
- USCS Silt
- Coal
- FERRICRETE
- USCS Silty Sand
- USCS Elastic Silt
- USCS Well-graded Sand
- MUDSTONE
- USCS Sandy Silt
- Topsoil
- USCS Low Plasticity Sandy Clay
- USCS Clayey Sand

GEOLOGY UNIT 1

- Channel Alluvial
- Upper Eastern View Formation (Basal Clay)
- Middle Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Upper Sands)
- Lower Eastern View Formation
- Boonah Formation
- Upper Eastern View Formation (Intermediate)
- Torquay Group
- Upper Eastern View Formation (Main Coal Seam)
- Upper Eastern View Formation (Lower Sands)
- Fill and Overburden

H 1:20000

0 200 400 600 800 1000m

V 1:1500

0 15 30 45 60 75m

Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station
Subsurface Section - G

DRAWN	DATE 28/10/2021	
CHECKED	DATE 28/10/2021	
SCALE H 1:20000 V 1:1500		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-24	

5.2.2.1 DBF (Anglesea Formation, Salt Creek Formation and Boonah Formation)

At the Anglesea mine, the following members of the DBF are present:

- Anglesea Formation.
- Salt Creek Formation.
- Boonah Formation.

The contact between the units above is shown in **Figure 5-25**. Each unit is described in detail below.

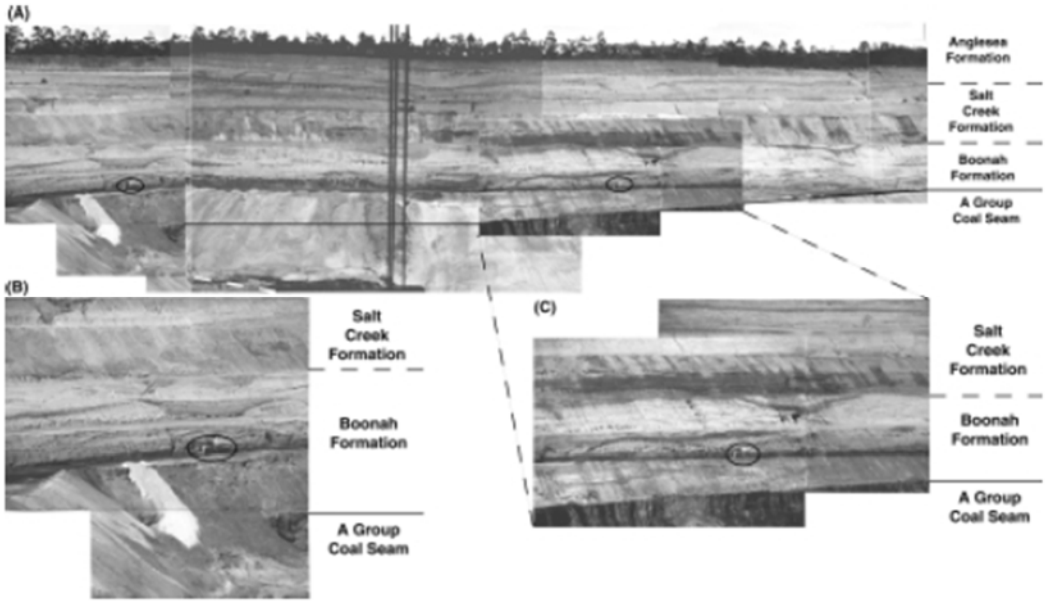

Figure 5-25 Contact Between DBF Units

Notes: Detailed (a) Composite photograph of the coal and highwall succession at the Anglesea coal mine and interpreted formation boundaries and lithostratigraphic units. (b) Channel structures and disconformity between the Boonah Sands Formation and the overlying Salt Creek Formation. (c) Channel structures, coaly units and disconformity between the Boonah Sands Formation and overlying Salt Creek Formation at the central part of the mine. Note 4.5 m-high dump trucks (circled) for scale
Source: after Holdgate et al., 2002.

5.2.2.1.1 Anglesea Formation

The upper highwall succession in the Anglesea coal mine comprises up to a 20 m-thick red to purple carbonaceous and pyritic siltstone to fine sandstone. The Anglesea Formation is interpreted to represent a complex of low-energy fluvial channel and braided sheet-like sands deposited on a lower coastal plain, which periodically became higher energy channel-like with increased downcutting into earlier deposits. At least one short-duration marine flooding event (preserved as pyritic shale containing marine dinoflagellates) followed the infilling of the basal downcut surface. The remaining facies preserve low-energy fluvial channel and braided sheet-like sandstone and shale-filled meander loops.

5.2.2.1.2 Salt Creek Formation

The Salt Creek Formation is on an erosional contact that can be linked across the mine face as a series of stratigraphically connected sandstone channels. The disconformity contact is a 0.1 m shale layer between cross-bedded micaceous fine quartz sandstone of the top Salt Creek Formation below, and the homogenous micaceous fine quartz sandstone of the overlying Anglesea Formation. Other more localised low-angle channel forms occur at the bases of overlying units, such as at samples shown on **Figure 5-26** where pervasive limonite cements form ferricrete layers in the coarser grained channel bases. Red limonite staining appears to increase rapidly over the top 5 m of the member and is associated with weathering from the present ground level. Interbedded carbonaceous shale and laminated siltstone units immediately overlie the basal channel layers and form a 5 to 7 m-thick unit along the mine face. The basal silty shale of this unit is pyritic and contains evidence indicative of a short-duration marine transgression.

5.2.2.1.3 Boonah Formation

Unconformably overlying the A Group coal seam (main Coal Seam) in the Anglesea coal mine, and in nearby bores, are clean sandstone with minor carbonaceous shale, clay and coal. Down dip the sandstones increase from 10 m to 70 m in thickness. These sediments belong to the Boonah Sands Formation (Holdgate 1996; Smith 1998). The basal coarse channel gravels and sandstones overlie the A Group coal seam at an erosional angular unconformity. The unit is thickest in the Anglesea Syncline, it thins to the northeast and southwest outside the synclinal area. The unconformity surface defines the upper boundary of the EVF. Due to this unconformity, the Boonah Sands Formation is placed in the DBF rather than the EVF.

In the Anglesea coal mine, the Boonah Formation is up to 32 m thick. It comprises fine to coarse-grained sand-channel units in the upper and lower 10 m, with interbedded shale and carbonaceous (leafy) siltstone occurring in the middle 10 to 12 m (**Figure 5-26**). The basal coarse facies is exposed mainly in the central part of the Anglesea Syncline and onlap the top of the A Group coal seam to the west.

Cross-cutting, fining-upward channel units range between 1 m and 3 m thick and extend laterally from 30 m to 50 m. Finer grained overbank deposits are poorly represented, but where preserved, consist of planar-laminated carbonaceous siltstone.

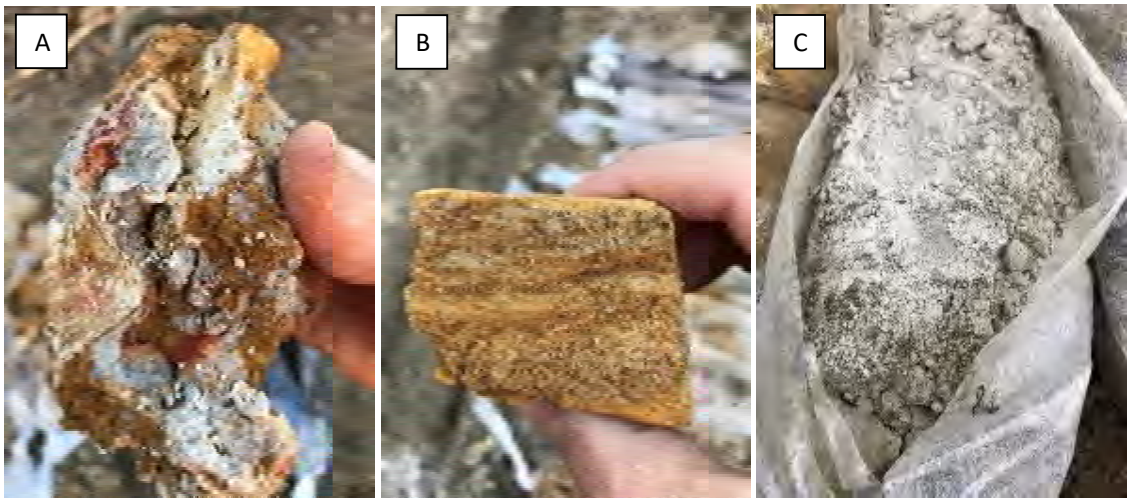

Figure 5-26 (a) Salt Creek Formation, (b, c) Boonah Formation

Note: refer **Figure 5-27** for full profile

5.2.2.2 Eastern View Formation

The following section is an adaption of Holgate *et al.,* 2002, as well as site observations.

The EVF comprises a largely non-marine to paralic succession of brown coal, shale and sandstone that is over 500 m thick at the core of the Anglesea Syncline. The EVF thins to the north and northwest over the Paraparap and Bellarine Highs. Offshore in Nerita 1 well, the group (Eastern View Coal Measures in the *Well Completion Report*, Shell Development, 1967) is 683 m thick. It is overlain by a 141 m-thick Boonah Formation that is separated from the EVF on seismic by an angular unconformity.

Most of the significant coal seams of the EVF occur in the upper parts of the Formation. This is interpreted to be the UEVF,(**Section 5.2.2.2.1** to **Section 5.2.2.2.4**; **Figure 5-27**). In the Anglesea area, the coal seams are folded by the Anglesea Syncline, the axis of which plunges south below the Anglesea township into the offshore Torquay Basin (**Figure 5-29**). The mining of the coal seams occurs northwest of the township in the up-dip direction, where the seams are shallowest (**Figure 5-29**). The uppermost and thickest A Group coal seam is up to 36 m thick (**Section 5.2.2.2.1 Main Coal Seam**) and locally splits near the base into the A1 and A2 seams.

Below the A Group coal seam in the Anglesea mine area is up to a 20 m-thick coarse sandstone and minor claystone interval (**Section 5.2.2.2.3 Upper Sands**). Beneath this unit for 60 to 70 m are a series of 2- to 15-m-thick B Group coal seams interbedded and laterally equivalent to shale and sandstone (**Section 5.2.2.2.4 Intermediate Coal and Clay**). These seams were mined in the 1950s on the western flanks of the Anglesea Syncline in two Roche Brothers' open cuts but are not exposed today (**Figure 5-29**).

The oldest C Group coal seams are separated from the B Group coal seams by a 10 to 15 m interval of fine sandstone and silty claystone that appear, on bore log cross-sections, to separate the two groups at a local disconformity (Holdgate, 1996). The C Group coal seams include a 20-m-thick seam at the top (the C1), which is best developed on the western flank of the Anglesea Syncline. In turn, C Group coals overlie a series of interbedded thin coal (<5 m thick), sandstone and shale over a stratigraphic interval of 60 m.

Below the C Group coal seams a 100-m-thick interval of interbedded sandstone and shale overlies a 250 m succession of thick mudstone with coarse sandstone, over Otway Group arkosic sandstone (**Section 5.4.5 LEVF**). To the north of the mine, the Anglesea Syncline merges against the prominent east-plunging Bald Hills Anticline. This anticline is interpreted to outcrop at the coast at Jarosite Headland, where it is expressed as a low-angle fold in beds of the DBF.

The Otway Group was intersected near Jarosite Headland at 135 m in WRC-121768 bore, overlain by 55 m of the Eastern View Group (mostly comprising the B Group seams and inter-seam sediments). In State Observation Bore (SOB) 121768 near the Bells Beach Anticline, only the B and C Group coal seams are present beneath towards 40 m of mid to lower EVF and 80 m of DBF.

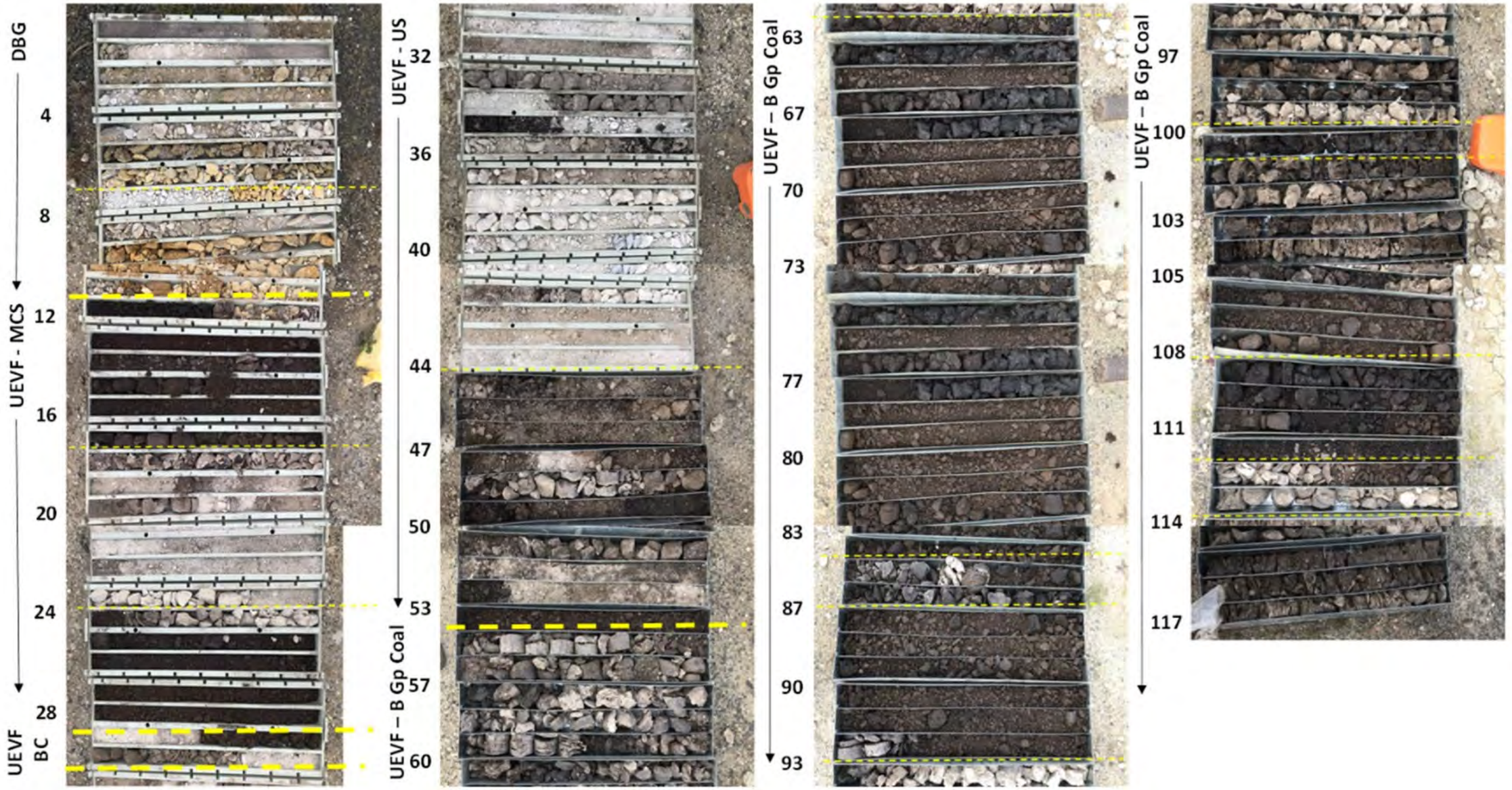

Figure 5-27 UEVF MB 7 Core

Notes:
MCS = Main Coal Seam
BC = Basal Clay

5.2.2.2.1 Main Coal Seam

The main coal seam, also referred to as “coal seam A or A Group coal seam” consists of brown coal and does not outcrop (**Figure 5-29**). At its thickest, the main coal seam is up to 45 m thick, and this occurs near the mine and Anglesea Syncline. This unit is not to be confused with other major coal seams within the UEVF sequence. Those coal layers below the main coal seam can be referred to as Seam B1/L1, B2/L2, B3/L3 etc and are more consistent with ligneous coal.

The extent of the formation (sub-crop) is shown on **Figure 5-34**.

Figure 5-28 Site Photo Showing the Main Coal Seam Exposure and Core Representation

Note: looking northwest from mine pit surface water sampling location

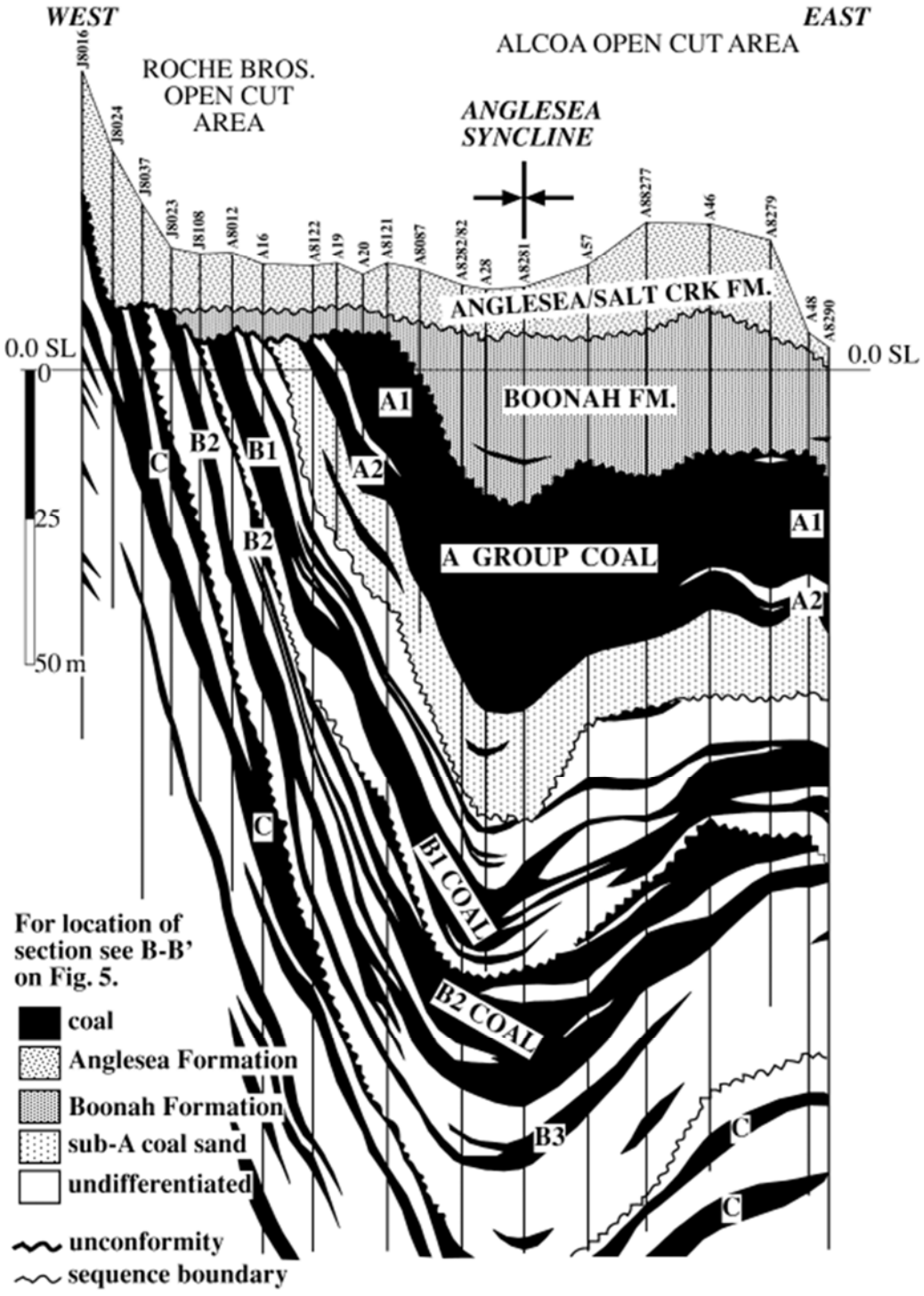

Figure 5-29 EVG Coal Seams

Source: Holdgate et al., 2002

5.2.2.2.2 Basal Clay

The basal clay consists of a low permeability grey to pale brown clay layer (**Figure 5-30**) and is located immediately below the main coal seam. The thickness of this clay varies from 1 to 4m has been derived from the databases listed in **Section 5.1.2,** and lithological logs from those bores presented in **Figure 5-8**. Where lithological logs do not describe the colour, the clay that is immediately below the main coal seam was allocated as the basal clay. Further information on the Basal Clay is discussed in **Section 5.4.3.1**.

Figure 5-30 Field Picture of the "Confining" Clay at the Base of the Coal

5.2.2.2.3 UEVF - Upper Sands

The upper sands of the UEVF are primarily found underneath the basal clay in the vicinity of the former mine and potentially extend towards the coast. **Figure 5-29** refers to these as the sub-A coal sand. After review of the bore logs shown in **Figure 5-8** and the geological cross section (**Figure 5-18** to **Figure 5-24**), the upper sands do not outcrop or extend in any great distance west and north of the mine, rather they pinch out within the subsurface. In bore log UEVF MB08 on the western margin of the mine, these sands were not encountered. These sands may also be referred to as "shoestrings sands" (i.e., an irregular, sinuous and variable thickness sand-body which often represents the preserved sandy deposit of a meandering river channel).

The thickest this unit is observed is 25 m and varies from 0.5 m to 25 m with a typical thickness being less than 5 m where the unit occurs. As mentioned above, these sands do not outcrop with the shallowest section identified at 22 m bgl. This occurs near UEVF MB07. **Figure 5-31** shows a sonic drill core section of these sands.

The extent of the formation and its outcrop area are shown on **Figure 5-35**.

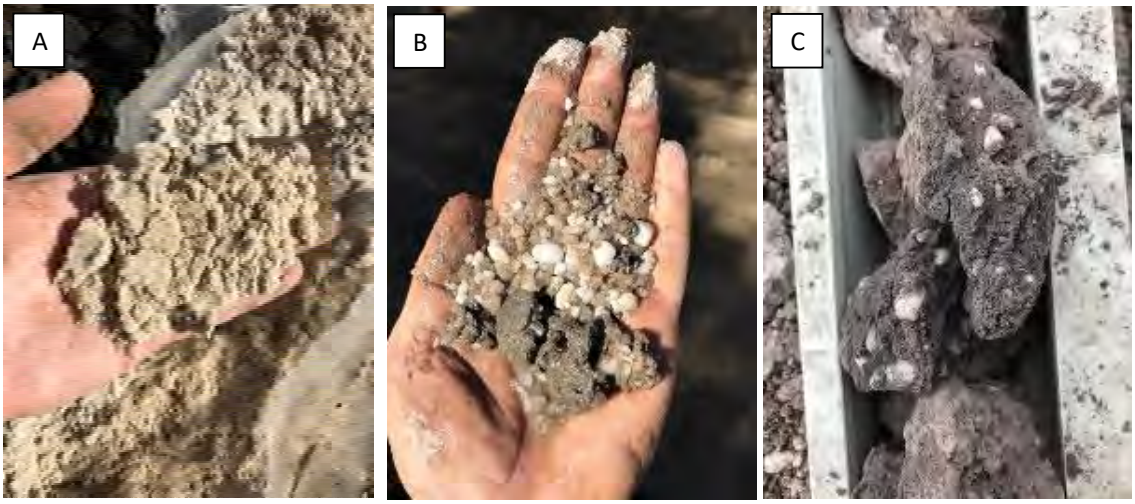

Figure 5-31 (a) Top of Unit, (b) Mid Unit, (c) Base of Unit

5.2.2.2.4 UEVF - Intermediate Zone

Below the A Group coal seam and the UEVF upper sands a series of peaty coal and tight clay that extends a further 60 to 150 m. Each sequence of coal and clay vary in thickness of between 2 to 30 m. The coal sequence are interbedded and laterally equivalent to shale and fine sandstone. The upper coal seams were mined in the 1950s on the western flanks of the Anglesea Syncline in two Roche Brothers' open cuts but are not exposed today. **Figure 5-32** shows what these coals and clays look like as well as a cracked drill bit resulting from the tightness of the formation and over torque required to progress. The outcrop area is shown on **Figure 5-6**.

Figure 5-32 UEVF Intermediate Coal (a) and Clay (b), Cracked Annular Steel Tooth Drill Bit (c)

Very occasionally a thin (<20cm) seam of coarse sand and gravel is encountered (**Figure 5-33**) in this sequence. In order to define the extent and hydraulic properties of these sand and gravel lenses, a single packer test was attempted over this interval. After ~250L of water was injected, the packer failed indicating some upper sand lenses may not be laterally extensive.

Figure 5-33 Packer Testing of 20cm Gravel Lens at 58m bgl (UEVF MB07)

5.2.2.2.5 UEVF – Lower Sand

The lower section of the UEVF comprises thicker and more frequent occurrence of thick coarse sandstone, with minor claystone and coal intervals. The total thickness is up to 180 m. No core return imagery is available for this lower sands unit. The outcrop area is shown on **Figure 5-6**.

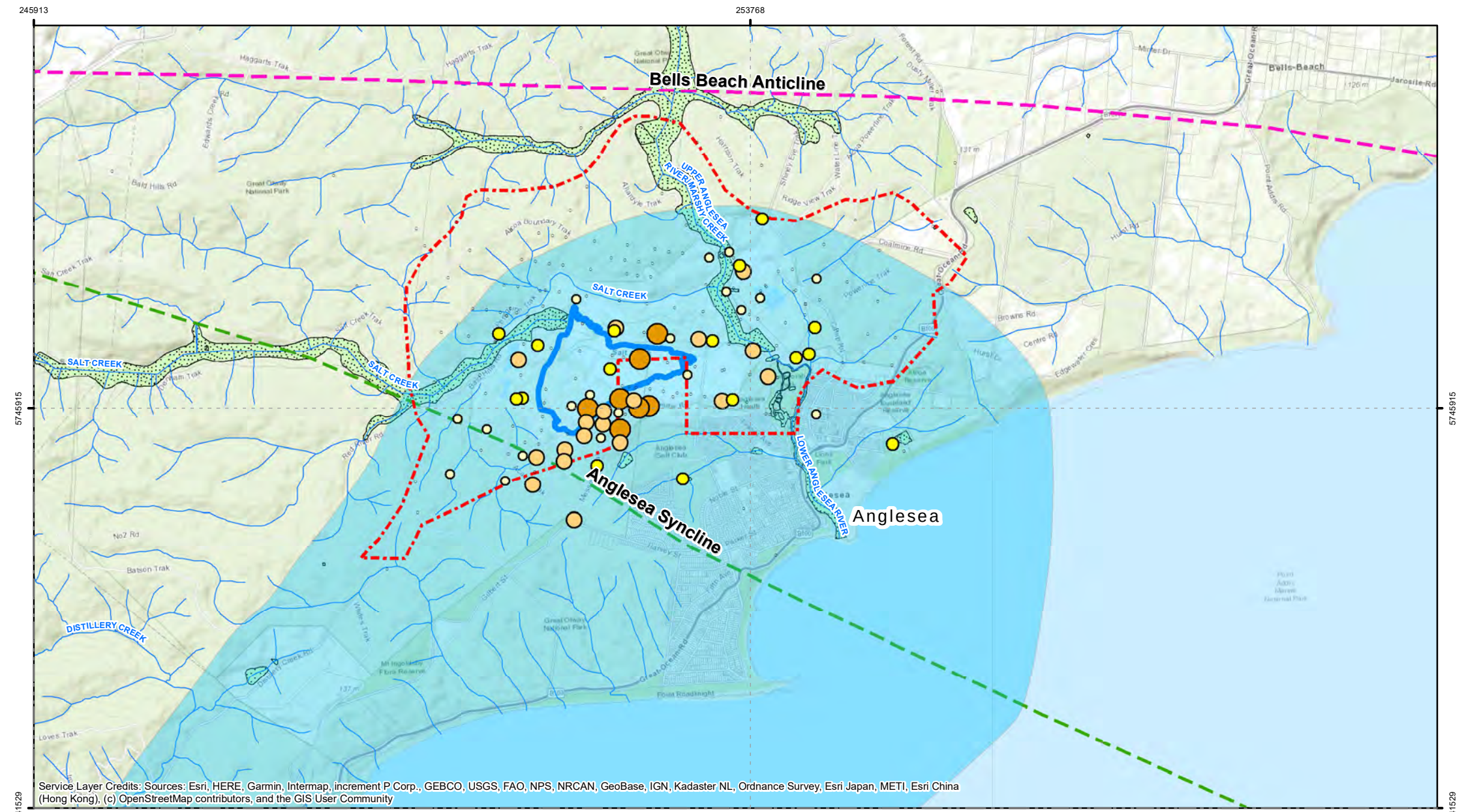

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Figure 5-34 Regional Coal Seams Inferred Area

Main Coal Thickness (m)

- 0.59 - 10.00
- 10.01 - 20.00
- 20.01 - 30.00
- 30.01 - 40.00
- Unit Not Present at This Bore

- Historical Anglesea Mine Coal Seam Location
- Main Coal Seam Extent
- Anticline
- Syncline
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

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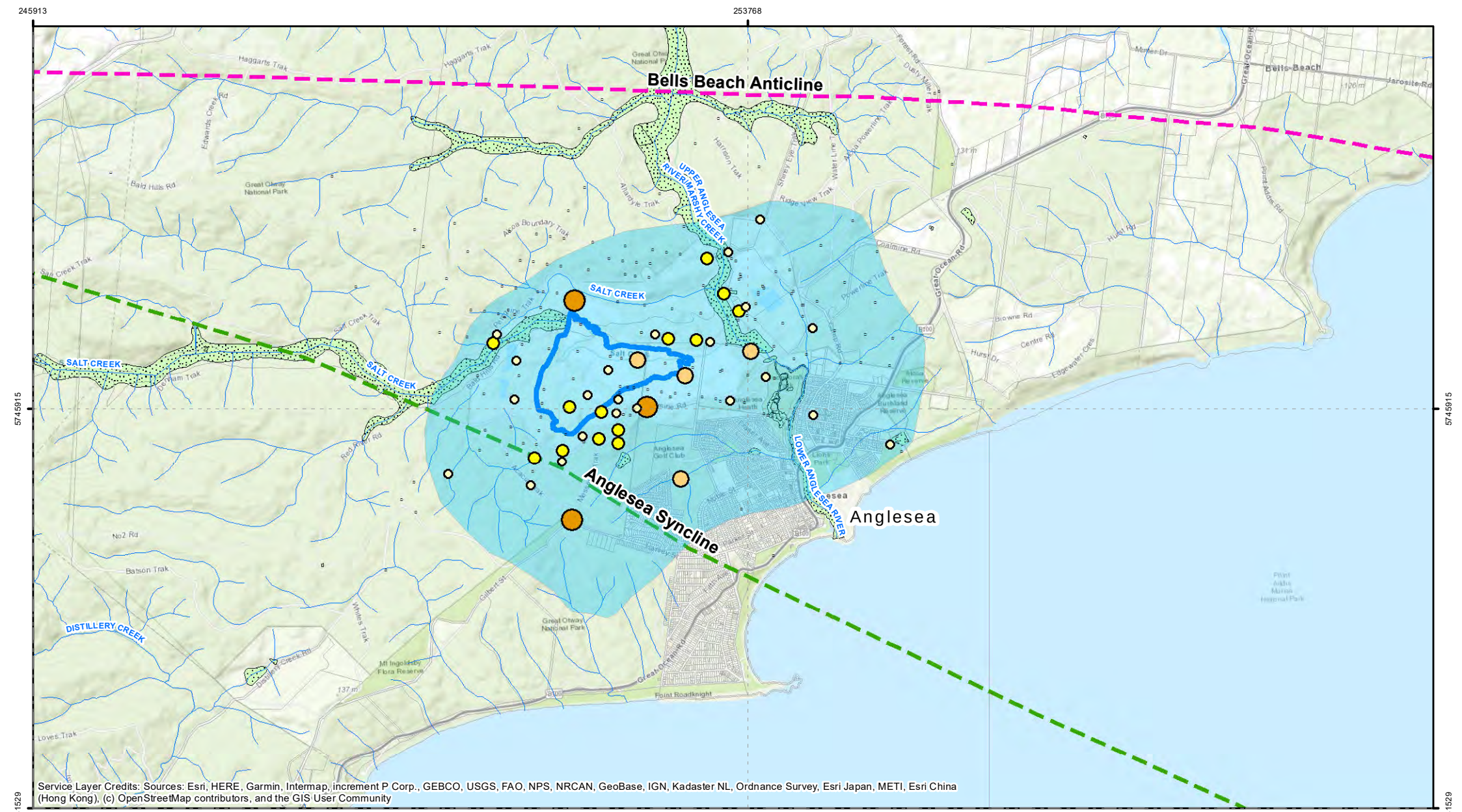
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:54,068

N

Kilometers

0 0.75 1.5 3



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-35 UEVF Upper Sands Extent.mxd

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Figure 5-35 UEVF Upper Sands Extent

UEVF US Thickness (m)

- 0.59 - 5.00
- 5.01 - 10.00
- 10.01 - 15.00
- 15.01 - 25.00
- Unit Not Present at This Bore

- UEVF Upper Sands Extent
- Anticline
- Syncline
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

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REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:54,068

N

Kilometers

0 0.75 1.5 3

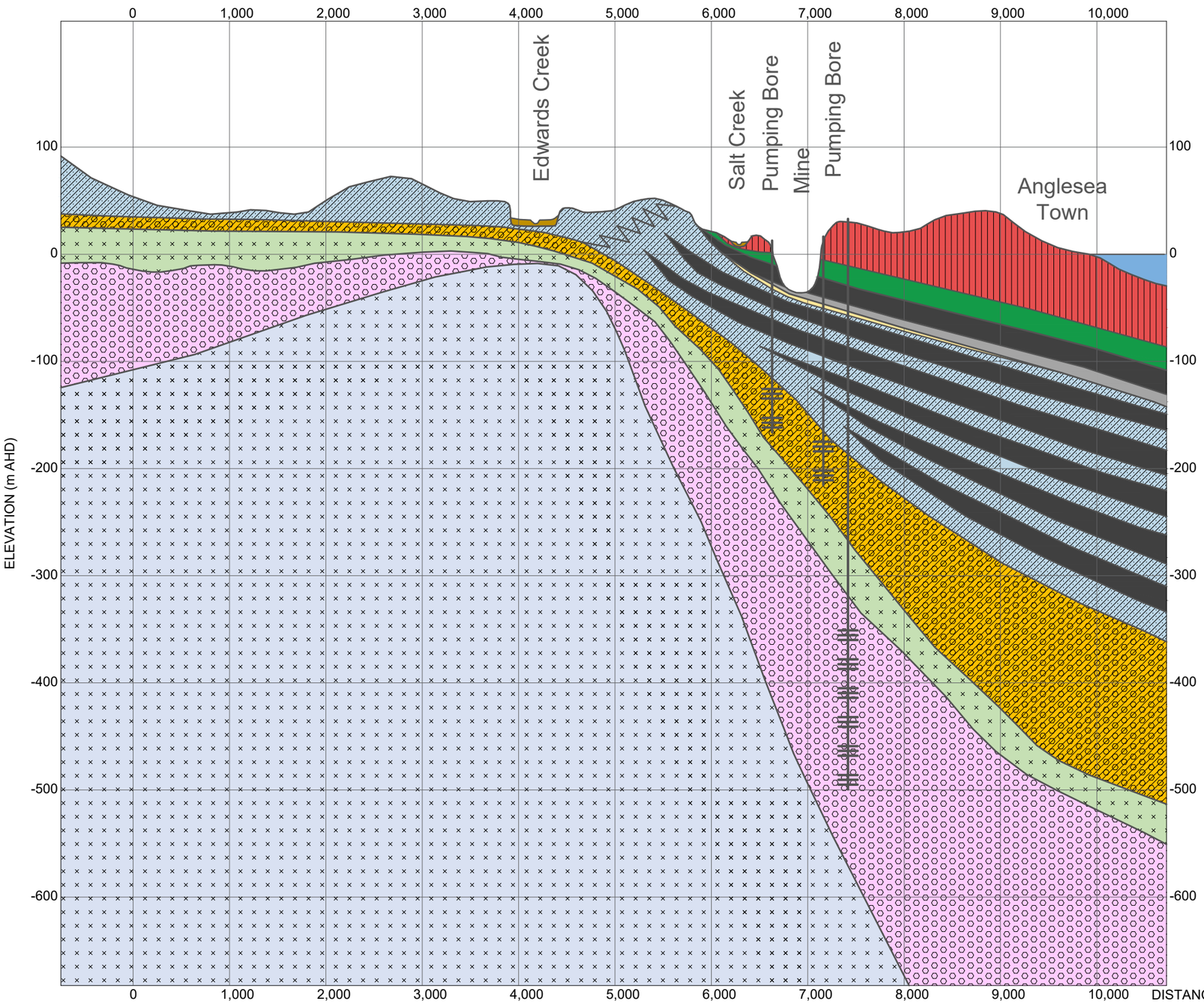
5.3 Regional Hydrogeology Overview

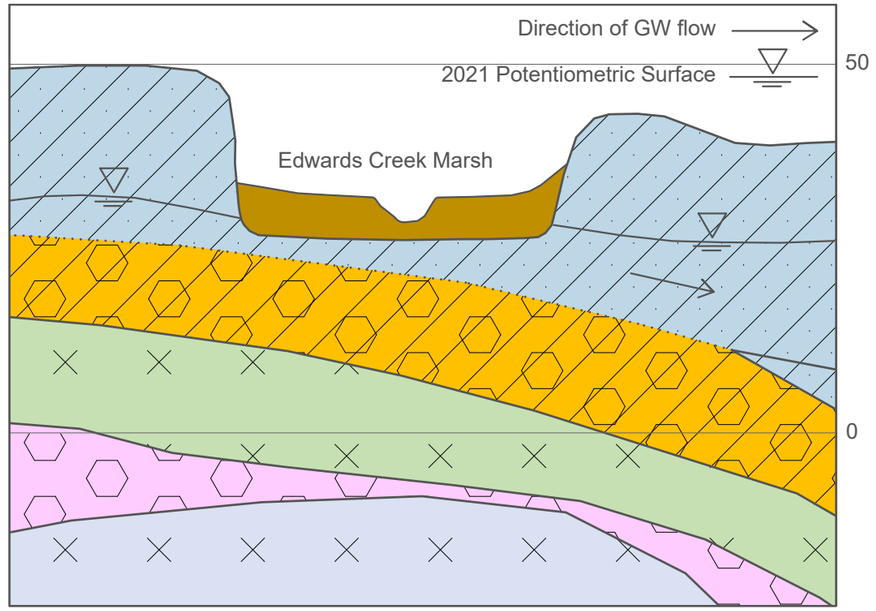
The regional hydrogeology comprises four main hydrogeological units:

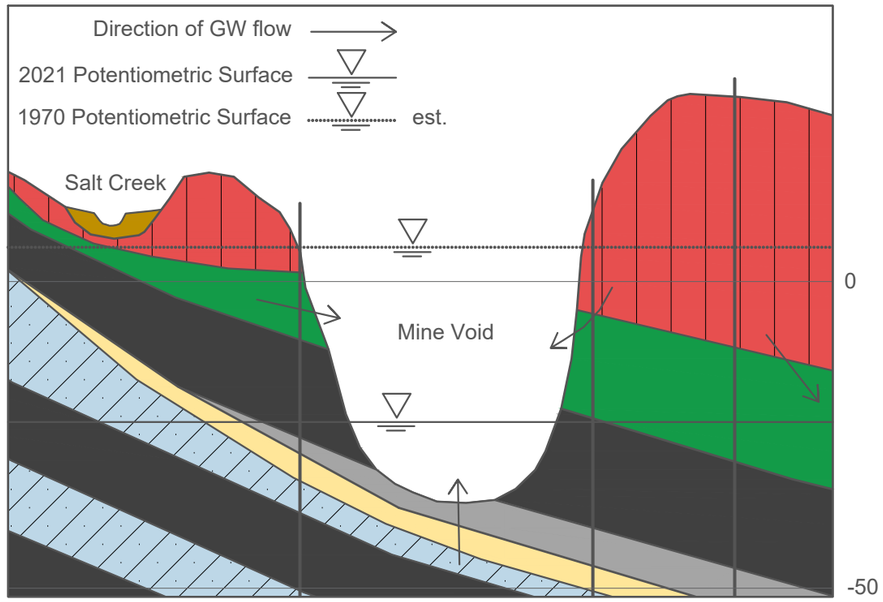
- The alluvial swamp aquifer (previously identified as a perched water table).
- The shallow unconfined DBF aquifer.
- The confined lower sands of the UEVF aquifer utilised by Alcoa.
- The deeper confined LEVF targeted by Barwon Water.

An overview of the hydrogeological setting for each of these three units is provided below, with further discussion on groundwater level trends provided in **Section 5.4** to **Section 5.6**.

A conceptual model of the regional hydrogeology is shown in **Figure 5-36**.







MATERIAL GRAPHIC

- Clayey Gravel
- Clayey Sand
- Well-graded Sand
- Siltstone
- Silt

GEOLOGY UNIT 1

- Channel Alluvial
- Upper Eastern View Formation (Coal Seam)
- Upper Eastern View Formation (Intermediate)
- Lower Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Basal Clay)
- Upper Eastern View Formation (Lower Sands)
- Torquay Group
- Boonah Formation
- Upper Eastern View Formation (Upper Sands)
- Middle Eastern View Formation

H 1:20000
0 1000m 2000m
V 1:1800
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station

DRAWN	DATE 25/11/2021	
CHECKED	DATE 25/11/2021	
SCALE H 1:20000 V 1:1800		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-36	

5.3.1 Alluvial Swamp Aquifer (also referred to as a Perched Aquifer)

In the Anglesea River and Salt Creek valleys, younger alluvial deposits overlie the regional aquifer systems (**Figure 5-37**). At the min and lower ends of the catchments, these sediments can be in the order of 30 m in thickness and referred to as the alluvial swamp aquifer (ASA). This ASA (previously referred to as a perched aquifer or PWT), supports the large swamplands is also located within the alluvial deposits. It is noted that along these valleys, the alluvial deposits are separated from the underlying DBF and UEVF by up to 60 m of low permeable coal and clay sequences, in affect isolating these shallow PWT systems from the deeper more permeable parts of the UEVF and LEVF.

The conceptualisation of these alluvial systems is shown on **Figure 5-36** and **Figure 5-70** to **Figure 5-77**. Furthermore, **Figure 5-37** presents the actual thickness of low permeability coal and clay that separates the base of the alluvial / swamp sediments in which surface water flows to the next most permeable layer underlying the surface water systems. The average thickness from all bores shown on **Figure 5-37** is 27.7 m with the maximum depth being 86m and the minimum thickness 2.4m.

5.3.2 Demon Bluff Formation and Boonah Formation

The Demon Bluff Formation (DBF) includes the Salt Creek Formation, the Anglesea Formation, the Addiscot Formation and the Angahook Formation (Holdgate, et al., 2001). In the greater Anglesea region, only the Salt Creek Formation, the Anglesea Formation are present.

The Boonah Formation is also present in the area and forms the base of the Demon Bluff Group and overlies the upper eastern view formation at an erosional angular unconformity (Holdgate, *et al.,* 2001). The formation is distinctly different from other members of the DBF and comprises cross cutting coarse-grained sand-channels in the lower and upper units, with shale and carbonaceous siltstone interbedded with lenses of fine-grained sandstone (Holdgate, *et al.,* 2001). The Boonah Formation is well exposed at the Alcoa Coal Mine and is expected to have highly variable aquifer properties.

Bore yields from the DBF are generally less than 0.5 litres/second (L/sec) and water quality generally exceeds 4,000 mg/L TDS. Groundwater conditions at the Alcoa Mine indicate that the DBF and Boonah Formation are largely unsaturated and discreet perched aquifers are common. These perched systems are mosty caused by leaky mine infrastructure (e.g., the former Ash ponds and other artificial water retention areas).

5.3.3 Eastern View Formation Overview

Hydrogeologically, the eastern view formation (EVF) can be sub-divided into three main units;

- Upper EVF.
- Middle EVF.
- Lower EVF.

In the Alcoa AOI, the UEVF is considered to be an unconfined to confined aquifer, the MEVF an aquitard and the LEVF a confined aquifer. Broadly speaking, these water-bearing zones approximately represent the individual aquifers within the EVF. However, sand aquifers occur at all levels in the sequence with potentiometric pressures increasing with depth, which means that

multiple permeable zones, that may or may not be interconnected may exist within the one formation. **Figure 5-3** and **Figure 5-4** show a cross-sectional relationship of each formation from the ranges to the coast.

J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-37 Confining Sediment Thickness.mxd

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Figure 5-37 Confining Sediment Thickness

- Anticline
- Syncline

Confining Sediment Thickness (m)

- 0.59 - 20.00
- 20.01 - 40.00
- 40.01 - 60.00
- 60.01 +

- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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UEVF 12 Month Pumping Test Licence APPLICATION

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SCALE:	1:54,068

N

Kilometers

0 0.75 1.5 3

5.4 Alcoa Area of Interest Hydrogeology

Figure 5-38 shows an overview of the hydrogeological units within the AOI. The groundwater level trends and hydrogeological parameters for each of the defined units within the AOI is further described in the sections below.

5.4.1 Alluvial Swamp Aquifer Overview

Close to the coal mine and former power station, the ASA exists within marshy creek and salt creek and appears disconnected from the underlying sediments of the DBF, Boonah Formation and UEVF by thick layers of clay located at its base. This, amongst other evidence-based observations is why in the past it's been referred to at a perched water table aquifer (PWT).

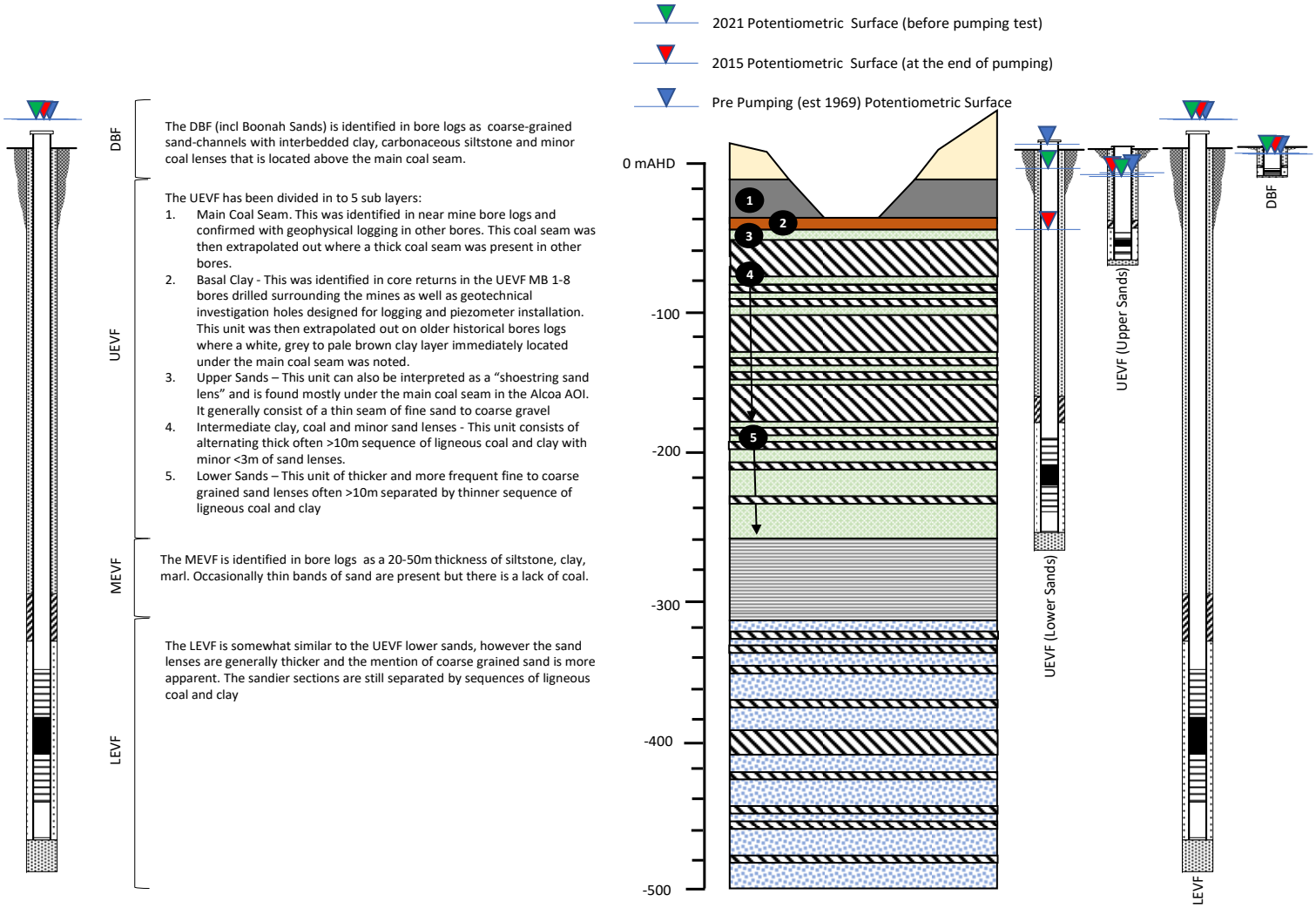

Figure 5-38 Overview of the Hydrogeological Units within the AOI

5.4.2 Demons Bluff and Boonah Formation Overview

A total of 37 groundwater observation wells have been installed across the former power station site, and 8 groundwater observation wells installed across the Alcoa Coal Mine site targeting the DBF and Boonah Formation. Due to the interconnectivity of the DBF and upper part of the Boonah Formation, it is hard to distinguishing in which many bores of these bores are screened. Where there is some uncertainty or where bore screens are likely to have screened the base of the DBF (most likely the Salt Creek Formation) and the top of the Boonah Formation, these are labelled DBF/BF.

The location of these wells and the interpreted spatial extent and current elevation (as of 17 November 2021) of the water table of this unit is shown on **Figure 5-39**.

Groundwater conditions at the Alcoa Coal Mine indicate that the DBF nearer the coal mine is largely unsaturated. For the saturated DBF bores located nearer the former power station, groundwater levels generally fall within the -4 to +4 m AHD range, which was the same range previously reported for the unconfined aquifer prior to Alcoa development (Hancock, 1967). This, combined with the absence of any widespread increases in DBF groundwater levels since Alcoa groundwater extraction from the UEVF aquifer ceased in 2016, indicates that past site activities, such as groundwater extraction from the UEVF or mine dewatering, are unlikely to have resulted in significant decreases in water levels within the DBF aquifer.

The direction of groundwater flow is expected to follow topography as well as being influenced by the mine pit void.

In addition, a discontinuous artificial perched system (PWTa) also exists within the upper weathered and disturbed zones of the DBF underneath the former power station. The PWTa is likely present due to past impacts from the former mine infrastructure such as the cooling tower, former ash ponds (now water reclamation pods) and stormwater management system.

In the majority of cases (i.e. those bores located away from the ASA or bores located adjacent to mine infrastructure influencing recharge, detailed information such as water quality and past hydraulic behaviours has been excluded from this report as much of the PowerStation have been decommissioned and the recharge controls on these systems removed. Further information regarding the behaviour of these artificial perched water tables and other shallow hydrogeological controls are found in EHS Support, 2021, Detailed Site Investigation, Alcoa Anglesea Power Station (April 2021) and EHS Support, 2021a, Supplemental Surface Water, Soil and Groundwater Investigation Works, Alcoa Anglesea Power Station(April 2021). These reports were submitted and verified by the EPA appointed Environmental Auditor, Darryl Strudwick, on 29 April 2021, to fulfil obligations of Clean Up Notice (CUN 90011694).

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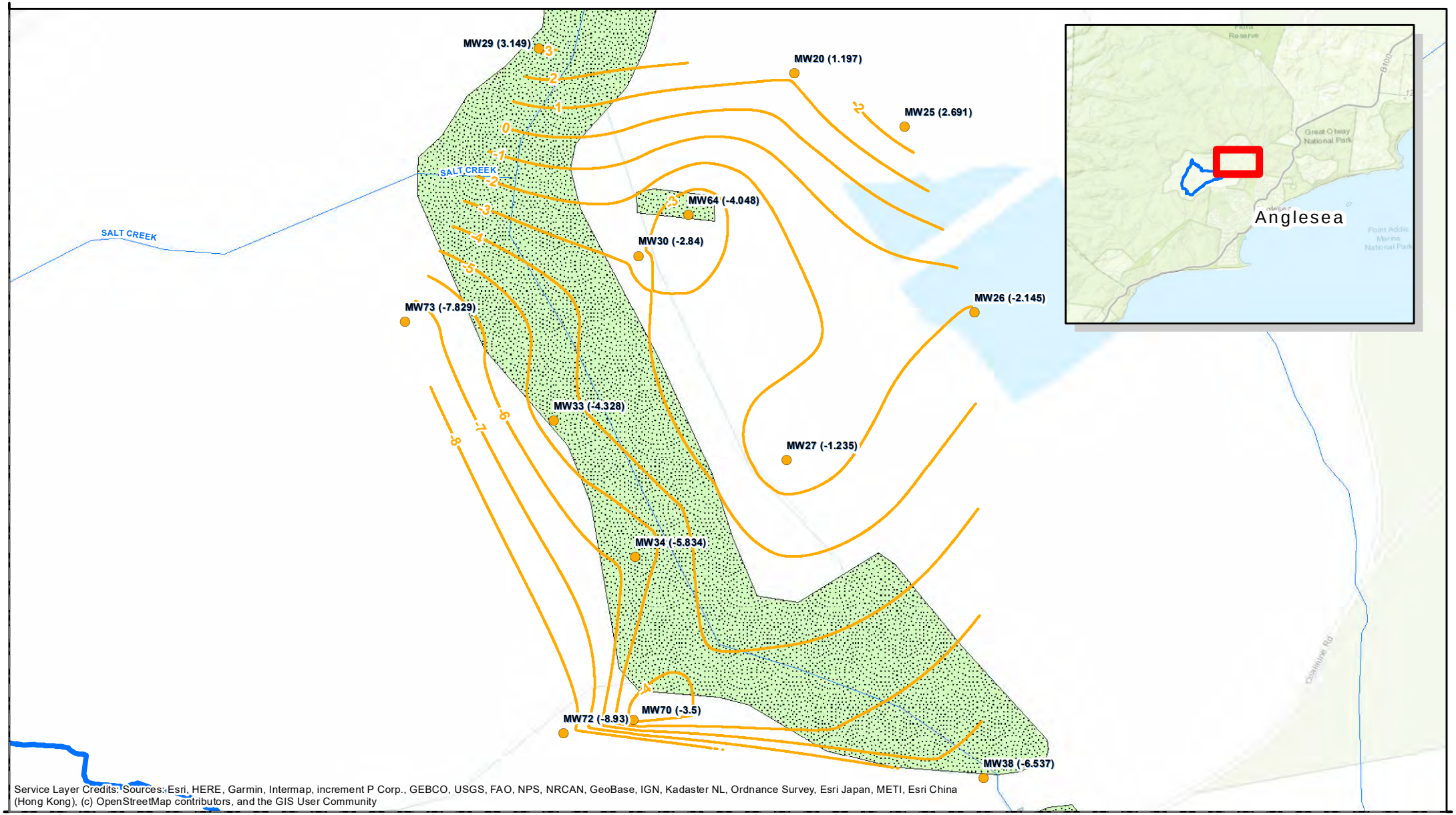

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-39 Groundwater Contours - Boonah Formation (Jan 2022).mxd

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Figure 5-39 Groundwater Contours - Boonah Formation (Jan 2022)

- Well Network
- Contour_BF
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Marshland

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REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:5,973

N

Kilometers

0 0.075 0.15 0.3

5.4.2.1 Water Levels and Trends

Historical annual groundwater elevation trends in the DBF aquifer are presented on **Figure 5-42**, and demonstrate relatively stable levels over time. Hourly water level data obtained during the groundwater pumping test are presented on **Figure 5-43**. The historical and current groundwater elevations are similar and show a stable trend.

The groundwater bores that display the greatest fluctuations such as MW08, MW016 and MW023 are generally located in proximity to the groundwater mounding below the former power station and cooling tower area and is directly influenced from the overlying PWT aquifer. Three locations have shown a notable decrease in groundwater levels since the power station operations ceased. The variability of water levels and presence of dry wells screened in the same unit highlights the discontinuous and complex nature of the DBF aquifer across the area.

More continuous pressure data has been recorded from four boreholes were drilled near the south wall in 1999, and piezometers were installed to monitor the water level with the DBF and Boonah Sand. These are,

- Hole 756 which targets a minor coal seam (Piezometer 1) and the Boonah Formation (Piezometer 2).
- Holes 762 which targets the DBF (Piezometer 3).
- Hole 764, which targets the DBF (Piezometer 4 and 5).
- GT2016_01S which targets the DBF.

Logs and piezometer depths are shown on **Figure 5-40.** Their historical elevation data is shown on **Figure 5-41**. This graph also shows piezometers GT2016_01D and GT2016_02D which target the UEVF upper sand/Intermediate clay.

The results show that levels remained quite consistent, with Hole 762 (P3) responding slightly to drainage of the more permeable section during the early 2000s when 10 dewatering holes were drilled at this location to dewater an observed perched water table (Mining One 2017). Hole 756 (P1) monitoring the Boonah Sands, seems to response to a wet period between 2000 and 2002.

It should be noted that the response from Hole 762 (P3 @ 15.29m RL) and Hole 764 (P4 @ 29.0m RL), the piezometer is likely reading a virtually dry hole.

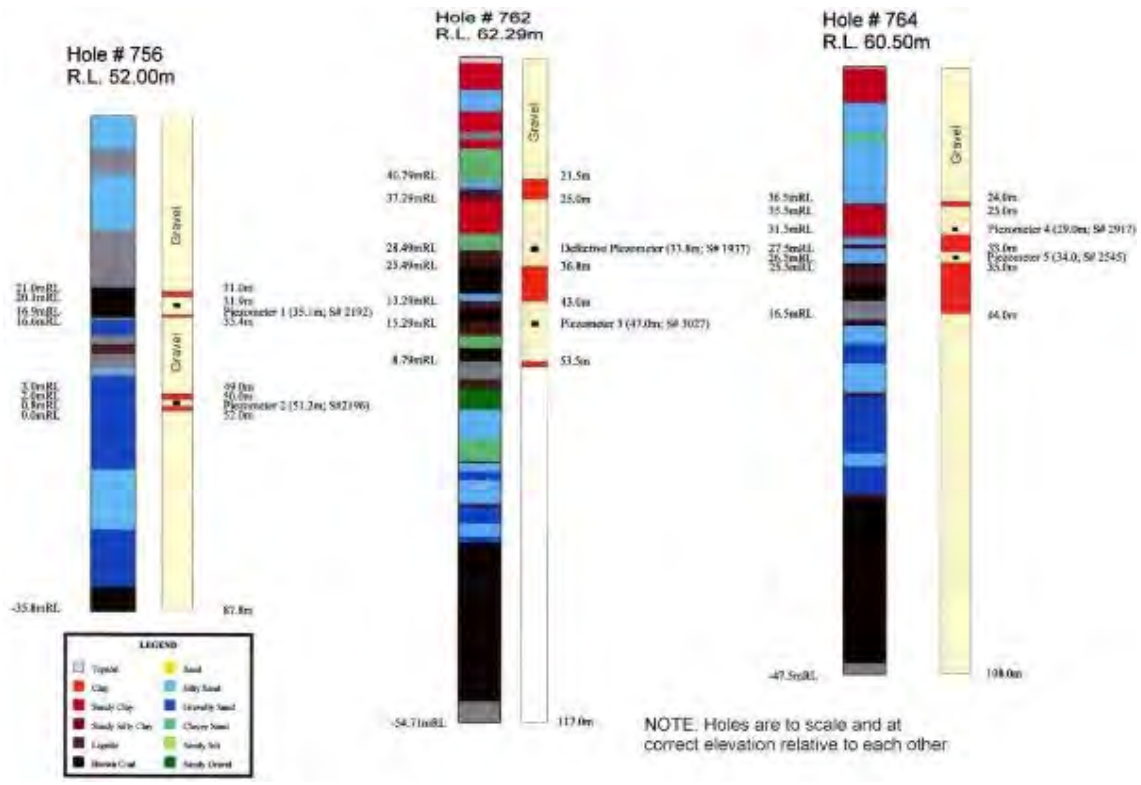

Figure 5-40 Boreholes and Piezometers in South Wall, 1999

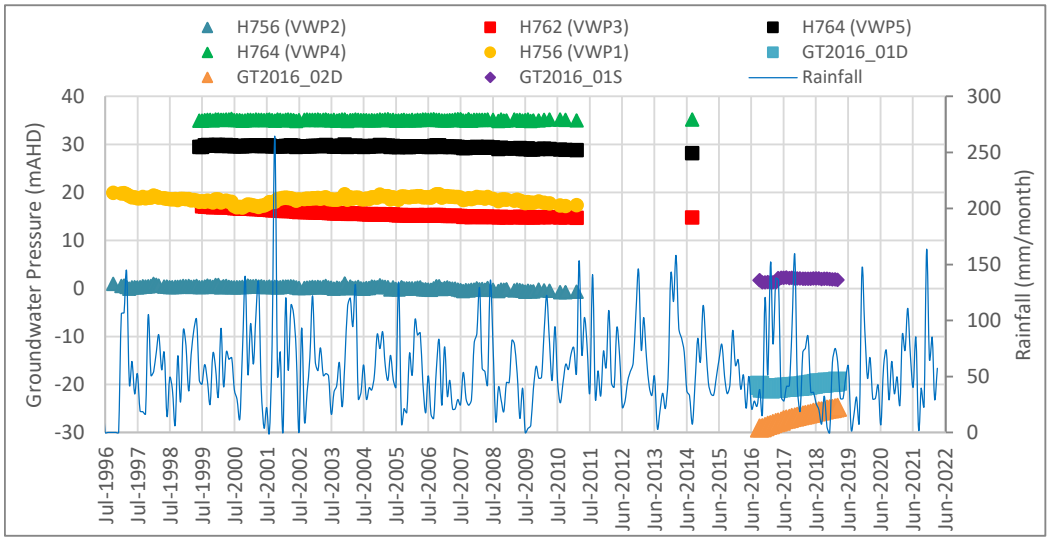

Figure 5-41 Boonah Formation and Potentiometric Surface

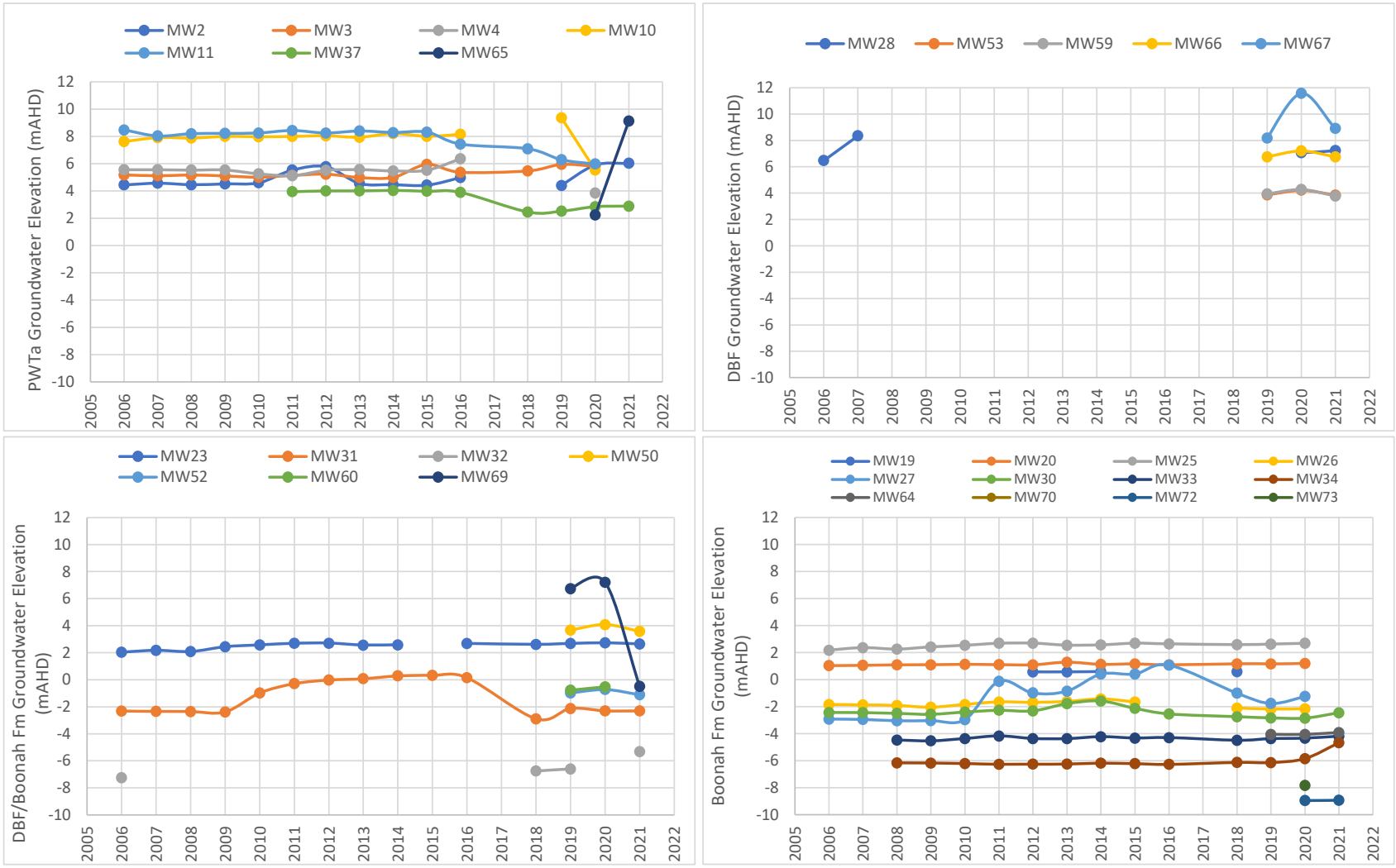

Figure 5-42 Historic Groundwater Elevations in the DBF/Boonah Fm

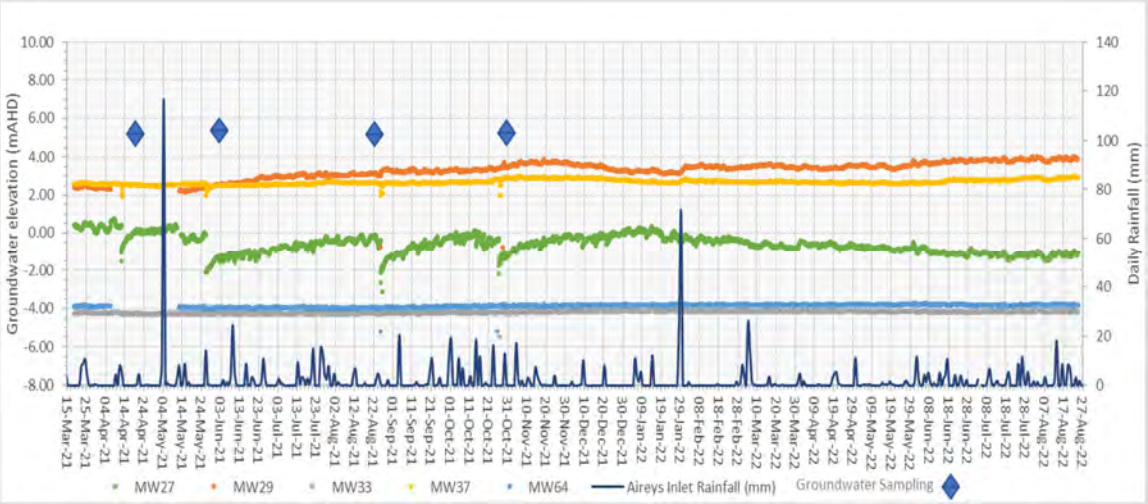

Figure 5-43 Daily DBF/Boonah Water Level Trends Recorded During the Pumping Test

5.4.2.2 Groundwater Quality

TDS in the DBF aquifer from the recent groundwater monitoring event in 2020 ranges between 578 mg/L and 6,660 mg/L with an average of 2,519 mg/L. The TDS from most wells is classified as Segment B or higher. MW29 shows the highest value and variability in TDS. This is located near the swamp at AV2 which also shows significant variability in TDS (1800 to 7020). This comparison is shown on **Figure 5-46**.

In the vicinity of the mine, the only monitoring bore that was saturated was DBF MB06 with an average TDS of 2,770 mg/L (**Figure 5-45**). This bore is installed within the backfilled overburden material and as such is not representative of the broader DBF (Boonah Formation) aquifer.

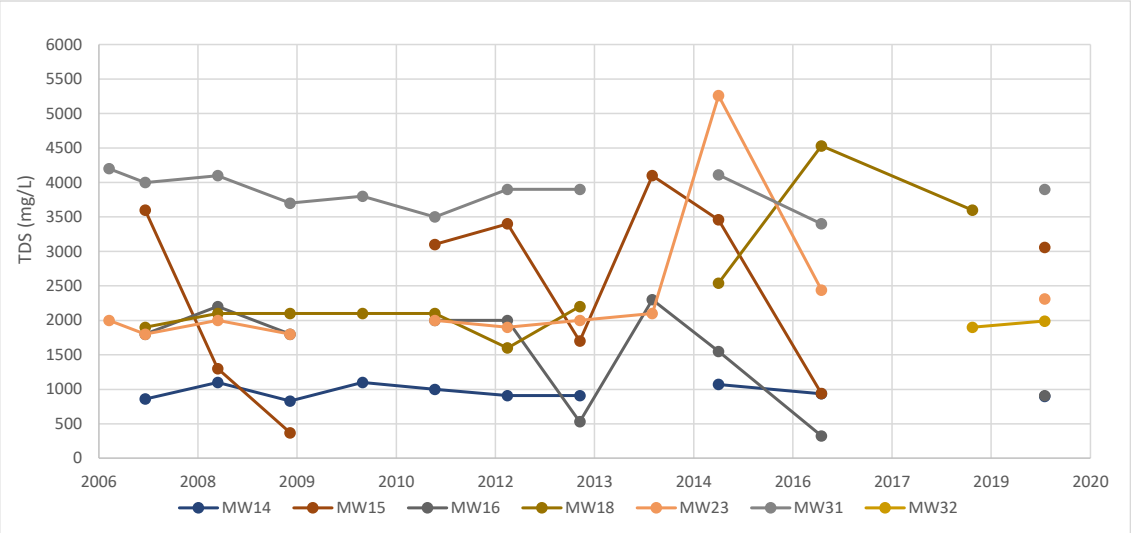

Figure 5-44 Historic TDS Concentrations in the DBF Aquifer

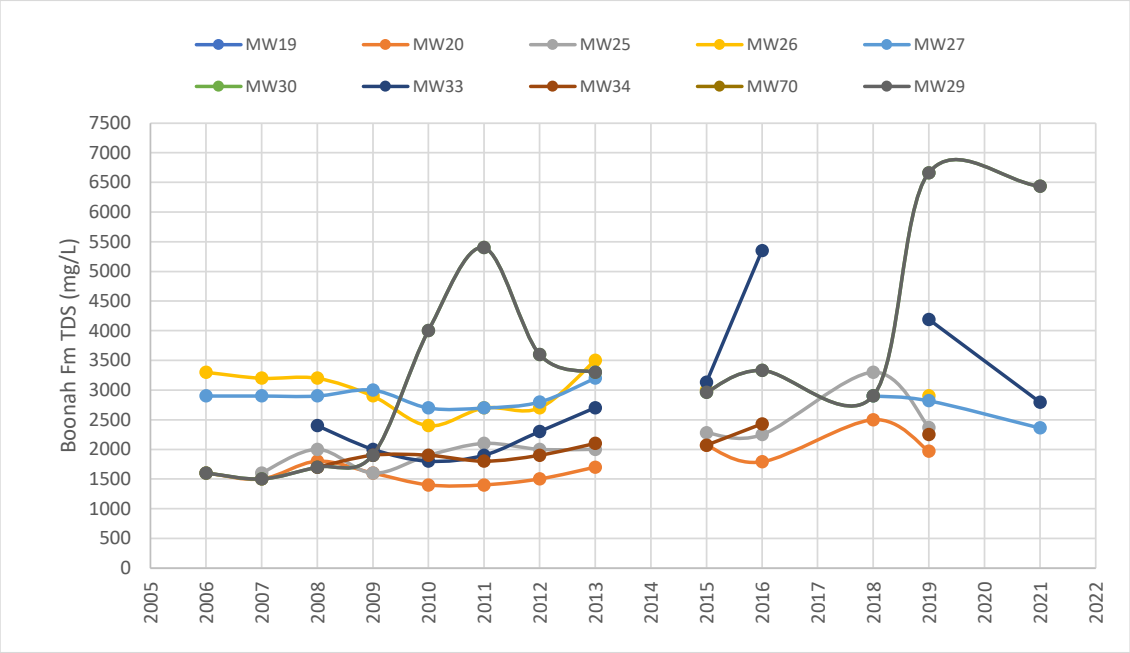

Figure 5-45 TDS Concentrations in the DBF Aquifer Recorded During the Groundwater Pumping Test

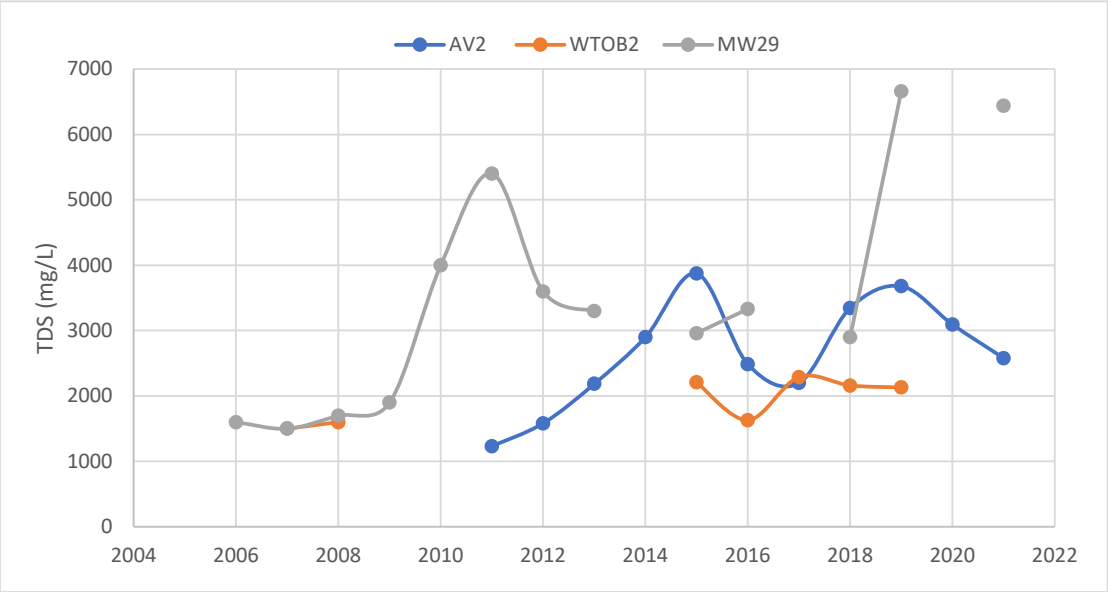

Figure 5-46 TDS Concentrations of WTOB2 (ASA), MW29 (Boonah Fm) and AV2 (surface Water)

5.4.2.3 Hydraulic Parameters

Estimates of hydraulic conductivity in the DBF (likely the Boonah Formation) were calculated from slug tests for four monitoring bores, MW4, MW10, MW11 and MW22 (Beattie, 2003). A summary of the results are presented in **Table 5-2**.

Table 5-2 Slug Test Summary (DBF)

Bore	Lithology	Bore Depth (m)	2015 Standing Water level (m AHD)	2015 EC (µS/cm)	Hydraulic Conductivity (m/day)
MW4	Silty Clay	3.5	5.7	7,170	0.09
MW10	Silty Sand	5.6	8.4	2,630	0.01
MW11	Clayey Gravel	5.5	8.3	3,260	0.27
MW22	Silty Clay	11.8	1.6	3,410	0.06

m = metres
AHD = Australian Height Datum
µS/cm = microseimens per centimetre
EC = electrical conductivity

In addition, during the 2021 drilling program, geological core was taken from the DBF (Boonah Formation) in the vicinity of UEVF MB07 (**Figure 5-39**). These core samples were analysed by Golder Associates geotechnical laboratory for permeability, dry density, porosity, reactivity and dispersion analysis. The results are presented in Table 5-3 and the laboratory reports are located in Appendix E. These tests were focussed on the clayier and compact erodible mine material of the Boonah Formation as opposed to the sandier lenses.

Furthermore, permeability tests from 29 sites located in the mine void representative of the reworked and backfilled BDG at depth between 0.5m and 8m show Kv (min = 6.9E-6m/d, max = 6.05E-3 and mean = 8.6E-5m/d). This work was undertaken after a four-day field sampling event to collect samples for permeability, chemical and Australian Standard Leaching Procedure (ASLP) analysis. The sampling event was focused on the north east part of the mine and within the fill material, which is assumed to be representative of backfilled mine overburden. These results are presented in **Table 5-4** and **Table 5-5**. The location of these sample sites is shown in **Figure 5-47** and **Figure 5-48**. Further information on these results is presented in EHS Support 2022 (Draft).

Table 5-3 DBF Permeability Analysis

Sample ID	Depth interval	Classification	Lithology- Hydro	Moisture content (%)	Dry density (t/m^3)	Assumed porosity (%)	Kv (m/sec)	Lithology - lab
ANG-21-0184	0.05-0.45	Gravelly SAND	pale brown - orange, coarse grained sands, loose, subangular to subrounded, well graded	10.3	2.02	23.7	2E-10	Sandy CLAY, low plasticity, mottled orange grey, fine to coarse sand, trace fine gravel
ANG-21-0189	0.2-0.6	Sandy CLAY	brown to pale brown, low to medium plasticity, fine to coarse grained subangular sands, poorly graded	9.9	2.04	23.1	4E-10	Sandy CLAY, medium plasticity, orange-brown, trace fine gravel, fine to coarse sand
ANG-21-0195	0 - 0.4	CLAY	grey to pale brown with orange mottles, low plasticity, soft	16	1.83	30.8	3.00E-10	CLAY, high plasticity, mottled grey and brown
ANG-21-0197	9 - 9.4	Sandy CLAY	dark brown to dark grey, high plasticity, firm and dry	19.8	1.56	41.2	4.00E-09	Sandy CLAY, medium plasticity, dark brown mottled orange, fine to coarse grained sand
ANG-21-0201	0.3 - 0.7	Sandy CLAY	light brown to orange, fine to medium grained sands, loose, trace low plasticity clays	13	1.97	25.8	2.00E-09	Sandy CLAY, medium plasticity, orange-brown, trace fine gravel, fine to coarse grained sand
ANG-21-0207	9 - 9.4	Sandy CLAY	dark brown to grey, low plasticity, soft, with trace subangular to subrounded sands. Increasing plasticity with depth	28.8	1.47	44.4	4.00E-09	Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand, trace fine gravel

t/m^3 = tonnes per cubic metre
m = metre

Table 5-4 Permeability Test Results (de-ionised water permeameter method)

Alcoa ID	Material	Texture	Permeability (m/sec)
ANG-22-0025	Fill material	Silty sandy CLAY	4×10^{-10}
ANG-22-0030	Fill material	Clayey SAND	7×10^{-8}
ANG-22-0034	Fill material	Clayey SAND	7×10^{-10}
ANG-22-0035	Fill material	Silty SAND	4×10^{-8}
ANG-22-0040	Fill material	Clayey SILT	2×10^{-9}
ANG-22-0044	Fill material	Silty CLAY	8×10^{-10}
ANG-22-0045	Fill material	Silty CLAY	9×10^{-11}
ANG-22-0048	Fill material	Silty CLAY	2×10^{-10}
ANG-22-0049	Fill material	Clayey SILT	2×10^{-8}

Table 5-5 Permeability Test Results (Saline water permeameter method, 5,000 ppm)

Alcoa ID	Material	Texture	Permeability (m/sec)
ANG-22-0017	Clay rich layer	Silty CLAY	2×10^{-10}
ANG-22-0018	Clay rich layer	Silty CLAY	5×10^{-9}
ANG-22-0020	Clay rich layer	Sandy CLAY	9×10^{-9}
ANG-22-0021	Clay rich layer	Sandy CLAY	1×10^{-8}
ANG-22-0024	Clay rich layer	Silty CLAY	7×10^{-10}
ANG-22-0025	Fill material	Silty sandy CLAY	3×10^{-10}
ANG-22-0027	Fill material	Sandy CLAY	3×10^{-9}
ANG-22-0029	Fill material	Silty CLAY	4×10^{-8}
ANG-22-0030	Fill material	Clayey SAND	Test not performed[8]
ANG-22-0032	Fill material	Silty sandy CLAY	5×10^{-10}
ANG-22-0034	Fill material	Clayey SAND	2×10^{-10}
ANG-22-0035	Fill material	Silty SAND	9×10^{-9}
ANG-22-0037	Fill material	Silty CLAY	1×10^{-9}
ANG-22-0039	Fill material	Silty CLAY	1×10^{-9}
ANG-22-0040	Fill material	Clayey SILT	2×10^{-9}
ANG-22-0042	Fill material	Silty CLAY	2×10^{-9}
ANG-22-0044	Fill material	Silty CLAY	7×10^{-10}
ANG-22-0045	Fill material	Silty CLAY	8×10^{-11}
ANG-22-0047	Fill material	Sandy CLAY	4×10^{-10}
ANG-22-0048	Fill material	Silty CLAY	2×10^{-10}
ANG-22-0049	Fill material	Clayey SILT	3×10^{-8}
ANG-22-0051	Fill material	Sandy CLAY	2×10^{-10}

[8] No saline test result - sample collapse between solutions

Internal Document Control Information: User Name: Danny.Barnes; Date and Time Printed: 31/08/22 10:18:42 AM; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20220525_AshDeposits\Figure 2 - Proposed Sample Investigation Locations and Domain Areas - June 2022 Consolidated Ash Area Sampling Event.mxd

Sampling Locations

0 20 40 60 80 Meters

- Sampling Locations 2021
- Sampling Locations - 2022
- Approximate extent of consolidated clay-rich cover

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Figure 5-47

CREATED BY:	D. Barnes
APPROVED BY:	R. Fraser
PROJECT REF. NO:	AUS_C03568
MAP PROJECTION:	Transverse Mercator
GRID/DATUM:	GDA 1994 MGA Zone 55
SCALE:	1:2,293
PAGE SIZE:	A4
AERIAL IMAGE SOURCE:	NEARMAP LTD

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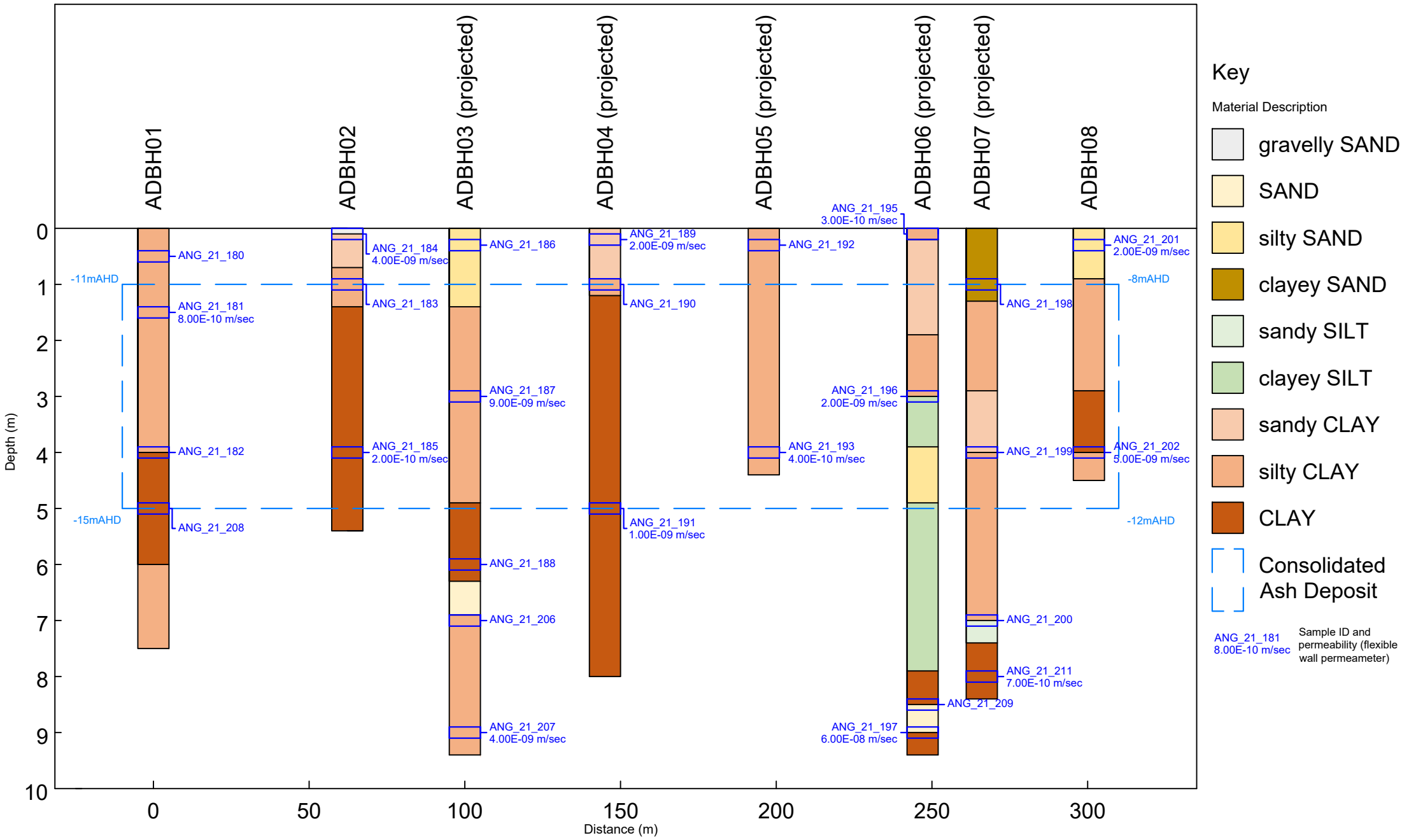

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TITLE

Figure 7 Location of Sample IDs and Cross Section

DRAWN	D. Barnes	DATE	01/06/2022
CHECKED	R. Fraser	DATE	01/06/2022
SCALE	H 1:1,000 V 1:55		A4
PROJECT No	AUS_C03568	FIGURE No	5-48

Finally, apart from where the permeable sections of the Boonah Formation may directly outcrop, groundwater and surface water interactions are expected to be limited. This is evidenced by hydrographs showing no instantaneous responses to episodic rainfall events (**Figure 5-43**). In addition, **Figure 5-49** presents pooled water photographed on 29 August 2021 on top of the DBF (Anglesea / Salt Creek Formation) near bore DBF MW07 after almost 40 mm fell in the prior 7 days. This water remained for 6 days before evaporation and infiltration eventually reduced the saturated surface area.

Figure 5-49 Recharge Potential of the Low Permeability DBF

5.4.3 Upper Eastern View Formation

Generally, the UEVF forms an unconfined (where it outcrops) to confined aquifer and consists of clay, silty clay, silt and fine to medium-grained sand sequences with minor fine gravel lenses. Brown coal is also common in the top of the UEVF sequence. In the vicinity of the Alcoa AOI, the UEVF is confined, and approximately 250 m thick. Whilst the unit has been classified as a single aquifer, evidence of different potentiometric heads exists (through site observations by Hancock [1967], as well as in recent installation of observation bores) throughout the profile.

Hancock (1967) noted artesian waters at several bores drilled in the region. Of these bores, one bore located on the Anglesea Golf Links drilled to 442 mbgl was believed to be completed in the LEVF. Another labelled “M274” located near the former power station site required an artesian cap after it flowed during drilling. This bore had flowed open hole from a sand recorded at a depth of 138 mbgl or approximately 120 m AHD, with an artesian head of 20.7 m AHD (approximately +2.7magl), a TDS of approximately 500 parts per million (ppm) and an approximate pH of 5.5. This is believed to be completed at the top of what is referred to within this report as the Lower sands; **Section 5.2.2.2.5**) and gives a good indication of the pre-mining UEVF potentiometric surface. Hancock (1967) also noted that within the EVF, ‘*sand aquifers occur in the sequence and show potentiometric pressures increasing in the deeper sand, possibly due to lithostatic pressure*’.

This is an important observation, as it gives an indication that the more permeable units in the upper part of the UEVF (i.e., just below the coal located from -65 m to -80 m AHD [approximately 55 to 70 mbgl]) are somewhat hydraulically disconnected and/or have significant response lags to induced pressure changes originating from the deeper part of the formation.

As a result, and from site investigations, the UEVF has been sub-divided into several units:

- UEVF Main Coal Basal Clay.
- UEVF Upper Sands.
- UEVF Intermediate Coal and Clay.
- UEVF Lower Sands.

Further discussion on each sub-unit of the UEVF is provided in the following sections.

5.4.3.1 Main Coal Basal Clay

A 1-4m thick clay unit underlies the mined coal seam within the Alcoa AOI and has been assessed in the following investigations:

- In 2013, a failure of the outer (southern) edge of a coal haulage ramp occurred in the north of the pit, by sliding on the south-dipping Basal Clay. Samples were collected from exposed clay and direct shear tests were conducted on remoulded samples; and
- In early 2016, Mining One conducted a field investigation of the Basal Clay, comprising three test pits and two drill holes. The work is presented in Mining One (2016) prepared a factual report of the data from tests from 2013 and 2016, the findings of which are summarised below.

5.4.3.1.1 Basal Clay Sampling

Three test pits and two drill hole locations were selected for sampling, at locations shown on **Figure 5-50**. Test pits were excavated on 24th February 2016, using one of Alcoa's 200 tonne excavators. The intention was to expose the coal/clay contact, and sample it either with 150 mm push tubes, or the trim around it and remove a 300 mm undisturbed cube. The sampling method was to be selected when the coal/clay contact was exposed and inspected.

- At Pit 1, the excavator found it difficult to break up the approximately 1m depth of coal remaining on the floor of the mine. The exposed clay contact was very stiff. The pit encountered no groundwater. A bulk sample was retrieved and is shown in **Figure 5-51**. Due to the coal being very hard and brittle, it was virtually impossible to sample the coal/clay interface in an undisturbed state.
- At Pit 2, the contact was wet, possibly because the location was in a depression in the coal floor. The Basal Clay was very stiff, as it was in Pit 1, but the contact between the coal and the clay was a zone of crushed coal and weak clay that appears to have been sheared or disturbed. An in-situ view of the contact is shown in **Figure 5-52**, and a sample recovered with considerable difficulty is shown in **Figure 5-53**.
- At Pit 3, the coal was again too hard, brittle, and jointed to be able to cut an undisturbed sample. The pit was extended to a long trench to get a better visual assessment of the contact. The contact is shown in **Figure 5-54**. .

Two sites were selected for boreholes. The intention was, at each site, to drill an exploratory hole using an auger to locate the base of the coal, then to drill one or more (as required) diamond cored boreholes using a PQ size core barrel (85 mm core size), taking care to core the coal/clay contact at the known depth. The diamond holes were cased through the overburden that covers the coal, then were diamond drilled for the last 0.5 m of coal and about 1 m into the Basal Clay. Each hole was about one metre from its neighbour.

- At Drill Site 1, despite several attempts at a number of locations at the site, there was either no or minimal clay recovered by the core barrel. No reason for this lack of recovery could be determined. Attempts were made to drill very slowly through the hard coal to the soft

contact and also the reverse by drilling fast through the clay to avoid washing it away. No clay was recovered at the contact in most cases.
A short sample of the clay was recovered in the core lifter. However, this had to be disturbed to recover it. This sample is shown in **Figure 5-55**.
Further inspection of the recovered coal and underlying disturbed clay suggested that there may be a carbonaceous shale or lignite at the base of coal, where shearing/disturbance has occurred. This is shown in **Figure 5-56**.
An attempt to recover a sample using the Geoprobe tubes was unsuccessful as the probe barrel could not be driven through the hard brittle coal. The probe uses a top hammer with around 2,000 impacts per minute to force the probe barrel down through typically soft formations such as sands and clays.

- At Drill Site 2, the PQ core barrel did not recover any substantial clay fraction. The only sample recovered was a minimal segment of coal with a thin layer of clay / lignite. This sample correlated to the auger probe hole, where a dry layer of silty clay was recovered. It could not be determined whether the lignite / clay was being washed away or being pushed aside as it was too soft / friable to push the coal further up the core barrel.

In addition to the information presented above, within core hole UEVF MB07, the shallowest clay underlying the main coal (inferred as the continuation of the basal clay) returned a permeability (vertical hydraulic conductivity) of 7×10^{-10} m/sec (6×10^{-5} m/day). Laboratory reports are provided in **Appendix H**.

The spatial extent of the Main Coal (seam A) and basal clay are shown on **Figure 5-57**. Note this differs from the larger extent presented on **Figure 5-34** which incorporates all the upper coal seam in the area.

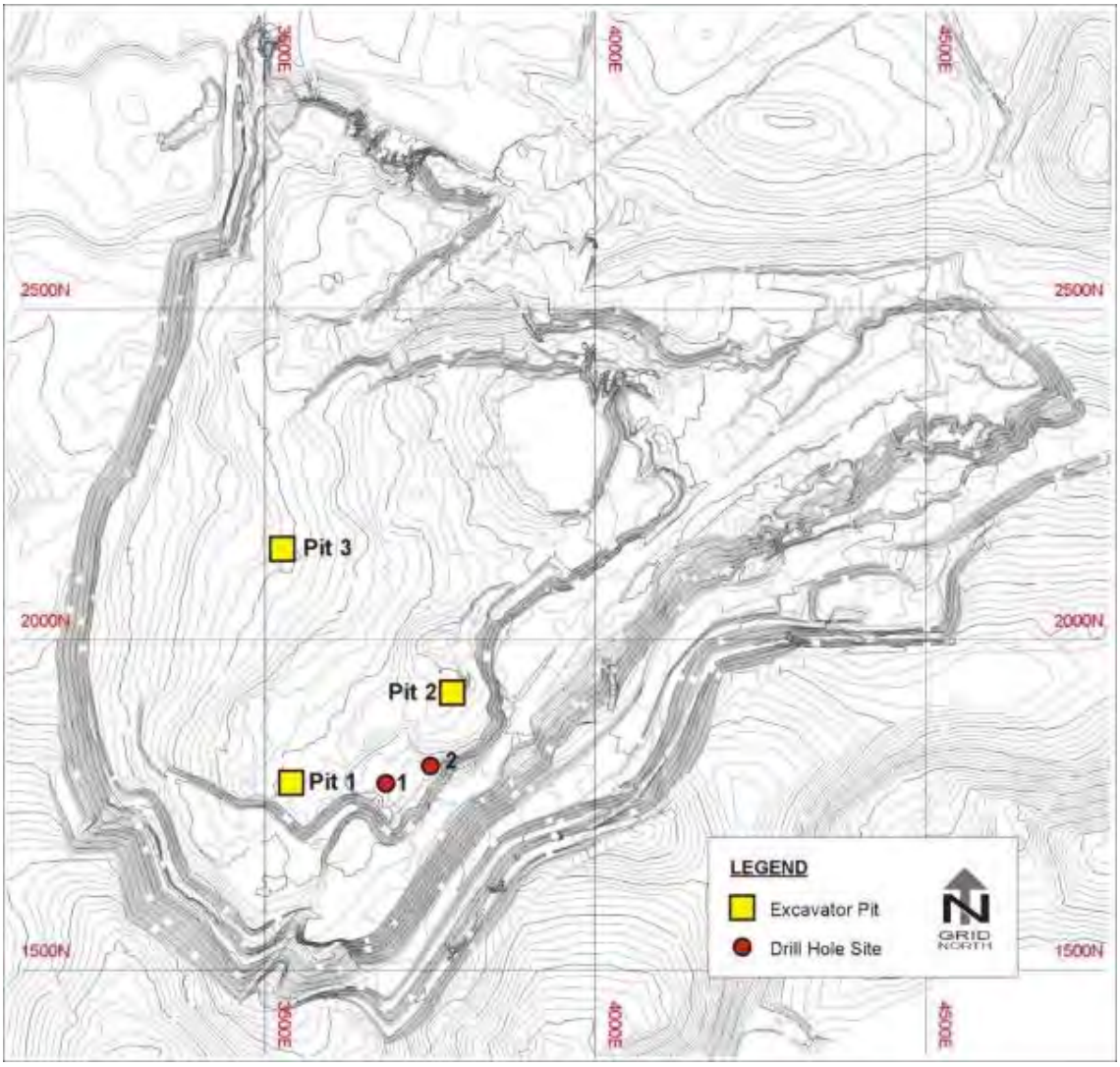


Figure 5-50 Location Plan, 2016 investigations of Basal Clay

Figure 5-51 Basal Clay Sample from Pit 1

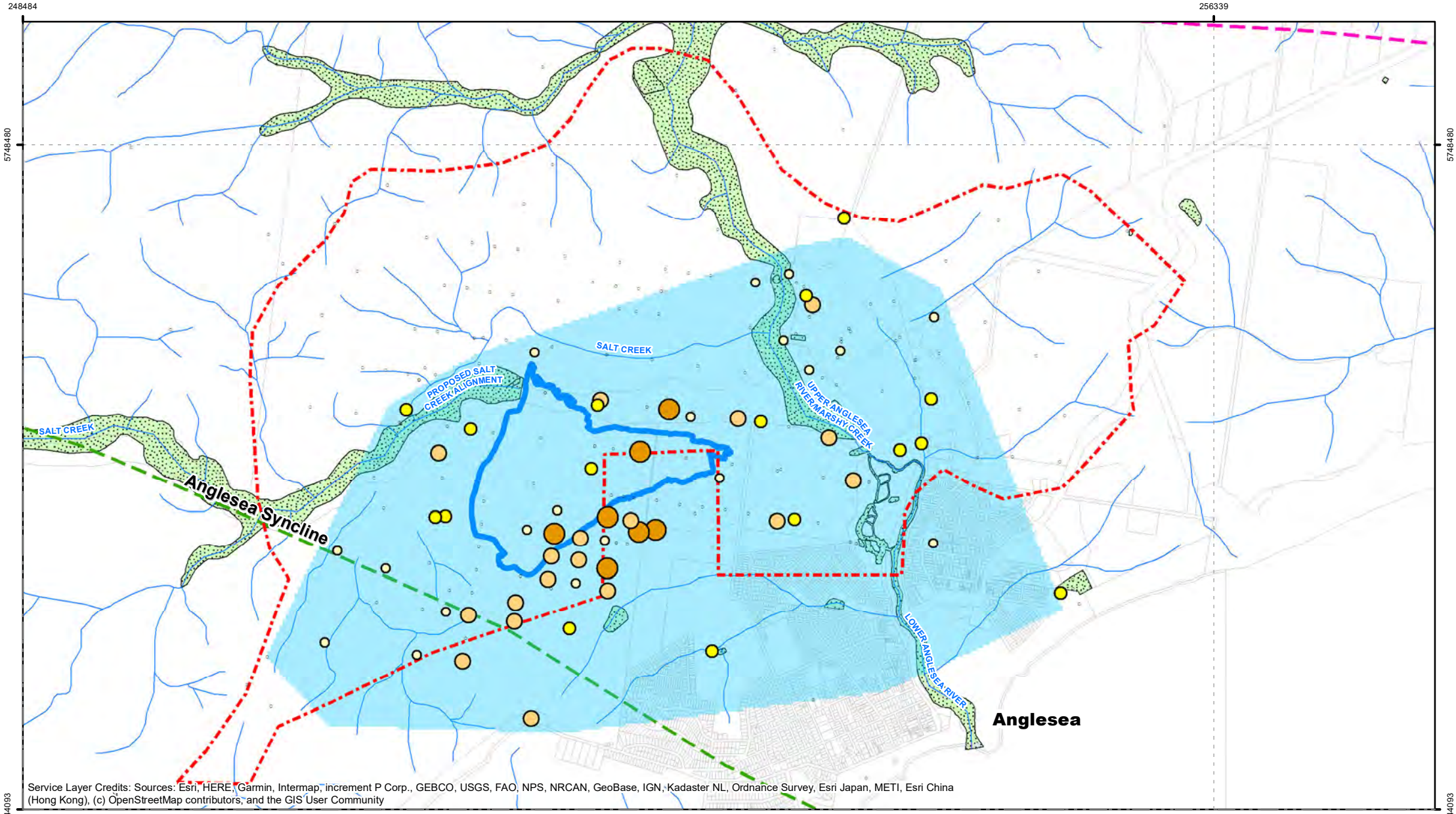
Figure 5-52 Basal Clay and Coal Contact, Pit 2

Figure 5-53 Basal Clay and Coal contact, Sampled from Pit 2

Figure 5-54 Basal Clay and Coal Contact, Pit 3

Figure 5-55 Coal and Partially Recovered Basal Clay, Drill Site 1

Figure 5-56 Weak and Disturbed Lignite and Clay from Second Attempt, Drill Site 1



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-55 Main Coal Extent – Seam A.mxd

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Figure 5-57 Main Coal Extent – Seam A

Main Coal Thickness (m)

- 0.59 - 10.00
- 10.01 - 20.00
- 20.01 - 30.00
- 30.01 - 40.00
- Unit Not Present at This Bore

- Historical Anglesea Mine Coal Seam Location
- Main Coal Extent
- Anticline
- Syncline
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

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REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:32,734

N

Kilometers

0 0.45 0.9 1.8

5.4.3.2 UEVF Upper Sands

Within the Alcoa AOI an upper permeable sand unit within the UEVF was observed in numerous observation and investigation bores across the Alcoa Coal Mine. Where these sands were encountered underneath the main mined coal seam, groundwater observation bores were installed. Where no sand lens was encountered immediately below the main coal seam, the next sand lens was targeted. Seven groundwater observation bores were installed in this unit in 2020/2021 and are shown on **Figure 2-2**.

The upper sands of the UEVF forms a discontinuous permeable unit that is separated from the shallow DBF by the basal clay and main coal seams. The spatial extent and current groundwater elevation (as of January 2022) of the water table of this unit is shown on **Figure 5-59**.

5.4.3.2.1 Water Levels and Trends

Seven groundwater monitoring bores were installed within the UEVF Upper Sands, and their hydrographic response is shown in **Figure 5-58**. In all bores the groundwater elevation is rising at a similar rate of approximately 0.2 m/month and has not been impacted by the groundwater pumping test.

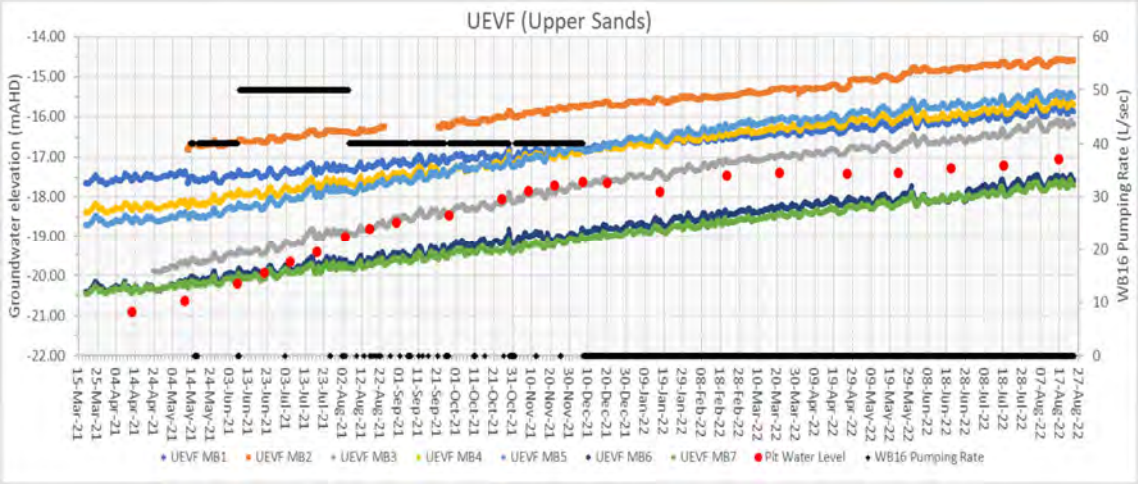
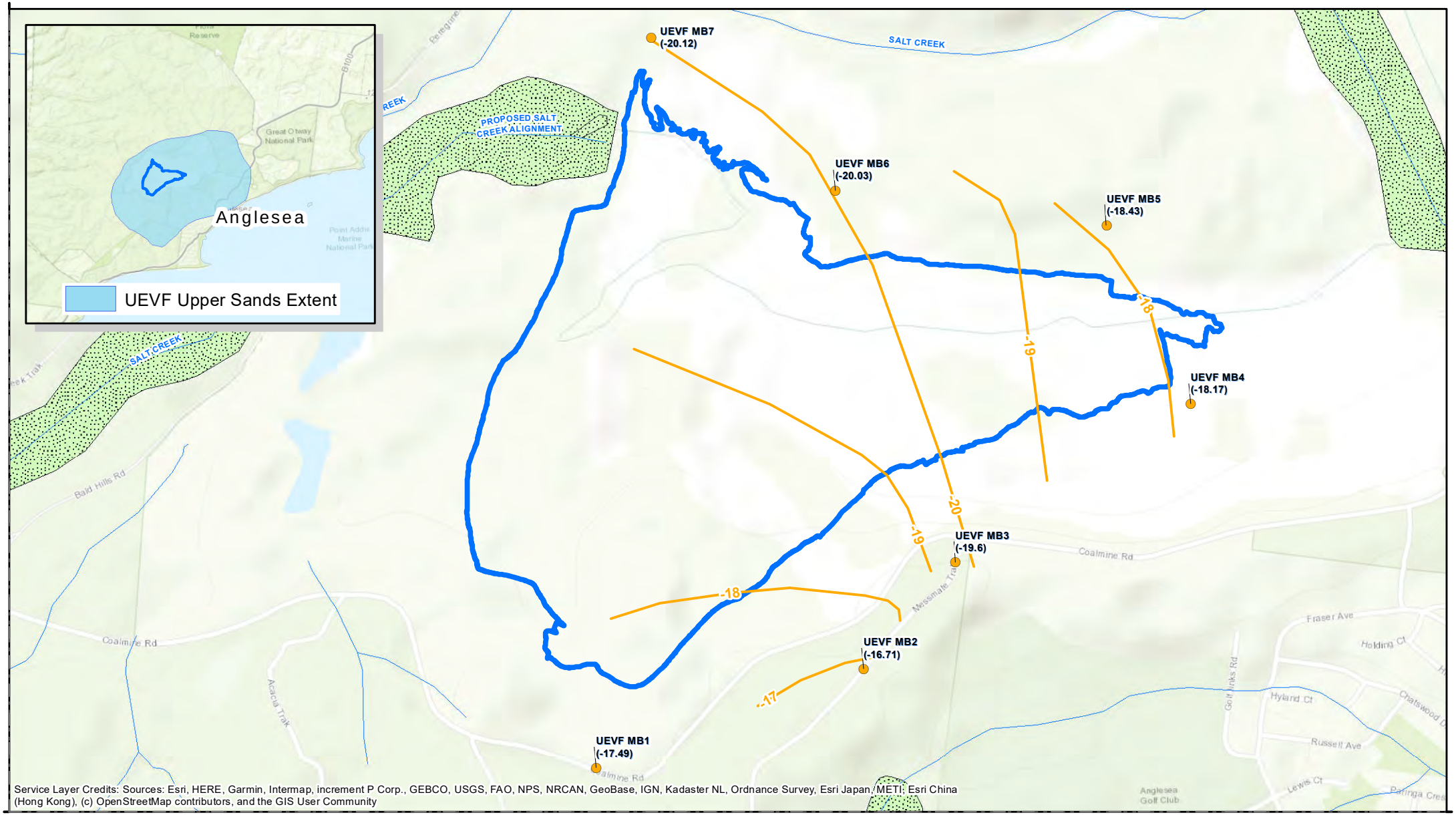


Figure 5-58 UEVF Upper Sands Water Levels Recorded During the Groundwater Pumping Test

250411



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-57 Groundwater Contours - UEVF Upper Sands (Nov 2021).mxd

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Figure 5-59 Groundwater Contours - UEVF Upper Sands (Nov 2021)

- Well Network
- Contours
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

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REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:11,429

N

Kilometers

0 0.15 0.3 0.6

5.4.3.2.2 Groundwater Quality

The TDS within the upper sands is variable ranging from 168 mg/L (UEVF MW07) to 3,470 mg/L (UEVF MW04) with a median concentration of 889 mg/L. The trend in TDS at each location has remained relatively stable over time (**Figure 5-60**).

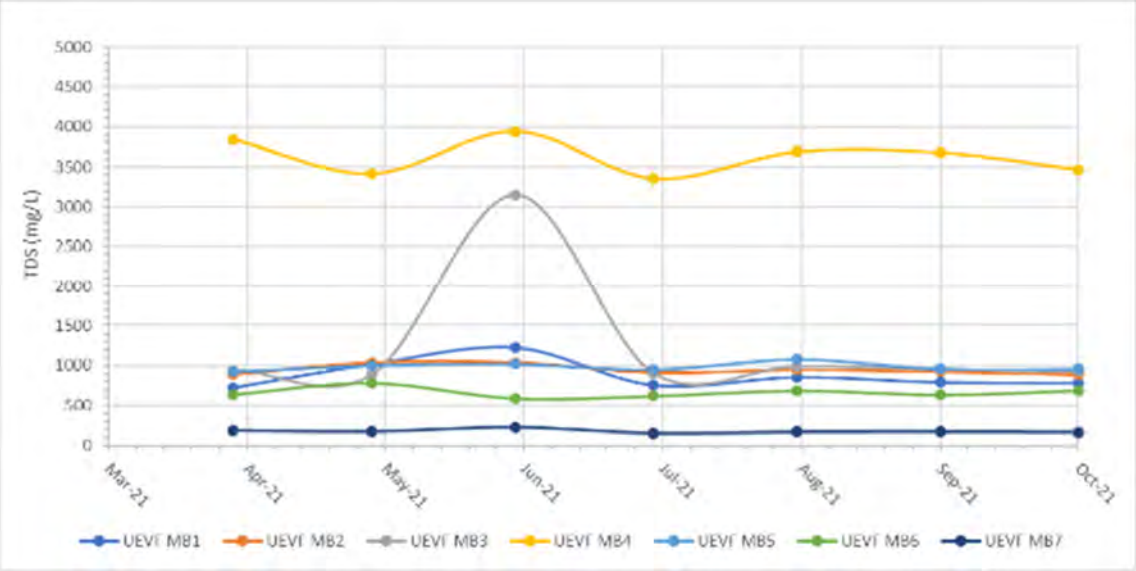


Figure 5-60 UEVF Upper Sands TDS Concentrations

5.4.3.2.3 Hydrogeological Parameters

No aquifer tests have been undertaken on the upper sands, however based on observed core sands returns from UEVF MB07 (**Figure 5-31**) and other bores, the hydraulic conductivity would be high (potentially up to 20 m/day) although these permeable sand lenes are only thin (and potentially discontinuous), which would result in a reduced transmissivity across the area.

5.4.3.3 UEVF Intermediate Coal and Clay

The intermediate clay, coal and minor sand lenses of the UEVF consists of alternating thick often greater than 10 m sequences of ligneous coal and clay with minor less than 3 m of sand lenses. Underneath the former mine, the total combined thickness of this unit is approximately 100 m. The outcropping extent of this section of the UEVF is estimated on **Figure 5-6**.

5.4.3.3.1 Water Levels, Groundwater Quality and Trends

As the name of this section of the UEVF suggests, there are limited permeable units and as such no water level or water quality data exists for this section of the overall formation.

5.4.3.3.2 Hydrogeological Parameters

During the installation of groundwater investigation bores surrounding the mine void, geological core was retained from several bores (UEVF MB7, UEVF MB3 and UEVF MB8) and 5 core sections within UEVF MB7 were subject to laboratory permeability tests. These sections were all from the coal and clay seams within the UEVF Intermediate zone which represent the lower permeability sections of the formation. The laboratory permeability tests of clay and coal sections indicate that vertical hydraulic conductivity (Kv) ranges from 7 x 10^{-10} m/sec at 33 mbgl to 3 x 10^{-9} m/sec at 55mbgl to 2 x 10^{-9} m/sec at 70.5 mbgl and 1 x 10^{-10} m/sec at 140 mbgl. The certificates of these results are presented in **Appendix H**.

5.4.3.4 UEVF Lower Sands

At the site, the UEVF Lower sands are confined by greater than 100 m of coal and clay that separate these sands from shallower permeable units (refer to sections above for lithological relationship between these two units). These clays and coals are indicated to act as a quasi-confining unit. The outcrop areas of the UEVF Lower sands are estimated on **Figure 5-6**.

A number of dewatering bores were installed by Alcoa across the former power station site targeting the lower sands of the UEVF to facilitate mining operations. Four of these dewatering bores are currently being monitored and are shown on **Figure 5-61**. The remainder of these dewatering bores have been decommissioned for various reasons.

Static groundwater elevations from May 2021 (i.e., prior to the commencement of the 12-month pumping test) indicate greater hydraulic pressures in the lower sands of the UEVF compared to overlying units (i.e., those in the upper sands).

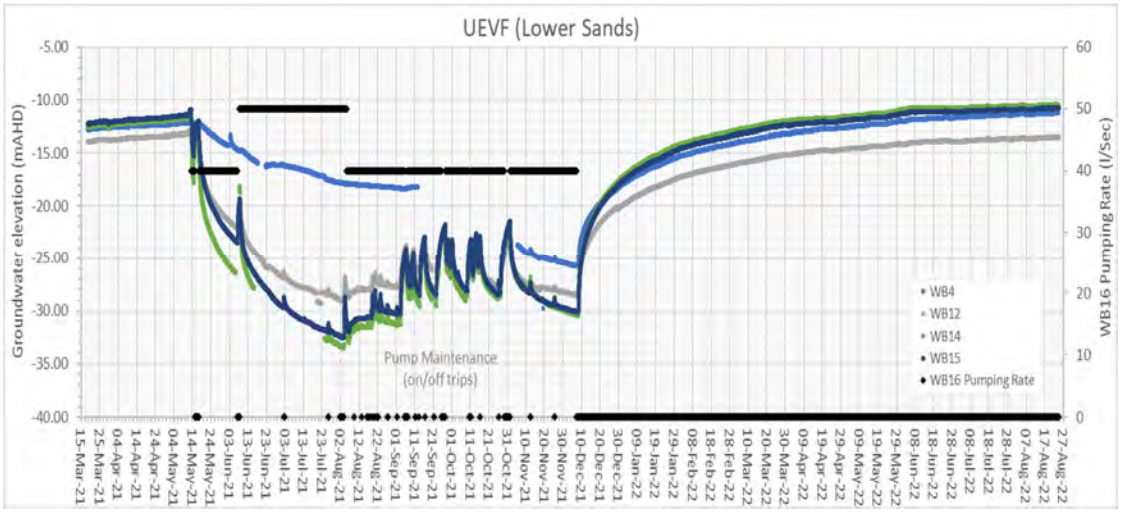


Figure 5-61 Daily UEVF Lower Sands Water Level Trends during the Groundwater Pumping Test

5.4.3.4.1 Water Levels and Trends

Figure 5-62 presents historic bore water level data in the UEVF with WB4, and WB5 being screened in the deeper portions of the UEVF. These bores are screened closer to (both spatially and vertically) the pumping bores and as such have been impacted by Alcoa's UEVF pumping. However, since pumping has ceased in 2016, groundwater is recovering at a faster rate than those screened in the

upper section, highlighting the disconnect between the upper and lower sections. **Figure 5-63** presents the groundwater contours of the UEVF Lower Sands at the end of 2021.

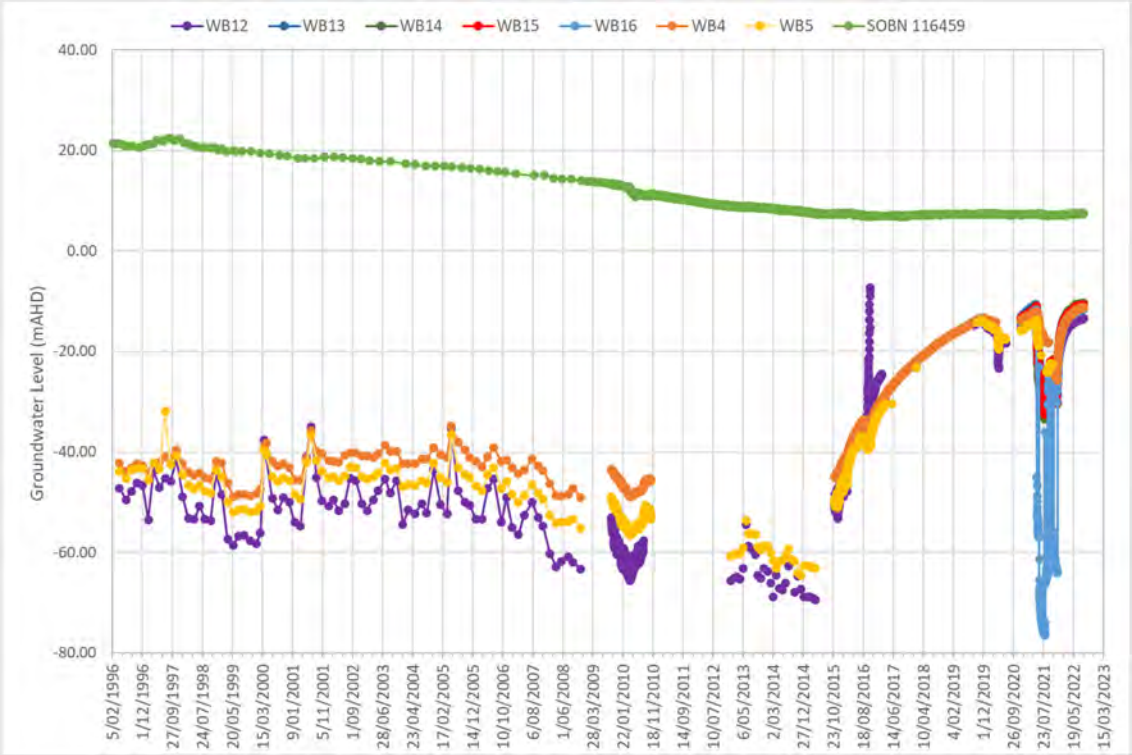
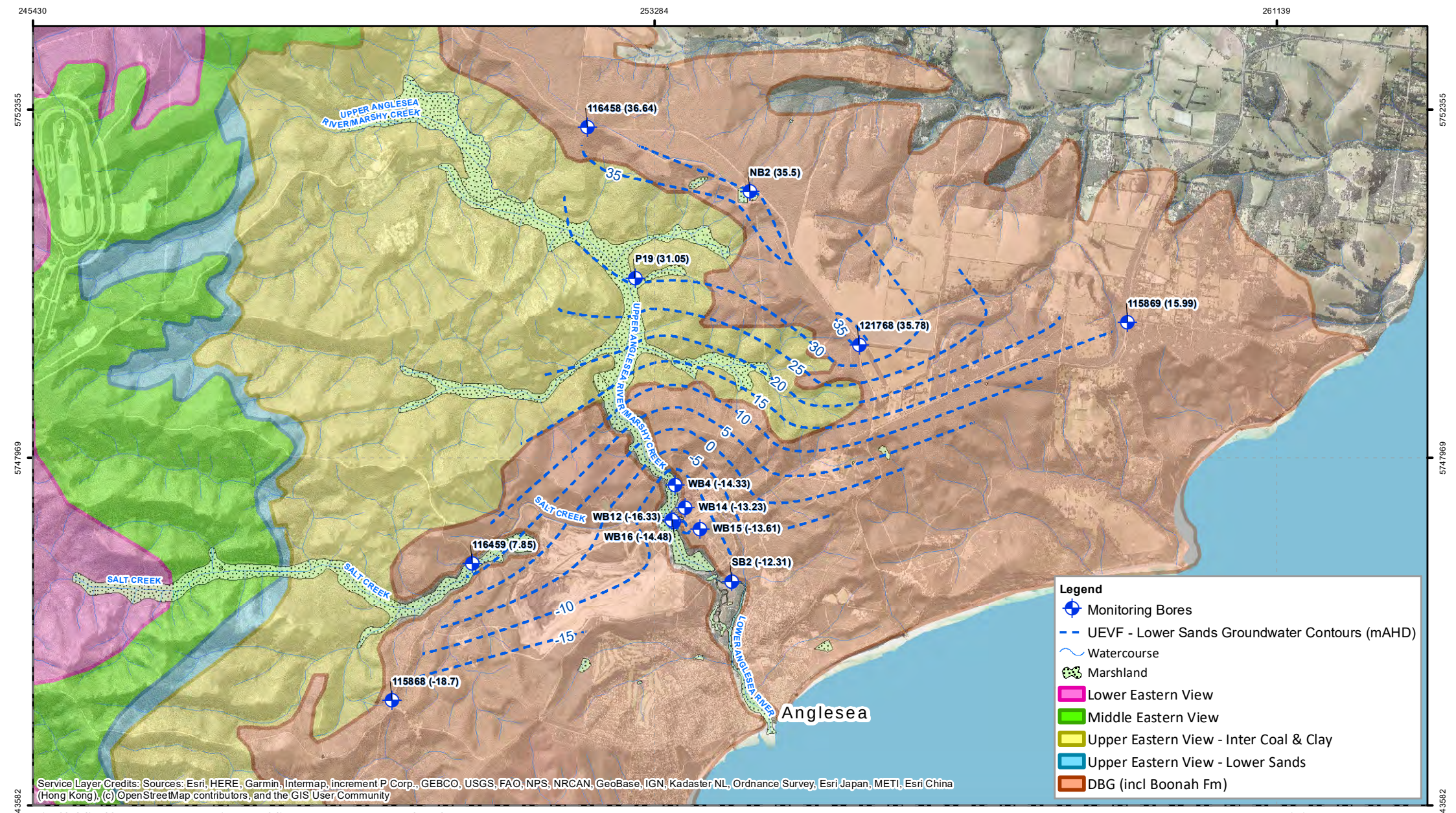


Figure 5-62 UEVF Lower Sands Local (Site and Mine) Groundwater Elevations (Note bore WB13 most likely screened across both UEVF and LEVF)



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5□61 2021 UEVF - Lower Sands Groundwater Elevation.mxd

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Figure 5-63

2021 UEVF - Lower Sands Groundwater Elevation

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Alcoa Anglesea Hydrogeological Investigation

DATE:	30/03/2022
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:61,912

N

Kilometers

0 0.75 1.5 3

5.4.3.4.2 Groundwater Quality

During the groundwater pumping test pH ranged from 6.3 to 6.7 with a mean of 6.5. The TDS ranged from 741 to 1,660 mg/L which is consistent with historical ranges reported prior to May 2021, of between 830 to 1,313 mg/L, indicating negligible changes in water quality due to the groundwater pumping test (**Figure 5-64**). Recorded trace metals concentrations (i.e., aluminium, boron, iron and zinc) during the groundwater pumping test are also consistent with historical observations (**Table 4-5**).

Figure 5-64 UEVF Lower Sands TDS Concentrations Recorded During the Groundwater Pumping Test

5.4.3.4.3 Hydrogeological Parameters

In 2015 and 2016, groundwater monitoring data associated with extraction activities from extraction bores WB3 and WB4 (screened in multiple locations across the UEVF) for the period November 2015 to June 2016 were analysed (**Table 5-6**). During the 8-month monitoring period, extraction bore WB3 was active over 4 pumping cycles ranging from 1 day to 10 days at pumping rates of up to 49 L/sec. Extraction bore WB4 was active over 9 cycles ranging from 2 days to 18 days pumping at rates of up to 44 L/sec. During these pumping cycles, groundwater levels were collected from observation bores WB1, OB4, OB5, OB9 and OB12. Vibrating Wire Piezometers (VWP1D and VWP2D) were also active during the later pumping cycles and were screened in the upper sections of the UEVF whilst the remaining bores (with the exception of OB4), were screened in the lower sections of the UEVF. OB4 was screened across both the UEVF and LEVF.

Data obtained from numerous hydraulic response periods was analysed in Aqtesolv™ (HydroSOLVE, Inc.) using the Cooper-Jacob solution with unconfined correction (1946). A summary of the derived hydraulic parameters are provided in **Table 5-6**.

Table 5-6 2015/2016 Pumping Periods Analysed

Test	Pumping Bore	Test Type	Observation Bore	Cooper-Jacob (Unconfined)	
				Transmissivity (m^2/day)	Storativity
Test Duration 1 (0 to 18.5 days)	WB4	Pumping	WB5	261.4	4.8×10^{-3}
			WB9	283.9	1.1×10^{-3}
			WB12	133.6	1.2×10^{-3}
Test Duration 2 (23.4 to 31.3 days)	WB4	Recovery	WB4	330.2	5.5×10^{-4}
			WB5	260.3	2.7×10^{-3}
			WB9	314.4	5.4×10^{-4}
			WB12	167	7.0×10^{-4}
Test Duration 3 (26.5 to 33.5 days)	WB3	Pumping	WB4	1013.3	4.6×10^{-2}
			WB5	281.7	1.3×10^{-1}
			WB9	549.3	6.4×10^{-4}
			WB12	110.2	9.9×10^{-3}
Test Duration 4 (43.5 to 48.5 days)	WB4	Pumping	WB4	1790.1	2.4×10^{-3}
			WB5	260.3	2.7×10^{-3}
			WB9	677.3	1.2×10^{-3}
			WB12	226.1	1.1×10^{-3}
Test Duration 5 (48.5 to 53.5 days)	WB4	Recovery	WB4	990.8	5.8×10^{-3}
			WB5	272.3	3.0×10^{-3}
			WB9	350.1	6.5×10^{-4}
			WB12	505.9	2.2×10^{-3}
Test Duration 6 (53.5 to 54.5 days)	WB3	Pumping	WB4	905.6	2.8×10^{-3}
			WB5	548.1	1.6×10^{-1}
			WB9	842.5	3.8×10^{-4}
			WB12	392.6	2.1×10^{-3}
Test Duration 7 (60.5 to 61.5 days)	WB4	Pumping	WB4	575.4	1.9×10^{-3}
			WB5	422.6	1.2×10^{-1}
			WB9	521.9	3.4×10^{-4}
			WB12	320.1	1.7×10^{-3}
Test Duration 8 (63.5 to 65.5 days)	WB4	Recovery	WB4	No Response	
			WB5	336.7	5.1×10^{-4}
			WB9	485.2	1.3×10^{-4}
			WB12	175	1.3×10^{-3}
Test Duration 9 (70.5 to 84.5 days)	WB4	Pumping	WB4	1024	3.7×10^{-2}
			WB5	370.4	2.6×10^{-3}
			WB9	483	6.9×10^{-4}
			WB12	194.8	7.4×10^{-4}
Test Duration 10 (84.5 to 92.5 days)	WB4	Recovery	WB4	572.5	5.4×10^{-3}
			WB5	282.8	2.4×10^{-3}
			WB9	382.6	5.5×10^{-4}
			WB12	161.8	6.5×10^{-4}
Test Duration 11 (96.5 to 107.5 days)	WB4	Pumping	WB4	No Response	
			WB5	385.7	3.0×10^{-3}
			WB9	382.6	6.0×10^{-5}
			WB12	161.8	6.4×10^{-4}
Test Duration 12 (115.5 to 116.5 days)	WB4	Pumping	WB4	83.2	2.0×10^{-5}
			WB5	29.03	4.0×10^{-5}
			WB9	64.03	1.0×10^{-5}
			WB12	9.83	2.0×10^{-5}

The results from WB5, WB9 and WB12 contained uniformity (i.e., each well had a normal distribution of its group of transmissivities) despite the variable stress periods and stress rates. For example, the transmissivity values for WB4 were almost double that of the other bores. To further analyse this, the mean and the standard deviation for each bore were determined (**Table 5-7**)

Table 5-7 Statistical Summary of Observation Bores

Bore ID	Mean of Transmissivity	Standard Deviation of Transmissivity
WB4	809.5	494.9
WB5	309.3	123.8
WB9	444.7	199.2
WB12	213.2	133.8

The aquifer parameter data suggest hydraulic conductivities of up to approximately 10 m/day can occur in individual sand horizons within the UEVF. However, lower average (or bulk) hydraulic conductivities of between 0.001 and 1 m/day have been recorded where longer and more varied sequences of sand, silts and clays have been tested.

Between 21 April 2020 and 29 April 2020, EHS Support undertook a step drawdown test consisting of three steps, and a seven-day constant rate pumping test from production bore WB16. The objective of the pumping test was to obtain an estimate of the aquifer properties (i.e., transmissivity and storativity) of the lower sands of the UEVF in the vicinity of the pumping bore location. The derived parameters were incorporated into the original numerical groundwater flow model.

During the step-drawdown test, the drawdown at the pumping bore (WB16) varied from approximately 21 m at 30 L/sec to approximately 40 m at the end of Step 3 at 50 L/sec. The specific capacity was approximately 1.3 L/sec per metre of drawdown. A well efficiency of approximately 80 percent was indicated for the pumping ranges used; however, at higher pumping rates, the well efficiency declined because of the increasing significance of well loss. Transmissivity was derived using Aqtesolv™ and the Dougherty-Babu (1984) solution was adopted. The displacement data did not indicate boundary condition effects, such as a recharge boundary or barrier boundary (i.e., geological dyke). The analysis indicated a transmissivity of 122.8 m^2/day.

The seven-day constant rate pumping test was conducted from 22 April 2020 to 29 April 2020 at WB16 to evaluate aquifer hydraulic properties when a steady stress was placed on the aquifer. Based on a review of available information and the results of the step-drawdown pumping test, a preliminary pumping rate estimate of 45 L/sec was made. Water level response at WB16 during the seven-day constant rate pump test indicated groundwater drawdown of 48.2 m was achieved at the pumping bore. Following pump shutdown, groundwater levels in WB16 initially recovered rapidly. Recovery was within about 94 percent of initial groundwater levels after seven days (i.e., with 2.8 m of static levels).

The time-drawdown relationship for WB16 was plotted using a log-linear (i.e., semi-log) plot to assess the indicative aquifer conditions. The plot was found to be uncharacteristic of the typical textbook relationship for confined, unconfined and leaky unconsolidated aquifers. This led to a high-level investigation of potential boundary impacts where it was discovered active extraction from the LEVF from a nearby bore (GW4) was likely impacting water levels in the UEVF.

However, and despite the potential interference, the early time data approximately resembled a confined aquifer type, and this was consistent with expectations based on geology. The Papadopolus-Cooper (1967) solution was adopted for analysis to determine the transmissivity and storativity of the UEVF. Based on the analyses of the seven-day constant rate pumping test, the estimated transmissivity was 112.9 m^2/day (hydraulic conductivity of 0.53 m/day) and a storativity of 6 x 10^{-4}. These derived parameters are consistent with previous estimates (GHD, 2013; median K = 0.65 m/day; EHS Support, 2018; median K = 0.48 m/day).

Based on the 6-month pumping test (**Appendix D**), the estimated transmissivity ranged from 58.2 to 114.2 m^2/day (hydraulic conductivity range of 0.8 to 1.6 m/day) and a storativity range of 2 x 10^{-4} to 5 x 10^{-4} (-).

5.4.4 Middle Eastern View Formation

The MEVF is approximately 40 to 60 m thick and generally behaves as an aquitard by restricting vertical groundwater flow between the UEVF and LEVF. The MEVF generally consists of mudstone and siltstone, but also has minor sand and gravel lenses as well as thin brown coal layers. The unit generally appears to be continuous and consistent in thickness throughout the Anglesea area. Geologically, this unit represents the Pember Mudstone member of the Dilwyn Formation.

The MEVF has been previously modelled as a leaky aquitard as depressurisation impacts have been observed in some deep Alcoa UEVF observation bores whilst pumping has been occurring from nearby the LEVF extraction bores. However, a recent bore assessment program involving down hole camera and wireline logging was undertaken by Alcoa to identify bores with potential integrity issues or those that may cross screen aquifers. In 2021, several at-risk bores were identified and decommissioned. Since the restarting of the LEVF extraction iby Barwon Water n early 2022, no depressurisation impacts have been recorded in the Alcoa UEVF deep observation bores. This indicates that the aquitard may not be as leaky an initially thought with these previous bores acting as preferential flow conduits.

5.4.5 Lower Eastern View Formation

The LEVF forms a confined to semi-confined aquifer (in the upper parts of the catchment) across the region and consists of unconsolidated micaceous silts, carbonaceous clays, silty clays, thin brown coal seams and fine to coarse-grained sands and gravels. At the coal mine site, the LEVF is up 200 m thick where aquifer material occurs within geological synclines. Geologically, this unit represents the Pebble Point Formation and, prior to Barwon Water groundwater extraction in the area, was artesian at the site.

5.4.5.1 Water Levels and Trends

Figure 5-65 displays historical groundwater elevations within the Barown Water pumping bores screened with the LEVF. Groundwater extraction by Alcoa from the lower sands of the UEVF has not influenced groundwater pressures within the deeper LEVF. **Figure 5-66** shows the 2021 LEVF Groundwater Elevations.

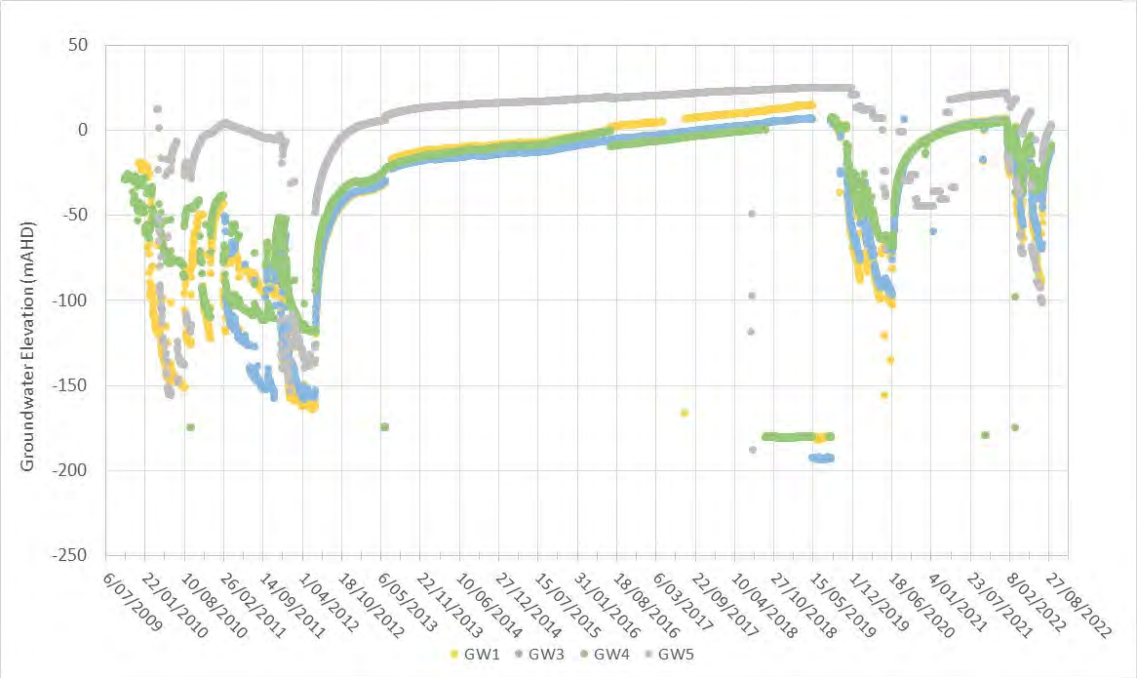


Figure 5-65 LEVF Historic Groundwater Elevations (data provided by Barwon Water)

5.4.5.2 Groundwater Quality

Groundwater quality (TDS) in the LEVF is fresher than that observed in the UEVF. GHD (2013) reported that groundwater salinity had been measured between approximately 500 to 900mg/L TDS.

5.4.5.3 Hydrogeological Parameters

A number of aquifer hydraulic tests of the LEVF have been undertaken in the region. Aquifer hydraulic parameters obtained from GW1-GW7 screened in the LEVF, have been estimated from a calibrated numerical groundwater flow model and groundwater pumping tests associated with Barwon Water's Southern Anglesea Borefield extraction program, (refer to GHD (2013) for more information).

These parameters of the LEVF, along with modelled parameters of the hydrogeological formations overlying, are presented in **Table 5-8** to **Table 5-11**. The aquifer parameter data suggest transmissivities of up to 330 m^2/day and hydraulic conductivities of up to 2.77 m/day can occur in individual sand horizons within the LEVF.

Table 5-8 Barwon Water Borefield Pumping Test Summary (after GHD, 2013)

Bore	Date	Duration (days)	Aquifer	Bore depth	Transmissivity (m^2/day)	Storativity
GW1	2009	1	LEVF	666	40	
GW3	2011	1	LEVF	596	90	

Bore	Date	Duration (days)	Aquifer	Bore depth	Transmissivity (m^2/day)	Storativity
GW4	2008	14	LEVF	468	120	0.0005 – 0.002
GW5	2010	3	LEVF	589	70	0.0001
GW6	2008	14	LEVF	264	150	0.0001 – 0.0004
GW7	2009	1	LEVF	317	230 - 330	0.00009 – 0.0008

Table 5-9 Summary of Modelled Horizontal Hydraulic Conductivity (after GHD, 2013)

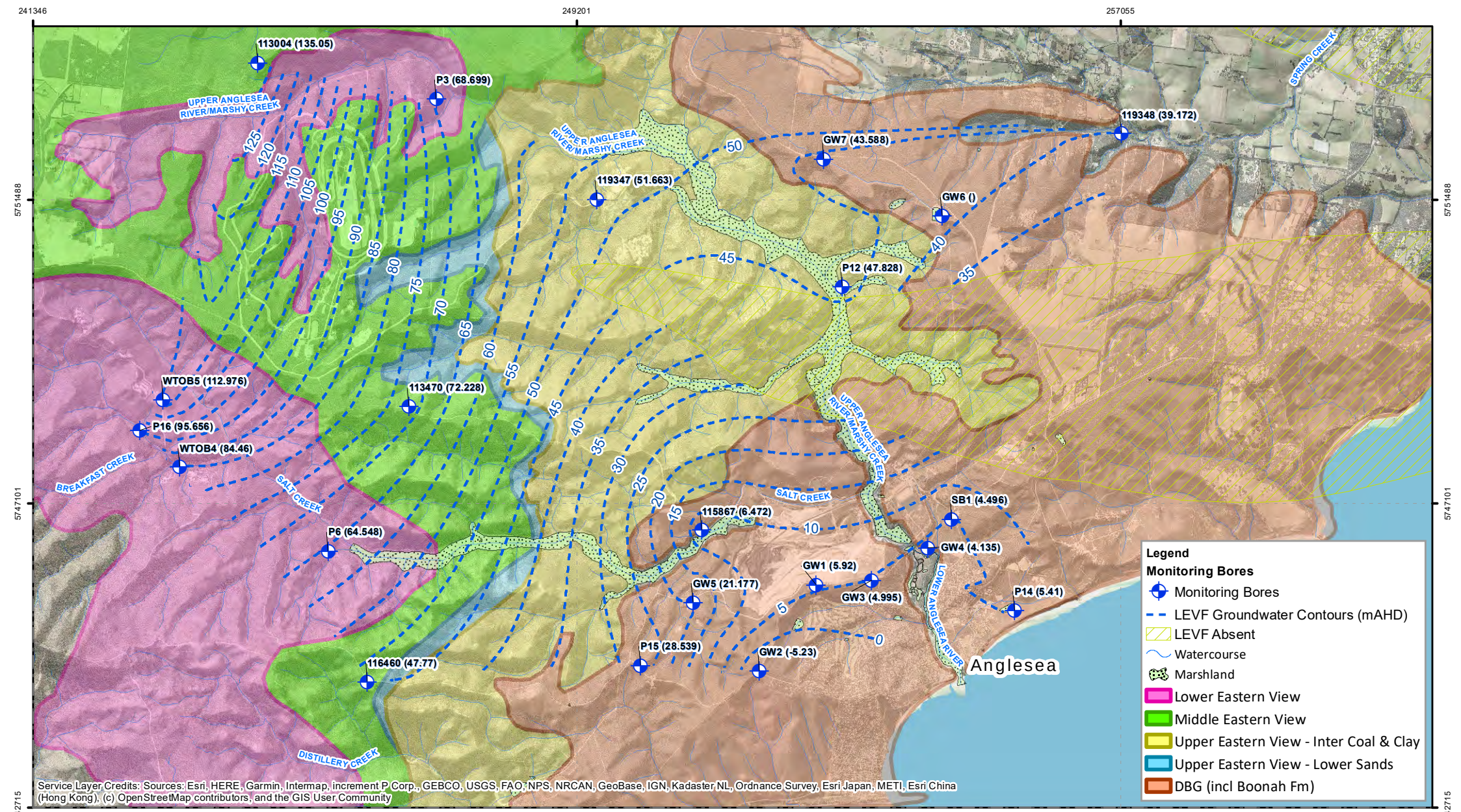
Aquifer	Min (Kh, m/day)	Max (Kh, m/day)	Median (Kh, m/day)
Alluvial	0.03	0.09	0.05
Demons Bluff Formation	0.03	0.21	0.05
UEVF (excl coals)	0.01	10.6	0.85
MEVF (Pemble Mudstone)	0.00001	0.08	0.0003
LEVF (Pebble Point Fm)	0.05	2.77	0.42
Coals	0.00003	0.16	0.02

Table 5-10 Summary of Modelled Vertical Hydraulic Conductivity (after GHD, 2013)

Aquifer	Min (Kv, m/day)	Max (Kv, m/day)	Median (Kv, m/day)
Alluvial	0.00002	0.002	0.0001
Demons Bluff Formation	0.006	0.05	0.008
UEVF (excl coals)	0.002	1.96	0.12
MEVF (Pemble Mudstone)	0.00001	0.08	0.0004
LEVF (Pebble Point Fm)	0.006	0.72	0.055
Coals	0.00003	0.16	0.021

Table 5-11 Summary of Other Hydraulic Parameters (after GHD, 2013)

Aquifer	Median Storativity	Median Specific Yield	Median Porosity (%)
Alluvial	0.00005	0.04	13
Demons Bluff Formation	0.00002	0.01	17
UEVF (excl coals)	0.00004	0.05	18
MEVF (Pemble Mudstone)	0.00001	0.02	24
LEVF (Pebble Point Fm)	0.000005	0.03	17
Coals	0.00003	0.03	26



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\20220323_FigureRequest\Figure 5□64 2021 LEVF Groundwater Elevation.mxd

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Figure 5-6**6**

2021 LEVF Groundwater Elevation

ALCOA

EHS Support

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Alcoa Anglesea Hydrogeological Investigation

DATE:	30/03/2022
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:71,046

N

Kilometers

0 1 2 4

5.4.6 Recharge to the EVF

Groundwater recharge to the EVF can occur via three main mechanisms:

1. Direct rainfall across the outcrop area in the Otway Ranges
2. Leakage from the DBF and/or from river recharge
3. Upwards leakage from underlying aquifers

Through numerical modelling, GHD (2013) estimated recharge to be approximately 10 mm/year and up to 50 mm/year to the UEVF. This was also in line with estimates derived from analysing hydrograph fluctuations within the UEVF where the recharge was estimated to be to be approximately 2 to 7 percent of the average annual rainfall over the outcrop area (approximately total annual rainfall of 700 to 900 mm/year)[9].

Direct recharge into the DBF is expected to be lower due to its outcrop area occurring in regions of lower rainfall and an increase in clay through its lithology.

5.5 Surface Water/Groundwater Interactions

The potential for surface water and groundwater interactions is described in the following segments:

- Upper reaches of the Anglesea River (also referred to as Marshy Creek).
- Swamps associated with the mid-reaches of Anglesea River/Marshy Creek.
- Lower Anglesea River.
- Upper Salt Creek.
- Lower Salt Creek.
- Former Power Station and mine void footprint.

Refer to **Figure 4-2** for the location of each segment above. Where the surface water segment is located outside of the Alcoa AOI (e.g. Upper Salt Creek and the upper reaches of the Anglesea River) the most up to date information has been summarised and referenced. To assist in ensuring those conclusions from these key references are still valid, recent groundwater observation data supplied from Barwon Water have been used in updated conceptual cross sections.

5.5.1 Upper Anglesea River

The previously documented (Hermon, 2002, Maher, 2011, GHD, 2013 and 2017) key surface water/groundwater interactions that occur are summarised below:

- The Upper Anglesea River is ephemeral and the UEVF aquifer is generally absent in this area.
- The salinity of the ASA generally ranges between 1,000 and 1,600 mg/L and is higher than the salinity of the LEVF (600 to 800 mg/L) as evapotranspiration helps concentrates salts within the ASA.

[9] the estimated recharge above is significantly lower than the 27 percent of rainfall used in the current determination of the Jan Juc PAV of 11,250 ML/year (comprising 250 ML/year from all formations in Zone 1; 4000 ML/y from the UEVF in Zone 2; and 7000 ML/year from the LEVF in Zone 2).

- The recorded groundwater level in the LEVF aquifer is around 7 m below the base of the river bed, and the groundwater level in the ASA is below the river water level, confirming that the river system is a potential losing system and not baseflow dependent.
- The head differences and the different temporal patterns observed between the ASA and the underlying LEVF aquifer suggests the ASA acts as a PWT with limited, or no connectivity to the LEVF.

In addition to the above, recent long term water level data presented in **Figure 5-70**, supports the previous conceptual understanding. The lines of evidence for this are:

- With the exception of an episodic rainfall event of 60mm on 14/11/2015, all other large rainfall events exceeding 40mm have resulted in an increase of P18 (ASA) groundwater levels to within centimetres of its maximum levels. Only a small "diffuse" response to rainfall is observed in P3 (LEVF) indicating limited connectivity between the LEVF aquifer system and the ASA in this location.
- Stage water level height variations at gauging station AV1 correlate well with the groundwater level fluctuation in the ASA indicating rainfall recharge is the dominant driver of recharge to the ASA.
- Between November 2014 and May 2016, the region experienced low rainfall. This caused a continual drop in groundwater levels within the ASA. The largest rate of decline was during spring and summer of 2015 and 2016. As the underling LEVF aquifer exhibits no trend either during or in the several years pre and post this period and as evaporation and evapotransipration are highest during spring and summer, this suggests that evapotranspiration is the most likely cause of water loss from the ASA as opposed to diffuse leakage to the underlying ASA.
- Assuming some diffuse leakage from the ASA to the LEVF occurs with hydraulic properties as detailed in **Table 5-10** and **Table 5-11**, Darcy flux (q = k(dH/dL) suggests this to be $2x10^{-5}$ m/d. Assuming the porosity of the underlying formation is 0.13, it would take ~142 years for the groundwater leaking from the ASA to reach the LEVF at P3.

5.5.2 Swamps Associated with the Mid-Reaches of Anglesea River/Marshy Creek

The previously documented (Hermon, 2002, Maher, 2011, GHD, 2013 and 2017) key surface water/groundwater interactions that occur are as follows:

- The salinity of the ASA generally ranges between 1,300 and 1,600 mg/L. The salinity of the UEVF generally ranges between 640 and 820 mg/L and the salinity of the LEVF ranges between 640 and 790 mg/L).
- The LEVF aquifer is artesian in this area. The high artesian LEVF heads (initially 13 m above ground level) may indicate that the river system has the potential to be a gaining system where direct connection is made.
- The UEVF and groundwater levels higher than those recorded in the ASA indicating an upward gradient exists and the shallower formations have the potential to be a gaining system.
- Several permanent water pools have been mapped (AGP1-B, AGP2 and ASP7). The LEVF directly underlies AGP1-B whilst the UEVF directly underlies AGP2 and ASP7. Groundwater chemistry including stable and radioactive isotopes indicate that these pools are not in direct connection with the underlying LEVF or UEVF aquifer and therefore not baseflow dependant despite an upward gradient existing.

- Where the MEVF aquitard is located at the base of the ASA, the low permeability of this formation effectively limits the connectivity between the LEVF and any surface water systems. During a six-month pumping test conducted by Barwon Water on the LEVF, there was no obvious decline in the ASA or UEVF aquifer heads that could be directly related to pumping and thus by inference reductions in stream baseflow. GHD (2013) noted that long-term continuous extraction (e.g., 47 years continuous high-rate extraction for the LEVF may then result in some drawdown being observed in the overlying formations).
- The ASA bores in the swamplands respond closely with rainfall events, as the aquifer system is recharged by direct rainfall and rainfall runoff.

In addition to the above, recent long term water level data presented in **Figure 5-71**, supports the previous conceptual understanding. The lines of evidence for this are:

- An upward gradient from the underling aquifers (LEVF and UEVF) to the ASA exists with the exception between 2009 and 2012 when Barwon Water conducted a series of pumping tests in the LEVF. During this period the LEVF potentiometric was lower than the UEVF or ASA. However, no impact on these shallower groundwater pressures were observed.
- Both the shallow aquifers (ASA and UEVF) have shown a stable trend over the last 10 years with no impact seen in either system despite Alcoa extraction up to 2016 and more recent aquifer tests (both in pumping and recovery stage), and also aquifer tests undertaken by Barwon Water between 2009 and 2012.
- Most large rainfall events exceeding 40mm have resulted in an immediate increase in groundwater levels within P8 (ASA) and to a lesser extent P19 (UEVF). This indicates that direct rainfall recharge is the dominant driver of recharge to the ASA and diffuse recharge at the UEVF outcrop areas may be significant in the UEVF at this location. It is at this location where the basal (and more permeable parts of the UEVF) would come close to surface.
- The steepest decline of groundwater levels occur within the ASA over spring and summer when episodic rainfall events are absent (refer spring and summer of 2012/13; 2013/14; 2015/16; and 2018/2019). This similar correlation does not hold true for the UEVF (P19). As discussed above evapotransipration is highest during spring and summer, suggesting that evapotranspiration and throughflow is the most likely cause of water loss from the ASA in this location.
- Assuming some diffuse baseflow from the UEVF to the ASA, with hydraulic properties as detailed in **Table 5-10** and **Table 5-11**, Darcy flux (q = k(dH/dL) suggests this rate to be 1.6 $x10^{-5}$ m/d. Assuming the porosity of the underlying formation is 0.18, it would take ~123 years for water to move from the UEVF and discharge in the ASA at P8.

5.5.3 Lower Anglesea River

Previously documented (Hermon, 2002, Maher, 2011, GHD, 2013 and 2017) key surface water/groundwater interactions that occur are as follows:

- Directly underlying the Lower Anglesea River is the low permeability DBF and/or the Boonah Formation.
- Salinities in the ASA were generally higher and more variable than in the upper catchment ranging between 1600 and 2470 mg/L. This has been attributed to longer groundwater travel and longer interactions with the sediments of the ASA as well as evapotranspiration concentrating the salts between flow events.

- Any surface water and groundwater interconnection between the Lower Anglesea River and underlying DBF aquifer is expected to be minimal due to the confining low permeability clays between the base of the surface water system and the aquifer.
- Locally around the mine, the groundwater pressure of the basal sands of the UEVF aquifer has been drawn down due to pumping from the coal mine.

In addition to the above, recent long term water level data presented in **Figure 5-72** (and **Figure 5-67**), supports the previous conceptual understanding. The lines of evidence for this are:

- Within the vicinity of AV2, a downward gradient exists from the ASA to the underlying aquifers. However, groundwater monitoring data from bores screened in the DBF and BF (near the former Power Station) as well as historical VWP suggest that the water table can be higher especially around areas of topographic highs.
- The UEVF Lower aquifer has been drawn down due to the historical pumping from the coal mine and bores, and there is also a downward hydraulic gradient from the ASA to the UEVF. The head difference between WTOB2 (ASA) and WB4 (UEVF) was approximately 20m as shown in **Figure 5-67**. Therefore, as shown by the relative groundwater levels, the ASA aquifer, which supports the swamplands, is generally hydraulically disconnected from the underlying UEVF lower sands aquifer in the lower reaches. The downward gradient suggests the potential for some diffuse leakage from the ASA towards underlying aquifers over time, however the low permeability coals and clays in the Anglesea Syncline provide an aquitard separating the UEVF sands from the ASA in the lower reaches. There is also a degree of hydraulic separation between the ASA and the underlying Boonah Formation aquifer (which is saturated on the eastern side of the mine void) due to the DBF aquitard.
- The salinity of the underlying Boonah Formation at MW29 ranges between 1500 and 6,660 mg/L which is significantly higher than the ASA (1600 and 2470 mg/L) and underling UEVF (170 to 200 mg/L at UEVF MB7 (upper sands) and 1100 to 1500 mg/L at WB16 (lower sands). The lower salinity in the upper sands likely reflects the short travel time from its recharge point. The higher salinity in MW29 is likely representative of the high portion of clay and silt in his formation.
- Most large rainfall events exceeding 40mm have resulted in an immediate increase in groundwater levels within WTOB2 (ASA), however unlike other up gradient ASA monitoring points, these increases are smaller in size. For example, on March 13, 2017, 101 mm fell at Aireys Inlet. The corresponding rate of groundwater rise in the ASA was 1.3m at P18 (Upper Anglesea River; 0.7m at P8 and 0.5m at WTOB2).
- The underlying DBF/BF shows a diffuse recharge response to rainfall and the upper sands of the UEVF show no recharge pulse from any rainfall events.
- As has previously been observed, the steepest decline of groundwater levels occurs within the ASA over spring and summer when episodic rainfall events are absent (refer spring and summer of 2012/13; 2013/14; 2015/16; and 2018/2019). Recent hourly data logger data from MW29 also shows an even steeper decline over the summer period. As discussed above evapotranspiration is highest during spring and summer, and this suggests that evapotranspiration and throughflow is the most likely cause of water loss from the ASA as well as potential leakage. The trend in the DBF/BF is likely exacerbated by preferential flow to the mine void as opposed to leakage to underlying aquifers.
- Assuming some diffuse leakage from the ASA to the DBF/BF, with hydraulic properties as detailed in **Table 5-10** and **Table 5-11**, Darcy flux ($q = k(dH/dL)$ suggests this rate to be $7x10^{-5}$ m/d. Assuming the porosity of the underlying formation is 0.13, it would take ~36 years for water to move from the ASA and into the underlying formation.

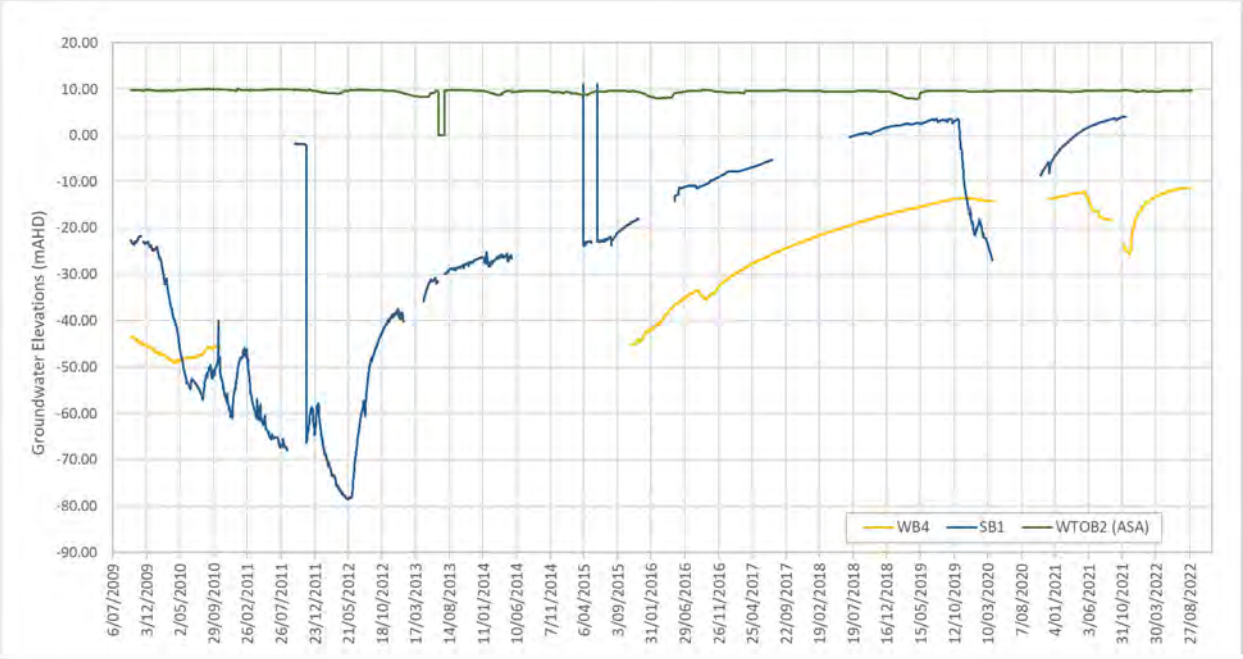

Figure 5-67 WTOB2 (ASA), WB4 (UEVF) & SB1 (LEVF) Nested Hydrographs (SB1 data supplied by Barwon Water)

5.5.4 Upper Salt Creek

Previously documented (Hermon, 2002, Maher, 2011, GHD, 2013 and 2017) key surface water/groundwater interactions that occur are summarised as follows:

- Upper Salt Creek is ephemeral and the UEVF is absent in this area.
- The salinity of the ASA generally ranges between 770 and 1,330 mg/L. The salinity of the LEVF generally ranges between 220 and 300 mg/L and shows low variation over time.
- At the nested site (SV3), the tributary is gaining and losing during different periods throughout the year. During the drier summer periods, the tributary at this site generally becomes losing.
- The Breakfast Creek tributary is baseflow dependent. The extent of the gaining and losing stretch of the tributary will vary over the year, depending on the climatic conditions.
- Upstream of this monitoring location it can generally be concluded that the tributary continues to receive groundwater baseflow over longer periods during the dry months, which is reflected in the perennial flows recorded at this site.
- The consistently low surface water salinity (i.e., 100 mg/L TDS to 300 mg/L TDS) is consistent with stretches of the tributary being a perennial gaining feature.
- The baseflow at this site is from the LEVF aquifer; however, the LEVF is thin in the gully and there is the possibility that there is some contribution to baseflow from the bedrock aquifer which may outcrop in the bed of some upstream stretches of the tributary.

In addition to the above, recent long term water level data presented in **Figure 5-75**, indicates:

- An upward gradient exists from the underling LEVF aquifers to the ASA.
- The hydrographs of the ASA and LEVF show a degree of seasonal fluctuation with groundwater elevation varying by up to 3m in the ASA and 2 m in the LEVF. As the LEVF elevation is higher this would indicate direct rainfall recharge is occurring as opposed to leakage from the ASA.

- Both the shallow aquifers (ASA and UEVF) have shown a stable trend over the last 10 years.
- Stage water level height variations at gauging station SV4 correlate well with the groundwater level fluctuation in the ASA indicating rainfall recharge is the dominant driver of recharge to the ASA. Diffuse recharge is the dominant driver for water level fluctuations in P6 (LEVF).
- Hydrographic recession curves look similar regardless of the timing of the year meaning that groundwater throughflow is the most likely cause of water loss from the ASA in this location as opposed to evaoptranspriation.
- Assuming some diffuse leakage from the LEVF, with hydraulic properties as detailed in **Table 5-10** and **Table 5-11**, Darcy flux (q = k(dH/dL) suggests this to be $4.0x10^{-3}$ m/d. Assuming the porosity of the underlying formation is 0.13, it would take ~0.36 years for the groundwater to move through the 50 m section of clay surrounding Salt Creek.

5.5.5 Lower Salt Creek

Previously documented (Hermon, 2002, Maher, 2011, GHD, 2013 and 2017) key surface water/groundwater interactions that occur are summarised below:

- The behaviour of EC (salinity) at this location compared to higher up in the catchment shows that the swamp evaporates/transpires most attenuated flows, resulting in accumulation of salts in the swamp. These salts are cyclically flushed from the swamp (usually between Jun and Oct), gradually diluting the down-swamp flows (SV2) through 'new' runoff, which mixes with 'older' transpired (higher EC) runoff in the swamp peats.
- The salinity of the ASA generally ranges between 350 and 640 mg/L. This is lower than the salinity recorded upgradient and is likely related to the timing of sampling events. Nearby at UEVF MB07, the salinity of the underling UEVF upper sands is 170 to 200 mg/L. The lower salinity in the upper sands likely reflects the short travel time from its recharge point.
- Significant rainfall across the catchment is required to fill the ASA before flow is seen at the base of Salt Creek (SV2).
- Sufficient low permeability confining layers exist between the permeable parts of the underlying aquifers and surface water, which inhibit interaction between the two.
- Locally around the mine, the UEVF aquifer, has been drawn down due to pumping from the coal mine. However, as between 0.8 GL/yr and 1.8 GL/yr has historically been extracted from the mine sump (**Figure 5-75**), the void itself is likely responsible for creating a local drawdown of the surficial aquifers (DBF) as opposed to dewatering of the UEVF.

In addition to the above, recent long term water level and quality data presented in **Figure 5-75** and **Figure 5-68**, supports the previous conceptual understanding. The lines of evidence for this are:

- Over the last 10 years, the ASA has an increasing water level trend. This is despite:
  - The mine void potentially draining the local area of the DBF/BF; and
  - The localised cone of depression formed in the lower UEVF as a result of historical UEVF extraction from the base of the UEVF.
- The hydrograph in WTOB1 indicates there is no direct connection between the ASA and UEVF lower sands and that the timing and type of rainfall the catchment experiences plus other climate characteristics such as evapotranspiration are the significant inflow/recharge component to the ASA.
- The hydrograph of UEVF MB07 (**Figure 5-58**) shows an increasing trend with no relationship to either the overlying ASA aquifer or the lower section of the UEVF.

- The water quality in UEVF MB07 ranges 170 to 200 mg/L TDS which is significantly fresher than all surface water systems. This suggests that this sand lens is recharged where the sand outcrops and is not influenced by the ASA or surface water.
- Assuming some diffuse leakage from the ASA, through the DBF/BF discharging into the mine water body, with hydraulic properties as detailed in **Table 5-10** and **Table 5-11**, Darcy flux (q = k(dH/dL) suggests this rate to be $4.0x10^{-4}$ m/d. Assuming the porosity of the underlying formation is 0.17, it would take ~29 years for water to move from the ASA and in to the mine water body.

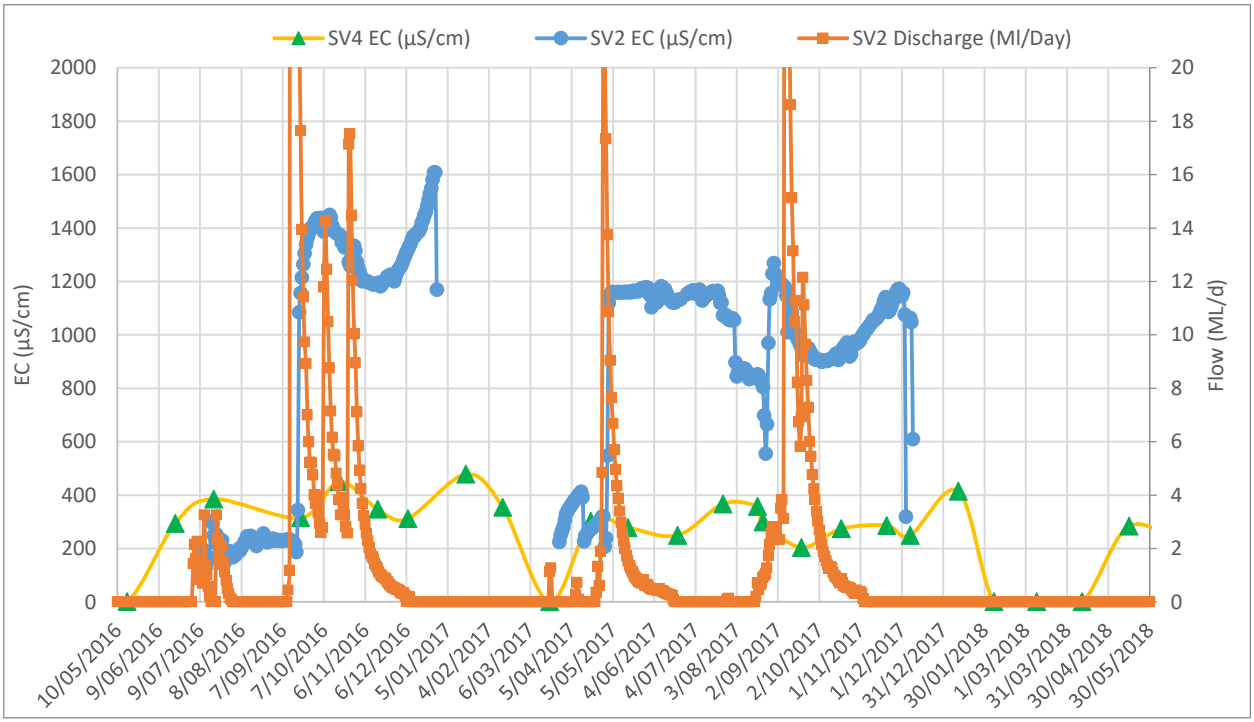

Figure 5-68 Salt Creek Flow and EC (data provided by Barwon Water)

5.5.6 Former PowerStation and Mine Void

As presented in **Section 2**, a significant amount of work has been undertaken at the site over the last 70 years. As the site is highly modified, some of these interactions have been complicated by evolving site activities over time. This has led to a high-level understanding of surface water and groundwater interactions that have been occurring at the site. Much of this understanding is presented in EPA Auditor verification reports (GHD, 2012; EHS Support 2021) and we all documents used in the development of the mine rehabilitation and closure plan (Mining One 2017, EHS Support 2017, 2019).

Within EHS Support 2019, a data gap in the surface water and groundwater interactions was noted in the immediate vicinity surrounding the mine. In response to this eight nested observation bores were installed in the periphery of the mine and data loggers placed in these as well as numerous others located across the former Power Station (refer **Figure 5-69**).

The information presented below is a summary of the current conceptual understanding of the behaviour of surface water and groundwater interactions in the immediate vicinity surrounding the mine.

- The mine void acts as a groundwater sink to the unconfined Boonah Formation.
- An artificial perched water table exists in the DBF sediment underlying the former PowerStation as a result of leaky mine infrastructure.
- The former mixing zone (part of marshy creek) is disconnected from the underlying sediments of the DBF, Boonah Formation with potential losing conditions. However, no evidence of groundwater mounding is observed under this part of the river system suggesting no leakage occurs.
- The water quality in UEVF MB07 ranges 170 to 200 mg/L TDS which is significantly fresher than all surface water systems. This suggests that this sand lens is recharged where the sand outcrops and is not influenced by the ASA or surface water.
- The development of catchment drains (**Section 2.3.2**) diverts local surface water into the mine void. At times the amount of water these drains can add is significant. During January 2022 when the pumping test was inactive, 129mm of rain fell across the mine. This resulted in a water level increase of 0.4m (from -17.9mAHD to -17.5mAHD). From the survey bathometry, this equates to 146ML. Using the surface area of the water body (280,000m^2), this rainfall directly contributed 36 ML (280,000m^2 x 0.129m) meaning the surface drains and groundwater seepage added the rest (110ML). Further calculations on a mine water balance is presented in **Section 5.7**.
- Prior to the exposed coal being covered, small seepage faces after heavy rain were observed near the main coal and basal clay interface leading into the pit void. As coal is unsaturated, its anticipated that its permeability has increased and within the vicinity of the mine, groundwater that would normally be held in the Boonah Formation, now has an easier migration path. This flux will continue to be high until the main coal seam becomes saturated.
- A sampling point located at AV2 has consistently recorded pH between 2.5 and 4 since 1967.
- The Anglesea River estuary had previously been artificially supported by a 3-5 ML/day of approximately pH 7-8 water discharged from Alcoa's power station (EPA License EM32162) at SP3. This discharge ceased in 2016.
- Continuous pressure monitoring data from VWPs from above the main coal seam (in the DBF and Boonah Sands) from 1999 to 2011 (**Figure 5-41**) so no response to drawdown from pumping in the lower sands of the UEVF.

5745228

J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 5-67 Active Well Locations of Interest - Powerplant and Mine.mxd

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5745228

Figure 5-69 Active Well Locations of Interest - Powerplant and Mine

Monitoring Bores
- Mine Overburden
- Boonah Formation
- UEVF (Intermediate Coal)
- UEVF (Lower Sands)
- UEVF (Upper Sands)
- LEVF

- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

ALCOA

EHS Support

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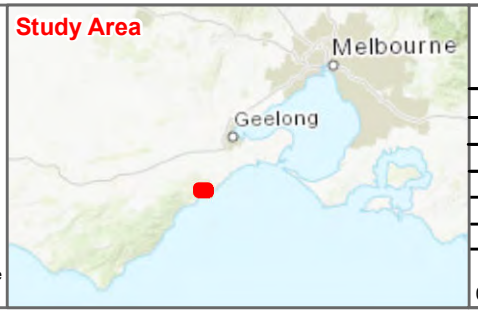


Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

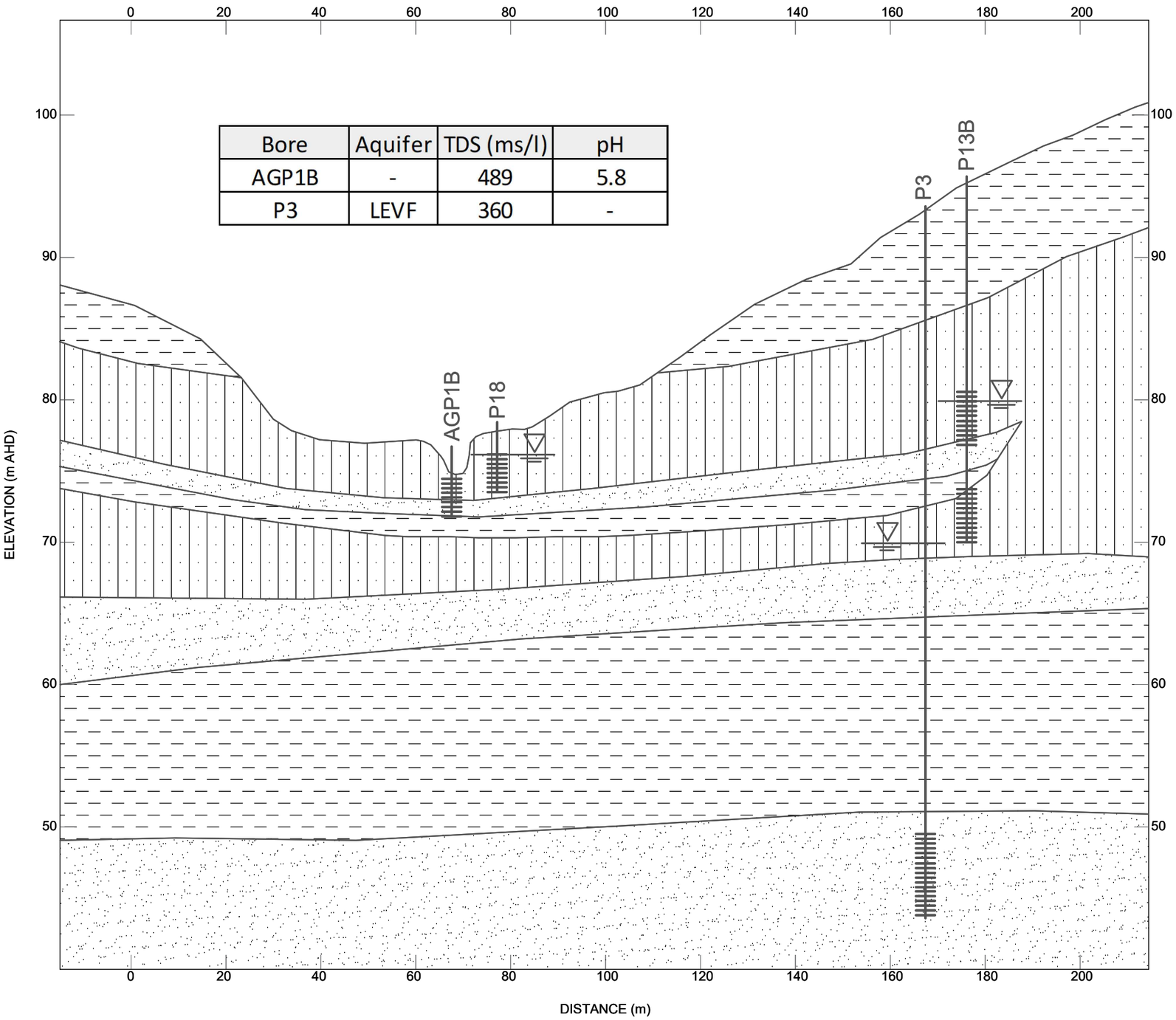
DATE:	30/03/2022
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:17,484

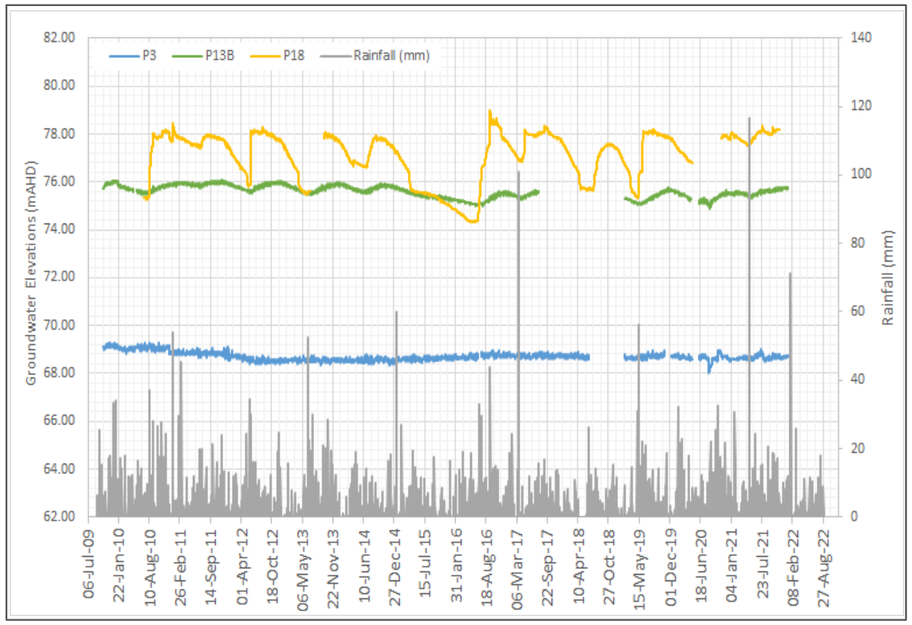
N

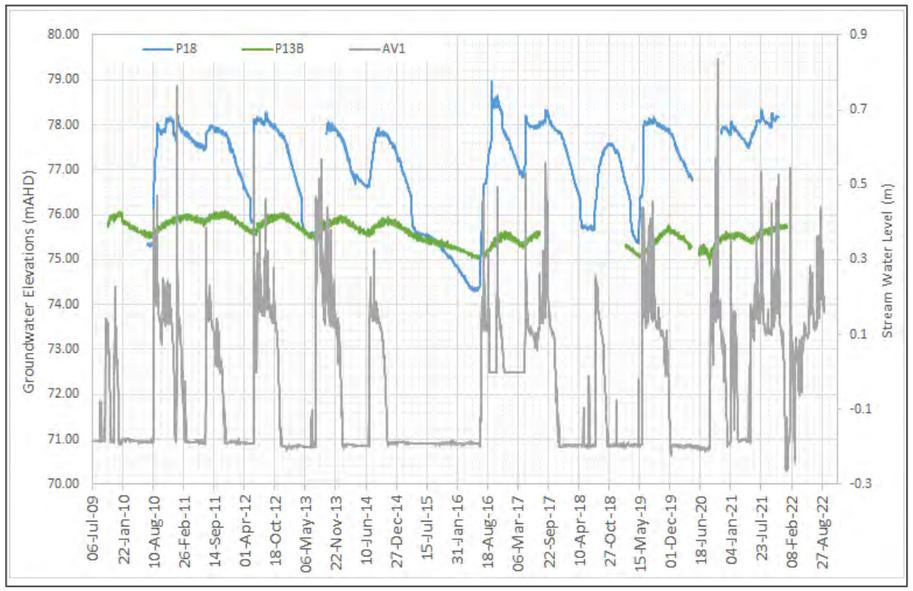
Kilometers

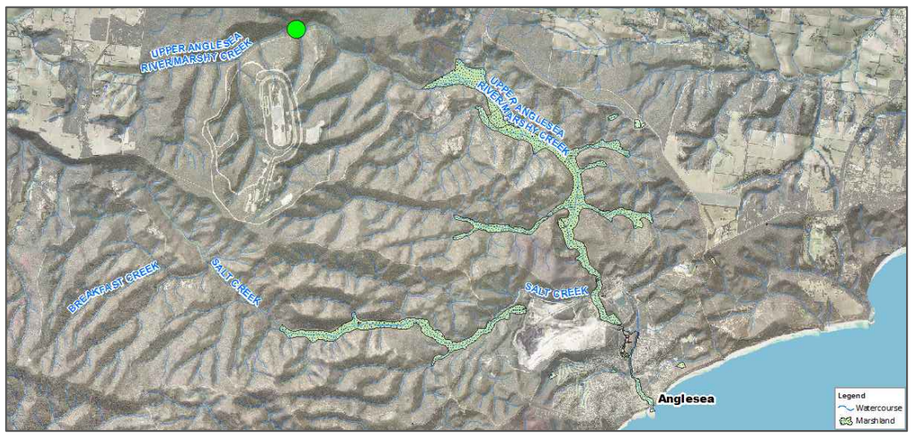
0 0.25 0.5 1

Bore	Aquifer	TDS (ms/l)	pH
AGP1B	-	489	5.8
P3	LEVF	360	-









MATERIAL GRAPHIC

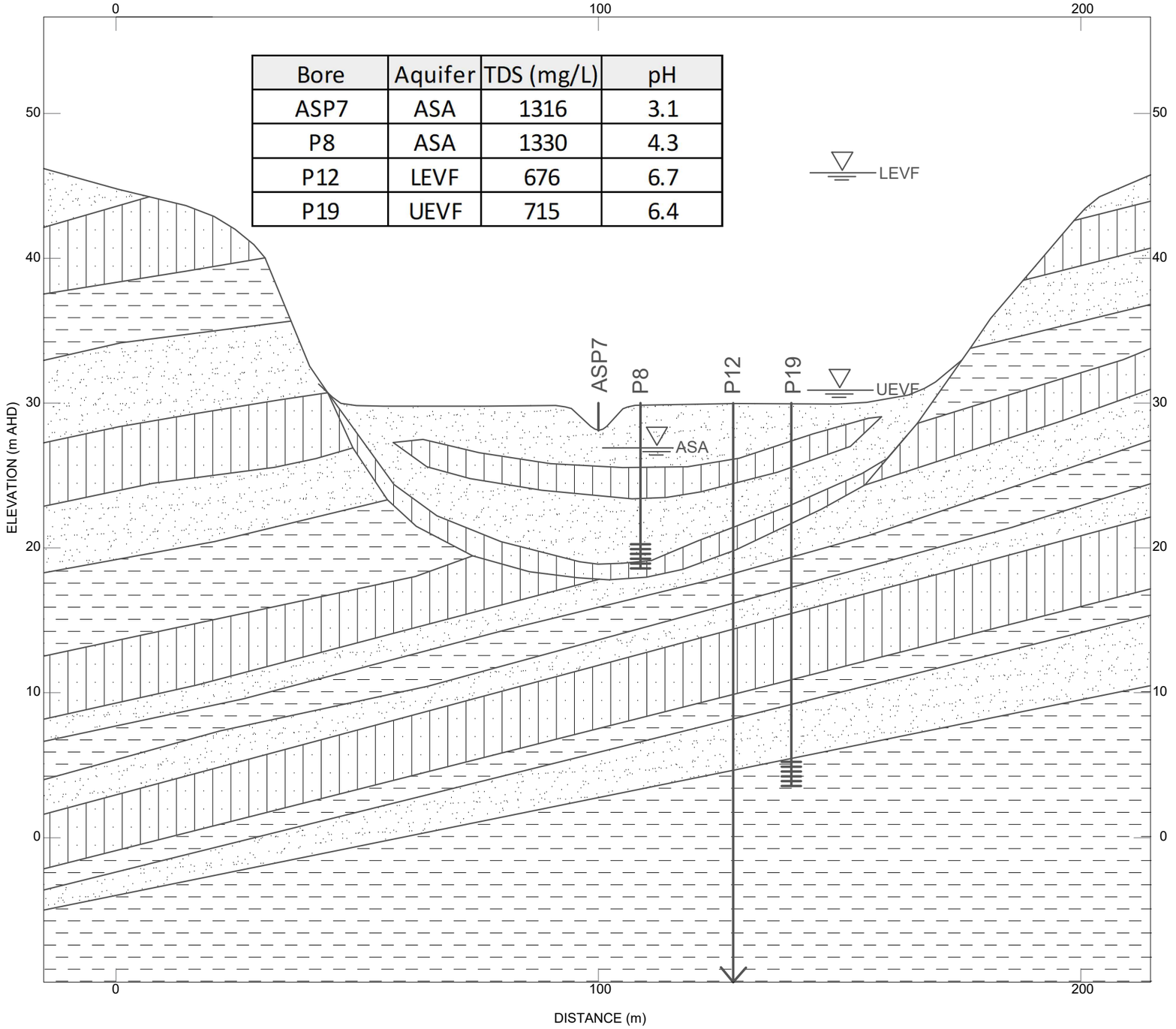
Clay | Sandy / Silty Clay | Sand / Sandstone | Bedrock | Coal

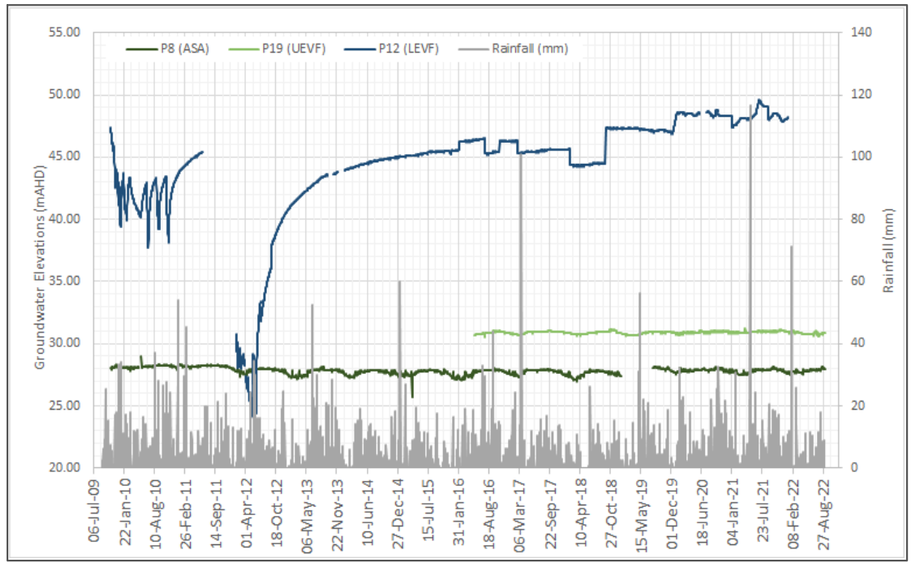
H 1:1000
0 25m 50m
V 1:333
0 10 20m
Coord.System: MGA94 Zone 55 Height Datum: AHD

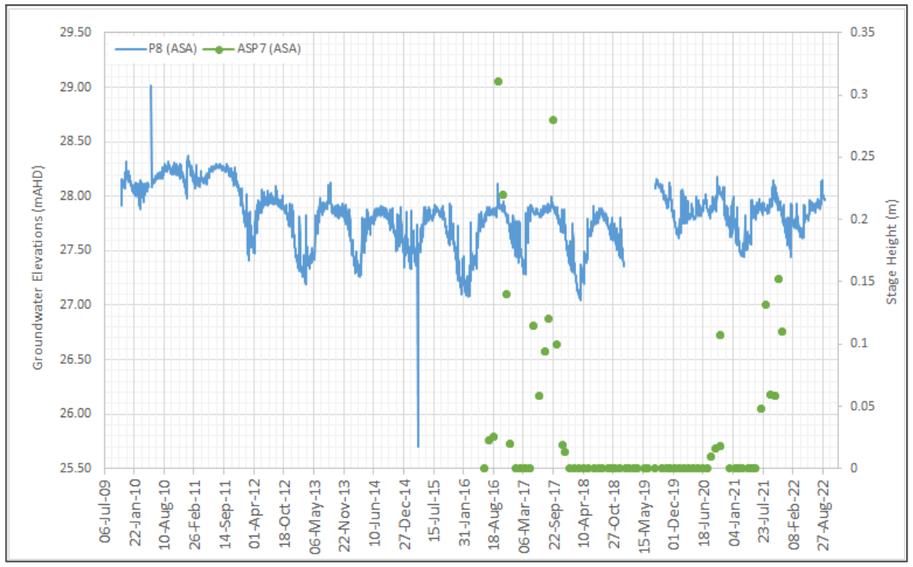
TITLE
Alcoa of Australia Limited
Alcoa Anglesea Mine and Power Station
EHS Support

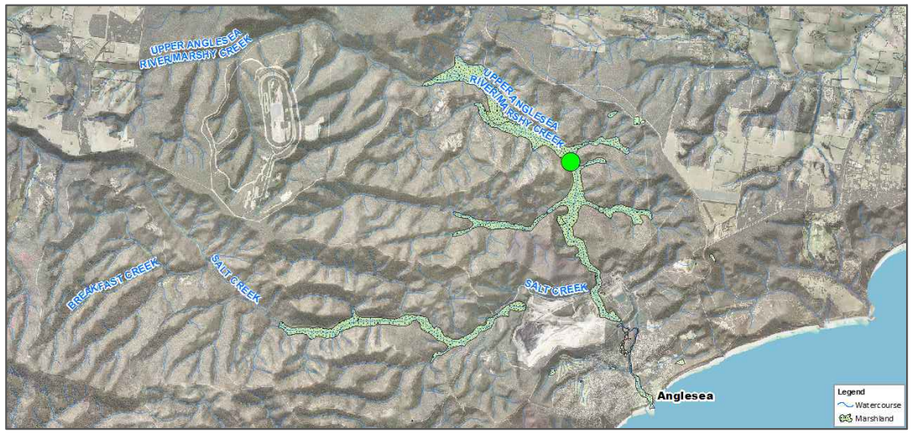
DRAWN	D. Barnes	DATE	07/02/2022
CHECKED	C. Smitt	DATE	07/02/2022
SCALE	H 1:1000 V 1:333		A3
PROJECT No	AUS##C03371_2021	FIGURE No	5-70

Bore	Aquifer	TDS (mg/L)	pH
ASP7	ASA	1316	3.1
P8	ASA	1330	4.3
P12	LEVF	676	6.7
P19	UEVF	715	6.4









MATERIAL GRAPHIC

Clay | Sandy / Silty Clay | Sand / Sandstone | Bedrock | Coal

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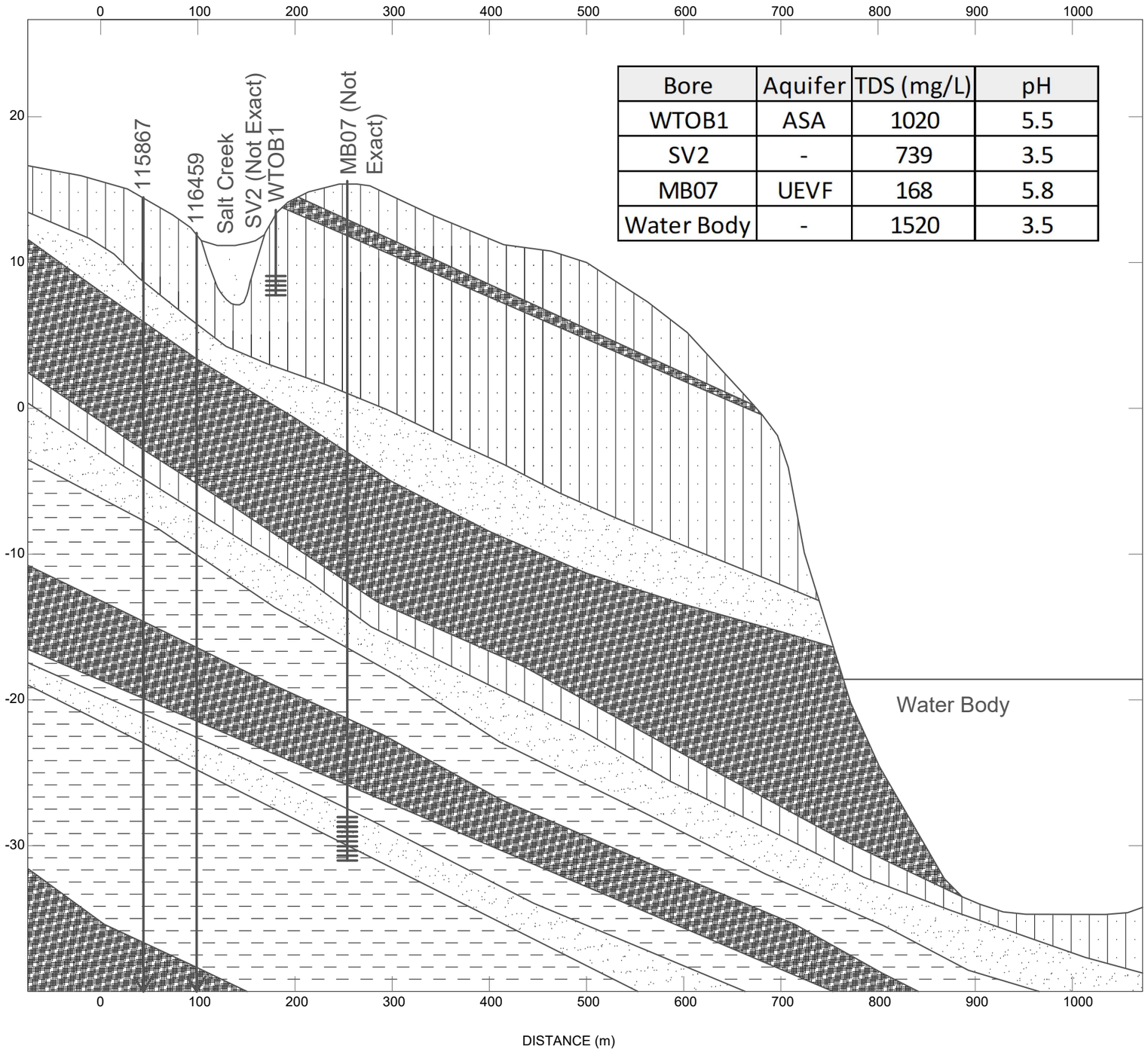
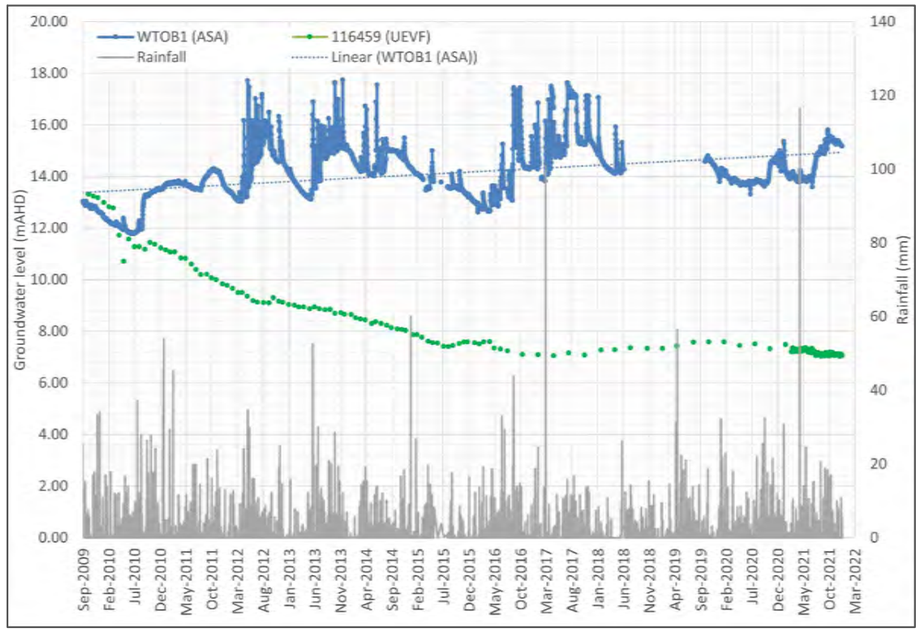
V 1:333
0 10 20m
Coord.System: MGA94 Zone 55 Height Datum: AHD

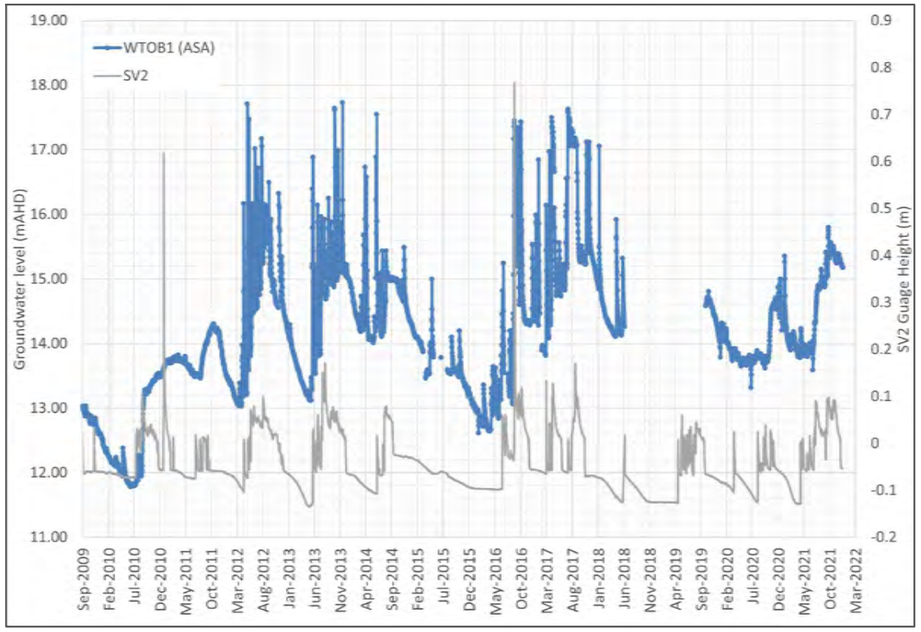
TITLE
Alcoa of Australia Limited
Alcoa Anglesea Mine and Power Station
EHS Support

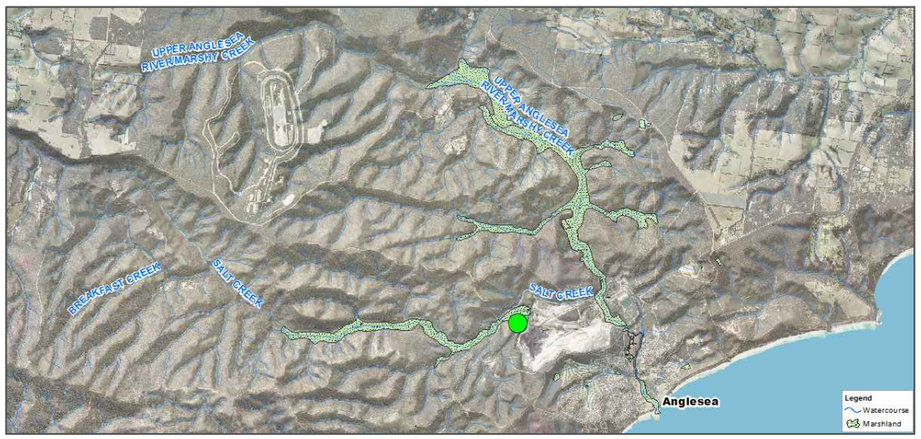
DRAWN	D. Barnes	DATE	07/02/2022
CHECKED	C. Smitt	DATE	07/02/2022
SCALE	H 1:1000 V 1:333		A3
PROJECT No	AUS##C03371_2021	FIGURE No	5-71

Bore	Aquifer	TDS (mg/L)	pH
WTOB1	ASA	1020	5.5
SV2	-	739	3.5
MB07	UEVF	168	5.8
Water Body	-	1520	3.5









MATERIAL GRAPHIC

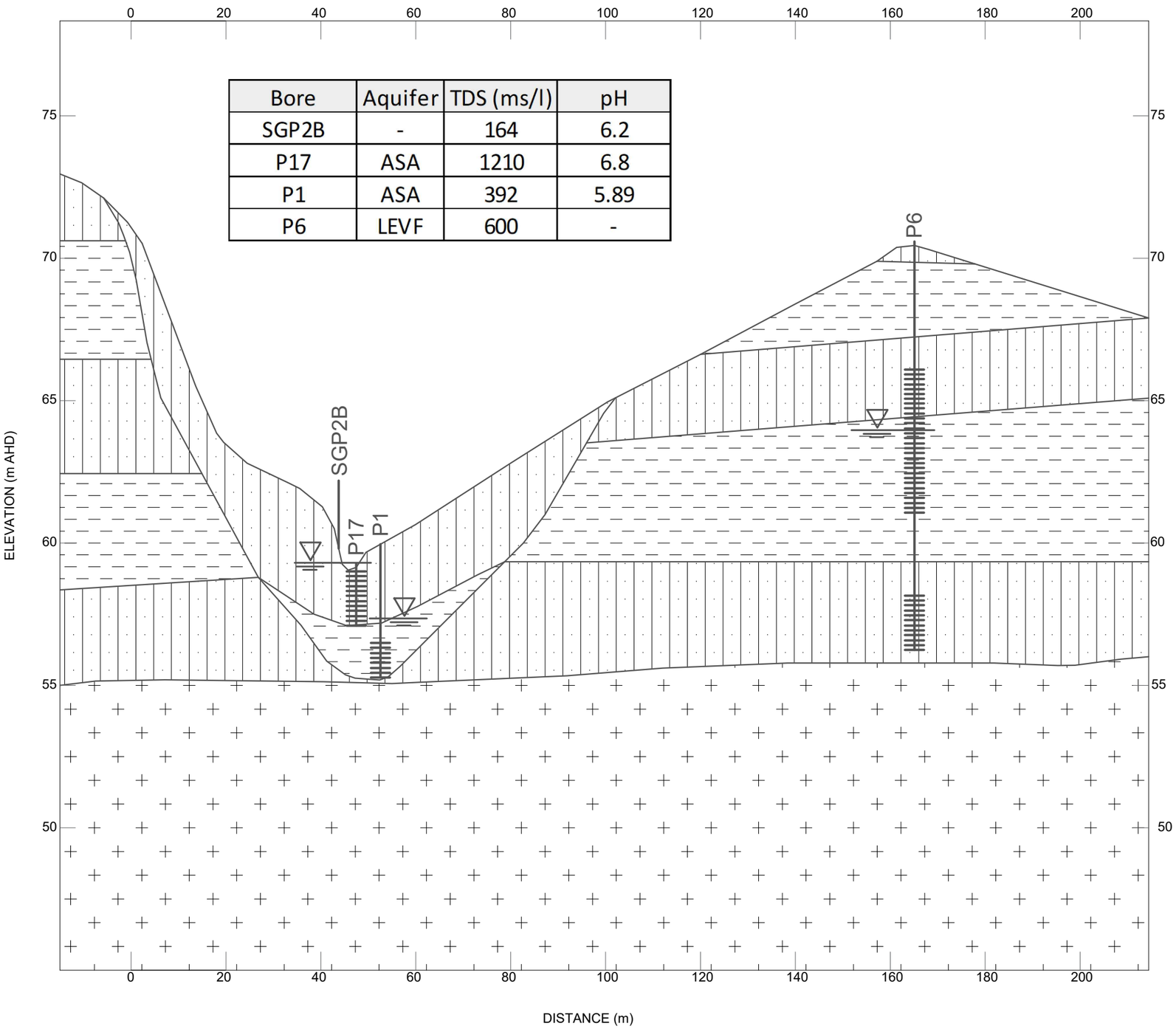
Clay | Sandy / Silty Clay | Sand / Sandstone | Bedrock | Coal

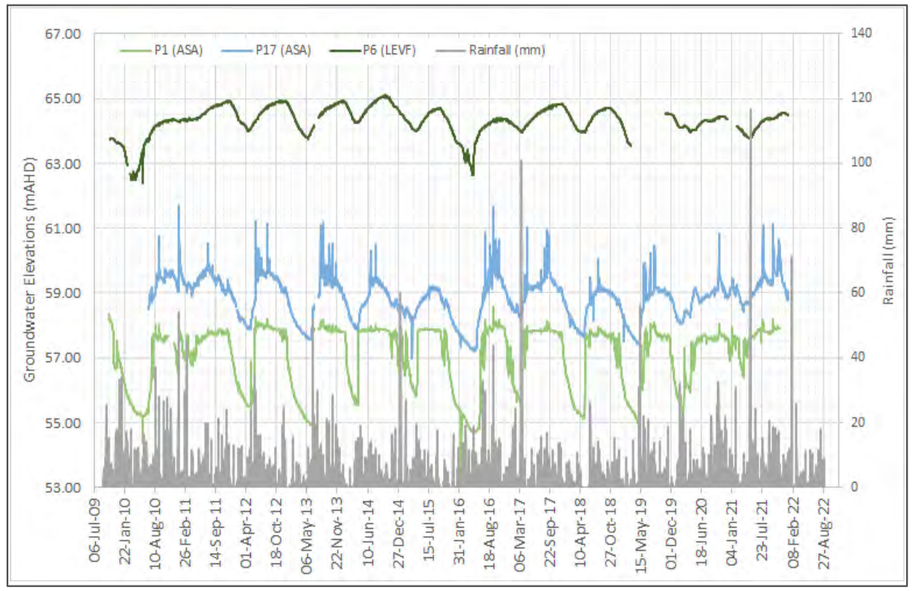
H 1:5000
0 25m 50m
V 1:333
0 10 20m
Coord.System: MGA94 Zone 55 Height Datum: AHD

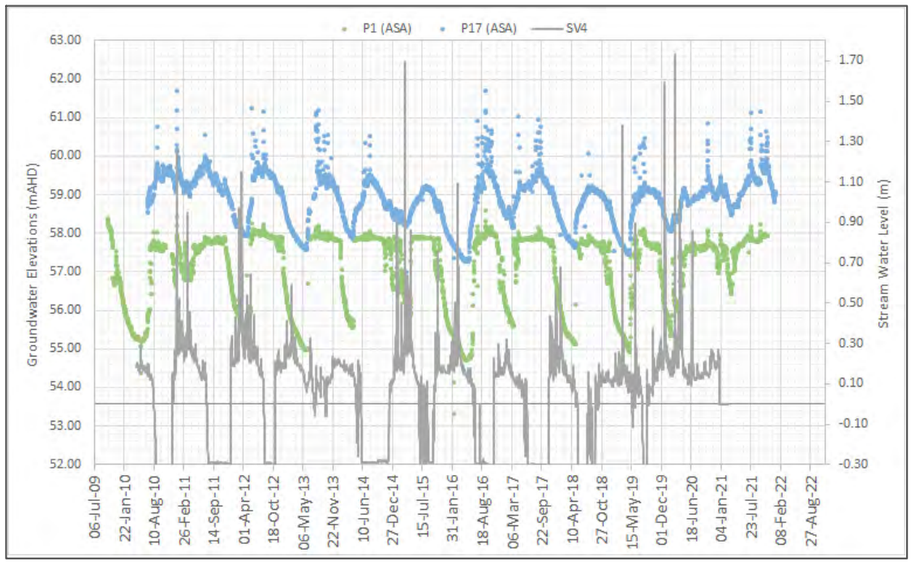
TITLE
Alcoa of Australia Limited
Alcoa Anglesea Mine and Power Station
EHS Support

DRAWN	D. Barnes	DATE	07/02/2022
CHECKED	C. Smitt	DATE	07/02/2022
SCALE	H 1:5000 V 1:333		A3
PROJECT No	AUS##C03371_2021	FIGURE No	5-72

Bore	Aquifer	TDS (ms/l)	pH
SGP2B	-	164	6.2
P17	ASA	1210	6.8
P1	ASA	392	5.89
P6	LEVF	600	-

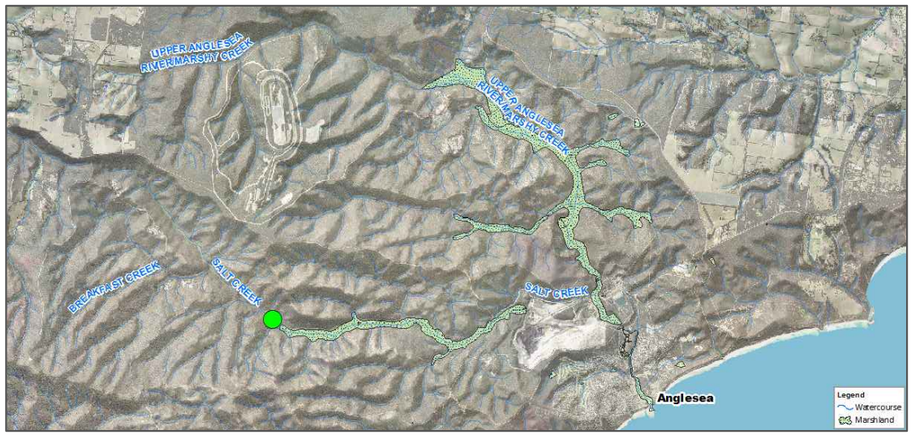






MATERIAL GRAPHIC

Clay | Sandy / Silty Clay | Sand / Sandstone | Bedrock | Coal



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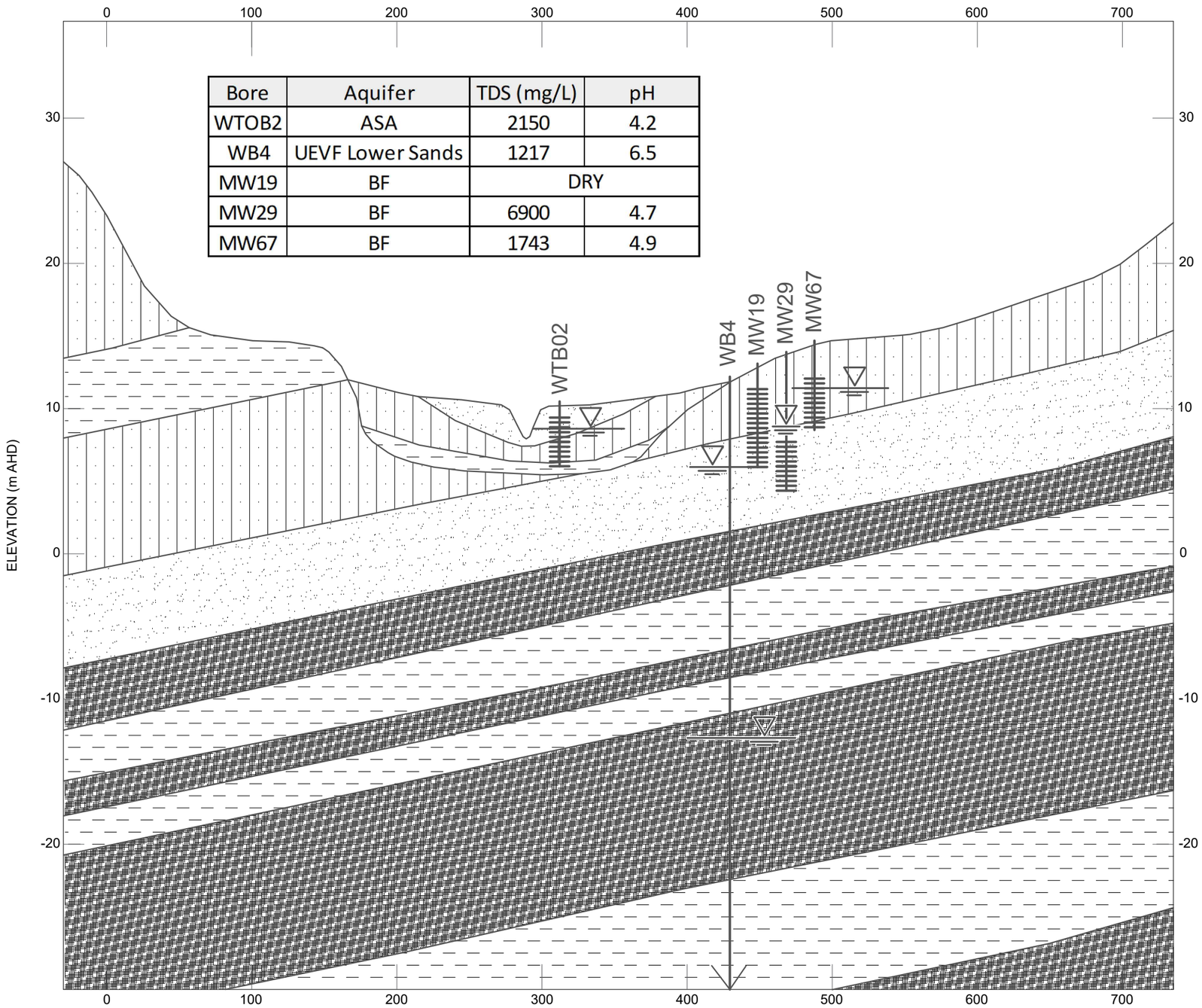
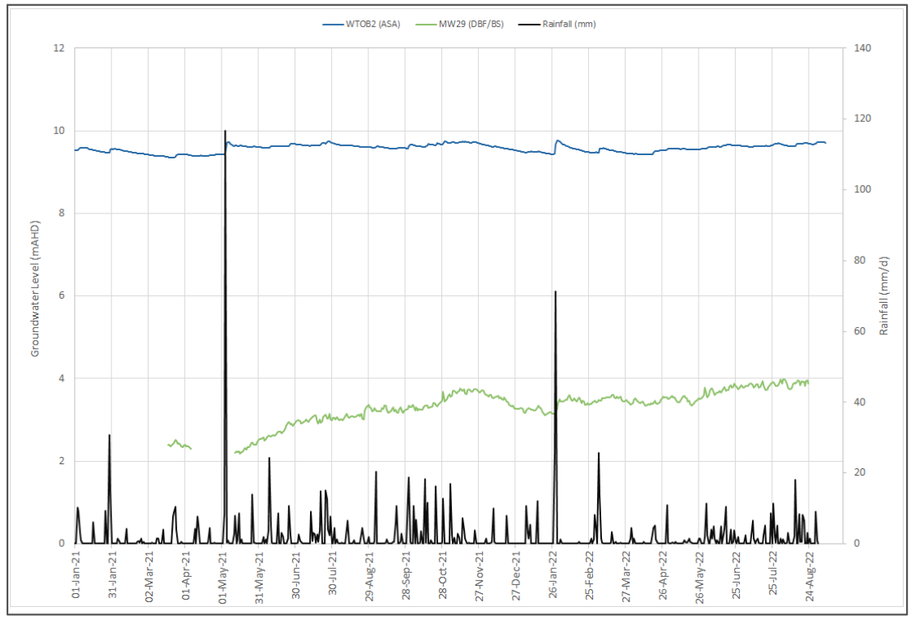
V 1:166
0 5 10m
Coord.System: MGA94 Zone 55 Height Datum: AHD

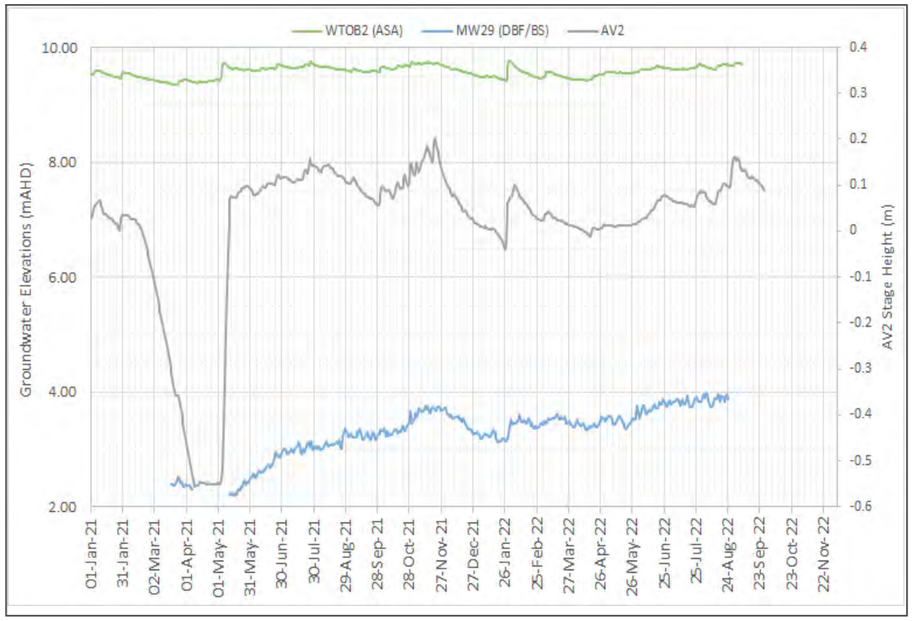
TITLE
Alcoa of Australia Limited
Alcoa Anglesea Mine and Power Station
EHS Support

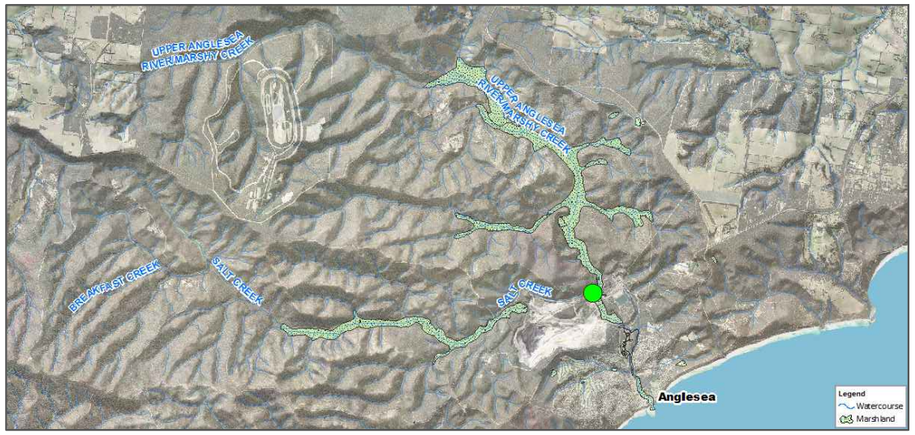
DRAWN	D. Barnes	DATE	07/02/2022
CHECKED	C. Smitt	DATE	07/02/2022
SCALE	H 1:1000 V 1:166		A3
PROJECT No	AUS##C03371_2021	FIGURE No	5-73

Bore	Aquifer	TDS (mg/L)	pH
WTOB2	ASA	2150	4.2
WB4	UEVF Lower Sands	1217	6.5
MW19	BF	DRY	
MW29	BF	6900	4.7
MW67	BF	1743	4.9









MATERIAL GRAPHIC

Clay | Sandy / Silty Clay | Sand / Sandstone | Bedrock | Coal

H 1:3333 (0, 100, 200m)

V 1:333 (0, 10, 20m)

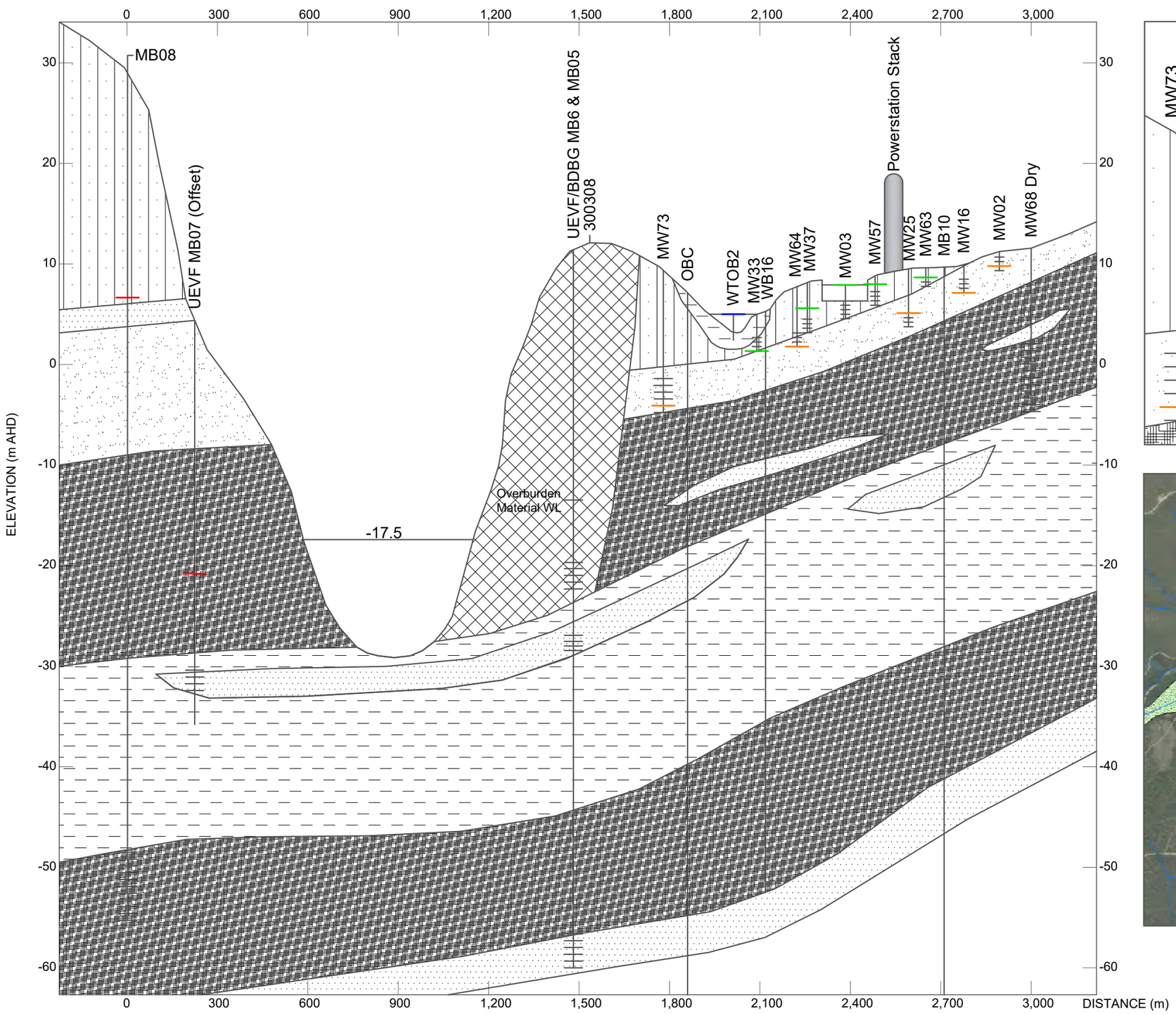
Coord.System: MGA94 Zone 55 Height Datum: AHD

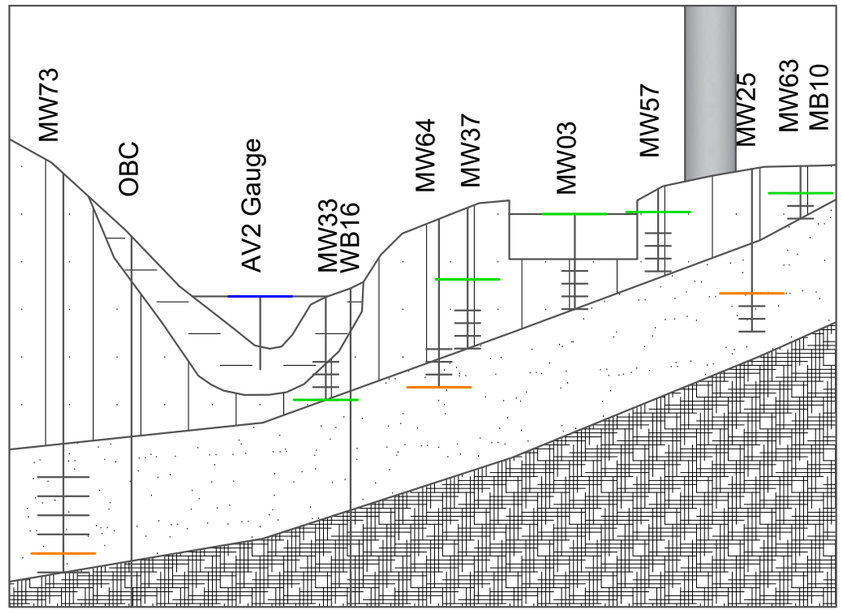
TITLE

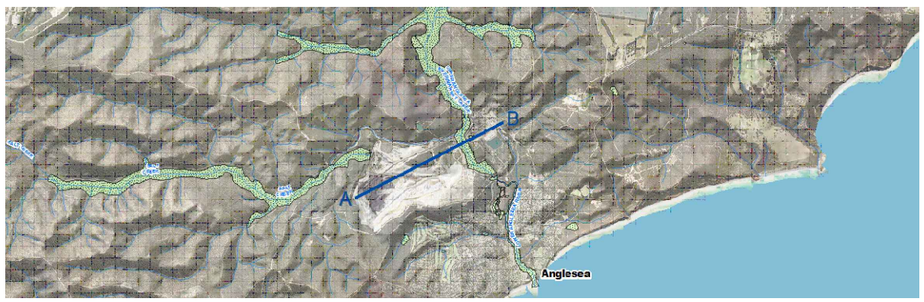
Alcoa of Australia Limited
Alcoa Anglesea Mine and Power Station

EHS Support

DRAWN	D. Barnes	DATE	07/02/2022
CHECKED	C. Smitt	DATE	07/02/2022
SCALE	H 1:3333 V 1:333		A3
PROJECT No	AUS##C03371_2021	FIGURE No	5-74







WATER LEVEL

DBF | Boonah | UEVF | ASA

MATERIAL GRAPHIC

Clay | Sandy / Silty Clay | Sand / Sandstone | Bedrock | Coal | Overburden | Sand

H 1:20000
0 1000m 2000m
V 1:1800
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station

DRAWN	DATE 25/11/2021	
CHECKED	DATE 25/11/2021	
SCALE H 1:20000 V 1:1800		A3
PROJECT No AUS##C03093_2020	FIGURE No 5-75	

5.6 Wetland/Swamp Conceptual Understanding and Water Balance

5.6.1 Conceptualisation

The generalised cross-section of the ASA is presented in **Figure 5-76**. In this figure the ASA is considered as a perched system with limited connectivity to underlying aquifer systems, having an aquitard (low permeable layer) separating the water within the ASA and underlying groundwater systems (GHD 2013).

To verify this conceptual cross section remains valid in and around the mine and former PowerStation, geological bores located either within or abutting the Alluvial channels have been interrogated. The location of these bores and their geology is presented in **Figure 5-77**. The data used to generate these logs was sourced from The Geological Exploration and Development Information System (GEDIS).

Of the bores interrogated, the results suggest that generalised cross section presented in **Figure 5-76** remains valid with the thickness of the ASA varying from 0.6m to 10m and consisting of organic sand and clay sediments. Underlying the ASA in all bores was a clay layer (highlighted on **Figure 5-77)** which has an average thickness of 3.6m. In all cases this clay is associated with the DBF or the Intermediate coal and clays of the UEVF which has very low vertical hydraulic conductivities.

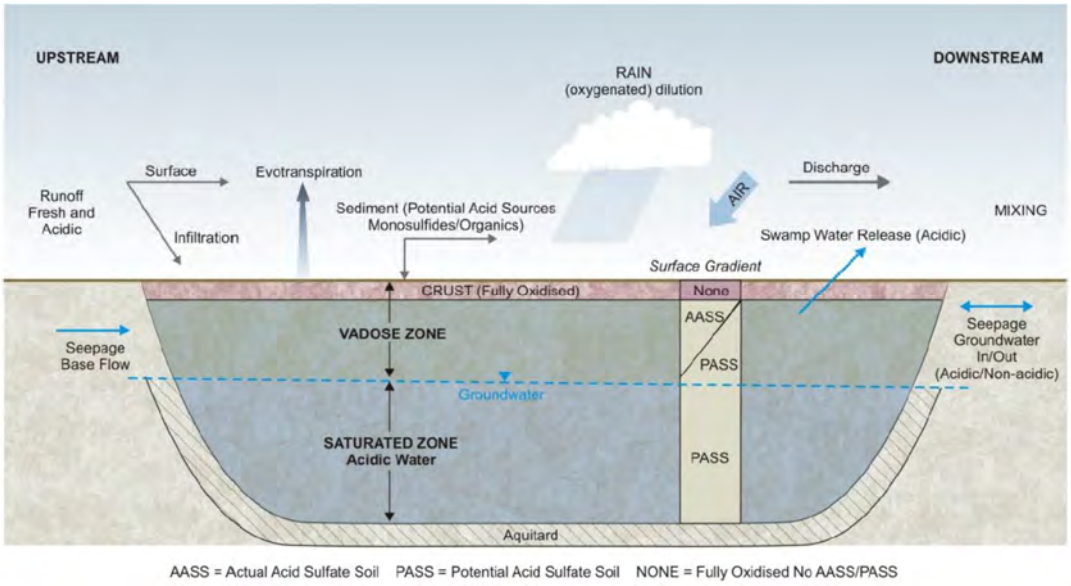


Figure 5-76 Conceptualisation of the Marshland / Alluvial Channels Where the ASA Forms

Source: GHD, 2013

MATERIAL

- Sand
- Clay
- Humic Coal Series
- Coal
- Clastic Sediment
- Wood
- Silt

GEOLOGY

- Alluvial Swamp Aquifer
- Demons Bluff Formation
- Boonah Formation
- Upper Eastern View Formation (Main Coal)
- Upper Eastern View Formation (Upper Sands)
- Upper Eastern View Formation (Intermediate)

TITLE

Alcoa of Australia Limited
Anglesea

EHS Support

DRAWN	D. Barnes	DATE	28/02/2022
CHECKED	C. Smitt	DATE	28/02/2022
SCALE	1:3400		A3
PROJECT No	AUS##C03093_2020	FIGURE No	5-77

5.6.2 Hydrodynamics

The principal water inputs to the ASA include rainfall and runoff (runoff either via overland flow or actual surface water flow from upgradient sources). As presented in the previous sections, there is limited connectivity with underlying aquifers by the presence of a low permeability clay base which limits baseflow from or leakage towards the underlying aquifer systems. However, where the ASA is incised within another unconfined aquifer (i.e. the ASA may have eroded through the Boonah Formation), there may be a higher level of side or horizontal component baseflow or leakage where this occurs.

The main discharge components include evapotranspiration and throughflow. The latter occurs when the ASA is fully saturated allowing a greater amount of water to be transmitted through the system. As discussed in the previous sections, water loss via leakage to underlying formations is expected to be negligible due to geological constraints as well as stable and radioactive isotope data indicating there is no connectivity between the ASA and underlying aquifer.

Recent hydrograph data from bores in the ASA also support limited connectivity with underlying aquifers as the steepest decline of groundwater levels occur over spring and summer during those seasons when episodic rainfall events have not occurred (such as spring and summer of 2012/13; 2013/14; 2015/16; and 2018/2019). In these years, the vegetation is transpiring at a greater rate (under higher heat stress) despite the stage height at the gauging station remaining relatively the same at the same point each season, this suggests leakage is not the main factor in water loss. An example of this is shown on **Figure 5-78**.

In addition, the closest bore to WTOB2 is MW29 which is located about 100m away on the edge of the alluvial channel and screened in sand and silt (likely the Boonah Formation underlying or adjacent the ASA). The response observed in this hydrograph shows that the water level change occurs at a far greater rate (both increases and decreases) again indicating two different recharge controls. Water quality differences (TDS) at these locations also suggest there is no connectivity/relationship with the salinity in MW29 (6,900 mg/L) being significantly higher than WTOB2 (2,150 mg/L).

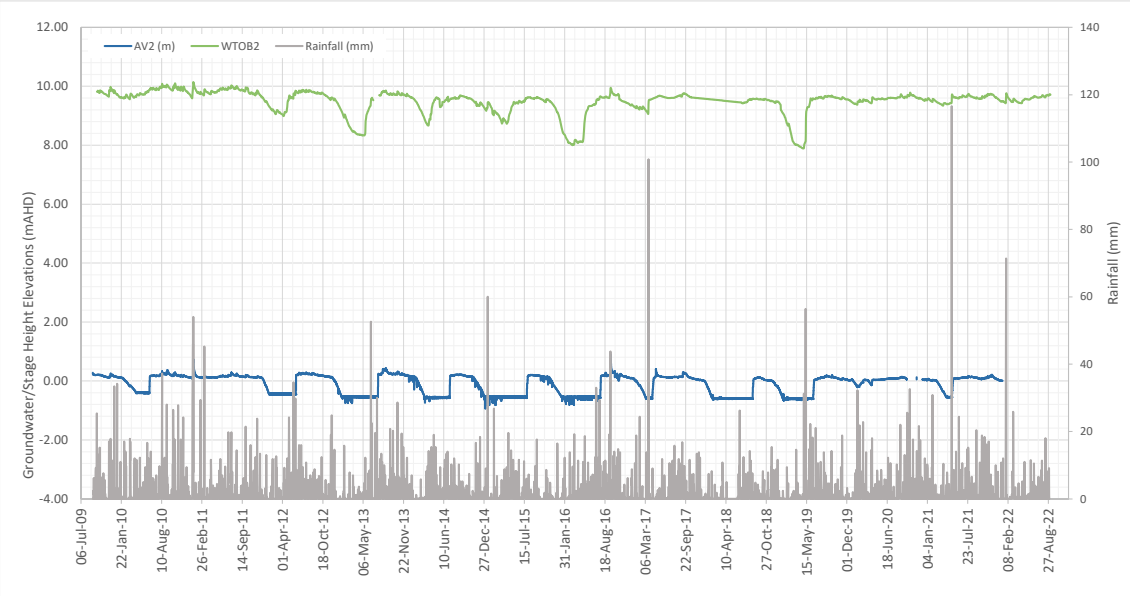


Figure 5-78 Hydrograph of WTOB2 (ASA) and AV2 Stage Height vs Rainfall

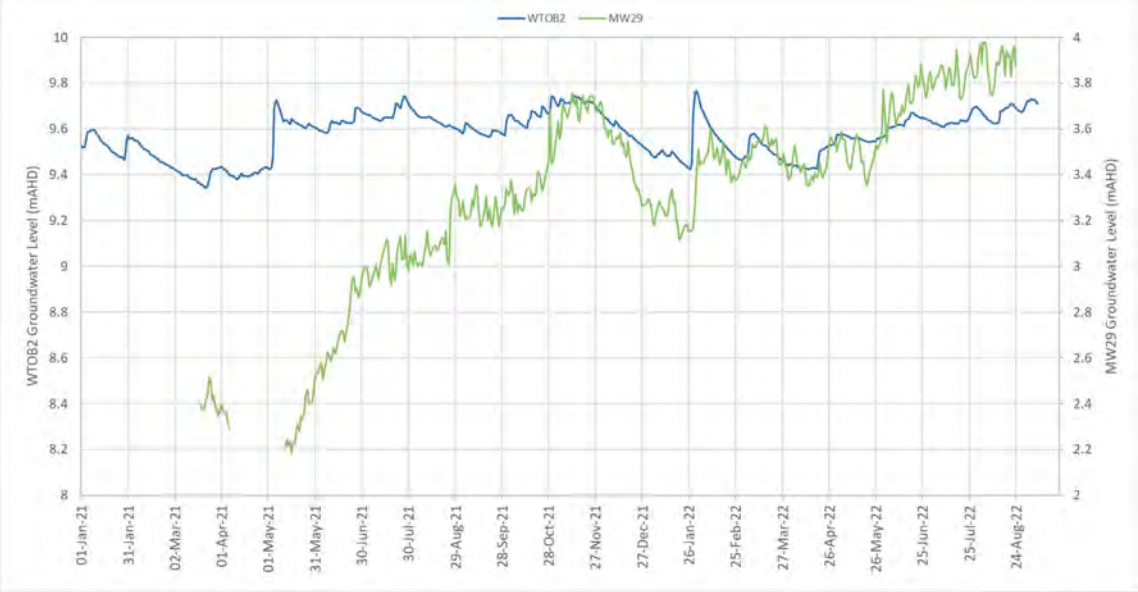


Figure 5-79 Hydrograph of WTOB2 (ASA) and MW29 (Boonah Formation)

Lastly, the (GHD 2013) groundwater model (which is currently being updated) suggested that at pre mine development steady state levels, evapotranspiration consisted of 72% of the discharge water balance across the whole model (Jan Juc GMA). That is 72% of the water entering the model, departed as evapotranspiration. Of this it is expected this would mostly be occurring via the vegetated areas of the marshlands and in the densely vegetated parts of the catchment.

5.6.3 Acidity

Building on from the information presented in **Section 3.5**, catchment acidity is generated when naturally occurring sulphide-bearing sediments, peat and coal (all primarily associated with the mid and lower reaches of the ASA) are exposed to air and oxidised in the vadose zone. This primarily occurs during dry spells and especially during low rainfall springs and summers when evapotranspiration is at its highest. This then causes the water table within the ASA to fall, exposing these sulphidic materials. In subsequent wet periods, these newly oxidised sediments and coal are rewet, completing the oxidisation process, acidifying infiltrating water and runoff. This leached acid is then mobilised via interflow through the ASA or as runoff if the ASA becomes fully saturated and surface waters begin to flow.

To test this concept at a high level within the Anglesea catchment the following will be investigated:

1. Is there evidence of catchment acidity prior to Alcoa activities?
2. Is there a seasonal or climatic impact observed on the historical pH record?
3. Can the timing of rainfall and flow events impact on the frequency and magnitude of acid generation?
4. Are there other contributing factors that can lead to low pH conditions within lower catchment?

5.6.3.1 Historical Catchment Acidity

The first indication comes from the original name of the Anglesea River. Prior to 1884 when the township was established, Anglesea River was originally known as Swampy Creek and as discussed in the sections above, significant acid generating material exists within the swampy/marshy material. Furthermore, in its basic form, acidity reported as pH has been well recorded since the late 1960's both within the estuary and at the location just north of the former PowerStation (where Anglesea River Gauge AV2 is located today, **Figure 5-80**).

The results indicate Upper Anglesea River pH at this location has consistently been low, averaging between 3 and 4 from 1970 to the early 2000's (**Figure 5-81)**. Occasional high pH is seen and this is likely attributed non flowing surface water systems and interaction with the organic matter associated with the alluvial swamps which (along with other processes) can assist in buffering the pH upwards. However, coinciding with the end of the Millennial drought, (2010), surface water pH's have begun to fall. The accepted rationale is again due to naturally occurring sulphide-bearing sediments, peat and coal being exposed to air for longer and oxidised. This primarily occurs during dry spells which causes the water table to fall, exposing these sulphidic materials. In subsequent wet periods, these oxidised sediments become mobile and acidify the water.

Figure 5-80 Location of AV2 and Historical pH Sampling Point

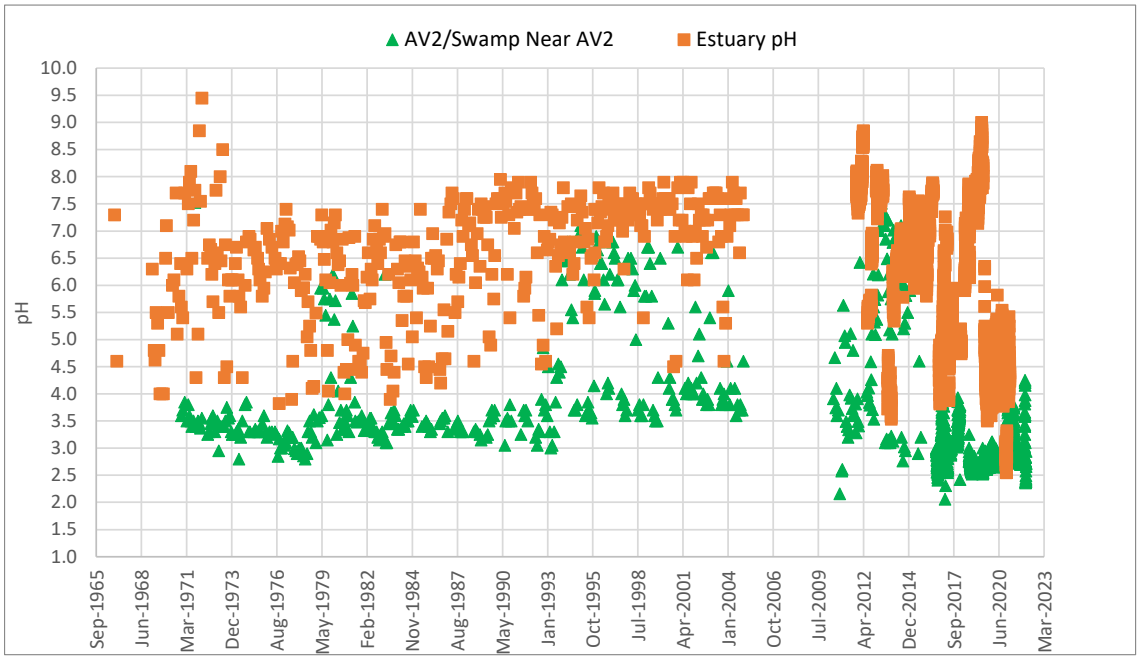


Figure 5-81 Historical pH (Data Source: Pope 2010; WMIS 2022)

5.6.3.2 Can a Seasonal or Climatic Trent be Observed on Historical pH

As it is understood that dry spells have the potential to cause acid accumulation and the subsequent wetter periods then mobilise these metals, it should be reasonable to assume historical climatic trends may also show a similar relationship.

It can be seen on **Figure 5-82** that coinciding with the start of the Millennial drought, (mid 1990's), surface water pH's have begun to fall. In addition, and interestingly, a cubic function was applied to the dataset for AV2. A cubic function was applied as there are 3 real roots seen in the long-term rainfall behaviours (i.e. crosses the x -axis 3 times (refer **Figure 3-3**)). The trend of this function matches closely with the annualised rainfall surplus and deficit which may give an indication that climate (rainfall) and catchment pH have some dependency.

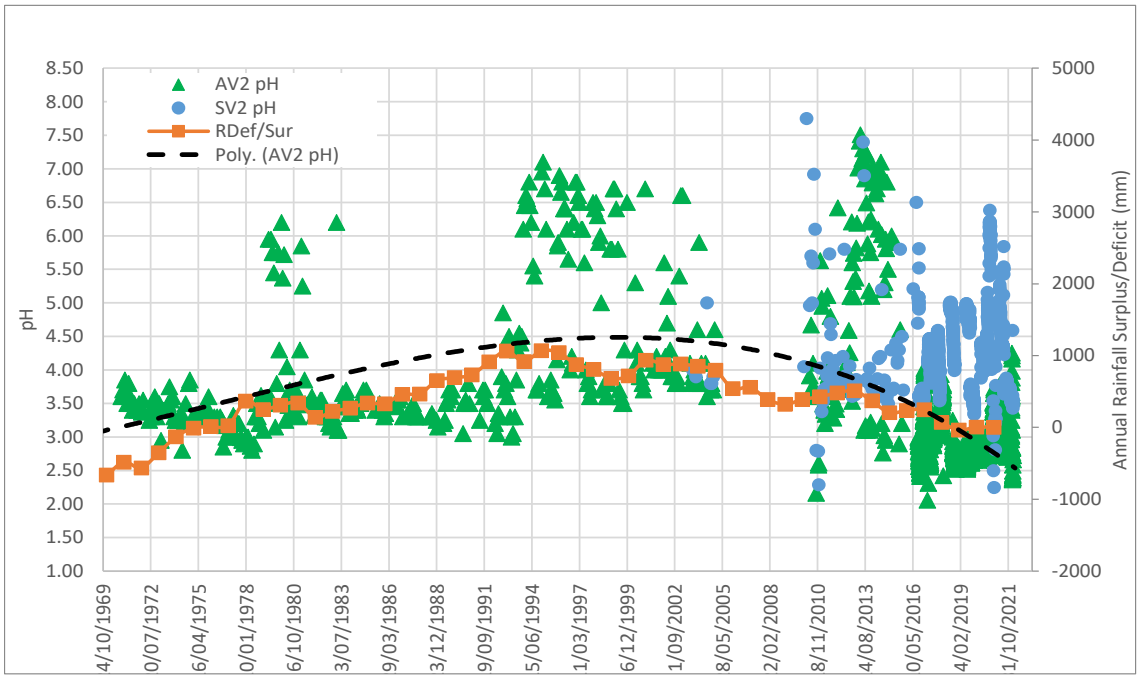


Figure 5-82 Historical pH and Climate (Annual Rainfall Surplus / Deficit)

5.6.3.3 Is Timing and Magnitude of Climatic Factors Important?

It is evident from the section above that low pH conditions have occurred in this location over the last 50 years. Knowing that acidic flushes by way of EPA recorded fish kill events occurred in 2010 and 2016 (**Figure 5-86)**, we can see that the corresponding pH at AV2 was 2.6. Interestingly this corresponds to the 5th percentile of rainfall. These events are denoted on **Figure 5-83** and **Figure 5-84** with **Table 5-12** listing the historical dates that pH has dropped below 2.6 as well as the preceding climate indicators.

With the exception of the low pH measured during March 2017 and February 2018 (these were measured when no flow occurred), it can be observed that leading up to these conditions, AV2 has recorded no flow for ~3 months or more, with the average flow cessation period being 180 days. Therefore, based on this high-level observation it can be conceptualised that flow cessation events of 180 days or more, significantly increase the likelihood of low pH conditions being experienced.

However and referring to **Figure 5-84,** it can also be seen that there have been multiple periods where the no flow period has been greater than 180 days and the following "first flush" pH have not dropped below 2.6 (e.g. In 2014 and 2015). In these years, the pH did fall to below 3 but the causal flow was significantly lower in magnitude than the other noted events.

This then gives us an indication that the timing of no flow events is as important as the magnitude of the flow event itself. Again referring to **Figure 5-84**, it can be observed that when the no flow period roughly exceeds 180 days and the magnitude of the first flows is >5 ML/day, these significant low pH conditions are observed.

In addition to this **Figure 5-86** presents 5-year cumulative rainfall totals against the long-term average (1900 to current) and the EPA notification of fish kill events within the Anglesea River estuary. Looking back at over the last 50 years of data it is clearly evident that rainfall totals have decreased and there is a clear correlation between the occurrence of acidification events (fish kills) during successive years of below average rainfall. In fact, from 122 years of data, the period 2005 to 2009 was the driest 5-year period on record (worse than millennial drought) resulting in a 24% reduction of annual rainfall. More recently, the period 2014 to 2018 represents the 2nd driest 5-year record on record resulting in a 21% rainfall reduction.

Table 5-12 Notable Low pH Conditions at AV2

Daye	pH	# days prior no flow	Preceding 3-month Rainfall (mm)	Peak Flow Rate (ML/day)
20/10/2010	2.16	137	319.2	14.80
01/10/2016	2.46	253	368	45.80
14/10/2018	2.57	244	157.4	2.50
24/06/2019	2.55	208	278.6	8.06
30/01/2022	2.38	82	327.5	5.35

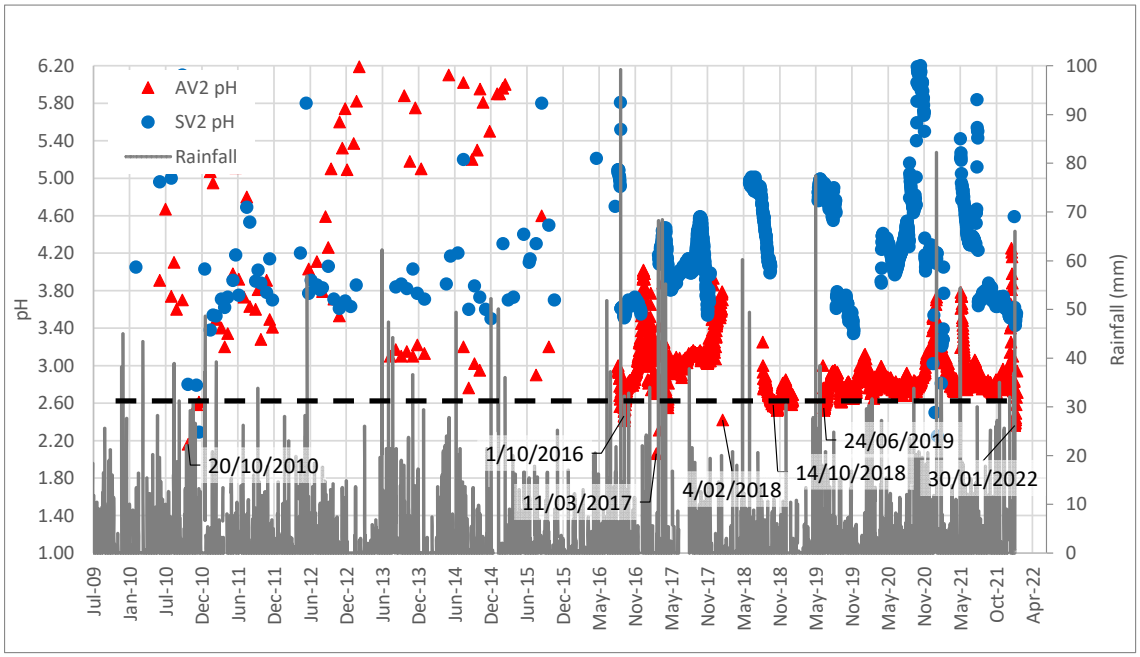


Figure 5-83 AV2, SV2 pH vs Rainfall Since 2009

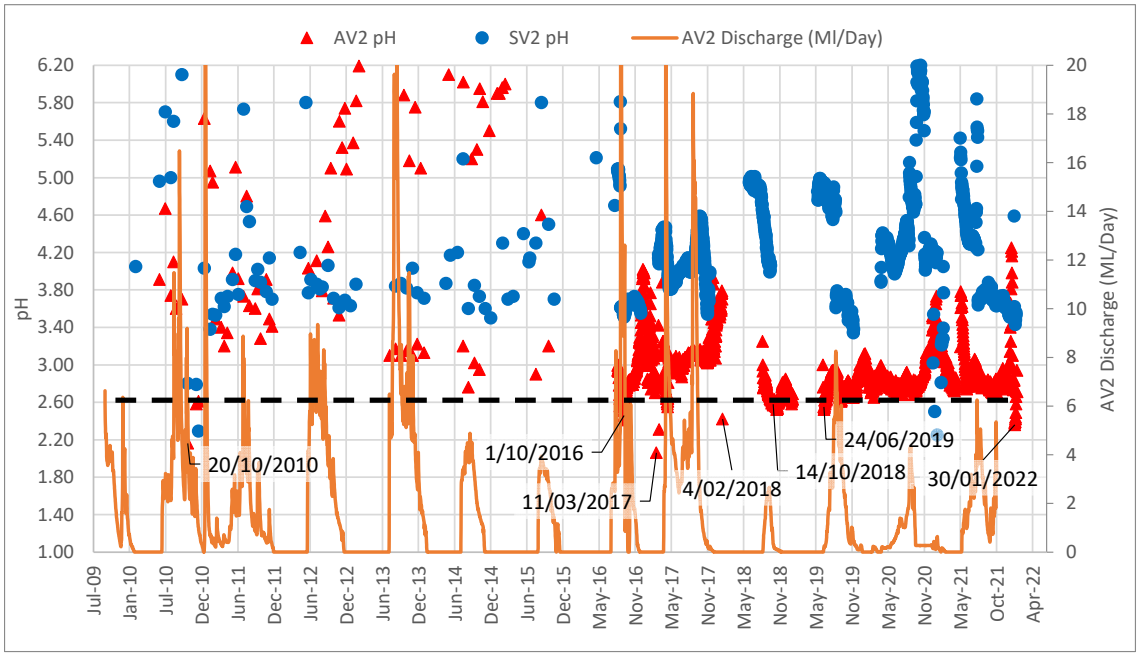


Figure 5-84 AV2, SV2 pH vs AV2 Discharge Since 2009

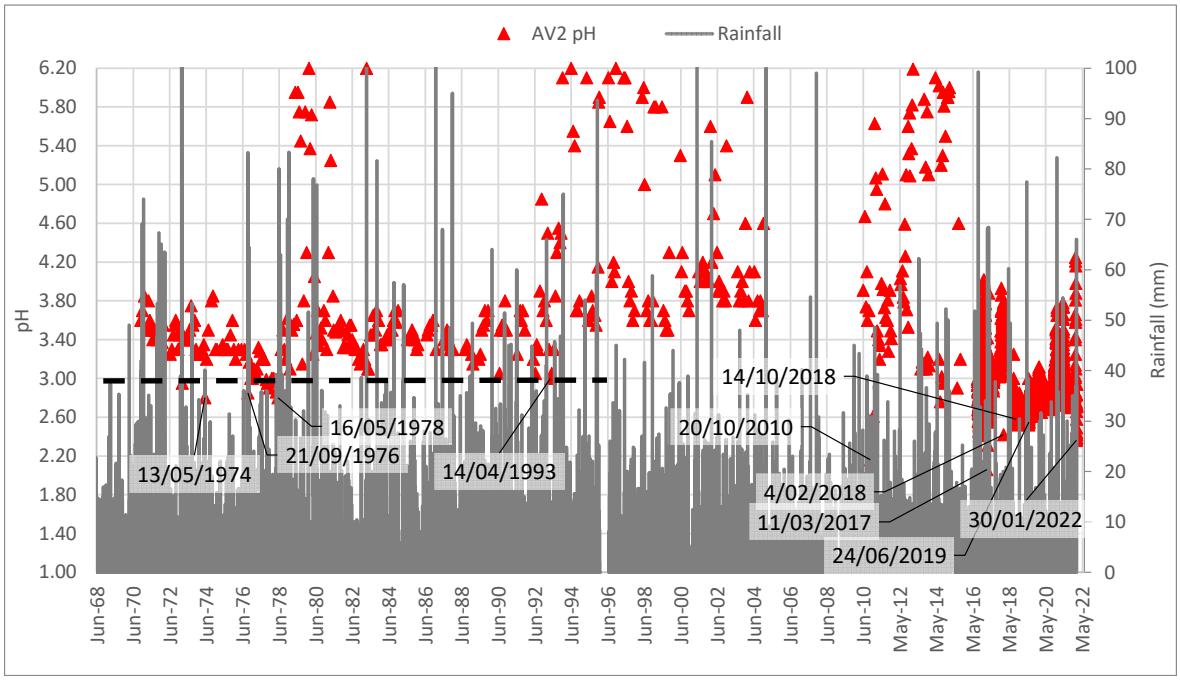


Figure 5-85 AV2 pH vs Rainfall Since 1970 to Current

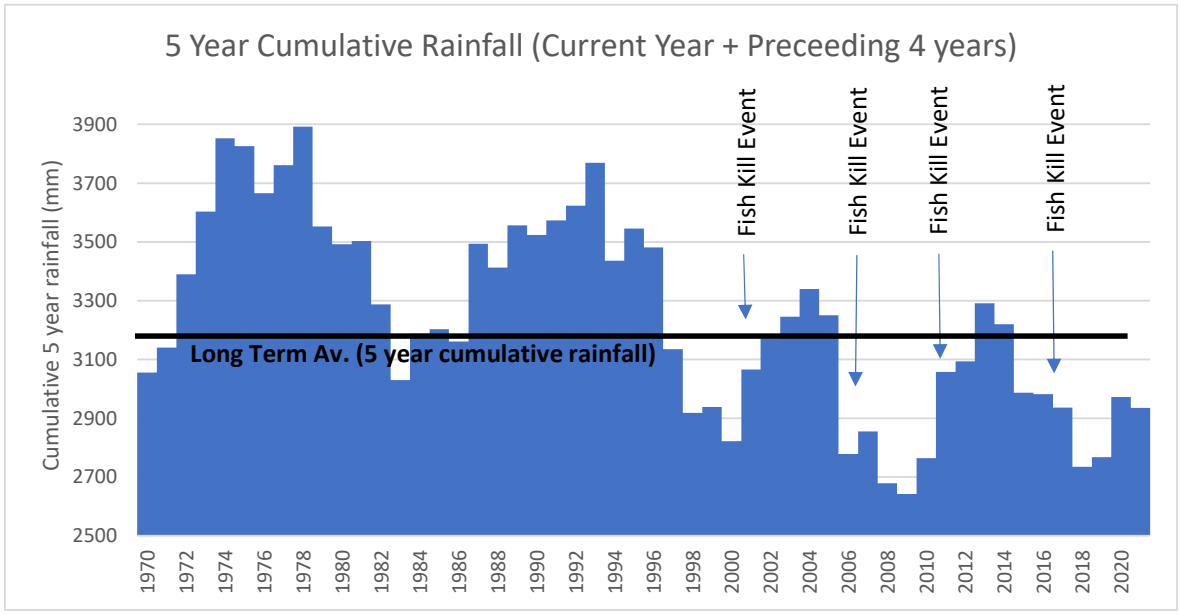


Figure 5-86 5-Year Cumulative Rainfall Totals Vs Estuary Acidification Events

5.6.3.4 Other Factors That Could Have Led to Low pH Conditions within Lower Catchment?

That catchment has always reported low acidity and whilst the above gives an indication that naturally occurring conditions within the catchment and climate is the most sensitive driver to lower catchment acidity, there are other potential causal pathways. Each along with their likelihood level of impact is explained below:

1. Coogoorah Park and River Mouth Changes and Management

   The head of the estuary branches in two main channels, the main channel and Coogoorah Park. The latter comprises a series of smaller channels constructed following the 1983 Ash Wednesday fires to flood smoldering peat. The development of Coogoorah park introduced a significant quantity of acid sulfate soils to the environment as well as requiring modification of the estuary mouth to maintain water levels. A study by Federation University (Sullivan *et al.,* 2016) showed that the acidification hazard posed by acid sulfate soils is almost entirely contained within Coogoorah Park and not the low-lying land on the south-eastern side of the bridge location at Anglesea and therefore likely impacts on the Estuary water quality.

2. Historical Mining Operations

   a. Alcoa EPA licenced discharge of ~ 4.5 ML/day Alkaline pH water; pH ~7 - 8, to the Lower Anglesea River.

      As presented on **Figure 2-1**, the licenced discharge of Alkaline water clearly shows the alkaline buffering capacity this discharge baseflow had on the pH of the Estuary. This discharge ceased in March 2016. With Climate beginning a drying phase since the late 1990's, the Estuary has to respond extremely quickly to this new normal as opposed to being able to response naturally over the last 20-25 years if the buffering flows were absent.

   b. Mining

      It is acknowledged that as the mine was progressively established, the local mine catchment surface water runoff that would have previously ran-off into a small section of Salt Creek was diverted away either into the mine or towards the former mixing zone low point. This activity may have led to a minor reduction of over land flow that would have recharged the ASA to maintain saturation of the sulfidic materials in this small reach of Salt Creek. However, it is anticipated that this disturbed area would only represent a very small part of the Salt Creek flow network and as this is at the end of the catchment, no measurable change in water quality likely to be observed.

   c. Groundwater Pumping

      Potential does exist whereby the long-term groundwater pumping from the UEVF and other aquifers may have caused leakage from the surface water systems and thus increasing the wetting and drying frequency of the ASA. As discussed throughout this report, all lines of evidence suggest UEVF groundwater extraction is unlikely to have resulted in leakage from the ASA into the UEVF aquifer.

5.7 Mine Catchment Water Balance

This section presents a high-level overview of the mine water balance.

5.7.1 Groundwater Contribution

The groundwater contribution into the former mine void (baseflow) can be complicated to determine in complex environments; however, Alcoa has historically installed a sump pump into the base of the mine void. As the mine acted as a groundwater sink, this pump extracted both groundwater inflow and surface runoff and as such can be used to calculate the total water input. As shown on **Figure 5-75**, the average water extraction from the sump was on average 1,242 ML/yr (3.4 ML/d) for the period 1998 to 2014. This reduced to 884 ML/yr (2.4 ML/d) in the later period of the mine development when the rate of inflow was more realistic of the current and final mine bathymetry. It is also noted that a portion of this volume would also be in-situ groundwater as mine sumps are typically placed 1 m below the surface to ensure dry conditions. This component can is estimated to be between 1 and 1.9 ML/d based on the surface area of the sump and a porosity ranging between 5 and 10 percent.

Taking this into consideration, the baseflow component entering the mine void is approximately 0.46 to 1.4 ML/d or 170 to 520 ML/yr. As groundwater pressures recover, this rate will increase.

5.7.2 Evaporation

As presented in **Section 3.2.1**, evaporative losses (rainfall deficit) per year were estimated at 311 ML/yr for a full water body however this is likely to be a under estimate. Under a drying climate, this is expected to increase closer to 500 ML/yr.

5.7.3 Rainfall and Runoff

To estimate the surface water component, direct rainfall was multiplied by the surface area of the water body. Runoff was calculated by working out the residual volume is would take to increase the water level after considering the groundwater components, rainfall and evaporation.

On occasion, significant surface water input can be achieved due to the installation of nine catchment drains in 2020 (**Section 2.3.1**). For example, on 4 May 2021, Airies inlet recorded 116.6 mm, with a rain gauge at the mine site recording 86 mm. This rainfall event caused the pit water level to rise by 0.2m with an estimated 159ML being contributed by runoff. Alluvium Consulting (pers comm.) calculated this event as a 1 in 2000 Annual Exceedance. Probability (AEP) event.

5.7.4 Budget

Assuming no other inputs (such as surface water diversion) or extractions, the resulting water balance is presented on **Figure 5-87** and is based on:

- Groundwater inflow averaging 24 ML/month (est. 0.8ML/d from old sump pumping records).
- Monthly rainfall records.
- Groundwater Pumping test discharge volumes.
- Evaporation raging 15 ML/month (winter) up to 41 ML/month (summer) or 354 ML in 2021.

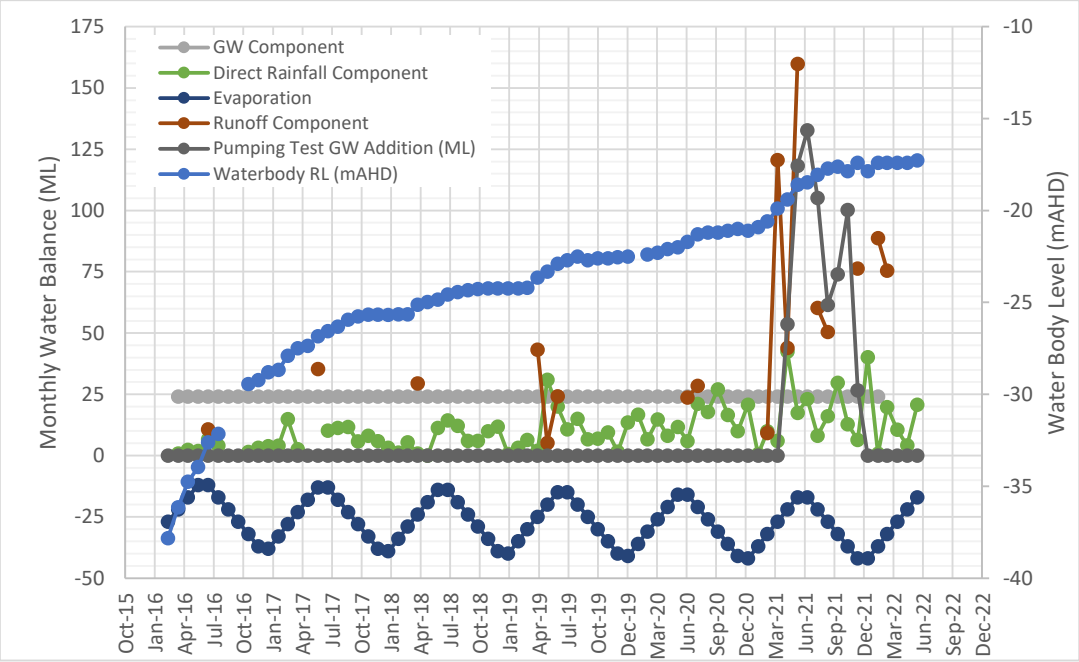


Figure 5-87 Monthly Mine Water Balance

6 Summary of the CHM

The following provides a summary of the conceptual hydrogeological (and hydrological) conditions.

6.1 Climate

Long-term average annual (LTA) rainfall at Wensleydale is 769 millimetres per year (mm/yr) based on data from 1935 to current. At Aireys Inlet, the LTA is 616 mm/yr based on data from 1994 to current. Mean annual potential evaporation (PE) does not vary significantly across the region, with an annual mean of 1,300 mm measured at Anglesea.

Over the last 120 years there have been 3 distinct climatic phases, that is:

- Between 1900 and 1950, the region exhibited a drying climate.
- Between 1950 and 1990, the region then experienced a strong wet period.
- Since 1990, a prolonged drying period is being observed. The millennial drought (late 1996 to mid-2010) occurs in this period and more recently the 5-year rainfall totals of 2004 to 2009 and 2014 to 2018 comprise the 2 driest 5-year totals on record for the region.

Future median climate projections estimate:

- Potential evapotranspiration is projected to increase by 3.7% by the Year 2040, and 6.4% by 2065 relative to the current climate baseline.
- Average annual rainfall is projected to decrease by 3.6% by year 2040 and 5.8% by 2065.
- By the 2030s, sea level is projected to rise by around 12 cm a under medium emissions scenarios. By the 2070s increases of around 32 cm are modelled. Victorian planning guidelines plan doe rises of 0.8m by 2100.

6.2 Surface Water and Catchment Acidity

The key conceptual learnings are:

6.2.1 Surface water

- The major waterways Anglesea River/Marshy Creek and Salt Creek are ephemeral; however, there are several non-groundwater fed, permanent pools that exist across its reach. These are recharged by overland / surface runoff and located in densely vegetated parts of the Alluvial Swamp system.
- The surface water that flows in the catchment is retarded in Alluvial Swamps located in the mid and upper parts of the catchment. These alluvial swamps store and use (via evapotranspiration) significant volumes of water. The water that is stored in these systems is referred to as groundwater of the alluvial swamp aquifer (ASA). When the ASA storage is fully saturated and / or runoff exceeds the ASA's storage capacity, surface water flows begin.
- The pH at SV2 generally ranges between pH 3.5 and 4. Further up the Salt Creek catchment at SV1, the pH is higher ranging between pH 5 to 7. The lowering of the pH in the mid and lower reaches of the catchment is due this section containing more ASS which is readily oxidised.
- Longer term pH data at or near location AV2 shows pH generally ranging between 3 and 4 since 1969, however since the onset of drier conditions since the late 1990's the pH is now usually less than pH 3 (net acidic). At AV1 (top of the catchment), is generally pH >5. As with

Salt Creek, acidity increases downstream where the mid and lower reaches of the catchment containing more ASS which is readily oxidised.

- EC at the lower end of Salt Creek at SV2 generally ranges between 250 and 2000 µS/cm), whilst in the upper part (SV4) this range is more constrained varying from 199 and 312 µS/cm.
- The EC in Upper Anglesea River/Marshy Creek at AV1 generally ranges between 500 and -1,000 microSiemens/centimetre [µS/cm]) and is lower than EC measured downstream at AV2 which ranges between (2,000 and 7,000 µS/cm).
- In both sub catchments, the larger variation in EC seen in the downstream part of the catchment is likely due to surface water flows being retarded in the Alluvial Aquifer and allowing evapotranspiration to concentrate salts.
- The majority of the water samples plot as a sodium chloride (NaCl) water type. The dominance of this water type is most likely related to the depositional environment of the Eastern View Formation (sub-littoral) and the geochemical influence on the younger aquifer sediments of the Demons Bluff and Boonah Formations.
- Since surface water monitoring began in 1967, Salt Creek has experienced a significant decline is annual flow. This decline is primarily related to climate although it is acknowledged that as the mine was *progressively established, local mine catchment surface water runoff that would have previously ran-off into Salt Creek was diverted away either into the mine or towards the former mixing zone low point. Its anticipated that this disturbed area would only represent a very small part of the Salt Creek flow network.*
- At the lower reaches of the Anglesea River catchment in the region of the site and downstream, flows had previously been artificially supported by a 3-5 ML/day of approximately pH 7 water discharges from Alcoa's power station (EPA License EM32162). This ceased in 2016.
- Within the mine void, evaporative losses per year are estimated at 311 mm/year.

6.2.2 Acidity

- An acid sulfate soil assessment undertaken within the Anglesea swamp by Fiona Glover and Assoc and Prof. John Webb (Report on Anglesea River Acid Sulfate Soils, April 2013) identified both potential (PASS) and actual acid sulfate soils (AASS) were present within the sediments. Wong et al., (2020), also found the catchment to contains high sulfur reserves from pyritic shales and siltstones, coal seams, tea tree swamps.
- The ASA contains naturally occurring sulphide-bearing sediments, peat and coal. As the water level fluctuates in the ASA these sediments are exposed to air and oxidised in the vadose zone. This happens over and over again resulting in a build-up of leachable acid and metals. When the ASA becomes fully saturated (usually after a significant wet period), these oxidised sediments are mobilised resulting is low pH (acidic) water. Usually, the longer the period between flow events, the lower the resulting pH flow is.
- The Upper Anglesea River has experienced low pH events prior to Alcoa. A sampling point located at AV2 has consistently recorded pH between 2.5 and 4 since 1967.
- A good statistical correlation exists between rainfall surplus and deficit trends and catchment acidity (pH) indicating that climate (rainfall) and catchment pH have some dependency.
- The Anglesea River estuary had previously been artificially supported by a 3-5 ML/day of approximately pH 7 water discharged from Alcoa's power station (EPA License EM32162). This discharge ceased in 2016. This along with the introduction of Cooroogarah park and the management of the estuary mouth have contributed to the variability in water quality seen in the Estuary over time.

- 12 km further south at Airies Inlet, Distillery Creek (a tributary of Painkalac Creek) has also reported frequent low pH conditions (Surf Coast Shire, 2006). Therefore, climatic drivers as opposed to anthropogenic factors (such as groundwater pumping) are understood to be the main reason for the low pH conditions experienced within the catchment.

6.3 Surface Water and Groundwater Interactions

Throughout this report multiple lines of evidence have been presented which gives the reader a greater appreciation of how surface water and groundwater moves and interacts through the catchment. This section summarises these lines of evidence.

Previously geological and hydrogeological evidence has indicated that the swamps and marshlands that make up the ASA act like a PWT (that is water in the ASA finds it very difficult to interact (leak or receive baseflow) with underlying aquifers). In summary these lines of evidence are:

- A review of all available exploration geological bore logs (22 logs) that were located either within or adjacent to the ASA shows that an average thickness of 27.7m (max = 86m; min = 2.4m) of either clay or silt (e.g. low permeability material) that separates the base of the alluvial / swamp sediments in which surface water flows to the next most permeable layer underlying the surface water systems.
- Laboratory testing of some of these low permeability materials indicated that the average vertical hydraulic conductivity was 0.0002 m/d with an average porosity of 41%. To put this in context, assuming a minimum thickness of 2.4m existed between the base of the swamp sediments and the next most permeable formation, surface water would need to be present for 5.6 years for water to leak though this barrier. As we know, the water ways are ephemeral and this driving head of water is rarely there for more than a few months at a time.
- Throughout the marshland areas several permanent water pools have been mapped (AGP1-B, AGP2 and ASP7). Stable and radioactive isotopes obtained within these pools indicate that they are not in direct connection with the underlying aquifers and therefore not baseflow dependant. At these locations there is an upward gradient. If the gradient were to reverse, as the impermeable base of the ASA inhibits baseflow, there is no reason to suggest it won't do the same and inhibit leakage.
- All ASA monitoring bores have shown a stable trend over the last 10 years with no impact seen in either system despite Alcoa extraction up to 2016 and more recent aquifer tests, and also aquifer tests undertaken by Barwon Water between 2009 and 2012. In fact, for reason unknown, the bore WTB02 in the lower part of salt creek ASA shows variable but overall increasing trend over the last 10 years.
- Most large rainfall events exceeding 40mm have resulted in an immediate increase in groundwater levels within most ASA monitoring locations. This indicates that direct rainfall recharge is the dominant driver of recharge to the ASA.
- Within the ASA, the steepest decline of groundwater levels occurs over spring and summer when episodic rainfall events are absent (such as spring and summer of 2011/12; 2013/14; 2015/16; and 2019/2020). This similar correlation is not commonly observed in unconfined aquifers surrounding the ASA such as the outcropping UEVF and BEF. As evapotranspiration is highest during spring and summer, this suggests that evapotranspiration and throughflow is the most likely cause of water loss from the ASA.

6.4 Hydrogeology

Beneath the site there exists an extensive and complex series of aquifers and aquitards. These are:

- Alluvial Swamp Aquifer
    - An unconfined aquifer comprised of alluvial sediments and organic clay and peaty mix. This aquifer sits in the bottom of incised valleys where over thousands of years erosion occurred through the surrounding sediments before hitting an impermeable base. Infilling of these channels now forms the base material of this aquifer.
    - Groundwater within this aquifer has limited connectivity with underlying formations due the presence of a low permeability clay at its base. Hydrographic analysis as well as water chemistry using stable and radioactive isotopes also suggest limited potential for surface water and groundwater interactions to occur.
    - Several non-baseflow dependant permanent pools supporting high value ecology are found in the mid and upper reaches. These pools are located in heavily vegetated parts of the catchment.
    - Rainfall and runoff are the dominant recharge driver and evapotranspiration and through flow is the dominant discharge driver.
    - The average TDS generally increases as you travel down the system with TDS in the upper part ranging from 569 mg/L (Upper Salt Creek WTB01) and 1082 mg/L (Upper Anglesea River WTB03) to 2024 mg/L at WTBO2. This occurs due to the longer travel time water have with the sediments it passes though as well as evapotranspiration assisting in salt accumulation.
    - A review of the aerial imagery along with ecological reports (Ecology Australia 2007, 2011, 2012, 2013a,b) indicates swamp vegetation and associated ecology has persisted. Coupled with persistent and stable groundwater levels in WTOB1 and WTOB2 suggests the ASA has remained saturated over the long term.
- Demons Bluff and Boonah Formation
    - The Demons Bluff Formation consists siltstone, clay, sandstone and minor coal seams. At the former Power Station site the DBF is extends from the surface to ~10m below ground level. It thickens and dips towards the southeast.
    - The Boonah Formation consists clean sandstone with minor shale, clay and coal. The Boonah Formation underlies the DBF and is ~25m thick.
    - The mine void acts as a groundwater sink and most observation bores surrounding the mine screened in this formation are unsaturated.
    - Permeability tests undertaken within this formation are highly variable with an average horizontal hydraulic conductivity (0.1 m/d, from slug tests) and vertical hydraulic conductivity of $1x10^{-4}$ m/d, from laboratory analysis). Note the vertical permeability tests target bores with a higher clay content, whilst the slug tests targeted bores that had a greater potential to transmit water.
    - The recharge potential of outcropping sediments is low as evidenced by a lack of water table response after heavy rainfall.
    - TDS in the DBF aquifer from the recent groundwater monitoring event in 2020 ranges between 578 mg/L and 6,660 mg/L with an average of 2,519 mg/L. The TDS from most wells is classified as Segment B or higher.
    - In the vicinity of the mine, the only monitoring bore that was saturated was DBF MB06 with an average TDS of 2,770 mg/L. This bore is installed within the backfilled overburden material and as such is not representative of the native aquifer.

- Upper Eastern View Formation
    - The UEVF consists of clay, silty clay, silt and fine to medium-grained sand sequences with minor fine gravel lenses. Brown coal is also common throughout the UEVF especially in the top half.
    - The UEVF is represented by multiple aquifers occurring as sand lenses separated by aquitards (clay and coal). In the upper half, there is significantly more clay and coal, whilst more permeable sand lenses exist near the base. These basal sand lenses were the target of Alcoa's historical extraction.
    - Pre mine levels suggested the potentiometric surface for the UEVF lower sands was ~4m AHD. Individual sand sequences above this within the UEVF showed slightly lower potentiometric surfaces the shallower the sand lenses occurred.
    - Vertical permeability testing of these clays and coal indicated an average vertical hydraulic conductivity of $1x10^{-4}$ m/d. Analysis of the pumping test Stage 1 results suggest the horizontal hydraulic conductivity is 1.3 m/d and a storativity of $4x10^{-4}$ (-).
    - A single packer test was attempted to define the hydraulic parameters of an upper sand lens. After ~250L of water was injected, the packer failed indicating some upper sand lenses may not be laterally extensive. Historical bore logs also indicate these upper sands may not fully interconnect.
    - Groundwater quality is variable with shallower sand sequences with the TDS within the upper sands is variable ranging from 168 mg/L (UEVF MW07) to 3,470 mg/L (UEVF MW04) with a median concentration of 889 mg/L. This provides further evidence that these lenses may be discontinuous.
    - In the lower sands, during the groundwater pumping test pH ranged from 6.3 to 6.7 with a mean of 6.5. The TDS ranged from 741 to 1,660 mg/L which is consistent with historical ranges reported prior to May 2021, of between 830 to 1,313 mg/L.
    - Based on Stage 1 of the pumping test, the estimated transmissivity ranged from 58.2 to 114.2 m^2/day (hydraulic conductivity range of 0.8 to 1.6 m/day) and a storativity range of 2×10^{-4} to 5×10^{-4}.
- Middle Eastern View Formation
    - The MEVF underlies the UEVF and generally consists of 30-40m of mudstone and siltstone, but also has minor sand and gravel lenses as well as thin brown coal layers.
    - It has been previously modelled as a leaky aquitard as depressurisation impacts have been observed in some deep Alcoa UEVF observation bores whilst pumping has been occurring from nearby the LEVF extraction bores. However, a recent bore assessment program involving down hole camera and wireline logging was undertaken by Alcoa to identify bores with potential integrity issues or those that may cross screen aquifers. In 2021, several at-risk bores were identified and decommissioned. Since the restarting of the LEVF extraction by Barwon Water in early 2022, no depressurisation impacts have been recorded in the Alcoa UEVF deep observation bores. This indicates that the aquitard may not be as leaky an initially thought with these previous bores acting as preferential flow conduits.
- Lower Eastern View Formation
    - The LEVF forms a confined to semi-confined aquifer (in the upper parts of the catchment) across the region and consists of unconsolidated micaceous silts, carbonaceous clays, silty clays, thin brown coal seams and fine to coarse-grained sands and gravels. Below the coal mine site, the LEVF is up 200 m thick where aquifer material occurs within geological synclines. Geologically, this unit represents the Pebble Point Formation and, prior to Barwon Water groundwater extraction in the area, was artesian at the site.

    - Groundwater quality (TDS) in the LEVF is fresher than that observed in the UEVF. GHD (2013) reported that groundwater salinity had been measured between approximately 500 to 900 mg/L TDS.
    - The aquifer parameter data suggests transmissivities of up to 330 m^2/day and hydraulic conductivities of up to 2.77 m/day can occur in individual sand horizons.
- The Mine Void
    - In addition to the hydrogeological units above, the mine void acts as a hydrogeological control. For the local catchment, the mine void acts as a groundwater sink.
    - Prior to the exposed coal being covered, seepage faces after heavy rain were observed near the main coal and basal clay interface leading into the pit void. As coal is unsaturated, its anticipated that its permeability has increased and within the vicinity of the mine, groundwater that would normally be held in the Boonah Formation, now has an easier migration path. This flux will continue to be high until the main coal seam becomes saturated.
    - TDS are observed to vary between 1,200 and 2,200 mg/L and this appears to be influenced by increases in major ions particularly sulfate. Prior to the pumping test, the median pH of the water body was 3.35. At completion of the Pumping test after ~670ML of UEVF Lower Sand (pH 6.5 median) groundwater was placed into the void, the median pH rose slightly to 3.53.

7 Assumptions and Limitations

EHS Support has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Alcoa Australia and only those third parties who have been authorised in writing by Alcoa of Australia. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It was prepared having regard to the purpose for which Alcoa Australia is intending to use this report and having regard to the purposes in accordance with the scope of work.

The sources of information used by EHS Support are outlined in this report. EHS Support has made no independent verification of this information beyond the agreed scope of works and EHS Support assumes no responsibility for any inaccuracies or omissions.

This report was prepared between December 2021 and September 2022 and is based on the conditions encountered and information reviewed at the time of preparation. EHS Support disclaims responsibility for any changes that may have occurred after this time. This document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

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This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessments. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of groundwater is complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of hydrogeological and other relevant environmental conditions and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, EHS Support must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Further, the objectives and scope regarding hydraulic testing, groundwater sampling and gauging and bore drilling, logging, completion and decommissioning have been directed by requests from Alcoa Australia. EHS Support disclaims responsibility for any influences these requests may have had on conclusions within this report.

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Appendix A Licence Entitlement BEE029662

Entitlement ID:

BEE029662

Printed on: 20 Apr 2010 11:23:45 am

COPY OF RECORD IN THE VICTORIAN WATER REGISTER

TAKE AND USE LICENCE

under Section 51 of the Water Act 1989

The information in this copy of record is as recorded at the time of printing. Current information should be obtained by a search of the register. The State of Victoria does not warrant the accuracy or completeness of this information and accepts no responsibility for any subsequent release, publication or reproduction of this information.

This licence does not remove the need to apply for any authorisation or permission necessary under any other Act of Parliament with respect to anything authorised by the take and use licence.

Water used under this entitlement is not fit for any use that may involve human consumption, directly or indirectly, without first being properly treated.

The Authority does not guarantee, by the granting of the licence, that the licensee will obtain any specific quantity or quality of water. The Authority is not liable for any loss or damage suffered by the licensee as a result of the quantity of water being insufficient or the quality of the water being unsuitable for use by the licensee at any particular time or for any particular purpose.

This take and use licence entitles its holders to take and use water as set out under the licence description, subject to the conditions that are specified.

Licence Holders

Alcoa Of Australia Ltd**

Licence Contact Details

Alcoa Of Australia Ltd** CAMP ROAD ANGLESEA
VIC 3230

Licence Description

Expiry date	30 Jun 2024
Status	Active
Authority	Southern Rural Water
Name of waterway, aquifer or works	LTA-Jan Juc
Water system type	Groundwater
River basin or groundwater unit	Jan Juc (GMU)
Licence volume	4000.0 megalitres
Licence volume adjusted for temporary trade	4000.0 megalitres
Method of taking	Direct extraction from Groundwater
Period during which water can be taken	01 Jul - 30 Jun inclusive
Use of water	Industrial or commercial use - as well as domestic and stock use
Trading zone	Jan Juc LTA

Licence Volume Details

Licence volume	4000.0 megalitres
Licence volume adjusted for temporary trade	4000.0 megalitres

Temporary volume transaction details

Approval date	*Volume traded (ML)*	*Expiry date*
Nil		

Extraction Point Details

Easting	*Northing*	*Zone MGA*	*Location description*
Nil			

Land on which the Water is to be Used

Crown allotment description

Allotment	*Portion*	*Section*	*Township*	*Parish*
64D				Jan Juc

Property address

ANGLESEA POWER STATION CAMP RD ANGLESEA 3230

This entitlement may be transferred to another parcel of land, if application is approved by the Authority.

Related Instruments

Related entitlements	Nil
Related works licence	WLE035161
Other related entities	Nil

Application History

Reference	*Type*	*Status*	*Lodged date*	*Approved date*	*Recorded date*
BER001814	Modify	Approved	20 Apr 2010	20 Apr 2010	
BEI479685	Issue	Approved	29 Aug 2009	29 Aug 2009	

Conditions

This take and use licence is subject to the following conditions:

Method of taking

1 Water may only be taken under this licence if it is taken by the methods expressly approved by this licence.

2 The licence holder must at all times provide the Authority with safe access to inspect all works and appliances used to take water under this licence.

Take location

3 Water may only be taken under this licence if it is taken at the location described as follows: the land parcels identified on this licence.

Take volume and rate

4 The volume of water taken under this licence in any twelve-month period from 1 July to 30 June must not exceed the licence volume, less any volume that has been temporarily transferred to another person or location.

5 The maximum volume that may be taken under this licence in any one day is 39.8 megalitres per day shared between 7 bores.

Temporary transfers to the licence holder

6 If there has been a temporary transfer of another licence to take water at the location, and use water on the land, specified in this licence: a) the extra volume of water taken must not exceed the volume transferred, and b) all the conditions of this licence apply to the taking and using of water consequential to the transfer.

Rosters and restrictions

7 When directed by the Authority, water must be taken in accordance with the rosters and restrictions determined by the Authority, and advised to the licence holder.

Metering of water taken and used

8 Water may only be taken under this licence if it is taken through a meter approved by the Authority.

9 Meters must be installed , in accordance with the specifications set by the Authority, at the licence holder's expense.

10 Meters used for the purpose of this licence are deemed to be the property of the Authority.

11 The licence holder must at all times provide the Authority with safe access to meters for the purpose of reading, calibration or maintenance.

12 The licence holder must notify the Authority within one business day if the meter ceases to function or operate properly.

13 The licence holder must, if required by the Authority, keep an accurate record of the quantity of water taken under this licence and allow the Authority to inspect this record at all reasonable times, and provide a copy of the record when requested.

14 The licence holder must not, without the consent of the Authority, interfere with, disconnect or remove any meter used for the purposes of the licence.

15 The Authority may, if it deems necessary, make an estimate of the total volume of water taken under this licence.

Use of water

16 Water taken under this licence may only be used on the land, and for the purposes, specified in the licence.

17 The licence holder must at all times provide the Authority with safe access to inspect the land on which water is licensed to be used.

Operation and maintenance

18 The licence holder must keep all works, appliances and dams associated with this licence,

including outlet pipes and valves, in a safe and operable condition, and free from obstacles and vegetation that might hinder access to works.

Preventing pollution

19 The licence holder must, construct and maintain bund walls around any hydrocarbon-fuel-driven engine, motor, fuel storage, or chemical storage used in connection with this licence, in accordance with the timeframe, specifications, guidelines and standards prescribed by the Authority.

Managing groundwater infiltration

20 The maximum volume of water that may be applied to the land referred to in the licence in any 12-month period from 1 July to 30 June is the annual use limit which is equal to the licence volume, or if the annual use limit is adjusted by the Authority on account of seasonal conditions this adjusted annual use limit.

Managing drainage disposal

21 Where water use results in drainage from the land specified in the licence, that drainage water must be disposed in ways that meet the standards, terms and conditions adopted from time to time by the Authority.

Fees and charges

22 The licence holder must, when requested by the Authority, pay all fees, costs and other charges under the Water Act 1989 in respect of this licence.

END OF COPY OF RECORD

Appendix B Amended Licence Documentation Provided by SRW

Appendix C Work Plan and Trigger Level Report

12-Month Groundwater Pumping Test Monitoring Plan Anglesea Power Station and Coal Mine

Prepared for:

Alcoa of Australia Limited

Prepared by:

EHS Support

May 2021

Document Control

REPORT DETAILS

Title:	12-Month Groundwater Pumping Test Monitoring Plan
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Main Author(s):	Chris Smitt, Ben Petrides
Approved By:	Nigel Goulding
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Appendix A Southern Rural Water Licence Documents
Appendix B Risk Assessment
Appendix C Bore Construction Details
Appendix D Permeability Results

Acronyms

ABP	Barwon Waters Anglesea Borefield Project
DBG	Demons Bluff Group
DELWP	Department of Environment, Land, Water and Planning
ERR	Earth Resources Regulator
GDE	Groundwater Dependent Ecosystem
GMA	Groundwater Management Area
LEVF	Lower Eastern View Formation
MEVF	Middle Eastern View Formation
MRCP	Mine Rehabilitation and Closure Plan
PWT	Perched Water Table
SRW	Southern Rural Water
UEVF	Upper Eastern View Formation

1 Introduction

During the progressive rehabilitation works (culminating in the completion of the major earthworks in June 2020 and native grassland hydroseeding on the southern slopes in September 2020) the mine void water level (also referred to as the pit water level) has been slowly rising as forecast as a result of natural groundwater recovery and direct rainfall and local catchment runoff only, refer **Figure 1-1**. It is estimated that allowing the pit to naturally fill would take between 50 and 100 years.

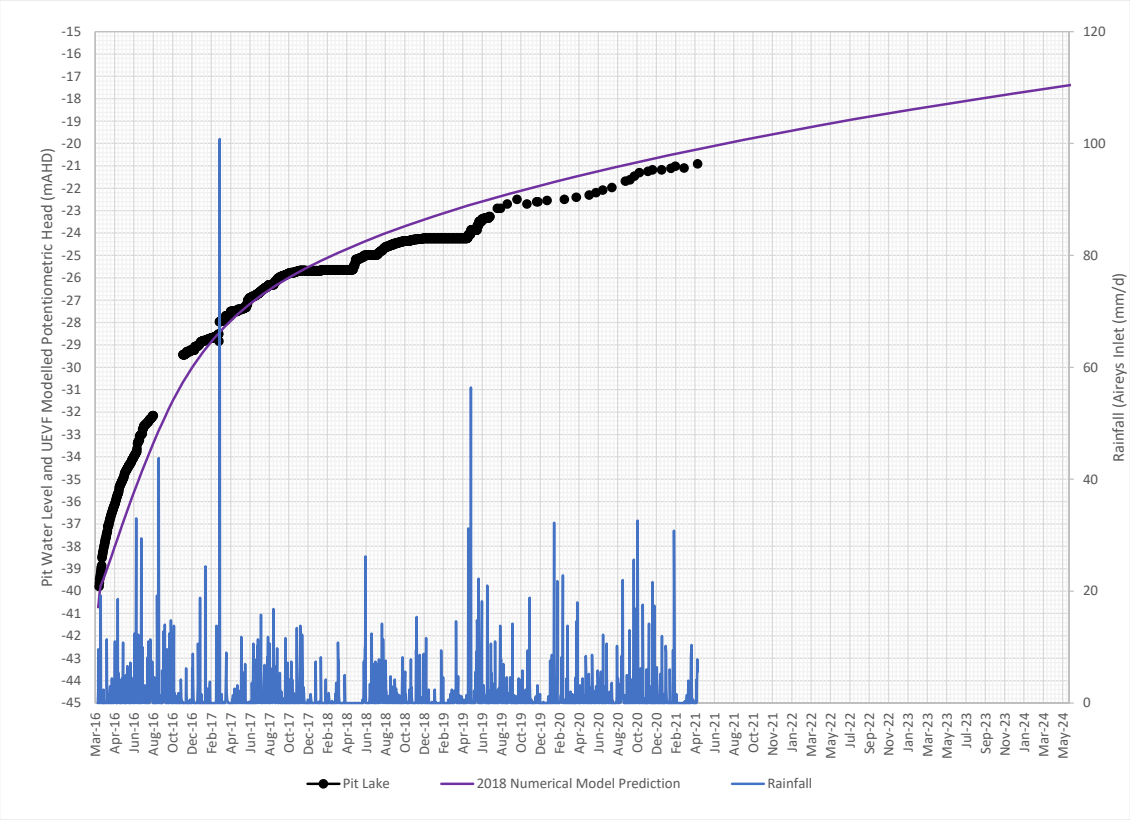

Figure 1-1: Actual and Predicted Natural Pit Water Level Recovery Over Time

Filling the mine void with water remains a key enabler for the draft Anglesea Mine Rehabilitation and Closure Plan (MRCP) as submitted to Earth Resources Regulator (ERR) in September 2017 (and the Eden Project Anglesea concept), with Alcoa's preferred "fast fill" strategy now based on a combination of surface water including potential peak flows from Salt Creek and groundwater sourced from the Upper Eastern View Formation (UEVF).

Whilst the use of surface water has not been agreed between Alcoa and the Department of Environment, Land, Water and Planning (DELWP), to enable further investigation of using groundwater and to commence the initial filling process, Alcoa proposes to undertake a 12-month groundwater pumping test of the Upper Eastern View Formation (UEVF) aquifer.

In September 2020, Alcoa submitted a Groundwater Impact Assessment (GIA) that looked at risks to the environment and other users if a 12-month groundwater pumping test of the UEVF aquifer was undertaken. On 26 October 2020, Alcoa received an amended groundwater licence from Southern

Rural Water (SRW) that permits the proposed 12-month groundwater pumping test and specifically the extraction of up to 1.5 GL of water '*for the purposes of discharging groundwater to the mine pit as part of the amended licence'*.

It should be noted that the proposed extraction rate is considered to be conservative compared to the long-term historical extraction of up to 4 GL per annum under Alcoa's existing UEVF groundwater licence during power station operation. The low extraction rate itself significantly mitigating any potential risks associated with the pumping test when compared to historical pumping.

A condition of the amended license was that *'An updated monitoring plan, including trigger levels and actions must be provided to SRW and accepted by SRW prior to any extraction occurring under this licence.*'

This monitoring plan is provided in response to that condition and as such also provides where necessary a summary of the GIA previously submitted.

1.1 Objectives of the Pumping Test

The overall objectives for the 12-month groundwater pumping test are to:

- Obtain additional hydrogeological data which can be used to develop a robust and peer reviewed numerical groundwater model that will determine if the use of longer term UEVF groundwater is a practical and environmentally sustainable water management strategy to fill the mine void as part of the MRCP (refer **Section 8**).
- Address data gaps identified in the draft MRCP (submitted to ERR September 2017 with a hydrogeological component update in 2018). These data gaps are summarised in **Section 1.7** of the original license amendment application referred to as the "Groundwater Impact Assessment".

To achieve this, it is proposed that the 12-month groundwater pumping test will be divided up into two periods each consisting of approximately six months, and is expected to;

1. within the first six (6) months:
    a. establish the required aquifer parameters;
    b. update the conceptual groundwater model; and
    c. Refine an existing numerical model (refer **Section 8**) that can be used to determine a sustainable extraction rate without unacceptable impact to other users or the broader environment.
2. After an approximate 2-week cessation period, groundwater extraction will then resume, and Period 2 will begin within the second six (6) months, and is expected to;
    a. complete model calibration and provide validation of the groundwater model and the associated risk assessment. This may involve Barwon Water pumping from the LEVF; and
    b. provide additional confidence to the community and key stakeholders.

The results will form part of a potential longer-term groundwater licence amendment application, with the aim that this will be submitted within the second 6-month period. The timing of the submission will be dependent on the results and ability of the numerical model to validate observed stress periods from the initial Period 1 trial.

As described above should the 12-month groundwater pumping test prove successful, Alcoa would prepare a further groundwater licence amendment to enable longer term use of the UEVF groundwater to support the mine void water body filling strategy (and also support the Eden

Project Anglesea concept) with this potentially being around 1.5 GL UEVF entitlement for up to 10 years. This would then be a key element in finalizing the submission of the Anglesea MRCP to ERR.

1.2 Objectives of the Monitoring Plan

The overall objectives for this monitoring plan are to:

- Provide the details of the groundwater monitoring network that will be used to monitor water level and water quality throughout the duration of the pumping test. This includes a rationale on bore locations.
- Provide a summary of environmental risks that the monitoring plan has been designed to protect or mitigate against potential impacts.
- To present a range of trigger levels for nominated trigger bores and contingency actions in the event a trigger level has been observed.

1.3 Take and Use Licence – BEE029662

On the 26 October 2020, SRW issued an amended groundwater licence including an Addendum (LH1575619) to the Take and Use Licence (BEE029662) and Licence to Operate Works (WLE0351661). These three documents are provided in **Appendix A**.

Outlined hereunder are the specific conditions in Addendum LH1575619;

1. *Alcoa's 4,000 ML Take and Use Licence BEE029662 has been amended to now include provision for the use 1,500 ML of the 4,000 ML to cater for what is effectively an eighteen (18) month pump test to facilitate the filling of the mine void at the now closed Anglesea Power Station and Coal Mine during this period and enable and establish the longer-term filling of this mine void.*
2. *The daily extraction rates from bores WRK041318 (WB16) and/or WRK041316 (WB14) combined is limited to 5.18ML/day (60 L/sec) and a total of 1,500 ML for the total duration of the 18-month licence.*
3. *An updated monitoring plan, including trigger levels and actions must be provided to SRW and accepted by SRW prior to any extraction occurring under this licence.*
4. *Monthly reporting must be provided to SRW of progress with the test and test results, including trigger levels and actions within four (4) weeks of the end of each calendar month.*
5. *The monthly monitoring report must include groundwater levels for bores P8/P12/P19 and reporting against Barwon Water's bulk entitlement trigger levels. In the event that these triggers are crossed while Alcoa is pumping then further analysis of the potential impacts must be undertaken by Alcoa and reported to SRW.*
6. *Confirmation is required prior to commencing extraction that the current Cultural Heritage Management Plan (CHMP) LH1575619 applies to both the area and the activity proposed.*

Note that the amended licence allows 18 months for completion of the proposed groundwater pumping test, allowing time prior to commencement for additional approvals (ERR), equipment set up, and completion of Item 3.

1.4 Key Tables and Figures in this Water Monitoring Plan

Table 1-1 provides an summary of key figures and tables within this monitoring plan.

Table 1-1 Key Tables and Figures

Reference	Description
Table 3-1	Presents the modelled groundwater levels within all monitoring bores after 3, 6, 9 and 12 months respectively at a pumping rate of 1.5Gl per annum. Note: a positive number means the system is recovering, a negative number indicates drawdown
Figure 3-2 to Figure 3-5	Visually presents the modelled drawdown in the lower sands (pumped section) of the UEVF after 3, 6, 9 and 12 months respectively at a pumping rate of 1.5Gl per annum
Table 3-2	Water level trigger rules
Figure 4-2	Location al all bores within the broader catchment
Figure 4-3	Monitored bores (trigger and observation bores)
Table 4-3	Basic construction details of monitoring and trigger bores
Table 5-1	Proposed stages of the aquifer testing program
Table 6-1	Summary of water level triggers and how each trigger is related to risk
Table 6-1	Summary of trigger level actions
Table 7-1	Schedule of water quality sampling for each bore and mine water body
Table 7-2	The analytical suite

2 Background Information

The majority of the information presented in this section is provided for report flow and data familiarity and to give the reader some context related to the environmental conditions. This section has been summarised from the GIA submitted to SRW in September 2020 which led to the issuing of an amended groundwater licence to allow for a 12-month pumping test of the UEVF.

2.1 Hydrogeological Summary

A lithological summary of the main hydrostratigraphic units at the Site is provided in **Table 2-1**. The aquifer of focus for the pumping test investigation is the deeper zone of the UEVF (refer blue highlight in **Table 2-1**). A summary of this unit is provided in the following sections. **Figure 2-1** and **Figure 2-2** visualise the first 60 m beneath the broader site (former coal mine and power station).

Table 2-1 Lithological Summary

Hydrostratigraphic Unit	Unit	Elevation (mAHD)	Approx. Thickness (m)	Lithology
DBG	PWT Aquifer	+40 to +5	0 to 1	Topsoil
			2 to 20	Sandy clay.
	Boonah Sands Aquifer of the DBG	+20 to -10	1 to 25	Sequences of sands, clay, minor coal and silty clay
UEVF	Main Seam	-10 to -65	40 (25m of coal)	Coal
	Basal Clay	-15 to -70	1 to 4	Low permeability clay
	UEVF Upper Sands	-30 to -80	5 to 30	Sequences of coarse-grained sands and gravels interbedded with thin low permeability clay and coal
	L1 to L3 Seams and Interburden	-80 to -130	40 to 80	Thick sequences of low permeability coal, clay and thin sands
	Sub L3 Seam Sediments	-180 to -220	50 to 100	Low permeability coal and clay interbedded with discontinuous sand layers
	UEVF Basal Aquifer	**-230 to -280**	**30 to 60**	**Sands interbedded with silt, clay and thin coal**
MEVF	Aquitard	-285 to -355	40 to 70	Shale/mudstone
LEVF	Aquifer	-500	200 to 300	Sands interbedded with silt, clay and thin coal
Torquay Group	Basement	-500 +	>50	Bluey white sandstone

DBG – Demons Bluff Group
PWT – Perched Water Table
MEVF – Middle Eastern View Formation
LEVF – Lower Eastern View Formation

UEVF – Upper Eastern View Formation

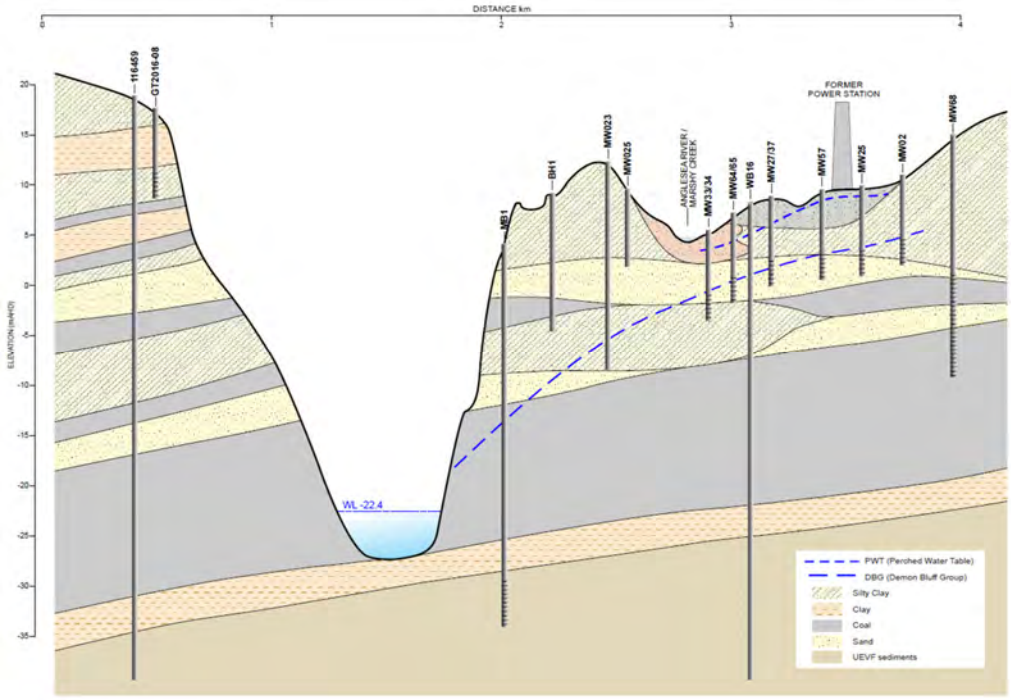

Figure 2-1: Mine Void CHM Cross-Section 1 (Water Levels from 2019)

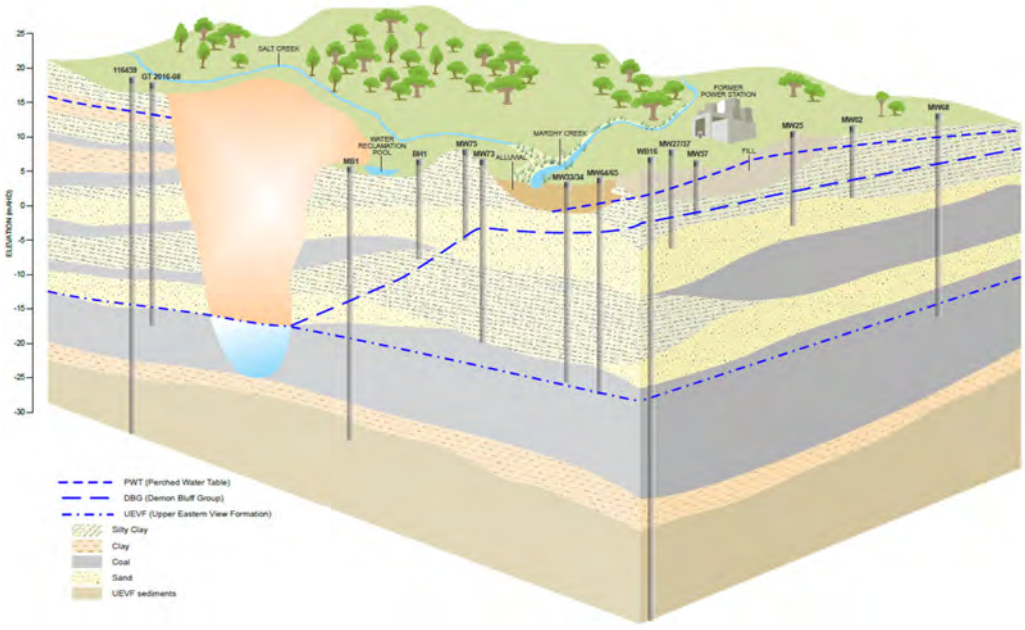

Figure 2-2: Mine Void CHM Cross-Section 2 (Water Levels from 2019)

2.1.1 Eastern View Formation

Hydrogeologically, the EVF can be sub-divided into three main units, namely the Lower, Middle and UEVF. In the vicinity of the coal mine, the upper unit is considered to be an unconfined to semi-confined aquifer, the middle unit an aquitard and the lower unit a confined aquifer. Broadly speaking, these water-bearing zones approximately represent the individual main aquifers within the EVF. However, sand aquifers occur at all levels in the sequence with potentiometric pressures increasing with depth, which means that multiple aquifers may exist within the one formation. **Figure 2-3** shows a cross-sectional relationship of each main formation from the ranges to the coast.

2.1.2 Upper Eastern View Formation

Generally, the UEVF forms an unconfined (where it outcrops) to confined aquifer and consists of clay, silty clay, silt and fine to medium-grained sand sequences with minor fine gravel lenses. A thick (20-30m) seam of brown coal is also common in the top of the UEVF sequence. In the vicinity of the coal mine, the UEVF is semi-confined, and approximately 200 to 250 m thick. Whilst the unit has been classified as a single aquifer, evidence of different potentiometric heads exists throughout the profile.

The 2020 drilling and wireline logging of 16 new bores and permeability testing of one new bore surrounding the coal mine (refer **Figure 4-3**) as well as wireline logging of the deeper production bores adjacent to the Power Station have also indicated that the UEVF can potentially be broken up into two more significant permeable units. Below the main coal seam and confining clay, a sequence of coarser sands ranging in thickness of 5-20 m is often identified, refer to **Photo 2-1** . This is referred to as the UEVF Upper Sands in **Table 2-1**. This upper sand is then separated by thick (100 m or more) of low permeability coal and clay (average permeability of $1x10^{-9}$ m/sec) before a lower section of coarser sands is found at the base of the UEVF. This is referred to as the UEVF basal aquifer in **Table 2-1**. These lower sands are where the former Alcoa production bores are screened and where the proposed pumping test bore (WB16) is screened, which is also located approximately 1.6 km from the mine pit void water body.

Photo 2-1 Photos of the UEVF Upper Sands from UEVF MB7

2.1.3 Middle Eastern View Formation

The MEVF is approximately 40 to 60 m thick and generally behaves as an aquitard by restricting vertical groundwater flow between the UEVF and LEVF. The MEVF generally consists of mudstone and siltstone, but also has minor sand and gravel lenses as well as thin brown coal layers. The unit generally appears to be continuous and consistent in thickness throughout the Anglesea area.

2.1.4 Lower Eastern View Formation

The LEVF forms a confined to semi-confined aquifer (in the upper parts of the catchment) across the region and consists of unconsolidated micaceous silts, carbonaceous clays, silty clays, thin brown coal seams and fine to coarse-grained sands and gravels. At the Site the LEVF is up to 200 m thick where aquifer material occurs within geological synclines. Groundwater total dissolved solids (TDS) in the LEVF is fresher than that observed in the UEVF.

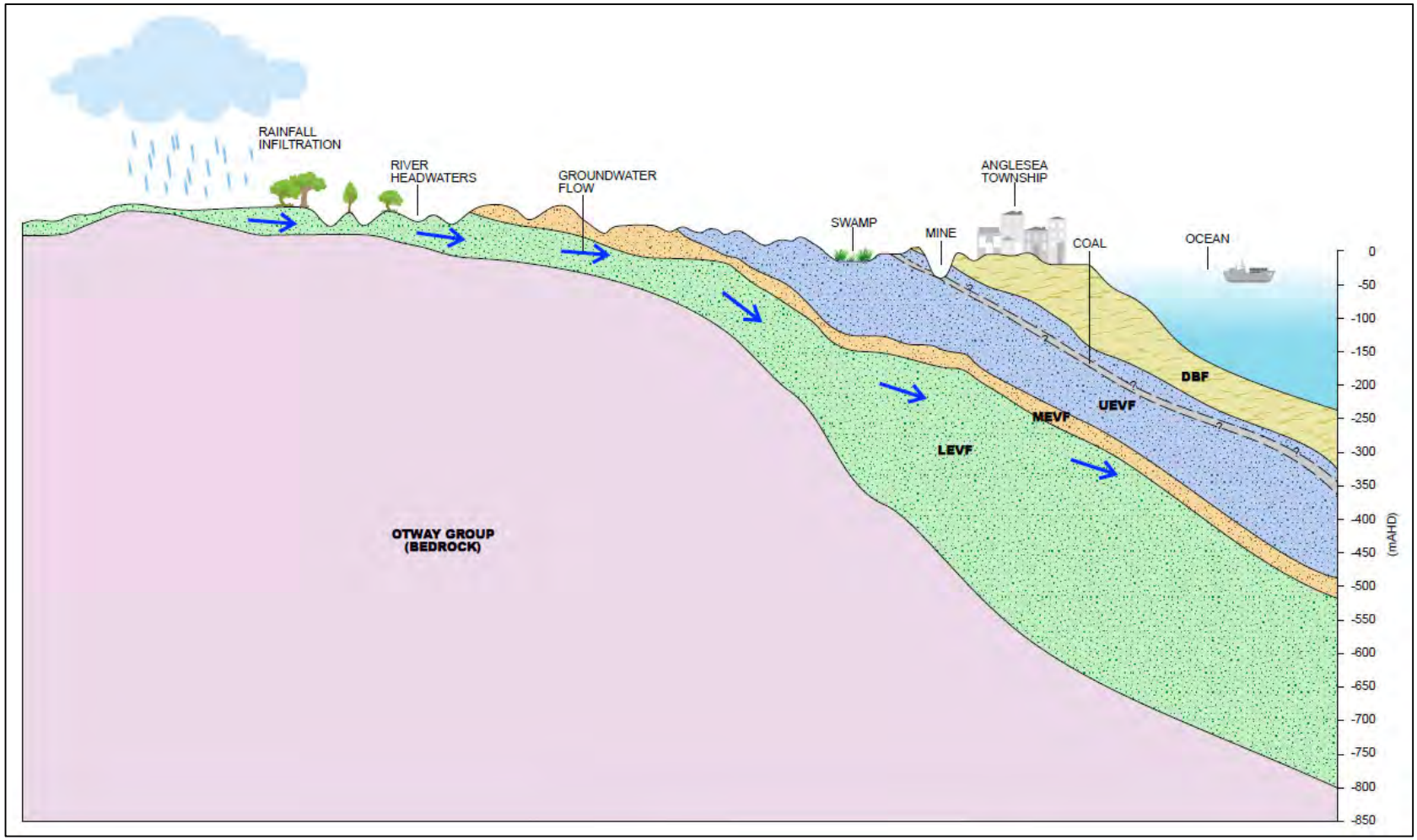

Figure 2-3 Regional Cross-Section (after GHD, 2013)

2.2 Groundwater Users

The location of the groundwater users (such as private and commercial water bores) are shown in **Figure 2-4**.

2.2.1 Private Bores

Groundwater bores within the local area have been determined through a search of the Victorian Water Measurement Information System (WMIS), refer **Figure 2-4**. The WMIS database was undertaken in October 2020 to identify registered bores within a 10 km buffer of the mine pit void and within the Jan Juc Groundwater Management Area (GMA).

A high density of stock, domestic and irrigation bores are located to the north-east of the Jan Juc GMA (north of Torquay); however, these bores are generally shallow and intersect the groundwater resources of the Beaumaris Sandstone (formerly known as the Moorabool Viaduct Sands) or the shallow sediments of the DBG. Of these bores, only two appear to be completed in the UEVF aquifer. Bore ID 68160 is completed to a depth of 278.9 m and located ~3 km south-east of the mine near the coast. Bore ID 68179 is completed to a depth of 28 m in coal and is ~8.5 km north-east of the mine.

The Moriac Quarry also has a licence to extract 250 ML/year. The quarry is located ~13 km north of the mine pit void with groundwater extracted from the LEVF (up-gradient of the Site) and used for industrial sand washing purposes.

Modelling simulations undertaken using conservative analytical solutions (i.e. Thies and Hantush-Jacob equations) predict no drawdown (Hantush-Jacob) and up to a maximum drawdown of 3.2 m (Thies) may be observed after 12 months of pumping at the nearest stock and domestic bore, 7 km from the pumping bore WB16. At the maximum drawdown case, this equates to a 1.4% loss of available drawdown assuming the licensed bore is screened within the UEVF. It is noted that predictions from the numerical groundwater model did not indicate any drawdown at this licensed stock and domestic bore. In fact numerical modelling suggests dewatering impacts resulting from the pumping test are likely to extend just under 3km, refer **Figure 3-2** to **Figure 3-5**.

2.2.2 Barwon Water Observation and Production Bores

Between 2007 and 2013, Barwon Water installed seven production bores (GW1 to GW7) in the LEVF and 42 observation bores in the LEVF, UEVF, DBG and PWT aquifers. These are shown in **Figure 4-2**.

2.3 Groundwater Dependant Ecosystems

Groundwater dependent ecosystems (GDE) as defined by the *Ministerial guidelines for groundwater licensing and the protection of high value groundwater dependent ecosystems 2015* means those ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals and ecological processes they support and the ecosystem services they provide. This definition has also been used in the recent Anglesea River and Estuary Environmental Flow Study (GHD 2021).

Whilst there is always conjecture in determining the degree of groundwater reliance of certain GDE's (a process that often takes years and a high level of detailed studies to define), GHD 2021 present that within the Anglesea River Catchment there are some vegetated communities in the swamplands (defined as the Perched Water Table, PWT) that rely on less than 10% groundwater contribution and therefore meet the definition of a GDE. These swamplands are typically found in the mid and upper reaches of Salt Creek and Marshy Creek and are shown on **Figure 2-4**. Importantly no other GDEs or areas where they could exist were identified and GDE's were identified to be in direct connection to the UEVF. GHD 2021 also state that low permeability coal and clay underlying the PWT act as an aquitard separating the UEVF and the PWT. This is an observation that is supported by recent drilling and permeability testing, refer to **Section 4.3.1** with other multiple lines of evidence suggesting that the PWT is hydraulically disconnected from the UEVF. These are:

- Historical monitoring of DBG/PWT in the vicinity of the former Power Station show no changes in water level over time at historical pumping rates approximately 2.5 times that proposed for the 12-month pumping test.
- Extensive sequences of very low permeability coal, clay and silty clays separate the base of the PWT (and surface water features) to underlying aquifers, refer **Photo 2-2**. (These impermeable units are presumably the reason the PWT exist).
- Pre-development (Hancock, 1967) noted strong artesian conditions at the former Power Station from a bore screened in the UEVF at 138 mbgl. This indicates that the presence of clay layers between the surface and the water bearing zones of the UEVF are strongly confining.

Photo 2-2 Photos of the Clay Sections Within UEVF MB7 between the Upper and Lower Sands

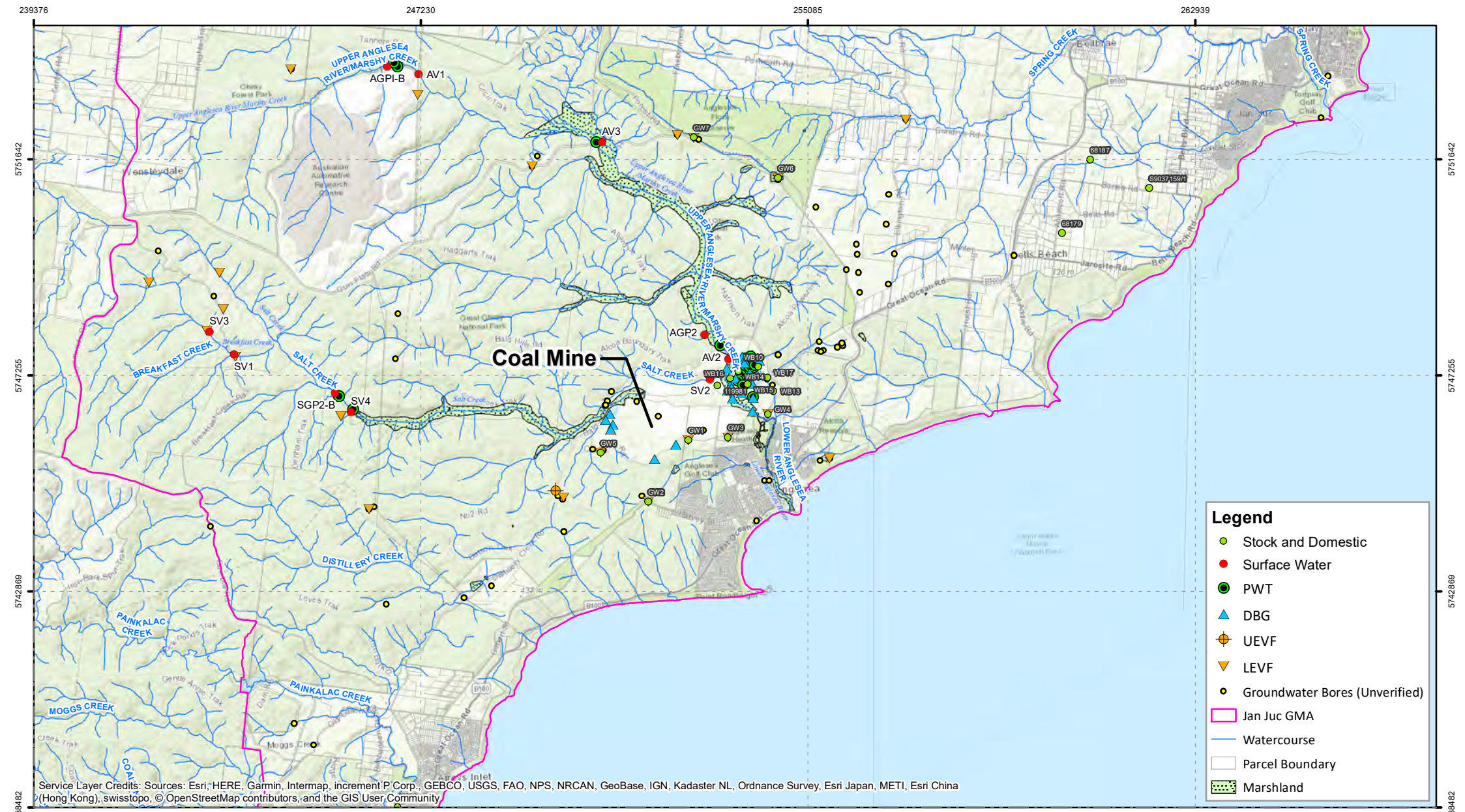

Figure 2-4

Groundwater Users, Environmental Sensitive Receptors and Gauge Locations

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Alcoa Anglesea Hydrogeological Investigation

DATE:	13/04/2021
CREATED BY:	G. Hatton [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	02
MAP PROJECTION:	GDA94
SCALE:	1:100,000

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Kilometers

0 1.25 2.5 5

3 Risk Assessment Overview

Two risk assessment processes were undertaken as part of determining the potential risks associated with the 12-month groundwater pumping test. These were:

1. A conventional risk assessment (e.g. consequence and likelihood) which was undertaken as part of the ERR Work Plan Notification process. This risk assessment aimed at identifying the risks that the activities may pose to the environment, to any member of the public, or to land or property in the vicinity of the activities.
2. A quantifiable risk assessment as part of the GIA which used a numerical model to quantify potential drawdown related impacts to overlying aquifers and surrounding beneficial users.

An overview of each "risk assessment" is provided below.

3.1 ERR Work Plan Risk Assessment

In December 2020 Alcoa submitted a risk assessment to ERR as part of the ERR Work Plan Notification – 12 Month Groundwater Pumping Test process, informing ERR of Alcoa's plan to undertake a 12-month pumping test with placement of the groundwater into the mine void. The risk assessment followed the process and definitions (e.g. likelihood and consequence ratings) as outlined in Version 6 Risk-based work plan using online RRAM - Guidelines for mining industry projects, issued by the Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

This framework, along with risk assessment matrix's are attached in **Appendix B**. A summary of the risk assessment outcome is presented below.

With respect to water, the risk assessment identified as assessed the following risks (Elements):

1. Equipment failure resulting in groundwater to be discharged to surface water systems.
2. Pumping of groundwater resulting in a reduction of baseflow to surface water systems and potential GDE's.
3. Pumping of groundwater results in unacceptable impacts to stock and domestic bores and LEVF production bores.
4. Placing 1.5GL of water into the pit void adversely impacts surface water quality.
5. Placing 1.5GL of water into the pit void results in mine water migration into the UEVF.
6. Placing 1.5GL of water into the pit void results in the DBG and consolidated ash material to become saturated.
7. Equipment failure resulting in unplanned release of water causing erosion.
8. Equipment failure resulting in unplanned release of fuels or oil on to the ground.

Based on the consequence and likelihood classifications (noted above) and after adopting the appropriate control measures, all residual risks for the above are low. Of the above, items 2, 3 and 5 were addressed in the GIA with water level trigger levels for nominated trigger bores being adopted as a mitigation measure to ensure these risks remain low, refer **Section 6**.

3.2 Groundwater Impact Assessment

While it is considered unlikely that there are any GDEs in direct connection to the UEVF (i.e. the aquifer most likely impacted as a result from pumping - refer **Section 2.3**), and there are no other licenced users of groundwater within the targeted aquifer (i.e. UEVF), a numerical groundwater model was still developed to quantify the following potential impacts of the 12 month pumping test:

1. What is the drawdown in the UEVF and DBG as a result of the 12-month pumping test?
2. Will pit water recharge the underlying aquifer at the proposed extraction rate?
3. Will the proposed pumping test impact on environmental assets such as the Anglesea River estuary or unmapped GDE's?

The outputs of this impact assessment are presented in **Table 3-1** (note a positive number means the system is recovering). **Figure 3-2** to **Figure 3-5** present modelled drawdown in the lower sands (pumped section) of the UEVF after 3, 6, 9 and 12 months respectively at a pumping rate of 1.5Gl per annum.

The results indicate that leakage of pit water into the UEVF is not expected as there is no drawdown expected in the permeable zone of the UEVF located beneath the basal clay (UEVF upper sands) as well as the DBG and by association the PWT. Drawdown in the lower sands (where the pumping bore is screened) ranges from 45m at the pumping bore and roughly extending 2.5km before drawdown dissipates.

To validate these findings, state observation bore (SOB) 116459 screened in the lower sands of the UEVF located ~3km west of the pumping bore has exhibited a decline of 0.5m per year since 1998, refer **Figure 3-1**. This trend which may have been impacted by both Alcoa's historical pumping (which was previously undertaken at a rate more than 2.5 times what is proposed for this pumping test) as well as a significant decline in rainfall since the onset of the millennium drought, suggests that the modelled extent of drawdown is a reasonable estimate.

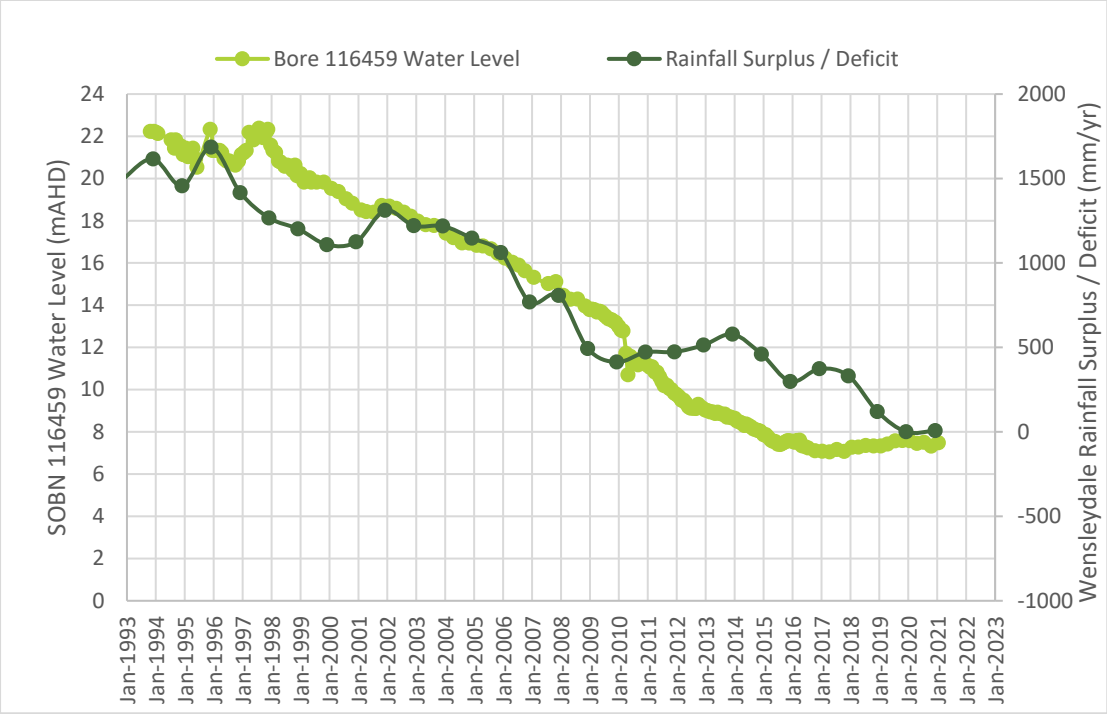

Figure 3-1 Historical Water Level in SOB 116459 and Wensleydale Rainfall Surplus/ Deficit

Table 3-1 Modelled Change in Groundwater Levels at Monitoring Locations Surrounding the Mine (note a positive number means the system is recovering, negative number indicates drawdown).

Bore ID	Aquifer Monitored	Screen interval (mbgs)	Well depth (mbgs)	Distance from WB16 (m)	Pumping WB16 @ 50 L/sec (Numerical Model)				
					Water Level at Time of Pumping (m)	3-month	6-month	9-month	12-month
						Change in Groundwater Level (m)	Change in Groundwater Level (m)	Change in Groundwater Level (m)	Change in Groundwater Level (m)
DBG MB1	DBG	37 – 40	42	2474	-17.52	+0.15	+0.30	+0.45	+0.60
DBG MB2	DBG	60 – 63	64	1904	-18.58	+0.19	+0.39	+0.58	+0.76
DBG MB3	DBG	69 - 72	73	1575					
DBG MB4	DBG	35 – 38	40	1002	-20.30	+0.30	+0.59	+0.86	+1.12
DBG MB5	DBG	18 – 21	24	794	-20.65	+0.36	+0.71	+1.04	+1.36
DBG MB6	DBG	34 – 37	40	1299	-20.20	+0.31	+0.63	+0.92	+1.21
DBG MB7	DBG	8 – 11	13	1644	-20.09	+0.29	+0.60	+0.89	+1.17
DBG MB8	DBG			2297					
MW27	PWT/DBG	10 -15	15	362	-21.20	+0.44	+0.87	+1.25	+1.62
MW29	PWT/DBG	6-12	12	214	-21.51	+0.53	+1.05	+1.51	+1.95
MW33	PWT/DBG	8 – 14	14	241	-21.13	+0.41	+0.82	+1.18	+1.54
MW37	PWT/DBG	3 – 6	6.6	231	-21.42	+0.52	+1.02	+1.46	+1.89
MW64	PWT/DBG	7 – 13	13	111	-21.42	+0.50	+0.98	+1.40	+1.82
UEVF MB1	$UEVF_U$	92 – 98	100	2473	-17.70	+0.15	+0.30	+0.45	+0.60
UEVF MB2	$UEVF_U$	122 – 128	130	1903	-18.71	+0.19	+0.38	+0.57	+0.75
UEVF MB3	$UEVF_U$	139.3 - 145.3	150	1540					

Bore ID	Aquifer Monitored	Screen interval (mbgs)	Well depth (mbgs)	Distance from WB16 (m)	Pumping WB16 @ 50 L/sec (Numerical Model)				
					Water Level at Time of Pumping (m)	3-month	6-month	9-month	12-month
						Change in Groundwater Level (m)	Change in Groundwater Level (m)	Change in Groundwater Level (m)	Change in Groundwater Level (m)
UEVF MB4	$UEVF_U$	71 – 77	79	1002	-20.33	+0.29	+0.59	+0.86	+1.13
UEVF MB5	$UEVF_U$	59 – 65	66	794	-20.68	+0.35	+0.70	+1.01	+1.32
UEVF MB6	$UEVF_U$	69 – 75	77	1298	-20.26	+0.31	+0.62	+0.90	+1.19
UEVF MB7	$UEVF_U$	42 – 51.6	52.6	1644	-20.15	+0.29	+0.59	+0.88	+1.16
UEVF MB8	$UEVF_U$			2327					
WB4	$UEVF_L$	108.2 – 195	222.5	442	-9.55	-6.77	-10.46	-12.40	-13.65
WB5	$UEVF_L$	132 – 216.6	220.1	262	-11.33	-11.23	-15.16	-17.18	-18.47
WB12	$UEVF_L$	147.2 – 221.3		28	-12.28	-28.77	-32.70	-34.68	-35.95
WB14	$UEVF_L$	155.9 - 213.7	218.8	228	-11.47	-12.56	-16.52	-18.54	-19.84
WB15	$UEVF_L$	186.8 - 247.5	250.5	371	-12.59	-6.65	-9.94	-11.74	-12.94
WB16 – Pumping Bore	$UEVF_L$	173.7 – 220.2	226.4	0	-12.21	-37.91	-41.87	-43.87	-45.14
116459	$UEVF_L$	243 - 246	253	2986	-12.82	+0.34	+0.65	+0.90	+1.09

$UEVF_U$ = Upper Sands of the UEVF
$UEVF_L$ = Lower Sands of the UEVF

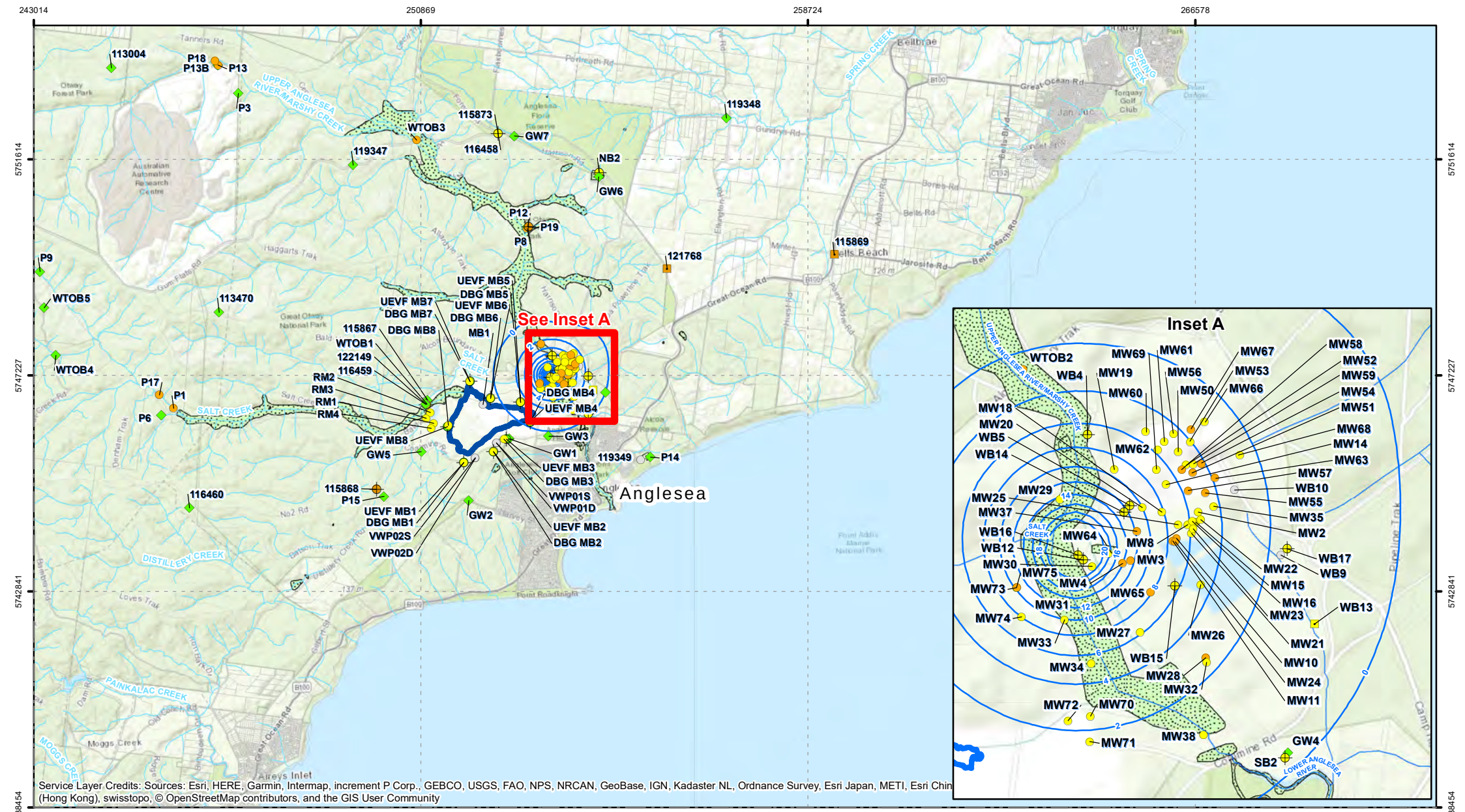

Figure 3-2 Modelled Drawdown in the Lower Sands of the UEVF after 3 Months

Monitoring Bore - Aquifer Monitored

- Demons Bluff Group - Perched Aquifer (Alluvial)
- Demons Bluff Group - Boonah Sands Aquifer
- UEVF
- UEVF (Basal Sands)
- UEVF (Upper Sands)
- UEVF/MEVF
- UEVF/LEVF
- LEVF
- Decommissioned
- Groundwater Contour (mAHD)
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

DATE:	14/04/2021
CREATED BY:	A. Smith [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:100,000

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Kilometers

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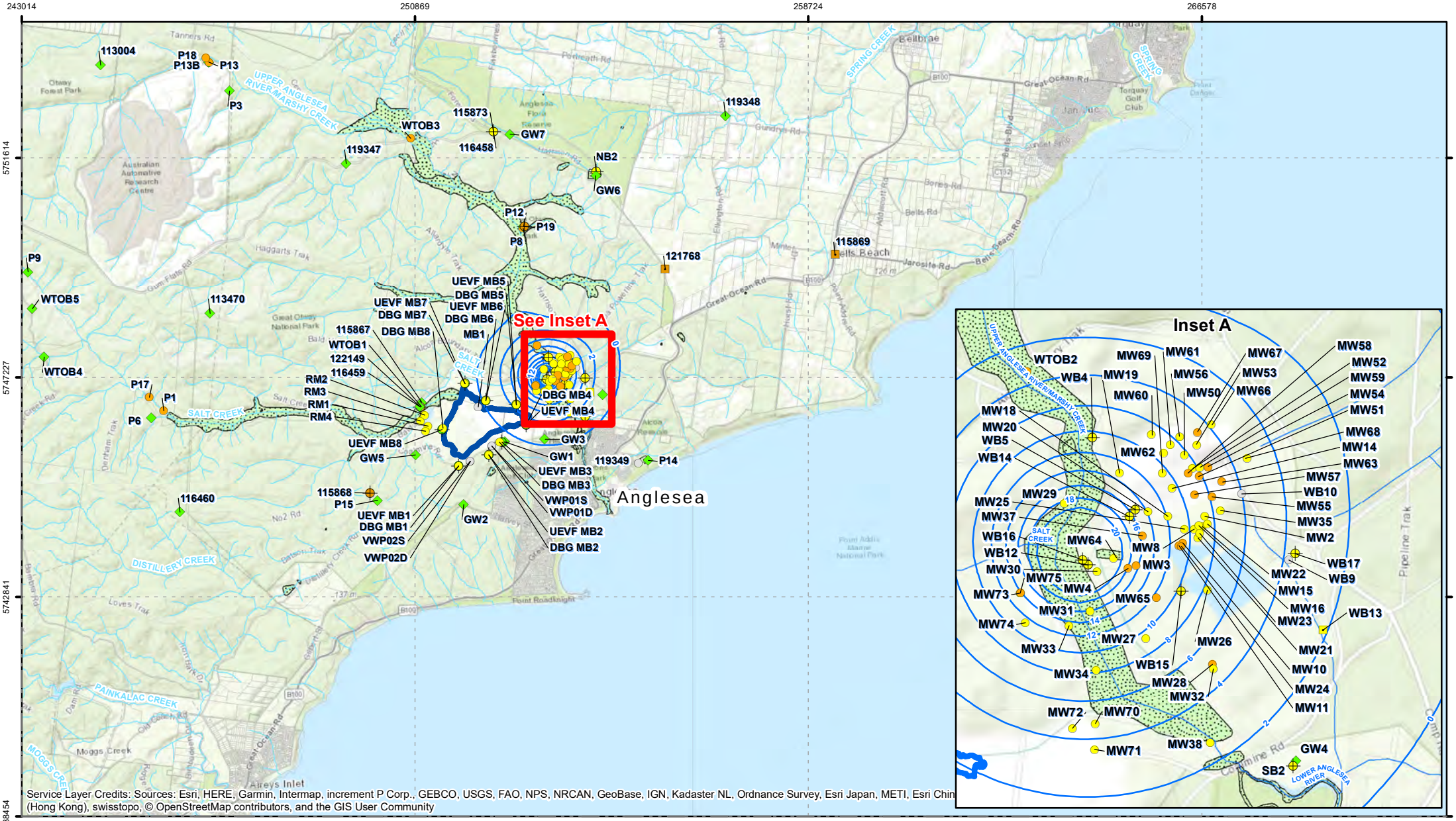
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Anglesea
Aireys Inlet
Moggs Creek
Bellbrae
Torquay
Jan Juc
Belmont
Belmont Beach
Point Addis Marine National Park
Point Roadknight
Australian Automotive Research Centre
Great Otway National Park
Anglesea Flora Reserve
Torquay Golf Club
UPPER ANGLESEA RIVER/MARSHY CREEK
SALT CREEK
DISTILLERY CREEK
PAINKALAC CREEK
SPRING CREEK
MOGGS CREEK
LOWER ANGLESEA RIVER
Great Ocean Rd
Anglesea Rd
Bells Blvd
Bells Rd
Belmont Rd
Jarosite Rd
Belmont Rd
Pipeline Trak
Loves Trak
Haggarts Trak
Derham Trak
Gum Flats Rd
Tanners Rd
Portreath Rd
Gundry Rd
Borea Rd
Elwington Rd
Aldersott Rd
Thirsk Rd
Plank Addis Rd
Old Coach Rd
Dam Rd
Hunt Rd
Gilpin Dr
Bamboo Rd
Creek Rd
No2 Rd
Patsons Trak
Distillery Creek Rd
Airey Trak
Alcoa Reserve
Anglesea Golf Course
Anglesea Heath
Anglesea Powerline Trak
Harrison Trak
Allanvale Trak
Fairbairn Rd
Forrest Rd
Fairbairn Rd
Gilpin Dr
Hunt Rd
Old Coach Rd
Dam Rd

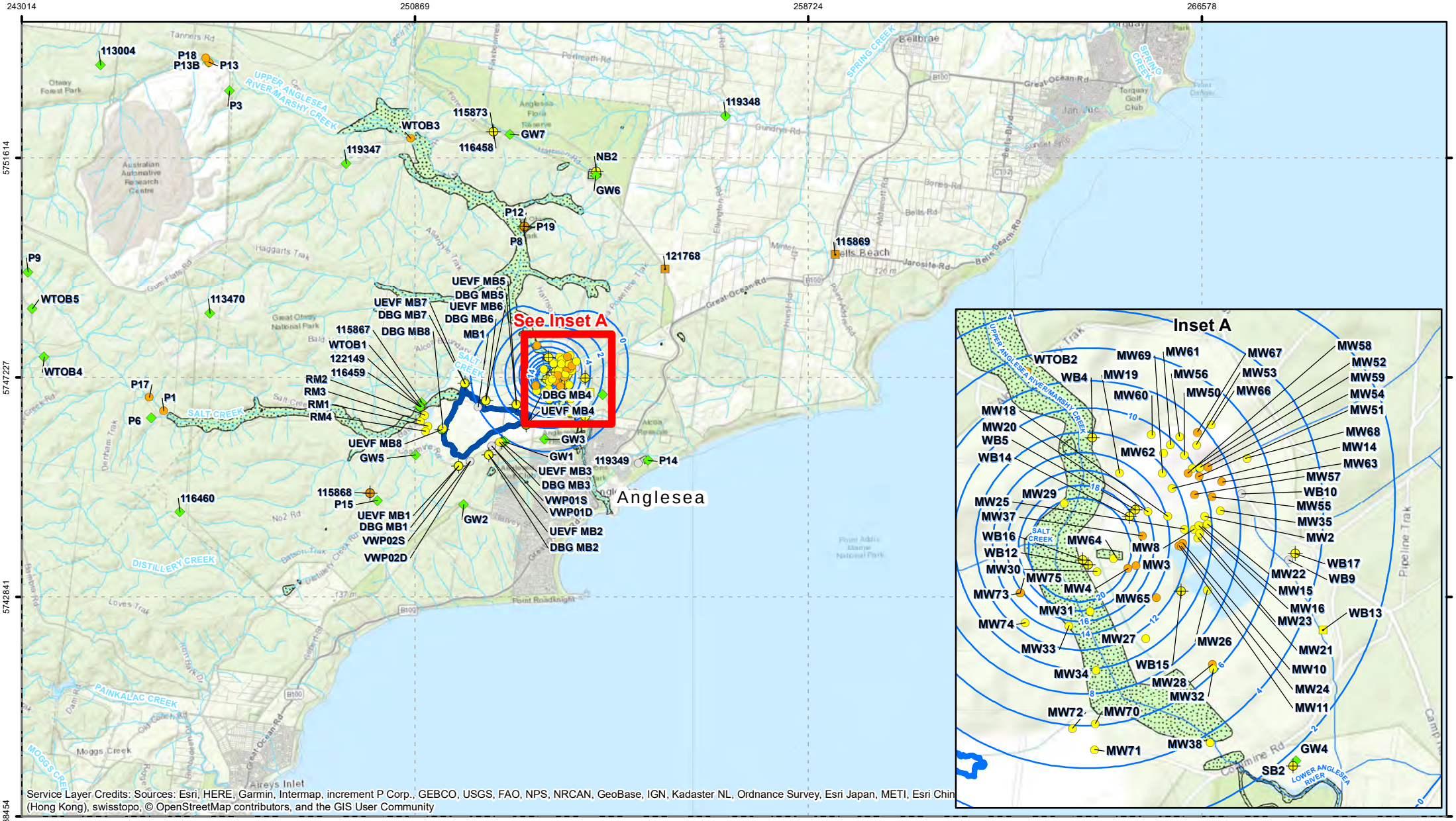

Figure 3-4 Modelled Drawdown in the Lower Sands of the UEVF after 9 Months

Monitoring Bore - Aquifer Monitored

- Demons Bluff Group - Perched Aquifer (Alluvial)
- Demons Bluff Group - Boonah Sands Aquifer
- UEVF
- UEVF (Basal Sands)
- UEVF (Upper Sands)
- UEVF/MEVF
- UEVF/LEVF
- LEVF
- Decommissioned
- Groundwater Contour (mAHD)
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

ALCOA

EHS Support

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

DATE:	14/04/2021
CREATED BY:	A. Smith [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:100,000

N

Kilometers

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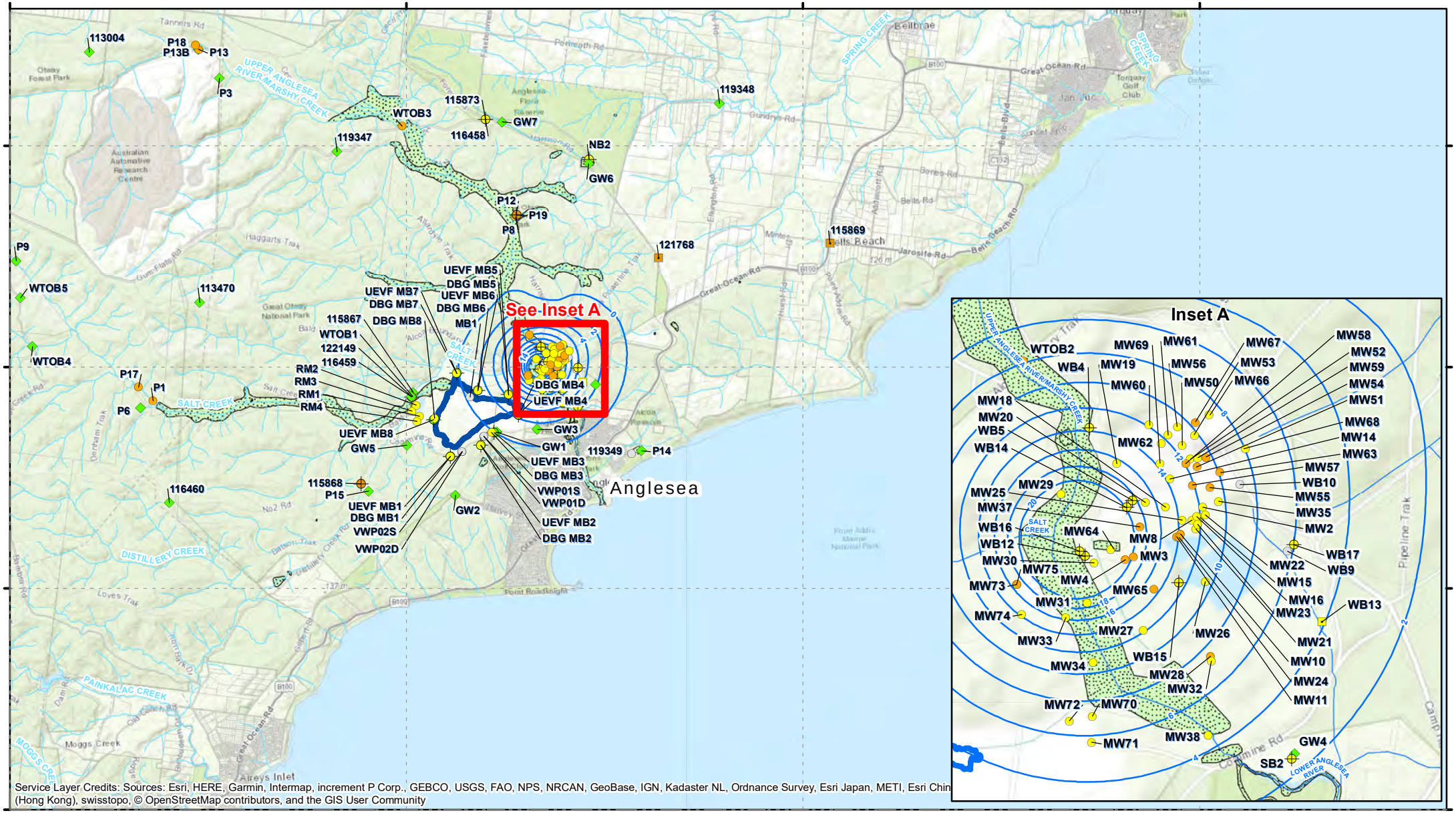
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3.3 Summary of Risks to by Managed by this Monitoring Plan

As highlighted in the above sections, dewatering risks to GDE's and leakage from the mine pit into the underlying aquifer (the key risks to be mitigated) are expected to be negligible to low. However due to model and data uncertainty, risks associated with these assets will form a key part of the monitoring plan to ensure these risks remain low. As presented in **Section 6**, five (5) water level trigger rules are proposed with the rationale for each shown in **Table 3-2**.

Table 3-2 Water Level Trigger Rules

Trigger Rule	Method to Determine Trigger	Rationale (What Risk Does Rule Relate to)
Trigger Rule 1	Median monthly water level - 2 x Std Dev	Mitigate against dewatering impacts to GDE's connected to shallow aquifers (DBG/PWT).
Trigger Rule 2	Median monthly water level - 3 x Std Dev	
Trigger Rule 3	Historical low water level	
Trigger Rule 4	Predicted drawdown after 12 months	Mitigate against dewatering impacts of beneficial users where the UEVF outcrops.
Trigger Rule 5	If the level of Pit water level reaches - 15.5mAHD.	Manage the short-term risk of pit water migrating into the DBG and also reaching the level where historical ash was consolidated above RL -15m (north east corner of the mine) as an EPA licenced activity and covered with at least 1m of sandy clay overburden material. Note the water level is not expected to reach RL -15m during the 12-month pumping test.

It should be noted that as this is a pumping test, impacts resulting from stress testing the aquifer are required as this is the purpose of a pumping test. The aquifer needs to be sufficiently stressed (in this case de-watered) in order to obtain high quality parameters which can inform the development of a robust and fit for purpose longer term numerical model (the proposed One Model) discussed in **Section 8**.

4 Current Baseline Data

Note that with the exception of the mine pit water body, baseline surface water data will not form part of this monitoring plan. Whilst surface water data at gauging stations within the catchment is collected for other MCRP activities, it does not form a requirement for a pumping test monitoring plan.

4.1 Mine Pit Water Quality and Level

Surface water has been collected within the low point of the mine pit void and consists of rainwater runoff and groundwater recharge from the UEVF and the overlying DBG sediments.

Between July 1999 and April 2021, analysis of the mine pit void water has reported limited variability of the majority of analytes measured above the limit of reporting (LOR). TDS is observed to vary between 1,300 and 2,200 mg/L (refer **Figure 4-1**) and this appears to be influenced by increases in major ions particularly sulfate. These variations may be related to historical differences in water body location testing and/or the differing chemistry of groundwater and mine pit void runoff that contribute to the mine pit void water body. Although runoff is considered to comprise a small component of the water body volume, the sample location could be locally influenced by runoff to a greater extent than groundwater discharging to the water body.

The likely beneficial uses are therefore potentially limited to maintenance of freshwater ecosystems. However, exceedances of the maintenance of freshwater ecosystems (95th percentile) beneficial use are observed for magnesium, iron, aluminium, boron and copper (refer **Table 4-1),** (these guideline values are more conservative than the Australian Drinking Water Guidelines [ADWG] values).

It should be noted that natural background surface water quality in the area is characteristic of the low pH, elevated aluminium, boron and other trace metals reported within the mine pit void water body.

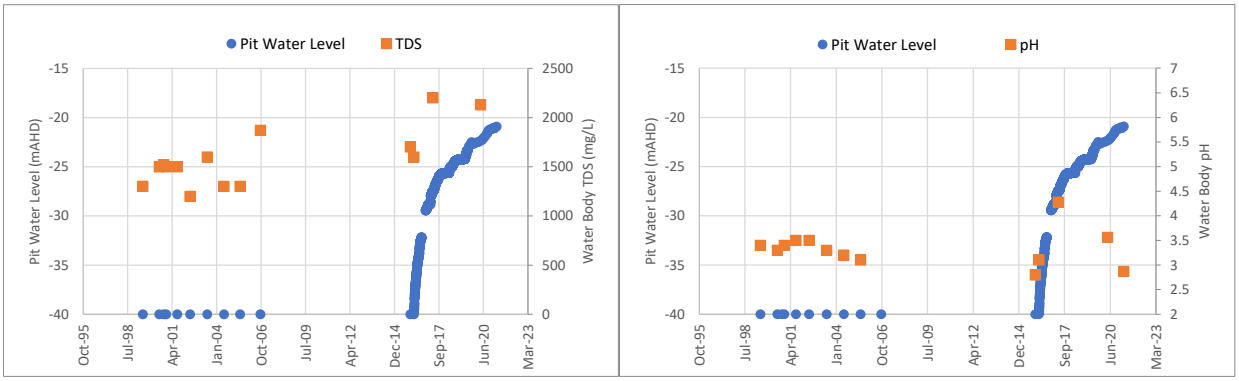


Figure 4-1 Mine Pit Water Level and Quality (TDS (Left), pH (Right)).

Table 4-1: Mine Water

Analyte	Units	ADWG†	Maintenance of Ecosystems	Stock Watering	Industrial Use	1/07/1999	5/07/2000	14/08/2001	29/05/2002	18/06/2003	30/06/2004	29/06/2005	21/12/2015	8/03/2016	10/05/2017	20/04/2020	12/04/2021
pH		6.5-8.5[a]			6.5-8.3[a]	**3.4**	**3.3**	**3.5**	**3.5**	**3.3**	**3.2**	**3.1**	**2.8**	**3.1**	**4.28**	**3.56**	**3.46**
Total Alkalinity	mg$CaCO_3$/L					<3.0	<1.0	<1.0	<1.0	<1.0	<1.0		<2	<2	<2	<1	<1
Total Hardness	mg$CaCO_3$/L					590	570	520	420	400	480	490				799	
Total Organic Carbon	mg/L					<5.0	1.8	<1.0	1.7	<1.0	2.0	1.0	0.8	0.6		3	1
Total Dissolved Solids	mg/L	500[a]				**1300**	**1500**	**1500**	**1200**	**1600**	**1300**	**1300**	**1700**	**1600**	**2200**	**2130**	**2020**
Total Suspended Solids	mg/L					18	<5	<5	<5	8	<5	<5		26	<5	18	
Bromide	mg/L					1.9	<0.5	1.1	0.8	<0.5	0.8	1.5		2.2		-	0.85
Chloride	mg/L					380	440	300	320	460	420	440	550	530	494	503	539
Fluoride	mg/L	1.5[h]				<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.12	0.06	0.21	<0.1	<0.1	
Phosphate	mg/L					<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.01	<0.01	
Sulfate as Sulfur	mg/L	250[a]		1000	<2700	150	**520**	120	**350**	**340**	**430**	**640**	**520**	**470**	**1110**	**894**	
Nitrate as Nitrogen	mg/L	9[h]		9.12		<1.0	<0.5	<0.2	<0.2	0.8	<0.5	<0.002	<0.01	<0.01	0.08	<0.01	
Nitrite as Nitrogen	mg/L	112[h]		90.3		<1.0	<0.5	<0.2	<0.2	<0.2	<0.5	<0.002	<0.01	<0.01	<0.01	<0.01	
Ammonia as Nitrogen	mg/L	4.1[a]				<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.44	0.75	0.53	0.21	<0.01	
Calcium	mg/L			1000	<420	52	52	56	41	37	45	40	52	45	238	142	124
Magnesium	mg/L	1[a]	1.9			**110**	**110**	**93**	**76**	**75**	**89**	**96**	**110**	**89**	**78**	**108**	**114**
Sodium	mg/L	180[a]				**230**	**310**	**230**	**270**	**230**	**260**	**240**	**280**	**220**	**363**	**337**	**314**
Potassium	mg/L												11		24	14	17
Iron	mg/L	3[a]	0.3			**9.4**	**12**	**2.3**	**3.8**	**4.4**	**2.2**	**11**	**11**	**14**	**0.3**	**2.46**	**2.84**

Analyte	Units	ADWG†	Maintenance of Ecosystems	Stock Watering	Industrial Use	1/07/1999	5/07/2000	14/08/2001	29/05/2002	18/06/2003	30/06/2004	29/06/2005	21/12/2015	8/03/2016	10/05/2017	20/04/2020	12/04/2021
Aluminium	mg/L	2[a]	0.055	5		**0.48**	**0.72**	**1.5**	**0.78**		**1.4**	**2.3**	**0.9**	**2**	**2.12**	**5.56**	**5.81**
Arsenic	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01	<0.001	<0.001	0.002	
Barium	mg/L					0.074	0.038	0.049	0.057	0.052	0.054	0.05	0.04	0.078	0.056	0.049	
Beryllium	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01			0.001	0.0022	
Boron	mg/L	40[h]	0.37	5		**1.4**	**0.03**	**1.9**	**1**	**0.79**	**1**	**1.6**	**0.9**	**1.1**	**3.65**	**2.31**	**2.0**
Cadmium	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002	<0.0002	0.00066	0.001	
Chromium	mg/L					<0.005	0.015	<0.005	0.008	<0.005	<0.005	<0.01	<0.01	0.002	<0.001	0.002	
Cobalt	mg/L					0.035	<0.005	0.065	0.039	0.053	0.031	0.05	0.05		0.0482	0.094	
Copper	mg/L	10a	0.0014	0.4		<0.005	**0.23**	**0.011**	**0.005**	<0.005	<0.005	<0.01	<0.01	<0.001	0.0008	0.002	
Cyanide	mg/L								<0.005	<0.005	<0.005			<0.005		-	
Lead	mg/L					<0.005	0.056	<0.005	<0.005	<0.005	<0.005	<0.01		0.002	0.002	0.004	
Manganese	mg/L	1[a]	1.9						0.45	0.44			0.48	0.52	0.271	0.435	
Mercury	mg/L					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	-	
Molybdenum	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01		<0.001	<0.001	-	
Nickel	mg/L					0.012	0.006	0.049	0.031	0.038	0.022	0.04	0.03	0.028	0.036	0.072	
Selenium	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01	0.005	0.0013	<0.01	
Tin	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01			<0.001	-	

Analyte	Units	ADWG†	Maintenance of Ecosystems	Stock Watering	Industrial Use	1/07/1999	5/07/2000	14/08/2001	29/05/2002	18/06/2003	30/06/2004	29/06/2005	21/12/2015	8/03/2016	10/05/2017	20/04/2020	12/04/2021
Vanadium	mg/L					<0.005	<0.005	<0.005	<0.005	<0.005	0.12	<0.01	<0.01	<0.001	<0.0002	<0.01	
Zinc	mg/L					0.20	0.10	0.52	0.20	0.30	0.11	0.24	0.1	0.1	0.127	0.217	
Benzene	mg/L	100	950	1		<0.005	<0.02	<0.02	<0.001	<0.001	<0.005	<0.001		<0.001		-	
Ethyl Benzene	mg/L	30	80	300		<0.005	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001		<0.001		-	
Toluene	mg/L	250	180	800		<0.005	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001		<0.001		-	
Xylene	mg/L	600[h]20[a]				<0.005	<0.02	<0.02	<0.001	<0.001	<0.003	<0.001		<0.002		-	
PCBs (Total)	mg/L					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.004				-	
C10 - C36 Fraction	mg/L	6000	600	600		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1		-	
Herbicides	mg/L					<0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2				-	
BOD	mg/L					<2	<2	<2	<2	<4	<4	<2				<2	
COD	mg/L					14	12	20	<5.0	<5	<5.0	5				-	
Total Plate Count	CFU/mL					29	<100	<100	26	2	4	<25				-	
Total Coliforms	orgs/100mL					4	1	23	230	<1	21	<100				-	
E coli	orgs/100mL					N/D	N/D	N/D	1	<1	<1	<100		<10		-	

Table Notes:
† = NHMRC–NRMMC, 2004
[a] = aesthetic value
[h] = health value
# = data from batch studies
Highlighted = indicates value exceeds a guideline value

4.2 Catchment Wide Groundwater Monitoring Network

Within the catchment there exists over 130 dedicated groundwater monitoring bores belonging to either Alcoa (87 bores), Barwon Water (32 bores) and the State Government SOBN (14 bores). These bores are shown in **Figure 4-2**. Many of these bores have been installed for a variety of reasons. These reasons (i.e. their purpose) along with basic construction details is presented **Appendix C**.

4.3 Pumping Test Groundwater Monitoring Network

Of the 130 catchment wide monitoring bores, 28 have been selected to act as dedicated monitoring or nominated trigger bores for the pumping test. These bores are shown in **Figure 4-2** and their construction details in **Table 4-3**. All bores that have a measurable water level will have an automatic pressure transducer with data logger capabilities installed (recording on an hourly basis). Eight (8) bores have also been specifically nominated as trigger bores with specific mitigation actions defined in response to trigger levels being reached. These bores are discussed further in **Section 6**.

Inclusive of the bores discussed above are 16 newly constructed groundwater observation bores around the periphery of the mine. The location of these bores are shown in **Figure 4-3**. The rational for the construction depth and location of these bores is discussed in **Table 4-2** and **Table 4-3.**

Table 4-2 Rationale for Construction of New Near Mine Void Bores

Bore ID	Targeted Lithology	Rationale
UEVF MB 1	The upper sands of the UEVF, refer Table 2-1	The purpose for construction of these bores is to: • Obtain a greater understanding of the lithology and water levels in the upper section of the UEVF. • Confirm extensiveness of the basal clay which is assumed to overlie and confine theses “upper sands”. • To act as monitoring bores to monitor for potential drawdown impacts arising from the pumping test which could then imply drawdown from the mine pit waterbody into formation.
UEVF MB 2		
UEVF MB 3		
UEVF MB 4		
UEVF MB 5		
UEVF MB 6		
UEVF MB 7		
UEVF MB 8		
DBG MB 8	The permeable zones (Boonah Sands) in the DBG and located above the main coal, refer Table 2-1	The purpose for construction of these bores is to: • Obtain a greater understanding of the lithology and water levels in the DBG surrounding the mine. • To act as monitoring bores to monitor for potential drawdown impacts arising from the pumping test and to obtain baseline data which can be used to monitor for pit water / aquifer when the waterbody reached such level that pit water may naturally migrate into the DBG.
DBG MB 1		
DBG MB 2		
DBG MB 3		
DBG MB 4		
DBG MB 5		
DBG MB 6		
DBG MB 7		
DBG MB 9		

Table 4-3: Pumping Test Monitoring and Trigger Bores

Bore ID	Aquifer Monitored	Screen Interval (mbgs)	Trigger Bore (T) or Observation Bore (O)	Rationale
DBG MB1	DBG	37 – 40	O	These monitoring bores are located spatially around the periphery of the mine void located as close to practical and in a safe to access area. The monitoring objective of these bores are to confirm the presence and behaviours of any groundwater within the DBG. If during the 12-month pumping test the mine pit water level reaches -15mAHD (currently water level is at -21mAHD), the pit water has the potential to migrate into the DBG formation. This was subject of EHS Support 'Ash Assessment Study' for the draft MRCP Appendix K as submitted to ERR Sept 2017 which indicated that geochemical mixing and transport modelling indicated that the discharge of ash pore water into UEVF groundwater or pit water body is likely to have a negligible effect on receiving water chemistry and also indicted that it would take up to 159 years for a particle of water to migrate into the formation. On this basis the risk of any adverse impact on groundwater was risk assessed as low risk. If this however does eventuate, data from these bores will be used with analytical and predictive modelling to estimate the seepage velocity from the pit back into the formation.
DBG MB2	DBG	60 – 63	O	
DBG MB3	DBG	69 - 72	O	
DBG MB4	DBG	35 – 38	O	
DBG MB5	DBG	18 – 21	O	
DBG MB6	DBG	34 – 37	O	
DBG MB7	DBG	8 – 11	O	
*DBG MB8	DBG		O	
MW27	PWT/DBG	10 -15	O	These bores are located in close vicinity (<250m) around the pumping bore and screened in either the shallow DGB formation or PWT associated with the surface water systems. These bores are also located as far away as practical from former power station assets such as the water reclamation pond which may influence water levels. MW27, MW 33 and MW29 are also located adjacent to Marshy Creek. Monitoring of these bores will be undertaken to understand potential surface water / groundwater interactions. Past monitoring of these bores suggest that there also exist sufficient water column to obtain water quality samples and are unlikely impacted by past mine activities.
MW29	PWT/DBG	6-12	O	
MW33	PWT/DBG	8 – 14	T	
MW37	PWT/DBG	3 – 6	O	
MW64	PWT/DBG	7 – 13	T	
UEVF MB1	$UEVF_U$	92 – 98	O	These monitoring bores are located spatially around the periphery of the mine void located as close to practical and in a safe to access area. The monitoring objective of these bores are to monitor for potential drawdown caused by pumping. If drawdown does occur in these bores, it increases the potential for mine water to seep into the aquifer which should be
UEVF MB2	$UEVF_U$	122 – 128	O	
UEVF MB3	$UEVF_U$	139.3 - 145.3	T	

Bore ID	Aquifer Monitored	Screen Interval (mbgs)	Trigger Bore (T) or Observation Bore (O)	Rationale
UEVF MB4	$UEVF_U$	71 – 77	O	minimised where possible. These bores will also help understand how different permeable zones in the UEVF behave which can then be used to help calibrate a numerical model.
UEVF MB5	$UEVF_U$	59 – 65	T	
UEVF MB6	$UEVF_U$	69 – 75	O	
UEVF MB7	$UEVF_U$	42 – 51.6	T	
*UEVF MB8	$UEVF_U$		T	
WB4	$UEVF_L$	108.2 – 195	O	These bores are either former power station production or observation bores. They are screened in the lower part of the UEVF and will monitor drawdown as a result of pumping. The data will be used to provide reliable hydraulic parameters for a future numerical model. Note: the lower 2 screened section of WB15 have been identified as potentially in the MEVF and as such to be conservative a packer will likely be installed in this bore to seal off these screened sections from the UEVF. Drawdown observations within these bores will also be used to ensure drawdown does not exceed what was modelled in the GIA and thus potential risks to environmental assets in outcrop areas remain low.
WB5	$UEVF_L$	132 – 216.6	T	
WB12	$UEVF_L$	147.2 – 221.3	O	
WB14	$UEVF_L$	155.9 - 213.7	O	
WB15	$UEVF_L$	186.8 - 247.5	O	
WB16	$UEVF_L$	173.7 – 220.2	PB	This is the Pumping Bore.
116459	$UEVF_L$	243 - 246	T	This is a state observation bore with a long history of water level data. Drawdown observations within this bore will be used to ensure drawdown does not exceed what was modelled in the GIA and thus potential risks to environmental assets in outcrop areas remain low.

$UEVF_U$ = Upper Sands of the UEVF
$UEVF_L$ = Lower Sands of the UEVF
*Currently being constructed

4.3.1 Learnings from Installation of New Observation Bores

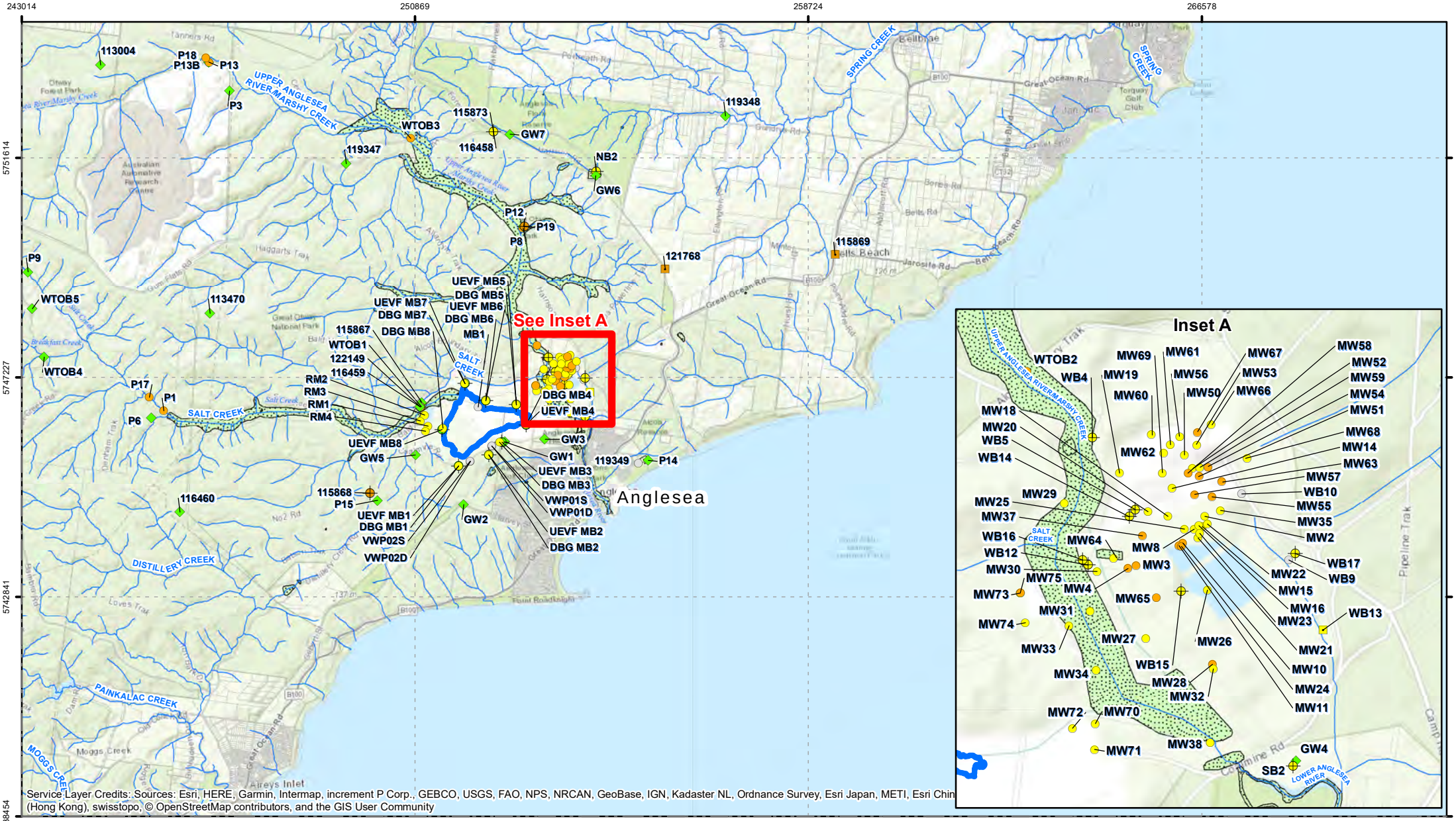
As shown in **Figure 4-3,** 8 nested pairs of bores have been installed in to the shallow DBG and the upper sands of the UEVF around the periphery of the mine. Geological core has been retained from several bores (UEVF MB 7, UEVF MB 3 and UEVF MB 8) and 5 core sections within UEVF MB 7 were subject to laboratory permeability tests. Key learnings with respect to the overall conceptual hydrogeology are summarised below.

- The majority of the DBG bores are dry indicating that near the mine void, these units discharge water into the mine void.
- The upper sands is not present at UEVF MB8 indicating that these sands may be discontinuous.
- The basal clay has been identified in all UEVF bores ranging in thickness of 1 to 5m with the exception of UEVF MB 6. At this location its thought that the mining of coal may have also scraped the basal clay to a minimal thickness.
- Field water quality parameters are variable with TDS ranging from 194 to 3919 mg/L, refer **Table 4-4**.
- Laboratory permeability tests of clay and coal sections within UEVF MB 7 indicate that permeability ranges from 7E-10 m/sec at 33mbgl to 3E-9m/sec at 55mbgl to 2E-9m/sec at 70.5mbgl and 1E-10 m/sec at 140mbgl.
- A total cumulative thickness of over 100m of low permeability clay and coal sequences separate the upper sands and lower sands of the UEVF suggesting that there is a very low risk of dewatering impacts being observed in the UEVF upper sands or overlying formations. This also means that it is likely that in the lower section of the UEVF, dewatering impacts may extend further due to the lower transmissivity (i.e. smaller thickness of formation), however this is not observed at SOB 116459, refer **Section 3.2** and **Figure 3-1**.

Table 4-4 Water Quality Results (Field Parameters from a GME undertaken April 8-12, 2021)

	TDS (mg/L)	pH
UEVF MB 1	945	5.74
UEVF MB 2	721*	6.0*
UEVF MB 3	755*	7.6*
UEVF MB 4	3919	4.52
UEVF MB 5	1033	5.36
UEVF MB 6	688	5.13
UEVF MB 7	194	5.56
UEVF MB 8	Currently being constructed (as of 30/04/2021)	
DBG MB 6	2299	6.8
DBG MB1-5, 7	Dry	Dry
DBG MB8	Currently being constructed (as of 30/04/2021)	

*Drilling development record. Not part of April 8-12, 2021 as bore only recently constructed. TDS calculated from EC x 0.65



J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 1-4A Well Locations.mxd

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Figure 4-2 Well Locations

Monitoring Bore - Aquifer Monitored

- Demons Bluff Group - Perched Aquifer (Alluvial)
- Demons Bluff Group - Boonah Sands Aquifer
- UEVF
- UEVF (Basal Sands)
- UEVF (Upper Sands)
- UEVF/MEVF
- UEVF/LEVF
- LEVF
- Decommissioned
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

DATE:	03/03/2021
CREATED BY:	A. Smith [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:100,000

N

Kilometers

0 1.25 2.5 5

250220

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J:\EHSS_GIS\AUSC030932020_AlcoaAnglesea\01_ANALYSIS\Figure 1-4E Active Well Locations of Interest - Powerplant and Mine.mxd

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Figure 4-3 Active Well Locations of Interest - Powerplant and Mine

- Trigger Bore
- Pumping Bore
- BW Pumping Bore
- PT Observation Bore
- Pit Lake Boundary (+7mAHD)
- Watercourse
- Parcel Boundary
- Marshland

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Groundwater Impact Assessment
UEVF 12 Month Pumping Test Licence APPLICATION

DATE:	14/04/2021
CREATED BY:	A. Smith [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
REVISION NO:	01
MAP PROJECTION:	GDA94
SCALE:	1:17,484

N

Kilometers

0 0.25 0.5 1

4.4 Baseline Data – Groundwater Levels

4.4.1 DBG/PWT Aquifer - Alcoa Entire Bore Network

Shallow groundwater levels have been recorded at the Anglesea Power Station since February 1993; with the results from 2006 – 2020 presented in **Figure 4-4**. Of the bores shown, MW33 is located nearest to the Anglesea River/Marshy Creek and furthest from surface water management assets associated within the Power Station (i.e. former Ash Ponds). This bore shows a water level of approximately -4.2 mAHD, some 9 m deeper than the base of the Creek, indicating that the Creek is not dependant on groundwater.

Prior to Alcoa development, groundwater levels in the shallow unconfined aquifer were estimated to be around -4 to +4 m AHD (Hancock, 1967). Data from piezometers in the mine south wall holes are plotted in **Figure 4-5**, and show that, after an initial stabilising period, groundwater levels fall within historical reported levels. However, before being decommissioned, VWP2S was still trending upwards. Furthermore, VWP1S shows a response of almost 1 m after heavy rainfall in March 2017 indicating potential unconfined conditions.

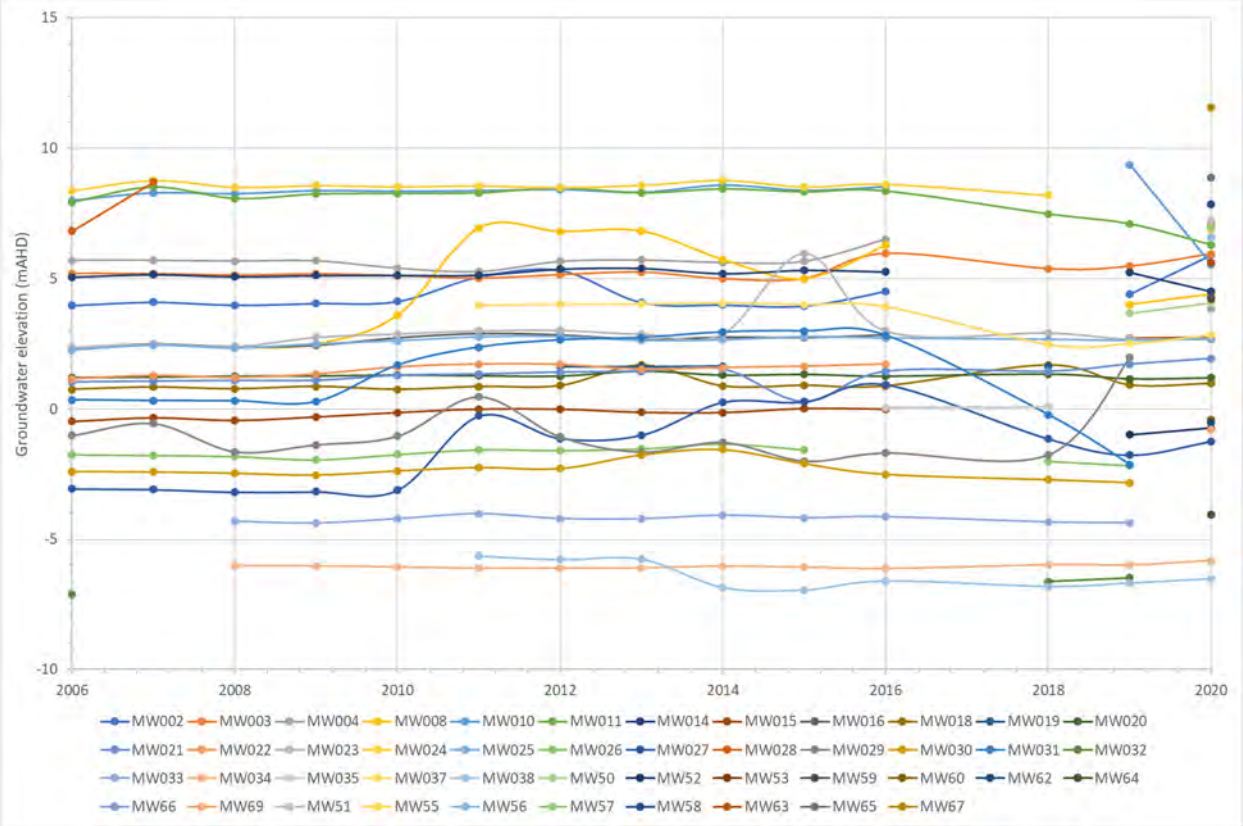


Figure 4-4 All Alcoa Power Station DBG/PWT Bores – Long-term Groundwater Levels

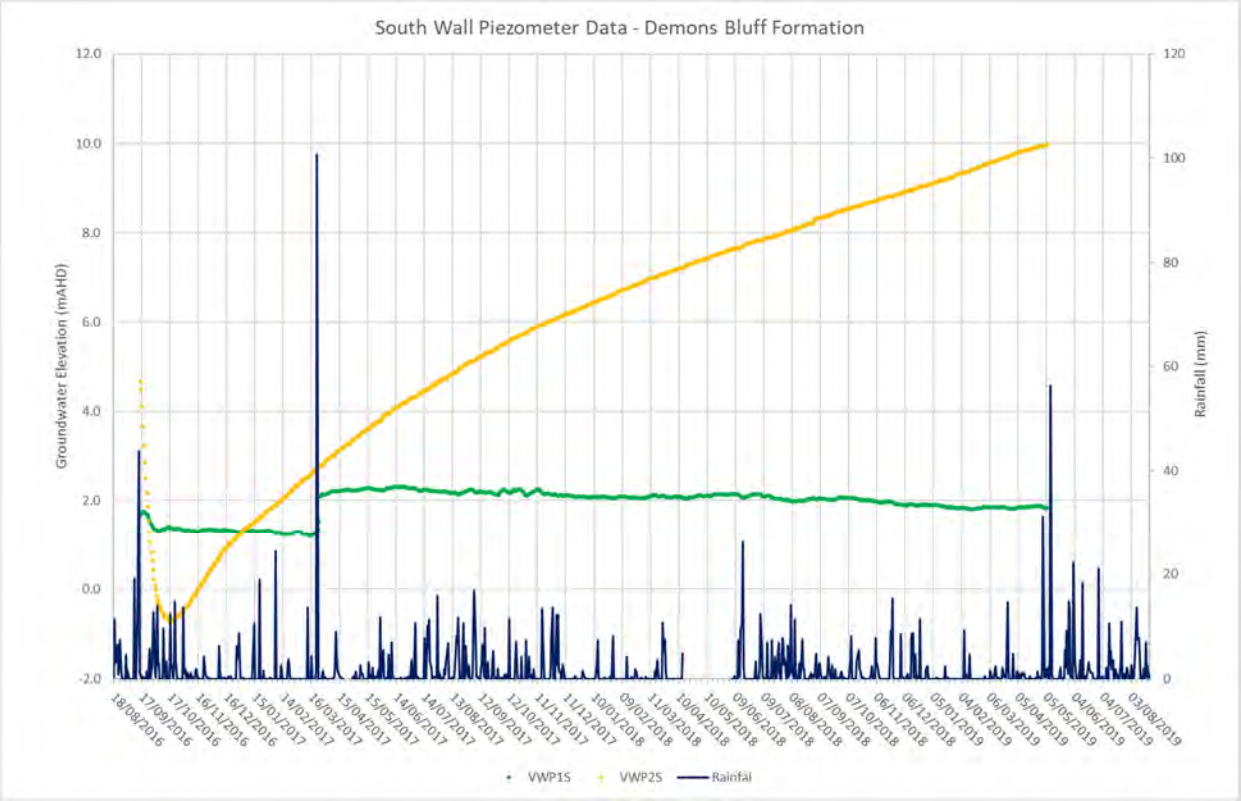


Figure 4-5 South Wall Piezometer Data, DBG (Rainfall obtained from Aireys Inlet, BOM ID: 090180, 6 km south-west of Site)

The PWT aquifer is a discontinuous perched unit associated with the upper weathered and disturbed zones of the DBG, as well as the alluvial channel fill deposits adjacent to Salt Creek and the Anglesea River outside of the Site. The PWT aquifer follows topography flowing in a south-west direction from the former Power Station Site. Groundwater elevation ranges from approximately 8.2 mAHD at MW67 in the north-west corner of the former Power Station to 2.5 mAHD at MW37 along the stormwater drain. Recharge to the PWT aquifer mostly occurs through stream/river loss.

4.4.2 DBG/PWT Aquifer - Nominated Monitoring Bores

For those monitoring bores screened in the DBG and PWT, the objective is to mitigate against water level impacts of surficial environmental receptors. Groundwater elevations of these monitoring bores are shown on **Figure 4-6**.

Note: as shown in **Table 4-4** the majority of the newly installed DBG bores around the mine are dry.

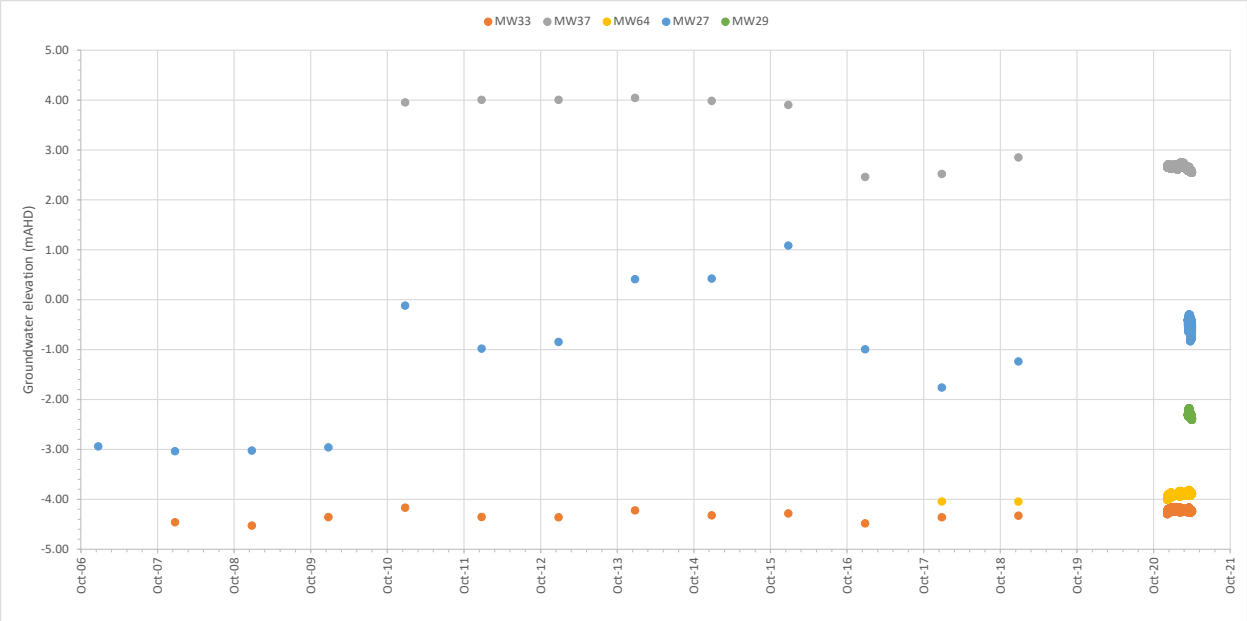


Figure 4-6 DBG/PWT Monitoring Bores – Historical Groundwater Level

It should be noted that the pumping test will place up to 1.5 GL of water into the mine pit void. The current mine pit void water level is approximately-21mAHD. Without the addition of this water, after 12 months, the water level is anticipated to rise to approximately -20.3 mAHD. With the additional 1.5 GL, the water level is expected to rise to approximately -17 mAHD. At the Site, the DBG begins above the main coal seam, the base of which is found approximately -15.5 mAHD. As such, there is not expected to be any interaction between the mine pit void water body and the DBG groundwater.

4.4.3 Deeper Zone of UEVF Aquifer - Nominated Monitoring Bores

The bores screened within the deeper zone of the UEVF surrounding the pumping bore (WB16) that have been nominated as monitoring bores include WB4, WB5, WB12, WB14 and WB15. Historical longer term groundwater monitoring data was available for WB4, WB5 and WB12 only (**Figure 4-7**).

Figure 4-7 presents all monitoring bore water level data in the UEVF with these bores screened in the deeper portions of the UEVF. These bores are screened closer to (both spatially and vertically) the pumping bore and as such have been impacted by Alcoa's UEVF pumping. However, since pumping has ceased, groundwater is recovering at a faster rate than those screened in the upper zone of the UEVF, highlighting the disconnect between the upper and lower zones.

Figure 4-8 presents recent water level data logger data since the installation of these automatic dataloggers in the nominated monitoring bores. The small drawdown observed on the 29/03/2021 is associated with installation and commissioning of the pump for the groundwater test within WB16.

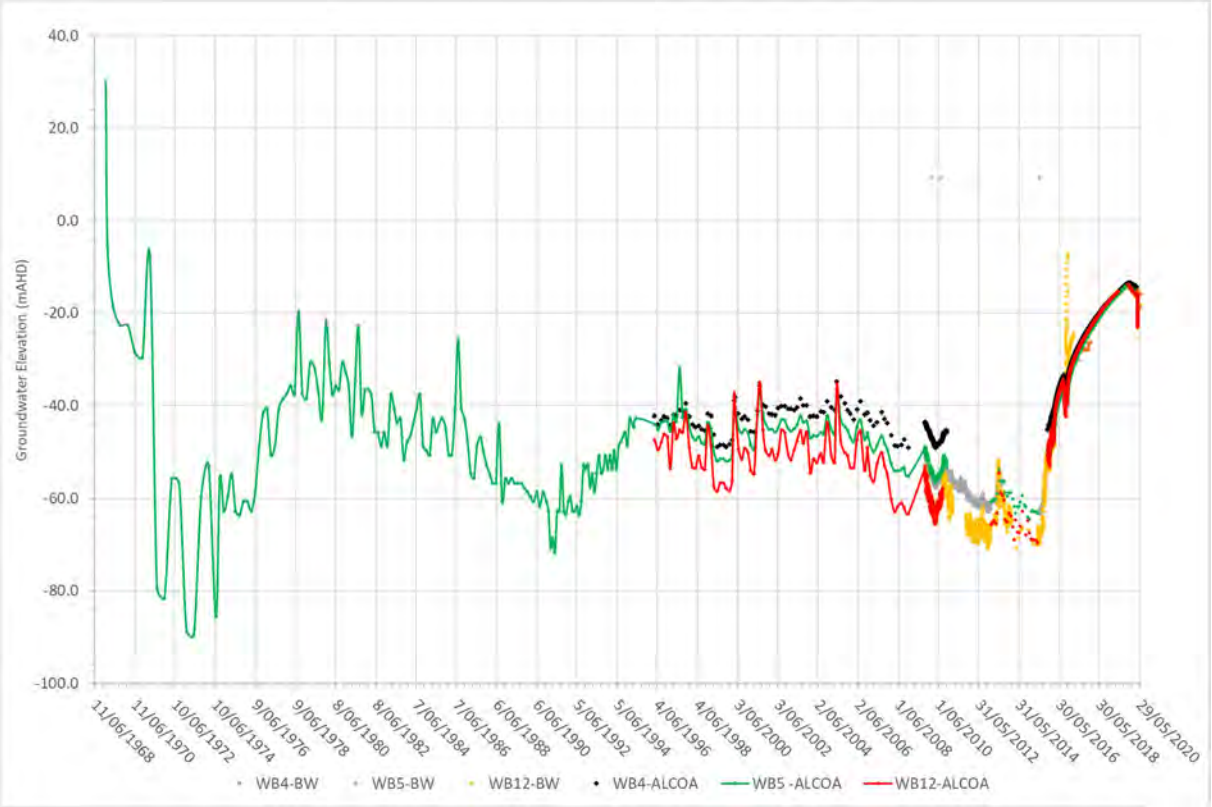


Figure 4-7 Deep Zone of UEVF Aquifer Monitoring Bores – Long-term Groundwater Levels

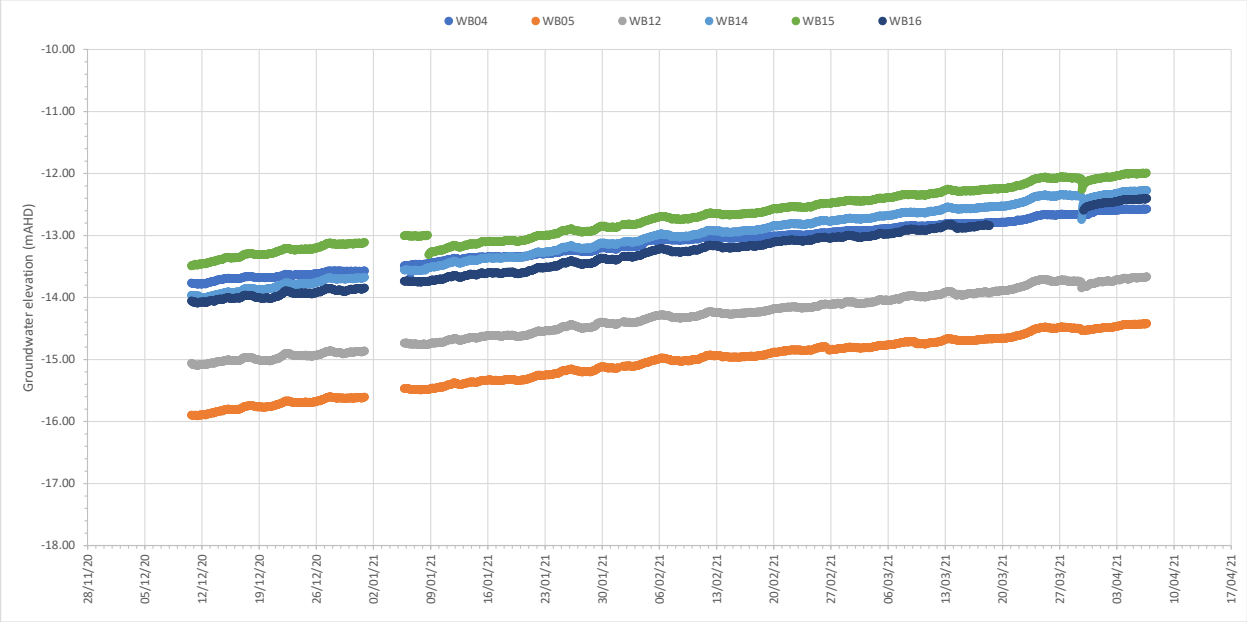


Figure 4-8 Deep Zone of UEVF Aquifer Monitoring Bores – Recent Groundwater Levels

4.4.4 Upper Zone of the UEVF Aquifer - Nominated Monitoring Bores

As noted above, 8 additional groundwater monitoring bores were installed surrounding the mine pit void and screened in the upper zone of the UEVF aquifer (UEVF MB1 to UEVF MB8). The purpose of these bores is to monitor any potential drawdown impacts associated with the 12-month pumping test and/or seepage from the mine pit void during the 12-month pumping test.

Seven of the eight bores have now been installed (as of 15 April 2021), with UEVF MB08 proposed to be completed by the end of April 2021. As a result, a long-term groundwater level database is not available to assist with defining a baseline groundwater level. Dataloggers have been deployed and those with more than 1 month of data are shown in **Figure 4-9**.

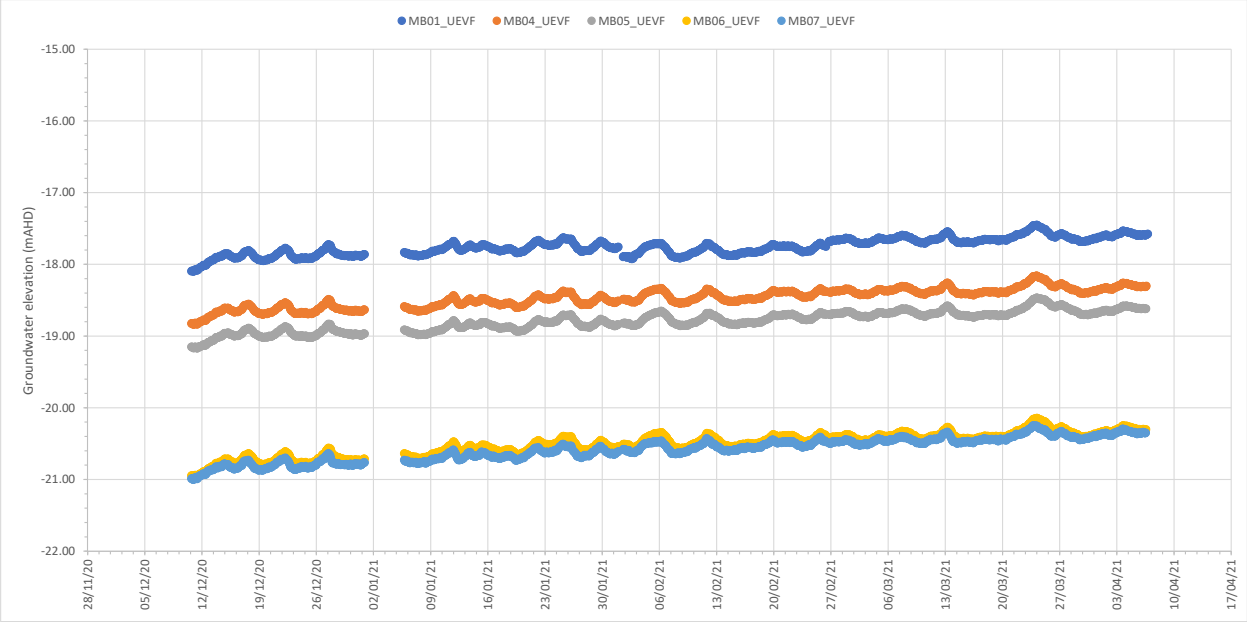


Figure 4-9 Shallow Zone of UEVF Aquifer Monitoring Bores – Recent Groundwater Levels

4.4.5 Barwon Water Trigger Bores

A condition on the Alcoa Licence Amendment (**Appendix A**) is that monthly monitoring of three Barwon Water bores P8, P12 and P19, which form part of Barwon Water's bulk entitlement monitoring program, must be undertaken.

Barwon Water have confirmed that monitoring bore P8 is screened in the PWT, P12 is screened in the LEVF and P19 is screened in the UEVF. Barwon Water have also confirmed that trigger levels have only been developed for P8 and P19 only, using the background/compliance bore, P17, to correct for natural climatic variation. The control bore is located in the Salt Creek swampland which is deemed outside the area of influence from pumping of the Barwon Water Anglesea Borefield. This means the control bore provides a useful comparison of the natural variation in groundwater levels due to seasonal conditions.

P12 is only being monitored to assess any potential drawdown impacts to the LEVF, which is considered unlikely given that vertical hydraulic gradients are already upwards.

Historical groundwater level fluctuations from these bores are shown on **Figure 4-10**. It is noted that Barwon Water will collect daily groundwater levels from these four bores during the 12-month pumping test.

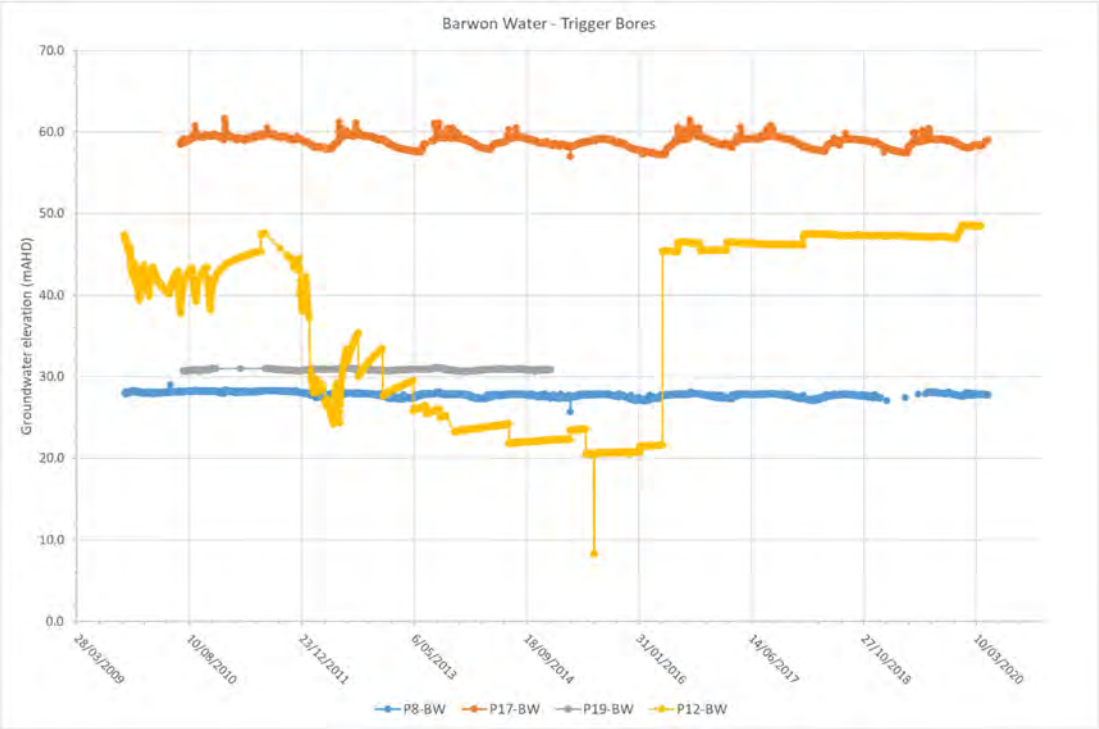


Figure 4-10 Barwon Water Trigger Bores – Historical Groundwater Level Data

4.5 Baseline Data – Groundwater Quality

4.5.1 DBG/PWT Aquifer

Historical TDS data for the selected monitoring bores in the DBG/PWT aquifer are presented in **Figure 4-11**. Considerable variability is noted and this is consistent with observations across the broader catchment. For a detailed overview of broader water quality refer Alcoa / Coffey annual GME reports 2006 to 2020, however in summary the following is noted concerning dissolved phase metals in the DBG/PWT aquifer:

- Antimony, beryllium, cadmium, total chromium, mercury, molybdenum, selenium, tin and vanadium have not been detected in concentrations exceeding relevant screening criteria.
- Aluminium, barium, cobalt, copper, iron, manganese, nickel, zinc and lead exceeded relevant screening criteria; however, the concentrations detected on Site are similar to or less than upgradient background well MW067. Therefore, it is likely that the elevated concentrations are representative of background concentrations.

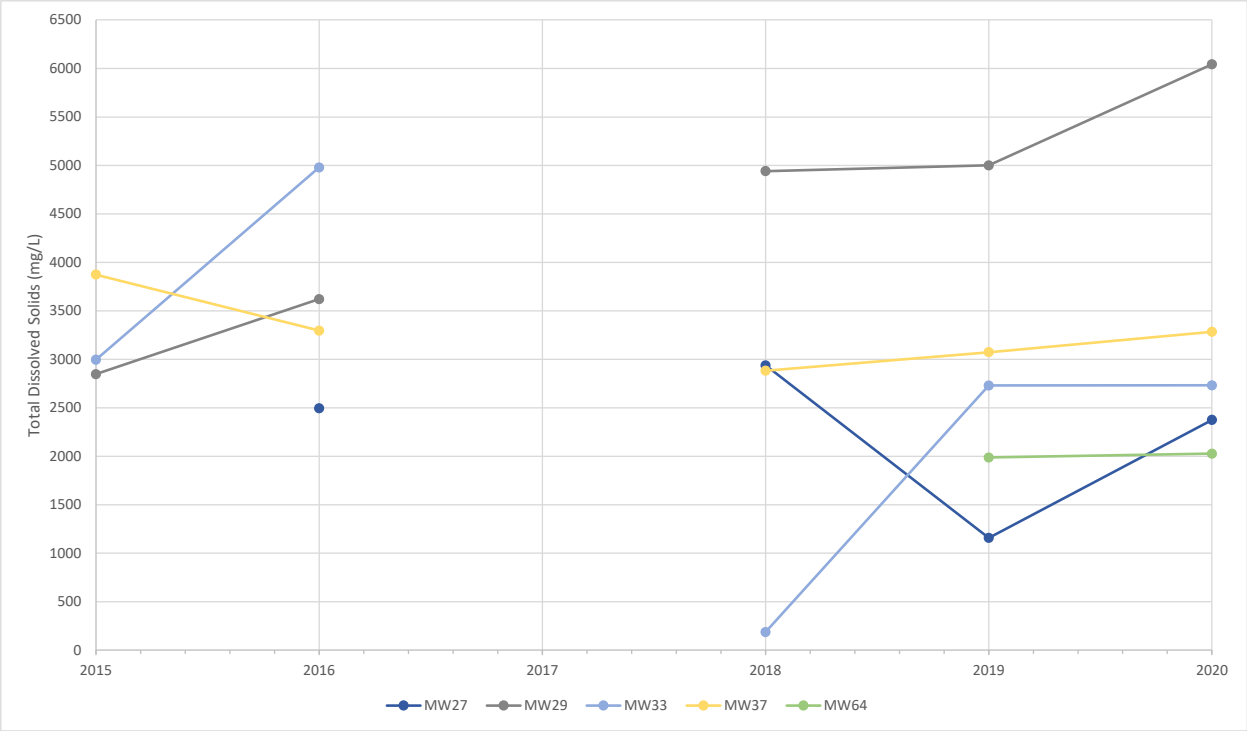


Figure 4-11 Historical TDS Measurements – Alcoa Mine Site DBG/PWT Bores

4.5.2 UEVF Aquifer

Only sporadic historical pH data from the groundwater monitoring bores screened in the deeper zone of the UEVF is available. This is presented in **Figure 4-12** and summarised in **Table 4-5.** Furthermore, **Figure 4-12** shows TDS from the bores located across the Power Station Site screened in the deeper zone of the UEVF ranged from 692 to 1300 mg/L. Individual bore statistics for TDS are summarised in **Table 4-6**.

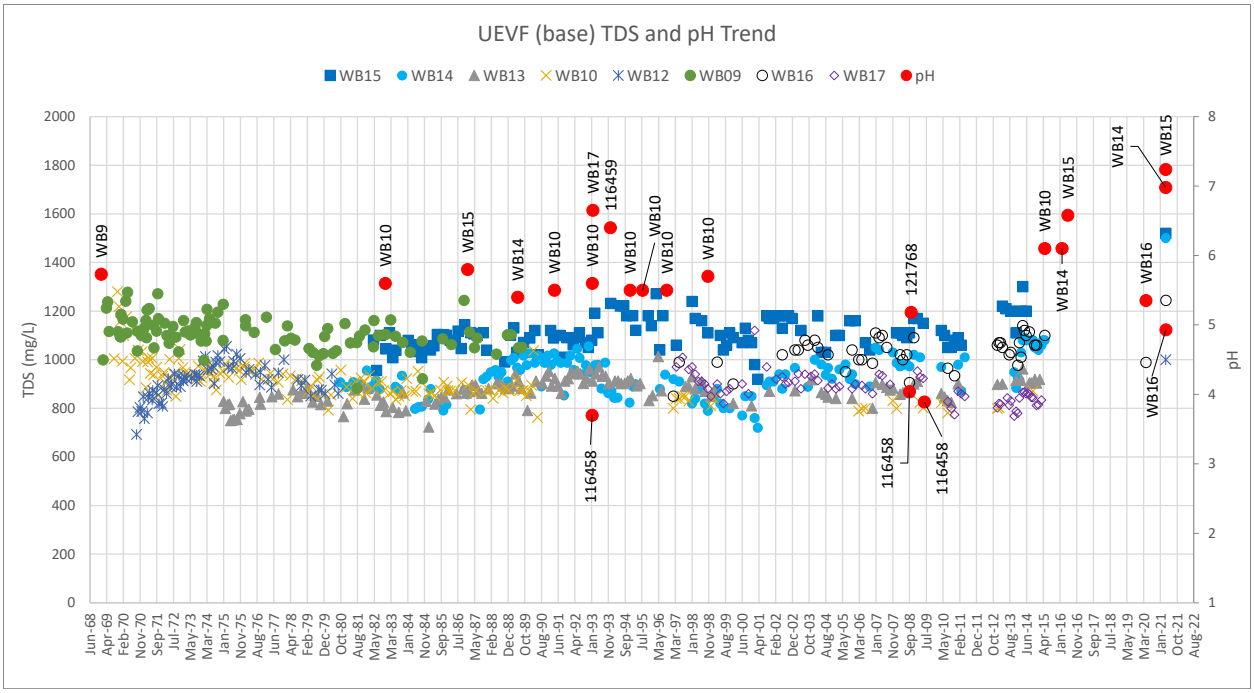


Figure 4-12 Historical TDS and pH Measurements –UEVF Bores

Table 4-5 pH Summary – Alcoa Mine Site UEVF Bores

Bore ID	Date range	# of measurements	Min (mg/L)	Max (mg/L)	Mean (mg/L)	% Difference between Mean and Max
WB4	-	-	-	-	-	-
WB5	-	-	-	-	-	-
WB09*	1968	1	5.9	5.9	-	-
WB10*	1969 – 2015	10	5.4	6.1	5.6	8
WB12	-	-	-	-	-	-
WB13**	-	-	-	-	-	-
WB14	**1986 & 2016**	**2**	**5.8**	**6.1**	**5.95**	**2**
WB15	**1982 & 2016**	**2**	**5.6**	**6.6**	**6.1**	**8**
WB16	**2015 – 2020**	**3**	**3.7**	**6.6**	**5.5**	**17**
WB17**	1993	1	6.7	6.7	-	-

Table Notes

Bores highlighted in **bold** form part of the monitoring bore network in the deeper zone of the UEVF.

* Bores now decommissioned.

** Bores scheduled to be decommissioned

Table 4-6 TDS Summary – Alcoa Mine Site UEVF Bores

Bore ID	Date range	# of measurements	Min (mg/L)	Max (mg/L)	Mean (mg/L)	% Difference between Mean and Max
WB09*	1968 – 1989	119	882	1,278	1,098	13
WB10*	1969 – 2015	204	700	1,280	908	29
WB12	**1970 – 1980**	**70**	**693**	**1,056**	**915**	**13**
WB13**	1975 – 2015	241	520	1,012	874	14
WB14	**1980 – 2016**	**242**	**720**	**1,090**	**931**	**15**
WB15	**1982 – 2016**	**212**	**802**	**1,300**	**1,103**	**15**
WB16	**1988 – 2020**	**112**	**810**	**1,140**	**1,020**	**11**
WB17**	1993 – 2015	134	768	1,120	901	21

Table Notes

Bores highlighted in **bold** form part of the monitoring bore network in the deeper zone of the UEVF.

* Bores now decommissioned

** Bores scheduled to be decommissioned

5 Pumping Test Description

5.1 Methodology and Design

The objectives of the 12-month groundwater pumping test are provided in **Section 1.1**. The principle of a pumping test involves applying a stress to an aquifer by extracting groundwater from a bore and measuring the aquifer response to that stress by measuring drawdown as a function of time. The measurements are incorporated into an appropriate well-flow equation to calculate the hydraulic parameters of the aquifer.

5.1.1 Aquifer Testing Program

A draft outline of the proposed stages of the aquifer testing program are presented in **Table 5-1**.

Table 5-1 Aquifer Testing Program

Stage	Activity	Date
Stage 1	Complete installation of groundwater monitoring bores around the mine pit void	End of April 2021
Stage 2	Datalogger installation and baseline monitoring period	Dataloggers installed by end of April 2021.
Stage 3	Begin Period 1 constant rate test (~50 L/sec)	May 2021
Stage 4	End Period 1	November 2021
Stage 5	2-week recovery period	November 2021
Stage 6	Start Period 2	November 2021
Stage 7	End Period 2*	June 2022*

*It is noted that the amended license allows 18 months to complete the pump test from 26 October 2020, with an end date of 26 April 2022. If any extension is required based on the above nominal timeline, then this will be discussed in advance with SRW.

5.1.2 Pumping Bore – WB16

WB16 is the nominated pumping bore and is shown in **Photo 5-1** and **Photo 5-2**. If for some reason WB16 becomes compromised WB14 and/or WB15 will be further evaluated for use as the pumping bore. This may involve undertaking step drawdown tests to establish the bore efficiency.

The construction details of the pumping bore WB16 are summarised in **Table 5-2** and the bore log is presented in **Appendix C**. The pumping bore has multiple screened intervals that all intersect the deeper zone of the UEVF. The bottom of the pumping bore is understood to be located at the base of the UEVF (i.e. where it intersects the MEVF).

Photo 5-1 WB16 Pumping Well Setup

Photo 5-2 WB16 Sampling Point and Flow Meter

Table 5-2 Pumping Bore WB16 – Construction Summary

Casing from (mbgl)	Casing to (mbgl)	Casing ID (mm)	Casing type and material
0	163.7	307	Fibre glass reinforced plastic casing
163.7	173.7	203	Mild Steel
173.7	177.8	203	Wire-wound stainless-steel screen, 1.0 mm slot
177.8	183.7	203	Fibre glass reinforced plastic casing
183.7	189.7	203	Wire-wound stainless-steel screen, 1.0 mm slot
189.7	199.2	203	Fibre glass reinforced plastic casing
199.2	203.2	203	Wire-wound stainless-steel screen, 1.0 mm slot
203.2	208.1	203	Fibre glass reinforced plastic casing
208.1	211.2	203	Wire-wound stainless-steel screen, 1.0 mm slot
211.2	216.6	203	Fibre glass reinforced plastic casing
216.6	220.2	203	Wire-wound stainless-steel screen, 1.0 mm slot
220.2	226.4	203	Fibre glass reinforced plastic casing

Table Notes:
mbgl – metres below ground level
mm - millimetres

5.1.3 Proposed Extraction Rate and Discharge

It is anticipated that a proposed extraction rate of 50 L/sec (±10 L/sec) will be adopted for the during of the 12 months, with the total extraction not to exceed 1.5GL. This extraction rate is approximately 40% of the annual historical extraction (between 1998 to 2015). Discharge monitoring will be undertaken via a dedicated magnetic flow meter at the pumping bore (refer **Photo 5-2**).

The pumped water will be transferred via pipe (connected at the wellhead, refer **Photo 5-1**) to the mine pit void where it will be discharged below the current mine water level, refer **Photo 5-3** and **Photo 5-4**. This will mitigate contact to atmospheric oxygen as well as potential erosion.

Photo 5-3 Discharge Pipe

Photo 5-4 Discharge Location

5.1.4 Pumping Test Evaluation

During the test and following the completion of Period 1 (i.e. 6 months of pumping) reviews will be conducted on the validity and appropriateness of the adopted groundwater monitoring bore network and monitoring and sampling program. This may include removing or adding bores to the network and/or increasing or reducing the frequency of monitoring and sampling. Further details on the monitoring and sampling plan are provided in **Chapter 7**.

5.1.5 Proposed Technical Steering/Reference Committee

A Co-Regulators Forum and Technical Working Group has been established as proposed by Alcoa to provide a forum for engagement and consultation with Alcoa and regulatory agencies about statutory, regulatory, and technical issues and activities related to the rehabilitation and closure of the Anglesea Coal Mine. This will be facilitated by ERR and specifically includes oversight of the 12-month groundwater pumping test, and comprises representatives from;

- Earth Resources Regulator (ERR)
- EPA Victoria (EPA)
- Department of Environment, Land, Water & Planning (DELWP)
- Southern Rural Water (SRW)

- Barwon Water and Corangamite Catchment Management Authority (CCMA) participation to be determined by ERR
- Independent Peer Reviewer (to be agreed)

as the appropriate regulatory and/or referral agencies to convene on a monthly basis to provide progress reports and technical updates throughout the 12-month groundwater pumping test.

The intent is to ensure there is common information/data being shared and discussed as required by all groups and for this forum to provide further opportunity for questions, concerns or risks to be raised and addressed as they arise, inclusive of review of any trigger value exceedances and proposed action plans.

6 Trigger Values and Response Actions

6.1 Trigger Level Methodology

Trigger values and response actions are developed to proactively respond to observed changes in the environment as a result of pumping activities and to both mitigate potential risks and also meet compliance objectives. While assessments have been conducted, inherent uncertainties must be addressed through monitoring. Given that the monitoring and management program is dynamic, assessments of performance of management activities need to be conducted over time and modifications made as required. In the context of this type of monitoring and management framework, a well-defined set of response actions for nominated trigger bores provides for protection of the environment, allows for proactive management of water quality issues and ensures regulatory compliance.

The groundwater framework for response actions is focused on groundwater levels (pressures) and water quality, with the any potential changes in water quality due to recharging the aquifer from the mine pit void water body the primary risk driver.

The response plans will involve six fundamental actions in relation to groundwater levels and groundwater quality. These are:

1. Preliminary analysis of data using summary statistics and trend analysis to assess whether data is consistent with historical monitoring and/or baseline data. This analysis will primarily involve the use of median water level across a defined period, standard deviations (Std Dev) of the same period and historical minimum. The methodology is further described in **Section 6.1.1**.
2. Decisions to re-gauge or re-sample (and analyse) the location, increase monitoring frequency or continue monitoring at the location.
3. Evaluate groundwater level change in relation to other surrounding monitoring bores.
4. Detailed assessments of geochemistry and key monitoring parameters at the monitoring locations.
5. Root cause analysis (for example climatic variation) of the likely source of variability (natural or induced by other activities).
6. Develop and implement an appropriate contingency plan in discussion with SRW or the monthly TRG meeting.

Note that for nominated trigger bores specific defined actions will also be taken as outlined below.

6.1.1 Water Level Trigger Rules

As discussed above, statistical analysis will form the initial part of defining trigger values. Due to considerable variability in both water level behaviors and water chemistry across the site (refer **Section 3.3**) as well as different bores designed to monitor for different risks (refer **Section 3**), numerous rules or analytical techniques must be used to determine an initial trigger value. For water level, the following rules will be used to define a trigger value.

- Trigger Rule 1: 30-Day average water level - 2 x Std Dev
- Trigger Rule 2: 30-Day average water level - 3 x Std Dev and where applicable 3 month average TDS or Cl:B - 3 x Std Dev

- Trigger Rule 3: Historical low water level
- Trigger Rule 4: Predicted drawdown after 12 Months
- Trigger Rule 5: If the Pit water level reaches -15.5mAHD (this is not expected to occur during the 12 month pumping test).

Rules 1 – 3 are designed to ensure dewatering impacts in the DBG/PWT and outcrop areas of the UEVF remains low (i.e. protection of any unmapped GDE's). Rule 4 is designed to minimise the risk of water in the pit void is migrating unacceptably into the underling aquifer.

Rule 5 is designed to minimise the short-term risk of pit water migrating into the DBG and also reaching the level where historical ash was consolidated above RL -15m (north east corner of the mine) as an EPA licenced activity and covered with at least 1m of sandy clay overburden material. It is conservatively estimated that the volume required as of April 2021 for the pit water level to reach the base of the DBG (i.e. RL = -15m) is an additional 2.045GL (approx.) of water. Therefore, it is unlikely that the pit water level will rise to - 15mAHD during the period of the test as the addition of pumping test groundwater and average mine catchment baseflow/rainfall/runoff is 1.86GL (1.5GL from groundwater; 0.36GL from rainfall, runoff and baseflow). The volume of 0.36GL has been the average annual volume of water (minus evaporation) entering the waterbody based on the last 60 months (5 years).

For each trigger bore, the relevant trigger rule and corresponding trigger value is presented in **Table 6-1** and shown graphically in **Figure 6-3** to **Figure 6-7**.

The use of standard deviations (measure of the variation or spread of a set of data which is equal to the square root of the variance) in monitoring data to assess potential groundwater impacts is common. This approach is used by Barwon Water to highlight potential impacts arising from the operation of Barwon Water's Bulk Entitlement for the Anglesea borefield. To assist in what a standard deviation may mean within a dataset, refer **Figure 6-1**. As an example, an outlier can be identified as a data point which is greater than four standard deviations from the mean (U.S. EPA 2009). If a data point falls outside 2 or 3 standard deviations, it is generally a good indication that change is occurring.

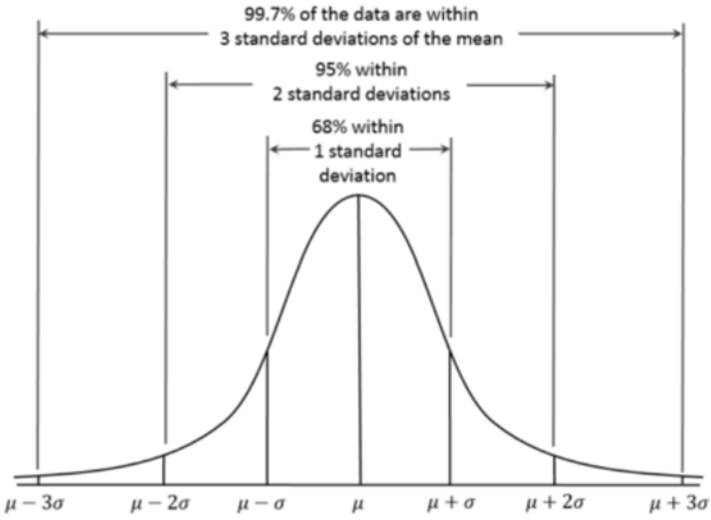


Figure 6-1 Normal distribution curve showing mean (μ), standard deviation (σ) and equivalent percentiles (U.S. EPA 2009)

6.1.2 Barwon Water Anglesea Borefield Trigger Levels

As discussed in **Section 2.2.2**, Barwon Water have 42 observation bores that monitor groundwater levels across the Anglesea catchment (**Figure 4-2**). These observation bores are located at different depths to monitor groundwater levels in different geological formations; in the PWT/DBG, UEVF and LEVF aquifers. Barwon Water holds a bulk entitlement to extract groundwater from the LEVF.

As part of Barwon Waters LEVF Bulk Entitlement, two key bores have been assigned groundwater level triggers to ensure groundwater levels can continue to support potential GDEs. These bores measure groundwater levels in the PWT (P8) in the Anglesea swamp and in the UEVF (P19), overlying the LEVF. It is the combination of groundwater levels in both of these bores that is important. If groundwater levels in both bores fall below a certain threshold level, then action must be taken – including reducing or ceasing pumping – to prevent any potential impacts to GDEs. The threshold level (also known as a "trigger") is determined by comparison to a control bore, to account for climatic influences on groundwater levels. The control bore (P17) is located in the Salt Creek swampland which is deemed outside the area of influence from operation of the Anglesea Borefield. This means the control bore provides a useful comparison of the natural variation in groundwater levels due to seasonal conditions.

Schedule 2 of the Bulk Entitlement Order (Anglesea Groundwater) 2009 sets out the method for calculating the Barwon Water trigger levels.

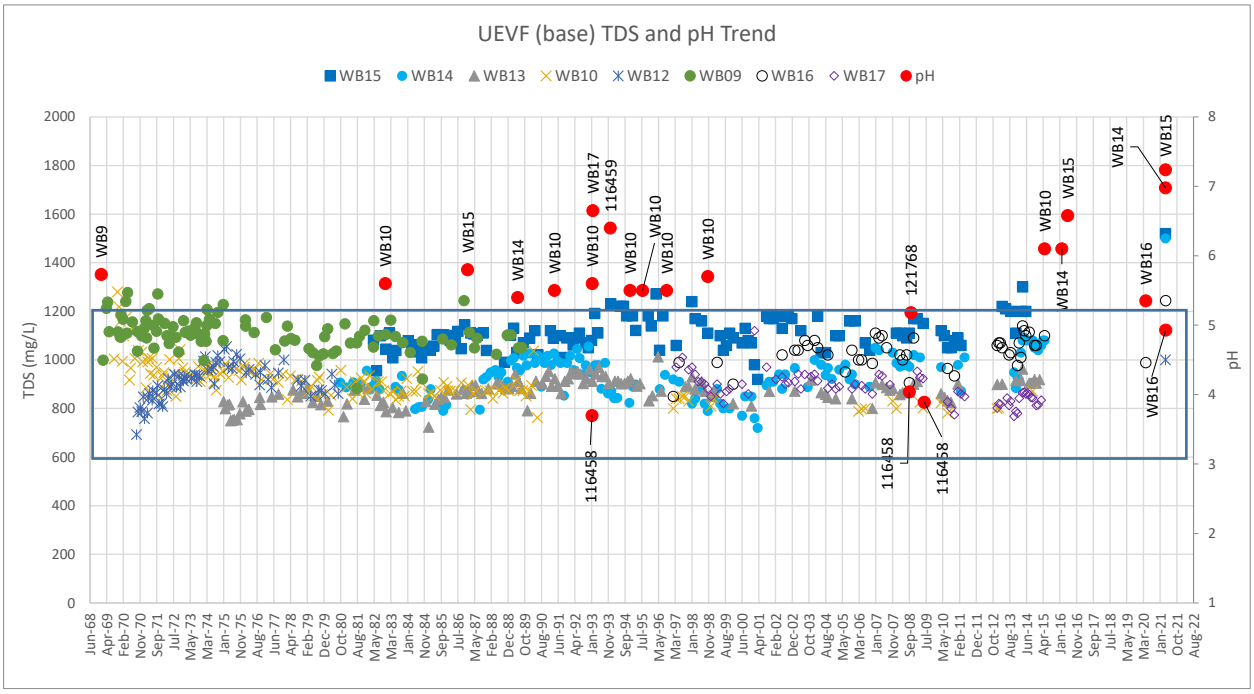
Alcoa will obtain the groundwater level information from Barwon Water for P8, P12, P17 and P19 groundwater bores on a monthly basis during the 12 Month Pumping Test including the Barwon Water trigger assessment for P8 and P19. These levels will be reported and incorporated along with Alcoa's data discussed in **Section 7.4.1**.

6.1.3 Water Quality Trigger Rules

Water quality triggers will be applicable to bores UEVF MB 3, 5, 7 and 8 as these bores are designed to monitor for potential migration of pit water into the UEVF. The trigger values will be based upon salinity (TDS) and Cl/B will be defined after 3 months of collation of baseline data. The resulting water quality trigger value will be determined by using the same method as the rule 2 water level trigger (e.g. average monthly Cl/B or TDS - 3 x Std Dev).

The reason why no water quality triggers are initially defined as follows:

- Water quality is a lagging indicator compared to water level. As water level triggers will be set (and are designed to mitigate the migration of water from the pit into the aquifer), achieving breakthrough in water quality values relating from the migrating pit water is unlikely.
- The initial round of TDS within the newly drilled bores around the mine is highly variable ranging from 194 mg/L (UEVF MB7) to 3,919 mg/L (UEVF MB04), refer **Table 4-4**. Furthermore, and generally, groundwater quality is highly variable across the site as evidenced in the annual groundwater monitoring events undertaken across the Power Station since 2006 (dataset sent to SRW March 29, 2021) also refer **Figure 6-2**. This makes setting groundwater triggers that can be representative of potential dewatering impacts difficult to justify.
- A comprehensive suite of water chemistry data (refer **Table 7-2**) is being collated on a monthly basis and will be subject to monthly analysis (same as water level), any outliers or changes in beneficial use segment will be highlighted and discussed at the monthly TRG meeting.



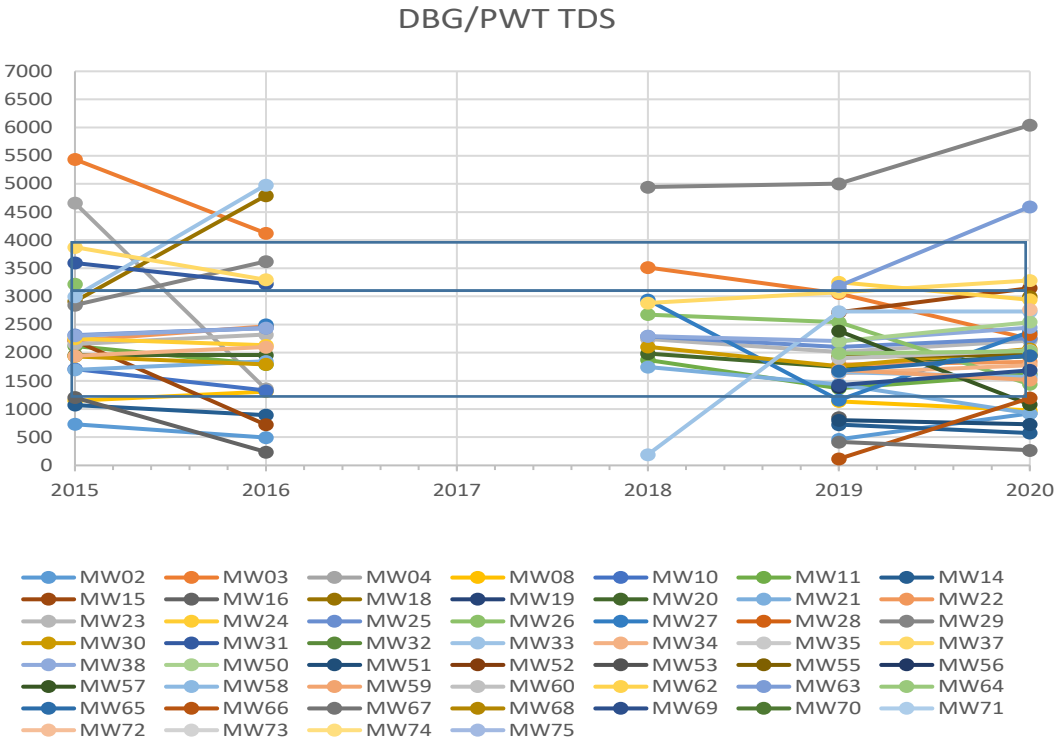


Figure 6-2 Historical TDS in the UEVF aquifer (Top) and DBG/PWT aquifer (Base). Blue Zone represents Segment A2. Orange represents Segment B and the green zone represents Segment C.

6.2 Trigger Level Summary

Table 6-1 presents the summary of water level triggers and how each trigger is related to risk. Note, as discussed in **Section 6.1.3**, water quality triggers based on TDS, chloride and boron will be defied after 3 months of data from bores UEVF MB 3, 5, 7 and 8.

Table 6-1 Summary of Water Level Triggers and Relationship to Risk

Bore ID	Aquifer Monitored	Monthly Groundwater Decline Trigger Level (m)	Monitored Risk (refer Section 3.1)	Risk Evaluation
116459	Lower Zone UEVF	Rule 1 = 0.14 Rule 2 & 3 = 0.6 Rule 4 = N/A due to historical declining trend	Risk 2 - Pumping of groundwater resulting in a reduction of baseflow to surface water systems and potential GDE's	**Uncontrolled risk ranking:** Low. No mapped GDEs present in the UEVF. Other mapped GDE are reliant on <10% baseflow contribution (refer GHD 2021. This bore has a history of declining water levels since the millennium drought (refer **Figure 3-1**). Numerical modelling suggests no impact will be observed at this location. Monitoring this bore will be used to manage drawdown risks where the aquifer may outcrop at some distance away from the pumping bore.
WB5		Rule 1 = 0.45. Rule 4 = 17. Rule 2 and 3 are not applicable as impacts are expected and necessary within the bore and the historical low is based on a larger pumping rate.		**Uncontrolled risk ranking:** Low. No mapped GDEs present in the UEVF. Other mapped GDE are reliant on <10% baseflow contribution (refer GHD 2021). (Note: Impact is expected in this bore as the purpose of the pumping test is to cause dewatering impacts). Using the Theis Method and assuming: • no leakage (i.e. very conservative) • The lower sands of the UEVF outcrop at the outer margins of the UEVF (refer Figure 4-5 of the GIA; e.g. near Bore 121768 at the closest point to the pumping bore). • Constant pumping rate (Q) at WB16 = 4320 m^3/d. • Aquifer storativity (S) = 0.00006. • Transmissivity (T) = 187 m^2/d. The results indicate 13m of drawdown after 30 days and 18m after 1 year. Numerical modelling suggests ~17m of drawdown after 1 year.
MW33	PWT/DBG	Rule 1 = 0.05 Rule 2 = 0.10 Rule 3 = 0.17. Rule 4 = N/A (insufficient history)	Risk 2 - Pumping of groundwater resulting in a reduction of baseflow to surface water	**Uncontrolled risk ranking = low.** Mapped GDE are reliant on <10% baseflow contribution (refer GHD 2021), these are generally located >5km from the site (mid catchment). At the site, surface water systems are losing systems, adoption of rule 2 or 3 will have no impact on lowering the risk. However, there may

Bore ID	Aquifer Monitored	Monthly Groundwater Decline Trigger Level (m)	Monitored Risk (refer Section 3.1)	Risk Evaluation
MW64		Rule 1 = 0.08 Rule 2 = 0.1 Rule 3 = 0.20 Rule 4 = N/A (insufficient history)	systems and potential GDE's	be times that vegetation may receive some groundwater contribution and/or surface water receives partial baseflow from perched water systems following heavy rainfall. Calculating this impact in a simplistically and conservatively way; a 0.2m decline in an unconfined aquifer system with a Sy of 0.2 would mean annually, 40mm (Rainfall= Sy x ΔS) of rainfall over this area would be required to replace this storage. In reality, recharge also gained from runoff and bank infiltration would mean the actual rainfall required would be much lower.
UEVF MB3*	Upper zone UEVF	Rule 1 = 0.20 Rule 2 = 0.22 Rule 3 = 0.60 Rule 4 = N/A (insufficient history)	Risk 5 - Placing 1.5GL of water into the pit void results in mine water migration into the UEVF	**<u>Uncontrolled risk ranking = low.</u>** Numerical modelling indicated this aquifer zone should not experience any drawdown impacts Underlying the mine water body is a 1-5m thick clay unit. This is referred to as the basal clay. Laboratory permeability testing of clay lenses encountered in MB7 averaged $1x10^{-9}$m/s ($8.6x10^{-5}$ m/d). To estimate the leakage related risks resulting from a 0.4m pressure decide in the underlying aquifer, the following equation can be used (Seepage velocity =(-K i) / n). Assuming: • hydraulic conductivity (K) = $8.6x10^{-5}$ m/d • Hydraulic gradient (i) = 0.4 (0.4m decline under the basal clay) • Porosity (n) = 5% After 1 year, the water will have potentially migrated up to 25cm through the clay.
UEVF MB5		Rule 1 = 0.20 Rule 2 = 0.22 Rule 3 = 0.60 Rule 4 = N/A (insufficient history)		
UEVF MB7		Rule 1 = 0.20 Rule 2 = 0.22 Rule 3 = 0.60 Rule 4 = N/A (insufficient history)		
UEVF MB8*		Rule 1 = 0.20 Rule 2 = 0.22 Rule 3 = 0.60 Rule 4 = N/A (insufficient history)		
DBG MB3, 5, 7, 8	DBG	Rule 5 = - 15.5mAHD	Risk 6 - Placing 1.5GL of water into the pit void results in the DBG and consolidated ash material to become saturated	**<u>Uncontrolled risk ranking = low as >2GL of water is required to reach -15mAHD.</u>** The DBG horizon is at RL-15m and also the level where historical ash was consolidated above RL -15m (north east corner of the mine) as an EPA licenced activity and covered with at least 1m of sandy clay overburden material. This trigger will provide a precursor to complete the historical analytical and numerical modelling with ERR/EPA (commenced in 2017) to understand and finalise any associated risks.

Trigger Rule 1: 30-Day Average Water level - 2 x Std Dev
Trigger Rule 2: 30-Day Average Water level - 3 x Std Dev and 3 month Average TDS or Cl:B - 3 x Std Dev (not yet calculated)

Trigger Rule 3: Historical Low Water Level
Trigger Rule 4: Predicted modelled drawdown after 12 Months
Trigger Rule 5: If the level of Pit water reaches - 15.5mAHD.

*Bores UEVF MB3 and UEVF MB8 are either in the process of being installed or not yet equipped with a data logger (i.e. only recently been installed). Trigger levels for these bores will be the same as UEVF MB5 and UEVF MB7 and will be confirmed after 3 months of data. As described, the risk of dewatering impacts in this aquifer is low. As a result, waiting 3 months before confirming a trigger should not increase the risk.

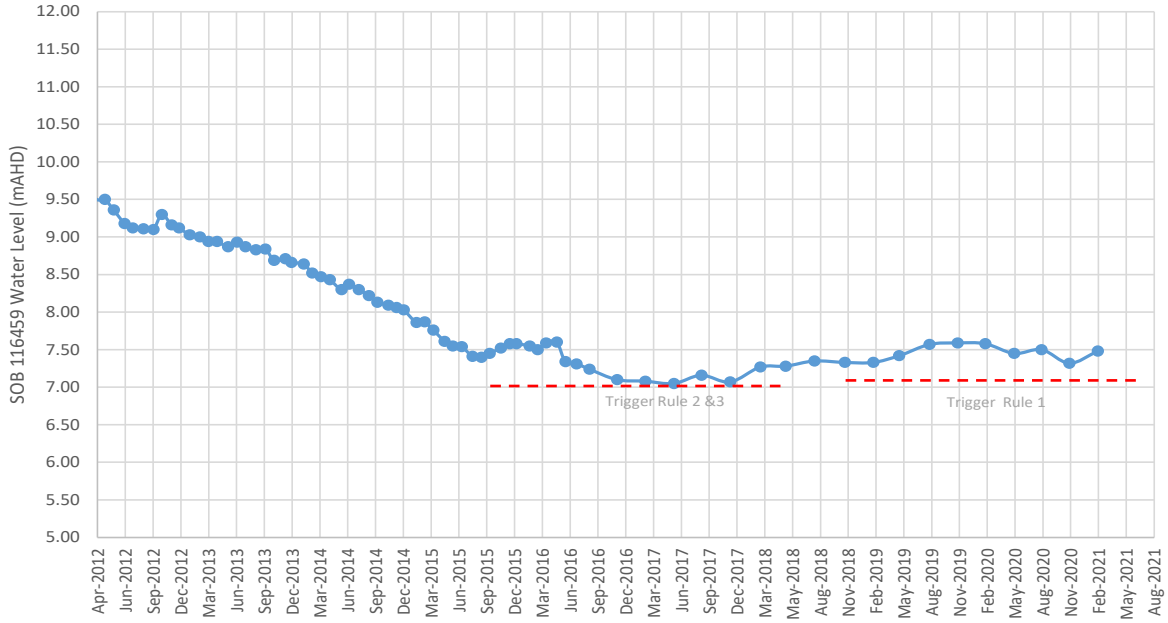


Figure 6-3 SOB 116459 Hydrograph and Trigger Indicators

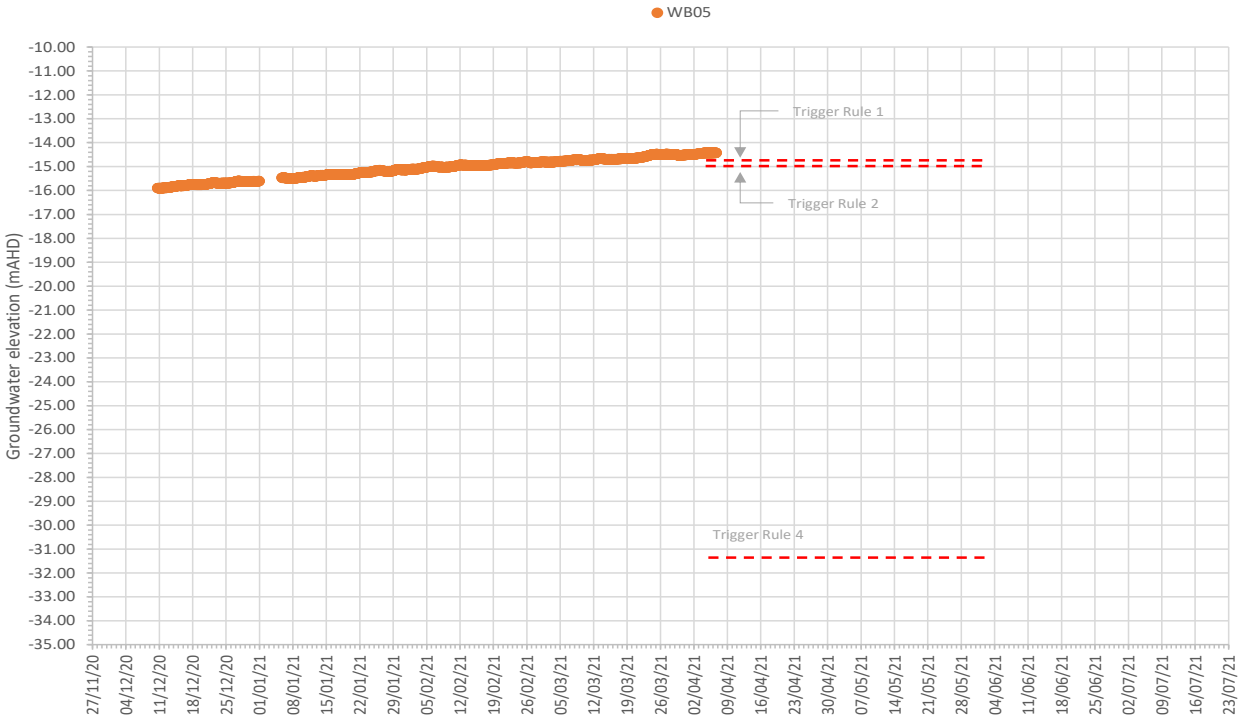


Figure 6-4 WB05 Hydrograph and Trigger Indicators

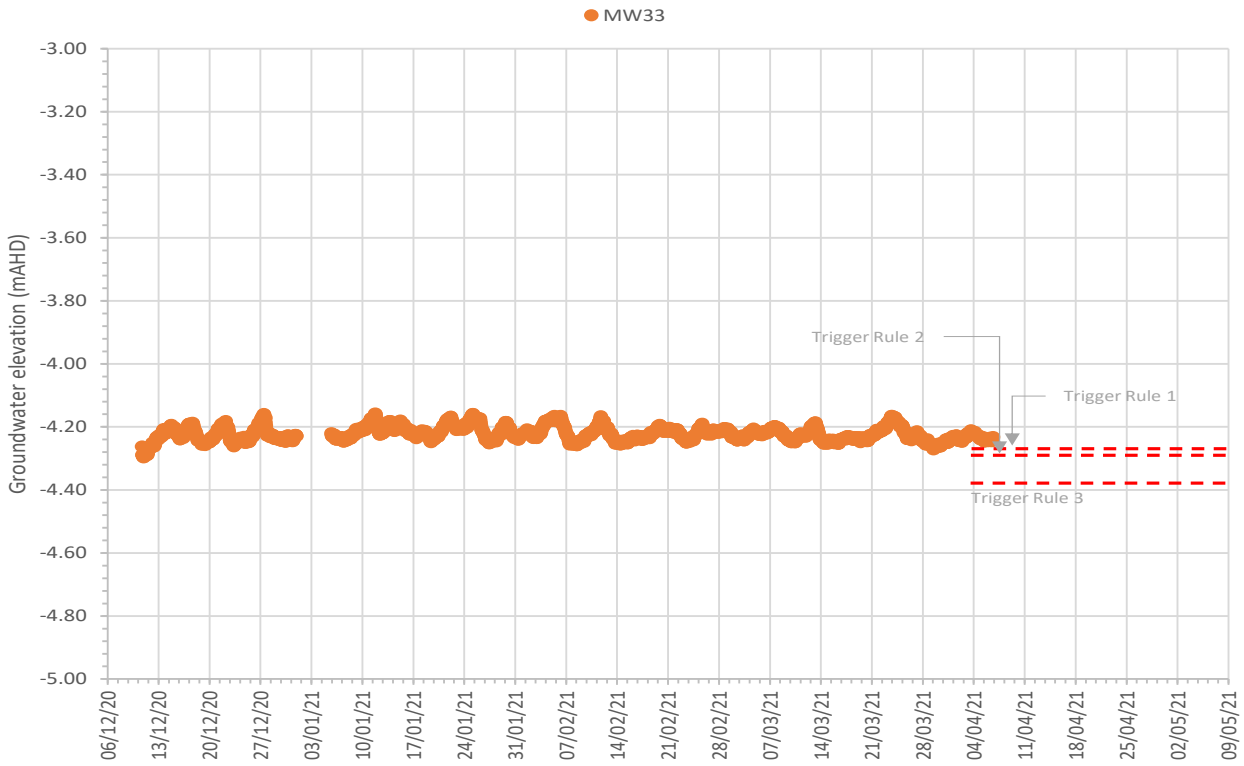


Figure 6-5 MW33 Hydrograph and Trigger Indicators

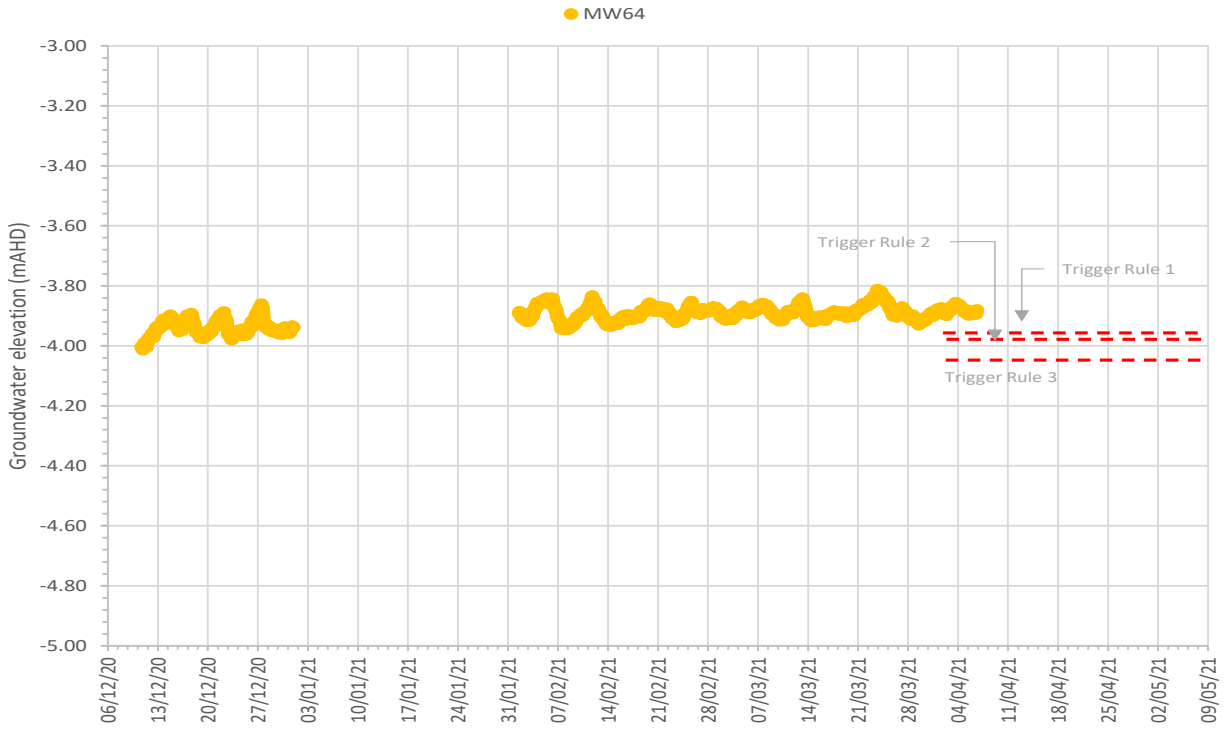


Figure 6-6 MW64 Hydrograph and Trigger Indicators

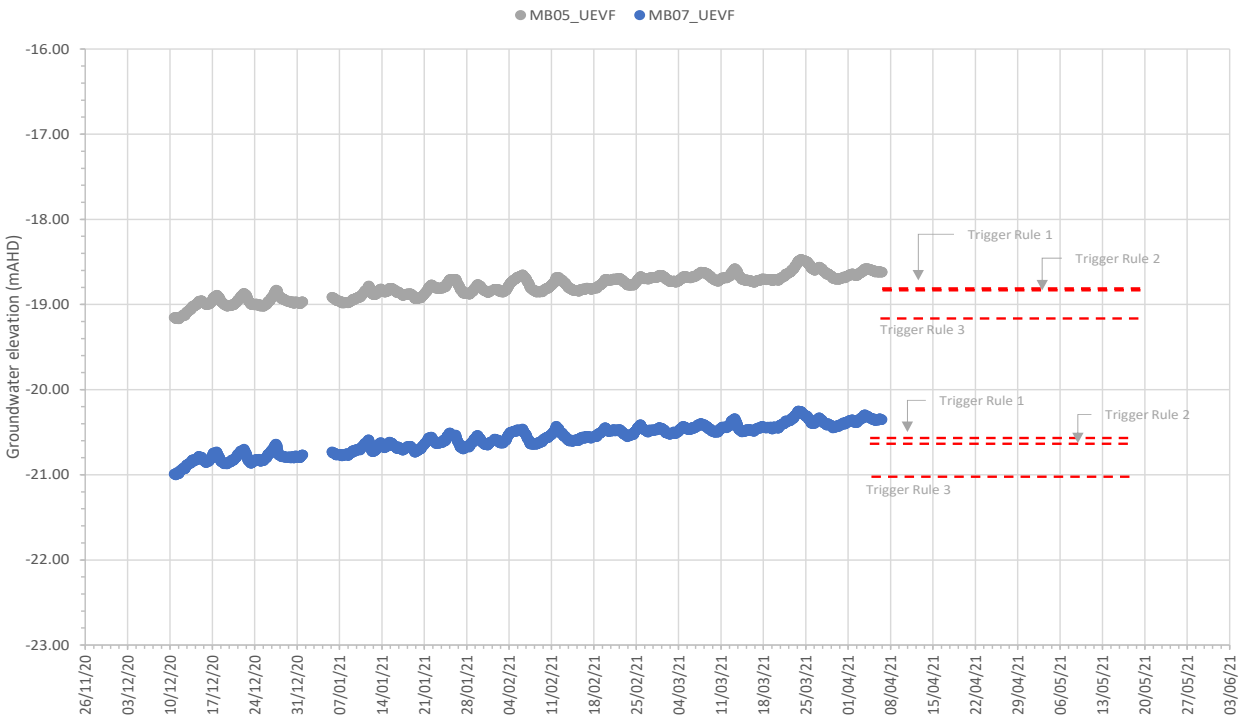


Figure 6-7 UEVFMB05 and UEVF MB07 Hydrograph and Trigger Indicators

6.3 Trigger Response Actions

As discussed in **Section 6.1** and **6.2** and summarised in **Table 6-1** trigger levels based on 5 different rules have been initially set. **Table 6-2** discussed the relevant actions that will be undertaken if a trigger level is observed.

Table 6-2 Actions if Trigger Level is Observed

Trigger Rule	Recommended Action	Relevant Bores Trigger is Applicable
Rule 1 (30-Day Average Water level - 2 x Std Dev)	Continue pumping but analyse water quality suite such as ion ratio trends to allow for a rapid assessment in case level continues to fall.	All bores except WB05
Rule 2 (30-Day Average Water level - 3 x Std Dev and 3 month average Cl:B or TDS - 3 x Std Dev)	Scale back pumping rates by 25% unless otherwise agreed with the Co-regulators TRG if: a. Rule 2 water level trigger is reached and b. there is no other identified reason for the decline (e.g. hydrographic recession following episodic recharge). Scale back pumping rates by 50% unless otherwise agreed with the Co-regulators TRG if: a. Rule 2 water level trigger is reached, and b. Rule 2 water quality (TDS or Cl/B) trigger is reached, and c. there is no other identified reason for the decline.	All bores except WB05
Rule 3 (Historical Low Water Level)	Scale back pumping rates by 50% unless otherwise agreed with the Co-regulators TRG if: a. the water level in the bore has reached its historical minimum, and b. there is no other identified reason for the decline (e.g. failed/blocked bore or climatic considerations).	All bores except WB05
Rule 4 (Water level exceeds 12 month modelled Drawdown	Scale back test by 25% each month until pressure increases above modelled drawdown unless otherwise agreed with the Co-regulators TRG.	WB05

Trigger Rule	Recommended Action	Relevant Bores Trigger is Applicable
Rule 5 Pit water level exceeds -15.5m AHD meaning Pit water may enter the DBG where historical buried Ash is located	The recommended actions are based upon an initial risk assessment undertaken in 2017 refer draft MRCP (EHS Support 2017 Technical Appendix K – Ash Assessment) which indicated that under steady state gradient, a conservative particle of water would take 159 years to move into the receiving environment. On this basis, the following actions related to pit water level are proposed for the pumping test: a. Within 9 months of the commencement of the pumping test, Alcoa to update and finalise the 2017 risk assessment in liaison with ERR/EPA and resolve outstanding risk issues. b. Stop the pumping test if the water level exceeds RL -15.5m unless otherwise agreed at the Co-Regulators Forum, with agreement to be dependent on item a above.	Nil. Applicable to pit water level, however DBG MB04 is the closest bore to Ash burial location.

Note if a trigger is observed, before any action is undertaken, the value will be verified through manual gauging. Additionally, if a statistically significant or anomalous water quality result is observed, the following specific response actions will be considered:

- Identify specific bores affected and review historical data.
- Re-sample and re-analyse to confirm the extent of change to water quality including a revised analytical suite if warranted.
- Assess all potential contributing factors to the change in water quality (e.g., groundwater migration from the mine, non-mine related activities and sustained below or above average rainfall).
- Evaluate potential site-specific environmental values at risk from changes to water quality.
- Re-evaluate trigger values based on new data, beyond which the water quality would be unfit for its intended purpose, in consultation with SRW (likely to be a direct reference to published water quality guidelines but may include derivation of location-specific guidelines for key parameters).

In addition to the actions listed above, as discussed in **Section 6.1.2**, Barwon Water will also provide monthly data for the Barwon Water trigger bores including if a trigger has been crossed. In the event that a Barwon Water trigger is crossed, Alcoa will initiate a review of potential causes in conjunction with Barwon Water with the result of this review and any recommendations to be discussed with the Technical Working Group.

7 Monitoring and Sampling Plan

7.1 Monitoring Activities and Elements

Monitoring activities will vary from general site observations to in-situ measurements and sample collection for laboratory analysis. The level (type and frequency) of monitoring included in this monitoring plan has been established to assess changes in groundwater and the mine pit void water body as part of the 12-month groundwater pumping test.

Alcoa and other parties have conducted periodic historical sampling that provides some data to assist in defining baseline conditions in groundwater and the mine pit void water body. However, and as noted above further monitoring and sampling is required to fully characterise these systems and assess potential risks associated with the 12-month pumping test.

Note that monitoring long term water levels/quality has always been considered to be a part of the MRCP, and Alcoa has always intended to monitor over the long term to the satisfaction of various regulators providing oversight of that activity. As such, Alcoa intends that the data loggers and sampling program (at an appropriate frequency to be determined) will remain in place following the pumping test until such time as it is considered that they are considered no longer warranted. This will be further informed by the data, results and outcomes of the pumping test

7.2 Groundwater Level Monitoring

As discussed above and shown on **Figure 4-2** and **Figure 4-3** groundwater monitoring locations have been established by Alcoa and Barwon Water within the PWT/DBG, UEVF (upper and deeper zone) and LEVF.

It is proposed that continuous (daily) groundwater level and pressure monitoring be undertaken in all nominated monitoring and trigger bores, including by Barwon Water for those owned by Barwon Water (bores P8, P12, P17 and P19). These results will be downloaded monthly. Groundwater level monitoring will be collected using two primary data collection methods:

- Continuous monitoring using Solonist Levelogger.
- Manual gauging prior to each groundwater sampling event.

The groundwater monitoring program is designed to validate the findings of the numerical groundwater model and demonstrate the absence of lateral or vertical migration and/or changes in water quality that could affect potential beneficial uses of the UEVF and LEVF.

7.3 Sampling Program

Mine pit void water body and groundwater sampling will be conducted in accordance with the requirements of publication Victorian EPA (2009). All identified monitoring bores that form part of the monitoring network will be sampled using laboratory supplied bottles and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. Groundwater sampling of Barwon Water trigger bores is not planned.

To acquire the sample, bores will be pumped or sampled with a bailer allowing a minimum of two bore volumes to be purged. A sample will then be taken once stable field parameters (pH, EC, T and Eh) are achieved. Grab samples will be taken from WB16 where pumping is under continuous operation. Field parameters will also be recorded at the time of sampling.

The sampling will be undertaken in accordance with the schedule shown in **Table 7-1**. Sampling will be conducted in accordance with QA/QC procedures outlined below.

There will be an opportunity to re-evaluate the frequency of monitoring and analytical suite based on actual data collected throughout the test, to be reviewed with SRW and as part of the proposed TRG where appropriate.

7.3.1 Analytical Suite

The groundwater monitoring program is designed to validate the findings of the numerical groundwater model and demonstrate the absence of lateral or vertical migration and/or changes in water quality that could affect potential beneficial uses of the UEVF. The analytical suite proposed is shown on **Table 7-2**. Additional analytes may still be collected to support data objectives attributed to potential mine pit void water body amendment activities and if collected will form part of the monthly notifications.

Groundwater sampling will be conducted in accordance with QA/QC procedures below.

7.3.2 Field Duplicate: Intra-Laboratory Duplicate Samples

During months 1-7, 9 and 12 (**Table 7-1**), one bore will be selected for a duplicate sample. The duplicate sample is to be analysed for the same analytes as the primary sample. This sample is used to assess the repeatability of the sampling and analytical processes. It is a measure of intra-laboratory precision and the repeatability of sampling.

7.3.3 Rinsate (or Equipment) Blank

One rinsate blank per day during sampling will be collected and analysed for the same analytes as the field sample collected immediately prior to decontamination of the field equipment. Rinsate samples are collected to assess if decontamination of sampling equipment has been conducted adequately to minimise the potential for cross-contamination between sampling points.

Table 7-1 Adopted Sampling Program

Bore ID	Aquifer Monitored	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
DBGMB1	DBG	x	x	x	x	x	x	x		x			x
DBGMB2	DBG	x	x	x	x	x	x	x		x			x
DBGMB3	DBG	x	x	x	x	x	x	x		x			x
DBGMB4	DBG	x	x	x	x	x	x	x		x			x
DBGMB5	DBG	x	x	x	x	x	x	x		x			x
DBGMB6	DBG	x	x	x	x	x	x	x		x			x
DBGMB7	DBG	x	x	x	x	x	x	x		x			x
DBGMB8	DBG	x	x	x	x	x	x	x		x			x
MW27	DBG/PWT	x			x				x				x
MW29	DBG/PWT	x			x				x				x
MW33	DBG/PWT	x			x				x				x
MW37	DBG/PWT	x			x				x				x
MW64	DBG/PWT	x			x				x				x
UEVFMB1	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB2	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB3	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB4	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB5	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB6	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB7	UEVF (Upper	x	x	x	x	x	x	x		x			x
UEVFMB8	UEVF (Upper	x	x	x	x	x	x	x		x			x
WB4	UEVF (Deeper	x		x			x			x			x
WB5	UEVF (Deeper	x		x			x			x			x
WB12	UEVF (Deeper	x		x			x			x			x
WB14	UEVF (Deeper	x		x			x			x			x
WB15	UEVF (Deeper	x		x			x			x			x
WB16	UEVF (Deeper	x	x	x	x	x	x	x	x	x	x	x	x
Mine Pit	Mine Water	x	x	x	x	x	x	x	x	x	x	x	x

Table 7-2 Water Quality Analytical Suite

Group	Parameter	Units	LOR
Physico-chemical (field)	Temperature (field)	°C	
	pH (field)	S.U.	
	Electrical conductivity (field)	µS/cm	
	Dissolved oxygen (field)	mg/L	
	Redox potential (field)	mV	
Physico-chemical (lab)	pH	S.U.	0.01
	Acidity as CaCO3	mg/L	1
	Total dissolved solids - gravimetric	mg/L	10
	Turbidity	N.T.U.	0.1
Major ions	Bicarbonate Alkalinity as $CaCO_3$	mg/L	1
	Carbonate Alkalinity as $CaCO_3$	mg/L	1
	Hydroxide Alkalinity as $CaCO_3$	mg/L	1
	Total Alkalinity as $CaCO_3$	mg/L	1
	Chloride	mg/L	1
	Sulfate	mg/L	1
	Calcium	mg/L	1
	Magnesium	mg/L	1
	Potassium	mg/L	1
	Sodium	mg/L	1
Nutrients	Organic Carbon (Total and Dissolved)	mg/L	1
	Total nitrogen	mg/L	0.1
	Total Phosphorus	mg/L	0.01
Trace inorganics	Aluminium-total and soluble	mg/L	0.001
	Boron-total and soluble	mg/L	0.05
	Iron-total and soluble	mg/L	0.05
	Bromide	mg/L	

7.4 Reporting and Communication Requirements

7.4.1 Monthly Factual Report

Following each monthly gauging and sampling round, a monthly report will be prepared inclusive of extraction rates from WB16 (daily volume extracted, daily limit, total volume extracted year to date and

yearly limit), manual groundwater levels and datalogger data, and water quality results. The report will also present the data against trigger levels and outline any trigger actions, contingency plans and provide recommendations for any modifications to the monitoring program.

The monthly report will be provided to SRW, key stakeholders and the community within four weeks of the end of each calendar month.

7.5 Continual Improvement

This Monitoring Plan will be reviewed periodically in response to monitoring results. Issues to be considered during this review includes but is not limited to:

- Re-assessing the suitability of the monitoring and trigger network bores.
- Re-evaluating the frequency of monitoring and analytical suite based on monthly data.
- Developing revised trigger values based on the collection and analysis of more than 3 months of daily baseline data.

In addition to this, a Co-regulator Forum Technical Reference Group has been established which will provide a regular opportunity to discuss any issues, risks or improvements and provide oversight of the 12-month groundwater pumping test throughout the test period.

7.5.1 Barwon Water and Alcoa Communication

Any amendments to pumping each Borefield, including both a UEVF and LEVF dual pumping sub 'test' (the detail to be agreed with Barwon Water) will be appropriately communicated to the parties including SRW in advance to ensure that the proposed hypothesis are captured and tested during the One Model approach and any impacts are attributed to pumping amendments which can be explained in the monthly reporting obligations.

7.5.2 Updates to the Environment Protection Act 2017

Alcoa also understands that from 1 July 2021, the State Environment Protection Policy (Waters) will be replaced by the Environment Reference Standard. On this basis it is noted that the groundwater segments will not change at this time with the new Act, and the environmental values (which replace beneficial uses) will not change in relation to the groundwater segment, the introduction of the new Act does not immediately impact the framework developed to define triggers levels at this time. Notwithstanding this the Monitoring Plan will be updated to include discussion of the new legislative changes associated with the Act, subordinate legislation, Environment Reference Standard and associated guidelines. If the Plan requires updating from 1 July 2021 then the appropriate changes will be made.

8 One Model (Proposed)

Alcoa and Barwon Water have in principle agreed to work together to refine and update Barwon Waters existing "Anglesea Groundwater Model" inclusive of both Alcoa's and Barwon Water's latest information, to provide a more comprehensive and detailed groundwater model for the region. This is referred to as the One Model approach. The existing Barwon Water model was initially developed by GHD between 2007 and 2013 and has been previously used to understand potential impacts associated with Barwon Water's Bulk Entitlement from the LEVF. Further details on this model can be found in GHD (2013).

Alcoa and Barwon Water anticipate the kickoff of the One Model development from May 2021 with EHS Support and GHD respectively involved for both parties.

As part of the development of the One Model, Alcoa and Barwon Water have kicked off discussions with SRW and DELWP regarding the inclusion of an appropriate Independent Peer Reviewer (IPR), potentially appointed the regulators, on the basis that the IPR would be involved in the process (with EHS Support and GHD) from kick off.

The model will be built in either MODFLOW-USG or MODFLOW 6 and represent a 3D recharge runoff groundwater flow model which will simulate groundwater flow and surface water / groundwater interactions between all underlying units to the base of the LEVF and (inclusive of the mine pit). Once the model has been completed and an Independent Peer Reviewer has verified the model is fit for purpose, the model will be made available as a stand-alone model to both Barwon Water and Alcoa to run predictive simulations.

Lithological and geophysical data obtained from the recent drilling of the new monitoring bores around the mine pit void as well geophysical data from the deeper bores nearer the Power Station will help refine the model layers (isopach's) in the UEVF and DBG within the vicinity of the mine pit void. Laboratory permeability testing of geological core will also be used to improve hydrogeological parameters within the upper sections of the UEVF.

During the 12-month groundwater pumping test and in discussion between Alcoa and Barwon Water, it is also proposed that Barwon Water will stress the LEVF in a planned manner by pumping certain bores. The monitoring response (along with geophysical logging) will help determine any potential aquifer interactions which can then be further considered by both Alcoa and Barwon Water.

The results of the first 6 months of the 12-month groundwater pumping test will be used to help calibrate the model and verify the model predictability. The groundwater model will then be used by Alcoa to inform a risk and impact assessment for any potential UEVF licence amendment following the 12-month pumping test.

9 References

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Appendix A Southern Rural Water Licence Documents

Entitlement ID:

BEE029662

Printed on: 20 Apr 2010 11:23:45 am

COPY OF RECORD IN THE VICTORIAN WATER REGISTER

TAKE AND USE LICENCE

under Section 51 of the Water Act 1989

The information in this copy of record is as recorded at the time of printing. Current information should be obtained by a search of the register. The State of Victoria does not warrant the accuracy or completeness of this information and accepts no responsibility for any subsequent release, publication or reproduction of this information.

This licence does not remove the need to apply for any authorisation or permission necessary under any other Act of Parliament with respect to anything authorised by the take and use licence.

Water used under this entitlement is not fit for any use that may involve human consumption, directly or indirectly, without first being properly treated.

The Authority does not guarantee, by the granting of the licence, that the licensee will obtain any specific quantity or quality of water. The Authority is not liable for any loss or damage suffered by the licensee as a result of the quantity of water being insufficient or the quality of the water being unsuitable for use by the licensee at any particular time or for any particular purpose.

This take and use licence entitles its holders to take and use water as set out under the licence description, subject to the conditions that are specified.

Licence Holders

Alcoa Of Australia Ltd**

Licence Contact Details

Alcoa Of Australia Ltd** CAMP ROAD ANGLESEA
VIC 3230

Licence Description

Expiry date	30 Jun 2024
Status	Active
Authority	Southern Rural Water
Name of waterway, aquifer or works	LTA-Jan Juc
Water system type	Groundwater
River basin or groundwater unit	Jan Juc (GMU)
Licence volume	4000.0 megalitres
Licence volume adjusted for temporary trade	4000.0 megalitres
Method of taking	Direct extraction from Groundwater
Period during which water can be taken	01 Jul - 30 Jun inclusive
Use of water	Industrial or commercial use - as well as domestic and stock use
Trading zone	Jan Juc LTA

Licence Volume Details

Licence volume	4000.0 megalitres
Licence volume adjusted for temporary trade	4000.0 megalitres

Temporary volume transaction details

Approval date	*Volume traded (ML)*	*Expiry date*
Nil		

Extraction Point Details

Easting	*Northing*	*Zone MGA*	*Location description*
Nil			

Land on which the Water is to be Used

Crown allotment description

Allotment	*Portion*	*Section*	*Township*	*Parish*
64D				Jan Juc

Property address

ANGLESEA POWER STATION CAMP RD ANGLESEA 3230

This entitlement may be transferred to another parcel of land, if application is approved by the Authority.

Related Instruments

Related entitlements	Nil
Related works licence	WLE035161
Other related entities	Nil

Application History

Reference	*Type*	*Status*	*Lodged date*	*Approved date*	*Recorded date*
BER001814	Modify	Approved	20 Apr 2010	20 Apr 2010	
BEI479685	Issue	Approved	29 Aug 2009	29 Aug 2009	

Conditions

This take and use licence is subject to the following conditions:

Method of taking

1 Water may only be taken under this licence if it is taken by the methods expressly approved by this licence.

2 The licence holder must at all times provide the Authority with safe access to inspect all works and appliances used to take water under this licence.

Take location

3 Water may only be taken under this licence if it is taken at the location described as follows: the land parcels identified on this licence.

Take volume and rate

4 The volume of water taken under this licence in any twelve-month period from 1 July to 30 June must not exceed the licence volume, less any volume that has been temporarily transferred to another person or location.

5 The maximum volume that may be taken under this licence in any one day is 39.8 megalitres per day shared between 7 bores.

Temporary transfers to the licence holder

6 If there has been a temporary transfer of another licence to take water at the location, and use water on the land, specified in this licence: a) the extra volume of water taken must not exceed the volume transferred, and b) all the conditions of this licence apply to the taking and using of water consequential to the transfer.

Rosters and restrictions

7 When directed by the Authority, water must be taken in accordance with the rosters and restrictions determined by the Authority, and advised to the licence holder.

Metering of water taken and used

8 Water may only be taken under this licence if it is taken through a meter approved by the Authority.

9 Meters must be installed , in accordance with the specifications set by the Authority, at the licence holder's expense.

10 Meters used for the purpose of this licence are deemed to be the property of the Authority.

11 The licence holder must at all times provide the Authority with safe access to meters for the purpose of reading, calibration or maintenance.

12 The licence holder must notify the Authority within one business day if the meter ceases to function or operate properly.

13 The licence holder must, if required by the Authority, keep an accurate record of the quantity of water taken under this licence and allow the Authority to inspect this record at all reasonable times, and provide a copy of the record when requested.

14 The licence holder must not, without the consent of the Authority, interfere with, disconnect or remove any meter used for the purposes of the licence.

15 The Authority may, if it deems necessary, make an estimate of the total volume of water taken under this licence.

Use of water

16 Water taken under this licence may only be used on the land, and for the purposes, specified in the licence.

17 The licence holder must at all times provide the Authority with safe access to inspect the land on which water is licensed to be used.

Operation and maintenance

18 The licence holder must keep all works, appliances and dams associated with this licence,

including outlet pipes and valves, in a safe and operable condition, and free from obstacles and vegetation that might hinder access to works.

Preventing pollution

19 The licence holder must, construct and maintain bund walls around any hydrocarbon-fuel-driven engine, motor, fuel storage, or chemical storage used in connection with this licence, in accordance with the timeframe, specifications, guidelines and standards prescribed by the Authority.

Managing groundwater infiltration

20 The maximum volume of water that may be applied to the land referred to in the licence in any 12-month period from 1 July to 30 June is the annual use limit which is equal to the licence volume, or if the annual use limit is adjusted by the Authority on account of seasonal conditions this adjusted annual use limit.

Managing drainage disposal

21 Where water use results in drainage from the land specified in the licence, that drainage water must be disposed in ways that meet the standards, terms and conditions adopted from time to time by the Authority.

Fees and charges

22 The licence holder must, when requested by the Authority, pay all fees, costs and other charges under the Water Act 1989 in respect of this licence.

END OF COPY OF RECORD

Appendix B Risk Assessment

Area: Anglesea Mine 12 Month Groundwater Pumping Test Risk Control Assessment					Date: December 22, 2020					Participants: W Sharp, J Osborne, A Robertson, N Marris, C Smitt (EHS)		
Element	**Mining Hazard**	**Potential Risk Source (incl activity or circumstance)**	**Potential Receptors at Risk**	**Control Measures (Physical and Administrative)**	**Performance Objective, Standard OR Criteria for Each Control OR combination of control measures**	**Consequence**			**Likelihood**	**Risk Rating**	**Monitoring and Reporting**
						Public Safety	**Community facilities, including property and infrastructure**	**Land and Environment**			
1	Surface Water	- Activity - Plant and Equipment Failure (UEVF groundwater loss to potential receptors)	- Anglesea River - Salt Creek	- Extraction bore site earthen bund to provide separation from Anglesea River - earthen bund and piping redundancy/sleeving to prevent any water leak from entering Anglesea River - Pipeline route to provide separation from Salt Creek Diversion Channel - Pipeline commissioning procedure to be developed - Pipeline & equipment inspections twice per day - Regular equipment maintenance by supplier for duration of test - Investigate instrumentation based automatic shutdown or notifications with equipment supplier - Anglesea Mine Water Management Plan	- No release of groundwater into the Anglesea River or Salt Creek. - Compliance with Alcoa EPA License 11429 condition LI_DW1 *You must ensure that surface water discharged from the premises is not contaminated with waste.* - compliance with Environment Protection Act 1970. *Note: In July 2021, the Environment Protection Amendment Act 2018 will come into effect.* - Compliance with Section 3.2(d) State Environment Protection Policy (SEPP WoV, 2018)	Insignificant	Insignificant	Insignificant	Unlikely	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - SRW monthly groundwater pumping test report to all key stakeholders including updates on groundwater levels, quality and agreed trigger status - Monthly Technical Steering Committee updates with key regulators and agencies - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
2	Surface Water	- Activity - groundwater extraction of up to 1.5Gl of UEVF results in reduction of baseflow to surface water (GDE's)	- Anglesea River - Salt Creek	- Groundwater impact assessment including groundwater modelling approved by SRW - SRW amended groundwater license conditions - Water Monitoring Plan -12 Month Groundwater Pumping Test including groundwater level and quality triggers to be approved by SRW - Daily and annual (1.5Gl) cap on extraction - Data logging and reporting of groundwater levels and quality - Installation of 16 new monitoring bores around the periphery of the mine void - Known multiple low permeability confining layers between receptors and extraction point - Anglesea Mine Water Management Plan - Monthly Technical Steering Committee review for regulators and agencies	- Compliance with Alcoa EPA License 11429 condition LI_DW1 *You must ensure that surface water discharged from the premises is not contaminated with waste.* - Compliance with Environment Protection Act 1970. *Note: In July 2021, the Environment Protection Amendment Act 2018 will come into effect.* - Compliance with Section 3.2(d) State Environment Protection Policy (SEPP WoV, 2018)	Insignificant	Insignificant	Insignificant	Unlikely	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Water Monitoring Report – 12 Month Groundwater Pump Test Monthly Report (as per SRW monthly groundwater pumping test report to all key stakeholders including updates on groundwater levels, quality and agreed trigger status) - Monthly Technical Steering Committee updates with key regulators and agencies - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting

Area: Anglesea Mine 12 Month Groundwater Pumping Test Risk Control Assessment					Date: December 22, 2020					Participants: W Sharp, J Osborne, A Robertson, N Marris, C Smitt (EHS)		
Element	**Mining Hazard**	**Potential Risk Source (incl activity or circumstance)**	**Potential Receptors at Risk**	**Control Measures (Physical and Administrative)**	**Performance Objective, Standard OR Criteria for Each Control OR combination of control measures**	**Consequence**			**Likelihood**	**Risk Rating**	**Monitoring and Reporting**
						Public Safety	**Community facilities, including property and infrastructure**	**Land and Environment**			
3	Surface Water	- Activity – Placement of 1.5Gl of UEVF groundwater into the mine void water body (consistent with accelerated mine void filling strategy) adversely impacting surface water quality	- Mine water body	- Historical water body water quality precludes beneficial uses (note that this is consistent with background surface waters including Anglesea River and Salt Creek) - UEVF water quality is higher quality than current mine water body. - Discharge of UEVF water will be below the pit water level to inhibit oxygenation of the water and mitigate geochemical reactions. - Water Monitoring Plan -12 Month Groundwater Pumping Test including mine void water quality to be approved by SRW - Mine water body is a physically closed system that is not able to discharge to surface water systems due to existing topography - Anglesea Mine Water Management Plan - Monthly Technical Steering Committee review for regulators and agencies	- Compliance with Alcoa EPA License 11429 condition LI_DL1.3 *You must ensure that the activities carried on at the premises do not do either of the following:* *a) cause detriment to any beneficial use which may be made of groundwater both within and beyond the boundary of the premises.* *b) pollute groundwater both within and beyond the boundary of the premises contrary to section 39 of the Environment Protection Act 1970* - Compliance with Environment Protection Act 1970. *Note: In July 2021, the Environment Protection Amendment Act 2018 will come into effect.* - Compliance with Section (43), 56 (a),(b) State Environment Protection Policy (SEPP WoV, 2018)	Insignificant	Insignificant	Insignificant	Unlikely	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Water Monitoring Report – 12 Month Groundwater Pump Test Monthly Report (as per SRW monthly groundwater pumping test report to all key stakeholders including updates on groundwater levels, quality and agreed trigger status) - Monthly Technical Steering Committee updates with key regulators and agencies - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
4	Groundwater availability	- Activity - groundwater extraction of up to 1.5Gl from UEVF that impacts third party or environmental beneficial users	- UEVF aquifer domestic users - LEVF Barwon Water	- Two nearest domestic users located 3 km southeast, 8.5 km northeast of the mine. - UEVF sits above the LEVF separated via the MEVF (aquitard). Due to an upward gradient from the LEVF to the UEVF, the only potential for impact to the LEVF is from pumping the LEVF itself. - Decommission of historical redundant power station bores where required. - Combined pumping test UEVF/LEVF agreed in principal with Barwon Water. - Plus all control measures described in Element 2 above.	- Compliance with Alcoa EPA License 11429 condition LI_DL1.3 *You must ensure that the activities carried on at the premises do not do either of the following:* *a) cause detriment to any beneficial use which may be made of groundwater both within and beyond the boundary of the premises.* *b) pollute groundwater both within and beyond the boundary of the premises contrary to section 39 of the Environment Protection Act 1970* - Compliance with Environment Protection Act 1970. Note: In July 2021, the Environment Protection Amendment Act 2018 will come into effect. - Compliance with Section (43), 56 (a),(b) State Environment Protection Policy (SEPP WoV, 2018)	Insignificant	Insignificant	Insignificant	Unlikely	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Water Monitoring Report – 12 Month Groundwater Pump Test Monthly Report (as per SRW monthly groundwater pumping test report to all key stakeholders including updates on groundwater levels, quality and agreed trigger status) - Monthly Technical Steering Committee updates with key regulators and agencies - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
5	Groundwater quality	- Activity - Placement of 1.5GL of UEVF groundwater into the mine void water body (consistent with accelerated mine void filling strategy) results in localised migration of mine void water into UEVF	- UEVF	- All control measures described in Element 2 above.	- Compliance with Alcoa EPA License 11429 condition LI_DL1.3 *You must ensure that the activities carried on at the premises do not do either of the following:* *a) cause detriment to any beneficial use which may be made of groundwater both within and beyond the boundary of the premises.* *b) pollute groundwater both within and beyond the boundary of the premises contrary to section 39 of the Environment Protection Act 1970* - Compliance with Environment Protection Act 1970. *Note: In July 2021, the Environment Protection Amendment Act 2018 will come into effect.* - Compliance with Section (43), 56 (a),(b) State Environment Protection Policy (SEPP WoV, 2018)	Insignificant	Insignificant	Insignificant	Likely	Medium	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Water Monitoring Report – 12 Month Groundwater Pump Test Monthly Report (as per SRW monthly groundwater pumping test report to all key stakeholders including updates on groundwater levels, quality and agreed trigger status) - Monthly Technical Steering Committee updates with key regulators and agencies - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting

Area: Anglesea Mine 12 Month Groundwater Pumping Test Risk Control Assessment					Date: December 22, 2020						Participants: W Sharp, J Osborne, A Robertson, N Marris, C Smitt (EHS)
Element	**Mining Hazard**	**Potential Risk Source (incl activity or circumstance)**	**Potential Receptors at Risk**	**Control Measures (Physical and Administrative)**	**Performance Objective, Standard OR Criteria for Each Control OR combination of control measures**	**Consequence**			**Likelihood**	**Risk Rating**	**Monitoring and Reporting**
						Public Safety	**Community facilities, including property and infrastructure**	**Land and Environment**			
6	Groundwater quality	- Activity - Placement of 1.5Gl of UEVF groundwater into the mine void water body (consistent with accelerated mine void filling strategy) results in mine void water coming into contact with consolidated ash material (placed in the mine as a licensed activity under EPA License 11429)	- Consolidated ash material within mine (placed in the mine as a licensed activity under EPA License 11429)	- Ash material located in the southeast corner of the mine known to be located between RL-15 and -8m - Current mine water level is ~RL-21m, based on surveyed bathymetry the water level is expected to rise to ~RL-16m. As such no interaction between pit water and the ash material is expected. - All ash material is covered with at least 1m of overburden material (as approved by ERR). - EHS Support 'Ash Assessment' Study MRCP Appendix K submitted to ERR 28/9/2017 geochemical mixing and transport modelling indicated the discharge of ash porewater into UEVF groundwater or pit water body is likely to have a negligible effect on the receiving water chemistry and also indicated it would take up to 159 years for a particle of water to migrate out into the formation. - Monthly mine void water level to be surveyed and reported. - Plus all control measures described in Element 2 above.	- Compliance with Alcoa EPA License 11429 condition LI_DL1.3 *You must ensure that the activities carried on at the premises do not do either of the following:* *a) cause detriment to any beneficial use which may be made of groundwater both within and beyond the boundary of the premises.* *b) pollute groundwater both within and beyond the boundary of the premises contrary to section 39 of the Environment Protection Act 1970* - Compliance with Environment Protection Act 1970. *Note: In July 2021, the Environment Protection Amendment Act 2018 will come into effect.* - Compliance with Section (43), 56 (a),(b) State Environment Protection Policy (SEPP WoV, 2018)	Insignificant	Insignificant	Insignificant	Unlikely	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Water Monitoring Report – 12 Month Groundwater Pump Test Monthly Report (as per SRW monthly groundwater pumping test report to all key stakeholders including updates on groundwater levels, quality and agreed trigger status) - Monthly Technical Steering Committee updates with key regulators and agencies - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
7	Noise Pollution	- Activity - Plant and Equipment	- Public safety	- Diesel generator located approx. 1300m from nearest resident, with significant vegetation and ridges in between. - Equipment maintenance regime in accordance with manufacturers specifications (approx. every 600 hours). - Diesel generator include appropriate engineered silencing canopy	- No detrimental noise emissions - Compliance with Alcoa EPA Licence 11429 - Amenity Condition for Noise (LI_A2) - Compliance with EPA Publication 1411 - Noise from industry in regional Victoria - Compliance with appropriate sections of the endorsed Work Plan 2011 (Schedule of Conditions)	Insignificant	Insignificant	Insignificant	Unlikely	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
8	Ground Instability	- Activity - Placement of 1.5Gl of UEVF groundwater into the mine void water body (consistent with accelerated mine void filling strategy) - Groundwater Level increase - Surface Water (erosion) - Geological Structure	- Public Safety - Flora and Fauna - Aboriginal Heritage - Infrastructure (Barwon Water pipeline, bores and power) - Infrastructure (powerlines) - Public Infrastructure (Coalmine Road and Messmate Track) - Private property (Anglesea Golf Club) - Crown Land disturbance	- Engineering control through geotechnical and hydrological design reducing overall slope angle - Independent peer review of the Geotechnical and Hydrological Design - Establishment by design of 20 metre set back to public infrastructure - Ground Control Management Plan - Water Management Plan - Construction informed by embankment compaction trials - Geotechnical inspections by trained personnel during construction - Geotechnical evaluation of survey data - Establishment of the Geotechnical Risk Zone (GRZ) - Surface drainage controls - Earthworks 'As Built Report' confirming compliance and that earthworks meet or exceed design criteria	- Creation of safe and stable slopes with probability of failure < 1 x 0.00001 - Compliance with relevant standards (ie. Guidance material for the assessment of geotechnical risk in open pit mines and quarries) - Maintain buffer to public infrastructure - Ensure slope construction is in accordance with engineering design (refer to separately submitted earthworks 'As Built' Report) - Early detection of geotechnical instability - Surface water erosion does not impact on geotechnical stability - Compliance with appropriate sections of the endorsed Work Plan 2011 (Schedule of Conditions)	Critical	Minor	Insignificant	Rare	Medium	- Daily supervision of works - Implementation of slope monitoring (to be agreed with ERR), analysis and reporting of data - Audit and reporting of contractor compliance against Ground Control Management Plan, Water Management Plan - Quarterly Geotechnical and surface water erosion Inspections and reporting - Incident reporting - Installation of 16 additional groundwater monitoring wells, monitoring, analysis and reporting of data - Community feedback and/or complaints and regulator feedback - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings

Area: Anglesea Mine 12 Month Groundwater Pumping Test Risk Control Assessment					Date: December 22, 2020						Participants: W Sharp, J Osborne, A Robertson, N Marris, C Smitt (EHS)
Element	**Mining Hazard**	**Potential Risk Source (incl activity or circumstance)**	**Potential Receptors at Risk**	**Control Measures (Physical and Administrative)**	**Performance Objective, Standard OR Criteria for Each Control OR combination of control measures**	**Consequence**			**Likelihood**	**Risk Rating**	**Monitoring and Reporting**
						Public Safety	**Community facilities, including property and infrastructure**	**Land and Environment**			
9	Erosion	- Activity - Pumping test pipeline unplanned release of water or uncontrolled discharge into water body	- Surface Water (contained within mine pit only)	- Pipeline placement at water body end for the last approx. 300m of its route into the engineered (concrete mat lined) drain 9 - Pipe discharge arrangement that extends out from the water body edge a distance of 5 to 10m, is floated towards the end to keep it off the water body floor - Pipe discharge arrangement appropriately fixed in position to minimise the risk of the discharge encroaching on the water body edge - Ground Control Management Plan - Water Management Plan	- No active erosion rill lines associated with pipeline - No active tunnel erosion on slopes or associated with pipeline - Compliance with appropriate sections of the endorsed Work Plan 2011 (Schedule of Conditions)	Insignificant	Insignificant	Insignificant	Possible	Low	- Daily supervision of works - Twice daily pipeline and equipment inspections including the discharge into the water body - Visual inspection for rill presence/absence/activity using accepted visual criteria for activity recording or rill location and dimensions - Inspection for tunnel erosion (including potential higher risk areas) for signs of seepage, ponding, or slumping - Visual assessment initiated after rainfall events > 20mm - Quarterly Geotechnical and surface water erosion Inspections and reporting - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
10	Unmanaged Hazardous Material/Waste	- Activity - Plant and Equipment - Spill of fuel or oils	- Groundwater - Surface Water - Biodiversity - Ecosystem	- Use of a engineered bunded diesel fuel storage tank - Earthen bund construction around equipment laydown area as secondary containment - Suitably qualified and experienced contractors (equipment set up and/or refuelling) - Equipment refuelling procedure - Equipment maintenance regime in accordance with manufacturers specifications. - Supervision - Spill response procedure and equipment (ie spill kits)	- No uncontrolled spill of fuel or oil - Compliance with Alcoa EPA Licence 11429 Condition LI_G1. - Compliance with Waters SEPP - Compliance with AS 1940 - 2004 The storage and handling of flammable and combustible fluids - Compliance with DG Act 1985 and Regulation (Storage and Handling) 2012. - Compliance with appropriate sections of the endorsed Work Plan 2011 (Schedule of Conditions)	Insignificant	Insignificant	Insignificant	Possible	Low	- Daily supervision of works - Equipment maintenance records - Twice daily pipeline and equipment inspections including the discharge into the water body - Reporting via monthly ERR report and bimonthly Community Consultative Network meetings - Health and Safety and Environmental Incident reporting
11											

Risk-based work plan using online RRAM - Guidelines for mining industry projects

Version v0.6

Department of Economic Development, Jobs, Transport and Resources

VICTORIA State Government | Economic Development, Jobs, Transport and Resources

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Figure 1: Key steps in mining industry project approval
Figure 2: Recommended steps to follow before preparing the work plan
Figure 3: Menu option in plans in RRAM
Figure 4: Schematic description of batter design for open pit
Figure 5: Risk matrix
Figure 6: Work plan assessment and approval issue resolution process

TABLES

Table 1: Requirements of regional plan, work plan and site layout plan areas
Table 2 (in appendix 5): Guidance to identify sensitive receptors in the vicinity of the work

Review and revisions

Version	Comment
Version V.01, June 2015	Available in RRAM
Version V.02	Internal review
Version V.03	Internal review and edit
Version V.04, November 2015	Available in RRAM
Version V.05, June 2016	For review
Version V.06, August 2016	Internal review and edit

Purpose

This guideline assists Tenement holders (mining licence, prospecting licence) proposing miningto plan, prepare and lodge a risk-based work plan or variation to an approved work plan (the work plan) under the *Mineral Resources (Sustainable Development) Act 1990* (MRSDA) and in accordance with the requirement for a risk-based work plan under Schedule 15 of the Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2013 (MRSD(MI)R).

An overview of the exploration project approval process is available here: http://www.energyandresources.vic.gov.au/__data/assets/pdf_file/0018/1144017/20140704-Overview-chart-exploration.pdfhttp://www.energyandresources.vic.gov.au/__data/assets/pdf_file/0018/1144017/20140704-Overview-chart-exploration.pdf

Tenement holders can prepare and lodge work plans using the online Resource Rights Allocation and Management (RRAM) system. RRAM is designed to administer and regulate Victoria's earth resources industries. RRAM enables work plans to be prepared, lodged, assessed, endorsed and approved online.

For access to RRAM and a guide to use RRAM please refer to: http://www.energyandresources.vic.gov.au/earth-resources/licensing-and-approvals

What is covered in this Guideline

Requirements under the Regulations and Schedule 15 of the Regulations	Information covered in this Guideline
Part 1—Required information— mining work 1. Description of work	Refer See Part B of this guideline
2. Identification of mining hazards	Refer See Part B of this guideline
3. Identification and assessment of risk	Refer See Part B of this guideline
4. Risk management plan	Refer See Part B of this guideline
5 Rehabilitation plan	Refer See Appendix 14
6 Community engagement plan	Refer See Appendix 13
Part 2—Stability requirements— declared mines	Information required under this clause is not described in this guideline.
Part 3—Fire risk management plan—coal mines	Information required under this clause is not described in this guideline.
32A Application for variation of work plan	Refer See Part D.

Who will use this Guideline

Earth Resources Regulation (ERR) requires an approved risk-based work plan when mining industry activities do not meet the requirements of section 40(2) of the MRSDA. Tenement holders of the mining project who require an approved risk-based work plan should use this Guideline.

A mining industry project must not commence without:

- a mining licence or a prospecting licence
- **an approved work plan** or compliance with Code of Practice provision under MRSDA
- **a planning permit** under the *Planning and Environment Act 1987* (P&E Act)
- **licence(s) and/or approval(s)** under other planning and environmental legislations (not mentioned above) that may affect the project
- compliance with other requirements under s42(1) of the MRSDA, including seven days' notice to the Chief Inspector under s42(1)(g).

A work plan is not required if the mining industry project meets requirements of s40(2) of the MRSDA:

(b) a licensee who holds a mining licence that—(i) covers an area of 5 hectares or less; and

(ii) does not involve underground operations, blasting, clearing of native vegetation or the use of chemical treatments; or

(c) a licensee who holds a prospecting licence that does not involve underground operations, blasting, clearing of native vegetation or the use of chemical treatments

If an approved work plan is not required, the site must comply with the Code of Practice for Low Risk Mines (available at http://www.energyandresources.vic.gov.au/earth-resources/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/code-of-practice-for-low-risk-mines).

How to use this Guideline

This section provides an overview of how to use this Guideline:

- Use Part E to understand whether you need to follow this Guideline to comply with the MRSDA and the MRSD(MI)R.
- Use Part A and Part B to propose a new mining industry project and lodge an application using RRAM.
- Use Part A, Part B and Part D to seek approval for proposed changes to existing work.
- Use Part C to understand how the approval is undertaken under the MRSDA for new projects and changes to existing mining industry projects
- Use Part F if you disagree with the ERR assessor about the assessment of the proposal.

The Guideline uses the following styles to guide you through the information:

- Green text in part B relate to fields in RRAM.
- Relevant extracts from the MRSDA and MRSD(MI)R are in italics and /or contained in a shaded box.
- Important information is presented in double line bordered boxes.

Processes are generally listed under headings containing the word 'Steps'.

Key steps – mining industry project approval

The key steps involves in the approval of a mining industry project are presented in figure 1.

Statutory steps

- Tenement holder obtains a mining licence or a prospecting licence.

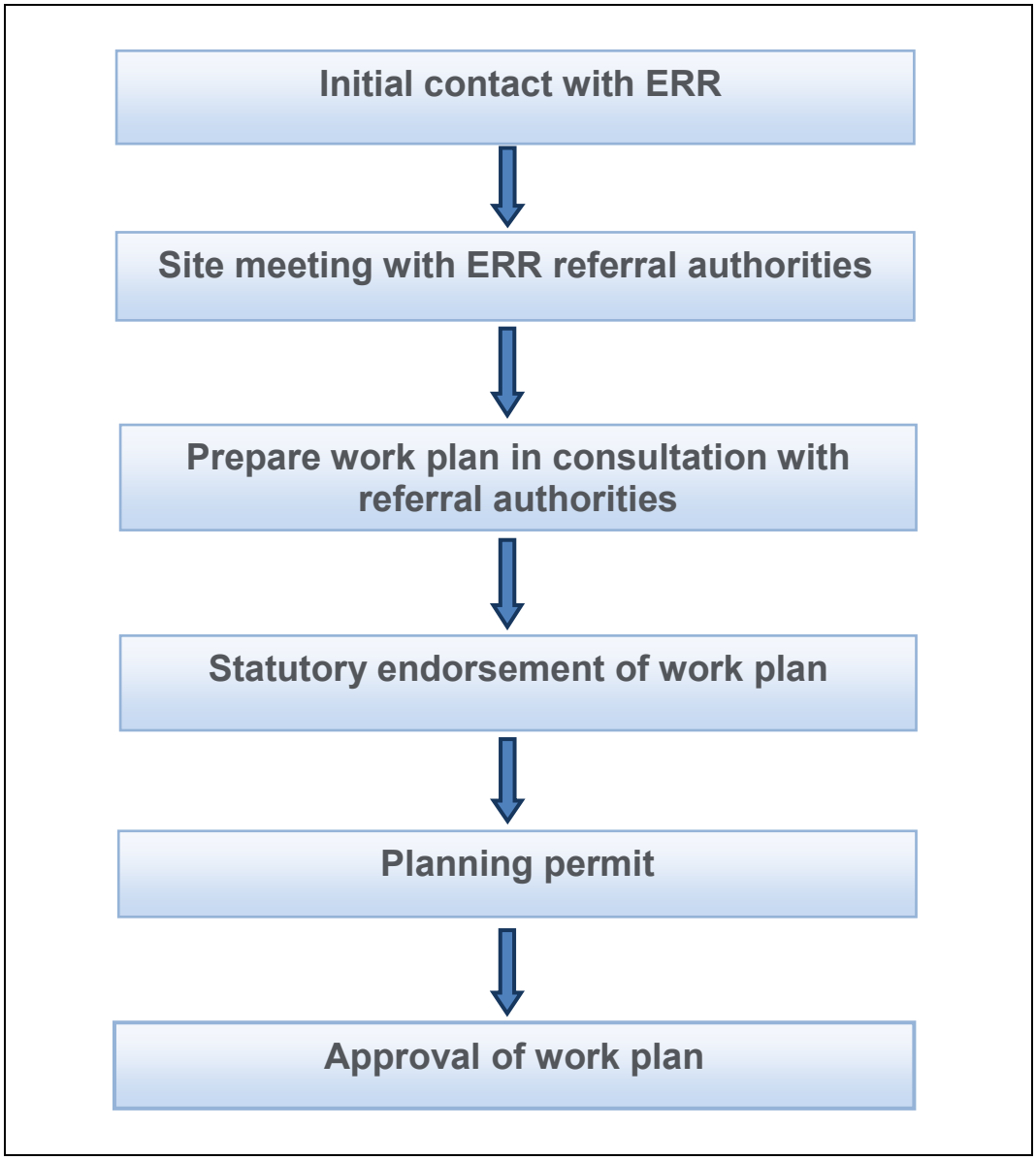
Non-statutory steps

- Tenement holder establishes contact with ERR within the Department of Economic Development, Jobs, Transport and Resources.
- Tenement holder schedules a site meeting with the department and the referral authority(s).
- Tenement holder prepares a risk-based work plan using RRAM online system.

Statutory steps

- Tenement holder lodges a risk-based work plan with the department.
- The department gives a copy of the risk-based work plan to the referral authority(s) within 28 days of receipt of the plan.
- Within 28 days, the referral authority(s):
    - agrees to statutory endorsement, or
    - agrees to statutory endorsement subject to conditions, or
    - objects to statutory endorsement on any specified ground.
- The department endorses (statutory endorsement) the risk-based work plan within 28 days of being told by a referral authority that it agrees with statutory endorsement.
- Tenement holder applies to the relevant council for a planning permit, and provides a copy of the permit to the department.
- The department approves the risk-based work plan within 28 days of the Tenement holder providing the planning permit to the department.
- Tenement holder gives seven days' notice to the department (Chief Inspector) before work commences.

Figure 1: Key steps in mining industry project approval



Part A – Steps before submitting a risk-based work plan using online RRAM

A.1 Introduction

Mining industry projects can be above ground and/or underground. They can involve many activities, use a variety of machines and equipment and takes years to complete.

Mining sites can be located in different locations, from remote regional locations to close proximity to residential properties. They could be near a waterway, intersect environmentally sensitive flora /faunal habitat, or be on a heritage site. This large number of variables creates a range of risks to onsite and offsite receptors.

> Purpose of the MRSDA:
> *The purpose of this Act is to encourage mineral exploration and economically viable mining and extractive industries which make the best use of, and extract the value from, resources in a way that is compatible with the economic, social and environmental objectives of the State.*

The risk-based work plan details the mining industry project. To meet the purpose of the MRSDA, the work plan must:

- *identify the risks that the work may pose to the environment, to any member of the public, or to land, property, or public infrastructure in the vicinity of the work; and*
- *specify what the licensee will do to eliminate or minimise those risks as far as reasonably practicable;*

The key to a successful mining industry project is early engagement by the Tenement holder with ERR, referral authorities and council. This engagement occurs initially at the site meeting and then through continued dialogue to resolve issues and information requirements.

> According to the MR(SD)(MI)R:
> ***mining hazard** means any mining activity and circumstance that may pose a risk to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of work carried out at a mine;*

The Tenement holder must collect information, and process it to facilitate an initial site meeting. That meeting will determine the information that will be required in the risk-based work plan.

Part A of the Guideline guides the Tenement holder on what information to research and compile to:

- facilitate the pre-work plan site meeting
- maximise the benefit of the site meeting
- prepare the risk-based work plan.

This part of the Guideline aims to streamline the background work that the Tenement holder would undertake. The collection and presentation of this background work in a structured way will benefit the Tenement holder, by identifying:

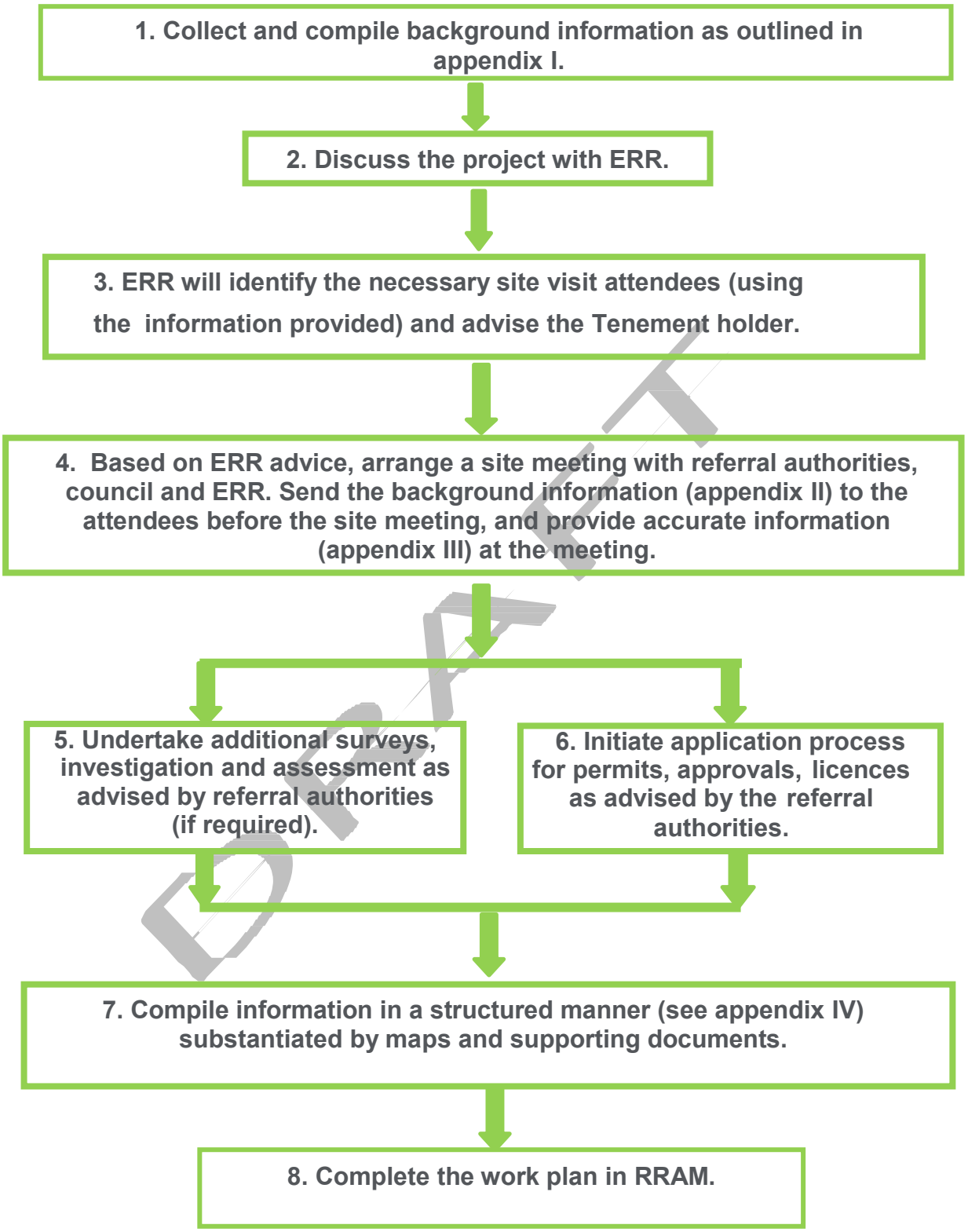
- any planning and environmental legislation that may affect the project
- any permits, approvals or licences that might be required before the project commences
- any requirement for additional environmental investigation, surveys and assessment to support the application and approval process
- how the Tenement holder can plan and progress several approval activities concurrently, thereby saving time and avoiding unnecessary project delays.

A.2 Steps before preparing the risk-based work plan online using RRAM

To achieve an effective outcome from the initial site meeting, the Tenement holder should follow these steps (**figure 2)**:

1. Collect and compile background information as outlined in appendix 1.
2. Discuss the project with ERR (see appendix 16 for contact details). ERR will identify the necessary site visit attendees and advise the Tenement holder.
3. Based on ERR advice, arrange a site meeting with referral authorities, the council and ERR.
4. Send the background information (appendix 2) to the attendees before the site meeting, and provide accurate information at the meeting. Appendix 3 lists possible questions that may be raised at the site meeting. Referral authorities may confirm or refute or clarify the background information used to develop the project.
5. Based on ERR, referral agency and council comment at the meeting, undertake additional surveys, investigations, or assessments (as required). Consult relevant referral authorities during this work so the surveys, investigations or assessments meet the referral authorities' requirements and objectives.
6. Progress with any application for required permits, licences or approvals, other than the MRSDA work plan and planning consent.
7. Compile information in a structured manner, substantiated by maps and supporting documents where necessary. Consider the risk assessment information included in appendix 4.
8. Go to part B to prepare and lodge the work plan online in RRAM.

Figure 2: Recommended steps before preparing the work plan



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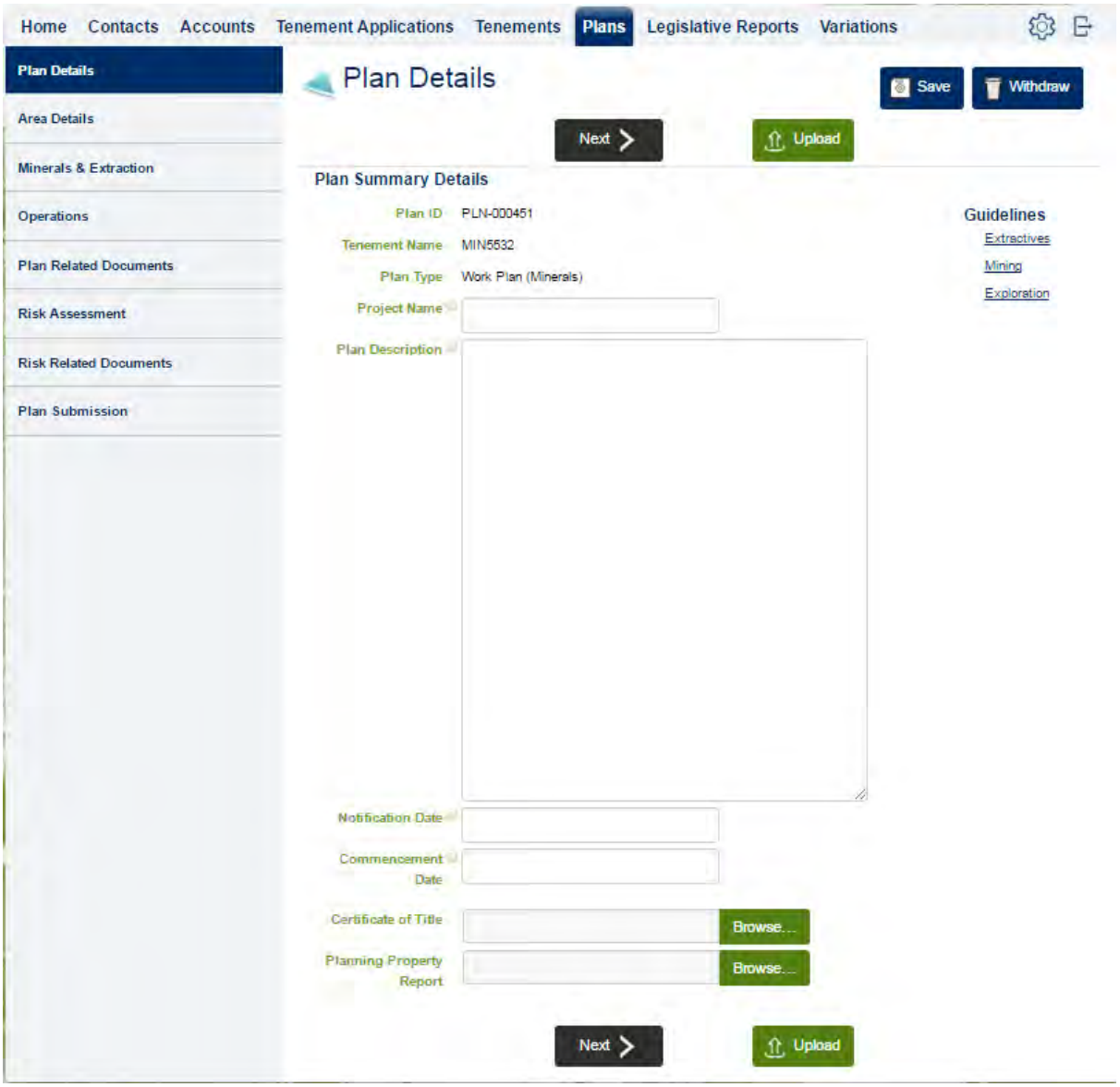
Part B – Preparing a risk-based work plan using RRAM

ERR's RRAM solution enables Tenement holders to complete risk-based work plans in accordance with the requirements of Schedule 15 of the MR(SD)(MI)R. The online form requires minimum targeted information that clearly identifies the risks that the proposed activity may pose to the environment, public safety, infrastructure and community, and how the Tenement holder proposes to eliminate or minimise the risk. It allows focus on key risks by priority.

Figure 3: Menu option in plans in RRAM



A risk-based work plan using RRAM contains three sections:

B.1. A high level description of the proposed exploration work

B.2 A risk assessment, including an assessment of the hazards relating to the activities, the receptors, consequences, controls, monitoring and reporting proposed

B.3 Attachments, including the site plans, a description of community consultation and rehabilitation

Initiating a work plan in RRAM

- Following contact with the department, ERR will create a new PLAN (work plan) in RRAM and change the author to the Tenement holder's nominated user.
- The Tenement holder accesses the PLAN through the RRAM business portal to prepare the risk-based work plan.

For a work plan variation, see part D.

B.1 Project description

B.1.1 Plan details

Fields or attachments in RRAM	Explanation
Project name	Provide the name of mining project – for example, 'Project Mineral Sand Mine'.
Work plan description	Provide a general description of the activities the risk-based work plan covers (include information for both above ground and underground work, under separate headings). For a new risk-based plan, information to be included in this section includes: MRSD(MI)R Schedule 15: ***"Part 1—Required information–mining work*** ***1 Description of work*** *1.2 A general description of geological information pertaining to the work, including stratigraphy, any adverse geological structures, the minerals to be extracted, and the estimated ore resources and reserves."* Description of geology, geological structure (faults, fractures etc.), current and past land uses (such as contaminated land, old tailing storage facilities, underground voids). MRSD(MI)R Schedule 15: **"*Part 1—Required information—mining work*** ***1 Description of work*** 1.3 *A general description of the mine operations that includes—* *(a) the method and scale of extraction; and* (b) *ore processing methods and facilities; and* *(c)waste disposal methods and facilities; and* *(d) stockpiling facilities; and* *Other mine infrastructure"* For an above ground mine, describe site layout and operations (as applicable): • Extraction methods and processing • Proposed area and depth of extraction, the proposed stages of extraction (if applicable) and the proposed design of the extraction pit, including the number of benches, the slope configuration (bench height, berm width), the terminal slope configuration • Location of water courses, proposed drainage diversions and water quality management; • Dewatering locations and methods. • Blasting methods, procedures and schedules • Location, dimensions, and design of dams and tailings ponds; • Location, dimensions and design of all waste dumps and soil stockpiles; • Vegetation and land management, particularly proposed clearing; • Mine rehabilitation and closure concept and planning • Permits, approvals and licences. • Specify the general location of topsoil, overburden and product. • Describe water sources for site operation (groundwater, dam etc.). • Describe the physical and chemical composition of quarry waste materials, identifying potential hazardous substances, including the presence of sulphides (if acid sulphate soil has been excavated and/or chemicals used in processing). In addition to the information above, information required for an underground mine includes: • access, the ventilation system • the extraction system • the stope and pillar layout; the stope or mining sequence • ore handling and transportation

Fields or attachments in RRAM	Explanation
	• the mine site layout and services. • Any backfilling methods/systems • The footprint at the surface of the underground mining operations MRSD(MI)R Schedule 15: "***Part 1—Required information—mining work 1 Description of work*** *1.5 A description of sensitive receptors (including their location) in relation to the environment, any member of the public, or land, property or infrastructure in the vicinity of the work."* • Description and location plan of roads, bridges, pipelines, power lines, easements, reserves, waterways, depth to groundwater, heritage sites and communities in the vicinity of the project area. MRSD(MI)R Schedule 15: ***"Part 1—Required information—mining work*** ***1 Description of work*** *1.1 A location map of the work plan area and surrounding areas, drawn at an appropriate scale proposed, that shows the following—* *the extent and status of Crown lands and private lands;* *residential, commercial and industrial development;* *public facilities and infrastructure;* *rivers and streams within the work plan area and within 2 km of the work plan area."* MRSD(MI)R Schedule 15: ***Part 1—Required information—mining work*** ***1 Description of work*** *1.4 A site map, drawn at an appropriate scale, showing the general layout of the mine and associated facilities and infrastructure.* • Show relevant information on a regional area map (see **table 1** for information to be included on a regional area map). • Show relevant information on a site layout plan (see **table 1** for information to be included on a site layout plan). Note: • See **appendix 5** for guidance on sensitive receptors in the vicinity of the work. • If there are sensitive receptors located within the generic GRZ (nominally=4H), attach a **Preliminary Slope Instability Impact Assessment** to the work plan. See **appendix 10** for the content of a Preliminary Slope Instability Impact Assessment. • In the case of a work plan variation, it should include how the variation relates to previously approved work plans (and variations) (see **part D** of this guideline).
Attachments	Planning property report (see **part a** and **appendix 1**)

B.1.2 Area details

Fields or attachments in RRAM	Explanation
Property name	Provide where applicable
Address	Provide property address of the project area. This is the physical address of the site. If street or rural road numbers are not used, refer to the nearest road.
Suburb / town	Provide suburb/town of the area.
Postcode	Provide postcode of the area.

Area size

Fields or attachments in RRAM	Explanation
Area (hectares)	Provide the size of the mining licence area.

Land tenure (ownership) details

Fields or attachments in RRAM	Explanation
Land tenure type	Select type of land tenure that applies to the tenement area.
Depth limitations	
Depth limit	

B.1.3 Minerals and extraction

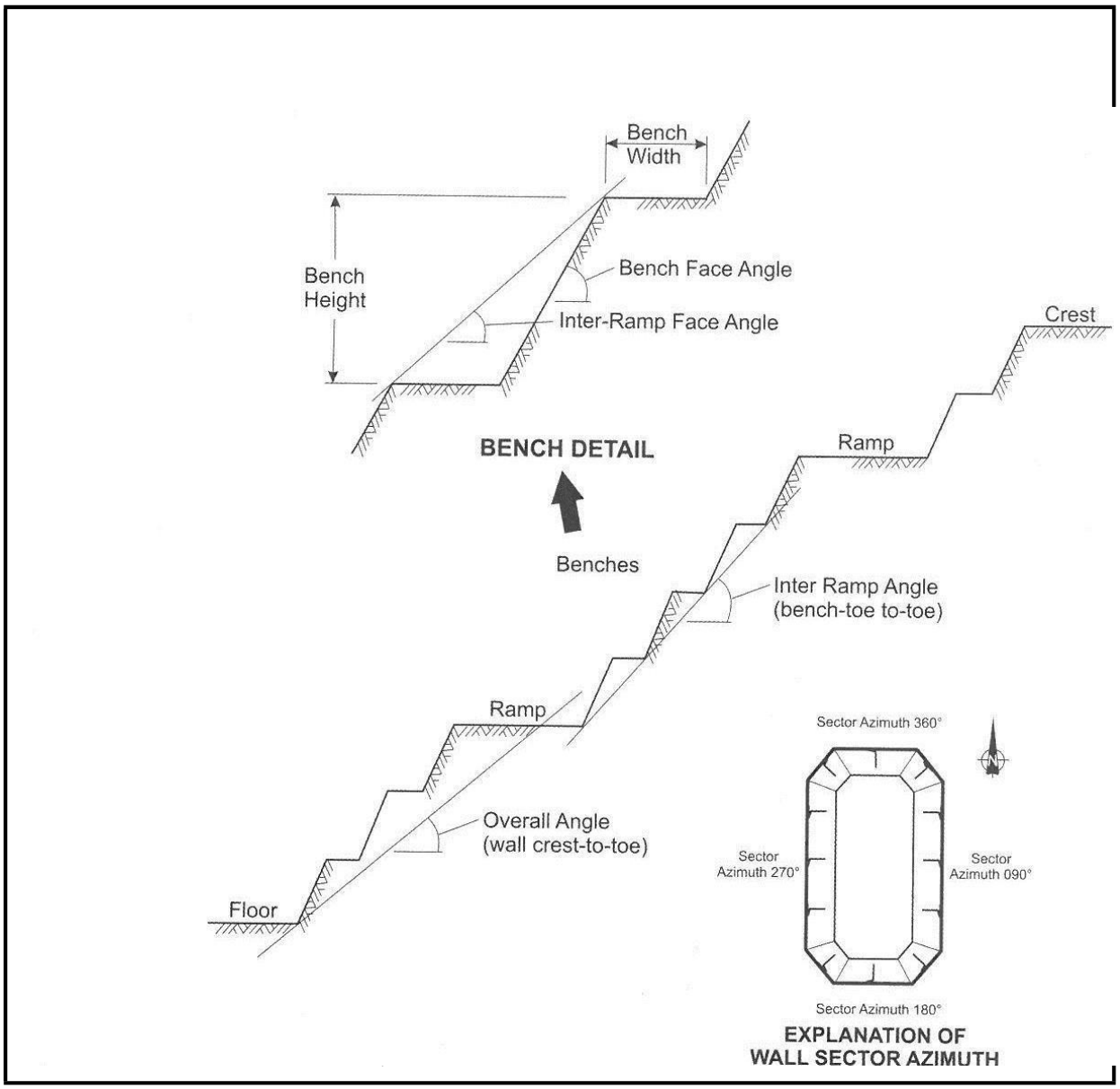
Resource type

Fields or Attachments in RRAM	Explanation
Commodity to which the work plan pertains	Select all commodity types to be extracted from the dropdown list. The selection must be the same as what appears on the licence. If more than one resource is selected, the primary resource must be indicated.
Commodity, primary	Indicate the principle commodity to be mined.
Total resource estimate	Provide the total resource estimate of the mineral resources. Note: This information in not available in the printed version of the risk- based work plan: you need to send the information to referral authorities and council.
Unit of measure	Select the unit of measure relevant to the estimate of the total resource provided.

Proposed final depth of extraction

Fields or attachments in RRAM	Explanation
Estimated maximum terminal depth	Give the maximum proposed vertical distance between the toe and crest of the terminal (final, overall) slopes of the pit before any rehabilitation. Include relevant information for an underground mine.
Batter slope angle	Provide the average horizontal angle of the terminal batter slopes of the pit before any rehabilitation, expressed in degrees (e.g. 15, 30, 45, 90). See the overall angle in figure 4. If operational batters differ from terminal batters provide details ot both. If rehabilitation is not undertaken within a reasonable time frame, the terminal batter slope must demonstrate that the slope will be safe and stable for the period of exposure. . You must detail the final rehabilitation slope in the rehabilitation plan. See figure 4.

Figure 4. Schematic description of batter design for open pit



Top soil, overburden and subsoil disturbance

Fields or attachments in RRAM	Explanation
Estimated depth of topsoil	Provide the estimated depth of topsoil to be disturbed (average across the extraction area).
Estimated volume of subsoil	Provide the estimated volume of subsoil to be disturbed. Subsoil is the layer of soil below the top soil. It is typically made up of sand, silt and/or clay, but lacks the organic matter and humus found in the topsoil. Subsoils can usually be used for rehabilitation purposes.
Unit of measure – subsoil	Select the unit of measure relevant to the estimate provided.
Estimated depth of subsoil	Provide the estimated depth of subsoil to be disturbed (metres), averaged across the mining area.
Estimated volume of overburden	Provide the estimated volume of overburden to be disturbed. Overburden is the soil and rock that is removed to gain access to the resource in a pit. It is usually piled on the surface at the site at designated areas where it will not impede expansion of the mine operation. It is used for the progressive and final rehabilitation of the site.
Unit of measure – overburden	Select the unit of measure relevant to the estimate provided.
Estimated depth of overburden	Provide the estimated depth of overburden (metres), averaged across the pit.
Area of disturbance	Provide the area of disturbance (square metres) relating to the surface area. The extent of disturbance should consider set-up/construction and operation/production activities, including the construction of roads, plant, pits, stockpiles, waste dumps and dams. This information to be depicted on the site area plan (see table 1).
Maximum disturbance at any time	Provide an estimate of the maximum area of disturbance (open area) in hectares at any given time. This estimate does not include any area undergoing progressive rehabilitation.

B.1.4 Operations

Operation type

Fields or attachments in RRAM	Explanation
Operation type	Specify the operation type(s) proposed for the site from the dropdown menu. Options include: • *Hard rock open pit*– Applicable to materials with high strength and/or abrasive materials such as granite or basalt, using surface techniques from an open pit • *Doze/excavate and detect* – Surface stripping with mechanical equipment, followed by intense hand-held detection techniques to extract the resource • *Shallow excavation* (depth must be less than 5 metres) – A surface technique for shallow deposits, which are typically softer materials such as sands • *Open pit* – Applicable to unconsolidated materials where extraction uses surface mining techniques. • *Dredging* – Use of a natural or human-made body of water overlying the deposit. Use of a variety of surface equipment, including bucket-wheel suction or a cutter-head with suction that can be used to extract the resource.
Operation type – other	Include any relevant operation type not included in the dropdown list.

Plant, equipment and method

Fields or attachments in RRAM	Explanation
Plant and equipment description	Provide a general description of operational equipment to be used on site, including but not limited to, equipment for extraction, processing, haulage. Describe (and show on the site layout plan) the location of processes or equipment (such as processing plants next to an open pit) that may heighten the potential for slope instability. Describe equipment to be used for dewatering (if applicable). Describe the number and location of any water bores and pumps. Show on a plan the location of: • workshops • storage sheds • lunchroom • the amenities block • the site office • the weighbridge • laboratory testing • training and meeting rooms • the maintenance hardstand and vehicle wash-down.

Operating hours

Fields or attachments in RRAM	Explanation		
	Operations	Sales	Processing
Monday to Friday – Start	Enter in 24 hour format, in half hour increments. Proposed hours for different business processes – for example, operations, sales, processing and maintenance should be entered separately.		
Monday to Friday – End			
Saturday – Start			
Saturday – End			
Sunday – Start			
Sunday – End			
Public holiday activity			

B.1.5 Attachments to risk-based work plan

Attach the following documents online. All maps and documents should be legible.

Table 1: Requirements of the regional plan, work plan and site layout plan areas

Fields or attachments in RRAM	Explanation
Work plan area (Location Map as per Regulation)	Work plan area maps clearly identify the location of the proposed mining activities. The maps should be of sufficient detail to enable the on-the-ground location of a work site. The amount of information on the work plan area map will depend on the complexity of the work plan area (for example, the variation of land types and vegetation across the regional plan area). **Requirements in risk-based work plan area** • Map prepared on a scale of 1:25,000 or at an appropriate scale for showing sensitive receptors within 2 kilometres of the surface footprint of the Tenement area. At a minimum, natural and human-made sensitive receptors within the Geotechnical Risk Zone (GRZ) area must be shown (see http://www.energyandresources.vic.gov.au/earth-resources/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/guidance-material-for-the-assessment-of-geotechnical-risks-in-open-pit-mines-and-quarries). GRZ applies to the surface footprint of the Tenement area. • North direction, legend, scale, date of and revision date of drawing • The extent of Crown lands, private lands and private land allotments for the proposed work plan area • Location of possible occupied houses, community facilities • Location of townships, cadastral boundaries • Location of waterways, parks and reserves, and environmental overlays (as included in the planning property report) • Radius of circles (at minimum 500 metres, 1 kilometre, 2 kilometres) from the surface footprint of the Tenement area • Maximum area of disturbance (provide separately for above ground and underground • Location of infrastructure, including major and minor roads (with names), bridges, rail lines, pipelines (water, gas, telecommunication), power lines, easements Note: See appendix 4.1 for guidance on sensitive receptors in the vicinity of the work. If there are sensitive receptors located within the GRZ (nominally=4H), attach a **Preliminary Slope Instability Impact Assessment** to the work plan. See appendix 10 for the content of a Preliminary Slope Instability Impact Assessment.
Regional plan area	**The regional location map is required to illustrate where the work plan area maps are located in relation to the licence boundary.** **Requirements in regional plan area** • Location of work authority area at a scale of 1:100,000 or 1:50,000 • Radius circles (at minimum 1 kilometre, 2 kilometres, 5 kilometres and 10 kilometres) from work authority boundary • Roads (including names), townships / built-up areas, l ocation of the mining area (proposed disturbed area), boundaries of the Tenement and risk-based work plan with distances and bearings • North direction, legend, scale, drawing and revision date *Note*: Please provide the map in an A3 size format and ensure it is legible.

Fields or attachments in RRAM	Explanation
Site layout plan area (site map as per regulation)	**A site layout plan area is required to illustrate the general layout of the plant-associated facilities and infrastructure.** **Requirements in site layout plan area** • A scale of 1:1,000, 1:2,500 or other appropriate scale, including North direction, legend, scale, date of and revision date of drawing • Mining licence boundaries, extraction boundaries (including underground), buffers and depth limitations • Cadastral boundaries • Cross-sections, showing geology, extraction and terminal batter design with proposed bench heights, berm details and working batters for all parts of the mining area • Existing surface contours, topographical features, drainage patterns, water courses and vegetation to be removed / retained • Plant and equipment (buildings and surface facilities, location of power generation and/or reticulation, offices and toilets) • Anticipated extent of open cut extraction • Sequence of open cut extraction (if applicable) • Proposals for landscaping of the surface footprint area, including buffer zones and retained areas of native vegetation • Adjoining public road(s) (including names) • A survey benchmark with a reduced level • Location of access roads • Location of water dams and storage, in-pit sumps, tailings storage and tailngs pipe lines • Location of onsite power lines, gas lines and any other easements • General location of stockpiles for topsoil, overburden, waste rock, and ROM product • Location of fuel storage areas – aboveground storage tank (AST), underground storage tank (UST) • Location of explosives, additives or hazardous waste storage areas • Location of water bores and pumps (if any) • Location and design of drainage diversion, including levees

B.2 Risk assessment

In this section of the risk-based work plan, the mining industry Tenement holder must identify mining hazards and assess risk in accordance with the requirement of Schedule 15 of the MRSD(MI)R.

Risk assessment is the process of finding, recognising and describing the mining hazard(s) within the work plan area, a clear pathway to one or more receptor(s), and the potential impact(s) on the receptor(s) if the hazard occurs.

> The MRSD(MI)R stipulates
> *"**mining hazard** means any mining activity and circumstances that may pose a risk to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of work carried out at a mine."*

Based on the possible questions raised at the site meeting (a**ppendix 3**), the Tenement holder should be able to identify the hazards, receptors and potential consequences for this section of the risk-based work plan.

A risk is not present if:

- the mining hazard does not exist within the work plan area, and/or
- there are no receptors that could be impacted.

The Tenement holder will:

- undertake a risk assessment by identifying the risks that the activities may pose to the environment, to any member of the public, or to land or property in the vicinity of the activities. This involves identifying hazards located within the tenement area and assessing the potential consequences of the hazard on public safety, the environment, public infrastructure, private infrastructure and community facilities (the receptors). Receptors may be located inside (for example, an historical heritage artefact) or outside the tenement boundary (for example, lakes, waterways, public roads, fauna), and could be adversely impacted if the impact of the hazard is not effectively controlled. See **section B.2.1**.
- specify what the Tenement holder will do to eliminate or minimise those risks **as far as reasonably practicable.** This specification involves proposing the controls that the Tenement holder will implement to remove, minimise and control the hazard and possible consequences. The objective of the control is to comply with the standards and thresholds set out in regulations, policies, guidelines and leading practice references. By focusing on the objectives/ outcomes to be achieved (based on the proportionality of the risk), the Tenement holder should demonstrate how the risk will be managed. See **section B.2.2**.

A risk assessment should be undertaken:

- for each phase of the project – set-up, construction, operation, production, rehabilitation and closure
- for combinations of all hazards, risk sources and receptors at risk (e.g. a single hazard may be associated with multiple risk sources and multiple receptors).

B.2.1 Risk 1

Fields or attachments in RRAM	Explanation
B.2.1a Risk hazard	Select the relevant identified hazard from the dropdown list. See **appendix 4** for a list of potential hazards. MRSD(MI)R Schedule 15: ***"Part 1—Required information—mining work*** ***2 Identification of mining hazards*** *2.1 An identification of mining hazards that may arise from each phase of the work, including set up/construction, operations/production and rehabilitation/closure."*
B.2.1b Risk source	Select from the dropdown list one or more potential sources of risk specific to the hazard identified. See **appendix 4** for a list of potential risk sources.
B.2.1c At risk	Select from the dropdown list what is at risk from the risk source if a standard control or additional control fails. See **appendix 4** for a list of potential 'at risk' features. MRSD(MI)R Schedule 15: ***"Part 1—Required information—mining work*** ***3 Identification and assessment of risk*** *3.1 An identification and assessment of the risks that the identified mining hazards may pose to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work."*

B.2.2 Risk management plan

A risk management plan is required under Clause 4, Schedule 15 of the MRSD(MI)R. The Tenement holder can meet the requirements of a risk management plan by completing the RRAM fields outlined in sections **B.2.2a** to **B.2.5**.

The extent of potential impacts depends on the controls that the Tenement holder implements. Control is defined as '*a system, process, procedure, equipment or other organisational capacity that prevents the consequences of the risk from occurring*'[1]

A standard control is considered to be accepted practice in the mining industry for addressing a potential impact on a sensitive receptor. Standard controls are recognised procedures, guidelines, methods, and codes of practice that can be sourced from regulations, policies, guidelines and leading practice references.

Standard controls can include:

- *Engineering/physical controls* – controls built into the physical design of plant or equipment, which do not rely on people to operate effectively. Examples include the substitution of a hazard with something less hazardous, such as using a less toxic chemical or an engineered control such as a pressure relief valve.
- *System-based controls* – part of a defined management system, which rely on staff to be implemented. Implementation is prescribed through rules, protocols and management reviews. An example is an Environmental Management System that features a range of policies, plans, procedures, roles and responsibilities to identify, plan, implement, monitor, evaluate and report on the effectiveness of controls to achieve environmental targets and objectives.
- *Procedural-based controls* – a written set of rules or guidelines, which rely on staff to be implemented. Staff implementing these controls need to be appropriately trained, assessed and monitored to maintain the required level of competency / performance.
- *Staff-based controls (least effective)* – controls that require people to identify, assess and respond to issues appropriately based on their skills, knowledge and experience.

Engineering and system controls are considered to provide a higher level of risk management than procedures or staff-based methods.

B.2.2a Standard controls and possible consequences

Fields or attachments in RRAM	Explanation

[1] Department of Resources, Energy and Tourism 2008

Fields or attachments in RRAM	Explanation
Standard control	List the standard controls identified to mitigate or lessen the risk. See **appendix 6** for a list of suggested standard controls. The Tenement holder should identify standard controls that will apply standards and thresholds set out in regulations, policies, guidelines and leading practice references. For example, they must demonstrate that the identified standard control will meet the noise threshold in SEPP N-1 or the ground vibration limit at the receptor. If the standard control is documented in a management plan (a blast management plan, for example) that is attached to the work plan, state it here. MRSD(MI)R Schedule 15: ***Part 1—Required information—mining work*** ***4 Risk management plan*** *4.1 A risk management plan that—* *(a) specifies the control measures to eliminate or minimise, as far as reasonably practicable, the identified risks associated with mining hazards; and* *(b) specifies the objectives, standards or acceptance criteria that each control measure or a combination of control measures will achieve;*
Possible consequence	Provide a brief description of the potential impacts remaining after the standard control has been implemented. Potential residual impacts relate to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work. *Example*: *Noise level will remain below SEPP N-1 threshold at two residential properties 400 metres south east from the WA boundary.*

B.2.2b Consequence and likelihood rating

MRSD(MI)R Schedule 15:

Part 1—Required information—mining work 3 Identification and assessment of risk

3.2 For the purposes of item 3.1, an assessment of a risk posed by a mining hazard must have regard to—

(a) the nature of the mining hazard; and

(b) the likelihood of the mining hazard causing, or contributing to, any harm or damage to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work; and

(c) the severity or consequence of the harm or damage that may be caused.

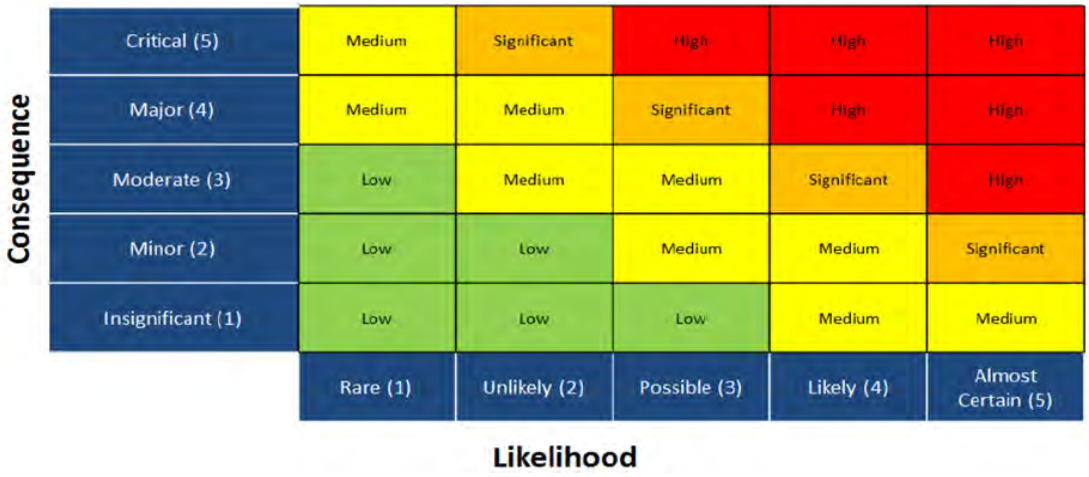
Fields or attachments in RRAM	Explanation
Consequence rating	Select the consequence rating from the dropdown list: • Insignificant • Minor • Moderate • Major • Critical This is the rating after accounting for the existence and effectiveness of the standard controls defined in B.2.2a. Base the consequence rating on reasonable judgement of the retained consequence described above. See **appendix 7.**

Fields or attachments in RRAM	Explanation
Likelihood rating	Select the likelihood rating from the dropdown list: • Almost certain • Likely • Possible • Unlikely • Rare This is the rating after accounting for the existence and effectiveness of the standard controls defined in B.2.2a. Base the likelihood rating on reasonable judgement of the likelihood described above. See **appendix 8**.

B.2.2c Risk rating

Fields or attachments in RRAM	Explanation
Risk rating	The risk rating is automatically calculated for each hazard type based on the selected consequence and likelihood ratings in B.2.2b. (Consequence and likelihood are applied after the implementation of standard control for that hazard.) RRAM calculates the following risk ratings: • Low • Medium • Significant • High

Figure 5: Risk matrix



B.2.2d Risk monitoring and reporting

MRSD(MI)R Schedule 15:

"Part 1—Required information—mining work

4 Risk management plan

4.1 A risk management plan that—

includes a monitoring program to measure performance against all the specified objectives, standards and acceptance criteria; and

specifies arrangements for reporting on performance against all the specified objectives, standards and acceptance criteria."

Fields or attachments in RRAM	Explanation
Risk monitoring and reporting	A risk rating of 'medium' and 'low' will require the monitoring of the identified standard controls, to ensure they remain effective. Describe the approach for monitoring whether the identified standard control is achieving the objectives/ outcomes specified in B.2.2a. Consider linking the monitoring to the overall site monitoring and Emergency Management Plans. • Describe the approach to monitoring in this section of RRAM (or as a separate attachment). Outline the monitoring method, location plan, key parameters to be monitored, trigger levels for key parameters, equipment to be used, the frequency of monitoring, and the capacity of the person undertaking monitoring. • Describe what mitigation measures or actions are to be taken should a threshold (trigger) level be exceeded. For example, what action will be taken should a certain amount of movement (as measured by eg. pins or prisms) be exceeded over a certain time period. Include the planned review of the monitoring program (for example, criteria for review, who, when and how). Describe how the information collected will be reviewed to consider control effectiveness. • Describe the approach to reporting in this section of RRAM. Outline reporting to whom (for example, the ERC), the frequency of reporting, reporting parameters, the format of reports (text, graphs, tables, cross sections), the presentation of reports (for example, trends, against standard/thresholds, trigger levels), mitigation/ measures where trigger levels are exceeded. It must also include the review process of the monitoring reports (for example, who reviews the report and makes the decision).

B.2.2e Additional control in risk treatment plan

The licensee is responsible for demonstrating that the standard control(s) specified under section B.2.2a are effective in achieving the objective/outcome (standards or thresholds) required under the applicable legislation, policies, guidelines or leading practice references.

If an objective/outcome cannot be met, the Tenement holder should review the consequence and likelihood ratings (under section B.2.2b) and re-assess the risk rating. **Appendix 9** provides acceptable risk ratings for various instances of consequences. The Tenement holder should discuss acceptable risk ratings with ERR and relevant agencies.

If the risk rating is 'significant' or 'high' (originally or after a review of risk assessment), then the standard control is considered to be not effective in meeting the objective/ outcome, and the Tenement holder must implement additional treatment (control) to mitigate the risk. The licensee is required to attach the risk management plan (see section **B.3**) to RRAM, outlining the additional mitigation measure(s) that the Tenement holder will implement to mitigate the significant or high risk(s).

Suggested contents of a risk management plan (see appendix 11 for examples)

- Relevant control design specification
- Documentation on the control's objectives and limitations
- Control monitoring and reporting program, including:
- an overview of the management process to monitor and report the control's performance
- the proposed monitoring and reporting program for the control and activity
- The qualifications of the personnel responsible for the design, implementation and operation of the control
- Relevant peer review reports on the control's effectiveness in comparable operations and environments
- Peer review reports on the control's design specification
- Modelling and simulation report(s)
- Documentation describing any proposed testing and observation of the control during operation

B.2.2f Add another risk

After completing the risk assessment for risk 1, the Tenement holder needs to select in RRAM 'Add another risk' and complete the iteration in RRAM as outlined in sections B.2.1a–B.2.2d (and B.2.2f if applicable) until all the hazards relating to the proposed project are captured in the risk-based work plan in RRAM.

B.3 Attachments – documents related to the work plan

Fields or attachments in RRAM	Explanation
Risk management plans	Attach a risk management plan for each hazard type if the risk rating is significant or high. See **appendix 11**.
Community engagement plan	Attach a community engagement plan. See **appendix 13**.
Rehabilitation plan	Attach a rehabilitation plan. See **appendix 14**.

Plan submission

After completing B.1 to B.3 in RRAM, the Tenement holder should select to submit the risk-based work plan for assessment. A payment request will be prompted at this stage. Consult with ERR about the correct fee for your work plan.

While RRAM checks for the completeness of mandatory fields in PLAN, the onus is on the licensee to ensure the completeness of the work plan before it is submitted.

Part C – Work plan assessment and approval

Risk-based work plans will be assessed as follows:

1. The department assesses the risk-based work plan within 28 days of receipt.
2. The department **accepts** the work plan as being satisfactorily compliant with the MRSD(MI)R for referral to referral authorities (if required).
3. The department forwards the work plan to referral authorities (within 28 days of receipt) as part of a statutory and/or non-statutory referral process (see **appendix 15** for the referral authorities).
4. ERR will send to the referral authority (for comment) a printable version of the risk-based work plan that the Tenement holder lodged in RRAM

According to MRSDA Section 40A:

(1) On receiving a work plan, the Department Head must, within 28 days, give a copy of the work plan or variation to an approved work plan to every referral authority that the Department Head considers, having regard to the kind of work proposed under the work plan or variation, should be given the work plan or variation.

(2) Before complying with subsection (1), the Department Head must be satisfied that the work plan or the variation to an approved work plan complies with the regulations.

5. The department statutorily endorses (under s40(4) of the MRSDA) the printable copy of the risk-based work plan, after the referral authorities confirm they have no objection to the plan's statutory endorsement.
6. ERR provides the endorsed printable risk-based work plan and the draft work authority conditions (including any condition imposed by referral authorities) to the Tenement holder so they can submit the plan and conditions to the council with the planning permit application.

According to Victorian Planning Provision Clause 52.08-2 Mineral extraction:

An application to use and develop land for mineral extraction must be accompanied by:

- *A copy of a work plan or a variation to an approved work plan that has **received statutory endorsement** under section 77TD of the Mineral Resources (Sustainable Development) Act 1990.*

7. The department approves the printable statutorily endorsed work plan after the Tenement holder provides a copy of the planning permit to the department.

Part D – Work plan variation or work plan notification

Under the MRSD(MI)R, the Tenement holder can take either of the two pathways through RRAM:

- pathway for acceptance of a work plan notification not legislated in the MRSDA, or
- pathway for approval of a work plan variation in accordance with s41 of the MRSDA.

The decision to follow the notification or variation pathway is based on whether the proposed changes to the work will **significantly increase the risk**.

Important information about significant increase in risk as stipulated in the MRSDA

- RRAM identifies four risk ratings: low, medium, significant, high (see section B.2.2c).
- A risk is considered significant when it falls in the category of significant and high.
- The Tenement holder can take the pathway of the work plan notification approval process (not a regulatory approval) when the proposed changes to work will not pose a risk that has a significant or high risk rating following the application of standard controls.
- The Tenement holder must make reasonable decisions about the risk assessment for their proposed new work.
- The onus is on the Tenement holder to demonstrate that the proposed new work will not constitute a significant risk.
- Se section D.2 of this guideline for more details.

The purpose of the notification is to allow ERR to assess the proposed changes and confirm whether a variation is required. This section provides guidance on how to assess whether a variation will likely be required.

The Tenement holder should consult with ERR whether a notification or a variation is required.

D.1 Work plan notification

A Tenement holder may seek acceptance of a work plan notification if the proposed new work retains a low / medium risk rating, or reduces the risk rating to medium / low when standard controls are applied, or eliminates the hazard. A Tenement holder must have an approved risk-based work plan to request acceptance of a notification.

A work plan notification may apply when:

- the Tenement holder/operator's details, address or land use change
- a change in resource, mining method, end use of site, hazards and/or sensitive receptors requiring only standard controls has:
  - not altered an existing low to medium risk rating that required only standard controls (for example, current standard controls remain effective for the proposed new work)
  - resulted in an existing low to medium rated risk that required only standard controls being eliminated (the risk no longer exists) or reduced. In this circumstance, the Tenement h older will notify ERR that approved standard controls are being ceased or changed.
  - resulted in a new risk being identified that requires only standard controls, and that has a risk rating of low to medium after the application of standard controls
  - the proposed new work does not require referral authority comment
  - reduced the risk rating from medium or low.
  - The proposed new work does not require planning permit amendment or Referral Authority comment

Examples of proposed new work that could represent an approved risk-based work plan notification

- Amending the staging of mining when the mining is entirely within the approved limit of the work plan
- Changing extraction methods
- Increasing the distance from neighbouring properties
- Reducing noise by enclosing the processing plant
- Reducing noise by switching from onsite power generation to mains power
- Using a new piece of equipment (that generates substantially less noise) to replace an existing piece of equipment
- Reducing dust by changing the mine access routes, increasing the distance to sensitive receptors
- Finding the mining area is no longer, or is significantly less likely to be, susceptible to flooding due to a sustained dry period

D.1.1 Steps for a work plan notification

The Tenement holder should take the following steps for work plan notification, and for the commencement of work relating to the notification:

- Assess that the proposed new works constitute a notification.
- Discuss with ERR that the proposed new work will be a notification.
- Confirm that the proposed new work will not require referral to referral authorities.
- Provide a formal notification to ERR, describing:
  a. the proposed new work in detail
  b. a risk assessment with supporting information (as stipulated under sections **2.1** to **2.2d** of this guideline)
  c. whether a risk rating remains unchanged, with reasons
  d. whether a risk rating has been eliminated, with explanation
  e. whether a risk rating has reduced (from medium to low), with reasons
  f. supporting map(s).

Important information about the approval of a work plan notification

- It is not a regulatory approval.
- It is the responsibility of the Tenement holder to ensure the proposed new work meets the criteria of notification described in this guideline at all times and throughout the operational period of the proposed new work.
- ERR will monitor whether the proposed new work accepted under the work plan notification meets the criteria of notification circumstances at all times.
- If the proposed new work no longer meets the notification criteria, ERR shall request that the Tenement holder lodges an application for variation in accordance with s41AA of the MRSDA.

D.2 Work plan variation

A Tenement holder should seek a variation to an approved work plan – in accordance with s41AA of the MRSDA – if the proposed new work involves:

- changes to mining methods
- a significant increase in risk, which requires an updated risk management plan (section **B.2.2** in this guideline)
- changes to the end of use of the mining area, which requires an update to the rehabilitation plan
- the identification of new hazards and sensitive receptors, requiring standard and additional controls
- changes to or lodgement (if previously not prepared) of a community engagement plan
- a new risk being identified that requires both standard and additional controls. The Tenement holder has to seek work plan variation approval for the proposed standard and additional controls.

Examples of proposed new work requiring a variation to an approved work plan and ERR approval, in accordance with s41AAB and Part 6B of the MRSDA:

- Discovery of a new species not previously listed
- The move of an existing listed species into a disturbed area
- Change in the direction of extraction, which moves it closer to sensitive receptors
- Inclusion of blasting as a new activity
- Change in extraction area
- Change in extraction methods, moving from dry extraction to wet extraction
- Change in processing method (for example, wash plant processing)
- Change in water storage, waste dump design, tailings storage facility
- Discovery of archaeological sites (deposits, features or artefacts)
- Removal of native vegetation. The removal, destruction or lopping of native vegetation is proposed, and an assessment is required under Victoria's Native Vegetation Permitted Clearing Regulations, with requirements determined by the relevant location category.
- Proposed new work requiring assessment or approval under other legislation. Other legislation could include but is not limited to:
  - *Aboriginal Heritage Act 2006*
  - *Crown Land (Reserves) Act 1978*
  - *Environment Effects Act 1978* (or consideration under s77T of the *Mineral Resources (Sustainable Development) Act 1990)*
  - *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
  - *Environment Protection Act 1970*
  - *Flora and Fauna Guarantee Act 1988*
  - *Heritage Act 1995*
  - *Land Act 1958*
  - *Planning and Environment Act 1987*
  - *Native Title Act 1993* (Commonwealth)
  - *Water Act 1989*
  - *Wildlife Act 1975*

D.2.1 Steps for a work plan variation

Preparation of a risk-based work plan variation in RRAM involves the same steps as a new risk-based work plan in RRAM (see p**art B** of this guideline) except the Tenement holder will complete only the sections in RRAM that are to be varied.

Important information about preparing a work plan variation in RRAM for the first time

The Tenement holder should complete a full risk-based work plan (the original approved work plan) in RRAM as if it is a new work plan, by completing all the sections in part B of this guideline.

A work plan variation through RRAM involves the following steps:

- The Tenement holder should consult with ERR about the proposed new work that requires a work plan variation.
- ERR prepares a clone of the existing work plan in RRAM (identifying the clone as a variation).
- The Tenement holder varies the sections of the cloned work plan in RRAM that apply to the proposed changes to work.
- The Tenement holder completes the full work flow process in RRAM from B.1 to B.3, and submits the work plan variation in RRAM.
- ERR approves the work plan variation by following the process in 'Work plan assessment and approval' in this Guideline.

Part E – Who is affected by the new regulation requirement?

All new work plans and variations to approved work plans submitted after 8 December 2015 must comply with Schedule 15 of MRSD(MI)R. A work plan will not need to comply with the new Schedule 15 requirements **if the plan has been submitted to ERR for assessment (or has been referred or endorsed) before the regulation's proclamation date.**

Part F – Work plan dispute resolution

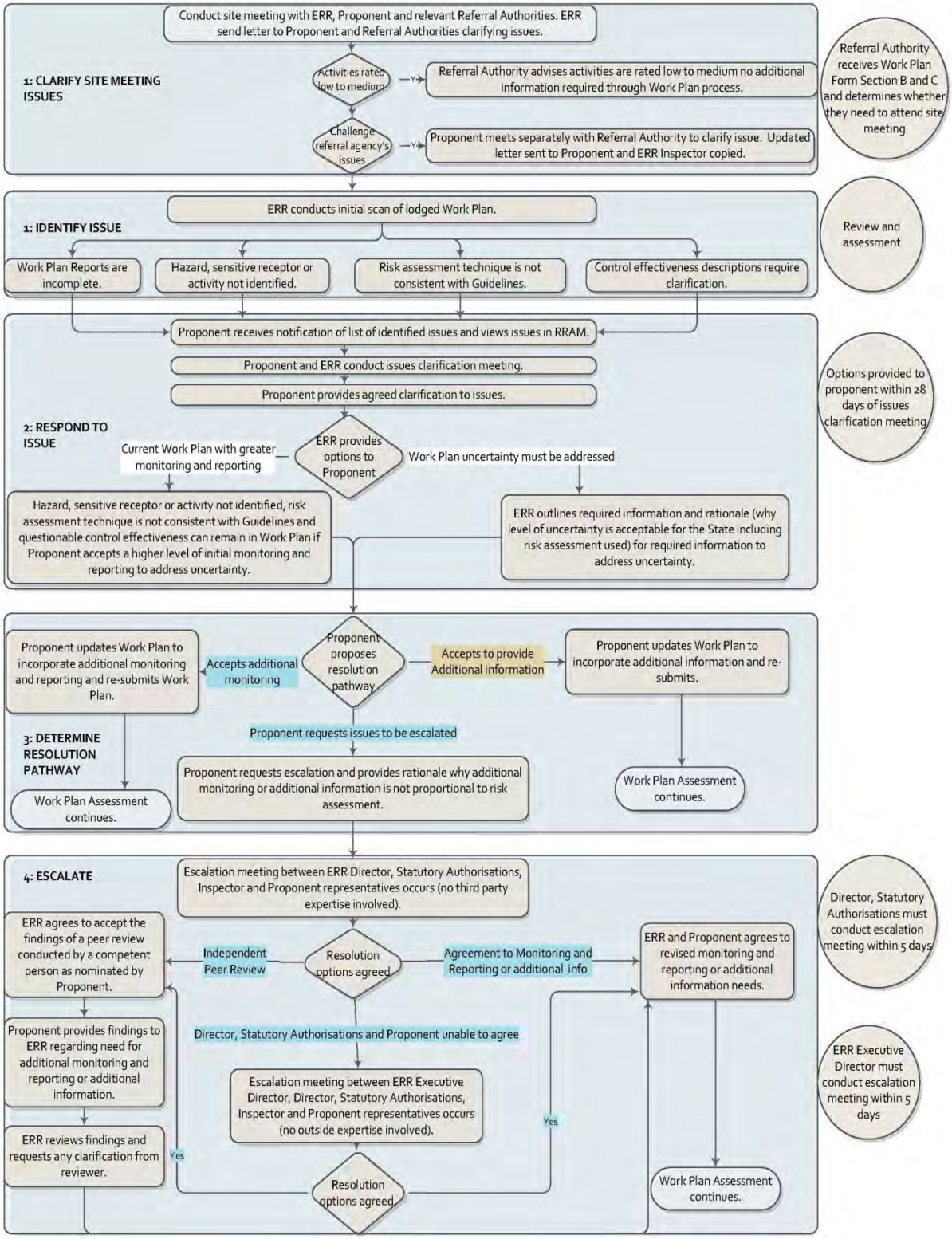
If a Tenement holder is not satisfied with – or is unable to resolve a specific issue with – ERR's assessment of a risk-based work plan, they may request (in writing) a management review by the Chief Inspector of Mines and/or the Executive Director of ERR. ERR will seek to complete a management review within five working days (**figure 6**).

If the management review identifies a deficiency in the assessment of the work plan, the Chief Inspector or Executive Director may decide to amend the assessment. The issue resolution process occurs concurrently with the assessment of the remaining activities contained in the work plan.

The process applies to only the Tenement holder challenging or clarifying conditions/controls imposed on the proposed works area.

ERR offers this informal non-statutory review process to help resolve issues early and to avoid unnecessary and costly Victorian Civil and Administrative Tribunal (VCAT) or other court processes. The review process cannot be used to challenge any conditions on the planning permit, or conditions imposed by referral authorities. Issues with a planning or referral authority decision will revert to the Victorian Civil and Administrative Tribunal (VCAT) for review.

Figure 6: Work plan assessment and approval issue resolution process



APPENDIXES

Appendix 1: Information to be supplied to ERR to identify referral authority for scheduling initial site meeting

1. Planning property report
2. Certificate of title
3. Plan of mining industry project area

Appendix 2: Information to be supplied to identified referral authorities before initial site meeting

1. Details of meeting place
2. Land tenure / status / allotment number
3. Plan of extraction or disturbed area
4. Commodity / resource type
5. Size / depth / life of proposed activity
6. Estimated total resource
7. Brief description of the proposed activity (for example, above ground or underground, blasting, dams, tailings storage facilities, hazardous waste issue etc.).

Appendix 3: Possible site meeting questions

The following questions/issues may be discussed at the initial site meeting. Use this checklist to identify information that may need to be provided in the work plan.

Discussion topic	Details
Mining proposal	• What is the estimated life of the activity? • What is the estimated/anticipated volume per year (output in tonnes or cubic metres) of the resource? • What is the estimated volume of soils and overburden to be disturbed? • What will be the operating hours?
General location information	• What road(s) are proposed to be used to enter/exit the activity area? • Are there any known inherited issues as a result of past or current land use?
Blasting	• Will blasting take place? • If so, could blasting related activity cause vibrations/noise/fly rock at the boundary of (or beyond) the activity area? If so, what would be the impact on sensitive receptors or infrastructure (including pipelines)?
Noise	• Is it likely that activity area noise will be heard at any sensitive receptor?
Dust	• Will the operations likely generate dust or spray that will be deposited or emitted outside the activity area boundary? • Will the operations likely generate any other substances listed as Class 1, 2 or 3 indicators under PEM (2007) that will be emitted outside the activity area boundary?
Community facility/private and public infrastructure	• Is known above and below ground infrastructure (electricity networks, water mains, designated waters etc.) located near the activity area? • Are known public roads, bridges or train lines located near the activity area?
Aboriginal heritage	• Are any areas of cultural heritage sensitivity or other protected areas in the proposed activity area? • Are any caves or dunes identified in the activity area? • Is a Cultural Heritage Management Plan is required?
Historic heritage	• Does the activity area contain places, sites or objects on: – the heritage overlay of the relevant planning scheme? – the Victorian Heritage Register? – the Victorian Heritage Inventory? – Must any historical heritage sites, structures or artefacts be retained as part of the post closure land form?
Flora and fauna	• Is any flora or fauna, including native vegetation, within the activity area to be removed or impacted? • Are there weeds, pests or feral animals within or from surrounding areas that could impact rehabilitation activities and/or potential land uses after closure?
Groundwater	• What is the depth to groundwater and water quality objectives as defined in the SEPP Groundwaters of Victoria? • Where are nearest groundwater users or groundwater sensitive ecosystems? • Will de-watering be required (for example, the lowering of the groundwater levels) or is the activity pit expected to intersect the water table? • Will there be any potential impacts on existing groundwater quality? Are there third party users of groundwater surrounding the activity? • Are there groundwater dependent ecosystems located within the specified distances surrounding the activity area? • Is the activity within a Groundwater Restricted Quality Usage Zone, a Water Supply Protection Area or a Groundwater Management Area?
Surface water	• What are the water quality objectives for the area defined in the SEPP Waters of Victoria? • Where are nearest water users or water sensitive ecosystems?

Discussion topic	Details
	• Are alterations to surface drainage needed (for example, waterway diversion)? If yes, will they increase the potential for flooding of adjacent land? • Are soil, overburden or proposed extracted materials (soils etc.) susceptible to erosion (created due to clearing of vegetation, problem soils etc.)? • Is there potential for soil and overburden stockpile to cause sedimentation outside the activity boundary? • Is the activity area located within a potable water catchment?
Dams	• Will there be water storages (for example, settlement pond, water storage, evaporation pond, bio-retention basin, other) or tailings storage facilities on the activity area? • Will any of the storages or tailings facilities meet the ANCOLD guidelines' criteria for a large dam? If yes, what is the type, area and embankment height of water storages or tailings facility and it's possible consequence category? • Will the storage or tailings facility be located on a waterway? • Will the storage or tailings facility receive runoff from a catchment upslope of the site? • Will any of the above storages or tailings facilities hold water that is unlikely to meet the SEPP guidelines for surface water or groundwater (or the ANZECC guidelines when a constituent is not specified)? • Will a tailings facility hold tailings that could be classed as contaminated or proscribed material? • What impact could failure of a storage or tailings facility have on public safety, infrastructure or the environment?
Geotechnical	• How will slope instability affect public safety, public infrastructure or environmental elements? • How can the site's lithology/geology and structural geology impact on slope stability? E.g. are there any active faults, dykes or shear zones (including adverse jointing) which may affect slope stability? • Is the overburden dispersive which may lead to long term erosion problems around the site? • What influence may seismic activity in the area have on slope stability? • Can elevated water levels in the batters have an impact on slope stability? • Are there areas where a perched water table may exist? • Could the proposed activity's operation and excavation methods heighten the potential for slope instability? Would such instability have any impact outside the activity area? • Are any historical voids (old mine underground workings, shafts etc.) within the activity area? • Could other adjacent land uses or features create triggers for land instability (for example, a neighbouring property that is performing blasting or surface water drainage near the batter crest)? • Will there be any crest loading, which may affect slope stability, such as an overburden dump or plant equipment situated near the crest of the open pit?
Environment – visual amenity (re overburden/ waste rock)	• Will stockpiles and overburden dump be located within the activity area? • If yes, what is the volume of material? And what is the proposed height of the largest stockpile / overburden dump?
Waste	• Will process wastewater be stored and treated within the activity area? • Will the operations (extraction and processing) generate hazardous wastes (for example, grease, oils, putrescible waste, batteries)?
Fuel	• Will fuel (for example, petrol, diesel) or other chemicals/additives be stored within the activity area? • Will refuelling, fuel storage and maintenance of machinery and equipment occur within the activity area?
Acid Mine Drainage	• Will acid sulphide soils be exposed/oxygenated during the proposed activities? • Is there potential for sulphide minerals to be present or exposed during the proposed

Discussion topic	Details
	activity (such as from overburden, waste and remnant pit shells surfaces)?
Radiation	• Is any part of the operation (extracted or processed material) going to be legally radioactive in accordance with the *Radiation Act 2005?*
Site Rehabilitation	• What is proposed for site rehabilitation and closure, and subsequent land use? • What is proposed for mine batter rehabilitation? • How will water storages and tailings storage facilities be rehabilitated? • What is proposed for surface water drainage and discharge from the activity area? • What land management or maintenance activities will be required after closure?

Appendix 4: Potential risks for consideration in the work plan (selection available in RRAM)

*"a **mining hazard** is any activity or circumstance that could pose a risk to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work."*

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)
• Air blast • Altered visual amenity • Biodiversity disturbance • Contaminated water • Excessive dust • Erosion and sedimentation • Fire • Flood • Fly rock • Ground instability, including slopes and sink-hole formation • Ground vibration, liquefaction • Unmanaged hazardous waste • Light emission • Noise pollution	• Activity – plant and equipment • Activity – blasting • Activity – drilling • Activity – overburden and waste dumps and stockpiles • Dams, drainage diversions and waterways • Fuel / chemicals storage • Geological rock types and structure • Geotechnical, including batter configuration • Seismicity • Night works • Surface water run-off • Tailings storage facilities, including pipelines	• Aboriginal h eritage • Historic heritage • Groundwater • Surface water • Biodiversity ecosystem • Air quality • Significant landscape • Crown land • National park • Public safety • Private property • Public infrastructure • Community facility

Appendix 5: Guidance for describing sensitive receptors in the vicinity of the work

Schedule 15 of the MRSD(MI)R notes information required in a work plan for mines includes:

*"A description of **sensitive receptors** (including their location), in relation to the environment, any member of the public, or land, property or infrastructure in the **vicinity** of the work"*

According to the MRSDA, the identification of quarrying hazards and assessment of risk relate to the environment, any member of the public, and land, property or infrastructure – called receptors. The MRSDA refers to Crown lands and private lands; residential, commercial and industrial development; public facilities and infrastructure; and rivers and streams. A selection of receptors is available in the RRAM field **'At risk'**. This list is not exhaustive, and the Tenement holder is responsible for identifying other receptors likely to be impacted. The Tenement holder is encouraged to describe all receptors around the project site that are likely to be potentially sensitive (if not described as sensitive receptors in **table 2**).

- **'In the vicinity of the work'** is defined by the required separation distances or buffer distances or other quantitative/qualitative references stipulated in legislation, policies or guidance material relating to those receptors.
- When receptors are in the vicinity of the work, those receptors are considered to be **sensitive receptors**. **Table 2: Guidance to identify sensitive receptors in the vicinity of the work**

Mining hazard	Receptors	Definition of vicinity	Is this a sensitive receptor?	Reference
Noise pollution	Public safety (as described in sensitive land uses and/or noise sensitive areas)	Mining industry project involving extraction, crushing, screening, stockpiling and conveying of rock, when the effective noise level for 'beneficial uses' cannot be protected in 'noise sensitive areas'	Yes	Sensitive land uses include residential premises, child care centres, preschools, primary schools, education centres and informal outdoor recreation sites. The effective noise level for 'beneficial uses' in 'noise sensitive areas' is as described in State Environment Protection Policy (Control of noise from commerce, industry and trade) No. N-1 (SEPP N-1), Applying NIRV to proposed and existing industry (EPA(publication 1413 – the Applying NIRV guide), SEPP N-1 and NIRV explanatory notes (EPA publication 1412), and *Noise from industry in regional Victoria – recommended maximum noise levels from commerce, industry and trade premises in regional Victoria* (publication 1411)

Mining hazard	Receptors	Definition of vicinity	Is this a sensitive receptor?	Reference
Excessive dust	• Air quality • Private property (as described in sensitive land uses) • Community facility (as described in sensitive land uses) • Public safety (as described in sensitive land uses)	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock: • without blasting when sensitive land uses are within 250 metres • with blasting when sensitive land uses are within 500 metres • with respirable crystalline silica when sensitive land uses are within 500 metres	Yes.	Sensitive land uses (residential premises, child care centres, preschools, primary schools, education centres, or informal outdoor recreation sites) as defined in *Recommended separation distances for industrial residual air emissions* (EPA publication 1518)
Altered amenity	• Public safety (as described in sensitive land uses)	Mining industry project involving mining , crushing, screening, stockpiling and conveying of rock : • without blasting when sensitive land uses are within 250 metres • with blasting when sensitive land uses are within 500 metres • with respirable crystalline silica when sensitive land uses are within 500 metres	Yes	Sensitive land uses (residential premises, child care centres, preschools, primary schools, education centres, or informal outdoor recreation sites) as defined in *Recommended separation distances for industrial residual air emissions* (EPA publication 1518)
Air blast **Fly rock** **Ground v vibration** **Ground instability** **Noise pollution**	• Private property (as described in sensitive land uses) • Community facility (as described in sensitive land uses) • Public safety (as described in sensitive land uses) • Public infrastructure	Mining industry project involving mining: • with blasting when sensitive land uses are within 500 metres • with blasting when the requirement of ground vibration and air blast limits cannot be met • with blasting when there are infrastructure and sensitive land uses within the GRZ zone • with blasting when the effective noise level for 'beneficial uses' cannot be protected in 'noise sensitive areas'	Yes	Sensitive land uses (residential premises, child care centres, preschools, primary schools, education centres, or informal outdoor recreation sites) as defined in '*Recommended separation distances for industrial residual air emissions'* (EPA publication 1518) Ground vibration and air blast limits as described in *Environmental guidelines – ground vibration and airblast limits for blasting in mines and quarries, blasting limit guidelines v1.2* (Department of Natural Resource and Environment) GRZ zone as described in *Guidance material for the assessment of geotechnical risks in open pit mines and quarries* (DEDJTR)

Mining hazard	Receptors	Definition of vicinity	Is this a sensitive receptor?	Reference
				Effective noise level for 'beneficial use' in 'noise sensitive areas' is as described in SEPP N-1, the Applying NIRV guide, the SEPP N-1 and NIRV explanatory notes, and *Noise from industry in regional Victoria – recommended maximum noise levels from commerce, industry and trade premises in regional Victoria* (Publication 1411)
Water quality	• Groundwater • Surface water • Aquatic and terrestrial ecosystem • Groundwater dependent ecosystem • Public safety (as described in sensitive land uses and users of surface water and groundwater)	Mining project involving drilling, excavating, crushing, screening, stockpiling and conveying of rock: • with dry and wet extraction, including transport and deposition of tailings, when the protection of ecosystem and/or beneficial uses of the surface water and groundwater cannot be met	Yes	Advised by Southern Rural Water Beneficial use surface water and groundwater as described in SEPP (Waters of Victoria) (2003); and SEPP (Groundwaters of Victoria) (2003) Storage of hazardous material (for example, fuels, oils)
Groundwater supply	• Water supply – users of groundwater	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock: • with dry or wet extraction when dewatering for excavation is proposed		Advised by Southern Rural Water: Groundwater Supply Protection Area, Groundwater Management Area
Ground instability	Heritage sites • Aboriginal heritage • Historic heritage Environmental features • Surface water • Biodiversity Ecosystem • Significant landscape • Crown land	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock: • without blasting with wet or dry extraction when there are heritage sites, environmental features, public infrastructure and sensitive land uses within the GRZ zone • on land of historical mine site (e.g. underground shaft)	Yes	Sensitive land uses (residential premises, child care centres, preschools, primary schools, education centres, or informal outdoor recreation sites) as defined in *Recommended separation distances for industrial residual air emissions* EPA publication 1518) GRZ zone as described in *Guidance material for the assessment of geotechnical risks in open pit mines and quarries* (DEDJTR)

Mining hazard	Receptors	Definition of vicinity	Is this a sensitive receptor?	Reference
	• National park Public infrastructure, which includes but is not limited to roads, bridges, railways, pipelines, power lines and human-made drains Public safety (as described in 'sensitive land'[2] uses and users of roads/bridges/railways)	• For power lines mining on land within 60 metres of a major electricity transmission line (220 kilovolts or more) or an electricity transmission easement. Other infrastructure in the GRZ.		Advised by Heritage Victoria Victorian Planning Provision Clause 66
Erosion and sedimentation	Surface water Public infrastructure (water related)	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock with or without blasting, with wet or dry extraction, when the area is close to water-sensitive assets		Proximity to assets as advised by Melbourne Water pre-feasibility advice (http://www.melbournewater.com.au/planning-and-building/land- development-process/pages/feasibility- checks.aspx), as per Dial Before You Dig Designated watercourses, lakes or floodways.
Flood	Surface water Significant landscape Land	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock: • in Special Areas declared under s27 of the *Catchment and Land Protection Act 1994* • on land that has been identified in this scheme as flood prone • on land that has been identified in this scheme as being subject to high erosion risk or areas • on land identified as being subject to salinity management	Yes	Victorian Planning Provision Clause 66
Fire	Crown land National park	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock, on Crown land or land abutting Crown land, other than a government road	Yes	Victorian Planning Provision Clause 66

[2] *Recommended separation distances for industrial residual air emissions' EPA publication No 1518*

Mining hazard	Receptors	Definition of vicinity	Is this a sensitive receptor?	Reference
Biodiversity disturbance	Biodiversity Ecosystem	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock: on land when the use or development involves the removal or destruction of native vegetation if the total area to be cleared is 10 hectares or greater in areas with communities or taxa listed or critical habitat determined under the *Flora and Fauna Guarantee Act 1988* on land that has been identified in this scheme as containing sites of flora or fauna significance	Yes	Victorian Planning Provision Clause 66
Offsite traffic	Public infrastructure Public safety	Mining industry project involving mining, crushing, screening, stockpiling and conveying of rock: on land that abuts a local road that intersects with a road declared as a freeway or an arterial road under the *Road Management Act 2004* and if the development is expected to increase traffic movement at the intersection of the local road and the declared road by 10 per cent or more on land that abuts a road declared as a freeway or an arterial road under the *Road Management Act 2004*. This does not apply to a development that generates less than 100 commercial trips per day, with road works at the entrance to the site built in accordance with the requirements of the Roads Corporation and when the declared road is not a freeway.	Yes	Victorian Planning Provision Clause 66

Appendix 6: Example of controls for managing risk from mining activities

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
Noise emissions	• Activity – plant and equipment • Activity – blasting • Activity – drilling • Night works	• Public safety • Private property • Community facility	For applicable standards or thresholds, see: • SEPP (Noise from industry in regional Victoria) (2011) (NIRV) • SEPP (Control of noise from commerce, industry and trade) (2001) (SEPP N-1)	• Equipment orientation and position • Equipment maintenance regime in accordance with manufacturer specifications • Engineering attenuation controls (that is, mufflers, acoustic screens and enclosures) • Restricted operation of noise generating equipment • Overburden stockpiles located to reduce noise emissions at sensitive receptors. • Noise / acoustic barriers or bunds • Engineered noise abatement of crushers, mills grizzlies, pumps, conveyors, trommels and vibrating screens when practical
Dust emissions	• Activity – plant and equipment • Activity – blasting • Activity – drilling • Activity – overburden dumps and stockpiles • Tailings storage facility	• Air quality • Public safety • Private property • Community facility	For applicable standards or thresholds, see: • SEPP (Air quality management) (2001)	• Reduce vehicle speed. • When clearing vegetation, minimise exposed areas by progressively clearance. • Implement watering of exposed areas during dry periods and restrict site traffic to areas serviced by water tanker. • Apply chemical bonding agents to exposed areas / unsealed roadways. • Minimise vehicle movement. • Minimise exposed areas. • Implement fixed sprinkler system. • Implement mobile sprinkler system. • Cease works during high wind conditions (wind speeds over 50 kph). • Apply water cart on roads within the site. • Seal internal roads when practicable.

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
				• Use dust suppressants on topsoil stockpiles. • Progressively establish vegetation on topsoil/overburden stockpiles and rehabilitated landforms. • Use enclosures for dust generating equipment (for example, an enclosure around a crusher).
Air blast **Fly rock** **Ground vibration**	• Activity – blasting • Activity – drilling	• Public safety • Private property • Public infrastructure • Community facility	For applicable standards or thresholds, see: • Ground vibration (peak particle velocity) below 5mm/s in at least 95 per cent of cases in a 12 month period, and not exceeding 10mm/s at any time • Airblast below 115dB(L) in at least 95% of cases in a 12 month period and not exceeding 120dB(L) at any time	• Pre-calculate the effect to ensure the charge load is correct. • Use some kind of structure to minimise fly rock (for example, blasting mats). • Consider using controlled blasting techniques to minimise slope damage. These techniques include buffer blasting, trim blasting, pre- or mid-split blasting, post-split blasting and line drilling. • Propose a blasting technique, considering geology and geological structures' face heights and orientation, any topographic shielding, stemming heights, blast hole to burden ratios, etc.
Unmanaged hazardous material / waste	Fuel / additive storage and handling	• Groundwater • Surface water • Biodiversity • Ecosystem • Air quality • Significant landscape • Crown land • National park • Public safety • Private property • Public property • Community facility	• Bunding guidelines (EPA publication 347) • SEPP (Waters of Victoria) (2003) • AS 1940-2004 The storage and handling of flammable and combustible liquids	For protection against potential impact from **stored fuel** on site: • The quantities of fuel stored on site shall be kept to a minimum, and must not be stored in or adjacent to surface waters, drainage lines or floodplains, unless the storage facilities prevent them from coming into contact with surface waters. • Refuelling of plant and equipment shall be undertaken in designated areas, away from waterway areas and drainage lines. • Re-fuelling should be undertaken in bunded areas only. Or, if a bunded area is not available, a portable tray is to be used to prevent on-ground spill. • Any area on which a vehicle can stand while being fuelled shall be so graded that spilled liquid will flow

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
				away from any building, and will not flow off the site. • Procedures for fuel spills will be documented. • A spill kit(s) of the appropriate size, quantities and contents applicable to the site shall be supplied. • Employee induction will include spill response information (location of spill kits, and how to clean up spills). • Concrete hard stands, bunding and triple interceptors will be used as primary controls. • Any drainage from a hardstand area where fuels and lubricants are stored and used will be directed to a sump and triple interceptor. • Spill prevention and clean-up equipment will be readily available in the vicinity of all plant and machinery, including mobile and fixed fuel storages. • Spills of fuels, lubricants and/or hazardous materials will be cleaned up as quickly as practicable. Such spillage should not be cleaned up by hosing, sweeping or otherwise releasing such contaminant into waterways. Equipment and soil contaminated by fuels, lubricants, hazardous materials, and clean-up substances which cannot be salvaged should be disposed of in an approved waste facility.
			• *Occupational Health and Safety Act 2004* • *Australian Code for Transport of Dangerous Goods by Road and Rail* • *Code of Practice for the Storage and Handling of Dangerous Goods (2013)*	Protection against potential impact from **stored chemicals/ additives** on site: • The quantities of chemicals stored on site shall be kept to a minimum, and must not be stored in or adjacent to surface waters, drainage lines or floodplains, unless the storage facilities prevent them from coming into contact with surface waters. • Procedures will be documented for the storage and handling of chemicals. • Procedures will be documented for chemical spills.

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
			•	•
Unmanaged hazardous material / waste	Tailings Storage Facility and associated infrastructure, seepage or overflow	• Groundwater • Surface water • Biodiversity • Ecosystem • Significant landscape • Crown land • National park • Public safety • Private property • Public property • Community facility	• *Guidelines on risk assessment* • *ANCOLD guidelines on the consequence category for dams (2012)* • *ANCOLD guidelines on selection of acceptable flood capacity for dams (2000)* • SEPP (Waters of Victoria) (2003) • *Environmental guidelines – management of water in mines and quarries: Victorian legal and policy requirements* • Consequence Screening Tool for Small Dams (2014) (Department of Environment and Primary Industries)	For protection against potential impact from **tailings storage facilities**: • Suitable dam liner permeability • Spillway capacity (for example, capacity can pass the one in 10,000 year flood event) • Appropriately designed freeboard • Planning to ensure sufficient material (rock, clay, sand and soil) is available for covering the tailings in final rehabilitation • Battering of external dam walls to allow effective revegetation and prevent erosion (slopes of 1V: 3H or shallower are recommended). • Installation of cut-off drains to reduce water flowing onto the dam surface, and long-term collection and treatment of seepage from the dam For protection against potential impact from process water: • All storages are lined, to prevent seepage to groundwater. • Bunding is placed around processing facilities to contain any water spillage. • Pipelines are inspected regularly to ensure structural integrity and no leaks. • Ongoing sampling and monitoring of surface water and groundwater are done to ensure no contamination.
	Surface water (on site)		• SEPP (Groundwaters of Victoria) (2003) • *National water quality management strategy: water quality management*	For protection against potential impact **on surface water:** • Drainage control works that divert surface water away from extraction areas and control erosion • Culvert and channel capacity that can convey

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
			– *guidelines for groundwater protection in Australia* (1995)	the relevant flood event design criteria (for example, one in 20 years) • Appropriately sized sediment ponds • Diversion of runoff from the up gradient catchment area around the crest of the slope • Diversion of runoff from the upper benches along drainage channels (toe drains) constructed on berms that allow gravity drainage to low points • Placement of surface water collection facilities on individual berms to shed localised runoff water as quickly as possible • Direction of all surface water from the disturbed areas to the pit floor sump. In the event of the pit floor sump becoming full, it may be used in on or offsite irrigation. • Document standard controls in the form of a surface water management plan and/or drainage management plan.
Water quality	• Activity – drilling • Surface water (on site)	• Groundwater • Surface water • Biodiversity • Ecosystem • Significant landscape • Crown land • National park • Public safety • Private property • Public property • Community facility	• SEPP (Waters of Victoria) (2003) • *SEPP (groundwaters of Victoria) (2003)* • *Guideline construction techniques for sediment pollution control (EPA 1991)*	For protection against potential impact **on groundwater** • Apply high standards in design, construction, operation, maintenance and decommissioning of wells. • Minimise chemical use and use environmentally benign alternatives. • Monitor groundwater (levels and quality). • Remove the direct pathway to groundwater by lowering groundwater levels below the pit levels. • Have a contaminants spill kit available at all times when mobile equipment is being refuelled near waterways or any minor servicing and/or simple maintenance tasks are undertaken on site. Conduct any major servicing / repairs in a contained facility.

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
				• Drain any areas where activities are being undertaken to ensure no water leaves the site without first going through a sediment retention basin. For protection against potential impact **from surface water generated on site:** • Maximise the use of onsite water to limit offsite discharges. Document standard controls in the form of a surface water management plan and/or drainage management plan.
Water quality	Waste rock dump	• Groundwater • Surface water • Biodiversity • Ecosystem • Significant landscape • Crown land • National park • Public safety • Private property • Community facility	• *Industrial waste resource guidelines* (EPA) • *Radiation Act 2005* • SEPP (Waters of Victoria) (2003) • SEPP (groundwaters of Victoria) (2003) • ERR Tailings Storage Facilities guideline	For protection against potential impact **of any contaminated material in EPA guidelines (including radioactive waste):** • Conduct staff and contractor training and induction on the presence of radiation within the work authority area • Limit exposure to and spread of dust by minimising potential dust generating surfaces and using dust control measures. (seals, water suppression etc.). • Ensure trucks or other vehicles transporting radioactive material are covered to prevent spillage. • Conduct regular monitoring using gamma monitors. • Limit potential for seepage and uncontrolled runoff by using under-dump liners and interception drainage; • Conduct groundwater monitoring (water quality sampling).
Water quality	Waste rock dump	• Groundwater • Surface water • Biodiversity • Ecosystem	• *Victorian best practice guidelines for assessing and managing coastal acid sulfate soils* • *Victorian coastal acid*	For protection against potential impact **of acid drainage from waste rock**: • Identify potentially problematic materials. • Actively manage problematic materials to reduce oxygen ingress and reduce the flow of water, which

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
		• Significant landscape • Crown land • National park • Public safety • Private property • Community facility	*sulfate soils strategy* • *Industrial waste management policy (waste acid sulfate soils)* (EPA 1999)	may include encapsulation, isolation and/or neutralisation of material.
Erosion and sedimentation	• Activity – plant and equipment • Activity – overburden dumps and stockpiles • Dams and waterways • Tailings storage facility • Disturbed, unrehabilitated ground	• Surface water • Biodiversity • Ecosystem • Crown land • National park • Private property • Public infrastructure	For applicable standards or thresholds, see SEPP (Waters of Victoria) (2003)	• Drainage control works to divert surface water away from extraction areas • Culvert and channel capacity that can convey the relevant flood event design criteria (for example, one in 20 years) • Appropriately sized sediment ponds • Diversion of runoff from the upgradient catchment area around the crest of the slope • Diversion of runoff from the upper benches along drainage channels (toe drains) constructed on berms that allow gravity drainage to low points • Placement of surface water collection facilities on individual berms to shed localised runoff water as quickly as possible • Direction of all surface water from the disturbed areas to the quarry floor sump. • Use of the quarry floor sump, if full, in onsite or offsite irrigation • Adequate surface water drainage control along berms • Rip-rap protection of bench toes and erosion matting • Windows/crest berms on individual berms to prevent run on to the bench face below • Sediment pit pumping station at the quarry floor. • For erosion control of waste dumps/stockpiles, final slopes of 1V: 3H or shallower, with benches to

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
				break long slopes • Maximise use of onsite water to limit offsite discharges • Standard controls documented in the form of a surface water management plan and/or drainage management plan
Biodiversity disturbance	• Activity – plant and equipment • Activity – blasting • Activity – overburden dumps and stockpiles • Dams and waterways • Fuel / additive storage • Tailings storage facilities • Ground disturbance in buffer or vegetation protection areas	• Groundwater • Surface water • Biodiversity • Ecosystem • Significant landscape • Crown land • National park		• Fence and sign native vegetation to inform site personnel of no-go areas. • Maintain a buffer zone to ensure an effective screen between the relevant operation activities and surrounding biodiversity. • Avoid disturbing the root zone of a tree, which generally extends to the edge of the canopy plus half the radius of the canopy again. • Use species that are indigenous to the area and appropriate to the site's Ecological Vegetation Class (EVC) when establishing plants within the buffer zone. • Prepare a wildlife management plan/ strategy to address potential interactions with wildlife. • Complete a targeted survey (by a qualified ecologist) of the proposed disturbance area. • Complete a habitat hectare assessment. • Locate and secure required offsets. (Offsets must be in place before any clearing activities taking place.) • Produce a post activity restoration plan for the site. • Collect seeds of remnant vegetation and establish a suitable seed bank. • Refer to DELWP guidelines on changes to native vegetation policy.
Cultural heritage disturbance	• Activity – plant and equipment • Activity – blasting	• Aboriginal heritage • European heritage		• Mitigation conditions/ measures, including fencing, burial monitoring, site recording, test excavation, complete archaeological investigation, and

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
	• Activity – overburden dumps and stockpiles • Dams and waterways • Tailing storage facilities			interpretation • Contingency measures for the discovery of new archaeological relics (s132 Heritage Act 1995) • Approved Cultural Heritage Management Plan
Ground instability	• Activity – plant and equipment • Activity – blasting • Activity – drilling • Activity - excavations • Activity – overburden dumps and stockpiles • Dams and waterways • Geological structure • Groundwater • Surface water • Tailings storage facilities	• Surface water • Crown land • National park • Public safety • Private property • Public infrastructure • Community facility		• Design of flatter angled slopes • Berms or fences to catch any rock falls • Surface drainage controls. • Safety bunds established along the edge of pit ramps and quarry faces. • Safety bunds to be constructed at appropriate height, width and durability to withstand forces from the vehicles moving through that area • Dewatering of batters through pumping, and installation of horizontal drains along batters • Regular pit inspections by appropriate operator staff to confirm safety and absence of adverse stability issues • Annual review of activity level and the likelihood of instability • Blasting controls, such as using pre-split or post-split blasting techniques on terminal walls • Operation within a safe set-back zone from the infrastructure/facility by following the appropriate GRZ assessment process and demonstrating set-back distances are safe through sound geotechnical investigation, which may include analyses (as per *Guidance Material for the Assessment of Geotechnical Risk in Open Pit Mines and Quarries*) • Management plans, such as Ground Control Management Plan for the site. The GCMP is to have a Trigger Action response Plan linked to the site

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
				Emergency Response Plan.
Flood and discharge during a flood event	• Dams and waterways • Surface water • Tailings storage facilities	• Surface water • Biodiversity • Ecosystem • Significant landscape • Public safety • Private property • Public infrastructure • Community facility	• SEPP (Waters of Victoria) (2003) • *Guideline construction techniques for sediment pollution control* (EPA 1991)	• Appropriately designed, constructed and maintained water and tailings structures with adequate retention and controlled discharge capacity • Water and tailings management plan • Water and slimes storage management plan, including dam wall stability • Inclusion of relevant authority in the community engagement plan and emergency risk management plan • Employee induction
Visual amenity	• Activity – plant and equipment • Activity – overburden dumps and stockpiles • Dams and waterways • TSF	• Public safety (aesthetic value) • Private property (aesthetic value)		No mining within 1 kilometre of the boundary of a declared national park
Light emission	Night works	• Public safety • Private property		• Keep lights off when not needed. • Mount lights low down, with lowest intensity for the job. • Stop all light escaping upwards and outwards. • Undertake close analysis and judicious use of terrain and vegetation before commencing the design of a facility, to significantly reduce the potential for light spill
Fire	• Fire generating activity (ignition source) • Fuel/additive storage	• Biodiversity • Ecosystem • Air quality • Crown land		• Maintenance of firebreaks • Inclusion of bushfire authority in community engagement plan and emergency risk management plan • Employee induction

Potential risk hazard (includes activity or circumstances)	Potential risk source (includes activity or circumstances)	Potential receptors at risk (includes environment, member of public, land, property, infrastructure in the vicinity of the work)	Objectives or outcomes to be met	Example of controls
		• National park • Public safety • Private property • Public infrastructure • Community facility		• Fire management plan

Appendix 7: Consequence rating (selection available in RRAM)

The following examples guide the selection of the consequence rating in RRAM, in relation to the level of risk posed to environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work. The consequence rating is selected after the implementation of a standard control and/or additional control. The examples are not exhaustive, and the Tenement holder should make reasonable judgement of the correct consequence rating for their proposed mining project.

Consequence rating	Public safety	Community facilities, including property and infrastructure	Land and environment
Critical	• One or more fatalities or life threatening injuries or illness • Public exposed to a severe, adverse long-term health impact or life-threatening hazard	• Services suspended for an extended (years) period • More than 100,000 people who are unable to access the service or experiencing disrupted access to the service	• Irreversible widespread damage to: – listed species (biodiversity) – groundwater dependent ecosystems – groundwater and surface water quality • Significant contribution to multiple environmental pollution events
Major	• One or more injuries or illness requiring surgery or resulting in permanent disablement • Public exposed to a hazard that results in surgery or permanent disablement • Hospitalisation for extensive treatment from injury or illness for more than four weeks	• Services suspended for a major (months) period • 50,000 – 100,000 people who are unable to access the service or experiencing disrupted access to the service	• Extensive, reversible and long-term (remediation lasts longer than three years) or irreversible and localised damage to: – listed species (biodiversity) – groundwater dependent ecosystems – groundwater and surface water quality • Damage that requires specialist equipment and resources from government agencies
Moderate	• One or more injuries or illness requiring treatment by a physician or hospitalisation • Public exposed to a hazard that could cause injuries or health effects requiring treatment by a physician or hospitalisation • Hospitalisation (for observation, for example) for injury or illness for less than four weeks	• Services suspended for a moderate (weeks) period • 1,000 – 50,000 people who are unable to access the service or experiencing disrupted access to the service	• Localised, extended (remediation lasts less than three years) and reversible damage to: – listed species (biodiversity) – groundwater dependent ecosystems – groundwater and surface water quality • Damage that requires specialist equipment from government agencies
Minor	• One or more injuries or illness requiring treatment by a qualified first aid person • Public exposed to a hazard that could cause injuries or adverse health effects requiring treatment by a qualified first	• Services suspended for a minor (days) period • 100 – 1,000 people who are unable to access the service or experiencing	• Localised, temporary (remediation lasts less than one year) and reversible damage to: – listed species (biodiversity) – groundwater dependent ecosystems

Consequence rating	Public safety	Community facilities, including property and infrastructure	Land and environment
	aid person • Medical treatment required for injury or illness (but not resulting in hospitalisation) – not a Lost Time Injury	disrupted access to the service	– groundwater and surface water quality • Damage that requires specialist advice from government agencies
Insignificant	• An injury or ailment that does not require medical treatment by a physician or a qualified first aid person (such as minor bruises, cuts, abrasions involving only local first aid)	• Services suspended for a negligible (hours) period • Fewer than 100 people who are unable to access the service or experiencing disrupted access to the service	• Superficial, short-term damage with cosmetic remediation required for impacts on: – listed species (biodiversity) – groundwater dependent ecosystems – groundwater and surface water quality • Damage that does not require any involvement from a government agency

Appendix 8: Likelihood rating (selection available in RRAM)

Rating	Description of rating	Probability	Historical
Almost certain	High probability of the consequences occurring during the project life	Has a greater than 90 per cent chance of occurring after the implementation of a standard control and /or additional control	Has occurred several times in the past year in the mining industry and in each of the previous five years in Victoria
Likely	Significant probability of the consequences occurring during the project life	Has a 70–90 per cent chance of occurring after the implementation of a standard control and /or additional control	Has occurred once or twice in the past year in the mining industry and in each of the previous five years in Victoria
Possible	Even probability of the consequences occurring during the project life	Has a 30–70 per cent chance of occurring after the implementation of a standard control and /or additional control	Has occurred in the past five years in the industry,
Unlikely	Low probability of the consequences occurring during the project life but not negligible	Has a 5–30 per cent chance of occurring after the implementation of a standard control and /or additional control	Has occurred once or twice in the industry
Rare	Very low probability of the consequences occurring during the project life but not impossible	May occur in exceptional circumstances – that is, has less than 5 per cent chance of occurring after the implementation of a standard control and /or additional control	Unheard of in the industry

Appendix 9: Example narrative of risk rating (as calculated in RRAM)

The following table contains example narratives for various risk ratings (low, medium, significant, high). The Tenement holder should describe the risk posed to the environment, to any member of the public, or to land, property or infrastructure in the vicinity of the work.

Activities or circumstances that create a hazard or source of hazard	Risk rating			
	Low	Medium	Significant	High
Blasting	A small blast charge occurring kilometres away from any sensitive receptor	One medium blast charge occurring between 500 metres and 1 kilometre from any sensitive receptor over a period of time Many small blast charges occurring between 500 metres and 1 kilometre from any sensitive receptor over a period of time	One large blast charge occurring within 50 metres and 500 metres of any sensitive receptor A few medium blast charges occurring between 50 metres and 500 metres of any sensitive receptor over a period of time Many small blast charges occurring between 50 metres and 500 metres of any sensitive receptor over a period of time	A single large blast charge in close proximity (for example, 50 metres) of sensitive receptors A few medium blast charges occurring within 50 metres of any sensitive receptor over a period of time Many small blast charges occurring within 50 metres of any sensitive receptor over a period of time
Dams	A small standalone dam with no reporting catchment	A medium size standalone dam with no reporting catchment	A large standalone dam with no reporting catchment and moderate levels of constituents of concern Medium size dam with a small reporting catchment and medium levels of constituents of concern The potential for flooding of adjacent land impacting private/public infrastructure and/or temporary contamination of land and waterways	A large dam (for example, high wall) with high levels of constituents of concern and a large uncontrolled catchment reporting to it The potential for flooding of adjacent land placing population at risk and/or irreversible/ permanent contamination of land and waterways
Hazardous waste	Low volume of waste	Medium volume of waste	Presence of hazardous materials	Presence of hazardous materials
Noise and air quality[3]	No sensitive receptors within 2 kilometres	Noise and air quality assessment within the noise	Noise and air quality modelling on or just exceeding noise thresholds	Noise and air quality modelling exceeding or significantly

Activities or circumstances that create a hazard or source of hazard	Risk rating			
	Low	Medium	Significant	High
		and air quality threshold Sensitive receptors just 500 metres from the work authority area Some existing barriers (for example, hills, trees, industrial zone) that will mitigate noise impacts	Sensitive receptors within 50 and 500 metres of the work authority area boundary Some existing barriers (for example, hills, trees, industrial zone) that may mitigate noise impacts	exceeding noise thresholds Sensitive receptors within 50 metres of the work authority area boundary
Additives	Minor spill that can be fully contained within a small area Minimal effort needed to clean up	Spill that can be contained onsite Effort needed to clean up Possible impact on site operations	Spill that migrates offsite, impacting neighbouring properties and creating potential human safety issues Significant effort needed to clean up Impacts on site operations	Spill that migrates offsite onto neighbouring properties and surface waters Impact of public safety Significant effort needed to clean up Significant impact on site operations
Slope instability	No sensitive receptors located within the GRZ (GRZ4) (=4H)	There are sensitive receptors (in part or whole) within the final GRZ. In an instability incident, the impact would be low (for example, a dirt road in a remote location is impacted by batter failure but does not need to be remediated immediately because it not used). An instability incident is unlikely, based on a precedent for how proposed slopes are to be designed in such geology, a clear absence of adverse triggers for stability, and no known past problems.	There are multiple sensitive receptors located with the final GRZ. In the case of an instability incident, the consequence for each sensitive receptor would be low but would collectively create a significant impact. There is a single sensitive receptor located within the final GRZ. In the case of an instability incident, the consequence would be significant (for example, the partial loss of public facility resulting in the service being unavailable to the community for some time). An instability incident is likely, as indicated by no precedent to guide how the proposed slopes are to be designed, adverse triggers for instability are known or likely, or at least one past instability problem.	There exists one or more sensitive receptor within the final GRZ and, if any sensitive receptor is impacted by an instability incident, the consequence would be assessed as critical (for example, it would result in death or serious injury to the public, loss of a protected ecosystem, or loss of a public service resulting in long term disruption to significant number of people). An instability incident is almost certain, as indicated by no previous precedent to guide how the proposed slopes are to be designed, the presence

[4] Victorian Planning Provisions 32.08 (2013) – General Residential Zones

Activities or circumstances that create a hazard or source of hazard	Risk rating			
	Low	Medium	Significant	High
				of several known and recognised instability triggers and / or several past instability problems.
Historic heritage		Reuse of existing pits with no associated historic machinery or foundations	Mining of pebble dumps (deep lead) The work authority area features Victorian Heritage Register places and objects, multiple sites where aggregate elevates significance, the presence of rare mining machinery and other relics, lonely graves and burial grounds, a settlement site or the probability of new sites being discovered.	Mining of mullock heaps (quartz and deep lead) Reuse of mining or processing areas with historic mining machinery and/or foundations The work authority area features Victorian Heritage Register places and objects, multiple sites where aggregate elevates significance, the presence of rare mining machinery and other relics, lonely graves and burial grounds, a settlement site or the probability of new sites being discovered.
Groundwater Level	Water table will not be intersected and groundwater levels will not be impacted by mining activities.	Water table will be intersected and low groundwater inflows can be controlled directly from the pit as required, with draw-down impacts beyond the licence area acceptable	Water will be intersected and a dewatering scheme is required to lower groundwater levels beneath the pit with drawdown impact extending beyond the licence area causing a major groundwater level impact sensitive receptors	Water will be intersected and a dewatering scheme is required to lower groundwater levels beneath the pit with unacceptable drawdown impact extending beyond the licence area to impact sensitive receptors.
Groundwater Quality	Water table will not be intersected and/or existing groundwater quality is poor and there are little or no surrounding users or sensitive receptors.	Potential changes in groundwater quality are acceptable. Existing groundwater quality is reasonable and there are nearby groundwater users or sensitive receptors.	Potential changes in groundwater quality alter the beneficial uses of the groundwater and impacts limited number of adjacent users and/or sensitive receptors who rely on groundwater.	Changes in groundwater quality alter the beneficial uses of the groundwater and render it unusable. Significant number of adjacent users and/or sensitive receptors who rely on groundwater are impacted

Appendix 10: Guidance for preparing preliminary slope instability impact assessment

The sole purpose of the Preliminary Slope Instability Impact Assessment is to determine the level of potential geotechnical instability. The purpose is not to propose or assess any additional controls. The information provided should be sufficient for the proponent, ERR, and any relevant asset holder to understand the instability in order to have an informed and objective assessment of required controls, ie, what, if any, further investigations or studies are needed to control the potential instability. Most of the information required to produce the Preliminary Slope Instability Impact Assessment report should be drawn from existing data held by the proponent and from public sources. The extent of the GRZ, the location and nature of the sensitive receptors will determine the scope of information required for the Preliminary Slope Instability Impact Assessment report. If there is no clear pathway for possible slope instability to impact a sensitive receptor, or the sensitive receptor is at the limits of the GRZ, or the potential consequence of the sensitive receptor being impacted is low to moderate, basaed on information provided by the relevant Referral Authority, the Preliminary Slope Instability Impact Assessment report should be relatively short.

Note: Relevant information from the preliminary slope instability impact assessment must be incorporated in sections B.2.1a–B.2.2d (and B.2.2f if applicable) of RRAM.

Guidance on report structure	Explanation	Supporting map (A3 at a scale of 1:1000) to show following features
GRZ	• Establish and justify the GRZ in accordance with *Guidance material for the assessment of geotechnical risk in open pit mines and quarries* – see http://www.energyandresources.vic.gov.au/earth-resources/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/guidance-material-for-the-assessment-of-geotechnical-risks-in-open-pit-mines-and-quarries)	GRZ
Sensitive receptors	• Establish or confirm receptor locations/types/sensitivities and impact pathways. Identify high value sensitive receptors based on available information and from relevant referral authority. • Identify asset owner's requirements/ guidelines for any asset in the GRZ (for example, utility installations near sewers, drains and water mains (Melbourne Water 2009) – see http://www.melbournewater.com.au/Planning-and-building/Forms-guidelines-and-standard-drawings/Documents/Utility-installation-guidelines.pdf).	Location of sensitive receptors within the GRZ
Batters and slopes	• Identify all proposed terminal quarry batters (including both toe and crest). • State proposed face heights, slope and bench details, overall and batter scale heights. • Describe the proposed terminal batter ranges (for example, one in three) and the geotechnical design assumptions (for example, groundwater systems).	All infrastructure facilities to be constructed, including overburden dumps and slimes dam, drainage and outlets, water storages
Geotechnical and geological information	• Provide available geological and geotechnical information. Include geological and geotechnical information already provided for obtaining the work authority (for example, past exploration data). Additional information could include geophysical surveying, interpretation and modelling drilling logs, imagery of the site area, regional and local geology interpretation, geological mapping, and regional stress	

Guidance on report structure	Explanation	Supporting map (A3 at a scale of 1:1000) to show following features
	field information. Information on intact rock material properties – • such as unit weight, porosity, compressive strength, tensile strength, friction angle, cohesion, and elastic constants – together with rock mass properties – such as shear strength, deformation modulus, normal and shear stiffness – may be required for modelling during the stability analysis phase. It should be obtained before that phase (applicable to risks assessed as significant or above).	
Potential instability Triggers	• Describe any adjoining activities that may impact on the stability of the operation (for example, other mining operations, fire, flooding, residential zone/easements). • Determine any past precedence of forming similar batters in a comparable geological setting (for example, the characteristics of a similar (uniform) stratigraphical setting such as alluvial sand, gypsum operations). • If extraction is expected to intersect groundwater, consider how the water table will need to be managed to maintain batter stability. • State whether the area is susceptible to natural faults or seismic activity, and describe an earthquake hazard setting from sources such as the Geoscience Australia website. • Identify any historical instability related to the type of extraction activities proposed. Gather data from databases of events, regional observation and the council. • If blasting, indicate the potential impact of blasting on instability.	• Location of adjoining activities that may impact on the stability of the operation • .Available overlays (for example, from local council) • Overlay earthquake hazard map from GeoScience Australia website • Location of any known past instability incidents
Risk assessment	• Describe potential impact pathways. Potential impact pathways include a risk statement or description. • For each risk statement or description, state a threshold or the acceptance criteria to be applied to the sensitive receptor. • For each potential impact pathway, identify standard batter and slope design controls that will be applied to avoid, minimise or mitigate any potential impact on the sensitive receptors. No additional controls are to be included in the preliminary slope instability impact assessment. • Based on the preliminary instability impact assessment and the applied controls, state whether each potential instability issue identified is low, medium, significant or high. Significant or high • If the identified instability issue is rated significant or above, then stability analysis is required. The type of stability analysis is largely governed by the anticipated failure modes, the scale of the slope and the available data. Numerous slope	• Location of significant and high instability issues and sensitive receptors

Guidance on report structure	Explanation	Supporting map (A3 at a scale of 1:1000) to show following features
	stability packages exist; the quarry operator must determine and verify the package suited to the conditions at their operation. The main types of slope stability analysis include: • kinematic analysis of structurally controlled failures – this is the analysis of the removability of rock blocks from the slope without referring to the forces that cause them to move. It is based on stereographic projections. Mainly applied for batter designs, it may also be used for large scale slope design, if structures control any anticipated failure. • limit equilibrium analysis – this two dimensional method of analysis is widely used for the computation of Factor Of Safety against rotational shear failure in soil slopes. The analysis can be applied to assess the FOS of structurally controlled 'kinematically unstable' rock block and wedges in batter and inter-ramp scale. It can also be used to assess the FOS against failure through rock material or rock mass in batter, inter-ramp and overall slopes. • numerical analysis – this is based on numerical modelling tools such as finite element and distinct element methods. It can overcome some of the limitations in the limit equilibrium analysis, in that it can model complex rock masses and the deformation and displacement of the failing mass. For industry acceptable guidelines for factors of safety and probability of failure values, see summary in Guidelines for open pit design (Stacey and Reid 2009).	

Appendix 11: Recommended information requirement in risk treatment plan

The risk treatment, or management, plan is to contain *"control measures to eliminate or minimise, as far as reasonably practicable, the identified risks associated with mining hazards; and specifies the objectives, standards or acceptance criteria that each control measure or a combination of control measures will achieve"*

The following tables provide examples of how to describe unique aspects of an additional control as per the control design effectiveness criteria in appendix 12. Examples have been provided for noise, air quality, blasting, dams and slope instability. Tenement holders should talk to ERR or the relevant referral authority about the information needed to demonstrate the effectiveness of a proposed additional control. The information should be consistent with the scope outlined in control design effectiveness criteria.

Noise

Control design appropriateness	Control modelling and simulation	Monitoring and reporting
• Description of the local terrain and meteorological conditions • Description of the level and source of influences on the existing noise environment at the nearest sensitive receptors • Potential future changes to the number or location of sensitive receptors, such as proposed housing developments • Description of the design of additional noise control measures. Measures to be considered include: – Earth bunds – Barriers – Enclosures – Damping – Attenuators – Broadband warning alarms – Procedural noise control measures (i.e. the use of certain plant at certain times) • Description of how additional controls will minimise noise emissions and impacts on sensitive receptors	• Prediction of noise levels at all potential affected noise sensitive areas, using an industry recognised noise prediction computer model. Include details on background noise studies and modelling assessments to demonstrate compliance with thresholds.	• Implementation of a noise monitoring plan if the predicted noise levels exceed the EPA/guideline noise limits. Key aspects to include: – program for attended noise measurements – program for unattended noise measurements – proposed weather recording for the period of monitoring – narrow band frequency noise measurements – unattended noise measurements to be conducted for at least seven days • The use of measured data as inputs to updated noise modelling

Air quality

Control design appropriateness	Control modelling and simulation	Monitoring and reporting
• Description of existing air quality data from monitoring that are representative of nearest sensitive receptors and that allow for yearly trends to be determined • Meteorological data that are representative of the conditions across the assessment domain, in a spatial sense. • Topography and land use that influence meteorological and air quality conditions • Explanation of how dust from all sources at the operation will be controlled • Details on dust assessments to demonstrate compliance with dust control guidelines	• Modelling of dust based on standard controls and additional controls to determine whether controls meet the limits.	• Implementation of a dust monitoring plan. Key aspects to include: – program for dynamic dust measurements (for example, mobile monitors) – program for static dust measurements (for example, dust deposition gauges) – proposed weather recording for the period of monitoring

Blasting

Control design appropriateness	Control modelling and simulation	Monitoring and reporting
• Description of blast charge and time delay • Geological structure of the rock • Distances to nearest sensitive receptors • The number of proposed blasts • Description of the type of explosives • Description of the type of mitigation measures	• Include modelling predictions to demonstrate compliance with blasting limits. • Modelling to that includes contour plans at a scale that can be overlaid on imagery or plans of the surrounding area • Influence of atmospheric / meteorological conditions.	• Ground vibration monitoring at specific distances between the source and the sensitive receptor • Comparison of the ground vibration monitoring to with predicted levels

Dams and tailings storage facilities

Control design appropriateness	Control modelling and simulation	Monitoring and reporting
• Compliance with ANCOLD dam criteria • Reference to DEDJTR technical guideline *Management of tailings storage facilities +http://www.energyandresources.vic.gov.au/earth-resources-regulation/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/management-of-tailings-storage-*	• Water balance modelling of site water management system (including dewatering inputs, evaporation facilities, process water demands, makeup water, etc.)	• Monitoring of groundwater (levels and water quality) to ensure that there is no offsite pollution or leakage from water storages • Monitoring of downstream surface water (flow rates and quality) to ensure that there are no uncontrolled releases from site.

Control design appropriateness	Control modelling and simulation	Monitoring and reporting
facilities • Review of appropriate water storage permeability, in relation to site-specific water quality and potential seepage concerns		

Instability

Control design appropriateness	Monitoring and reporting	Control modelling and simulation
• Detailed geotechnical assessment and stability analysis of operational and final landform slopes, possibly including: – evidence that all rehabilitated slopes will not be unduly impacted by ground and groundwater conditions, considering relevant seismic loading and liquefaction, and other factors influencing stability and ground movement. This evidence will rely on limit equilibrium (or finite element) analyses. – justification of assumed design parameters, probably including engineering geological evaluation, laboratory and field testing, rock mass assessment, weathering and erosion, potential for degradation, dispersive process and expansion – historical instability and presence of landslide triggers – previous performance of slopes in similar settings and lithology • The use of appropriate control measures, including (but not limited to): – changed site working patterns – the use of a different method of processing – the use of supporting or reinforcing structures – analysis and submissions as necessary to satisfy all asset owners requirements for any receptor/asset in the GRZ	• Inspections of all areas where slope failures, erosion or sedimentation are likely to occur, including rehabilitated landforms, pit walls, benches and haul roads, drainage lines, discharge points • Monitoring plan for assessment and management of geotechnical and hydrogeological issues (actual monitoring points on plan, and a schedule for measuring these points – prisms, piezometers, extensometers, inclinometers etc.). • Development of a ground control management plan that outlines the management of geotechnical and hydrogeological issues to ensure stability	• Modelling and simulation that could include: – 2D modelling (significant rated activity) – ground movement (strain rates) and dewatering modelling (high rated activity)

Control design appropriateness	Monitoring and reporting	Control modelling and simulation
– development of a surface water management plan describing how surface water diversion and control structures will be designed and maintained to minimise potential for an impact on and recharge to the pit slope materials – a description of the dewatering system and maintenance/monitoring procedures – controls related to subsidence, landslips, toppling, settlement, heave, slumping and fracturing		

Groundwater

Control design appropriateness	Monitoring and reporting	Control modelling and simulation
Describe existing groundwater levels and water quality. – Identify groundwater beneficial use and water quality objectives that are to be protected. – Describe any groundwater extraction or site discharge requirements. – Describe potential groundwater impacts (groundwater quality and level) and sensitive receptors. – Describe control measures to minimise impacts which may include (but not be limited to): – Minimisation of groundwater extraction; – Containment for fuel or chemical storage areas; – Lining of tailings dams; – Collection and treatment of waste rock dump runoff; – Re-injection to maintain groundwater levels. • Design documentation that outlines – proposed remediation techniques for	• The groundwater monitoring plan should document – the application of control measures for groundwater levels and quality – the frequency and type of monitoring – impact assessment review criteria for groundwater level and quality – control failure response actions • The appropriate control measures for groundwater are those that protect the existing groundwater quality and beneficial use, per the objectives and standards for groundwater in the SEPP Groundwater of Victoria and ANZECC water quality guidelines. • The control design should reference minimising impact to beneficial use not exceeding water quality criteria such that remediation is expected to be required. • Monitoring and reporting should be against the appropriate water quality criteria identified in the risk assessment.	• For complex groundwater systems, or where a significant or high risk rating results from the risk review, a groundwater numerical model should be established to assess the potential effectiveness of the proposed controls.The availability of suitable data for model establishment should be incorporated into the risk assessment and data gathering included in the Groundwater Management Plan.

Control design appropriateness	Monitoring and reporting	Control modelling and simulation
any contaminated groundwater – the time that remediation will take – control measures to deal with unplanned events (for example heavy rain during remediation)		

Surface Water

Control design appropriateness	Monitoring and reporting	Control modelling and simulation
• Describe existing surface water quality. • Identify water quality objectives that are to be protected and any site water discharge requirements. • Describe potential surface water impacts and sensitive receptors. • Describe control measures to minimise impacts which may include (but not be limited to): – Minimisation of sediment from erosion; – Management of rainfall runoff; – Collection and treatment of waste rock dump runoff; – Settlement prior to discharge; – Water management during flood events.	• Document in a surface water management plan; – the application of control measures for water quality; – frequency and type of monitoring; – impact assessment review criteria for water quality; – control failure response actions.	• For sites where a significant or high risk rating results from the risk review, a numerical hydraulic model should be established to assess the potential effectiveness of proposed controls. The availability of suitable data for model establishment should be incorporated into the risk assessment and data gathering included in the Surface Water Management Plan.

Appendix 12: Additional control effectiveness rating criteria

Control design effectiveness	Level of control design effectiveness required for significant rated risks	Level of control design effectiveness required for highly rated risks
Control design appropriateness *Is the control design appropriate considering the potential consequences?*	• People-based control – Mature organisation with experienced and skilled workforce, low turnover of staff, clear and documented roles and responsibilities, high level of process discipline with clear process leadership • System-based control – Procedures documented and managed under document control, periodic competency assessment of operators, periodic conformance and outcome evaluation, management reporting	• System-based control – System-initiated control tasks, periodic and system-generated conformance and outcome, system-set rules and protocols, management defined conformance target, continuous conformance and outcome evaluation • Engineering-based control – documented control, training on and understanding of control and control objective, control managed as part of a preventative maintenance system, system generated alarm / notification in the event of failure
Accountability *Is there an accountable owner for the control?*	Control owner is clearly identified and documented (for example, the site manager).	Control owner is clearly identified, and their role and responsibilities are documented (for example, tasks that they should perform in the design, implementation, operation, monitoring and reporting of the control).
Documentation *Are the control's objective, process and limits documented?*	Documentation of the control includes: • an understanding of what the control is attempting to achieve • the relevant limits (for example, under what circumstances/events the control will not work) • process steps relating to, but not limited to, the design, implementation, operation, monitoring and reporting of the control's effectiveness • a hazard and activity register outlining the hazards and risks that the control is seeking to minimise or mitigate • incident reporting (for example, a response process if the control fails). • Escalation process is set for resolving design, implementation, operation and monitoring control issues when relevant entities are unable to agree	All the relevant documentation related to significant rated activities, as well as: • formal periodic reviews of the documentation • a continuous improvement process outlining how learnings are identified, analysed and used to improve the control's performance
Monitoring and reporting *Does the monitoring and reporting program proposed include a clear*	Monitoring and reporting processes are established, but not fully embedded in existing processes, reviews and systems. Monitoring and reporting processes clearly identify:	Monitoring and reporting processes and programs detect non-performance. Performance measures for the control are established, and control documentation is regularly reviewed.

Control design effectiveness	Level of control design effectiveness required for significant rated risks	Level of control design effectiveness required for highly rated risks
management process to assess control effectiveness?	• the impact to be measured • the data to be collected on the impact, and acceptable ranges for the data • relevant thresholds that would apply to monitoring data and actions if thresholds are exceeded • data collection frequency • data collection methods (equipment to be used, by whom, and how calibrated) • monitoring location(s) • reporting frequency, schedule and format.	The monitoring and reporting process includes a continuous improvement processes outlining how the Tenement holder intends to improve control effectiveness and/or reduce the risk. Monitoring and reporting processes clearly state: • the impact to be measured • the data to be collected on the impact, and acceptable ranges for the data • relevant thresholds that would apply to monitoring data and actions if thresholds are exceeded • data collection frequency • data collection methods (equipment to be used, by whom and how calibrated) • monitoring location(s) • reporting frequency, schedule and format.
Competency *Are control owners/ operators competent to operate the control?*	Control owner is directly responsible for executing or maintaining the control, or supervises others that have been assessed as having the necessary knowledge and capability. The level of competency needed to design, implement and operate the control is documented. For significant rated activities, the competency level should be a high level of practical understanding of the hazard/activity control based on several years of experience.	As per significant rated activities. In addition, formal review and performance processes are in place to assess the control operator's competence and ensure they maintain their competence. For high rated activities, the competency level could include tertiary qualifications and/or higher education training, accreditation from a recognised professional industry body, and extensive experience in similar circumstances.
Assurance *Is there an independent assurance process for this control?*	Control will be monitored through an independent assurance assessment (in addition to routine monitoring). Independent assurance assessment will be undertaken by a qualified employee of the Tenement holder who is not directly involved in the site operations or with any direct reporting to the control owner. The appropriately qualified employee will undertake an assurance process to check the control is being operated as designed. The assurance process will involve interviews with the control owner and other relevant stakeholders. Control assurance reports need to be reviewed and endorsed by the Tenement holder, and made available to	Control will be monitored through an independent assurance assessment (in addition to routine monitoring). The independent assurance assessment will be undertaken by a competent person (not directly related to the site) who is suitably qualified in the design and operation of the control. A competent person (not directly related to the site) will undertake an assurance process to check the control is being operated as designed. The assurance process will involve interviews with the control owner and other relevant stakeholders. Control assurance reports need to be reviewed and endorsed by the Tenement holder and made available to the relevant regulator.

Control design effectiveness	Level of control design effectiveness required for significant rated risks	Level of control design effectiveness required for highly rated risks
	relevant regulator.	
Past use of proposed control *Has the control been effective in comparable operating environments?*	Peer reviewed reports describe the effectiveness of the control in comparable situation.	Peer reviewed reports describe the effectiveness of the control in the same application.
Peer review by competent person *Has the control design been reviewed by a competent person?*	A suitably qualified employee of the Tenement holder not directly involved in the operations of the work authority area has completed a peer review of the activity and the suitability of the control, and concludes the control is appropriate and proportional.	A competent person (not directly related to the site) has completed a study assessing the activity and the suitability of the control, and concludes the control is appropriate and proportional. If the proposed technology is new or unusual technology (for example, it has not been previously or extensively used at the site, and has not been used previously under anticipated conditions), the Tenement holder could be subjected to several peer reviews.
Control modelling and simulation *Has the control been tested using different operating assumptions and variables?*	Modelling and simulation of the control are undertaken and results are provided.	Extensive modelling and simulation of the control are undertaken and results are provided. If the proposed technology is new or unusual (for example, it has not been previously or extensively used at the site and has not been used previously under anticipated conditions), the Tenement holder should test the control against a wide range of operating variables and parameters.

Appendix 13: Community engagement plan requirements

According to Schedule 15 of the MRSD(MI)R, a work plan must include a community engagement plan.

Schedule 15 (Part 1) of MRSD(MI)R – community facilities and community engagement plan

"8. A description of the significant community facilities that may be affected by the proposed works.

9. A community engagement plan that –

(a) identifies any community likely to be affected by mining activities authorised by the licence; and

(b) includes proposals for –

(i) identifying community attitudes and expectations; and

(ii) providing information to the community; and

(iii) analysing community feedback and considering community concerns or expectations –

in relation to mining activities authorised by the licence; and

(c) includes a proposal for registering, documenting and responding to complaints and other communications from members of the community in relation to mining activities authorised by the licence."

Section 39A of the MRSDA – licensee's duty to consult with community

"A licensee has a duty to consult with the community throughout the period of the licence by -

sharing with the community information about any activities authorised by the licence that may affect the community; and

giving members of the community a reasonable opportunity to express their views about those activities."

A consultation / community engagement plan is required under clauses 8 and 9 of Schedule 15 of the MRSDM(EI)R. A licensee also has a duty to consult with the community under s39 A of the MRSDA throughout the period of the licence. This consultation provides valuable information that can go into the consultation / community engagement plan.

The consultation / community engagement plan must include:

1. a report cover sheet, including the name, date, author and contact details for the report's author
2. a contents and subheadings for easy assessment and use of the document
3. a brief overview of the proposed operations associated with the exploration licence
4. a brief overview of potential / likely social and environmental impacts of the proposed operations
5. a list of the community and any other stakeholders likely to be affected by the proposed operations, or interested in the proposed activities – including landholders, land owners, local government, community groups and Crown land managers
6. likely community and stakeholder attitudes towards and expectations of the proposed operations
7. how each of the identified community members / stakeholders will potentially be impacted
8. how each of the identified community members / stakeholders will be engaged (and at what level)
9. proposed information channels / types for the community (newsletters / meetings / facilitated events / web content / social media / dedicated contact person etc.)
10. how the community can provide feedback on the operations (online / meetings / phone calls etc.)
11. how community feedback will be captured, registered and responded to (that is, a register or similar that demonstrates how feedback is managed), including an example
12. a description of the proposed complaint / community feedback handling process, including when and how ERR will be notified
13. a timeline for the proposed community engagement, including:
    (a) community / stakeholder groups to be engaged
    (b) how the engagement will take place
    (c) when the engagement will take place

(d) what the engagement will address.

For further information, please see:

1. *Community engagement guidelines for mining and mineral exploration in Victoria* (2008)
2. Code of Practice for Mineral Exploration – Standards, procedures and practical guidance under the *Mineral Resources (Sustainable Development) Act 1990* (2014, section 3 – Community engagement).

Both documents are available on ERR's website at http://www.energyandresources.vic.gov.au/home

Appendix 14: Rehabilitation plan requirements

MRSD(MI)R Schedule 15 **Part 1—Required information—mining work 5 Rehabilitation plan** **5.1 A rehabilitation plan that—**	**Supporting map** **Scale: 1: 2,500 or 1:1,000** **and size: A1 or A2 size preferred**
(a) addresses concepts for the end utilisation of the mine site; and The concept plan should establish expected end use(s) of the site and its general characteristics at the completion of rehabilitation. It may consider: • future land uses that do not depend on the need to obtain a planning permit. If uses requiring a planning permit are being proposed (such as a land fill), the concept plan should be accompanied by a letter from the relevant waste management group. • the capability/suitability of the land – describe the land's inherent features to help demonstrate that the proposed final end use is suitable • possible end land use(s) – provide a conceptual statement on final landform based on all available geophysical, geochemical and biological information • conceptual slope configuration • conceptual rehabilitation of waste dumps, stockpiles, water storages and tailings storage facilities • surface water management for runoff control and erosion prevention • the nature of soils and overburden/waste rock to be used in rehabilitation • evidence that sufficient suitable material is available to complete the proposed final landform. • any constraints on final land use (for example, regulatory constraints, physical constraints, agreements with private land owners) • an overview of proposed action to confirm rehabilitation strategy with relevant stakeholders.	Drawings and plans should show: • North direction, legend, scale, date of/revision date of drawing. • Cross-sections, tenement area boundaries and final pit • Conceptual slope configuration • Proposed final rehabilitated land form • Salient features of the land following rehabilitation (for example, revegetated areas, pit faces, roads, drainage lines and water bodies).
(b) includes proposals for the progressive rehabilitation, stabilisation and revegetation of extraction areas, waste disposal areas, stockpile areas, dams and other land affected by the operation; and *(c) includes proposals for landscaping to minimise the visual impact of the mine site; and* The progressive rehabilitation strategy should detail:	Drawings and plans should show: • Progressive rehabilitation/staging • The progress of rehabilitation over time (for example, topsoil and waste dumps, bunding, final pit faces, benches, areas of landscaping and revegetation, roads, drains

- how a progressive rehabilitation strategy will deliver the final landform / land use outcomes
- how progressive landscaping will be undertaken so visual impact is minimised
- the timeframe between establishing terminal slope and commencing progressive rehabilitation
- the constraints that may limit progressive rehabilitation works
- the approach to undertaking progressive rehabilitation (for example, the availability of suitable material, landscaping, revegetation, the depth of soil stripping, the approximate depth of respread soil, proposed seedbed treatments and the reasons for their selection, the proposed revegetation method, the general mix of species, stockpile dimensions)
- the process for reviewing and improving the rehabilitation plan.

and dams)
- A materials balance

(d) includes proposals for the final rehabilitation and closure of the site, including the security of the site and the removal of plant and equipment, taking into account any potential long term degradation of the environment.

The proposal for the final rehabilitation plan should include:

- whether the proposed final land use is sympathetic to the surrounding landscape (for example, analysis of the visual impact from critical views)
- how the proposed final land form may impact on the long-term surface water/groundwater regime/system
- how final security of the tenement area (for example, water dams/slimes dams etc.) is to be achieved
- the proposed rehabilitation method of any quarry features (slimes dams etc.) to ensure their long-term physical and chemical integrity, including the management of erosion, seepage and potential exposure to contamination
- the proposed general plans for the removal of plant and equipment, including:
  - demobilisation of mobile plant, rolling stock and temporary facilities
  - decommissioning of fixed plant, including the removal and disposal of hazardous materials
  - demolition, refurbishment or reuse of buildings or facilities, including a description of expected waste and disposal methods
- objectives and acceptance criteria to demonstrate achievement of the proposed final land use
- short and long term monitoring and reporting to be undertaken to demonstrate achievement of the final land use.

Appendix 15: Possible statutory referral authority

Catchment Management Authorities (CMA)	Victoria has 10 Catchment Management Authorities, such as Melbourne Water for the Port Phillip region, and the Goulburn Broken Catchment Management Authority for the Goulburn Broken region. Under the Water Act 1989, the local CMA may have an interest and approval requirement for quarries if the proposed quarry area relies on riverine extractions or is situated: on a floodplain (the CMA is the statutory referral authority when a flood or land subject to inundation overlay is present in the local government planning scheme) on or adjacent to a wetland or waterway where CMA contribution to revegetation activities has occurred on relevant land.
Rural Water Authorities (e.g. Southern Rural Water)	Rural Water Authorities implement regulations and policy for groundwater and surface water management, in accordance with delegated powers under the Water Act 1989. These authorities have an interest in mining activities that relates to the intersection with groundwater.
Environment Protection Authority (EPA)	EPA has an interest in mining activities that includes noise, air quality, offsite discharges to water, waste disposal and infill.
Heritage Victoria	Heritage Victoria has an interest in mining activities that includes the potential impacts on state listed historical and archaeological sites (excluding Aboriginal heritage).
Department of Environment, Land, Water and Planning (DELWP)	DELWP has an interest in the possible removal of / impact on threatened species and native vegetation present on and near the mining lease area, if the work authority area is located in a salinity management overlay, impacts on Crown land and its reservation purposes at or adjoining the site.
Council	Council has an interest in mining activities that includes the offsite impacts of mining operations (for example, work hours and offsite traffic during set-up/construction and operation phases).
Other authorities –power (e.g. SP AustNet), **communication** (e.g. Telstra) **and water** (e.g. Yarra Valley Water)	These authorities have an interest in mining activities that include the potential impacts on an easement or asset on or near the work authority boundary.

Appendix 16: Earth Resources Regulation contacts

Manager Operations North West Region	Bob Disken (Acting) **T:** +61 3 5430 4692 bob.disken@ecodev.vic.gov.au
Manager Operations South West Region	Bessie Abbott (Acting) **T:** +61 3 5336 6802 bessie.abbott@ecodev.vic.gov.au
Manager Operations North East Region	David Whitehouse **T:** +61 3 5761 1501 david.whitehouse@ecodev.vic.gov.au
Manager Operations Melbourne Region	Ian McLeod **T:** +61 3 9092 1954 ian.r.mcleod@ecodev.vic.gov.au
Manager Operations Gippsland Region	Andrew Marshall (Acting) **T:** +61 3 5160 9011 andrew.marshall@ecodev.vic.gov.au

Authorised by the _____

Department of Economic Development, Jobs, Transport and Resources

1 Spring Street Melbourne Victoria 3000

Telephone (03) 9651 9999

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Appendix C Bore Construction Details

Well ID	Easting	Northing	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Owner
113004	244592	5753475	180.267		LEVF			100.6	State of Victoria
113470	246774.774	5748512.17	202.789		LEVF	192	195	206.6	State of Victoria
115867	251003	5746726	22.697		LEVF				State of Victoria
115869	259258	5749682			UEVF/MEVF?	127	130	167.2	State of Victoria
115873	252435	5752140			LEVF				State of Victoria
116458	252433	5752143	113.372		UEVF (Basal Sands)	100	112	116	State of Victoria
119349	255327	5745521	22.288		UEVF (Basal Sands)	183	186	343	State of Victoria
121768	255864	5749399	113.72		UEVF/MEVF?	117	120	133.5	State of Victoria
122149	250970.792	5746646.72	19.356		LEVF				State of Victoria
115868	249965	5744913	83.165		UEVF	178	184	245.4	State of Victoria
116459	250977	5746638	18.913		UEVF (Basal Sands)	243	246	253	State of Victoria
116460	246176	5744536	218.129		LEVF				State of Victoria
119347	249492	5751501	84.804		LEVF				State of Victoria
119348	257067	5752454	50.982		LEVF				State of Victoria
DBG MB1	251736.01	5745457.74	47.21	46.84	DBG	37	40	41	Alcoa
DBG MB2	252341.28	5745680.31	60.63	60.12	DBG	60	63	64	Alcoa
DBG MB3	252556.845	5745929.78	#N/A	#N/A	DBG	68.8	71.8	73	Alcoa
DBG MB4	253083.015	5746278.66	20.4	19.76	DBG	35	38	39	Alcoa
DBG MB5	252891.153	5746682.7	16.863	16.32	DBG	18	21	22	Alcoa
DBG MB6	252277.41	5746760.96	11.92	11.29	DBG	34	37	38	Alcoa
DBG MB7	251861.709	5747105.24	17.54	16.96	DBG	8	11	12	Alcoa
DBG MB8	251423.169	5746214.02			DBG				Alcoa
GW1	252659	5745938			LEVF	510	654	666	Barwon Water

Well ID	Easting	Northing	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Owner
GW2	251840	5744691			LEVF	538	660	672	Barwon Water
GW3	253462	5745996			LEVF	426	584	596	Barwon Water
GW4	254271	5746465			LEVF	288	456	468	Barwon Water
GW5	250880	5745681			LEVF	386	580	589	Barwon Water
GW6	254480	5751261			LEVF	192	525	264	Barwon Water
GW7	252768	5752089			LEVF	237	305	317	Barwon Water
MB1	252128.6	5746634.5		1	UEVF (Upper Sands)	74	86	87	Alcoa
MW10	253862.9	5747249.3	10.729	10.71	DBG / PWT	1.8	5.5	5.6	Alcoa
MW11	253849.1	5747239.3	11.102	10.96	DBG / PWT	1.5	4.5	5.47	Alcoa
MW14	253824.9	5747445.4	11.034	11.12	DBG	5	8	8	Alcoa
MW15	253933.1	5747307.5	10.889	11.06	DBG	7	10	9.66	Alcoa
MW16	253921.1	5747310.9	10.987	11.03	DBG	7	10	9.56	Alcoa
MW18	253810	5747345.3	11.704	10.93	DBG	6.3	10.8	10.9	Alcoa
MW19	253635.8	5747500.8	11.021	11.11	DBG	5.5	11.5	10.45	Alcoa
MW2	253942.8	5747344.5	10.688	10.77	DBG	2.5	7	7.4	Alcoa
MW20	253738.9	5747361.7	10.895	10.99	DBG	8	12	11.8	Alcoa
MW21	253918	5747266.9	11.305	11.36	DBG	8	12	11.8	Alcoa
MW22	253951.5	5747317.8	11.97	12.05	DBG	8	12	11.8	Alcoa
MW23	253924	5747284.5	11.057	11.11	DBG	8	12	11.43	Alcoa
MW24	253859	5747237.1	11.077	11	DBG / PWT	8	12	4.4	Alcoa
MW25	253869.7	5747298.8	11.151	11.26	DBG	8	11	10.93	Alcoa
MW26	253952	5747079.7	10.616	10.65	DBG	8.5	14.5	14	Alcoa
MW27	253730.2	5746905.4	11.165	11.22	DBG	10	15	14.92	Alcoa
MW28	253969.7	5746813.4	10.912	11.05	DBG / PWT	1.2	7.2	0	Alcoa
MW29	253437.8	5747391.8	8.99	9.13	DBG	6	12	11.9	Alcoa
MW3	253695.2	5747168.5	7.2	7.29	DBG / PWT	1.5	4	4.18	Alcoa
MW30	253555	5747146.4	9.021	9.08	DBG	7.4	13.4	12.72	Alcoa
MW31	253531.4	5747003.9	6.367	6.37	DBG	6.7	9.7	9.66	Alcoa
MW32	253972.8	5746796.6	10.828	11.06	DBG	11	18	18.5	Alcoa
MW33	253455.5	5746952.2	6.71	6.19	DBG	8	14	14.05	Alcoa
MW34	253551.7	5746791.7	12.799	12.21	DBG	14	20	20.41	Alcoa
MW35	253998.6	5747365.8	12.585	11.86	DBG	7	13	12.8	Alcoa

Well ID	Easting	Northing	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Owner
MW37	253717.9	5747275.4	7.826	7.06	DBG / PWT	3	6	6.6	Alcoa
MW38	253962.4	5746530.2	6.759	5.95	DBG	7	15	15.68	Alcoa
MW4	253667	5747157.3	7.209	7.28	DBG / PWT	1	4	3.5	Alcoa
MW50	253869.78	5747565.35	11.818	11.08	DBG	6.5	11.5	0	Alcoa
MW51	253923.06	5747489.25	11.472	10.78	DBG / PWT	2	5	0	Alcoa
MW52	253898.33	5747517.94	11.674	10.9	DBG	9.3	12.3	0	Alcoa
MW53	253913.63	5747601.38	11.608	10.92	DBG	3	7	0	Alcoa
MW54	253954.48	5747522.37	11.506	10.73	DBG / PWT	2	7	0	Alcoa
MW55	253967.86	5747414.74	11.656	10.89	DBG / PWT	2	6	0	Alcoa
MW56	253818.55	5747602.9	11.888	11.13	DBG	0	0	0	Alcoa
MW57	253906.46	5747423.24	10.244	10.34	DBG / PWT	2	4.5	0	Alcoa
MW58	253882.79	5747500.62	11.431	10.76	DBG / PWT	2	5	0	Alcoa
MW59	253925.15	5747520.49	11.639	10.84	DBG	2	8	0	Alcoa
MW60	253750.8	5747638.9	11.265	11.52	DBG	8.2	12.2	0	Alcoa
MW61	253852.88	5747631.75	11.811	11.89	DBG	8	12	0	Alcoa
MW62	253795.3	5747574.29	9.619	8.85	DBG	6.1	10.1	0	Alcoa
MW63	254004.19	5747470.51	11.955	11.24	DBG / PWT	4	8	0	Alcoa
MW64	253614.43	5747194.65	6.553	6.66	DBG	7	13	0	Alcoa
MW64	253614.43	5747194.65	6.553	6.66	DBG	7	13	0	Alcoa
MW65	253768.57	5747052.39	12.377	11.57	DBG / PWT	4.2	7.2	0	Alcoa
MW66	253965.57	5747675.04	11.878	11.17	DBG	4	10	0	Alcoa
MW67	253916.63	5747646.06	11.57	10.87	DBG / PWT	2.3	7.3	0	Alcoa
MW68	254095.69	5747553.99	11.798	11.06	DBG	14.3	20.3	0	Alcoa
MW69	253790.76	5747500.15	9.736	9.02	DBG	8	10	0	Alcoa
MW8	253904.8	5747298.9	11.595	11.67	DBG	7	10	10.57	Alcoa
NB2	254484	5751336	101.82		UEVF (Basal Sands)	159	162	165	Barwon Water
P1	245855	5746562.4	58.964		DBG / PWT	0.5	5.9	5.9	Barwon Water
P10	241711.4	5749134.7	142.145		LEVF	0.4	4.7	4.7	Barwon Water
P11									Barwon Water
P12	253035.8	5750242.3	33.53		LEVF	18	21	21	Barwon Water
P13	246753.2	5753527.6	95.326		LEVF	36	116	128	Barwon Water

Well ID	Easting	Northing	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Owner
P13B	246756.6	5753526	95.855		DBG / PWT	15	27	27	Barwon Water
P14	255524	5745565			LEVF	394.1	492.1	570.3	Barwon Water
P15	250122	5744773			LEVF	362.9	460.4	530	Barwon Water
P16	242887.5	5748160.6	97.385		LEVF	0.3	3.6	3.9	Barwon Water
P17	245564.6	5746834	61.61		DBG / PWT	0.3	5.4	5.4	Barwon Water
P17	245564.6	5746834	61.61		DBG / PWT	0.3	5.4	5.4	Barwon Water
P18	246686.8	5753613.6	79.469		DBG / PWT	0.3	5.4	5.4	Barwon Water
P3	247168.4	5752954.9	111.649		LEVF	25	130	142	Barwon Water
P6	245608.2	5746425.9	75.622		LEVF	7	15	27	Barwon Water
P7B			31.978		DBG / PWT	2	3.3	3.3	Barwon Water
P8	253022.156	5750212.51	29.017		DBG / PWT	0.36	2.73	3.62	Barwon Water
P9	243141.3	5749338.2	111.29		LEVF	0.3	5.2	5.2	Barwon Water
RM1	251126.7	5746255.4			DBG	13.5	17.5	17.42	Alcoa
RM2	251060.7	5746478.5			DBG	9	12	10.31	Alcoa
RM3	250977.3	5746353.4			DBG	7	11.5	11.13	Alcoa
RM4	251078.4	5746156.1			DBG	13.5	17.5	17.65	Alcoa
SB1	254617	5746883							Barwon Water
SB2	254259	5746419			UEVF (Basal Sands)	223	226	0	Barwon Water
UEVF MB1	251737.19	574557.26	47.38	46.84	UEVF (Upper Sands)	92	98	100	Alcoa
UEVF MB2	252342.02	5745681.11	60.69	60.12	UEVF (Upper Sands)	122	128	130	Alcoa
UEVF MB3	252606.476	5745936.23			UEVF (Upper Sands)	139.3	145.3	146.3	Alcoa
UEVF MB4	253081.748	5746278.97	20.296	19.76	UEVF (Upper Sands)	71	77	79	Alcoa
UEVF MB5	252891.153	5746682.7	16.9495	16.32	UEVF (Upper Sands)	59	65	66	Alcoa
UEVF MB6	252278.4	5746761.66	11.93	11.29	UEVF (Upper Sands)	69	75	77	Alcoa
UEVF MB7	251862.316	5747106.23	17.619	16.96	UEVF (Upper Sands)	42	51.6	52.6	Alcoa
UEVF MB8	251405.185	5746183.75			UEVF (Upper Sands)				Alcoa
WB12	253524	5747169	6.45	0	UEVF (Basal Sands)	0	0	0	Alcoa

Well ID	Easting	Northing	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Owner
WB13	254368	5746937			UEVF/LEVF	165.05	232.29	234.44	Alcoa
WB14	253671	5747343			UEVF (Basal Sands)	155.9	213.7	218.8	Alcoa
WB15	253857	5747075			UEVF (Basal Sands)	186.8	247.5	250.5	Alcoa
WB16	253504	5747188			UEVF (Basal Sands)	173.7	220.2	226.4	Alcoa
WB17	254267	5747210			UEVF (Basal Sands)	120.6	189.6	195.9	Alcoa
WB4	253538	5747629			UEVF (Basal Sands)	108.2	195	222.5	Alcoa
WB5	253693	5747370	9.27		UEVF (Basal Sands)	132	216.6	220.1	Alcoa
WTOB1	250991	5746647	18.89		DBG / PWT	1.7	13.7	13.7	Barwon Water
WTOB2	253304	5747866	11.05		DBG / PWT	1.6	6.6	6.6	Barwon Water
WTOB3	250784	5752005	42.29		DBG / PWT	7.4	13.4	13.4	Barwon Water
WTOB4	243462.7	5747636.8	89.37		LEVF	1.1	7.1	7.1	Barwon Water
WTOB5	243224.7	5748605.2	159.32		LEVF	38	68	70	Barwon Water
MW70	253549.28	5746598.95	9.429	8.67	DBG	0	0	0	Alcoa
MW71	253546.16	5746506.22	10.306	9.45	DBG	0	0	0	Alcoa
MW72	253466.45	5746583.32	10.431	9.69	DBG	0	0	0	Alcoa
MW73	253279.346	5747068.928	7.696	7.03	DBG / PWT	0	0	0	Alcoa
MW74	253297.226	5746962.754	8.021	7.25	DBG / PWT	0	0	0	Alcoa
MW75	253280.379	5747070.716	7.732	7.03	DBG / PWT	2	5	0	Alcoa

Appendix D Permeability Results

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL202009047
Client:	EHS Support		
Client address:	Po Box 297, Port Melbourne VIC 3207		
Project ID:	1772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	(CI) Sandy CLAY, medium plasticity, black, fine to medium grained sand		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	37.00
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

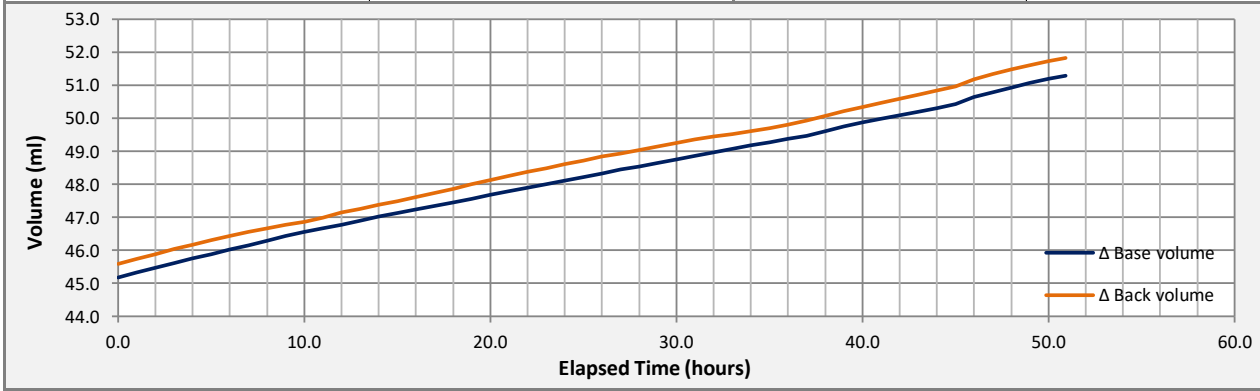
Specimen before testing		Compaction Details	
Height [H] (mm)	63.5	**Method**	-
Diameter [D] (mm)	63.3	**Material retained on 19mm sieve (g):**	-
[D]:[H]	1:1	**Optimum Moisture Content:**	-
Mass (g)	318.2	**Maximum Dry Density (t/m^3):**	-
Moisture Content:	5.3%	**Target moisture content to OMC:**	-
Dry Density (t/m^3):	1.51	**Target dry density relative to MDD:**	-
Assumed Porosity (%)	39.5%	**Laboratory Moisture Ratio:**	-
Assumed Pore Volume (mL)	78.8	**Laboratory Density Ratio:**	-

Pre-test photo

Post-test photo

Permeability test details

Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	20.4%
Saturation B value:	98%
Confining Pressure (kPa):	2212
Inlet Pressure (kPa):	1805
Outlet Pressure (kPa):	1795
Mean effective stress (kPa):	412
Hydraulic Head (kPa):	10
Moisture content after test:	22.7%
Permeability: (m/s)	**7E-10**



Notes: Specimen prepared from a u63 tube sample, subsampled from a larger undisturbed core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 30/09/20

Cert. Ref.: 1772660-038-001_MB7_2009047_TRM20-0581_PERM_R20057065 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL202009048
Client:	EHS Support		
Client address:	PO Box 297, Port Melbourne, VIC, 3207		
Project ID:	772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	(CL) CLAY, low plasticity, brown		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	55.50
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

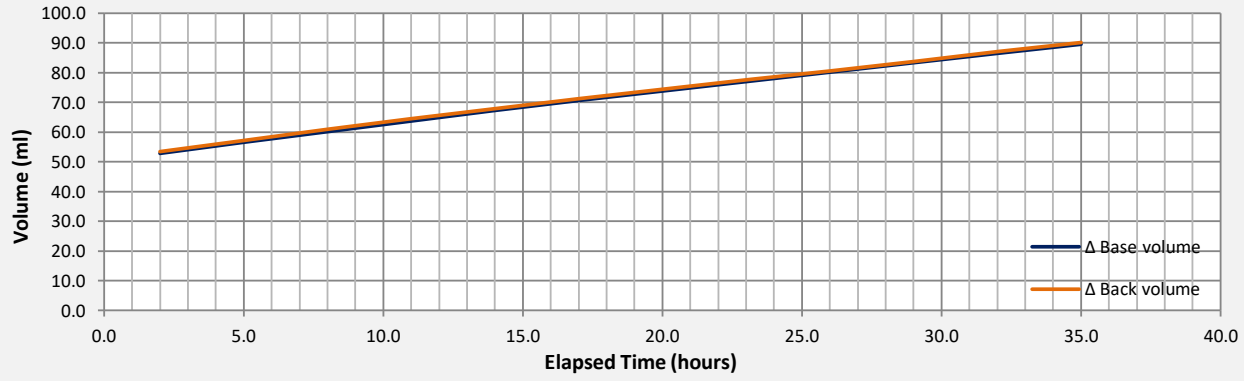
Specimen before testing		Compaction Details	
Height [H] (mm)	63.3	**Method**	-
Diameter [D] (mm)	63.3	**Material retained on 19mm sieve (g):**	-
[D]:[H]	1:1	**Optimum Moisture Content:**	-
Mass (g)	350.5	**Maximum Dry Density (t/m^3):**	-
Moisture Content:	17.9%	**Target moisture content to OMC:**	-
Dry Density (t/m^3):	1.49	**Target dry density relative to MDD:**	-
Assumed Porosity (%)	43.7%	**Laboratory Moisture Ratio:**	-
Assumed Pore Volume (mL)	87.1	**Laboratory Density Ratio:**	-

Pre-test photo

Post-test photo

Permeability test details

Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	61.2%
Saturation B value:	97%
Confining Pressure (kPa):	2152
Inlet Pressure (kPa):	1510
Outlet Pressure (kPa):	1490
Mean effective stress (kPa):	652
Hydraulic Head (kPa):	20
Moisture content after test:	26.4%
Permeability: (m/s)	**3E-09**



Notes: Specimen prepared from a u63 tube sample, subsampled from a larger core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 16/09/20

Cert. Ref.: 1772660-038-001_MB7_2009048_TRM20-0581_PERM_R20056426 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL2020090410
Client:	EHS Support		
Client address:	PO Box 297, Port Melbourne VIC 3207		
Project ID:	772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	COAL, black		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	-
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

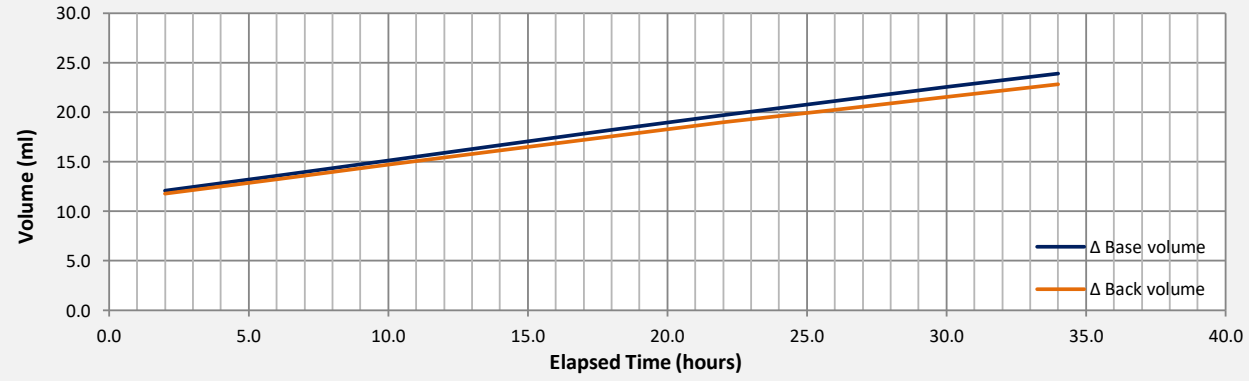
Specimen before testing	
Height [H] (mm)	63.2
Diameter [D] (mm)	63.4
[D]:[H]	1:1
Mass (g)	218.5
Moisture Content:	100.3%
Dry Density (t/m^3):	0.55
Assumed Porosity (%)	76.2%
Assumed Pore Volume (mL)	151.8

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	72.1%
Saturation B value:	100%
Confining Pressure (kPa):	2257
Inlet Pressure (kPa):	1505
Outlet Pressure (kPa):	1495
Mean effective stress (kPa):	757
Hydraulic Head (kPa):	10
Moisture content after test:	97.4%
Permeability: (m/s)	**2E-09**



Notes: Specimen prepared from a u63 tube sample , subsampled from a larger undisturbed core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** NL
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **25/09/20**

Cert. Ref.: 1772660-038-001_MB7_20090410_TRM20-0581_PERM_R20056885 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL2020090411
Client:	EHS Support		
Client address:	PO Box 297, Port Melbourne VIC 3207		
Project ID:	1772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	(ML) SILT, low plasticity, brown		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	140.00
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

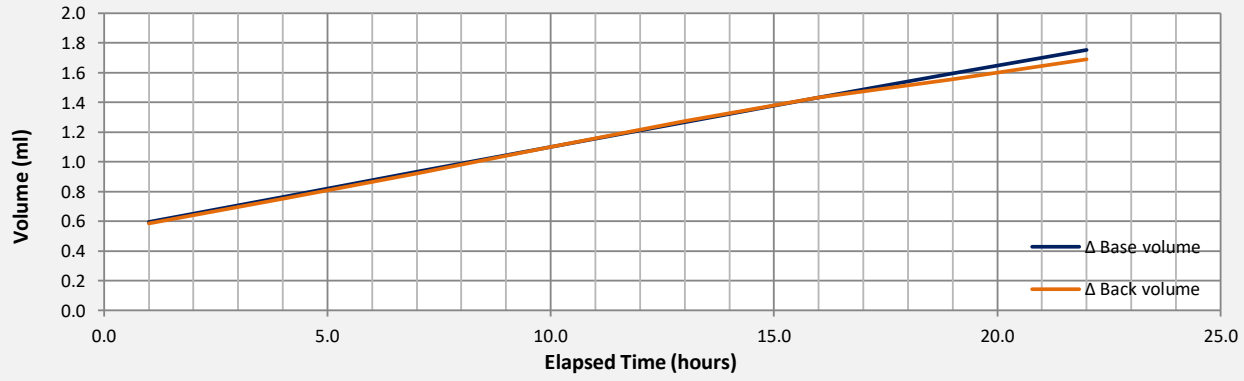
Specimen before testing	
Height [H] (mm)	56.7
Diameter [D] (mm)	63.1
[D]:[H]	1:0.9
Mass (g)	356.0
Moisture Content:	17.3%
Dry Density (t/m^3):	1.71
Assumed Porosity (%)	32.9%
Assumed Pore Volume (mL)	58.4

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	90.1%
Saturation B value:	100%
Confining Pressure (kPa):	1996
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	996
Hydraulic Head (kPa):	20
Moisture content after test:	19.2%
Permeability: (m/s)	**1E-10**



Notes: Specimen prepared from a u63 tube sample, subsampled from a larger core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 21/09/20

Cert. Ref.: 1772660-038-001_MB7_20090411_TRM20-0581_PERM_R20056616 **Approved Signatory:**

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Appendix D 6-Month Pumping Test Outcomes

The long-term pumping test is an important component of the overall mine water strategy. The pumping test observations and analysis allow for understanding aquifer behaviour, constraining long-term sustainable pumping rates, and evaluating risks to receptors or environmental values. This section outlines:

- The adopted trigger levels and contingency measures to manage potential risks during the pumping test.
- The pumping test methodology.
- The observations and outcomes from the first 6-month groundwater pumping test.
- The derived UEVF aquifer hydraulic parameters (i.e., storativity and transmissivity).

D.1 Aquifer Pumping Test Methodology

The principle of a pumping test involves applying a stress to an aquifer by extracting groundwater from a well and measuring the aquifer response to that stress by measuring drawdown as a function of time. The measurements are incorporated into an appropriate well-flow equation to calculate the hydraulic parameters of the aquifer.

D.1.1 Objectives

The overall objectives of the aquifer pumping test (13 May 2021 to 8 December 2021) are to:

- Obtain additional hydrogeological data that can be used to develop a robust and peer-reviewed conceptual and numerical groundwater flow model that will determine if the use of longer term UEVF groundwater is a practical and an environmentally sustainable water management strategy to fill the mine pit void as part of the MRCP.
- Address data gaps identified in the draft MRCP.

To achieve these objectives the following was undertaken:

- Derive UEVF aquifer hydraulic parameters (i.e., storativity and transmissivity) to support the refinement of a numerical groundwater flow model by monitoring the aquifers response to pumping in surrounding observation bores.
- Update a CSM within the vicinity of the coal mine and former power station to inform localised refinement of an existing numerical groundwater flow model, as well as a risk assessment.

Following the completion of the first six-month pumping test, the revised numerical groundwater flow model will be used to determine a long-term sustainable pumping rate that can be used to help accelerate the filling of the water body (GHD 2022 (DRAFT)). In this event Alcoa proposes to seek a long-term groundwater license amendment from SRW to support the filling of the mine void.

After an approximate three-month cessation period, groundwater extraction will then resume for another six months. This period of pumping is expected to:

- Provide further validation of the numerical groundwater flow model calibration and predictions and the associated risk assessment; and
- Provide additional confidence to the community and key stakeholders.

D.1.2 Aquifer Pumping Test Program

The aquifer pumping test program included several stages to understand responses to aquifer stress as summarised in **Table D-1**.

Table D-1 Aquifer Pumping Test Program

Activity	Date
Installation of DBG MB1 – MB8 and UEVF MB1 – MB8	27 August 2020 to 30 April 2021
Baseline monitoring period – water level observations	10 December 2020 to 13 May 2021
Baseline monitoring period – groundwater quality sampling	8 – 12 & 23 April 2021
Pumping Test – 40 L/sec	13 May 2021 to 8 June 2021 and 6 August 2021 to 8 December 2021
Pumping Test – 50 L/sec	8 June 2021 to 6 August 2021
Pumping test recovery monitoring	From 8 December 2021 ongoing

D.1.3 Pumping Bore Specification

Groundwater was extracted from WB16 during the entire pumping test. The pumping infrastructure was installed and maintained by Agmek Ballarat Pty Ltd and is shown on **Photo 6-1** and **Photo 6-2**.

Photo 6-1 WB16 Pumping Bore Setup

Photo 6-2 WB16 Sampling Point and Flow Meter

The construction details of the pumping bore WB16 are summarised in **Table D-2** and the bore log is presented in **Appendix F**. The pumping bore has multiple screened intervals that all intersect the deeper zone of the UEVF. The bottom of the pumping bore is understood to be located at the base of the UEVF (i.e. where it intersects the MEVF).

Table D-2 Pumping Bore WB16 – Well Construction Summary

Casing From (mbgl)	Casing To (mbgl)	Casing ID (mm)	Casing Type and Material
0	163.7	307	Fibre glass reinforced plastic casing
163.7	173.7	203	Mild Steel
173.7	177.8	203	Wire-wound stainless-steel screen, 1.0 mm slot
177.8	183.7	203	Fibre glass reinforced plastic casing
183.7	189.7	203	Wire-wound stainless-steel screen, 1.0 mm slot
189.7	199.2	203	Fibre glass reinforced plastic casing
199.2	203.2	203	Wire-wound stainless-steel screen, 1.0 mm slot
203.2	208.1	203	Fibre glass reinforced plastic casing
208.1	211.2	203	Wire-wound stainless steel screen, 1.0 mm slot
211.2	216.6	203	Fibre glass reinforced plastic casing
216.6	220.2	203	Wire-wound stainless steel screen, 1.0 mm slot
220.2	226.4	203	Fibre glass reinforced plastic casing

Table Notes:

mbgl – metres below ground level

D.1.4 Groundwater Extraction Rate and Discharge

Groundwater extraction commenced on the 13 May 2021 at 11:00am. A summary of the extraction rates and duration is summarised in **Table D-3**.

Table D-3 Groundwater Extraction Rate Summary

Pumping Rate (L/sec)	Pumping Dates	Duration (hours)
40	13 May 2021 to 8 June 2021	630
50	8 June 2021 to 6 August 2021	1,412
40	6 August 2021 to 8 December 2021	2,970

The pumped groundwater was transferred via pipe to the mine pit void where it was discharged below the current mine water level, refer **Photo 6-3** and **Photo 6-4**. This mitigated contact to atmospheric oxygen as well as potential erosion.

Photo 6-3 Discharge Pipe

Photo 6-4 Discharge Location

D.1.5 Pumping Test Groundwater Monitoring Network

Of the 130 catchment wide monitoring bores, 31 (including the 4 Barwon Water bores) were selected to act as dedicated monitoring or nominated trigger bores for the pumping test. These bores are shown in above, and their construction details summarised in **Table D-4**. The pumping test groundwater monitoring network also incorporated the broader monitoring network Barwon Water use for their monitoring and assessment program (MAP), part of their monitoring requirements for their Bulk Entitlement.

Table D-4 Pumping Test Monitoring and Trigger Bores

Bore ID	Aquifer Monitored	Screen Interval (mbgl)	Trigger Bore (T) or Monitoring Bore (M)	Rationale
DBG MB1	Boonah Formation	37 – 40	M	These monitoring bores are located spatially around the periphery of the mine pit void located as close as practical and in a safe to access area. The monitoring objective of these bores are to confirm the presence and behaviours of any groundwater within the Boonah Formation and Mine Overburden. If during the 12-month pumping test the mine pit water level reaches -15mAHD, the pit water has the potential to migrate into the Boonah Formation.
DBG MB2	Boonah Formation	60 – 63	M	
DBG MB3	Boonah Formation	69 - 72	M	
DBG MB4	Mine Overburden	35 – 38	M	
DBG MB5	Mine Overburden	18 – 21	M	
DBG MB6	Mine Overburden	34 – 37	M	
DBG MB7	Boonah Formation	8 – 11	M	
DBG MB8	Boonah Formation	28 – 31	M	
MW27	Boonah Formation	10 -15	M	These bores are located in close vicinity (<250 m) around the pumping bore and screened in either the shallow DBF (PWTa) or the Boonah Formation associated with the surface water systems. These bores are also located as far away as practical from former power station assets such as the water reclamation pond which may influence water levels. MW27, MW29 and MW33 are also located adjacent to Marshy Creek. Monitoring of these bores was
MW29	Boonah Formation	6 – 12	M	
MW33	Boonah Formation	8 – 14	T	
MW37	DBF (PWTa)	3 – 6	M	
MW64	Boonah Formation	7 – 13	T	

Bore ID	Aquifer Monitored	Screen Interval (mbgl)	Trigger Bore (T) or Monitoring Bore (M)	Rationale
				undertaken to understand potential surface water / groundwater interactions.
UEVF MB1	$UEVF_U$	92 – 98	M	These monitoring bores are located spatially around the periphery of the mine void located as close as practical and in a safe to access area. The objective of these bores are to monitor for potential drawdown caused by pumping. If drawdown does occur, it increases the potential for mine water to seep into the aquifer. UEVF MB8 exhibits a higher groundwater elevation than the other bores in the upper section of the UEVF (MB1 – MB7). The higher groundwater level seen in this bore is likely representative of the confining coal and clay in which the bore is screened. During drilling, no upper sands were observed in this bore (as was observed in MB1 to MB7) apart from a possible 10-20cm lens located at approximately 82 mbgl in which the bore was screened.
UEVF MB2	$UEVF_U$	122 – 128	M	
UEVF MB3	$UEVF_U$	139.3 - 145.3	T	
UEVF MB4	$UEVF_U$	71 – 77	M	
UEVF MB5	$UEVF_U$	59 – 65	T	
UEVF MB6	$UEVF_U$	69 – 75	M	
UEVF MB7	$UEVF_U$	42 – 51.6	T	
UEVF MB8	$UEVF_U$	81 – 84	M	
WB4	$UEVF_L$	108.2 – 195	M	These bores are either former power station production or observation bores. They are screened in the lower part of the UEVF and will monitor drawdown as a result of pumping. The data will be used to provide reliable hydraulic parameters for a future numerical groundwater flow model.
WB12	$UEVF_L$	147.2 – 221.3	M	
WB14	$UEVF_L$	155.9 - 213.7	T	
WB15	$UEVF_L$	186.8 - 247.5	M	
WB16	$UEVF_L$	173.7 – 220.2	PB	This is the Pumping Bore.
116459	$UEVF_L$	243 - 246	T	This is a State observation bore with a long history of water level data. Drawdown observations within this bore will be used to ensure drawdown does not exceed what was modelled in the GIA and thus potential risks to environmental assets in outcrop areas remain low.
P8	ASA	0.36 – 2.73	M	These bores form part of the Barwon Water monitoring network. These were monitored by Barwon Water during the pumping test.
P12	LEVF	18 – 21	M	
P17	ASA	0.3 – 5.4	M	
P19	UEVF	19 – 22	M	
SB2	UEVF	223 - 226	M	

Table Notes:

mbgl – metres below ground level

$UEVF_U$ = Upper Sands of the UEVF

$UEVF_L$ = Lower Sands of the UEVF

D.1.6 Monitoring Activities and Elements

Monitoring activities varied from general site observations to in-situ water level measurements and sample collection for laboratory analysis. The level (type and frequency) of monitoring was established to assess changes in groundwater and the mine pit void water body.

D.1.7 Groundwater Level Monitoring

As discussed above and shown on **Figure 2-2** groundwater monitoring locations have been established by Alcoa and Barwon Water within the DBF (PWTa), Boonah Formation, UEVF (upper and deeper zone) and LEVF. During the baseline period and throughout the pumping test, continuous (hourly) groundwater pressure monitoring was recorded in all nominated monitoring and trigger bores, including by Barwon Water for those owned by Barwon Water (bores P8, P12, P17, P19 and SB2).

Groundwater level monitoring was collected using two primary data collection methods:

- Continuous monitoring using Solinst Levelogger.
- Manual gauging prior to each groundwater sampling event, undertaken monthly.

A Solinst barometric pressure transducer, in the vicinity of the Alcoa office, logged fluctuations in barometric pressure. The barometric data was used to correct groundwater pressures for the effects from barometric pressures and used to calculate the groundwater elevation.

D.1.8 Mine Pit Water Level Surveying

The mine pit water level has been surveyed by an independent surveying contractor (Cardno TGM) since June 2020. The survey point is along the south mine face and is shown on **Figure 2-2**. The mine pit water level since the commencement of pumping is shown on **Figure D-8** below.

D.1.9 Groundwater and Mine Pit Void Sampling Program

Mine pit void water body and groundwater sampling was conducted in accordance with the requirements of publication Victorian EPA (2009). All identified Alcoa owned monitoring bores and trigger bores that form part of the monitoring network (refer to **Section 6.2.5**) were sampled using a submersible pump and collected in laboratory supplied bottles and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. Groundwater sampling of Barwon Water monitoring bores was not undertaken. Grab samples were taken from WB16 where pumping was under continuous operation. In-situ field parameters were also measured at the time of sampling.

The sampling was undertaken in accordance with the schedule shown in **Table D-5**. Sampling was conducted in accordance with QA/QC procedures outlined in *EHS Support (August 2021) 12-month Groundwater Pumping Test Monitoring Plan – Anglesea Power Station and Coal Mine*. The analytical suite is shown on **Table D-6**.

Table D-5 Adopted Sampling Program

Bore ID	Aquifer Monitored	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
DBGMB1	Boonah Formation	x	x	x	x	x	x	x		x			x
DBGMB2	Boonah Formation	x	x	x	x	x	x	x		x			x
DBGMB3	Boonah Formation	x	x	x	x	x	x	x		x			x
DBGMB4	Mine Overburden	x	x	x	x	x	x	x		x			x
DBGMB5	Mine Overburden	x	x	x	x	x	x	x		x			x
DBGMB6	Mine Overburden	x	x	x	x	x	x	x		x			x
DBGMB7	Boonah Formation	x	x	x	x	x	x	x		x			x
DBGMB8	Boonah Formation	x	x	x	x	x	x	x		x			x
MW27	Boonah Formation	x			x				x				x
MW29	Boonah Formation	x			x				x				x
MW33	Boonah Formation	x			x				x				x
MW37	DBF (PWTa)	x			x				x				x
MW64	Boonah Formation	x			x				x				x
UEVFMB1	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB2	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB3	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB4	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB5	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB6	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB7	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
UEVFMB8	UEVF (Upper zone)	x	x	x	x	x	x	x		x			x
WB4*	UEVF (Deeper zone)	x		x			x			x			x
WB12	UEVF (Deeper zone)	x		x			x			x			x
WB14	UEVF (Deeper zone)	x		x			x			x			x
WB15	UEVF (Deeper zone	x		x			x			x			x
WB16	UEVF (Deeper zone)	x	x	x	x	x	x	x	x	x	x	x	x
Mine Pit Void	Mine Water	x	x	x	x	x	x	x	x	x	x	x	x

Table D-6 Water Quality Analytical Suite

Group	Parameter	Units	LOR
Physico-chemical (field)	Temperature (field)	°C	
	pH (field)	S.U.	
	Electrical conductivity (field)	µS/cm	
	Dissolved oxygen (field)	mg/L	
	Redox potential (field)	mV	
Physico-chemical (lab)	pH	S.U.	0.01
	Acidity as CaCO3	mg/L	1
	Total dissolved solids - gravimetric	mg/L	10
	Turbidity	N.T.U.	0.1
Major ions	Bicarbonate Alkalinity as $CaCO_3$	mg/L	1
	Carbonate Alkalinity as $CaCO_3$	mg/L	1
	Hydroxide Alkalinity as $CaCO_3$	mg/L	1
	Total Alkalinity as $CaCO_3$	mg/L	1
	Chloride	mg/L	1
	Sulfate	mg/L	1
	Calcium	mg/L	1
	Magnesium	mg/L	1
	Potassium	mg/L	1
	Sodium	mg/L	1
Nutrients	Organic Carbon (Total and Dissolved)	mg/L	1
	Total nitrogen	mg/L	0.1
	Total Phosphorus	mg/L	0.01
Trace inorganics	Aluminium-total and soluble	mg/L	0.001
	Boron-total and soluble	mg/L	0.05
	Iron-total and soluble	mg/L	0.05
	Bromide	mg/L	

D.2 Baseline Groundwater Levels

Prior to conducting the pumping test, baseline conditions were monitored for approximately five months to evaluate static groundwater conditions. The following section discusses the evaluation of water levels, and pressure transducer data to establish baseline conditions.

D.2.1 Potentiometric Surface

D.2.2 Demons Bluff Formation

A total of 37 groundwater monitoring bores have been installed across the former power station site, and 8 groundwater monitoring bores installed across the Alcoa coal mine site targeting the DBF (mostly screened in the Boonah Formation). Of these monitoring bores, 13 were incorporated in the pumping test monitoring program. The baseline elevation (as of 17 November 2021) of the water table of this unit is shown on **Figure 5-39**.

Groundwater conditions at the Alcoa coal mine indicate that the DBF nearer the coal mine is largely unsaturated. For the saturated DBF bores located nearer the former power station, groundwater levels generally fall within the -4 to +4 m AHD range, which was the same range previously reported for the unconfined aquifer prior to Alcoa development (Hancock, 1967). This, combined with the absence of any widespread increases in DBF groundwater levels since Alcoa groundwater extraction from the UEVF aquifer ceased in 2016, indicates that past site activities, such as groundwater extraction from the UEVF or mine dewatering, are unlikely to have resulted in significant decreases in water levels within the DBF aquifer.

The direction of groundwater flow is expected to follow topography as well as being influenced by the mine pit void.

D.2.3 UEVF Upper Sands

An upper permeable sand unit within the UEVF was recorded in close vicinity to the Alcoa coal mine, noting that this unit pinches out along the western embankment of the mine pit void. Eight groundwater monitoring bores were installed in this unit in 2020/2021 and form part of the pumping test monitoring program.

The upper sands of the UEVF forms a discontinuous permeable unit that is separated from the shallow Boonah Formation by the basal clay and main coal seams. The direction of groundwater flow is expected to follow topography as well as being influenced by the mine pit void (**Figure 5-59**).

D.2.4 UEVF Lower Sands

At the site, the UEVF lower sands are confined by greater than 100 m of coal and clay that separate these sands from shallower permeable units (refer to sections above for lithological relationship between these two units).

A number of dewatering bores were installed by Alcoa across the former power station site targeting the lower sands of the UEVF to facilitate mining operations. Five of these dewatering bores form part of the pumping test monitoring program; the remainder of these dewatering bores have been decommissioned for various reasons.

Static groundwater elevations from May 2021 (i.e., prior to the commencement of the 12-month pumping test) indicate greater hydraulic pressures in the lower sands of the UEVF compared to the overlying upper sands (**Figure 5-62**).

D.2.5 Hydrographs

Hydrographs of monitoring and trigger bores during the baseline period are provided as **Figure D-1** to **Figure D-3**. Groundwater bores screened with the upper and lower sands of the UEVF show generally increasing groundwater elevations throughout the baseline period (**Figure D-1** and **Figure D-2** respectively). Groundwater bores screened within the Boonah Formation/DBF show a static response with minimal influence from direct rainfall recharge (**Figure D-3**).

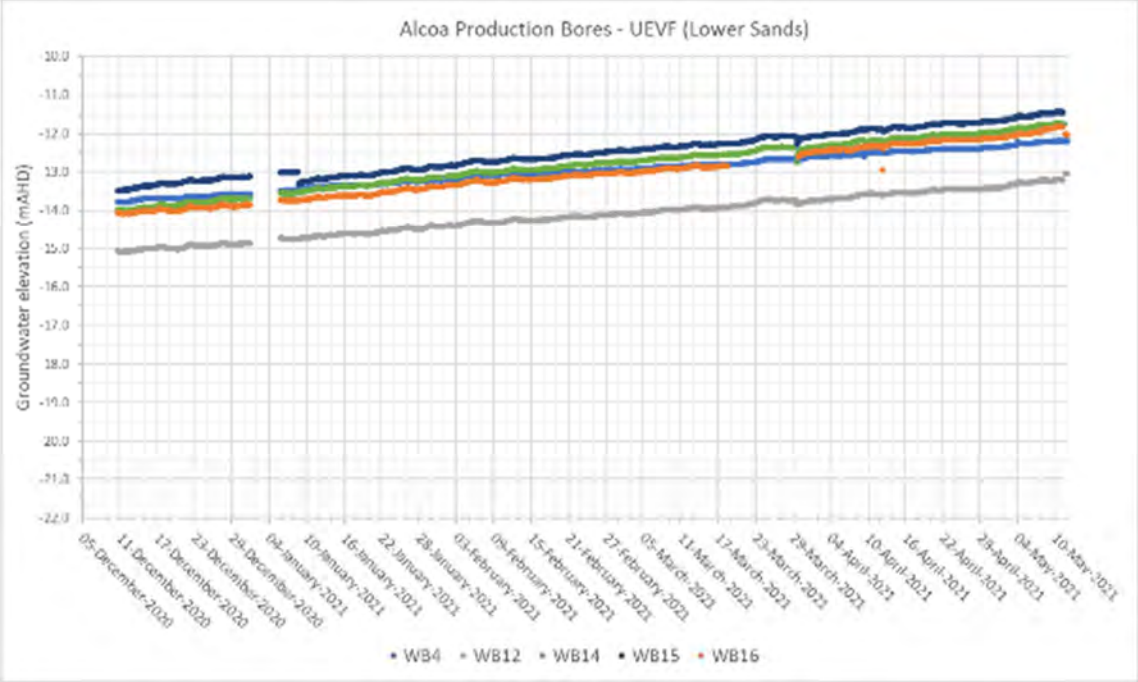

Figure D-1 UEVF (Lower Sands) Alcoa Production Bores – Baseline Groundwater Elevations

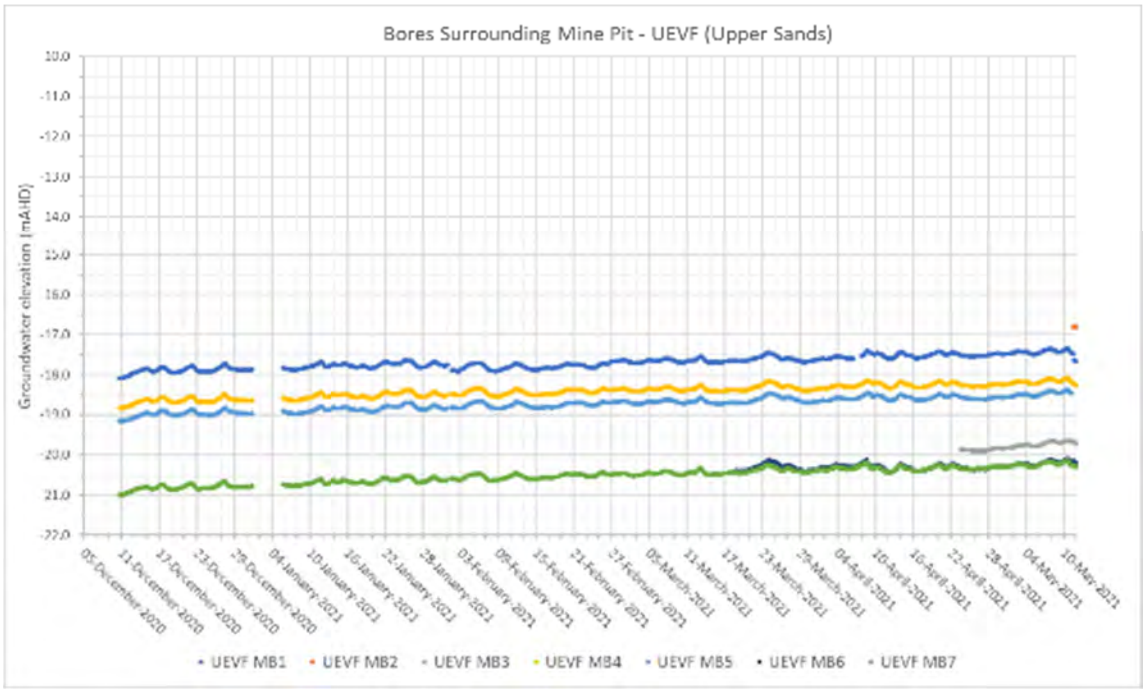

Figure D-2 UEVF (Upper Sands) Bores Surrounding Mine Pit – Baseline Groundwater Elevations

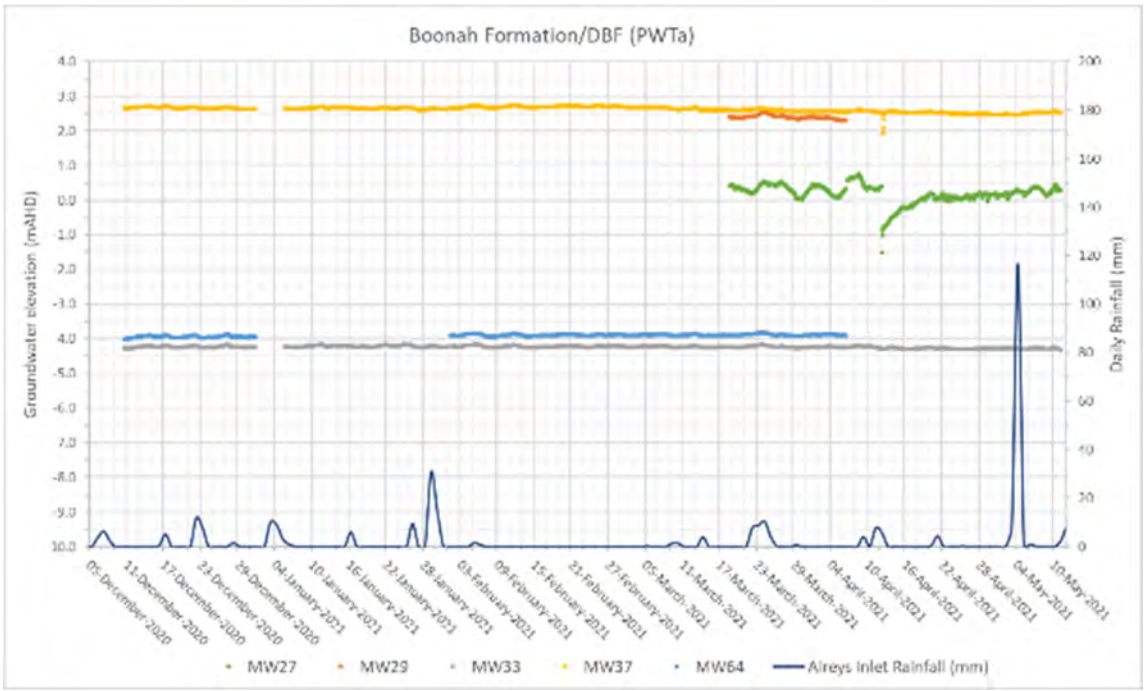

Figure D-3 Boonah Formation/DBF (PWTa) Bores – Baseline Groundwater Elevations

D.3 First 6-month Pumping Test Results

As noted in **Section 6.3.1** above, the main objective of the first 6-month pumping test was to derive UEVF aquifer hydraulic parameters to support the refinement of a numerical groundwater flow model and to update the CSM as well as the risk assessment based on the groundwater pressure and water quality observations during the test.

Groundwater is extracted from the aquifer and regulated to maintain a constant uniform rate during a constant rate pump test. The pressure response within the pumped bore and surrounding bores are monitored during the drawdown phase and during the subsequent recovery period to provide a means for estimating hydraulic and storage properties of the aquifer as well as for discerning formational and non-formational flow conditions (i.e., boundary effects).

The pumping test was conducted from 13 May 2021 to 8 December 2021 at WB16. The constant rate pumping test had a pre-selected pumping rate of 40 L/sec based on specific drawdown/discharge characteristics exhibited during the previous 7-day constant rate pumping test undertaken in April 2020, and historical Alcoa dewatering pumping rates. The pumping test commenced at 40 L/sec for a period of approximately 26 days and then was increased to 50 L/sec for an additional 59 days. Based on the drawdown observations, the pumping rate was reduced back to 40 L/sec for the remainder of the pumping test (124 days). Discharge was monitored using a calibrated magnetic flow meter at WB16, and groundwater was discharged to the mine pit void. Groundwater recovery has been monitored since the pump was turned off on the 8 December 2021.

The data analysis approach to the pumping test is based on type-curve matching methods commonly used to analyse standard pumping test responses.

D.3.1 Methodology and Design

The pumping test was monitored in the pumping bore WB16 and 26 monitoring bores. The depth to groundwater (and subsequent calculation of groundwater elevations) was recorded by a pressure transducer at 1-hour intervals and measured manually monthly to ensure that the flow rate and drawdown was satisfactory for the test. The pump flow-rate was logged electronically by the magnetic flow meter and checked regularly during the pumping test. The pressure transducers have been left in the monitoring bores to record groundwater recovery following the cessation of pumping on the 8 December 2021. A barometric pressure logger is located at the site and used to compensate all datalogger data for atmospheric pressure changes.

Table D-7 summarises the pumping and recovery test program.

Table D-7 Summary of Pumping Test

Phase	Start	Finish	Duration (hours)	Flow Rate (L/sec)	Max. Observed Drawdown / Recovery (m)
Pumping	13/08/2021 11:00 pm	08/12/2021 08:00 am	5,013	40 to 50	64.66
Recovery	08/12/2021 08:00 am			NA	

Table Notes:
L/sec - litres per second
m - metre

During the pumping test, drawdown versus time from WB16 was plotted on a semi-logarithmic plot and updated as new data was collected. Projections of drawdown were made as the test proceeded and compared with measured results. The plot assists in identifying boundary effects and other hydraulic features. When field data curves of drawdown versus time deviate from theoretical curves of the main types of aquifer, the deviation is usually due to specific boundary conditions (e.g., change in aquifer transmissivity and storativity, well bore storage, recharge boundary, impermeable boundary, geological boundaries, extraction of groundwater elsewhere).

D.3.2 Monitoring and Recovery

Field activities conducted during the pumping test included the following:

- Manual gauging of groundwater levels prior to, during and after the pumping test in the monitoring bore network.
- Manual gauging of groundwater levels monthly during the pumping test to supplement the datalogger data and verify groundwater elevations.
- Automated measurement of groundwater levels using pressure transducers.
- Discharge monitoring via a magnetic flow meter supplied by Agmek Ballarat Pty Ltd.
- Management of extracted groundwater to the mine pit void.
- Monthly sampling of the monitoring network and mine pit void.

D.3.3 Data Analysis

A range of analytical solutions were initially applied to the pumping test data using Aqtesolv™ (HydroSOLVE, Inc.). Diagnostic flow plots (i.e., radial flow) and derivative analysis (Bourdet et al. 1983; Bourdet et al. 1989) are tools used to facilitate and strengthen the interpretation of the pumping test data. A plot of linear drawdown (s) against log time (t), also referred to as a Jacob plot, was undertaken to identify the category of aquifer and the pattern of behaviour. Such plots inform if the system is confined or unconfined, has delayed yield, or exhibits leakage properties.

Based on the findings of the preliminary analysis, appropriate solutions can be applied to derive aquifer and aquitard characteristics such as transmissivity, hydraulic conductivity, storativity, and leakage coefficients. The Papadopulos-Cooper (1967) solution was adopted for this analysis to estimate the transmissivity and storativity of the UEVF lower sands aquifer.

D.3.4 Pre- Pumping Test Groundwater Levels

Prior to commencing the pumping test, the monitoring bore network was manually gauged on 11 May 2021. The recorded groundwater levels are summarised in **Table D-8**.

Table D-8 Pre- Pumping Test Groundwater Levels

Bore ID	Aquifer Monitored	Trigger Bore (T) or Monitoring Bore (M)	Standing Water Level prior to Pumping (mbtoc)	Groundwater elevation (mAHD)
DBG MB1	Boonah Formation	M	-	-
DBG MB2	Boonah Formation	M	-	-
DBG MB3	Boonah Formation	M	-	-
DBG MB4	Mine Overburden	M	-	-
DBG MB5	Mine Overburden	M	-	-
DBG MB6	Mine Overburden	M	30.36	-18.44
DBG MB7	Boonah Formation	M	-	-
DBG MB8	Boonah Formation	M	-	-
MW27	Boonah Formation	M	12.46	-1.29
MW29	Boonah Formation	M	6.78	2.21
MW33	Boonah Formation	T	11.0	-4.29
MW37	DBF (PWTa)	M	5.22	2.61
MW64	Boonah Formation	T	10.52	-3.97
UEVF MB1	$UEVF_U$	M	65.01	-17.63
UEVF MB2	$UEVF_U$	M	77.85	-17.16
UEVF MB3	$UEVF_U$	T	76.91	-20.32
UEVF MB4	$UEVF_U$	M	38.57	-18.27
UEVF MB5	$UEVF_U$	T	35.51	-18.56
UEVF MB6	$UEVF_U$	M	32.10	-20.17
UEVF MB7	$UEVF_U$	T	37.87	-20.25
UEVF MB8	$UEVF_U$	M	29.67	3.26
WB4	$UEVF_L$	M	21.80	-12.18
WB12	$UEVF_L$	M	19.48	-13.03
WB14	$UEVF_L$	T	21.66	-11.70
WB15	$UEVF_L$	M	23.36	-11.02
WB16	$UEVF_L$	PB	19.14	-12.02
116459	$UEVF_L$	T	11.72	7.19
P8	ASA	M	-	-
P12	LEVF	M	-	-
P17	ASA	M	-	-
P19	UEVF	M	-	-

Bore ID	Aquifer Monitored	Trigger Bore (T) or Monitoring Bore (M)	Standing Water Level prior to Pumping (mbtoc)	Groundwater elevation (mAHD)
SB2	UEVF	M	-	-

Table Notes:
mbgl – metres below top of casing
mAHD - metres Australian Height Datum
$UEVF_U$ = Upper Sands of the UEVF
$UEVF_L$ = Lower Sands of the UEVF

D.3.5 Rainfall and Barometric Pressure

Approximately 431 mm of rain (Aireys Inlet BoM Station 90180) fell during the pumping test. Rainfall prior to and during the test period was considered in the pump test evaluation and barometric pressure changes were compensated for in the analysis of the transducer data.

D.3.6 Pumping Bore WB16 Groundwater Level Response

The pumping test was initiated on 13 May 2021 at 11:00am. As discussed above the starting pumping rate was 40 L/sec. At 5:00 pm on 8 June 2021 the pumping rate was increased to 50 L/sec. Following the temporary increase in the pumping rate, the pumping rate was adjusted back to 40 L/sec at 2:00 pm on 6 August 2021 for the remainder of the pumping test. The test was terminated at 08:00 am on 8 December 2021. A total volume of 671.9 ML was discharged to the mine pit void.

Water level response at WB16 during the pumping test indicated a maximum drawdown of 64.66 m was achieved at the pumping bore, and a drawdown of 51.94 m was recorded at the end of the pumping test. Following pump shutdown, groundwater levels in WB16 initially recovered rapidly. Recovery was within about 90% of initial groundwater levels after 30 days (i.e. with 5.7 m of static levels).

A plot of drawdown and recovery versus time at WB16 is displayed on **Figure D-4**. It is noted that during the entire duration of the pumping test, the pump intermittently shut off either due to malfunction or for maintenance activities. These shut down periods can be seen in the plot where groundwater levels start to recover.

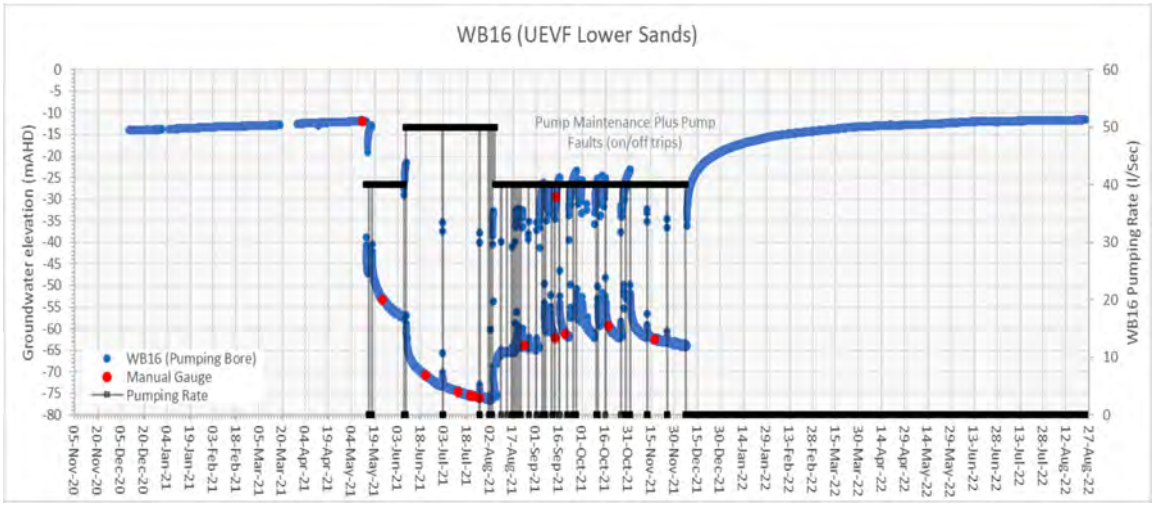

Figure D-4 Plot of Drawdown and Recovery at WB16 Versus Time

D.3.7 Monitoring Bore Network Groundwater Level Response

Groundwater level changes during the pumping test across the monitoring network are presented in **Figure D-5** to **Figure D-9**.

As expected, a drawdown response is observed in the Alcoa production bores screened in the lower sands of the UEVF (**Figure D-5**). SOB 116459 is screened within the lower sands of the UEVF and does not show a response to groundwater pumping (**Figure D-6**). This bore is located approximately 2.5 km from WB16. Barwon Water monitoring bore SB2 is screened within a 3 m section at the base of the lower sands of the UEVF. This monitoring bore is located approximately 1 km to the south of WB16 and recorded a response during pumping (**Figure D-7**).

Groundwater bores screened within the Boonah Formation/DBF (PWTa) do not show a response to the pumping test. Groundwater bores screened within the upper sands of the UEVF also do not show a response to the pumping test, with groundwater elevations continuing to increase as noted during the baseline period (**Figure D-8** and **Figure D-9** respectively).

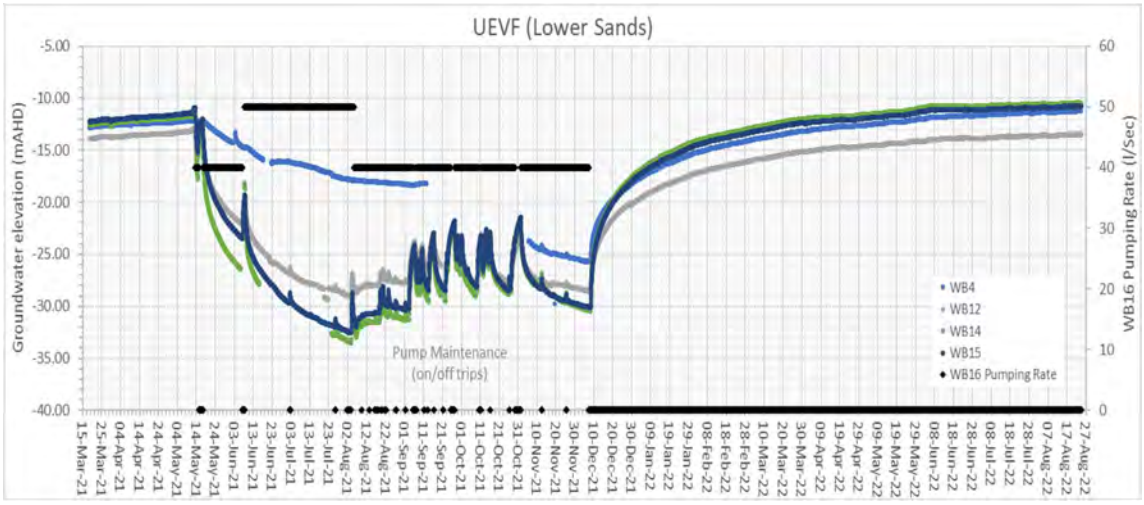

Figure D-5 UEVF (Lower Sands) Alcoa Production Bores – Plot of Drawdown and Recovery Versus Time

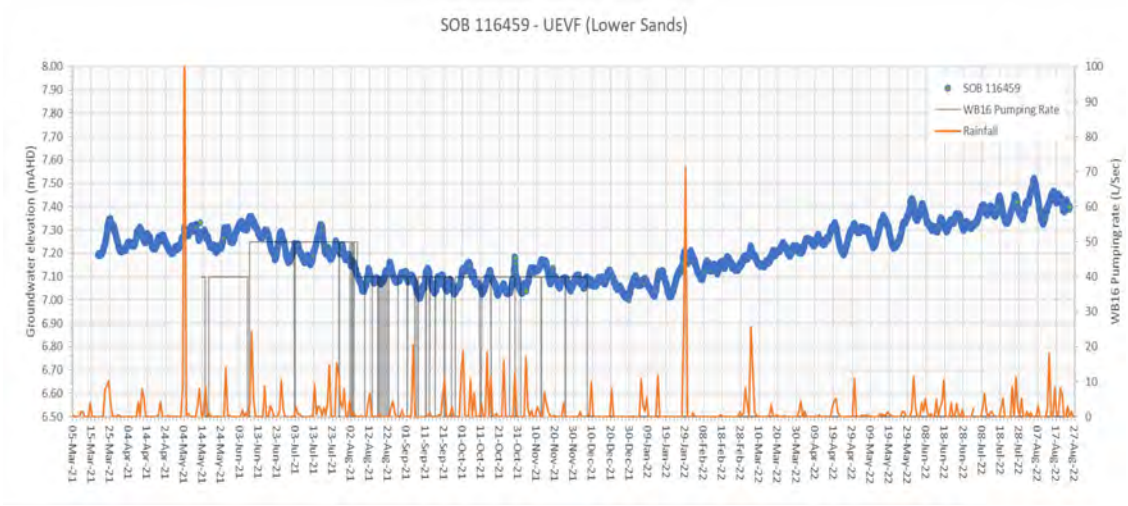

Figure D-6 SOB 116459 – Plot of Drawdown and Recovery Versus Time

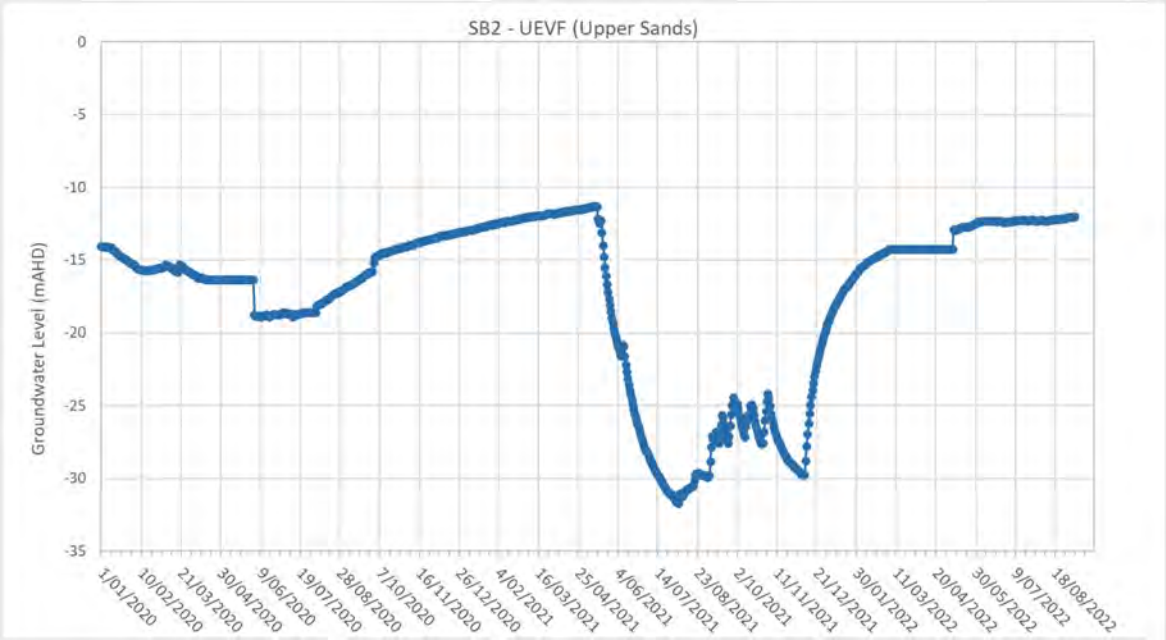

Figure D-7 Barwon Water Monitoring Bore SB2 – Plot of Drawdown and Recovery Versus Time

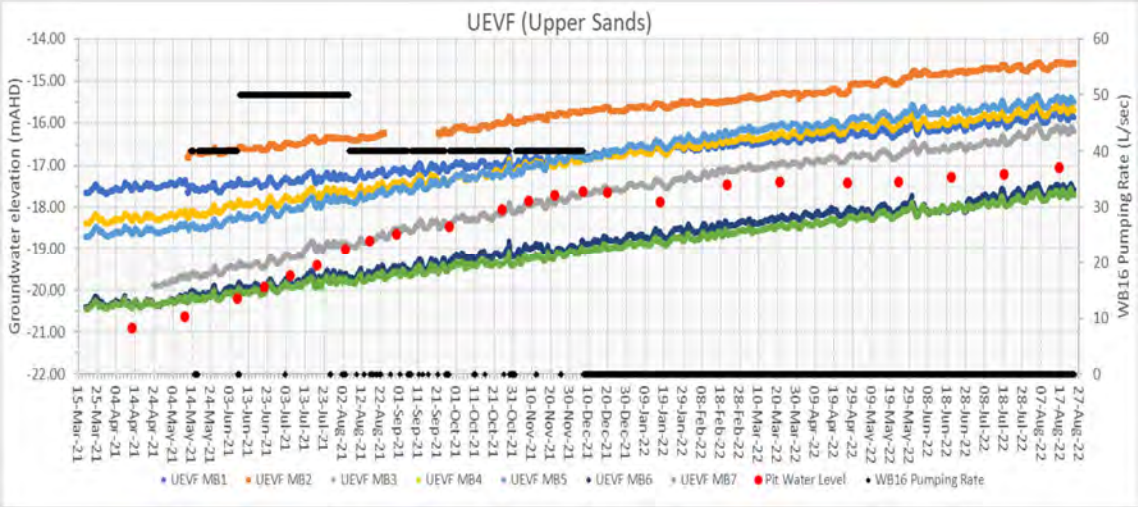

Figure D-8 UEVF (Upper Sands) Bores Surrounding Mine Pit – Plot of Drawdown and Recovery Versus Time

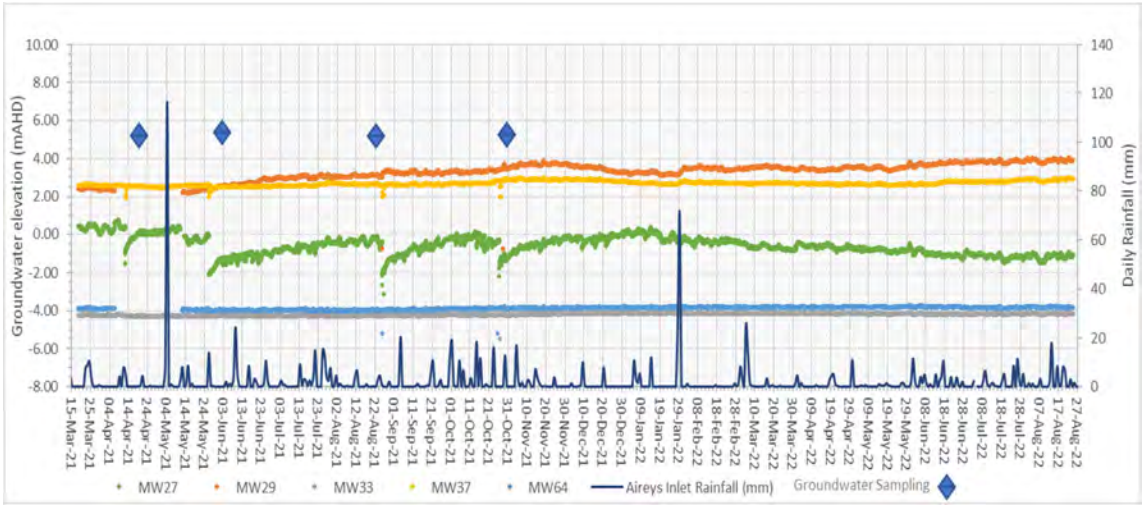

Figure D-9 Boonah Formation/DBF (PWTa) Bores – Plot of Drawdown and Recovery Versus Time

D.3.8 Distance Drawdown Analysis

The lithology of the UEVF lower sands aquifer comprises a series of alternating lenses (between 1 and 10 m) of high permeability sands and thicker alternating lenses of lower permeability silts/clays and coals. The Alcoa production bores monitored during the pumping test were constructed with a focus on intersecting these more permeable sands, and in some cases have six or seven screened sections ranging in length from 2 to 7 m, over a saturated thickness of approximately 75 m (i.e. the saturated thickness of the UEVF lower sands aquifer). Some of these production bores however may have intersected and screened the upper 5 m section of the MEVF aquitard. The Barwon Water monitoring bore SB2, however was constructed to intersect a 3 m permeable section only, at the base of the UEVF lower sands aquifer (i.e. screened from 223 – 226 mbgl).

The drawdown response observed at these monitoring bores at a distance from the pumping bore is a function of a number of factors, and lithological uncertainties, such as:

- Are the sand lenses screened at WB16 laterally equivalent across the catchment?
- Do the other observation bores screen the same sand lenses as those at WB16?
- Are some of these sand lenses drained during the pumping period?
- Are some of the sand lenses more permeable than others?
- Are the alternating lenses of lower permeability silts/clays/coals providing leakage across the aquifer?

The drawdown response in an observation bore(s) is used to derive aquifer hydraulic parameters. Therefore if any of the factors above are controlling the drawdown responses at the observation bores, which they likely are, they may also impact the derivation of transmissivity and storativity. Unfortunately the aquifer solution methods used to derive transmissivity and storativity can't account for these factors, and have a number of inherent assumptions and limitations, such as the aquifer is homogenous, isotropic and of uniform thickness, and the aquifer has infinite aerial extent.

A summary of the drawdown recorded at the pumping bore, and closest monitoring bores screened in the lower sands of the UEVF, calculated at different time intervals during the pumping test are provided in **Table D-9**.

The drawdown recorded at WB14 (228 m from WB16), WB15 (371 m from WB16) and SB2 (1,060 m from WB16) after approximately 2-3 months of pumping display a similar extent, and this trend is observed until the end of the 6-month test, indicating that the cone of depression may have reached a steady state. The responses in these three monitoring bores appear to be reflective of the aquifer and are considered suitable for analysis.

WB12 is located adjacent to the pumping bore and showed a subdued drawdown response. Subsequent bore investigations (down-hole camera survey) identified issues with the well casing and well screens. Therefore the data collected from WB12 is not considered appropriate for analysis.

Monitoring bore WB4 was re-sleaved during the pumping test as well casing issues were also highlighted. These investigations and rectification works occurred between July and October 2021. Therefore the data collected from WB4 is not considered appropriate for analysis. However the rectifications works mean that this bore is suitable for future and ongoing monitoring purposes.

Table D-9 Drawdown and Recovery During Pumping Test

Bore ID	Distance from WB16 (m)	Drawdown (m)				Recovery (m)	% Recovery
		1 month	3 months	6 months	End of test	After 1 month	
WB16	0	56.10	53.38	49.51	51.94	46.27	89
WB12	28	10.75	15.11	14.65	15.70	9.55	61
WB14	228	15.28	19.90	16.48	18.39	14.22	76
WB15	371	14.55	19.80	17.27	19.04	13.50	70
WB4	442	3.14	5.90	12.37	13.59	8.65	64
SB2	1,060	11.34	19.46	16.14	18.47	11.52	62

D.3.9 Groundwater Quality

The mine pit void and groundwater monitoring network, including the pumping bore, were sampled prior to the commencement of the pumping test (i.e. baseline) and monthly during the pumping test in accordance with the schedule and analytical suite outlined in **Table D-5** and **Table D-6** respectively.

Total dissolved solids (TDS), ion ratios (i.e. Cl/Br and Cl/B) and dissolved metals trends were evaluated to assess whether mine pit void seepage and groundwater mixing may be occurring as a result of filling the mine pit void with groundwater. **Figure D-10** to **Figure D-13** present the major ion ratios across the monitoring network. These ratio plots indicate that groundwater quality across the entire monitoring network has not changed significantly from baseline conditions, apart from minor variations likely associated with climatic conditions, and mine pit water is not migrating into the upper sands of the UEVF and/or the Mine Overburden/Boonah Formation/DBF (PWTa).

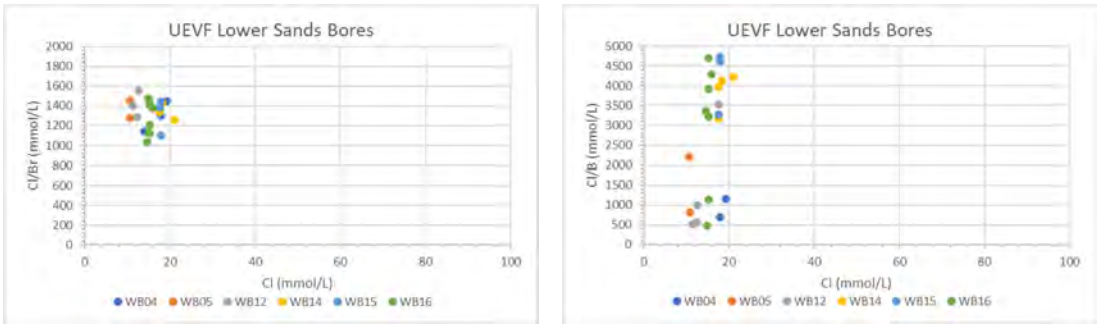

Figure D-10 Cl/Br vs Cl and Cl/B vs Cl Ratios – UEVF (Lower Sands) Alcoa Production Bores

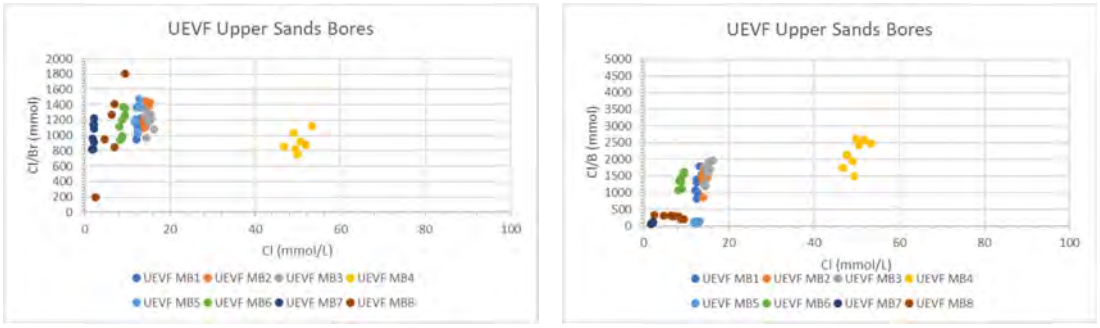

Figure D-11 Cl/Br vs Cl and Cl/B vs Cl Ratios – UEVF (Upper Sands) Bores Surrounding Mine Pit

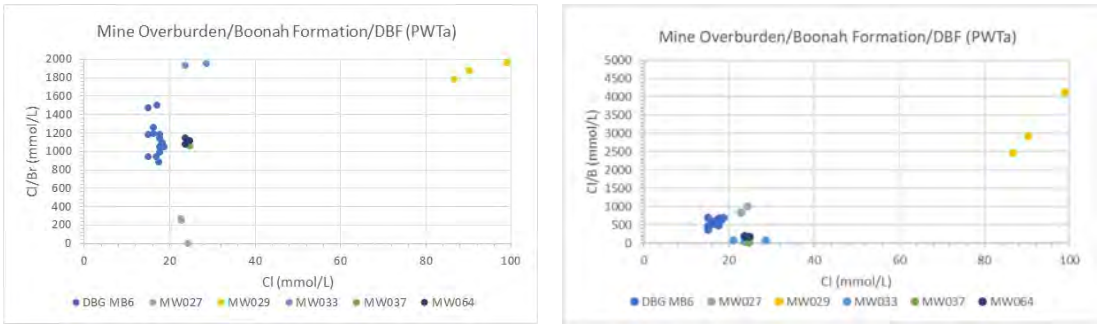

Figure D-12 Cl/Br vs Cl and Cl/B vs Cl Ratios – Mine Overburden/Boonah Formation/DBF (PWTa) Bores

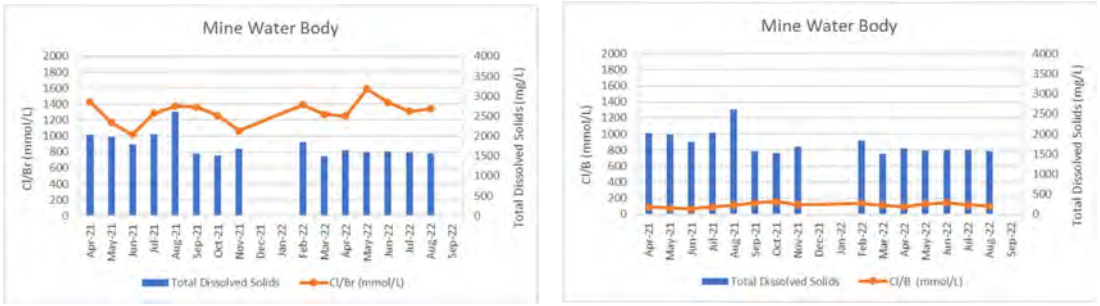

Figure D-13 Cl/Br vs Cl and Cl/B vs Cl Ratios – Mine Pit Water

D.4 Aquifer Pumping Test Interpretation

D.4.1 Diagnostic Flow Plots

The time-drawdown relationship for WB16 was plotted using a log-linear (i.e., semi-log) plot to assess the indicative aquifer conditions (**Figure D-14**). The plot was found to be uncharacteristic of the theoretical time-drawdown relationships for confined, unconfined and leaky unconsolidated aquifers, however the early time data approximately resembles a confined aquifer type and this is consistent with expectations based on geology (Kruseman and de Ridder 2000).

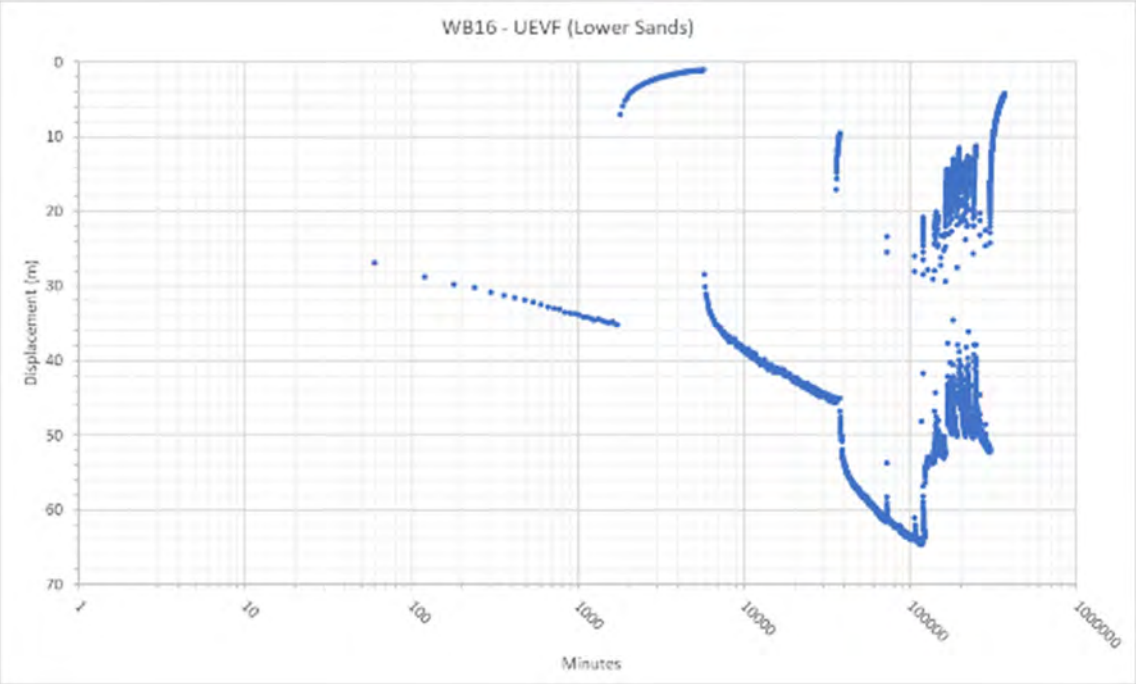

Figure D-14 Semi-Log Plot of Time-Drawdown Relationship (WB16)

Radial flow plots were evaluated to assist in identifying radial flow behavior or well bore storage. Due to the intermittent pump stoppages throughout the 6-month test, unit slope analysis on the early (well bore storage characteristics) and late (infinite acting radial flow) time data could not be characterised. However, the drawdown data across the monitoring bore network does not indicate that local boundary conditions were encountered during the test, such as dykes or geological boundaries where the drawdown in observation bores adjacent to these features would be greater than that observed at other spatial distributed observation bores at an equal distance from the pumping bore.

It was observed that the drawdown at SB2 located 1,060 m from WB16 is roughly equal to that of drawdown recorded at WB14 and WB15 located approximately 300 m from WB16. This may indicate that the cone of depression may have reached a steady state or that preferential flow pathways exist to the south towards the coastline, the former the most likely scenario.

D.4.2 Solution Matching and Aquifer Parameters

The Papadopolus-Cooper (1967) solution was adopted for analysis to determine the transmissivity and storativity of the UEVF lower sands aquifer. Aqtesolv™ (HydroSOLVE, Inc.) was used as the modelling platform. Outputs from the analysis are provided in **Appendix G**.

The following assumptions were adopted in the modelling, and limitations identified:

- The pumping bore WB16 fully penetrates the aquifer.
- Monitoring bores WB14 and WB15 fully penetrate the aquifer.
- Monitoring bore SB2, partially penetrates the aquifer.
- Solution methods for pumping tests assume one continuous screen length. It is noted that WB14, WB15 and WB16, that fully penetrate the aquifer, have segregated screened intervals at varying depths.
- Aquifer thickness of 72 m was adopted based on the bore logs from WB16 and SB2.
- A Kv/Kh ratio of 0.1 was adopted.
- The solution method accounts for well bore storage.

A number of different analyses were undertaken, selecting different observation bores for analysis, to derive aquifer hydraulic properties. This approach was adopted to account for the heterogeneity of the aquifer formation (i.e. alternating lenses of high and low permeability unconsolidated material), uncertainty around the lateral continuity of the higher permeable sand lenses, and the potential for the production bores to be partially screened in lower permeable lenses or underlying formations. This approach provides for a range of hydraulic parameters, that can be used as preliminary input parameters for the numerical groundwater flow model.

Based on the analyses, the estimated transmissivity ranged from 58.2 to 114.2 m^2/day (hydraulic conductivity range of 0.8 to 1.6 m/day) and a storativity range of 2 x 10^{-4} to 5 x 10^{-4} (**Table D-10**). The tight, deep drawdown curve observed at WB16 is representative of aquifers of low transmissivity. These derived parameters are also consistent with previous estimates (GHD 2013, EHS Support, 2018, EHS Support, 2019).

Table D-10 Derived Hydraulic Properties

Observation bores active during solution matching	Transmissivity (m^2/day)	Hydraulic Conductivity (m/day)	Storativity
WB14, W15, SB2 and pumping bore WB16	111.7	1.5	2 x 10^{-4}
WB14, W15, SB2 only	88.6	1.2	5 x 10^{-4}
WB14 only	114.2	1.6	3 x 10^{-4}
WB15 only	84.5	1.2	5 x 10^{-4}
SB2 only	58.2	0.8	3 x 10^{-4}
Average	**91.4**	**1.3**	**4 x 10^{-4}**

Appendix E Bore Construction and Data Collection Information

Table E-1 Bore Construction Information

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
WB4	PT Observation Bore	253538.0	5747629.0	9.62		UEVF (Lower Sands)	108.2	195	222.5
WB5	Decommissioned	253693.0	5747370.0	9.27		Decommissioned	132	216.6	220.1
WB9	Decommissioned	254244.0	5747188.0	6.36		Decommissioned	263	266	268.2
WB10	Decommissioned	254076.0	5747425.0	11.1		Decommissioned	108.2	212.14	215.8
WB12	PT Observation Bore	253524.0	5747169.0	6.45		UEVF (Lower Sands)	147.2	221.3	223
WB13	Decommissioned	254368.0	5746937.0	5.68		Decommissioned	165.05	232.29	234.44
WB14	Trigger Bore	253671.0	5747343.0	9.96		UEVF (Lower Sands)	155.9	213.7	218.8
WB15	PT Observation Bore	253857.0	5747075.0	12.34		UEVF (Lower Sands)	186.8	247.5	250.5
WB16	Pumping Bore	253504.0	5747188.0	7.12		UEVF (Lower Sands)	173.7	220.2	226.4
WB17	Decommissioned	254267.0	5747210.0	8.1		Decommissioned	120.6	189.6	195.9
SB1	Other Observation Bore	254616.0	5746886.0			LEVF	460	266	376

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
SB2	Other Observation Bore	254256.0	5746415.0			UEVF (Lower Sands)	230	223.5	226.6
NB1	Other Observation Bore	254482.0	5751333.0			LEVF	300	213.3	275.2
NB2	Other Observation Bore	254484.0	5751336.0	101.82		UEVF (Lower Sands)	159	162	165
WTOB1	Other Observation Bore	250991.0	5746647.0	18.89		ASA	1.7	13.7	13.7
WTOB2	Other Observation Bore	253304.0	5747866.0	11.05		ASA	1.6	6.6	6.6
WTOB3	Other Observation Bore	250784.0	5752005.0	42.29		ASA	7.4	13.4	13.4
WTOB4	Other Observation Bore	243462.7	5747636.8	89.37		LEVF	1.1	7.1	7.1
WTOB5	Other Observation Bore	243224.7	5748605.2	159.32		LEVF	38	68	70
P1	Other Observation Bore	245855.0	5746562.4	58.964		ASA	0.5	5.9	5.9
P3	Other Observation Bore	247168.4	5752954.9	111.649		LEVF	25	130	142
P6	Other Observation Bore	245608.2	5746425.9	75.622		LEVF	7	15	27
P7B	Other Observation Bore	252943.0	5750691.0	31.978		ASA	3.3	2	3.3
P8	PT Observation Bore	253020.0	5750213.0	29.017		ASA	3.62	0.36	2.73
P9	Other Observation Bore	243141.3	5749338.2	111.29		LEVF	0.3	5.2	5.2
P10	Other Observation Bore	241711.4	5749134.7	142.145		LEVF	0.4	4.7	4.7

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
P11	Other Observation Bore	242958.0	5752478.0			LEVF	2.77	0.77	2.77
P12	PT Observation Bore	253035.8	5750242.3	33.53		LEVF	18	21	21
P13	Other Observation Bore	246753.2	5753527.6	95.326		LEVF	36	116	128
P13B	Other Observation Bore	246756.6	5753526.0	95.855		ASA	15	27	27
P14	Other Observation Bore	255524.0	5745565.0			LEVF	394.1	492.1	570.3
P15	Other Observation Bore	250122.0	5744773.0			LEVF	362.9	460.4	530
P16	Other Observation Bore	242887.5	5748160.6	97.385		LEVF	0.3	3.6	3.9
P17	PT Observation Bore	245564.6	5746834.0	61.61		ASA	0.3	5.4	5.4
P18	Other Observation Bore	246686.8	5753613.6	79.469		ASA	0.3	5.4	5.4
P19	PT Observation Bore	253035.0	5750242.0			UEVF (Lower Sands)	22	19	22
113004	Other Observation Bore	244592.0	5753475.0	180.267		LEVF	51	57	100.6
113470	Other Observation Bore	-38.4	144.1	202.789		LEVF	192	195	206.6
115867	Other Observation Bore	251003.0	5746726.0	22.697		LEVF	359	362	
115868	Other Observation Bore	249965.0	5744913.0	83.165		UEVF (Lower Sands)	178	184	245.4
115869	Other Observation Bore	259258.0	5749682.0			UEVF (Lower Sands)	127	130	167.2

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
115873	Decommissioned	252435.0	5752140.0			Decommissioned	330.3	333.4	
116458	Other Observation Bore	252433.0	5752143.0	113.372		UEVF (Lower Sands)	100	112	116
116459	Trigger Bore	250977.0	5746638.0	18.913		UEVF (Lower Sands)	243	246	253
116460	Other Observation Bore	246176.0	5744536.0	218.129		LEVF	174	180	
119347	Other Observation Bore	249492.0	5751501.0	84.804		LEVF	197	200	
119348	Other Observation Bore	257067.0	5752454.0	50.982		LEVF	277	280	
119349	Decommissioned	255327.0	5745521.0	22.288		Decommissioned	183	186	343
122149	Decommissioned	-38.4	144.1			Decommissioned	349	383	
121768	Other Observation Bore	255864.0	5749399.0	105		UEVF (Lower Sands)	117	120	133.5
122149	Other Observation Bore	-38.4	144.1	19.356		LEVF			
VWP01S	Decommissioned	252399.9	5745853.7			Decommissioned	56	63	133
VWP01D	Decommissioned	252399.9	5745853.7			Decommissioned	119	131	133
VWP02S	Decommissioned	251970.4	5745552.9			Decommissioned	56	63	123
VWP02D	Decommissioned	251970.4	5745552.9			Decommissioned	116	123	123
MW2	Other Observation Bore	253942.8	5747344.5	10.688	10.77	DBF (PWTa)	2.5	7	7.4

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
MW3	Other Observation Bore	253695.2	5747168.5	7.200	7.29	DBF (PWTa)	1.5	4	4.18
MW4	Other Observation Bore	253667.0	5747157.3	7.209	7.28	DBF (PWTa)	1	4	3.5
MW8	Other Observation Bore	253904.8	5747298.9	11.595	11.67	Boonah Formation	7	10	10.57
MW10	Other Observation Bore	253862.9	5747249.3	10.729	10.71	DBF (PWTa)	1.8	5.5	5.6
MW11	Other Observation Bore	253849.1	5747239.3	11.102	10.96	DBF (PWTa)	1.5	4.5	5.47
MW14	Other Observation Bore	253824.9	5747445.4	11.034	11.12	Boonah Formation	5	8	8
MW15	Other Observation Bore	253933.1	5747307.5	10.889	11.06	Boonah Formation	7	10	9.66
MW16	Other Observation Bore	253921.1	5747310.9	10.987	11.03	Boonah Formation	7	10	9.56
MW18	Other Observation Bore	253810.0	5747345.3	11.704	10.93	Boonah Formation	6.3	10.8	10.9
MW19	Other Observation Bore	253635.8	5747500.8	11.021	11.11	Boonah Formation	5.5	11.5	10.45
MW20	Other Observation Bore	253738.9	5747361.7	10.895	10.99	Boonah Formation	8	12	11.8
MW21	Other Observation Bore	253918.0	5747266.9	11.305	11.36	Boonah Formation	8	12	11.8
MW22	Other Observation Bore	253951.5	5747317.8	11.970	12.05	Boonah Formation	8	12	11.8
MW23	Other Observation Bore	253924.0	5747284.5	11.057	11.11	Boonah Formation	8	12	11.43
MW24	Other Observation Bore	253859.0	5747237.1	11.077	11	DBF (PWTa)	8	12	4.4

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
MW25	Other Observation Bore	253869.7	5747298.8	11.151	11.26	Boonah Formation	8	11	10.93
MW26	Other Observation Bore	253952.0	5747079.7	10.616	10.65	Boonah Formation	8.5	14.5	14
MW27	Other Observation Bore	253730.2	5746905.4	11.165	11.22	Boonah Formation	10	15	14.92
MW28	Other Observation Bore	253969.7	5746813.4	10.912	11.05	DBF	1.2	7.2	
MW29	Other Observation Bore	253437.8	5747391.8	8.990	9.13	Boonah Formation	6	12	11.9
MW30	Other Observation Bore	253555.0	5747146.4	9.021	9.08	Boonah Formation	7.4	13.4	12.72
MW31	Other Observation Bore	253531.4	5747003.9	6.367	6.37	Boonah Formation	6.7	9.7	9.66
MW32	Other Observation Bore	253972.8	5746796.6	10.828	11.06	Boonah Formation	11	18	18.5
MW33	Trigger Bore	253455.5	5746952.2	6.710	6.19	Boonah Formation	8	14	14.05
MW34	Other Observation Bore	253551.7	5746791.7	12.799	12.21	Boonah Formation	14	20	20.41
MW35	Other Observation Bore	253998.6	5747365.8	12.585	11.86	Boonah Formation	7	13	12.8
MW37	Other Observation Bore	253717.9	5747275.4	7.826	7.06	DBF (PWTa)	3	6	6.6
MW38	Other Observation Bore	253962.4	5746530.2	6.759	5.95	Boonah Formation	7	15	15.68
MW50	Other Observation Bore	253869.8	5747565.4	11.818	11.08	Boonah Formation	6.5	11.5	11.5
MW51	Other Observation Bore	253923.1	5747489.3	11.472	10.78	DBF (PWTa)	2	5	5

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
MW52	Other Observation Bore	253898.3	5747517.9	11.674	10.90	Boonah Formation	9.3	12.3	12.3
MW53	Other Observation Bore	253913.6	5747601.4	11.608	10.92	DBF	3	7	7
MW54	Other Observation Bore	253954.5	5747522.4	11.506	10.73	DBF (PWTa)	2	7	7
MW55	Other Observation Bore	253967.9	5747414.7	11.656	10.89	DBF (PWTa)	2	6	6
MW56	Other Observation Bore	253818.6	5747602.9	11.888	11.13	DBF (PWTa)	2	5	5
MW57	Other Observation Bore	253906.5	5747423.2	10.244	10.34	DBF (PWTa)	2	4.5	4.5
MW58	Other Observation Bore	253882.8	5747500.6	11.431	10.76	DBF (PWTa)	2	5	5
MW59	Other Observation Bore	253925.2	5747520.5	11.639	10.84	DBF	2	8	8
MW60	Other Observation Bore	253750.8	5747638.9	11.265	11.52	Boonah Formation	8.2	12.2	12.2
MW61	Other Observation Bore	253852.9	5747631.8	11.811	11.89	Boonah Formation	8	12	12
MW62	Other Observation Bore	253795.3	5747574.3	9.619	8.85	Boonah Formation	6.1	10.1	10.1
MW63	Other Observation Bore	254004.2	5747470.5	11.955	11.24	DBF (PWTa)	4	8	8
MW64	Trigger Bore	253614.4	5747194.7	6.553	6.66	Boonah Formation	7	13	13
MW65	Other Observation Bore	253768.6	5747052.4	12.377	11.57	DBF (PWTa)	4.2	7.2	7.2
MW66	Other Observation Bore	253965.6	5747675.0	11.878	11.17	Boonah Formation	4	10	10

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
MW67	Other Observation Bore	253916.6	5747646.1	11.570	10.87	DBF (PWTa)	2.3	7.3	7.3
MW68	Other Observation Bore	254095.7	5747554.0	11.798	11.06	Boonah Formation	14.3	20.3	20.3
MW69	Other Observation Bore	253790.8	5747500.2	9.736	9.02	Boonah Formation	8	10	10
MW70	Other Observation Bore	253549.3	5746599.0	9.429	8.67	Boonah Formation	3	12	12
MW71	Other Observation Bore	253546.2	5746506.2	10.306	9.45	Boonah Formation	9	21	21
MW72	Other Observation Bore	253466.5	5746583.3	10.431	9.69	Boonah Formation	8	20	20
MW73	Other Observation Bore	253279.3	5747068.9	7.696	7.03	Boonah Formation	10	16	16
MW74	Other Observation Bore	253297.2	5746962.8	8.021	7.25	DBF (PWTa)	2.5	5.5	5.5
MW75	Other Observation Bore	253280.4	5747070.7	7.732	7.03	DBF (PWTa)	3	6	6
RM1	Other Observation Bore	251126.7	5746255.4			Boonah Formation	13.5	17.5	17.42
RM2	Other Observation Bore	251060.7	5746478.5			Boonah Formation	9	12	10.31
RM3	Other Observation Bore	250977.3	5746353.4			Boonah Formation	7	11.5	11.13
RM4	Other Observation Bore	251078.4	5746156.1			Boonah Formation	13.5	17.5	17.65
GW1	BW Pumping Bore	252659.0	5745938.0			LEVF	510	654	666
GW2	BW Pumping Bore	251840.0	5744691.0			LEVF	538	660	672

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
GW3	BW Pumping Bore	253462.0	5745996.0			LEVF	426	584	596
GW4	BW Pumping Bore	254271.0	5746465.0			LEVF	288	456	468
GW5	BW Pumping Bore	250880.0	5745681.0			LEVF	386	580	589
GW6	BW Pumping Bore	254480.0	5751261.0			LEVF	192	525	264
GW7	BW Pumping Bore	252768.0	5752089.0			LEVF	237	305	317
UEVF MB1	PT Observation Bore	251737.19	574557.26	47.38	46.84	UEVF (Upper Sands)	92	98	100
UEVF MB2	PT Observation Bore	252342.02	5745681.11	60.69	60.12	UEVF (Upper Sands)	122	128	130
UEVF MB3	Trigger Bore	252550.24	5745921.9	56.59	56.38	UEVF (Upper Sands)	139.3	145.3	146.3
UEVF MB4	PT Observation Bore	253081.748	5746278.973	20.296	19.76	UEVF (Upper Sands)	71	77	79
UEVF MB5	PT Observation Bore	252891.153	5746682.701	16.9495	16.32	UEVF (Upper Sands)	59	65	66
UEVF MB6	PT Observation Bore	252278.4	5746761.66	11.93	11.29	UEVF (Upper Sands)	69	75	77
UEVF MB7	Trigger Bore	251862.316	5747106.234	17.619	16.96	UEVF (Upper Sands)	42	51.6	52.6
UEVF MB8	PT Observation Bore	251272.17	5746026.56	32.93	32.56	(UEVF Intermediate Coal)	81	84	85
DBG MB1	PT Observation Bore	251736.01	5745457.74	47.21	46.84	Boonah Formation	37	40	41
DBG MB2	PT Observation Bore	252341.28	5745680.31	60.63	60.12	Boonah Formation	60	63	64

Well ID	Purpose	Easting (MGA94)	Northing (MGA 94)	RL (TOC)	RL (Near Surface)	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)
DBG MB3	Trigger Bore	252550.03	5745920.6	56.51	56.38	Boonah Formation	68.78	71.78	72.78
DBG MB4	PT Observation Bore	253083.015	5746278.655	20.4	19.76	Mine Overburden	35	38	39
DBG MB5	PT Observation Bore	252891.153	5746682.701	16.863	16.32	Mine Overburden	18	21	22
DBG MB6	PT Observation Bore	252277.41	5746760.96	11.92	11.29	Mine Overburden	34	37	38
DBG MB7	Trigger Bore	251861.709	5747105.244	17.5395	16.96	Boonah Formation	8	11	12
DBG MB8	PT Observation Bore	251271.43	5746025.66	32.96	32.56	Boonah Formation	28	31	32

Table E-2 Groundwater Level Data Summary

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
WB4	UEVF (Lower Sands)	108.2	195	222.5	-53.3	-15.92	2348	1975 to 2008 - Manual Gauging (adhoc) 2015 to Current - Data Logger (at least daily)
WB5	Decommissioned	132	216.6	220.1	-80.53	-13.86	2387	1975 to 2008 - Manual Gauging (adhoc) 2015 to 2021 - Data Logger (at least daily)
WB9	Decommissioned	263	266	268.2	#N/A	#N/A	#N/A	Bore was believed to be screened in multiple aquifers. Historical data not reliable
WB10	Decommissioned	108.2	212.14	215.8	-83.56	10.7	174	Bore was believed to be screened in multiple aquifers. Historical data not reliable
WB12	UEVF (Lower Sands)	147.2	221.3	223	-69.94	-12.89	2423	1975 to 2008 - Manual Gauging (adhoc) 2015 to Current - Data Logger (at least daily)
WB13	Decommissioned	165.05	232.29	234.44	-93.84	-10.23	296	Bore was believed to be screened in multiple aquifers. Historical data not reliable
WB14	UEVF (Lower Sands)	155.9	213.7	218.8	-95.7	-11.63	327	1975 to 2012 - Manual Gauging (adhoc) 2020 to Current - Data Logger (at least daily)
WB15	UEVF (Lower Sands)	186.8	247.5	250.5	-97.52	-10.94	327	1982 to 2012 - Manual Gauging (adhoc) 2020 to Current - Data Logger (at least daily)
WB16	UEVF (Lower Sands)	173.7	220.2	226.4	-133.46	-11.61	332	1987 to 2012 - Manual Gauging (adhoc) 2020 to Current - Data Logger (at least daily)
WB17	Decommissioned	120.6	189.6	195.9	-78.6	10.92	212	Bore was believed to be screened in multiple aquifers. Historical data not reliable
SB1	LEVF	460	266	376	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
SB2	UEVF (Lower Sands)	230	223.5	226.6	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
NB1	LEVF	300	213.3	275.2	#N/A	#N/A	#N/A	2009 to 2021 - Daily measurement frequency
NB2	UEVF (Lower Sands)	159	162	165	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
WTOB1	ASA	1.7	13.7	13.7	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
WTOB2	ASA	1.6	6.6	6.6	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
WTOB3	ASA	7.4	13.4	13.4	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
WTOB4	LEVF	1.1	7.1	7.1	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
WTOB5	LEVF	38	68	70	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P1	ASA	0.5	5.9	5.9	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P3	LEVF	25	130	142	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P6	LEVF	7	15	27	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P7B	ASA	3.3	2	3.3	#N/A	#N/A	#N/A	2011 to 2022 - Daily measurement frequency
P8	ASA	3.62	0.36	2.73	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P9	LEVF	0.3	5.2	5.2	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P10	LEVF	0.4	4.7	4.7	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P11	LEVF	2.77	0.77	2.77	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P12	LEVF	18	21	21	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P13	LEVF	36	116	128	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P13B	ASA	15	27	27	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P14	LEVF	394.1	492.1	570.3	#N/A	#N/A	#N/A	2010 to 2022 - Daily measurement frequency
P15	LEVF	362.9	460.4	530	#N/A	#N/A	#N/A	2010 to 2022 - Daily measurement frequency
P16	LEVF	0.3	3.6	3.9	#N/A	#N/A	#N/A	2010 to 2022 - Daily measurement frequency
P17	ASA	0.3	5.4	5.4	#N/A	#N/A	#N/A	2010 to 2022 - Daily measurement frequency
P18	ASA	0.3	5.4	5.4	#N/A	#N/A	#N/A	2009 to 2022 - Daily measurement frequency
P19	UEVF (Lower Sands)	22	19	22	#N/A	#N/A	#N/A	2011 to 2022 - Daily measurement frequency
113004	LEVF	51	57	100.6	#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
113470	LEVF	192	195	206.6	#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
115867	LEVF	359	362		#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
115868	UEVF (Lower Sands)	178	184	245.4	#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
115869	UEVF (Lower Sands)	127	130	167.2	#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
115873	Decommissioned	330.3	333.4		#N/A	#N/A	#N/A	1993 to 2009 - Monthly measurement frequency

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
116458	UEVF (Lower Sands)	100	112	116	#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
116459	UEVF (Lower Sands)	243	246	253	#N/A	#N/A	#N/A	1993 to 2022 - Daily measurement frequency
116460	LEVF	174	180		#N/A	#N/A	#N/A	1994 to 2022 - Daily measurement frequency
119347	LEVF	197	200		#N/A	#N/A	#N/A	1994 to 2022 - Daily measurement frequency
119348	LEVF	277	280		#N/A	#N/A	#N/A	1994 to 2021 - Daily measurement frequency
119349	Decommissioned	183	186	343	#N/A	#N/A	#N/A	1994 to 2018 - Daily measurement frequency
122149	Decommissioned	349	383		#N/A	#N/A	#N/A	2009 to 2016 - Daily measurement frequency
121768	UEVF (Lower Sands)	117	120	133.5	#N/A	#N/A	#N/A	1994 to 2021 - Daily measurement frequency
122149	LEVF				#N/A	#N/A	#N/A	2009 to 2016 - Daily measurement frequency
VWP01S	Decommissioned	56	63	133	#N/A	#N/A	#N/A	2016 -2018 – hurly measurement frequency
VWP01D	Decommissioned	119	131	133	#N/A	#N/A	#N/A	2016 -2018 – hurly measurement frequency
VWP02S	Decommissioned	56	63	123	#N/A	#N/A	#N/A	2016 -2018 – hurly measurement frequency
VWP02D	Decommissioned	116	123	123	#N/A	#N/A	#N/A	2016 -2018 – hurly measurement frequency
MW2	DBF (PWTa)	2.5	7	7.4	#N/A	#N/A	#N/A	2006 to Current - Annually
MW3	DBF (PWTa)	1.5	4	4.18	#N/A	#N/A	#N/A	2007 to Current - Annually
MW4	DBF (PWTa)	1	4	3.5	#N/A	#N/A	#N/A	2007 to Current - Annually
MW8	DBF	7	10	10.57	#N/A	#N/A	#N/A	2007 to Current - Annually
MW10	DBF (PWTa)	1.8	5.5	5.6	#N/A	#N/A	#N/A	2007 to Current - Annually
MW11	DBF (PWTa)	1.5	4.5	5.47	#N/A	#N/A	#N/A	2007 to Current - Annually
MW14	DBF	5	8	8	#N/A	#N/A	#N/A	2007 to Current - Annually
MW15	DBF	7	10	9.66	#N/A	#N/A	#N/A	2007 to Current - Annually
MW16	DBF	7	10	9.56	#N/A	#N/A	#N/A	2007 to Current - Annually
MW18	DBF	6.3	10.8	10.9	#N/A	#N/A	#N/A	2007 to Current - Annually
MW19	Boonah Formation	5.5	11.5	10.45	#N/A	#N/A	#N/A	2006 to Current - Annually
MW20	Boonah Formation	8	12	11.8	#N/A	#N/A	#N/A	2006 to Current - Annually

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
MW21	DBF	8	12	11.8	#N/A	#N/A	#N/A	2006 to Current - Annually
MW22	DBF	8	12	11.8	#N/A	#N/A	#N/A	2006 to Current - Annually
MW23	DBF/BF	8	12	11.43	#N/A	#N/A	#N/A	2006 to Current - Annually
MW24	DBF	8	12	4.4	#N/A	#N/A	#N/A	2006 to Current - Annually
MW25	Boonah Formation	8	11	10.93	#N/A	#N/A	#N/A	2006 to Current - Annually
MW26	Boonah Formation	8.5	14.5	14	#N/A	#N/A	#N/A	2006 to Current - Annually
MW27	Boonah Formation	10	15	14.92	-2.63	0.76	129	2006 to Current - Annually 13/03/2021 to Current - Hourly Data Logger
MW28	DBF	1.2	7.2		#N/A	#N/A	#N/A	2006 to Current - Annually
MW29	Boonah Formation	6	12	11.9	2.17	3.14	124	2006 to Current - Annually 18/03/2021 to Current - Hourly Data Logger
MW30	Boonah Formation	7.4	13.4	12.72	#N/A	#N/A	#N/A	2006 to Current - Annually
MW31	DBF/BF	6.7	9.7	9.66	#N/A	#N/A	#N/A	2006 to Current - Annually
MW32	DBF/BF	11	18	18.5	-1.82	-0.72	98	2018 to Current - Annually 18/03/2021 to Current - Hourly Data Logger
MW33	Boonah Formation	8	14	14.05	-4.32	-4.16	222	2008 to Current - Annually 10/12/2020 to Current - Hourly Data Logger
MW34	Boonah Formation	14	20	20.41	#N/A	#N/A	#N/A	2008 to Current - Annually
MW35	DBF	7	13	12.8	#N/A	#N/A	#N/A	2008 to Current - Annually
MW37	DBF (PWTa)	3	6	6.6	#N/A	#N/A	#N/A	2011 to Current - Annually
MW38	Boonah Formation	7	15	15.68	#N/A	#N/A	#N/A	2011 to Current - Annually
MW50	DBF/BF	6.5	11.5	11.5	#N/A	#N/A	#N/A	2019 to Current - Annually
MW51	DBF (PWTa)	2	5	5	#N/A	#N/A	#N/A	2019 to Current - Annually
MW52	DBF/BF	9.3	12.3	12.3	#N/A	#N/A	#N/A	2019 to Current - Annually
MW53	DBF	3	7	7	#N/A	#N/A	#N/A	2019 to Current - Annually
MW54	DBF (PWTa)	2	7	7	#N/A	#N/A	#N/A	2019 to Current - Annually

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
MW55	DBF (PWTa)	2	6	6	#N/A	#N/A	#N/A	2019 to Current - Annually
MW56	DBF/BF	2	5	5	#N/A	#N/A	#N/A	2019 to Current - Annually
MW57	DBF (PWTa)	2	4.5	4.5	#N/A	#N/A	#N/A	2019 to Current - Annually
MW58	DBF (PWTa)	2	5	5	#N/A	#N/A	#N/A	2019 to Current - Annually
MW59	DBF	2	8	8	#N/A	#N/A	#N/A	2019 to Current - Annually
MW60	DBF/BF	8.2	12.2	12.2	#N/A	#N/A	#N/A	2019 to Current - Annually
MW61	DBF/BF	8	12	12	#N/A	#N/A	#N/A	2019 to Current - Annually
MW62	DBF/BF	6.1	10.1	10.1	#N/A	#N/A	#N/A	2019 to Current - Annually
MW63	DBF (PWTa)	4	8	8	#N/A	#N/A	#N/A	2019 to Current - Annually
MW64	Boonah Formation	7	13	13	-4.02	-3.81	222	2019 to Current - Annually 10/12/2020 - 20/07/2021 Hourly Data Logger
MW65	DBF (PWTa)	4.2	7.2	7.2	#N/A	#N/A	#N/A	2019 to Current - Annually
MW66	DBF	4	10	10	#N/A	#N/A	#N/A	2019 to Current - Annually
MW67	DBF	2.3	7.3	7.3	#N/A	#N/A	#N/A	2019 to Current - Annually
MW68	UEVF (Upper Sands)	14.3	20.3	20.3	#N/A	#N/A	#N/A	2019 to Current - Annually
MW69	DBF/BF	8	10	10	#N/A	#N/A	#N/A	2019 to Current - Annually
MW70	Boonah Formation	3	12	12	#N/A	#N/A	#N/A	2020 to Current - Annually
MW71	Boonah Formation	9	21	21	#N/A	#N/A	#N/A	2020 to Current - Annually
MW72	Boonah Formation	8	20	20	#N/A	#N/A	#N/A	2020 to Current - Annually
MW73	Boonah Formation	10	16	16	#N/A	#N/A	#N/A	2020 to Current - Annually
MW74	DBF (PWTa)	2.5	5.5	5.5	#N/A	#N/A	#N/A	2020 to Current - Annually
MW75	DBF (PWTa)	3	6	6	#N/A	#N/A	#N/A	2020 to Current - Annually
RM1	Boonah Formation	13.5	17.5	17.42	#N/A	#N/A	#N/A	#N/A
RM2	Boonah Formation	9	12	10.31	#N/A	#N/A	#N/A	#N/A
RM3	Boonah Formation	7	11.5	11.13	#N/A	#N/A	#N/A	#N/A

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
RM4	Boonah Formation	13.5	17.5	17.65	#N/A	#N/A	#N/A	#N/A
GW1	LEVF	510	654	666	#N/A	#N/A	#N/A	#N/A
GW2	LEVF	538	660	672	#N/A	#N/A	#N/A	#N/A
GW3	LEVF	426	584	596	#N/A	#N/A	#N/A	#N/A
GW4	LEVF	288	456	468	#N/A	#N/A	#N/A	#N/A
GW5	LEVF	386	580	589	#N/A	#N/A	#N/A	#N/A
GW6	LEVF	192	525	264	#N/A	#N/A	#N/A	#N/A
GW7	LEVF	237	305	317	#N/A	#N/A	#N/A	#N/A
UEVF MB1	UEVF (Upper Sands)	92	98	100	-18.1	-17.14	222	10/12/2020 to Current - Hourly Data Logger
UEVF MB2	UEVF (Upper Sands)	122	128	130	-16.82	-16.3	70	11/05/2021 to Current - Hourly Data Logger
UEVF MB3	UEVF (Upper Sands)	139.3	145.3	146.3	-19.9	-18.8	88	23/04/2021 to Current - Hourly Data Logger
UEVF MB4	UEVF (Upper Sands)	71	77	79	-18.84	-17.53	222	10/12/2020 to Current - Hourly Data Logger
UEVF MB5	UEVF (Upper Sands)	59	65	66	-19.17	-17.69	222	10/12/2020 to Current - Hourly Data Logger
UEVF MB6	UEVF (Upper Sands)	69	75	77	-20.96	-19.52	222	10/12/2020 to Current - Hourly Data Logger
UEVF MB7	UEVF (Upper Sands)	42	51.6	52.6	-21	-19.78	222	10/12/2020 to Current - Hourly Data Logger
UEVF MB8	(UEVF Intermediate Coal)	81	84	85	-2.21	4.09	70	11/05/2021 to Current - Hourly Data Logger
DBG MB1	Boonah Formation	37	40	41	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021
DBG MB2	Boonah Formation	60	63	64	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021

Well ID	Aquifer Monitored	Screen From (m)	Screen To (m)	Well Depth (mBTOC)	Water Level Min (m AHD)	Water Level Max (m AHD)	Number of daily records	Date - Measurement Description
DBG MB3	Boonah Formation	68.78	71.78	72.78	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021
DBG MB4	Mine Overburden	35	38	39	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021
DBG MB5	Mine Overburden	18	21	22	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021
DBG MB6	Mine Overburden	34	37	38	-25.21	-17.88	222	10/12/2020 to Current - Hourly Data Logger
DBG MB7	Boonah Formation	8	11	12	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021
DBG MB8	Boonah Formation	28	31	32	#N/A	#N/A	#N/A	Bore is dry. Checked monthly since 2021

Appendix F Bore Logs

Drilling Log

GROUNDWATER TECHNOLOGY

Monitoring Well **MW1**

Project *ALCOA Anglesea* Owner *ALCOA OF AUSTRALIA LTD*

Location *Anglesea, Victoria* Project No. *M6149* Date drilled *18-2-93*

Surface Elev. _____ Total Hole Depth *10.0 m.* Diameter *0.130 m.*

Top of Casing _____ Water Level Initial _____ Static _____

Screen: Dia *5 cm.* Length *6.0 m.* Type/Size *0.05 cm.*

Casing: Dia *5 cm.* Length *4.0 m.* Type *Class 18 PVC*

Filter Pack Material *8/16 grade sand* Rig/Core Type *Gemco*

Drilling Company *L. J. Turnbull* Method *Hollow Auger* Permit # _____

Driller *Mark Rule* Log By *Mohamad Daud*

Checked By *JR* License No. _____

See Site Map For Boring Location

COMMENTS:

- *PID type = MICROTIP*
- *AREA I - USTs ULP and Super*
- *N/D denotes not detected*

Depth (m.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-1						
0						FILL: crushed rocks and clayey sandy gravel.
1		26.7	MW1/1.0		CL	Silty CLAY (fill?): little sand, brown, moisture content < plastic limit, firm to stiff. becoming light brown, trace of roots.
2		18.5	MW1/2.0			as above.
3		4.5	MW1/3.0		ML	Clayey SILT: grey with mottled yellow-orange, moisture content at approx. plastic limit, firm.
4		44.4	MW1/4.0		CL	Silty CLAY: with little sand, brown with mottled red-brown, moisture content at approximately plastic limit, firm to stiff, trace of ironstone, slight hydrocarbon odour.
5		994	MW1/5.0		GC	Clayey GRAVEL: with some sand, grey, dry to moist, medium dense, hydrocarbon odour.
6		979	MW1/6.0		ML	Clayey SILT: with trace of sand, grey, firm to stiff, moisture content at approximately plastic limit, hydrocarbon odour.
7		804	MW1/7.0			as above.
8		537	MW1/8.0		ML	Clayey SILT: as above, becoming dark red-brown
9		62.7	MW1/9.0		CL	as above. Silty CLAY: dark brown, stiff, moisture content less than plastic limit.
10		N/D	MW1/10.0			End of drilling at 10 metres below grade.
11						
12						

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GROUNDWATER TECHNOLOGY

Drilling Log

GROUNDWATER TECHNOLOGY

Monitoring Well **MW2**

Project *ALCOA Anglesea* Owner *ALCOA OF AUSTRALIA LTD*

Location *Anglesea, Victoria* Project No. *M6149* Date drilled *18-2-93*

Surface Elev. ____ Total Hole Depth *7.0 m.* Diameter *0.130 m.*

Top of Casing ____ Water Level Initial ____ Static ____

Screen: Dia *5 cm.* Length *4.5 m.* Type/Size *0.05 cm.*

Casing: Dia *5 cm.* Length *2.5 m.* Type *Class 18 PVC*

Filter Pack Material *8/16 grade sand* Rig/Core Type *Gemco*

Drilling Company *L. J. Turnbull* Method *Hollow Auger* Permit # ____

Driller *Mark Rule* Log By *Mohamad Daud*

Checked By *JR* License No. ____

See Site Map For Boring Location

COMMENTS:

- *PID type = MICROTIP*
- *AREA 5 - Waste Oil Sump*
- *N/D denotes not detected*

Depth (m.)	PID (ppm)	Sample ID Blow Count/ % Recovery	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0				FILL: Clayey gravel and sandy gravel.
1	5.3	MW2/1.0	CL	Silty CLAY (fill?): with some sand, grey with mottled yellow firm to stiff, moisture content at approximately plastic limit, medium to coarse sand particles.
2	4.7	MW2/2.0	CL	Silty CLAY: with little sand, grey-brown with mottled red, moisture content less than plastic limit, firm to stiff. as above, slightly friable, red becoming dominant colour. as above.
3	N/D	MW2/3.0		Silty SAND: with some gravel and clay, brown with mottled orange, moist, medium dense.
4	N/D	MW2/4.0		As above, becoming light grey/white
5	N/D	MW2/5.0	SM	as above, moist to wet.
6	N/D	MW2/6.0		becoming clayey silty SAND
7	N/D	MW2/7.0	OL	Sandy CLAY: with some silt, dark brown/black (trace of coal? or organic clays?) moisture content= plastic limit, firm.
				End of drilling at 7.0 metres below grade.

03/19/1993 lithlog-mar92

GROUNDWATER TECHNOLOGY

Drilling Log

GROUNDWATER TECHNOLOGY

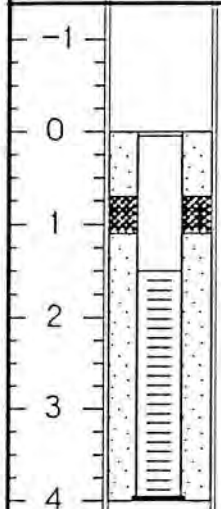
Monitoring Well MW3

Project ALCOA Anglesea — Owner ALCOA OF AUSTRALIA LTD
Location Anglesea, Victoria — Project No. M6149 — Date drilled 19-2-93
Surface Elev. ____ — Total Hole Depth 4.0 m. — Diameter 0.130 m.
Top of Casing ____ — Water Level Initial ____ — Static ____
Screen: Dia 5 cm. — Length 2.5 m. — Type/Size 0.05 cm.
Casing: Dia 5 cm. — Length 1.5 m. — Type Class 18 PVC
Filter Pack Material 8/16 grade sand — Rig/Core Type Gemco
Drilling Company L. J. Turnbull — Method Hollow Auger — Permit # ____
Driller Mark Rule — Log By Mohamad Daud
Checked By ____ — License No. ____

See Site Map For Boring Location

COMMENTS:

- PID type = MICROTIP
- AREA 6 – Treatment Pond
- N/D denotes not detected



Depth (m.)	PID (ppm)	Sample ID Blow Count/ % Recovery	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0				FILL: Clayey sandy gravel (some quartz).
1	N/D	MW3/1.0		Sandy CLAY (fill?): brown/grey with mottled white, firm to stiff moisture at approximately plastic limit.
2	N/D	MW3/2.0	CL	Sandy Silty CLAY: grey/black with occasional yellow and red, firm to stiff, moisture more than plastic limit. As above.
3	N/D	MW3/3.0	CL	As above. Silty CLAY: grey brown with mottled red, firm to stiff, moisture at approximately plastic limit.
4	N/D	MW3/4.0		End of drilling at 4.0 metres below grade.

03/19/1993 lithlog-mar92

GROUNDWATER TECHNOLOGY

Drilling Log

GROUNDWATER TECHNOLOGY

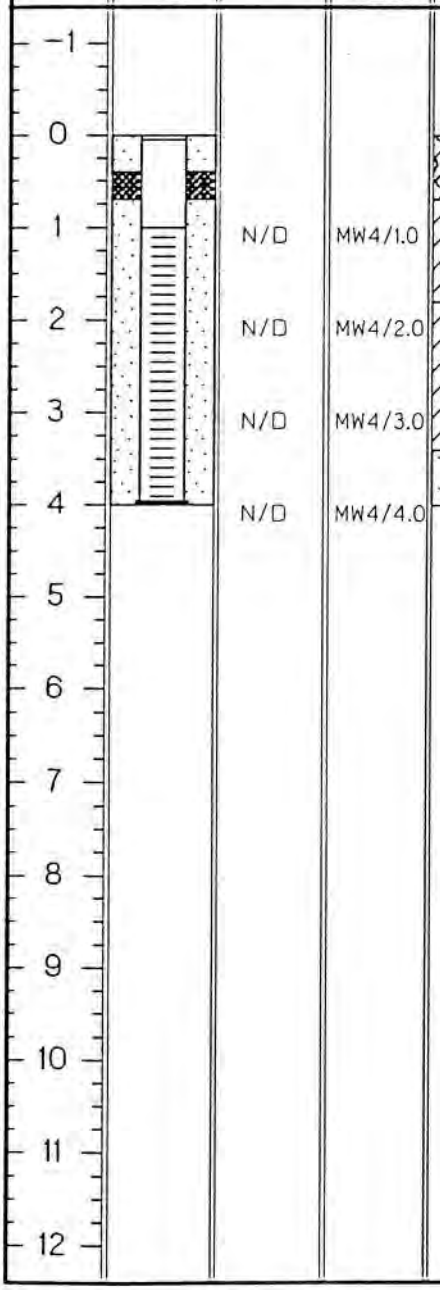
Monitoring Well MW4

Project ALCOA Anglesea — Owner ALCOA OF AUSTRALIA LTD
Location Anglesea, Victoria — Project No. M6149 — Date drilled 19-2-93
Surface Elev. ____ — Total Hole Depth 4.0 m. — Diameter 0.130 m.
Top of Casing ____ — Water Level Initial ____ — Static ____
Screen: Dia 5 cm. — Length 3.0 m. — Type/Size 0.05 cm.
Casing: Dia 5 cm. — Length 1.0 m. — Type Class 18 PVC
Filter Pack Material 8/16 grade sand — Rig/Core Type Gemco
Drilling Company L. J. Turnbull — Method Hollow Auger — Permit # ____
Driller Mark Rule — Log By Mohamad Daud
Checked By JR — License No. ____

See Site Map For Boring Location

COMMENTS:

- PID type = MICROTIP
- AREA 6 - Treatment Pond
- N/D denotes not detected



Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
FILL: Sandy clayey gravel.
Silty CLAY (fill?): with some sand, moisture = plastic limit, grey-black, firm to stiff. becoming wet.
Silty CLAY: grey/black with mottled yellow, moisture > plastic limit, firm to stiff.
As above.
Silty SAND: grey brown with mottled red, fine particles, some clay moist to wet, medium dense.
End of drilling at 4.0 metres below grade.

GROUNDWATER TECHNOLOGY

GROUNDWATER TECHNOLOGY

Drilling Log

Monitoring Well MW5

Project ALCOA Anglesea — Owner ALCOA OF AUSTRALIA LTD
Location Anglesea, Victoria — Project No. M6149 — Date drilled 19-2-93
Surface Elev. ____ — Total Hole Depth 6.0 m. — Diameter 0.130 m.
Top of Casing ____ — Water Level Initial ____ — Static ____
Screen: Dia 5 cm. — Length 4.5 m. — Type/Size 0.05 cm.
Casing: Dia 5 cm. — Length 1.5 m. — Type Class 18 PVC
Filter Pack Material 8/16 grade sand — Rig/Core Type Gemco
Drilling Company L. J. Turnbull — Method Hollow Auger — Permit # ____
Driller Mark Rule — Log By Mohamad Daud
Checked By JR — License No. ____

See Site Map For Boring Location

COMMENTS:

- PID type = MICROTIP
- AREA 5 – Diesel UST
- N/D denotes not detected

Depth (m.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0						FILL: Sandy gravel.
		14.9	MW5/0.5			Gravelly SAND (fill?): grey, moist, loose.
1		1.4	MW5/1.0		CL	Silty CLAY: grey/brown with mottled yellow-red, moisture less than plastic limit, firm to stiff.
2		1.7	MW5/2.0		SM	Silty SAND: grey, moist to wet, fine sand particles, loose to medium densem
3		0.1	MW5/3.0		ML	Clayey SILT and sandy SILT: grey-brown with mottled red-brown, firm, slightly friable, moisture at approximately plastic limit.
4		0.1	MW5/4.0		CL	Silty CLAY: with trace of sand, grey with mottled brown, moisture at plastic limit, firm to stiff.
5		0.1	MW5/5.0		SM	Silty SAND: with some gravel and trace of clay, grey, moist medium dense. gravel more abundant.
6		0.4	MW7/6.0			End of drilling at 6.0 metres below grade.

GROUNDWATER TECHNOLOGY

GROUNDWATER TECHNOLOGY

Drilling Log

Monitoring Well MW6

Project ALCOA Anglesea — Owner ALCOA OF AUSTRALIA LTD
Location Anglesea, Victoria — Project No. M6149 — Date drilled 19-2-93
Surface Elev. ____ — Total Hole Depth 6.0 m. — Diameter 0.130 m.
Top of Casing ____ — Water Level Initial ____ — Static ____
Screen: Dia 5 cm. — Length 4.0 m. — Type/Size 0.05 cm.
Casing: Dia 5 cm. — Length 2.0 m. — Type Class 18 PVC
Filter Pack Material 8/16 grade sand — Rig/Core Type Gemco
Drilling Company L. J. Turnbull — Method Hollow Auger — Permit # ____
Driller Mark Rule — Log By Mohamad Daud
Checked By JR — License No. ____

See Site Map For Boring Location

COMMENTS:

- PID type = MICROTIP
- AREA 4 – Oil Sump
- N/D denotes not detected

Depth (m.)	Well Completion	PID (ppm)	Sample ID Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0						FILL: Sandy clayey gravel.
1		97.9	MW6/1.0			FILL: sandy clay, light to dark brown, moisture < plastic limit firm to stiff.
2		105	MW6/2.0			FILL: clayey sand and sandy clay, light to dark brown, dry to moist, loose to medium dense.
3		18.8	MW6/3.0			becoming sandy gravel with little clay, wet, oil sheen.
4		2.8	MW6/4.0		CL	Sandy CLAY (in-situ?): grey, moisture =plastic limit, firm to stiff.
5		1.8	MW6/5.0		SC	Silty SAND: grey brown with mottled red, fine particles, some clay moist to wet, medium dense.
6		1.1	MW6/6.0		CL	Silty CLAY: grey with mottled red-brown, moisture = plastic limit, firm to stiff, slightly friable.
						End of drilling at 6.0 metres below grade.

GROUNDWATER TECHNOLOGY

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW7**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149C*

Surface Elev. _____ Total Hole Depth *10.0 m* Diameter *150 mm*

Top of Casing _____ Water Level Initial _____ Static _____

Screen: Dia *50 mm* Length *3.0 m* Type/Size *0.05 mm*

Casing: Dia *50 mm* Length *7.0 m* Type *Class 18 PVC*

Fill Material *Sand 8/16* Rig/Core *Fox B40L*

Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*

Driller *Greg Crowder* Log By *Rowena Gale* Date *1/2/95* Permit # _____

Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA I

Depth (m)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0					FILL	GRAVEL: dark grey, coarse, dry.
					FILL	FILL: crushed rocks and sandy, clayey GRAVEL.
1		6.5	1.0		CL	Silty CLAY: light brown, little sand, firm, moisture content less than plastic limit.
2		27.4	2.0			Silty CLAY: grey to light brown, little sand, firm, stiff, moisture content less than plastic limit, contains plant roots.
3		30	3.0		ML	Clayey SILT: light grey, some sand, soft, fine grained, slightly moist.
4		31	4.0			Silty CLAY: red-brown with some mottled grey, little sand, firm to stiff, moisture content less than plastic limit, slightly moist.
5		1464	5.0		CL	Sandy, silty CLAY: light grey, firm, stiff, slightly moist, hydrocarbon odour.
6		12.4	6.0			

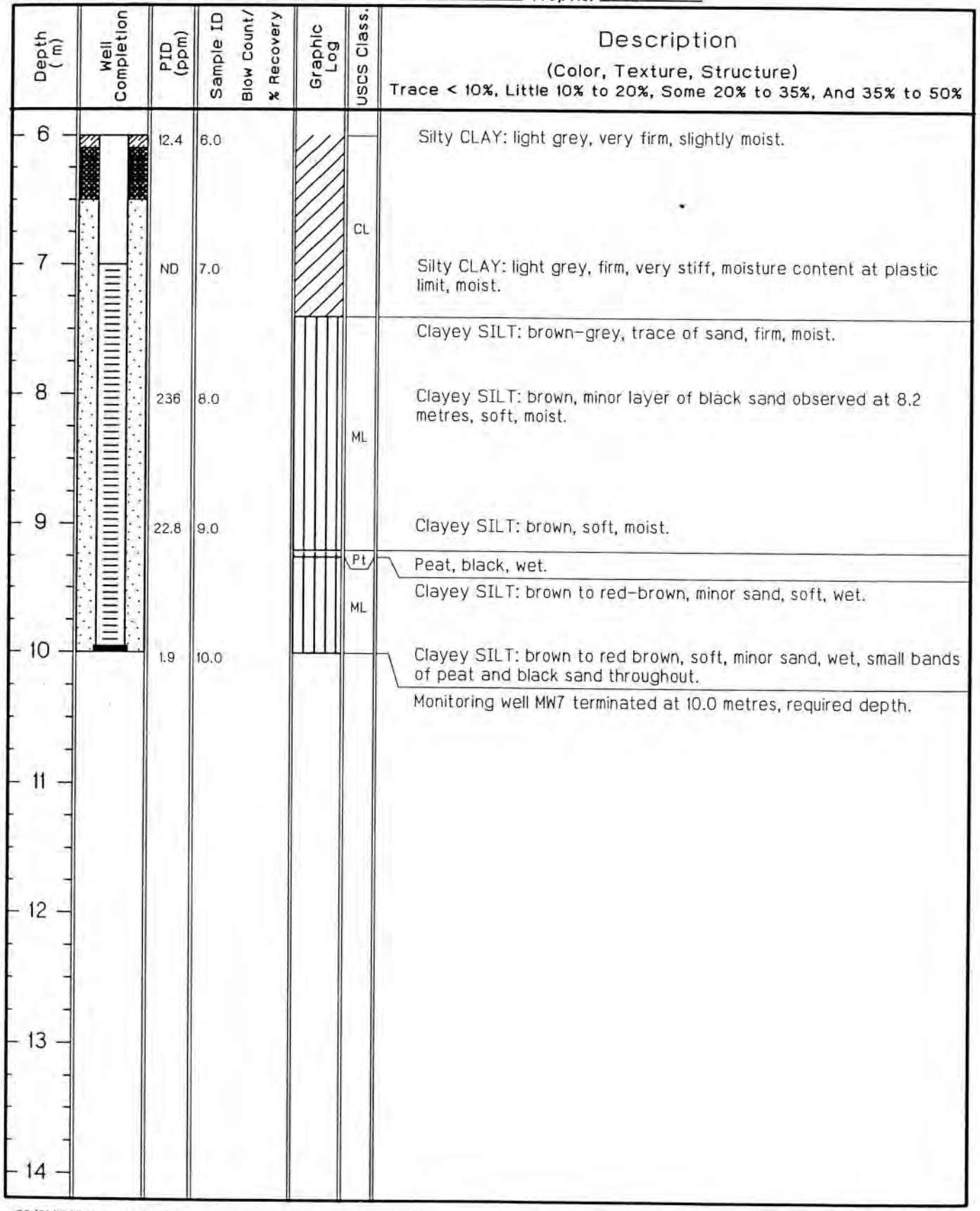
GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW7**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149C*



GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW8**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149C*

Surface Elev. _____ Total Hole Depth *10.0 m* Diameter *150 mm*

Top of Casing _____ Water Level Initial _____ Static _____

Screen: Dia *50 mm* Length *3.0 m* Type/Size *0.05 mm*

Casing: Dia *50 mm* Length *7.0 m* Type *Class 18 PVC*

Fill Material *Sand 8/16* Rig/Core *Fox B40L*

Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*

Driller *Greg Crowder* Log By *Rowena Gale* Date *1/2/95* Permit # _____

Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA 1

Depth (m)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0						FILL	GRAVEL: dark grey, coarse, dry.
						FILL	FILL: crushed rocks and sandy, clayey GRAVEL.
1		2.2	1.0			CL	Silty CLAY: light brown to grey, some sand, stiff, firm, moisture content less than plastic limit, slightly moist.
2		1.8	2.0				Silty CLAY: grey to light brown, little sand, firm, stiff, moisture content less than plastic limit, contains plant remains, dry.
3		2.3	3.0			ML	Clayey SILT: light grey mottled with light brown, soft, fine grained, slightly moist.
4		2.3	4.0			CL	Silty CLAY: yellow-brown, some sand, firm, stiff, moisture content less than plastic limit, slightly moist.
5		2.4	5.0				Silty CLAY: grey mottled with brown, some sand, firm, stiff, slightly moist.
						GC	Clayey GRAVEL: grey, little sand, medium density, slightly moist.
6		14.0	6.0			CL	

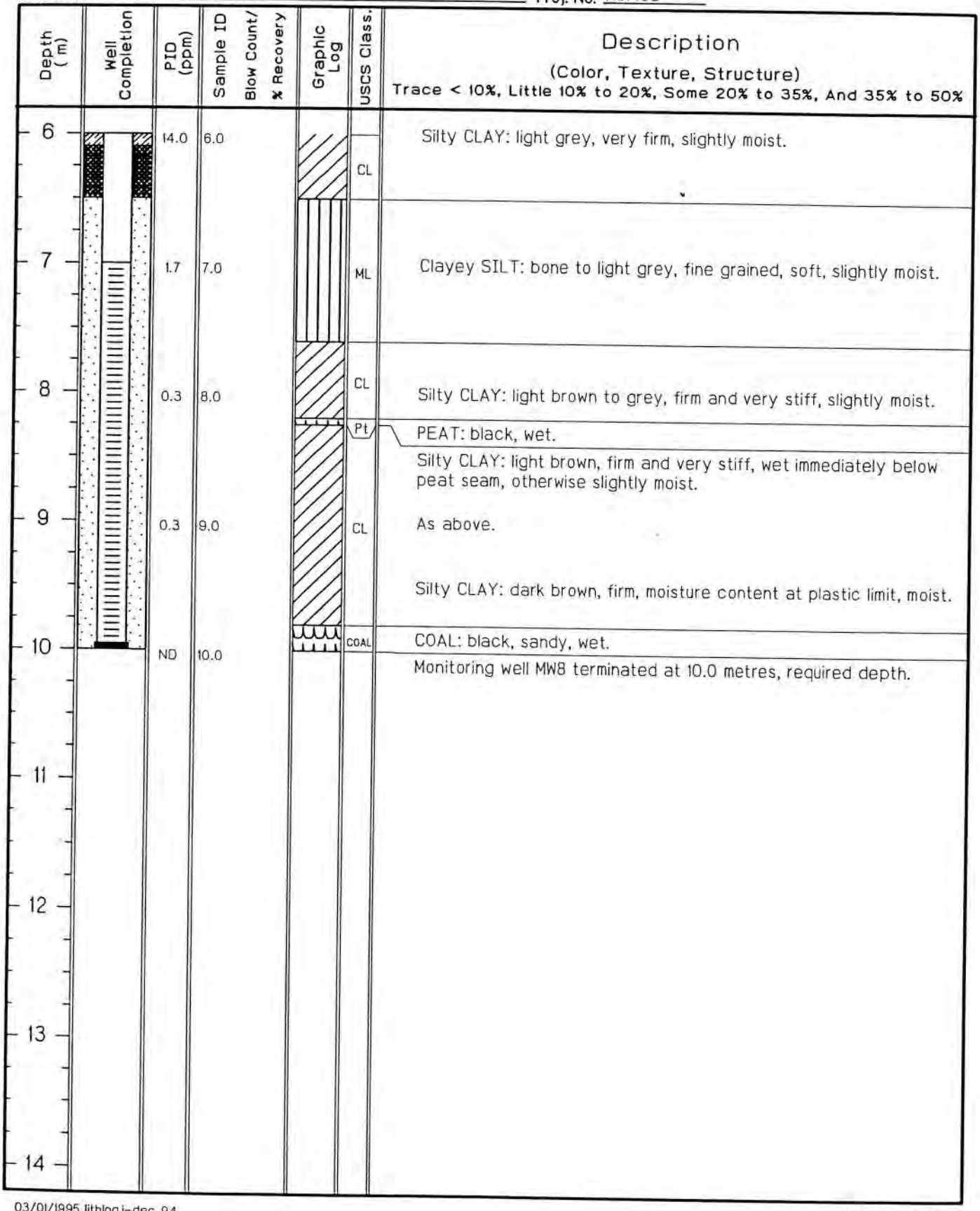
GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW8**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149C*



GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW9**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149C*

Surface Elev. _____ Total Hole Depth *10.0 m* Diameter *150 mm*

Top of Casing _____ Water Level Initial _____ Static _____

Screen: Dia *50 mm* Length *3.0 m* Type/Size *0.05 mm*

Casing: Dia *50 mm* Length *7.0 m* Type *Class 18 PVC*

Fill Material *Sand: 8/16* Rig/Core *Fox B40L*

Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*

Driller *Greg Crowder* Log By *Rowena Gale* Date *1 to 2/2/95* Permit # _____

Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA 1

Depth (m)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-1							
0						FILL	GRAVEL: dark grey, coarse, dry.
						FILL	FILL: crushed rocks and sandy, clayey GRAVEL.
1		0.4	1.0			CL	Silty CLAY: mottled yellow-brown and grey, firm, stiff, moisture content less than plastic limit, slightly moist.
							Silty CLAY: light grey, soft, moisture content less than plastic limit.
2		5.3	2.0				Sandy, silty CLAY: yellow-brown, medium size sand grains, soft, moisture content less than plastic limit, contains some organic material, slightly moist.
							Silty CLAY: grey mottled with yellow-brown, firm, hard, moisture content less than plastic limit, contains large amount of organic material, slightly moist.
3		15.2	3.0			ML	Clayey SILT: light grey, mottled with yellow-brown, friable, soft, slightly moist.
							Sandy, gravelly CLAY: yellow brown mottled with grey, contains gravel particles of 1 to 2 mm dia., firm, stiff, dry.
4		12.4	4.0				Silty CLAY: red-brown, little sand, moisture content less than plastic limit, firm to stiff, slightly moist.
						CL	
5		79.9 303	5.0 5.1				Sandy, gravelly CLAY: red-brown, firm to stiff, contains gravel particles of 0.2 cm dia., slightly moist.
							Sandy, gravelly CLAY: dark grey, firm to stiff, moisture content less than plastic limit, slightly moist.
6							

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW9**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149C*

Depth (m)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
6							Silty CLAY: light grey with mottled red-brown, little sand, firm, stiff, slightly moist.
		75.0	6.5				As above.
7		36.6	7.0				Silty CLAY: bone, very firm, very stiff, moisture content less than plastic limit, contains plant roots, slightly moist.
						CL	
8		913	8.0				Silty CLAY: dark to light grey, very firm, very stiff, slightly moist, notable hydrocarbon odour.
9		7.7	9.0				Silty CLAY: light brown to grey, very firm, very stiff, slightly moist.
						COAL	COAL: black, wet.
						CL	
10		10.0	10.0				Silty CLAY: dark brown to black, fine grained, soft, wet, with coal seams up to 0.2 metres thick, black, soft, wet.
							Monitoring well MW9 terminated at 10.0 metres, required depth.
11							
12							
13							
14							

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW10**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*
Location *Anglesea Power Station* Proj. No. *M6149D*
Surface Elev. ____ Total Hole Depth *5.5 m* Diameter *150 mm*
Top of Casing ____ Water Level Initial ____ Static ____
Screen: Dia *50 mm* Length *4.0 m* Type/Size *0.05 mm*
Casing: Dia *50 mm* Length *1.5 m* Type *Class 18 PVC*
Fill Material *Sand 8/16* Rig/Core *Fox B40L*
Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*
Driller *Greg Crowder* Log By *Rowena Gale* Date *2/2/95* Permit # ____
Checked By *Mohamad Daud* License No. ____

See Site Map For Boring Location

COMMENTS:

AREA 4

Depth (m)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0					FILL	GRAVEL: dark grey, coarse, dry.
					FILL	FILL: clayey SAND: yellow-brown, loose, soft, well graded, medium grained sand, slightly moist.
						Silty CLAY: white, fine grained, firm, stiff, slightly moist.
1		0.4	1.0			Sandy, silty CLAY: yellow brown and mottled grey, moisture content less than plastic limit, firm, slightly moist.
					CL	Sandy CLAY: dark grey, soft, medium grained, moist.
2		0.7	2.0			Sandy CLAY: brown, medium grained, contains plant roots, soft, moist.
3		4.2	3.0		SC	Clayey SAND: yellow-brown, medium grained, some plant roots, soft, wet.
4		0.8	4.0			Clayey SAND: yellow-brown, medium grained, soft, loose, wet.
					CL	Silty CLAY: grey, firm, stiff, fine grained, contains large amount plant material, moist.
5		1.2	5.0		SC	SAND: yellow-brown, slightly clayey, coarse grained, very loose, wet.
		2.3	5.5		CL	CLAY: mottled grey and red-brown, some silt, firm, stiff, slightly moist.
						Silty CLAY: yellow-brown, firm, stiff, slightly moist.
6						Monitoring well terminated at 5.5 metres, required depth.

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW11**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149D*

Surface Elev. _____ Total Hole Depth *6.0 m* Diameter *150 mm*

Top of Casing _____ Water Level Initial _____ Static _____

Screen: Dia *50 mm* Length *4.5 m* Type/Size *0.05 mm*

Casing: Dia *50 mm* Length *1.5 m* Type *Class 18 PVC*

Fill Material *Sand 8/16* Rig/Core *Fox B40L*

Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*

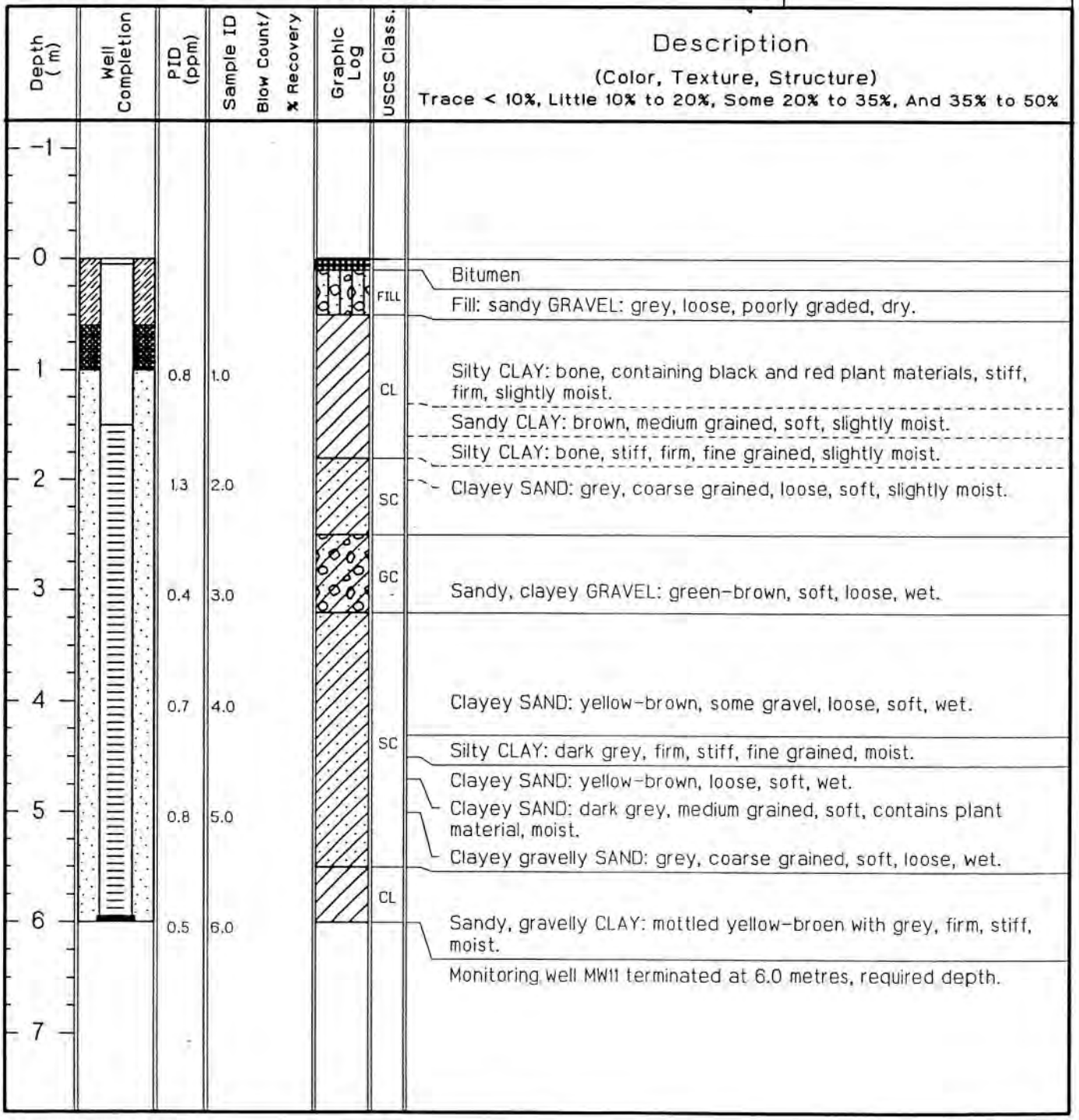
Driller *Greg Crowder* Log By *Rowena Gale* Date *2/2/95* Permit # _____

Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA 4



GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

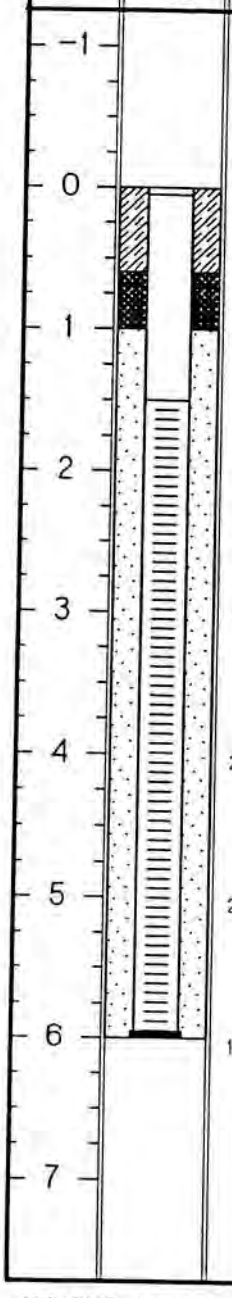
Monitoring Well **MW12**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*
Location *Anglesea Power Station* Proj. No. *M6149D*
Surface Elev. ____ Total Hole Depth *6.0 m* Diameter *150 mm*
Top of Casing ____ Water Level Initial ____ Static ____
Screen: Dia *50 mm* Length *4.5 m* Type/Size *0.05 mm*
Casing: Dia *50 mm* Length *1.5 m* Type *Class 18 PVC*
Fill Material *Sand 8/16* Rig/Core *Fox B40L*
Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*
Driller *Greg Crowder* Log By *Rowena Gale* Date *3/2/95* Permit # ____
Checked By *Mohamad Daud* License No. ____

See Site Map For Boring Location

COMMENTS:

AREA 4



Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
GRAVEL: dark grey, well graded, coarse, dry, particles up to 3cm dia.
FILL: sandy GRAVEL: yellow-brown, loose, well sorted, slightly moist.
FILL: sandy GRAVEL: grey with some red-brown, loose, well sorted, slightly moist.
FILL: gravelly SAND: yellow-red brown, loose, coarse grained sand, soft, slightly moist.
Silty CLAY: yellow-brown, little sand, firm, stiff, moisture content less than plastic limit, slightly moist.
Gravelly SAND: yellow-brown, loose, soft, slightly moist.
Sandy, clayey GRAVEL: green-brown, soft, loose, wet, gravel particles up to 0.4 cm.
Clayey SAND: yellow-brown, some gravel, coarse grained, loose, soft, wet.
Silty CLAY: dark grey, fine grained, firm, stiff, moist.
Clayey, gravelly SAND: yellow-brown, coarse grained, loose, soft, wet.
CLAY: red-brown, firm, stiff, fine grained, slightly moist, contains plant materials.
Monitoring well MW12 terminated at 6.0 metres, required depth.

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW13**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*
Location *Anglesea Power Station* Proj. No. *M6149D*
Surface Elev. ____ Total Hole Depth *11.0 m* Diameter *150 mm*
Top of Casing ____ Water Level Initial ____ Static ____
Screen: Dia *50 mm* Length *4.0 m* Type/Size *0.05 mm*
Casing: Dia *50 mm* Length *7.0 m* Type *Class 18 PVC*
Fill Material *Sand 8/16* Rig/Core *Fox B40L*
Drill Co. *LA and LJ Turnbull* Method *Hollow Auger*
Driller *Greg Crowder* Log By *Rowena Gale* Date *3/2/95* Permit # ____
Checked By *Mohamad Daud* License No. ____

See Site Map For Boring Location

COMMENTS:

AREA 4

Depth (m)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-1						
0					GW	GRAVEL: dark grey, well graded, coarse, dry, particles up to 3cm dia.
					GM	FILL: sandy GRAVEL: yellow-brown, loose, well sorted, slightly moist.
1		0.4	1.0			FILL: sandy GRAVEL: grey with some red-brown, loose, well sorted, slightly moist.
						FILL: gravelly SAND: yellow-red brown, loose, coarse grained sand, soft, slightly moist.
					CL	
2		1.4	2.0			Silty CLAY: yellow-brown, little sand, firm, stiff, moisture content less than plastic limit, slightly moist.
					SP	Gravelly SAND: yellow-brown, loose, soft, slightly moist.
3		1.3	3.0		GC	Sandy, clayey GRAVEL: green-brown, soft, loose, wet, gravel particles up to 0.4 cm.
					SC	
4		2.7	4.0			Clayey SAND: yellow-brown, some gravel, coarse grained, loose, soft, wet.
					CL	Silty CLAY: dark grey, fine grained, firm, stiff, moist.
5		2.2	5.0		SC	Clayey, gravelly SAND: yellow-brown, coarse grained, loose, soft, wet.
					CL	
6		1.5	6.0			

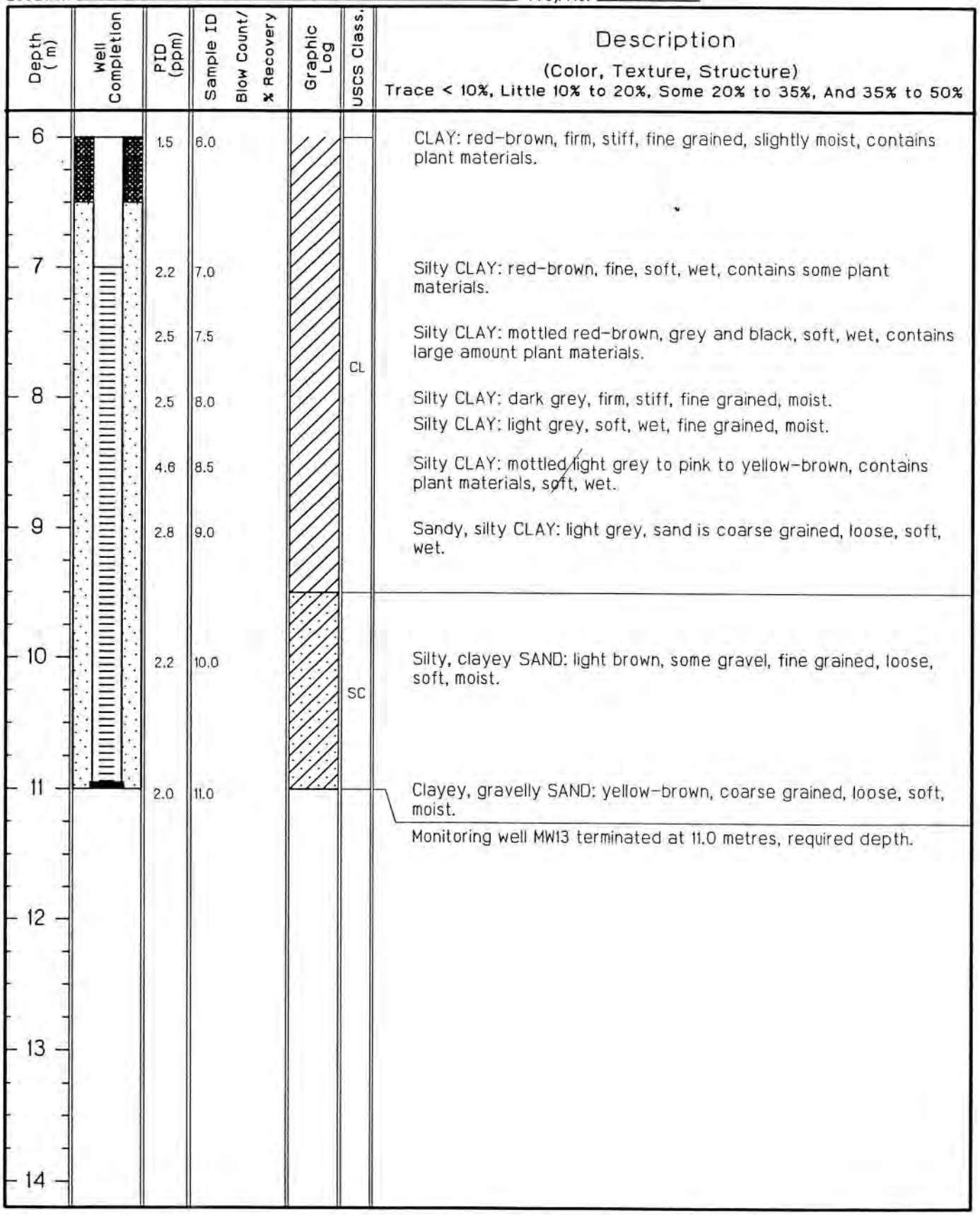
GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW13**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149D*



GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW14**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*
Location *Anglesea Power Station* Proj. No. *M6149D*
Surface Elev. _____ Total Hole Depth *8.0 m* Diameter *150 mm*
Top of Casing _____ Water Level Initial _____ Static _____
Screen: Dia *50 mm* Length *3.0 m* Type/Size *0.05 mm*
Casing: Dia *50 mm* Length *5.0 m* Type *Class 18 PVC*
Fill Material *Sand 8 6* Rig/Core *Fox B40L*
Drill Co. *L.A. & L.J. Turnbull* Method *Hollow Auger*
Driller *Greg Crowder* Log By *Rowena Gale* Date *2/2/95* Permit # _____
Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA B

Depth (m)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-1						
0						Bitumen
		0.49	0.5		FILL	FILL: sandy, clayey GRAVEL: red-yellow, brown with white gravel particles, loose, soft, slightly moist, gravel particles up to 4cm dia
					COAL	Sandy, clayey COAL: black, loose, medium to fine grained, soft, slightly moist.
1		1.4	1.0		CL	Sandy, peaty CLAY: black, loose, medium to fine grained, soft, slightly moist.
2		2.7	2.0		ML	Clayey SILT: bone to light brown, very fine grained, soft, moist.
3		1.8	3.0			Clayey SILT: light brown, very fine grained, friable, slightly moist.
					CL	Silty CLAY: light brown, very fine grained, stiff, firm, slightly moist.
4		0.4	4.0		ML	Clayey SILT: dark grey, very fine grained, bedding planes at 4 degrees evident, spacing every 2 mm, soft, friable, dry.
5		0.5	5.0			

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW14**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149D*

Depth (m)	Well Completion	PID (ppm)	Sample ID	Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
5		0.5	5.0			ML	As above.
6		0.4	6.0				As above.
						CL	Silty CLAY: light brown to grey, very firm, stiff, slightly moist.
7		0.2	7.0			COAL	Sandy COAL: black, loose, soft, wet.
							No sample as bedrock too hard to retrieve sample.
8							Monitoring well MW14 terminated at 8.0 metres due to refusal.
9							
10							
11							
12							

Drilling Log

GROUNDWATER TECHNOLOGY AUSTRALIA

Monitoring Well **MW15**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*
Location *Anglesea Power Station* Proj. No. *M6149E*
Surface Elev. _____ Total Hole Depth *10.0 m* Diameter *150 mm*
Top of Casing _____ Water Level Initial _____ Static _____
Screen: Dia *50 mm* Length *3.0 m* Type/Size *0.05 mm*
Casing: Dia *50 mm* Length *7.0 m* Type *Class 18 PVC*
Fill Material *Sand 8/16* Rig/Core *Gemcodrill 210B Trailer mounted*
Drill Co. *Geotechnical Eng.* Method *Hollow Auger*
Driller *Bernie Anderson* Log By *Rowena Gale* Date *9/5/95* Permit # _____
Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA 1

Depth (m)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-1						
0					FILL	GRAVEL.
					FILL	FILL: yellow-brown to grey, crushed rocks and sandy, clayey GRAVEL.
1		1.6	1.0			Silty CLAY: light grey, slight yellow-brown mottling, firm, stiff, contains plant roots, moisture content less than plastic limit, dry.
						As Above: green-brown, containing white gravel size particles.
2		1.8	2.0		CL	Silty CLAY: light grey, slight yellow mottling, friable, contains plant roots, moisture content less than plastic limit, dry.
3		–	3.0			As Above.
					ML	Clayey SILT: light grey, soft, fine grained, friable, low plasticity, dry.
4		1.5	4.0			Silty CLAY: yellow-brown and mottled pink, fine grained, firm, stiff, dry.
					CL	Silty CLAY: light grey, fine grained, firm, stiff, dry.
						As Above: light brown
5		2.0	5.0			

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW15**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149E*

Depth (m)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
5		2.0	5.0				Silty CLAY: as above.
6		1.9	6.0			CL	Silty CLAY: light brown, firm, medium stiff, sticky, soft, moist.
							As Above: dark brown.
							Silty CLAY: medium brown, fine grained, firm, stiff, moisture content less than plastic limit, dry.
7		2.6	7.0				As Above.
						PT	COAL Seam.
						CL	Silty CLAY: medium brown, firm, medium stiff, contains some coal, dry.
						PT	COAL Seam: black, flaky, dry.
8		2.1	8.0				Silty CLAY: light brown, fine grained, firm, very stiff, moisture content less than plastic limit, damp.
							As Above.
						CL	
9		1.9	9.0				As Above: wet.
							Silty CLAY: dark brown, firm, medium stiff, wet.
10		-	10.0				No Sample
							Monitoring well MW15 terminated at 10.0 metres, required depth.
11							
12							

GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW16**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*
Location *Anglesea Power Station* Proj. No. *M6149E*
Surface Elev. _____ Total Hole Depth *10.0 m* Diameter *150 mm*
Top of Casing _____ Water Level Initial _____ Static _____
Screen: Dia *50 mm* Length *3.0 m* Type/Size *0.05 mm*
Casing: Dia *50 mm* Length *7.0 m* Type *Class 18 PVC*
Fill Material *Sand 8/16* Rig/Core *Gemcodrill 210B Trailer mounted*
Drill Co. *Geotechnical Eng.* Method *Hollow Auger*
Driller *Bernie Anderson* Log By *Rowena Gale* Date *9-10/05/95* Permit # _____
Checked By *Mohamad Daud* License No. _____

See Site Map For Boring Location

COMMENTS:

AREA 1

Depth (m)	Well Completion	PID (ppm)	Sample ID / Blow Count / % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
0					FILL	GRAVEL.
					FILL	FILL (gravel): yellow-brown to grey, crushed rocks, sandy, clayey.
1		1.9	1.0			Silty CLAY: light grey, yellow-brown mottling, firm, stiff, contains plant remains, moisture content less than plastic limit, dry.
						As Above.
2		2.9	2.0			As Above
3		1.4	3.0		CL	Sandy gravelly CLAY: yellow brown, fine to coarse grained, gravel particles up to 0.5cm, soft, loose, wet.
						Gravelly CLAY: yellow-brown,firm, stiff, moisture content less than plastic limit, damp.
4		1.5	4.0			Silty CLAY: light grey, firm, stiff, moisture content less than plastic limit, damp.
						As Above.
5		2.2	5.0			

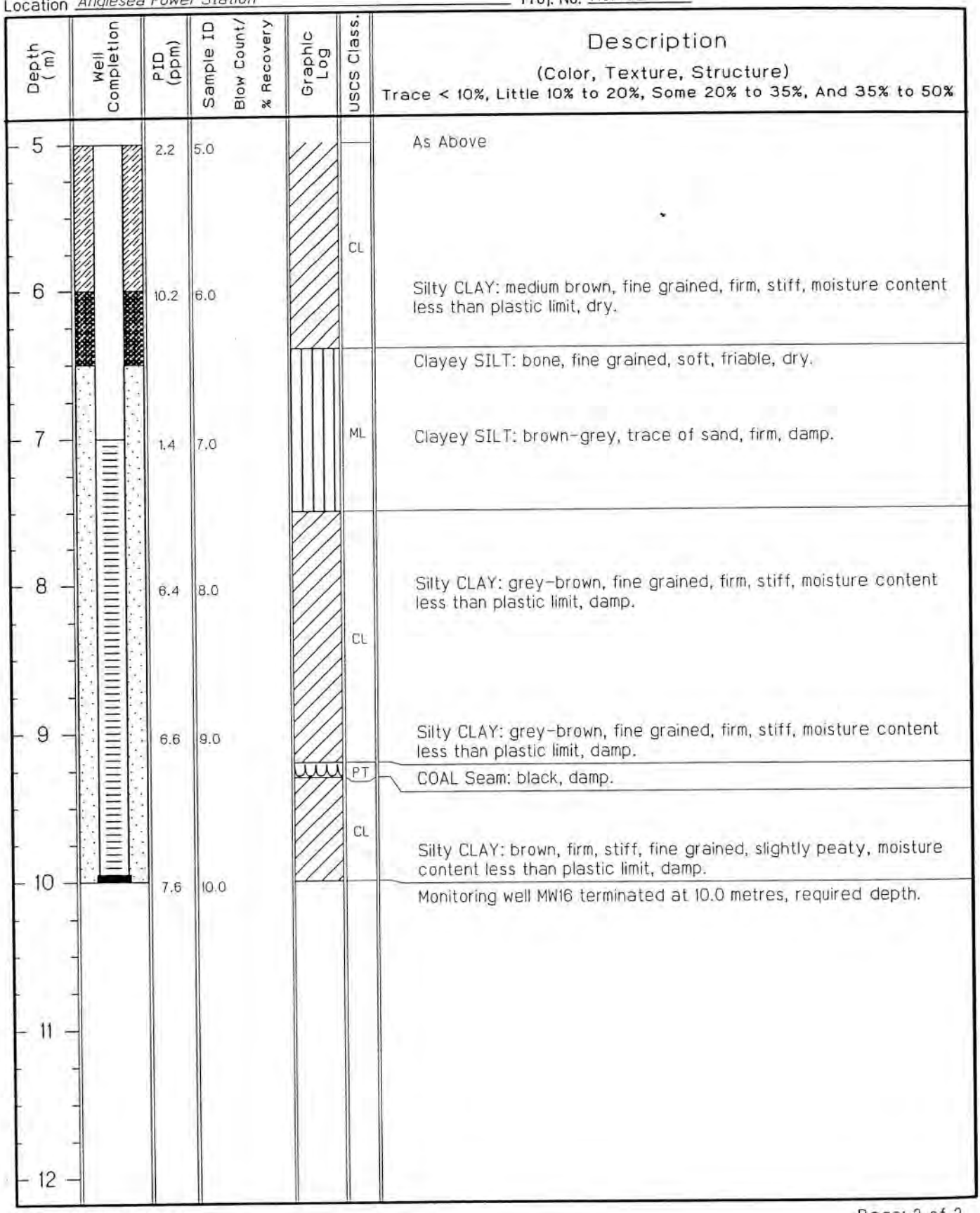
GROUNDWATER TECHNOLOGY AUSTRALIA

Drilling Log

Monitoring Well **MW16**

Project *Alcoa Anglesea* Owner *Alcoa of Australia Limited*

Location *Anglesea Power Station* Proj. No. *M6149E*



Drilling Log

FLUOR DANIEL GTI

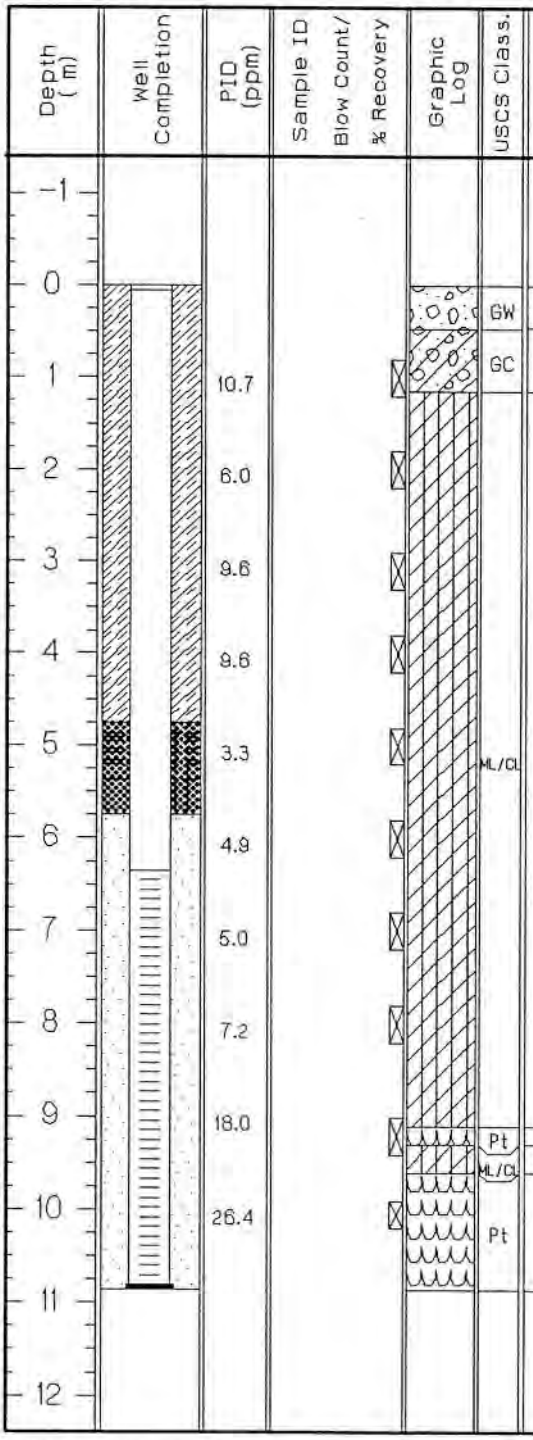
Monitoring Well **MW18**

Project *Alcoa Anglesea Lightning Oil Area* Owner *Alcoa of Australia Ltd*
Location *Anglesea Power Station, Victoria* Proj. No. *J-30-06419K*
Surface Elev. _____ Total Hole Depth *10.85 m* Diameter *150 mm*
Top of Casing _____ Water Level Initial _____ Static _____
Screen: Dia *50 mm* Length *4.5 m* Type/Size *0.5 mm*
Casing: Dia *50 mm* Length *6.35 m* Type *Class 18 PVC*
Fill Material _____ Rig/Core *GEMCO 210B*
Drill Co. *South Western Drilling* Method *Hollow Flight Auger*
Driller *G. Bourke* Log By *P. Egberts* Date *08/12/98* Permit # _____
Checked By _____ License No. _____

See Site Map For Boring Location

COMMENTS:

[X] Split Spoon Sample Depths.



Description

(Color, Texture, Structure)
Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%

FILL: Sandy GRAVEL: dark grey, medium dense, subangular-sand, well graded, gravel predominantly medium to coarse grained, moist.

FILL: Gravelly SAND: orange, medium dense, well graded sand, some silt and clay (moisture content greater than plastic limit), moist.

Silty CLAY (extremely weathered Siltstone): light grey, stiff, non-plastic to very low plasticity, moisture content less than plastic limit, a little fine to medium grained sand. Orange Silty Clay fractures, a few very fine layers of moist coarse sand noted in the 1.8 to 2.2 metre split spoon sample a fine horizontal layer (4cm thick) of Clayey Sand at 3.2 metres, wet.

SILT/Silty CLAY (extremely weathered Siltstone): light grey, very stiff, non-plastic, no sand detected, homogenous clolour and texture.

As above.

As above: light greyish brown.

PEAT/COAL: very dark brown, moderately weak.

Silty CLAY: brown, stiff, moisture content less than plastic limit.

COAL: very dark brown, moderaately strong, wet.

Monitoring Well MW18 terminated at 10.85 metres below grade due to refusal.

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Drilling Log

WELL ID SB7

Project Alcoa Anglesea Pwr Stn EIA Owner Alcoa of Aust. Ltd.
Location Cnr Thompsons Rd & Yard Proj. No. J30614-9M
Surface Elev. _____ Total Hole Depth 11.7m North _____ East _____
Top of Casing _____ Water Level Initial — Static _____ Diameter 150mm
Screen: Dia 50mm Length 6m Type/Size class 18 PVC
Casing: Dia 50mm Length 6m Type class 18 PVC
Fill Material 8/16 sand Rig/Core Pioneer 500
Drill Co. Sth Western Drilling Method hollow stem auger
Driller G. Burne Log By KO Date 27.4.00 Permit # NA
Checked By _____ License No. 405

COMMENTS: converted to MW19.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0	concrete	3.5	0.0 SB7/0·1			FILL	Silty sandy FILL
		4.0	1.0 SB7/1·0			FILL	clayey sandy silty FILL
2		9.0	2.0 SB7/2·1			SW	Silty SAND: grey, dry, med dense
	existing		3.0			SW	grading to clayey silty SAND: w/ some gravel, med dense - dense, dry
4	bedsite ply		4.0			CL/CH	Sandy silty CLAY: moist, brown/orange, stiff
			5.0			CL/CH	As above: v. stiff, some grey mottling
6			6.0			SW	Silty sand + GRAVEL: med dense, brown, moist
			7.0			SW	becoming more moist
8			8.0			ML/CL	clayey sandy SILT: med dense, moist, brown
	sand		9.0			ML/CL	
10			10.0			COAL	grading to COAL.

EOH @ 11.7m due to refusal on hard coal

IT_COMMERCIAL_UK Rev: 03/03/00 LOG.GPJ IT_CORP.GDT 24/03/00

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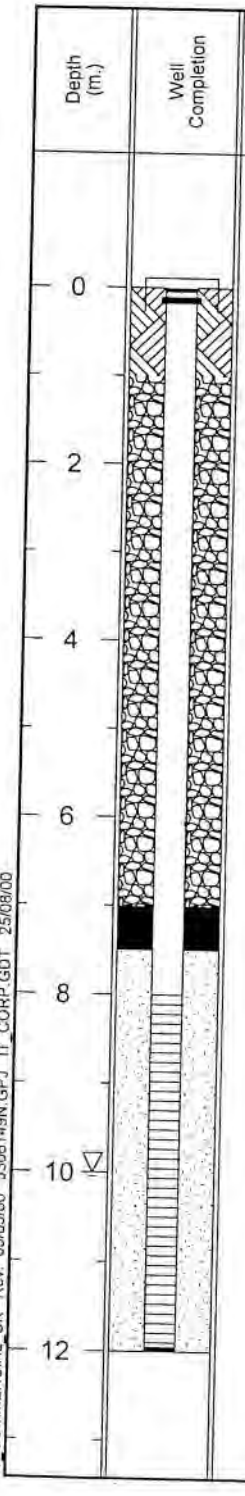
Drilling Log

Monitoring Well MW20

Project: ALCOA Anglesea Power Station - Well Install. Owner: Alcoa of Australia Ltd
Location: Anglesea, Victoria Proj. No.: J306149N
Surface Elev.: NA Total Hole Depth: 12.0 m. North: 5747361.675 m. East: 253738.927 m.
Top of Casing: NA Water Level Initial: ▽ 10.0 m. Static: NA Diameter: 200 mm.
Screen: Dia: 50 mm. Length: 4 m. Type/Size: Class 18 PVC/0.5 mm.
Casing: Dia: 50 mm. Length: 8 m. Type: Class 18 PVC
Fill Material: See Comments Rig/Core: Pioneer 400
Drill Co.: South Western Drilling Method: 0.0-1.2m Hand Auger/1.2-12.0m Hollow Stem Auger
Driller: N. Huby Log By: M. Newnham Date: 01/08/00 Permit #: 55955
Checked By: [signature] License No.: 405

COMMENTS
No samples taken.
Casing/Screen covered with filter sock.
0.0-1.0m Cement/Grout.
1.0-7.0m Drill Cuttings.
7.0-7.5m Bentonite.
7.5-12.0m 8/16 Sand.



USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
FILL	Compacted CRUSHED ROCK. CRUSHED ROCK. FILL: Silty CLAY: dark to light brown/grey/orange, firm, low plasticity, some gravel, damp.
CL	Silty CLAY: dark to light brown/grey/orange, firm, moderate plasticity, damp.
CH	As above: slightly light pink/grey/orange, firm, high plasticity, damp.
SM	Silty SAND: dark grey/grey, soft, large grained, some larger quartz pebbles, moist.
CL	Silty CLAY: light brown/orange, firm, moderate plasticity, damp.
CH	As above: light brown/orange, soft, high plasticity, damp. As above: very soft, very high plasticity, damp to moist.
SC	Clayey SAND: orange, fine grained, soft, medium dense, moist. As above: lighter orange/light brown, very soft, very moist. As above.
	Monitoring Well MW20 terminated at 12.0 metres below grade.

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Drilling Log

Monitoring Well **MW21**

Project: ALCOA Anglesea Power Station - Well Install. Owner: Alcoa of Australia Ltd
Location: Anglesea, Victoria Proj. No.: J306149N
Surface Elev.: NA Total Hole Depth: 12.0 m. North: 5747266.911 m. East: 253917.981 m.
Top of Casing: NA Water Level Initial: ▽ 10.0 m. Static: ▼ 9.5 m. Diameter: 200 mm.
Screen: Dia: 50 mm. Length: 4 m. Type/Size: Class 18 PVC/0.5 mm.
Casing: Dia: 50 mm. Length: 8 m. Type: Class 18 PVC
Fill Material: See Comments Rig/Core: Pioneer 400
Drill Co.: South Western Drilling Method: 0.0-1.2m Hand Auger/1.2-12.0m Hollow Stem Auger
Driller: N. Huby Log By: M. Newnham Date: 31/07/00 Permit #: 55955
Checked By: M. Newnham License No.: 405

COMMENTS
No samples taken.
Casing/Screen covered with filter sock.
0.0-1.0m Cement/Grout.
1.0-7.0m Drill Cuttings.
7.0-7.5m Bentonite.
7.5-12.0m 8/16 Sand.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count / Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0						FILL	CRUSHED ROCK/GRAVEL. FILL: Gravelly SAND: light brown, loose, unsorted, medium dense, moist.
							FILL: Silty SAND: dark brown, fine grained, sand, sorted, damp.
2						CL	Silty CLAY: light to dark brown/grey, soft to firm, moderate plasticity, some shell fragments, moist.
						GC	Sandy Clayey GRAVEL: dark brown, loose, small pebbles, very large grained sand, damp.
							Silty Gravelly CLAY: dark brown, soft, low plasticity, small gravel pieces, damp.
4							Silty CLAY: light brown/orange, soft to firm, low plasticity, damp.
						CL	As above: light brown/orange, firm.
6							
							As above: dark brown, very soft, very high plasticity, damp, some light brown clay organic texture.
8							
							As above: lighter brown, soft to firm, less organic texture.
10 ▽ ▼						CH	
							As above: dark brown, firm, moderate plasticity.
12							Monitoring Well MW21 terminated at 12.0 metres below grade.

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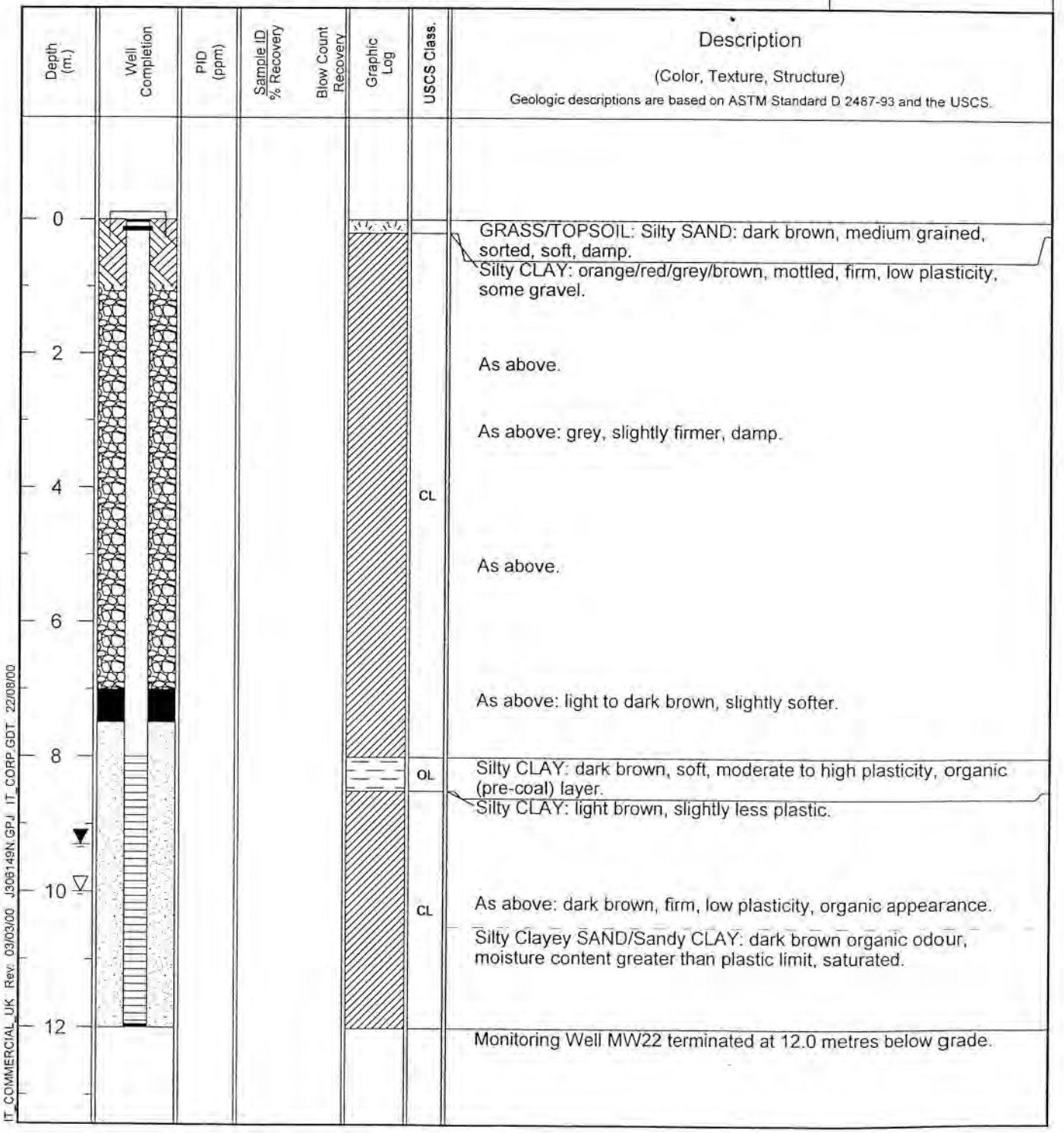
Drilling Log

Monitoring Well **MW22**

Project ALCOA Anglesea Power Station - Well Install. Owner Alcoa of Australia Ltd
Location Anglesea, Victoria Proj. No. J306149N
Surface Elev. NA Total Hole Depth 12.0 m. North 5747317.844 m. East 253951.476 m.
Top of Casing NA Water Level Initial ▽ 10.0 m. Static ▼ 9.3 m. Diameter 200 mm.
Screen: Dia 50 mm. Length 4 m. Type/Size Class 18 PVC/0.5 mm.
Casing: Dia 50 mm. Length 8 m. Type Class 18 PVC
Fill Material See Comments Rig/Core Pioneer 400
Drill Co. South Western Drilling Method 0.0-1.2m Hand Auger/1.2-12.0m Hollow Stem Auger
Driller N. Huby Log By M. Newnham Date 01/08/00 Permit # 55955
Checked By M Newnham License No. 405

COMMENTS
No samples taken.
Casing/Screen covered with filter sock.
0.0-1.0m Cement/Grout.
1.0-7.0m Drill Cuttings.
7.0-7.5m Bentonite.
7.5-12.0m 8/16 Sand.



IT_COMMERCIAL_UK Rev: 03/03/00 J306149N.GPJ IT_CORP.GDT 22/08/00

coffey environments **Drilling Log**

Monitoring Well **MW23**

Project: ALCOA Anglesea Power Station - Well Install. Owner: Alcoa of Australia Ltd
Location: Anglesea, Victoria Proj. No: J306149N
Surface Elev.: NA Total Hole Depth: 12.0 m. North: East:
Top of Casing: NA Water Level Initial: ▽ 11.0 m. Static: ▼ 10.0 m. Diameter: 120 mm.
Screen: Dia: 50 mm. Length: 6 m. Type/Size: Class 18 uPVC Slotted
Casing: Dia: 50 mm. Length: 6 m. Type: Class 18 uPVC
Fill Material: Monitoring Well Rig/Core: GEMCO 210B
Drill Co.: South Western Drilling Method: Solid Stem Auger
Driller: G. Bourke Log By: M. Newnham Date: 6/5/02 Permit #: NA
Checked By: License No.: 405

COMMENTS
Re-Installation of dry MW23

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0							Compacted CRUSHED ROCK.
							CRUSHED ROCK.
						FILL	FILL: Silty CLAY: dark to light brown/grey/orange, firm, low plasticity, some gravel, damp.
2						CL	Silty CLAY: dark to light brown/grey/orange, firm, moderate plasticity, damp.
						CH	As above: slightly light pink/grey/orange, firm, high plasticity, damp.
4						SM	Silty SAND: dark grey/grey, soft, large grained, some larger quartz pebbles, moist.
						CL	Silty CLAY: light brown/orange, firm, moderate plasticity, damp.
6							
						CH	As above: light brown/orange, soft, high plasticity, damp.
8							As above: very soft, very high plasticity, damp to moist.
						SC	Clayey SAND: orange, fine grained, soft, medium dense, moist.
10 ▼							

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coffey environments **Drilling Log**

Monitoring Well **MW23**

Project *ALCOA Anglesea Power Station - Well Install.* Owner *Alcoa of Australia Ltd*

Location *Anglesea, Victoria* Proj. No. *J306149N*

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure). Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
10						*Continued*
						As above: lighter orange/light brown, very soft, very moist.
	▽				SC	As above.
12						Monitoring Well MW20 terminated at 12.0 metres below grade.
14						
16						
18						
20						
22						

coffey environments **Drilling Log**

Monitoring Well **MW24**

Project: ALCOA Anglesea Power Station - Well Install. Owner: Alcoa of Australia Ltd

Location: Anglesea, Victoria Proj. No.: J306149N

Surface Elev.: NA Total Hole Depth: 4.5 m. North: _____ East: _____

Top of Casing: NA Water Level Initial: NA Static: NA Diameter: 120 mm.

Screen: Dia: 50 mm. Length: 3 m. Type/Size: Class 18 uPVC Slotted

Casing: Dia: 50 mm. Length: 1.5 m. Type: Class 18 uPVC

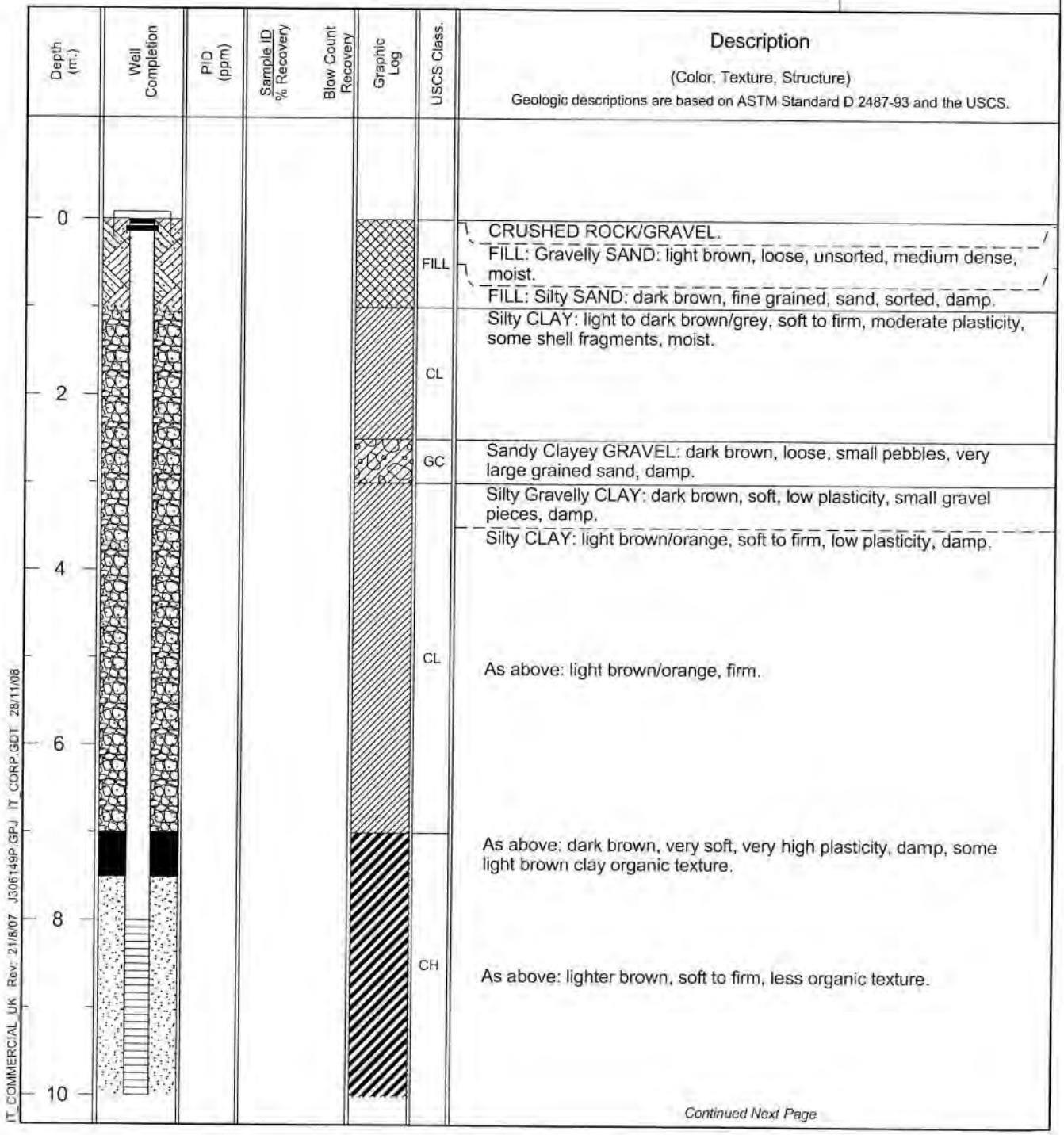
Fill Material: Monitoring Well Rig/Core: GEMCO 210B

Drill Co.: South Western Drilling Method: 110mm Solid Auger

Driller: G. Bourke Log By: K. Orchard Date: 17/4/02 Permit #: NA

Checked By: _____ License No.: 405

COMMENTS



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coffey environments **Drilling Log**

Monitoring Well **MW24**

Project *ALCOA Anglesea Power Station - Well Install.* Owner *Alcoa of Australia Ltd*

Location *Anglesea, Victoria* Proj. No. *J306149N*

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
10						*Continued*
					CH	As above: dark brown, firm, moderate plasticity.
12						Monitoring Well MW21 terminated at 12.0 metres below grade.
14						
16						
18						
20						
22						

coffey environments **Drilling Log**

Monitoring Well **MW25**

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Project Alcoa Anglesea — Owner Alcoa

Location Alcoa Anglesea — Proj. No. Enviabtf06149XA

Surface Elev. NA — Total Hole Depth 11.0 m. — North — East

Top of Casing NA — Water Level Initial ▽ 9.0 m. — Static ▼ 8.9 m. — Diameter 150 mm.

Screen: Dia 50 mm. — Length 3.0 m. — Type/Size Class 18 uPVC/Slotted

Casing: Dia 50 mm. — Length 8.0 m. — Type Class 18 uPVC

Fill Material Sand/Bentonite/Grout — Rig/Core Geoprobe 6610DT

Drill Co. South Western Drilling — Method Hand Auger/Solid Auger

Driller G. Bourke — Log By C. Molloy — Date 7/8/06 — Permit # 9026143

Checked By — License No. 713

COMMENTS
North West of the cooling tower.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure). Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		6.2	MW25-0.2				ASHPHALT at Surface.
		4.3	MW25-0.5			FILL	FILL: clayey gravel, dark orange, gravel content ~50%, coarse rounded quartz, river gravels in a sandy clay matrix, poorly sorted.
		2.8	MW25-1.0			MLS	Clayey Sandy SILT: light grey/white, sand content fine to very fine grained, low plasticity due to sand.
2		0.2	MW25-2.0			SW	SAND: light orange/yellow, fine grained with rare very coarse grained sand, high slimes content(>20%), dry.
		0.6	MW25-3.0				As above: yellow/brown, clay content ~30%(slimey sand), sands fine grained, moist (perched water).
4		0.3	MW25-4.0				Silty CLAY: sandy, grey/brown, sand content fine grained, slightly moist.
		0.2	MW25-5.0			CL ML	As above: dark orange/brown, minor organic material, low sand content (<10%).
6		0.1	MW25-6.0				As above: gravelly, orange/brown, weathered brecciated quartz, large quartz pebbles (total quartz content in sample ~20%
		0.6	MW25-7.0				As above: orange/brown, minor undurated rounded Fe pisoliths to 8mm, slightly moist.
8		2.2	MW25-8.0				As above: dark brown, high plasticity, high silt content, slightly moist.
		0.4	MW25-9.0				Silty SAND: light brown/grey, fine to medium grained sands, slightly moist.
10		0.2	MW25-10.0			SM	As above: light brown, fine to medium grained, rare coarse grained, moist(saturated).
		0.2	MW25-11.0				As above: dark brown, organic material, wet, strong organic smell.
12							As above: increasing content of organic material, wet. End of Hole at 11.0m - Limit of Investigation.

coffey environments — Drilling Log

Monitoring Well **MW26**

Project: Alcoa Anglesea — Owner: Alcoa
Location: Alcoa Anglesea — Proj. No.: Enviabtf06149XA
Surface Elev.: NA — Total Hole Depth: 14.5 m. — North: — East: —
Top of Casing: NA — Water Level Initial: ▽ 12.0 m. — Static: ▼ 12.3 m. — Diameter: 150 mm.
Screen: Dia 50 mm. — Length: 6.0 m. — Type/Size: Class 18 uPVC/Slotted
Casing: Dia 50 mm. — Length: 8.5 m. — Type: Class 18 uPVC
Fill Material: Sand/Bentonite/Grout — Rig/Core: Geoprobe 6610DT
Drill Co.: South Western Drilling — Method: Hand Auger/Solid Auger
Driller: G. Bourke — Log By: C. Molloy — Date: 7/8/06 — Permit #: 9026143
Checked By: — License No.: 713

COMMENTS
Eastern Side of ash ponds.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.8	MW26-0.2			GW	GRAVEL at Surface.
		2.2	MW26-0.5			FILL	FILL: sandy clayey gravel, coarse, poorly sorted.
		0.9	MW26-1.0			CLS	Sandy CLAY: poorly sorted (~40% gravel and sand content). As above: minor organic material.
2		0.3	MW26-2.0				
		0.6	MW26-3.0			SW	SAND: gravelly, grey brown, coarse to very coarse grained, minor pebble, very poor sorting, moist. As above: minor clay, wet (perched water).
4		0.7	MW26-4.0			CLS	Sandy CLAY: sand content ~ 15%, slightly moist.
		0.8	MW26-5.0				
6		0.3	MW26-6.0			ML	Clayey SILT: sands predominantly fine grained. As above.
		0.2	MW26-7.0				
8		0.2	MW26-8.0			CL	CLAY: red and grey, dark Fe staining and minor rounded indurated pisoliths, high plasticity, clean clay, dry. As above: orange/red/brown.
		0.3	MW26-9.0				
10		0.2	MW26-10.0			SM	Silty SAND: grey/brown/orange, ~ 20% sand. As above: grey/brown, fine grained sand, rare pebble, very high slimes content, moist.
		0.1	MW26-11.0				As above: gravelly, grey/brown, coarse gravelly sand with minor pebble, high slimes content.
12 ▽▼		0.1	MW26-12.0			SW	SAND: grey/brown (~20% slimes content), fine grained, good sorting, minor organic matter, wet.
						SC	Clayey SAND: as above with approx 30% organic coal-like clay, dark grey/black.
14						CL	CLAY: black, coal-like, organic, very strong organic odour. Refusal on Rock at 14.5m. End of Hole at 14.5m - Limit of Investigation.
16							

coffey environments **Drilling Log**

Monitoring Well **MW27**

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Project Alcoa Anglesea — Owner Alcoa

Location Alcoa Anglesea — Proj. No. Enviabtf06149XA

Surface Elev. NA — Total Hole Depth 15.0 m. — North — East

Top of Casing NA — Water Level Initial NA — Static ▼ 13.9 m. — Diameter 150 mm.

Screen: Dia 50 mm. — Length 6.0 m. — Type/Size Class 18 uPVC/Slotted

Casing: Dia 50 mm. — Length 10.0 m. — Type Class 18 uPVC

Fill Material Sand/Bentonite/Grout — Rig/Core Geoprobe 6610DT

Drill Co. South Western Drilling — Method Hand Auger/Solid Auger

Driller G. Bourke — Log By C. Molloy — Date 8/8/06 — Permit # 9026143

Checked By — License No. 713

COMMENTS
Western Side of ash ponds near the weather tower.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.5	MW27-0.2			CL	GRASS at Surface.
		0.6	MW27-0.5			ML	Silty CLAY: loamy, sandy, ~20% sand content.
		0.8	MW27-1.0			SC	Clayey SAND: gravelly, loamy, as above with large fractured quartz pebbles, dry.
2		0.6	MW27-2.0			CL ML	Silty CLAY: loamy, dark brown/black, minor sand, high organic matter, dry.
		0.2	MW27-3.0			CLG	As above: gravelly content ~20% Gravelly CLAY: dark brown, sand and gravel content, moist becoming wet (perched water).
4		0.2	MW27-4.0				Silty CLAY: sandy, as above with decreasing gravel content, wet. As above: sandy, grey/brown, minor sand, moist.
		0.3	MW27-5.0				As above: minor sand, slightly moist.
6		0.1	MW27-6.0			CL ML	As above: minor sand, slightly moist.
		0.1	MW27-7.0				As above: minor sand.
8		0.1	MW27-8.0				As above: minor sand.
		0.2	MW27-9.0				As above: sandy, light grey/brown, sand content ~30% increasing with depth.
10		0.1	MW27-10.0				SAND: silty, grey/brown, high slimes content >25%, sands mostly fine to medium grained with rare pebble.
		0.2	MW27-11.0				As above: slimey, minor clay, medium grained sands, moderately sorted.
12		0.4	MW27-12.0			SW	As above.
		0.5	MW27-13.0				As above.
14 ▼		0.5	MW27-14.0				
		0.5	MW27-15.0			SWG	Gravelly SAND: coarse angular quartz gravel, coarse grained to pebble, slimey (not as slimey as 11.0m). As above: wet.
16							End of Hole at 15.0m - Limit of Investigation.

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coffey environments — Drilling Log

Monitoring Well **MW28**

Project: Alcoa Anglesea — Owner: Alcoa
Location: Alcoa Anglesea — Proj. No.: Enviabtf06149XA
Surface Elev.: NA — Total Hole Depth: 16.0 m. — North: — East: —
Top of Casing: NA — Water Level Initial: ▽ 4.0 m. — Static: ▼ 4.9 m. — Diameter: 150 mm.
Screen: Dia 50 mm. — Length: 6.0 m. — Type/Size: Class 18 uPVC/Slotted
Casing: Dia 50 mm. — Length: 1.2 m. — Type: Class 18 uPVC
Fill Material: Sand/Bentonite/Grout — Rig/Core: Geoprobe 6610DT
Drill Co.: South Western Drilling — Method: Hand Auger/Solid Auger
Driller: G. Bourke — Log By: C. Molloy — Date: 8/8/06 — Permit #: 9026143
Checked By: — License No.: 713

COMMENTS
South Side of ash pond # 2. Bentonite plug installed at 7.2 to 7.7mBGS.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure). Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.2	MW28-0.2			GRASS at Surface.
		0.2	MW28-0.5		MLS	Gravelly LOAM: brown, common tree roots.
		0.2	MW28-1.0		SW	Sandy SILT: light grey/orange, mottled, minor gravel, organic matter.
2		0.1	MW28-2.0			SAND: light grey/brown, medium grained to pebble, poorly sorted.
					CLS	As above: minor clay content.
		0.4	MW28-3.0			Sandy CLAY: dark grey/black, sticky clay, sand content approx 30%, slightly moist.
4 ▽		0.3	MW28-4.0		SC	Clayey SAND: dark grey/black, poorly sorted, sands medium grained to pebble, approx 30-40% clay content, moist.
▼						As above: grey/brown, slight decrease in clay content.
		0.2	MW28-5.0			SAND: gravelly, light brown/grey, slimey sand (>20% slimes).
6		0.2	MW28-6.0		SW	As above: light grey/grey brown, coarse with minor pebble, slimey sand, wet.
		0.4	MW28-7.0			As above: clayey, minor clay.
						Bentonite Plug 7.2-7.7m.
8		0.3	MW28-8.0			CLAYEY SAND: minor sandy clay bands.
		0.2	MW28-9.0			As above: minor clay bands (up to 200mm thick).
10		0.1	MW28-10.0		SC	As above: coarse grained, poorly sorted, slimey sand.
		0.2	MW28-11.0			
12		0.1	MW28-12.0			
		0.2	MW28-13.0		CLS	Sandy CLAY band.
14		0.2	MW28-14.0			Clayey SAND: coarse grained, poorly sorted, moist.
		0.3	MW28-15.0		SC	
16		0.3	MW28-16.0			End of Hole at 16.0m - Limit of Investigation (well installed to 7.2m due to collapse in saturated sands).

coffey environments **Drilling Log**

Monitoring Well **MW29**

Project *Alcoa Anglesea* Owner *Alcoa*

Location *Alcoa Anglesea* Proj. No. *Enviabtf06149XA*

Surface Elev. *NA* Total Hole Depth *12.0 m.* North _____ East _____

Top of Casing *NA* Water Level Initial ▽ *10.0 m.* Static ▼ *6.6 m.* Diameter *150 mm.*

Screen: Dia *50 mm.* Length *6.0 m.* Type/Size *Class 18 uPVC/Slotted*

Casing: Dia *50 mm.* Length *6.0 m.* Type *Class 18 uPVC*

Fill Material *Sand/Bentonite/Grout* Rig/Core *Geoprobe 6610DT*

Drill Co. *South Western Drilling* Method *Hand Auger/Solid Auger*

Driller *G. Bourke* Log By *C. Molloy* Date *8/8/06* Permit # *9026143*

Checked By _____ License No. *713*

COMMENTS
Most Northern well (background).

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.5	MW29-0.2				GRASS at Surface.
		0.4	MW29-0.5				Silty LOAM: common bark and sticks, dry.
		0.3	MW29-1.0			MLS	Sandy SILT: light yellow, fine grained sands, dry, friable (natural).
2		0.2	MW29-2.0			CL ML	Silty CLAY: light orange/brown, high silt content, low plasticity, dry, friable.
		0.2	MW29-3.0				CLAY: orange/grey, moderate plasticity, Fe stained. As above: orange/grey, clean clay, with minor zones containing rounded quartz pebbles and sandy clay.
4		0.2	MW29-4.0			CL	As above.
		0.2	MW29-5.0				As above: tight clean clay, moderate to high plasticity, no sand content.
6		0.3	MW29-6.0				Sandy SILT: light orange/brown, sand content fine grained, slightly moist.
		0.5	MW29-7.0				As above: light orange/brown, minor clay and increasing grain size.
8		0.2	MW29-8.0			MLS	As above: moist.
		1.0	MW29-9.0				As above: moist.
10 ▽		0.8	MW29-10.0				Silty SAND: dark grey/black, fine to very coarse sands, minor rounded pebbles, moist.
		0.4	MW29-11.0			SW SM	As above: wet (saturated).
12		0.5	MW29-12.0				End of Hole at 12.0m - Limit of Investigation.

coffey environments **Drilling Log**

Monitoring Well **MW30**

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Project *Alcoa Anglesea* Owner *Alcoa*

Location *Alcoa Anglesea* Proj. No. *Enviabtf06149XA*

Surface Elev. *NA* Total Hole Depth *13.4 m.* North _____ East _____

Top of Casing *NA* Water Level Initial ▽ *12.0 m.* Static ▼ *11.2 m.* Diameter *150 mm.*

Screen: Dia *50 mm.* Length *6.0 m.* Type/Size *Class 18 uPVC/Slotted*

Casing: Dia *50 mm.* Length *7.4 m.* Type *Class 18 uPVC*

Fill Material *Sand/Bentonite/Grout* Rig/Core *Geoprobe 6610DT*

Drill Co. *South Western Drilling* Method *Hand Auger/Solid Auger*

Driller *G. Bourke* Log By *C. Molloy* Date *9/8/06* Permit # *9026143*

Checked By _____ License No. *713*

COMMENTS
North Side of sewerage pond beside the main road to the mine.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.2	MW30-0.2			GRASS at Surface.
		0.3	MW30-0.5			LOAM: dark grey/black, organic, plant roots.
		0.2	MW30-1.0		FILL	FILL: clay, dark black, heavily organic (area likely to have an accumulation of coal dust from nearby crusher).
2		0.3	MW30-2.0			As above.
		0.2	MW30-3.0			Silty CLAY: grey/brown with minor black, high silt content, slightly moist.
4		0.5	MW30-4.0			As above: orange/grey, Fe stained, organic matter, slightly moist.
		0.1	MW30-5.0		CL ML	As above.
6		0.2	MW30-6.0			As above: dark grey and orange, high plasticity.
		0.2	MW30-7.0			As above.
8		0.1	MW30-8.0			As above: minor sand (~5-10%).
		0.2	MW30-9.0			As above: increasing sand content, fine grained.
10		0.2	MW30-10.0		SC	Clayey SAND: silty, light grey/brown, sands fine grained with rare very coarse, good sorting in fine sands, clay and fines content ~30-50%
▼		0.3	MW30-11.0			As above: increasing sand content.
12 ▽		0.5	MW30-12.0		SW	SAND: light grey/brown, fine grained, good sorting, micaceous, high slimes/fines content.
		0.2	MW30-13.0			As above: minor very coarse gravel content.
14						As above: increasing gravel content, poor sorting, minor clay band at end of hole.
						End of Hole at 13.4m - Limit of Investigation.

IT_COMMERCIAL_UK Rev: 30/6/06 ENVIABTF06149XA.GPJ IT_CORP.GDT 23/8/06

coffey environments **Drilling Log**

Monitoring Well **MW31**

Project *Alcoa Anglesea* Owner *Alcoa*

Location *Alcoa Anglesea* Proj. No. *Enviabtf06149XA*

Surface Elev. *NA* Total Hole Depth *10.0 m.* North _____ East _____

Top of Casing *NA* Water Level Initial *NA* Static ▼ *8.7 m.* Diameter *150 mm.*

Screen: Dia *50 mm.* Length *3.0 m.* Type/Size *Class 18 uPVC/Slotted*

Casing: Dia *50 mm.* Length *6.7 m.* Type *Class 18 uPVC*

Fill Material *Sand/Bentonite/Grout* Rig/Core *Geoprobe 6610DT*

Drill Co. *South Western Drilling* Method *Hand Auger/Solid Auger*

Driller *G. Bourke* Log By *C. Molloy* Date *9/8/06* Permit # *9026143*

Checked By _____ License No. *713*

COMMENTS

Between sewerage ponds and creek.

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure)
							Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.5	MW31-0.2				Gravel Road at Surface.
		0.5	MW31-0.5				FILL: gravelly clay.
		0.3	MW31-1.0				As above: orange/grey silty clay, mottled, organic material, Fe staining.
							As above: sandy clay, orange/brown, fine to medium grained, good sorting, minor clay.
2		0.5	MW31-2.0			FILL	As above: silty sandy clay, sand content ~20%, fine grained sand, moderate plasticity, mottled.
		0.3	MW31-3.0				As above: slightly moist, mottled, minor sand.
4		0.1	MW31-4.0				Silty CLAY: light grey, high silt content, high plasticity.
		0.2	MW31-5.0				
6		0.2	MW31-6.0			CL ML	As above: high plasticity, high silt content, no sand.
		0.3	MW31-7.0				As above: minor sand.
8	▼	0.5	MW31-8.0			SW SM	Silty SAND: light grey, slimey, minor clay, fine sands, minor very coarse pebble.
		0.4	MW31-9.0			SW	As above: increasing grain size, slimes/fines content >20%
							SAND: coarse grained, slimey.
10		0.6	MW31-10.0				End of Hole at 10.0m - Limit of Investigation.

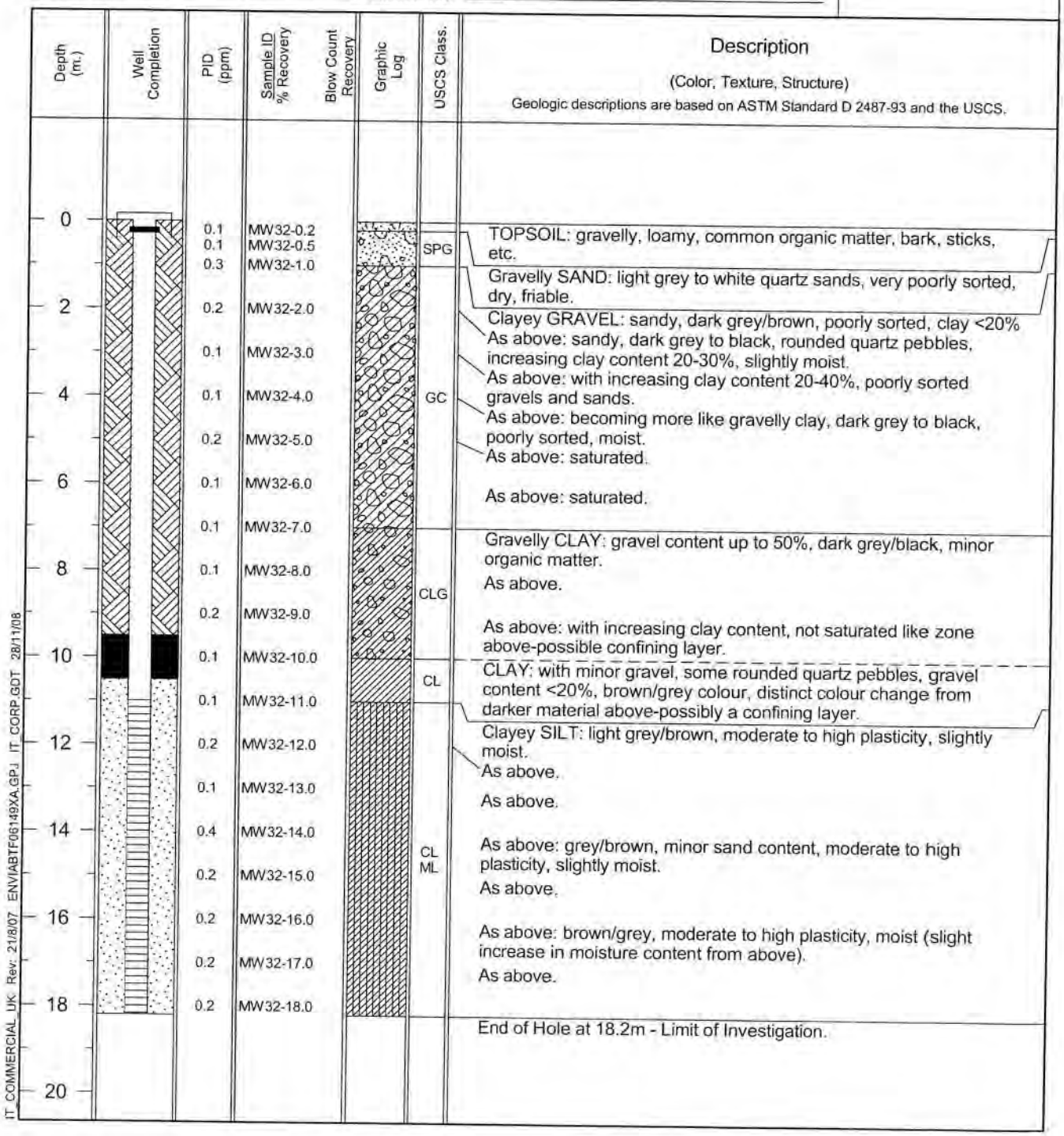
IT_COMMERCIAL_UK Rev: 30/6/06 ENVIABTF06149XA.GPJ IT_CORP.GDT 23/8/06

coffey environments **Drilling Log**

Monitoring Well **MW32**

Project: Alcoa Anglesea - Additional MW Installation | Owner: Alcoa
Location: Coal Mine Road, Anglesea | Proj. No.: ENVIABTF06149XA
Surface Elev.: NA | Total Hole Depth: 18.2 m. | North: | East:
Top of Casing: NA | Water Level Initial: NA | Static: NA | Diameter: 225 mm.
Screen: Dia 50 mm. | Length: 7.2 m. | Type/Size: uPVC Class 18/Slotted
Casing: Dia 50 mm. | Length: 11.0 m. | Type: uPVC Class 18
Fill Material: Sand/Bentonite/Grout | Rig/Core: Geoprobe 6610 DT
Drill Co.: South Western Drilling | Method: Hollow Auger
Driller: Gavin Bourke | Log By: Chris Molloy | Date: 16/11/06 | Permit #: 9026143
Checked By: Chris Molloy | License No.: 713

COMMENTS
South side of ash ponds.



coffey environments **Drilling Log**

Monitoring Well **MW33**

Project *Alcoa Anglesea* Owner *Alcoa*

Location Proj. No. *ENVIABTF06149BB*

Surface Elev. *NA* Total Hole Depth *14.0 m.* North *5746592.2 m.* East *253455.5 m.*

Top of Casing *NA* Water Level Initial *NA* Static ▼ *11.2 m.* Diameter *150 mm.*

Screen: Dia *50 mm.* Length *6.0 m.* Type/Size *Class 18 uPVC*

Casing: Dia *50 mm.* Length *8.0 m.* Type *Class 18 uPVC*

Fill Material *Sand/Bentonite/Grout* Rig/Core

Drill Co. *A.S.James* Method *Solid Auger*

Driller *D.Barry* Log By *C.Molloy* Date *28/5/08* Permit # *701*

Checked By *C.Molloy* License No. *9084546*

COMMENTS

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure). Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.1	MW33/0.2			**GRASS/GRAVEL.**
		0.0	MW33/0.5		CL ML	**FILL: CRUSHED ROCK:** brown-grey, minor silt/clay, moist.
					ML	**FILL: SILTY CLAY:** dark grey, minor gravels, organic matter.
		0.2	MW33/1.0		CL	**SILT:** minor clay, minor organic matter, moist. **CLAY:** brown to orange brown, silty, stiff, slightly moist.
2		0.3	MW33/2.0			**CLAY:** grey, mottled orange-brown, silty with minor sand, medium to coarse grained, sand content increasing with depth, dry.
		0.2	MW33/3.0			
4		0.1	MW33/4.0		CL	
		0.1	MW33/5.0			Increasing sand content.
6		0.1	MW33/6.0			**SAND:** grey to pale grey, minor silt and clay, sticky sands, slightly moist.
		0.2	MW33/7.0		SW	
8		0.1	MW33/8.0			
		0.2	MW33/9.0			**SAND:** grey to dark grey, minor clay, moist to very moist, becoming saturated, coarse to very coarse grained sand.
10					SW	

Continued Next Page

coffey environments **Drilling Log**

Monitoring Well **MW33**

Project *Alcoa Anglesea* Owner *Alcoa*

Location _____ Proj. No. *ENVIABTF06149BB*

Depth (m)	Well Completion	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
10		0.1	MW33/10.0		SW	*Continued*
12		0.1	MW33/12.0		CL	**CLAY:** brown, silty with minor sand, stiff, wet.
14		0.1	MW33/14.0			End of hole at 14.0m - Limit of investigation.
16						
18						
20						
22						

coffey environments

Drilling Log

Monitoring Well MW34

Project Alcoa Anglesea | Owner Alcoa

Location | Proj. No. ENVIABTF06149BB

Surface Elev. NA | Total Hole Depth 19.7 m. | North | East

Top of Casing NA | Water Level Initial NA | Static NA | Diameter 150 mm.

Screen: Dia 50 mm. | Length 6.0 m. | Type/Size Class 18 uPVC

Casing: Dia 50 mm. | Length 13.7 m. | Type Class 18 uPVC

Fill Material Sand/Bentonite/Grout | Rig/Core

Drill Co. A.S.James | Method Solid Auger

Driller D.Barry | Log By C.Molloy | Date 30/5/08 | Permit # 701

Checked By C.Molloy | License No. 9084546

COMMENTS
South West of Asbestos Landfill)

Depth (m.)	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure)
						Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0						GRASS/ORGANIC MATTER.
	0.2	MW34/1.0			ML	FILL: SANDY SILT: grey-brown, toots, trace of gravels, trace of clay.
2	1.1	MW34/2.0			SW	FILL: SAND: fine grained, dark grey to black, dry, minor coal.
	1.9	MW34/3.0				COAL: black, gravel sized chips uo to 50mm in diameter, dry, organic odour, minor fine sand/silt.
4	1.5	MW34/4.0				Black, stong organic odour.
	1.2	MW34/5.0			SW	CLAYEY SAND/ GRAVELLY SAND:dark grey, sands poorly sorted, medium gravel sized, moist, clay content at ~20%.
6	2.8	MW34/6.0				SAND: brown to dark grey, gravelly, very coarse grained sand, poorly sorted, slightly moist, minor clay (<10%) gives slight cohesion between gravels.
	0.3	MW34/7.0			SW	With minor clay.
8	0.4	MW34/8.0			SW	GRAVELLY SAND: grey-brown, coarse to very coarse sub-rounded grains, dry to slightly moist, minor clay (<10%).
	0.5	MW34/9.0			SW	CLAYEY SAND: dark grey, coarse grained sands, poorly sorted, increasing clay content with depth.
10						

Continued Next Page

coffey environments

Drilling Log

Monitoring Well MW34

Project Alcoa Anglesea Owner Alcoa

Location Proj. No. ENVIABTF06149BB

Depth (m.)	PID (ppm)	Sample ID / % Recovery / Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
10	0.2	MW34/10.0		ML	Continued SANDY CLAYEY SILT:dark grey, sand content approx 20-30%, fine to coarse grained with rare pebbles, slightly plastic, slightly moist.
	0.3	MW34/11.0		SW	SAND: dark grey, high slimes content giving cohesives to sand, coarse to very coarse grained.
12					
				SW	SAND: grey-brown, minor clay content, (some minor sandy clay bands), coarse to very coarse sands, poorly sorted.
14					
				SW	SAND: dark brown to black, coarse grained, high silt content, moist. Noted change in level of torque required during drilling.
16					
					COAL: black, stiff, insolidated.
18					
					End of hole at 19.7m - Limit of investigation.
20					
22					

coffey environments **Drilling Log**

Monitoring Well **MW35**

Project *Alcoa Anglesea* Owner *Alcoa*

Location _____ Proj. No. *ENVIABTF06149BB*

Surface Elev. *NA* Total Hole Depth *13.0 m.* North *5747365.8 m.* East *253998.6 m.*

Top of Casing *NA* Water Level Initial *NA* Static *Dry* Diameter *150 mm.*

Screen: Dia *50 mm.* Length *6.0 m.* Type/Size *Class 18 uPVC*

Casing: Dia *50 mm.* Length *7.0 m.* Type *Class 18 uPVC*

Fill Material *Sand/Bentonite/Grout* Rig/Core _____

Drill Co. *A.S.James* Method *Solid Auger*

Driller *D.Barry* Log By *C.Molloy* Date *3/6/08* Permit # *701*

Checked By *C.Molloy* License No. *9084546*

COMMENTS

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count / Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure). Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0		0.3	MW35/0.2				**GRASS/ORGANIC PLANT MATTER.**
		0.4	MW35/0.5			ML	**SILT:** light brown, common organic matter, dry, (natural).
		0.4	MW35/1.0			CL	**SILTY CLAY:** grey-brown, mottled orange, minor fine and medium grained sand, moderate plasticity, dry.
2		0.3	MW35/2.0			CL	**SILTY CLAY:** light grey, motted orange, minor deep red Fe stained, moderate plasticity, dry.
		0.2	MW35/3.0			CL	**SILTY CLAY:** light grey, with deep red Fe staining, trace of fine grained sand, trace of fibrous organic matter.
4		0.2	MW35/4.0			CL	**CLAYEY SILT/SILTY CLAY:** light grey, with minor deep red, minor gravelly silt band comprising poorly sorted sub-rounded gravels to 10mm.
		0.1	MW35/5.0			CL	**SILTY CLAY:** light grey to white, with mottled orange, moderate plasticity, dry.
6		0.2	MW35/6.0			CL	**SILTY CLAY:** light grey with mottled orange-pink (Fe stained), trace of consolidated ferruginous fragment, moderate plasticity. Low plasticity, due to high silt content.
		0.3	MW35/7.0			CL	**SILTY CLAY:** brown, moderately plasticity, uniform lithology (no sand, slightly moist.
8		0.2	MW35/8.0			CL	Minor sand.
10							

Continued Next Page

coffey environments Drilling Log

Monitoring Well **MW37**

Project	Alcoa Anglesea Powerstation ERA	Owner	Alcoa Australia Pty Ltd				
Location	Anglesea Powerstation			Proj. No.	ENVIABTF06149BE		
Surface Elev.	NA	Total Hole Depth	6.0 m.	North		East	
Top of Casing	NA	Water Level Initial	▽ 4.0 m.	Static	▼ 4.0 m.	Diameter	50 mm.
Screen: Dia	50 mm.	Length	3 m.	Type/Size	Class 18 uPVC/0.5 mm.		
Casing: Dia	50 mm.	Length	3 m.	Type	Class 18 uPVC		
Fill Material	Sand/Bentonite/Grout			Rig/Core	EVH7720 DT Geoprobe		
Drill Co.	South Western Drilling	Method	Hand Auger/Solid Stem Auger				
Driller	P. Maule	Log By	D. White	Date	19/4/11	Permit #	WLE049554
Checked By	C. Molloy	License No.	0792				

COMMENTS

Depth (m.)	Well Completion	PID (ppm)	Sample ID / % Recovery	Blow Count Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) — Geologic descriptions are based on ASTM Standard D 2487-93 and the USCS.
0							
						CLS	**SANDY CLAY:** very dark brown, top soil with plant matter, low plasticity, moist, soft.
1							**SANDY CLAY:** grey mottled light brown, fine-medium sands, medium plasticity, very sandy, moist, firm.
						CL ML	**SILTY CLAY:** dark brown mottled red, medium-high plasticity, moist, firm.
2							
						CL	**CLAY:** light brown, high plasticity, no sand, slightly moist, firm.
3							
4	▼						
						CLS	**SANDY CLAY:** light brown, fine sands, medium plasticity, wet, very soft.
5							
						SC	**CLAYEY SAND:** grey-light brown, saturated, sandier with depth, very soft.
6							
							End of hole @6.0mbgs. Limit of investigation.
7							
8							

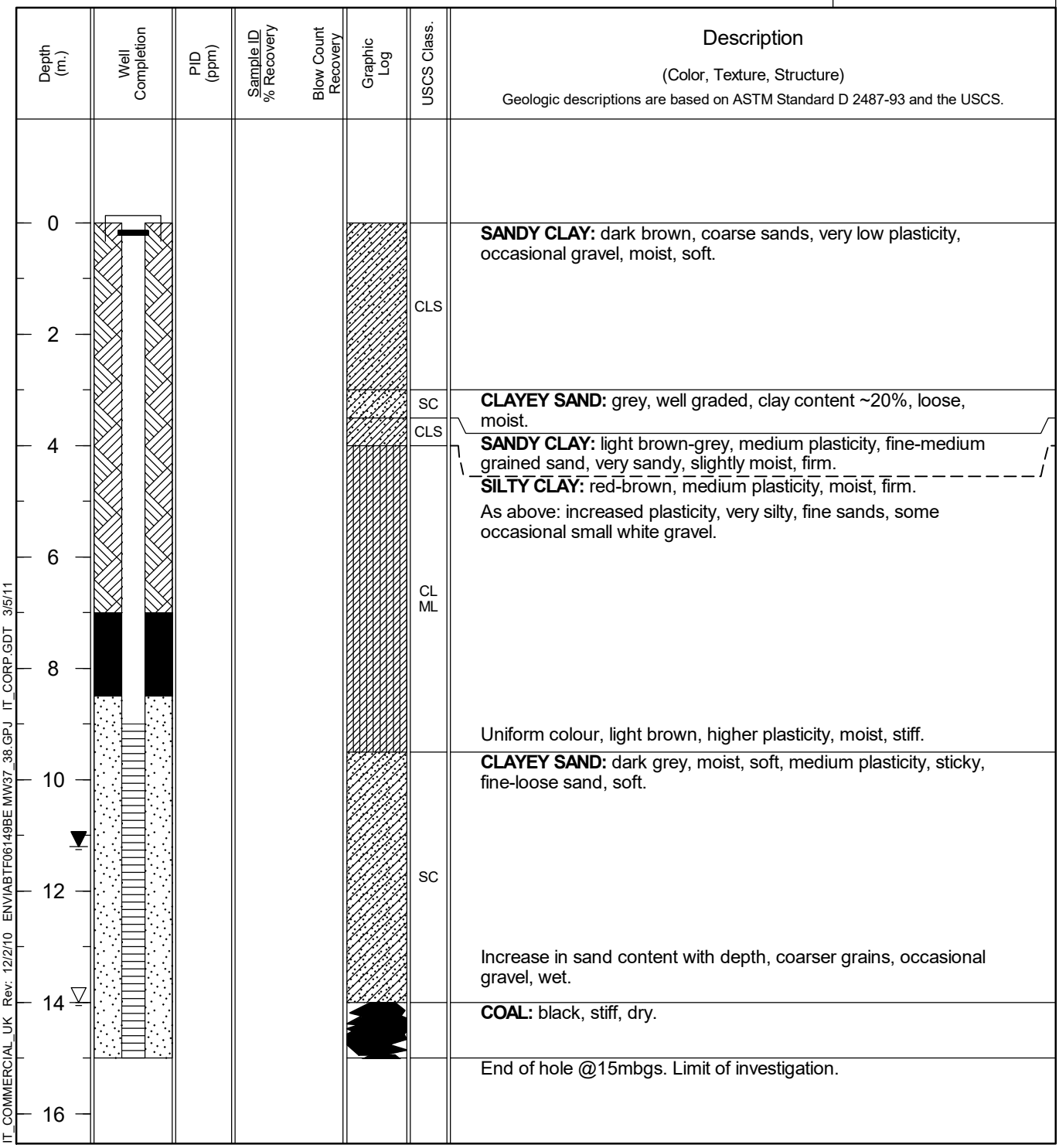
coffey environments **Drilling Log**

Monitoring Well **MW38**

Project	Alcoa Anglesea Powerstation ERA	Owner	Alcoa Australia Pty Ltd		
Location	Anglesea Powerstation			Proj. No.	ENVIABTF06149BE
Surface Elev.	NA	Total Hole Depth	15.0 m.	North	East
Top of Casing	NA	Water Level Initial	▽ 14.0 m.	Static	▼ 11.2 m.
Screen: Dia	50 mm.	Length	6 m.	Type/Size	Class 18 uPVC/0.5 mm.
Casing: Dia	50 mm.	Length	9 m.	Type	Class 18 uPVC
Fill Material	Sand/Bentonite/Grout			Rig/Core	EVH7720 DT Geoprobe
Drill Co.	South Western Drilling	Method	Hand Auger/Solid Stem Auger		
Driller	P. Maule	Log By	D. White	Date	19/4/11
Checked By	C. Molloy	License No.	0792		

Diameter: 50 mm. Permit #: WLE049554

COMMENTS



EHS Support

Drilling Log
Monitoring Well ID: MW050 (SB014)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 02-Oct-19	Total Depth (mbgs): 12.00	
Ground Surface (m AHD): 11.08	Top Casing (m AHD): 11.818	Easting (m): 253869.8	Northing (m): 5747565.4
Hole Dia. (mm): 60/150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 7.41	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 738
Screen Dia. (mm): 50	Length (m): 5.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 6.50	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113505
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m		SC	Gravelly Clayey SAND (FILL): dark grey; loose; wet; with crushed rock.
			0.40-0.60 m			CL	Sandy CLAY (FILL): low plasticity, grey to brown; firm; with coarse grained sand.
			0.80-1.00 m				
1				S 1.20-2.40 m			
							Black gravelly lense with coal at 1.5mbgs.
			1.80-2.00 m				
2						CL	Sandy CLAY: low plasticity, brown; firm.
				S 2.40-3.60 m		SC	Clayey SAND: fine to medium grained, orange; dense.
			2.80-3.00 m				
3							Becomes grey to orange, medium to coarse grained and slightly wet sand from 3.2mbgs.
				S 3.60-4.80 m		CL	Sandy CLAY: low plasticity; firm; with fine to medim grained sands.
			3.80-4.00 m				
4						SC	Clayey SAND: fine grained, grey.
						CL	Sandy CLAY: low plasticity, grey; soft; with fine grained sand.
			4.80-5.00 m	S 4.80-6.00 m		SW	Gravelly SAND: fine to coarse grained, well graded, dark grey; loose; moist; with rounded to angular gravel.
5						SC	Clayey SAND: fine grained, grey; dense; moist.
			5.80-6.00 m				
6				S 6.00-7.20 m		SW	Gravelly SAND: well graded, grey; loose; with sub-rounded gravels up to 4.0mm in diameter.
						SC	Clayey SAND: fine grained, grey; dense; with some gravelly lenses.

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW050 (SB014)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 02-Oct-19	Total Depth (mbgs): 12.00	
Ground Surface (m AHD): 11.08	Top Casing (m AHD): 11.818	Easting (m): 253869.8	Northing (m): 5747565.4
Hole Dia. (mm): 60/150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 7.41	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 738
Screen Dia. (mm): 50	Length (m): 5.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 6.50	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113505
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
7			6.80-7.00 m	S 6.00-7.20 m		SM	Silty SAND: fine grained, brown; dense. *(continued)*
				S 7.20-8.40 m		ML	Clayey SILT: light brown to grey; soft; with traces of peat.
						ML	Clayey SILT: pale brown; firm.
8			7.80-8.00 m			CL	Push Tube terminated at 8.0mbgs CLAY: medium plasticity, light brown to grey; very moist.
9				S 8.40-9.60 m			
10				S 9.60-10.80 m			Becomes moist at 10.0mbgs.
11				S 10.80-12.00 m			
12							COAL: coal layer.
							Hole Terminated at 12.00 m Target depth reached and well installed
13							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

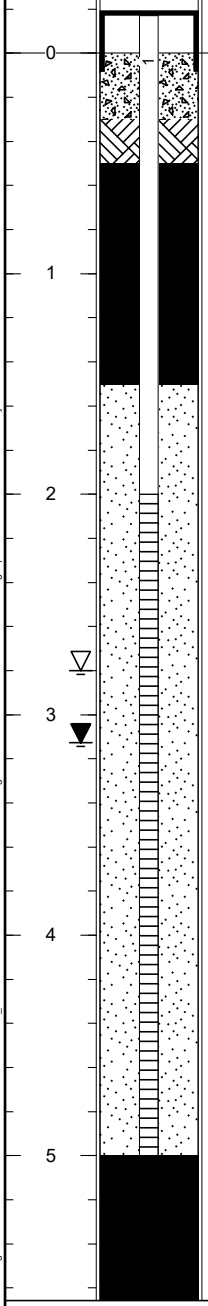
EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW051 (SB032)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 8.10	
Ground Surface (m AHD): 10.78	Top Casing (m AHD): 11.472	Easting (m): 253923.1	Northing (m): 5747489.3
Hole Dia. (mm): 65	Water Level Initial (mbgs): 2.80	Water Level Static (mbgs): 3.13	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 692
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113506
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: P Matheson	Checked By:



Depth (m)	Sample Collected	% Recovery	USCS Classification	Material Description
0	0.00-0.35 m	S 0.00-1.20 m Rec=92%	CL	Gravelly Sandy CLAY (FILL): medium plasticity, dark brown; firm; dry; with fine to coarse grained sand (approximately 30%) and fine to coarse grained gravel (approximately 20%).
	0.40-0.60 m		CL	CLAY: medium plasticity, brown to orange with light grey mottling; stiff; moist.
	0.80-1.10 m		CL	Sandy CLAY: medium plasticity, brown to orange; firm; with fine to medium grained sand (approximately 30%).
1			CL	CLAY: medium plasticity, light grey mottling; stiff; moist.
		S 1.20-2.40 m Rec=88%	CL	Sandy CLAY: medium plasticity, brown; firm; with fine to medium grained sand (approximately 30%).
			SM	Silty SAND: fine to medium grained, orange to brown; dense; moist; with silty matrix (approximately 30%).
2	1.80-2.00 m			
		S 2.40-3.60 m Rec=88%		
	2.80-3.00 m			Moist to wet from 2.8mbgs.
3				Dark brown from 3.1mbgs. Brown with grey motting from 3.2mbgs.
		S 3.60-4.80 m Rec=83%		
4	4.10-4.30 m			Black and slight grease/oil odour from 4.1 - 4.4mbgs.
			CL	Sandy CLAY: medium plasticity, brown to grey; stiff; moist; with fine to coarse grained sand (approximately 20%).
	4.80-5.30 m	S 4.80-6.00 m Rec=75%	CL	CLAY: medium plasticity, brown with red mottling; stiff. Grey with red mottling from 4.7mbgs.
5				Brown with grey mottling from 5.4mbgs.

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW051 (SB032)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 8.10	
Ground Surface (m AHD): 10.78	Top Casing (m AHD): 11.472	Easting (m): 253923.1	Northing (m): 5747489.3
Hole Dia. (mm): 65	Water Level Initial (mbgs): 2.80	Water Level Static (mbgs): 3.13	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 692
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113506
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
6			5.80-6.00 m	S 4.80-6.00 m Rec=75%		CL	Brown from 5.6mbgs. CLAY: medium plasticity, brown with red mottling; stiff. *(continued)* Grey from 5.8mbgs.
				S 6.00-7.20 m Rec=100%			
7			6.90-7.10 m				Brown with grey mottling from 6.6mbgs. Grey with brown mottling from 6.8mbgs. Black from 7.0mbgs. Grey from 7.1mbgs.
				S 7.20-8.10 m Rec=89%			
8			7.80-8.00 m			CL	Sandy CLAY: medium plasticity, grey; firm; moist; with fine to medium grained sand (approximately 30%). Push Tube terminated at 8.0mbgs
							Hole Terminated at 8.10 m Target depth reached and well installed
9							
10							
11							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW052 (SB036)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 29-Oct-19	Total Depth (mbgs): 12.30	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): 11.674	Easting (m): 253898.3	Northing (m): 5747517.9
Hole Dia. (mm): 150/60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 11.88	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 774
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 9.30	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113507
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m			(FILL): Crushed rock, dark grey, loose, wet.
			0.40-0.60 m			SC	Gravelly Clayey SAND (FILL): brown; compacted.
1			0.80-1.00 m				
				S 1.20-2.40 m			
			1.80-2.00 m			CL	Sandy CLAY (FILL): low plasticity, brown to grey; firm; with fine to medium grained sand, some gravels and traces of coal ash.
2							Becomes soft at 2.0mbgs.
				S 2.40-3.60 m			Becomes brown to grey and very moist at 2.5mbgs.
3			2.80-3.00 m				Becomes orange to grey from 3.0mbgs.
				S 3.60-4.80 m			Wet, gravelly lense at 3.6mbgs.
4			3.80-4.00 m				
			4.80-5.00 m	S 4.80-6.00 m		CH	CLAY: high plasticity, grey; soft.
5							Becomes light grey and moist from 5.0mbgs.
			5.80-6.00 m			SC	Clayey SAND: grey; moist.
6				S 6.00-7.20 m		CL	Sandy CLAY: grey; moist.
						SC	Clayey SAND: fine to medium grained, grey; dense.

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW052 (SB036)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 29-Oct-19	Total Depth (mbgs): 12.30	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): 11.674	Easting (m): 253898.3	Northing (m): 5747517.9
Hole Dia. (mm): 150/60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 11.88	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 774
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 9.30	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113507
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
7			6.80-7.00 m	S 6.00-7.20 m		SW	Gravelly SAND: well graded, brown; loose; high gravel fraction 25%, with rounded-angular quartz gravel, mostly rounded, up to 1.5cm diameter. *(continued)*
				S 7.20-8.40 m		ML	Clayey SILT: pale brown; stiff.
8						CL	Push Tube terminated at 8.0mbgs Silty CLAY: low plasticity, brown to grey; dry to moist.
9				S 8.40-9.60 m			
				S 9.60-10.80 m			
10							
11				S 10.80-12.30 m			
12							COAL: coal layer.
							Hole Terminated at 12.30 m Target depth reached and well installed
13							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

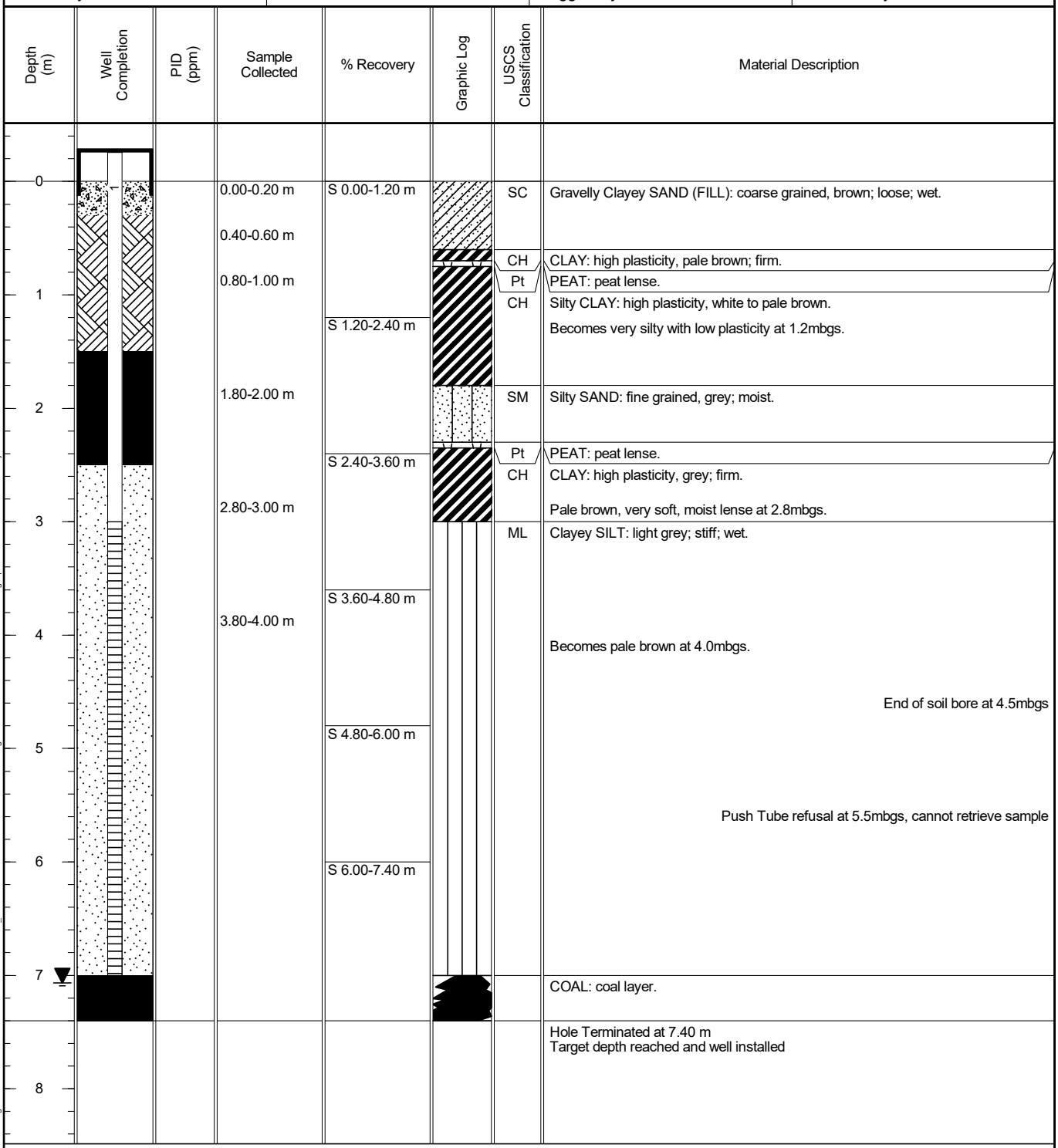
EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW053 (SB083)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-Jun-19	Date Finished: 02-Oct-19	Total Depth (mbgs): 7.40	
Ground Surface (m AHD): 10.92	Top Casing (m AHD): 11.608	Easting (m): 253913.6	Northing (m): 5747601.4
Hole Dia. (mm): 150/60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 7.07	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 688
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113508
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:



EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW054 (SB098)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 05-Jun-19	Date Finished: 02-Sep-19	Total Depth (mbgs): 8.20	
Ground Surface (m AHD): 10.73	Top Casing (m AHD): 11.506	Easting (m): 253954.5	Northing (m): 5747522.4
Hole Dia. (mm): 150/60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 776
Screen Dia. (mm): 50	Length (m): 5.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113509
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m		CL	Sandy Gravelly CLAY (FILL): black to brown; moist; with coal ash.
							(FILL) ROAD BASE: with orange, coarse sand and quartz gravel.
			0.40-0.60 m			SW	Gravelly SAND (FILL): fine to medium grained, light brown; wet.
1			0.80-1.00 m			SC	Clayey Gravelly SAND (FILL): fine to medium grained, brown to grey; moist.
				S 1.20-2.40 m			
2			1.80-2.00 m			CH	Silty CLAY: high plasticity, grey with light brown steaks; stiff.
				S 2.40-3.60 m			Becomes white with red streaks at 2.5mbgs.
3			2.80-3.00 m				
				S 3.60-4.80 m			
4			3.80-4.00 m			ML	Clayey SILT: light grey; soft; moist.
							Becomes stiff at 4.5mbgs.
5			4.80-5.00 m	S 4.80-6.00 m			
						CH	CLAY: high plasticity, grey; firm.
6			5.80-6.00 m				Becomes moist at 6.0mbgs.
				S 6.00-7.20 m		CL	Silty CLAY: low plasticity, grey; stiff; moist; very silty.
7			6.80-7.00 m			CH	CLAY: high plasticity, brown; firm.
				S 7.20-8.20 m			
8			7.80-8.00 m				COAL: coal layer.
							Push Tube terminated at 8.0mbgs
9							Hole Terminated at 8.20 m Target depth reached and well installed

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:40 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW055 (SB106)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): 10.89	Top Casing (m AHD): 11.656	Easting (m): 253967.9	Northing (m): 5747414.7
Hole Dia. (mm): 150/60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 3.83	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 766
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113510
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m 0.40-0.60 m	S 0.00-1.20 m		SW	Gravelly SAND (FILL): dark grey to brown to black; loose; with traces of coal ash.
1			0.80-1.00 m	S 1.20-2.40 m		CH	CLAY: high plasticity, white with light brown streaks; firm.
2			1.80-2.00 m	S 2.40-3.60 m		SW	Gravelly SAND (FILL?): medium to coarse grained; medium dense; moist; with quartz gravel up to 1.0cm diameter.
						CH	CLAY: high plasticity, brown; firm.
						CL	Gravelly Sandy CLAY: low plasticity, brown; with medium grained sand and rounded gravel up to 5.0mm diameter.
3			2.80-3.00 m			SW	Gravelly SAND: coarse grained, dark grey to brown; loose.
						CL	Sandy Gravelly CLAY: low plasticity, light brown to grey; firm; wet; very sandy.
4	▼		3.80-4.00 m	S 3.60-4.80 m		SW	Gravelly SAND: medium to coarse grained; loose; wet; with gravel up to 5.0mm diameter.
						CL	Gravelly Sandy CLAY: low plasticity, grey; firm; wet; with coarse, orange sands.
						CH	Silty CLAY: high plasticity, grey; very stiff; wet.
5			4.80-5.00 m	S 4.80-6.00 m		CL	Sandy Gravelly CLAY: low plasticity, grey; wet; with medium to coarse grained sands, very sandy.
6			5.80-6.00 m	S 6.00-7.20 m		CH	Silty CLAY: high plasticity, grey with streaks of red and light brown; stiff; wet. Solid Stem Auger terminated at 6.0mbgs
7			6.80-7.00 m	S 7.20-8.00 m			
8			7.80-8.00 m				Hole Terminated at 8.00 m Target depth reached and well installed

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

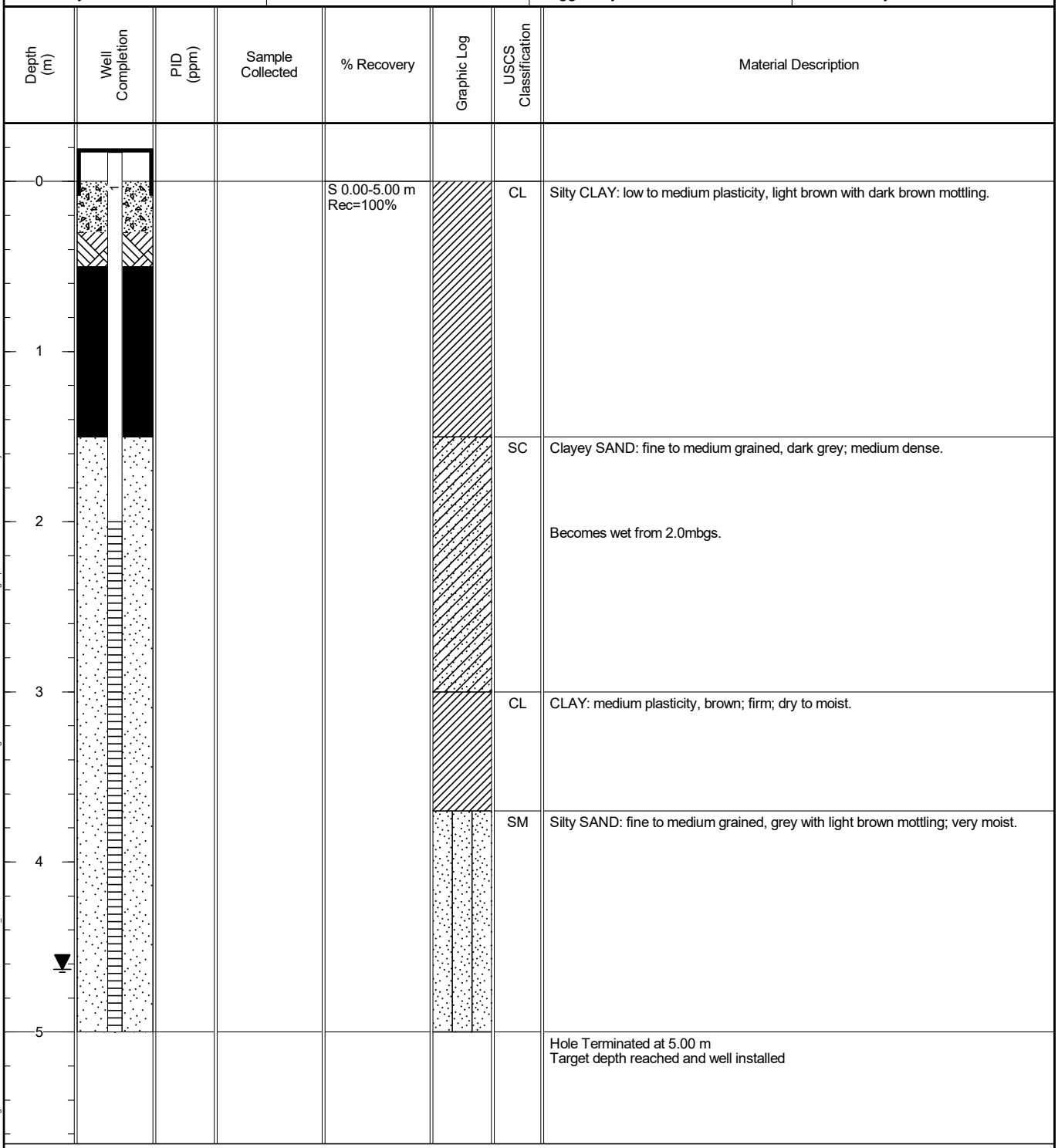
EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW056

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 25-Oct-19	Date Finished: 28-Oct-19	Total Depth (mbgs): 5.00	
Ground Surface (m AHD): 11.13	Top Casing (m AHD): 11.888	Easting (m): 253818.6	Northing (m): 5747602.9
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 4.63	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 758
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Solid Auger	Bore Permit #: WRK113511
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: P Matheson	Checked By:



EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW057 (SB109)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-May-19	Date Finished: 23-May-19	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): 10.34	Top Casing (m AHD): 10.244	Easting (m): 253906.5	Northing (m): 5747423.2
Hole Dia. (mm): 150	Water Level Initial (mbgs): 3.50	Water Level Static (mbgs): 3.42	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -96
Screen Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.50	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113512
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m Rec=83%		SM	Silty SAND (FILL): fine to medium grained, brown; dry to moist; with organic rootlets and well graded, sub-angular gravels present.
			0.40-0.60 m			SP	Gravelly SAND (FILL): well graded, sub-rounded, orange to red; loose; dry; with low plasticity minor fines; no odour.
1			0.90-1.10 m			CL	Silty CLAY: medium to high plasticity, brown; with minor sands.
			1.20-1.40 m	S 1.20-2.40 m Rec=83%		SW	Clayey lens at 1.2mbgs.
			1.60-1.80 m				Silty SAND: fine grained, poorly graded, grey to brown, mottled red, grey; dense; dry; with low to medium plasticity fines.
			1.80-2.00 m			CL	Clayey lens at 1.3mbgs. Coarse, sub-angular sand lens 1.6-16.5mbgs, no odour.
2			2.20-2.40 m				Silty CLAY: medium to high plasticity, light grey to off white, mottled orange; firm; grading to fine grained, moderately graded, dense sand.
				S 2.40-3.60 m Rec=83%			Sandy lens at 2.4mbgs, orange to brown, loose. AS ABOVE: with high plasticity, stiff.
3			2.80-3.00 m			SM	Silty SAND: fine to medium grained, well graded, orange to brown, mottled red; medium dense; moist.
				S 3.60-4.80 m Rec=83%			
4			3.80-4.00 m				Solid Stem Auger terminated at 4.5mbgs
			4.80-5.00 m	S 4.80-6.00 m Rec=67%		CL	Silty CLAY: low to medium plasticity, dark brown to black; moist; with possible coal and weathered fragments; organic odour.
5							
			5.80-6.00 m				
6				S 6.00-7.00 m Rec=100%		CH	
			6.80-7.00 m				
7				S 7.00-8.00 m Rec=100%			
			7.80-8.00 m				
8							Hole Terminated at 8.00 m Target depth reached and well installed
9							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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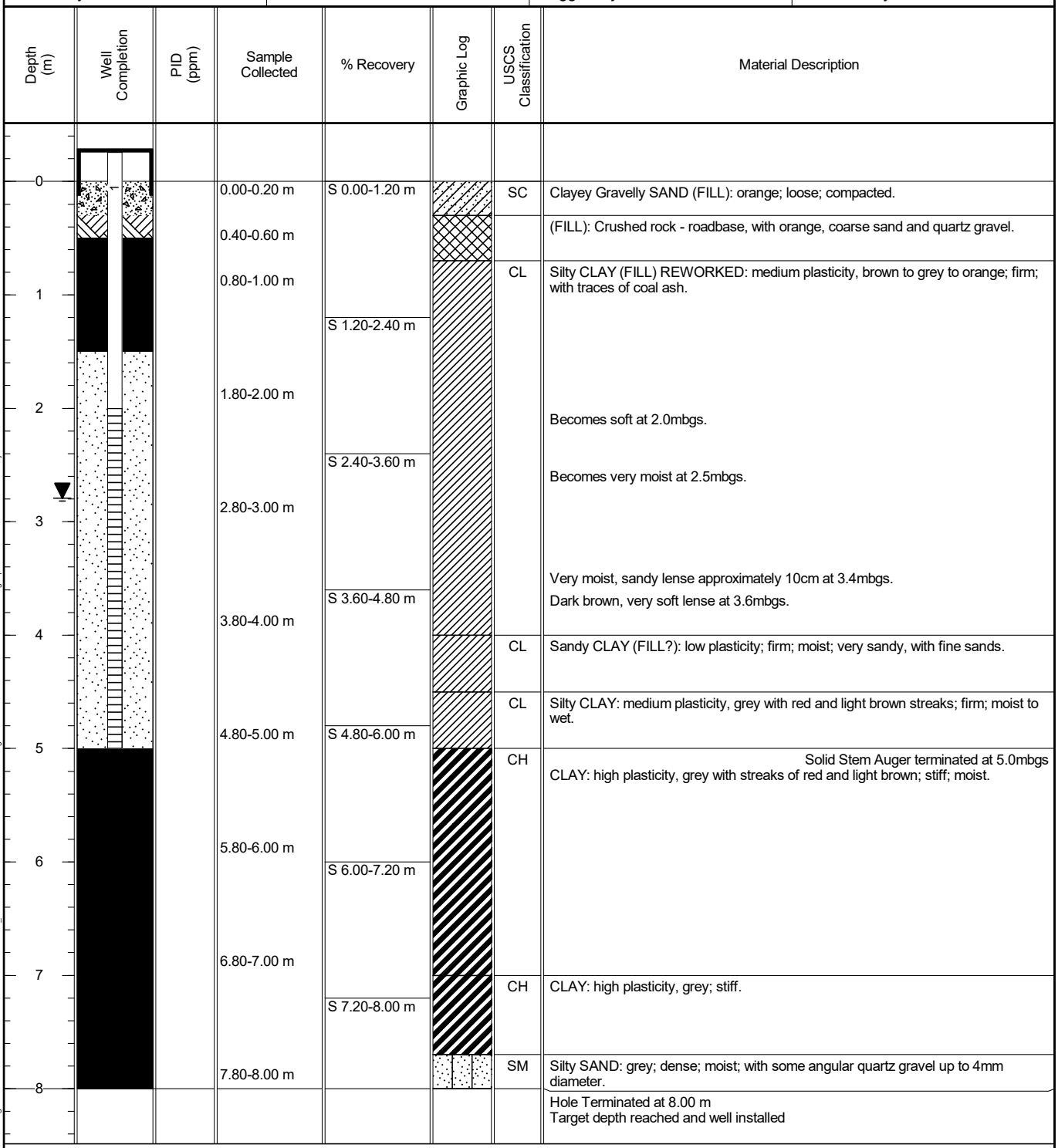
EHS Support

Drilling Log
Monitoring Well ID: MW058 (SB116)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 28-Oct-19	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): 10.76	Top Casing (m AHD): 11.431	Easting (m): 253882.8	Northing (m): 5747500.6
Hole Dia. (mm): 60/150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 2.79	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 671
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113513
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:



EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW059 (SB117)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 02-Oct-19	Total Depth (mbgs): 11.00	
Ground Surface (m AHD): 10.84	Top Casing (m AHD): 11.639	Easting (m): 253925.2	Northing (m): 5747520.5
Hole Dia. (mm):	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 6.91	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 799
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113514
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-1.00 m	S 0.00-1.20 m Rec=38%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, dark grey; stiff; moist; with fine to coarse grained gravel (approximately 10%) and traces of fine to coarse pebbles.
1						CL	Gravelly CLAY (FILL): medium plasticity, grey with brown mottling; firm; moist; with fine grained gravel (approximately 5%).
				S 1.20-2.40 m Rec=58%		CL	Sandy CLAY: medium plasticity, grey; moist; with firm to medium sand (approximately 40%).
2			1.70-2.00 m				
				S 2.40-3.60 m Rec=92%			
3			2.80-3.00 m			CL	CLAY: medium plasticity, grey with brown mottling; firm; moist.
				S 3.60-4.60 m Rec=85%		CL	Sandy CLAY: medium plasticity, dark grey to brown; moist; with fine to medium grained sand (approximately 30%). Brown to grey from 3.6mbgs.
4			3.80-4.10 m				Red to brown from 4.2mbgs.
				S 4.60-5.60 m Rec=100%			Brown and grey mottling from 4.5mbgs.
5			5.00-5.30 m				Slight diesel odour from 4.9mbgs. Dark grey, soft, moist to wet, moderate diesel odour and traces of fine grained gravel from 5.1mbgs.
				S 5.60-6.60 m Rec=100%		CL	Silty CLAY: medium plasticity, light grey; stiff; moist; with silt (approximately 30%); hydrocarbon diesel odour.
6			5.80-6.00 m			CL	CLAY: medium plasticity, light brown; stiff; moist. Brown, soft and moist to wet from 6.4mbgs.

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW059 (SB117)

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 02-Oct-19	Total Depth (mbgs): 11.00	
Ground Surface (m AHD): 10.84	Top Casing (m AHD): 11.639	Easting (m): 253925.2	Northing (m): 5747520.5
Hole Dia. (mm):	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 6.91	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 799
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113514
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
7			6.80-7.00 m	S 6.60-7.20 m Rec=100%		CL	CLAY: medium plasticity, light brown; stiff; moist. *(continued)*
				S 7.20-8.40 m Rec=100%			
8			7.80-8.00 m				Moist and stiff from 7.8mbgs.
				S 8.40-11.00 m		CL	Push Tube refusal at 8.4mbgs CLAY: medium plasticity, light brown; stiff; moist.
9							Soft from 9.0mbgs.
							COAL.
10							
11							Hole Terminated at 11.00 m Target depth reached and well installed
12							
13							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW060 (SB120)

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-May-19	Date Finished: 01-May-19	Total Depth (mbgs): 12.20	
Ground Surface (m AHD): 11.52	Top Casing (m AHD): 11.265	Easting (m): 253750.8	Northing (m): 5747638.9
Hole Dia. (mm): 150	Water Level Initial (mbgs): 11.50	Water Level Static (mbgs): 12.16	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -255
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 8.20	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Hand Auger/Push Tube	Bore Permit #: WRK113515
Drilled By: S Ward	Driller's License: 0772	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.2	0.00-0.20 m	S 0.00-1.10 m Rec=55%		GW	Sandy Silty GRAVEL (FILL): well graded, sub-angular, medium brown; loose; dry; weathered; no odour.
			0.40-0.60 m				
			0.80-1.00 m				
1				S 1.10-2.30 m Rec=33%			AS ABOVE WITH: fine to coarse grained, angular, dark brown to black; rootlets present, large trace gravels, weathered.
			1.80-2.00 m				
2				S 2.30-3.50 m Rec=67%		GW	GRAVEL (FILL): well graded, grey; dry; basaltic gravels, highly weathered, vesicular; no odour.
						CL	Assumed natural at 2.7mbgs Silty CLAY: well graded, dark brown, black; stiff; dry.
			2.80-3.00 m				
3						CH	Silty CLAY: medium to high plasticity, red brown to orange brown, light grey mottling; very stiff; dry; no odour.
				S 3.50-4.70 m Rec=100%		CH	Sandy Silty CLAY: high plasticity, brown to orange with minor grey mottling; very stiff; with poorly graded, fine grained sand; no odour. AS ABOVE WITH: increased grey mottling from 4.0mbgs.
			3.80-4.00 m				
4							
			4.80-5.00 m	S 4.70-5.80 m Rec=91%		SM	Gravelly Silty SAND: fine to coarse grained, red brown; moist; weathered.
5						CL	Silty Sandy CLAY: fine grained, poorly graded, medium plasticity, red to brown; stiff; moist; trace silt.
			5.80-6.00 m	S 5.80-6.60 m Rec=125%			Increasing moisture from 6.0mbgs.
6						CH	Silty CLAY: high plasticity, grey; very stiff; moist.
						CL	Sandy Clayey SILT: fine grained, poorly graded, light brown; stiff; dry to moist.
			6.70-7.00 m 6.80-7.00 m	S 6.60-7.00 m Rec=250%			
7							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW060 (SB120)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-May-19	Date Finished: 01-May-19	Total Depth (mbgs): 12.20	
Ground Surface (m AHD): 11.52	Top Casing (m AHD): 11.265	Easting (m): 253750.8	Northing (m): 5747638.9
Hole Dia. (mm): 150	Water Level Initial (mbgs): 11.50	Water Level Static (mbgs): 12.16	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -255
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 8.20	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Hand Auger/Push Tube	Bore Permit #: WRK113515
Drilled By: S Ward	Driller's License: 0772	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
				S 7.00-12.20 m Rec=100%		CL	Sandy Clayey SILT: fine grained, poorly graded, light brown; stiff; dry to moist. *(continued)*
							Push Tube terminated at 7.0mbgs
8			7.80-8.00 m			SC	Clayey SAND: fine grained, low plasticity, medium brown to orange brown; moist; no odour.
9			8.80-9.00 m				
10			9.80-10.00 m			SM	Clayey Silty SAND: fine grained, low plasticity, brown to orange brown; moist; hard bands; no odour.
11	▽		10.80-11.00 m				Grading to coal from 11.5mbgs, slight sulphuric organic putrid odour.
12	▼		11.80-12.00 m				Hole Terminated at 12.20 m Target depth reached and well installed
13							
14							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW061 (SB123)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-May-19	Date Finished: 07-May-19	Total Depth (mbgs): 14.00	
Ground Surface (m AHD): 11.89	Top Casing (m AHD): 11.811	Easting (m): 253852.9	Northing (m): 5747631.8
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -79
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 8.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger/Push Tube	Bore Permit #: WRK113516
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m Rec=100%		GP	Sandy GRAVEL: medium to coarse grained, poorly graded, black to brown; dry to moist; some silts; no odour.
			0.40-0.60 m			CL	Silty CLAY: low plasticity, light brown; stiff; dry; some gravel; no odour.
							COAL SEAM: brown; dry.
			0.80-1.00 m			CH	CLAY: high plasticity, light brown to dark brown to white; soft; dry to moist; no odour.
1				S 1.20-2.40 m Rec=83%			
			1.80-2.00 m			SM	Sandy SILT: fine grained, brown; dry; no odour. White from 2.2-2.4mbgs.
2				S 2.40-3.60 m Rec=100%		CH	CLAY: high plasticity, light brown to orange to white; some gravel, fine grained, poorly graded; no odour.
			2.80-3.00 m				
3				S 3.60-4.80 m Rec=100%		SM	SAND: fine grained, poorly graded, white, becoming mottled orange; dry; no odour.
			3.80-4.00 m			CL	CLAY: low plasticity, white; very stiff; dry; no odour.
4						ML	SILT: fine grained, well graded, white to yellow; dry; no odour.
			4.80-5.00 m	S 4.80-6.00 m Rec=100%		CH	CLAY: high plasticity, yellow to orange; stiff; dry; no odour.
5						CL	Silty CLAY: low plasticity, yellow to orange; stiff; dry.
			5.80-6.00 m			CH	CLAY: high plasticity, yellow to light brown; stiff; dry; no odour.
6				S 6.00-7.20 m Rec=100%		SM	Silty SAND: fine grained, poorly graded, white; dry; no odour.
						CL	Sandy CLAY: non plastic, dark brown; stiff; dry; possibly bown coal; no odour.
			6.80-7.00 m				
7				S 7.20-8.40 m Rec=100%		ML	SILT: non plastic, light brown to white; stiff; dry; no odour.
			7.80-8.00 m				
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Monitoring Well ID: MW061 (SB123)

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-May-19	Date Finished: 07-May-19	Total Depth (mbgs): 14.00	
Ground Surface (m AHD): 11.89	Top Casing (m AHD): 11.811	Easting (m): 253852.9	Northing (m): 5747631.8
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -79
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 8.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger/Push Tube	Bore Permit #: WRK113516
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
				S 7.20-8.40 m Rec=100%		ML	SILT: non plastic, light brown to white; stiff; dry; no odour. *(continued)*
				S 8.40-9.60 m Rec=100%		CL	Silty CLAY: non plastic, light brown; stiff; dry; no odour.
9			8.80-9.00 m				
			9.60-10.20 m	S 9.60-10.20 m Rec=33%		CH	CLAY: medium plasticity, light brown to brown; stiff; dry; no odour.
10						CH	CLAY: high plasticity, brown; very stiff; dry; no odour. Push Tube refusal at 10.2mbgs. Solid Auger to target depth.
11				S 11.00-12.00 m Rec=100%			COAL: non plastic, dark brown; dry; strong hydrocarbon odour. Sample collected from auger every metre from 11.0mbgs.
12				S 12.00-13.00 m Rec=100%			
13				S 13.00-14.00 m Rec=100%			
14							Hole Terminated at 14.00 m Target depth reached and well installed
15							
16							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW062 (SB124)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 11.00	
Ground Surface (m AHD): 8.85	Top Casing (m AHD): 9.619	Easting (m): 253795.3	Northing (m): 5747574.3
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 9.62	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 769
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 6.10	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger/Push Tube	Bore Permit #: WRK113517
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m 0.40-0.60 m 0.80-1.20 m	S 0.00-1.20 m Rec=75%		CL	Clayey SILT: low plasticity, black; stiff; dry; no odour.
1				S 1.20-2.40 m Rec=100%		CH	CLAY: high plasticity, orange to grey; stiff; dry to moist; no odour.
						SM	Silty SAND: light brown to grey; loose; dry; no odour.
2			1.80-2.00 m			CL	CLAY: orange to grey; stiff; dry to moist; no odour.
				S 2.40-3.60 m Rec=100%		CH	CLAY: high plasticity, grey to red to orange; stiff; dry to moist; no odour.
3			2.80-3.00 m				
				S 3.60-4.80 m Rec=92%		CL	CLAY: medium plasticity, brown to orange; stiff; moist; with sand, poorly graded; no odour.
4						CH	CLAY: high plasticity, red to orange to grey; stiff; dry to moist; no odour.
						SM	Silty SAND: ornage to yellow to white to grey; medium dense; moist; no odour.
5			4.80-5.00 m	S 4.80-5.40 m Rec=83%			
				S 5.40-6.60 m Rec=83%		CH	CLAY: high plasticity, light brown to brown, mottled grey; moist; some sand, medium grained, poorly graded; no odour.
6			5.80-6.00 m				

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Monitoring Well ID: MW062 (SB124)

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 11.00	
Ground Surface (m AHD): 8.85	Top Casing (m AHD): 9.619	Easting (m): 253795.3	Northing (m): 5747574.3
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 9.62	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 769
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 6.10	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger/Push Tube	Bore Permit #: WRK113517
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
7			6.80-7.00 m	S 6.60-7.80 m Rec=100%		SM	Silty SAND: medium grained, poorly graded, light brown to white; moist; no odour. *(continued)*
						CH	CLAY: medium plasticity, light grey to white; very stiff; moist; no odour.
						SM	Silty SAND: medium grained, well graded, light grey to white; moist; no odour. Becoming orange at 7.7mbgs.
8			7.80-8.00 m	S 7.80-9.00 m Rec=75%		SP	SAND: fine to medium grained, poorly graded, orange; moist to wet; no odour.
						SP	SAND: medium to coarse grained, well graded, light grey to white; moist to wet.
9			8.80-9.00 m	S 9.00-10.20 m Rec=92%		SW	Silty SAND: fine grained, well graded, light brown to white, mottled orange; wet; no odour.
10			9.80-10.00 m	S 10.20-11.00 m Rec=100%		SP	SAND: fine to medium grained, poorly graded, light brown to orange; wet; no odour. Push Terminated at 10.2mbgs Drilled to 11.0mbgs however sands have collapsed back to 10.1mbgs
11							Hole Terminated at 11.00 m Target depth reached and well installed
12							
13							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW063 (SB131)

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): 11.24	Top Casing (m AHD): 11.955	Easting (m): 254004.2	Northing (m): 5747470.5
Hole Dia. (mm): 150/60	Water Level Initial (mbgs): 3.00	Water Level Static (mbgs): 6.02	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 715
Screen Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113518
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: M Reynolds	Checked By:

Depth (m)	PID (ppm)	Sample Collected	% Recovery	USCS Classification	Material Description
0	0.3	0.00-0.20 m	S 0.00-1.20 m Rec=67%	SW	Gravelly SAND (FILL): brown; loose; moist to wet; with tree roots.
				CL	Silty CLAY (FILL): medium plasticity; moist; with minor gravel and sand.
	0.3	0.40-0.60 m		SW	Gravelly SAND: fine to coarse grained, well graded, orange; loose; moist to wet.
	0.4	0.80-1.00 m		CH	Silty CLAY: high plasticity, pale brown to white; firm; moist; some sandy clay lenses.
1				SP	Silty SAND: fine grained, poorly graded, grey brown; very loose; wet.
			S 1.20-2.40 m Rec=83%	CH	Silty CLAY: high plasticity, pale brown to white; firm; moist.
				SP	Clayey SAND: fine grained, poorly graded, pale orange and brown; dense; moist; with silt and clay.
2	0.2	1.80-2.00 m			
			S 2.40-3.60 m Rec=75%	SP	Silty SAND: fine grained, poorly graded, grading from light brown and grey to dark grey; loose; moist.
					Clay lense.
	0.2	2.80-3.00 m		SP	Silty SAND: fine grained, poorly graded, orange and brown; loose; moist.
3 ▽				CH	CLAY: high plasticity, light grey and ornage mottling; stiff; moist.
	0.2	3.80-4.00 m	S 3.60-4.80 m Rec=75%		
4					Becomes wet at 4.0mbgs.
					Minor sand from 4.5mbgs.
	0.2	4.80-5.00 m	S 4.80-6.00 m Rec=67%	SW	SAND: medium to coarse grained, well graded, orange; loose; dry to moist.
5				CL	Silty CLAY: medium plasticity, brown; soft; wet.
				SM	Silty SAND: fine to coarse grained, well graded, grey and orange; dense; moist to wet.
				CL	CLAY: medium plasticity, grey; stiff; moist to wet.
6 ▼			S 6.00-7.00 m Rec=120%		Becomes brown from 6.0mbgs.
					Becomes orange to red from 6.3mbgs.
				CL	Silty CLAY: low plasticity, brown grading to light brown; very soft; wet; with trace fine sand.
7				CH	CLAY: high plasticity, light grey; stiff; moist.
					Push Tube terminated at 7.0mbgs
8					Hole Terminated at 8.00 m Target depth reached and well installed

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW064

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-May-19	Date Finished: 23-May-19	Total Depth (mbgs): 13.00	
Ground Surface (m AHD): 6.66	Top Casing (m AHD): 6.553	Easting (m): 253614.4	Northing (m): 5747194.7
Hole Dia. (mm): 150	Water Level Initial (mbgs): 12.00	Water Level Static (mbgs): 10.70	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -107
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 7.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: AD/Push Tube/V	Bore Permit #: WRK113519
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m Rec=83%			Gravelly CLAY: with crushed rock, grass and rootlets.
			0.40-0.60 m			CL	Silty CLAY: low to medium plasticity, brown, mottled grey to orange; dry; with some fine grained, poorly graded sand; no odour.
			0.80-1.00 m				
1							Increasing medium to high plastcity clay content with depth.
				S 1.20-2.40 m Rec=92%			
			1.80-2.00 m				
2							
				S 2.40-3.60 m Rec=92%		CL	Sandy Silty CLAY: low to medium plasticity, grey mottled orange; stiff; dry.
			2.80-3.00 m				
3							
			3.40-3.60 m			ML	Clayey SAND: fine grained, poorly graded, light brown to grey; medium dense; moist; with non to low plasticity clay.
				S 3.60-4.80 m Rec=92%		CH	Silty CLAY: high plasticity, brown mottled orange; stiff.
			3.80-4.00 m				Black region (0.05m thick).
4							
						CL	Sandy CLAY: low to medium plasticity, brown, mottled orange; dry to moist; with fine grained sand; no odour.
			4.80-5.00 m	S 4.80-6.00 m Rec=92%			Increasing clay content with depth.
5							
			5.80-6.00 m				
6				S 6.00-7.00 m Rec=110%			
						SM	Silty SAND: poorly graded, grey, mottled orange; loose; moist; with minor clay; no odour.
			6.80-7.00 m				
7							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW064

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-May-19	Date Finished: 23-May-19	Total Depth (mbgs): 13.00	
Ground Surface (m AHD): 6.66	Top Casing (m AHD): 6.553	Easting (m): 253614.4	Northing (m): 5747194.7
Hole Dia. (mm): 150	Water Level Initial (mbgs): 12.00	Water Level Static (mbgs): 10.70	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Gatic Cover	Headworks height (mm): -107
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 7.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: AD/Push Tube/V	Bore Permit #: WRK113519
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
8			7.80-8.00 m	S 7.00-8.00 m Rec=110%		SM	Silty SAND: poorly graded, grey, mottled orange; loose; moist; with minor clay; no odour. *(continued)*
				S 8.00-13.00 m Rec=100%			Increasing grain size to coarse grained pebbles.
							Push Tube terminated at 8.0mbgs
9			8.80-9.00 m				Descreasing sand grain size, light grey.
10			9.80-10.00 m				
						CL	Sandy CLAY: brown; moist; with fine grained sands.
11			10.80-11.00 m				
12			11.80-12.00 m				Saturated.
13							Hole Terminated at 13.00 m Target depth reached and well installed
14							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW065 (SB137)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-May-19	Date Finished: 24-May-19	Total Depth (mbgs): 8.20	
Ground Surface (m AHD): 11.57	Top Casing (m AHD): 12.377	Easting (m): 253768.6	Northing (m): 5747052.4
Hole Dia. (mm): 150	Water Level Initial (mbgs): 4.80	Water Level Static (mbgs): 3.46	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 807
Screen Dia. (mm): 50	Length (m): 3.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 4.20	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113520
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Tawse	Checked By:

Depth (m)	Sample Collected	% Recovery	USCS Classification	Material Description
0	0.00-0.20 m	S 0.00-1.20 m Rec=58%	CL	Grass and organic matter at surface.
	0.40-0.60 m			Silty CLAY: low plasticity, brown; dry; with well graded, loamy sand; no odour.
	0.80-1.00 m			
1	1.00-1.20 m		CL	Sandy CLAY: medium plasticity, brown; dry; with fine grained sand and plant roots.
		S 1.20-2.40 m Rec=67%	CL	Silty CLAY: medium to high plasticity, dark brown to grey and back; stiff; dry; with minor sands; no odour.
2	1.80-2.00 m			
		S 2.40-3.60 m Rec=67%	CL	Gravelly CLAY: low plasticity, dark brown to grey to black; moist; with poorly graded, sub-angular sand and gravel; no odour.
3	2.80-3.00 m		CL	Silty CLAY: medium plasticity, grey to brown, mottled light grey; moist; with fine sands present; no odour.
		S 3.60-4.80 m Rec=75%		Coal fragments present.
4	3.80-4.00 m		CL	Sandy CLAY: dark brown, grey; moist; with fine to coarse grained sand.
			SW	Sandy lense, grey to brown, fine to medium grained sand, moist, no odour.
5	4.80-5.00 m	S 4.80-6.00 m Rec=58%	SC	Clayey SAND: fine to medium grained, brown; wet; with low plasticity clay; no odour.
6	5.80-6.00 m		CL	Clay lense, brown to grey, medium plasticity, stiff with sand present.
		S 6.00-7.20 m Rec=83%	SC	Clayey SAND: fine to medium grained, brown to grey; loose; wet; with low plasticity clay; no odour.
7	6.80-7.00 m			
		S 7.20-8.20 m Rec=120%	CL	Silty CLAY: medium to high plasticity, grey mottled orange to red; stiff; moist; with fine grained silt; no odour. Solid Stem Auger to 7.2mbgs (collapse to 5.5mbgs), hollow auger to 7.2mbgs
8	7.80-8.00 m			
9				Hole Terminated at 8.20 m Borehole terminated on refusal at 8.2mbgs

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW066 (SB140)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-Jun-19	Date Finished: 06-Jun-19	Total Depth (mbgs): 10.00	
Ground Surface (m AHD): 11.17	Top Casing (m AHD): 11.878	Easting (m): 253965.6	Northing (m): 5747675.0
Hole Dia. (mm): 150	Water Level Initial (mbgs): 5.50	Water Level Static (mbgs): 4.43	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 708
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113521
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m			Crushed rock/ballast.
			0.40-0.60 m			CH	Silty CLAY (FILL): high plasticity, light brown; soft.
1			0.80-1.00 m	S 1.20-2.40 m		GW	GRAVEL (FILL): black; loose; with coal ash.
2			1.80-2.00 m	S 2.40-3.60 m		ML	Clayey SILT: pale brown; very stiff.
3			2.80-3.00 m	S 3.60-4.80 m		CL	Silty CLAY: light brown; hard. Push Tube refusal at 3.0mbgs
4				S 4.80-6.00 m		ML	Clayey SILT: pale brown; hard.
5							
6				S 6.00-7.20 m			Slightly moist at 6.0mbgs.

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW066 (SB140)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-Jun-19	Date Finished: 06-Jun-19	Total Depth (mbgs): 10.00	
Ground Surface (m AHD): 11.17	Top Casing (m AHD): 11.878	Easting (m): 253965.6	Northing (m): 5747675.0
Hole Dia. (mm): 150	Water Level Initial (mbgs): 5.50	Water Level Static (mbgs): 4.43	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 708
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 4.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113521
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
7				S 6.00-7.20 m		ML	Clayey SILT: pale brown; hard. *(continued)*
				S 7.20-8.40 m			Very moist at 7.0mbgs.
8				S 8.40-10.00 m			
9						CL	Silty CLAY: dark brown; soft; wet; very silty.
				9.60 m			
10							Hole Terminated at 10.00 m Target depth reached and well installed
11							
12							
13							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW067 (SB142)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-May-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 9.20	
Ground Surface (m AHD): 10.87	Top Casing (m AHD): 11.57	Easting (m): 253916.6	Northing (m): 5747646.1
Hole Dia. (mm): 150/150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 2.70	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 700
Screen Dia. (mm): 50	Length (m): 5.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.30	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113522
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=75%		GP-GC	Clayey GRAVEL: poorly graded, brown; wet; no odour.
			0.40-0.60 m			CH	CLAY: high plasticity, light brown, mottled dark brown; stiff; dry to moist; no odour.
			0.80-1.00 m				
1							CONCRETE.
				S 1.20-2.40 m Rec=100%		CH	CLAY: high plasticity, light brown to orange; stiff; dry to moist; no odour.
						SW-SM	Silty SAND: fine grained, well graded, yellow to orange; moist; no odour.
			1.80-2.00 m			CH	CLAY: high plasticity, light brown to orange; stiff; dry to moist; no odour.
2						MH	SILT: light brown to brown; soft; moist; no odour.
				S 2.40-3.60 m Rec=100%		CH	CLAY: high plasticity, black; soft; wet; no odour.
						CH	CLAY: high plasticity, brown; stiff; moist; no odour.
3			2.80-3.00 m				Becomes wet from 3.0mbgs.
						CH	CLAY: low plasticity, black; stiff; wet; no odour.
						CL	CLAY: low plasticity, light brown; stiff; wet; *expansive silt/clay from 7.8 - 7.75mbgs; no odour.
				S 3.60-4.80 m Rec=100%			
4			3.80-4.00 m				
			4.80-5.00 m	S 4.80-5.40 m Rec=200%		ML	SILT: non plastic, light brown; soft; dry; friable.
5				S 5.40-6.00 m Rec=167%			Becomes dark brown, no odour from 5.2mbgs.

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW067 (SB142)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-May-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 9.20	
Ground Surface (m AHD): 10.87	Top Casing (m AHD): 11.57	Easting (m): 253916.6	Northing (m): 5747646.1
Hole Dia. (mm): 150/150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 2.70	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 700
Screen Dia. (mm): 50	Length (m): 5.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 2.30	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113522
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
6			5.80-6.00 m	S 5.40-6.00 m Rec=167%		ML	SILT: non plastic, light brown; soft; dry; friable. *(continued)*
				S 6.00-6.60 m Rec=200%			Expansive silt/clay resulting in short drill runs from 5.9-7.75mbgs.
7			6.80-7.00 m	S 6.60-7.20 m Rec=200%			
				S 7.20-7.80 m Rec=200%			Solid Stem Auger terminated at 7.2mbgs
8			7.80-8.00 m	S 7.80-8.40 m Rec=117%			COAL: Hydrocarbon odoour,.
				S 8.40-9.00 m Rec=117%			
9			8.80-9.00 m	S 9.00-9.20 m Rec=100%			Hole Terminated at 9.20 m Target depth reached and well installed
10							
11							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW068 (SB143)

Comments
Drilled to 13.0mbgs and left open for one week and remained dry. Drilled to 20.5mbgs and installed.

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 05-Jun-19	Date Finished: 07-Jun-19	Total Depth (mbgs): 20.50	
Ground Surface (m AHD): 11.06	Top Casing (m AHD): 11.798	Easting (m): 254095.7	Northing (m): 5747554.0
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 738
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 14.30	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113523
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.50 m Rec=100%		ML	Clayey SILT: light brown; firm.
			0.40-0.60 m			CL	Silty CLAY: low plasticity, grey to red to light brown; very silty.
			0.80-1.00 m				Hand Auger terminated at 1.5mbgs
			1.80-2.00 m	S 1.50-3.70 m		SW	Gravelly Clayey SAND: fine grained, grey; medium dense; with sub-angular quartz gravel up to 5.0mm diameter.
2						CL	Silty CLAY: low plasticity, grey with streaks of red and light brown; very stiff; very silty.
			2.80-3.00 m				
			3.80-4.00 m	S 3.70-4.90 m		ML	Clayey SILT: grey with streaks of red and light brown; very stiff.
4			4.80-5.00 m	S 4.90-6.10 m			
			5.80-6.00 m	S 6.10-7.20 m			
6			6.80-7.00 m			ML	SILT: pale brown; friable.
				S 7.20-8.00 m		ML	Clayey SILT: dark brown; friable. Becoming darker with depth.
			7.90-8.00 m	S 8.00-20.50 m Rec=100%		ML	Peaty CARBONATE SILT: black; dry. Push Tube refusal at 8.0mbgs
8							COAL: black.
10							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW068 (SB143)

Comments
Drilled to 13.0mbgs and left open for one week and remained dry. Drilled to 20.5mbgs and installed.

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 05-Jun-19	Date Finished: 07-Jun-19	Total Depth (mbgs): 20.50	
Ground Surface (m AHD): 11.06	Top Casing (m AHD): 11.798	Easting (m): 254095.7	Northing (m): 5747554.0
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 738
Screen Dia. (mm): 50	Length (m): 6.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 14.30	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113523
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
12				S 8.00-20.50 m Rec=100%			COAL: black. *(continued)*
14						ML	Clayey SILT: grey; stiff; moist.
16							COAL: black; dry.
18						SM	Silty SAND: fine grained, grey; moist.
20							Hole Terminated at 20.50 m Target depth reached and well installed

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW069 (SB005)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-May-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 11.00	
Ground Surface (m AHD): 9.02	Top Casing (m AHD): 9.736	Easting (m): 253790.8	Northing (m): 5747500.2
Hole Dia. (mm): 150/94	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 9.97	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 716
Screen Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 8.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113524
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		GC	Clayey GRAVEL: fine to coarse grained, well graded, dark brown; dry; with low plasticity clay and crushed rock present; no odour.
			0.40-0.60 m				
			0.60-0.80 m			SC	Clayey SAND: fine to coarse grained, sub-angular to angular, orange brown; medium dense to loose; dry; with quartz; no odour.
			0.80-1.00 m				AS ABOVE: with brown, fine to medium grained, medium dense sand.
1							Increasing low plasticity clay content with depth.
				S 1.20-2.40 m Rec=100%		CH	Silty CLAY: high plasticity, brown, dark brown to black, mottled grey to red; stiff; dry; no odour.
2			1.80-2.00 m				
				S 2.40-3.40 m Rec=80%		SC	Clayey SAND: fine grained, grey to brown; dry to moist.
						CH	Silty CLAY: medium to high plasticity, grey to brown; very stiff; dry to moist; with fine grained, dense sand.
3			2.80-3.00 m				
				S 3.40-4.40 m Rec=80%		CL	Sandy CLAY: low to medium plasticity, dark brown, grey to black mottled; moist.
						CH	Silty CLAY: medium plasticity, dark brown, mottled light grey; very stiff; dry.
4			3.80-4.00 m				
				S 4.40-5.50 m Rec=55%		SC	Clayey SAND: fine to medium grained; dry to moist; with non to low plasticity clay.
						CH	Silty CLAY: high plasticity, red with grey to brown mottling; very stiff; dry; no odour.
5			4.80-5.00 m				
				S 5.50-6.60 m Rec=100%			Various colour changes with depth (brown, orange brown, red, light grey, dark brown).
6			5.80-6.00 m				

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Monitoring Well ID: MW069 (SB005)

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-May-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 11.00	
Ground Surface (m AHD): 9.02	Top Casing (m AHD): 9.736	Easting (m): 253790.8	Northing (m): 5747500.2
Hole Dia. (mm): 150/94	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): 9.97	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: Monument	Headworks height (mm): 716
Screen Dia. (mm): 50	Length (m): 2.00	Type/Size (mm): Class 18 PVC 50 / 0.5 Slotted	
Casing Dia. (mm): 50	Length (m): 8.00	Type/Size (mm): Class 18 PVC 50	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube/Solid Auger	Bore Permit #: WRK113524
Drilled By: B Steenvoorden	Driller's License: 0714	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
7			6.80-7.00 m	S 6.60-7.50 m Rec=122%		CH	Silty CLAY: high plasticity, red with grey to brown mottling; very stiff; dry; no odour. *(continued)*
8			7.80-8.00 m	S 7.50-8.20 m Rec=100%			Becomes low to medium plasticity, dry to moist with increasing fine to medium grained sand content with depth.
9				S 8.20-11.00 m		SP	SAND: wet.
10							
11							Hole Terminated at 11.00 m Target depth reached and well installed
12							
13							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB001

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253725.2	Northing (m): 5747475.6
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			0.00-0.20 m 0.30-0.50 m	S 0.00-0.50 m Rec=100%		CH	CLAY: high plasticity, orange; soft; wet; no odour.
							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite

1.0 1.5 2.0 2.5 3.0 3.5 4.0

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:41 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB002

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253698.9	Northing (m): 5747460.4
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.10 m	S 0.00-0.50 m Rec=100%		SC	Clayey SAND: medium grained, well graded, medium plasticity, light brown to brown; loose; moist to wet.
			0.40-0.50 m			CH	CLAY: high plasticity, orange; stiff; moist to wet; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB003

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253743.1	Northing (m): 5747451.8
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-0.50 m Rec=100%		CH	CLAY: high plasticity, orange; soft; moist to wet; no odour.
			0.30-0.50 m			SC	Clayey SAND: well graded, yellow to orange; medium dense; dry to moist; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB004

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253785.5	Northing (m): 5747519.3
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: G Bourke	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5				S 0.00-0.50 m Rec=100%		SC	Clayey SAND: well graded, non plastic, brown; medium dense; dry; no odour.
							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite

1.0 1.5 2.0 2.5 3.0 3.5 4.0

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB006

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253795.2	Northing (m): 5747502.6
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-0.50 m Rec=100%		SC	Clayey SAND: medium grained, low plasticity, light brown, mottled orange; medium dense; moist to wet; with some gravel; no odour.
0.5			0.40-0.50 m			CH	CLAY: high plasticity, light brown; stiff; moist to wet; with some gravel; no odour.
							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB007

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253613.4	Northing (m): 5747518.5
Hole Dia. (mm): 50	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=58%		MH	SILT: dark brown to black, mottled orange; soft; moist; no odour.
0.5			0.40-0.60 m			CH	CLAY: high plasticity, orange to brown; stiff; moist; no odour.
			0.80-1.00 m			CH	CLAY: high plasticity, orange; stiff; dry to moist; no odour.
1.0							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB008

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253650.2	Northing (m): 5747570.3
Hole Dia. (mm): 50	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=100%		CL	CLAY: low plasticity, orange to dark brown; stiff; dry to moist; no odour.
			0.30-1.00 m			CL	CLAY: medium plasticity, brown to orange; stiff; dry; no odour.
0.5			0.40-0.60 m			SC	Clayey SAND: well graded, non plastic, light brown to brown mottled orange; dense; dry to moist; no odour.
						CL	CLAY: low plasticity, orange mottled grey; stiff; dry to moist; no odour.
1.0							
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB009

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253707.4	Northing (m): 5747541.3
Hole Dia. (mm): 50	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		CH	CLAY: high plasticity, light brown to brown; moist; no odour.
0.5			0.40-0.60 m				
			0.80-1.00 m			SC	Clayey SAND: brown mottled orange; loose; dry; no odour.
1.0						OL	Clayey ORGANIC SILT: light brown to brown; moist; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB010

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253717.7	Northing (m): 5747606.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		SM	Silty SAND: non plastic, yellow/orange/brown; dry; no odour.
						CH	CLAY: high plasticity, orange/brown; dry to moist; no odour.
0.5			0.40-0.60 m			SM	Silty SAND: well graded, light grey; dry; no odour.
						CH	CLAY: medium plasticity, light brown/orange mottled black; dry to moist; no odour.
1.0			0.80-1.00 m			SP-SC	Clayey SAND: poorly graded, low plasticity, light brown/orange; dry to moist; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB011

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253803.3	Northing (m): 5747512.0
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-0.50 m Rec=100%		SM	SAND: fine to medium grained, poorly graded, brown/orange; wet; no odour.
			0.40-0.50 m			CH	CLAY: medium plasticity, light brown/brown; stiff; dry to moist; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB012

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253809.9	Northing (m): 5747531.3
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-0.50 m Rec=100%		CL	CLAY: low plasticity, Brown; stiff; dry to moist; no odour.
			0.40-0.50 m			SC	Clayey SAND: well graded, light brown/brown; dry to moist; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB013

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253841.7	Northing (m): 5747560.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		1.8	0.00-0.20 m	S 0.00-1.20 m Rec=83%		SM	Silty SAND (FILL?): fine to coarse grained, well graded, low plasticity; loose; dry; with some gravels, weathered; no odour.
						SW	Gravelly SAND: fine to coarse grained, well graded, low plasticity, orange brown; no odour.
			0.40-0.60 m			CH	Bark/wood segment approximately 0.01 thick.
0.5							Assumed natural at ~0.4mbgs Silty CLAY: fine grained, medium to high plasticity, dark brown, mottled orange to brown; stiff; dry; no odour.
						SP	Clayey SAND: fine grained, poorly graded, low plasticity, orange to brown, mottled light brown to grey; dry; no odour.
			0.80-1.00 m			CH	Sandy Silty CLAY: fine grained, high plasticity, medium brown; stiff; dry to moist.
1.0							
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB015

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.12	Top Casing (m AHD): N/A	Easting (m): 253937.9	Northing (m): 5747631.0
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Gravelly Sandy CLAY (FILL): light brown; soft; moist.
						CL	Gravelly Sandy CLAY (FILL): low plasticity, dark brown; very soft; wet; with coal ash, coarse grained sand and quartz gravel.
0.5			0.40-0.60 m				
			0.80-1.00 m				
1.0						CH	Silty CLAY: high plasticity, light brown; soft.
							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB016

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253938.2	Northing (m): 5747624.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Sandy Gravelly CLAY: low plasticity, dark brown; firm; with coarse grained sand and quartz gravel.
0.5			0.40-0.60 m			CL	Peaty CLAY: black; soft.
			0.80-1.00 m			CH	Silty CLAY: high plasticity, pale brown; very stiff.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB017

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253927.8	Northing (m): 5747603.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		2.0	0.00-0.20 m	S 0.00-1.20 m Rec=83%		SM	Gravelly Silty SAND: fine to coarse grained, low plasticity, medium brown; loose; dry; no odour.
			0.40-0.60 m				
0.5							CONCRETE.
			0.80-1.00 m			CL	Sandy CLAY: fine to coarse grained, well graded, low plasticity, dark brown; loose; dry.
1.0		1.9				CL	Sandy CLAY: low to medium plasticity, dark brown to black; loose; dry; possible coal fragments,; no odour.
			1.20-1.40 m	S 1.20-2.40 m Rec=67%		CL	Assumed natural at ~1.2mbps Sandy Silty CLAY: poorly graded, medium plasticity, dark brown, mottled red-brown; stiff; moist; no odour.
1.5							
			1.80-2.00 m				
2.0						CH	Silty CLAY: fine grained, poorly graded, medium to high plasticity, light brown, mottled red brown; stiff; moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB018

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253922.3	Northing (m): 5747599.0
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		1.8	0.00-0.20 m	S 0.00-1.20 m Rec=75%		SM	Silty SAND: fine to coarse grained, well graded, sub-angular, low plasticity, medium brown; dry; with gravel, weathered; no odour.
0.5			0.40-0.60 m			SC	Clayey SAND: fine to coarse grained, low plasticity, orange to brown; firm; dry to moist; fine silts present; no odour.
						CL	Sandy CLAY: fine to medium grained, well graded, low to medium plasticity, medium brown; dry to moist; no odour.
						SC	Assumed natural at 0.65mbgs (difficult to visualise)
1.0			0.80-1.00 m				Clayey SAND: fine to coarse grained, low plasticity, orange to brown; firm; moist; quartz fragments; no odour.
						CL	Silty CLAY: fine grained, low plasticity, dark brown; possible coal fragments, mottled.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB019

Comments
Refusal at 0.6mbgs on suspected concrete, second attempt had refusal also at 0.6mbgs, abandon after second attempt, natural not encountered

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 0.60	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253930.8	Northing (m): 5747591.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		0.1	0.00-0.20 m	S 0.00-0.60 m Rec=100%		SM	Silty SAND: fine to coarse grained, well graded, sub-angular, low plasticity, light brown to medium brown; loose; dry; with some gravel, weathered; no odour.
			0.40-0.60 m			CL	Sandy CLAY: fine to coarse grained, well graded, low plasticity, medium to dark brown; loose; dry; no odour.
0.5							Hole Terminated at 0.60 m Borehole terminated on refusal at 0.6mbgs
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB020

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253923.5	Northing (m): 5747585.0
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.1	0.00-0.20 m	S 0.00-1.20 m Rec=92%		SM	Silty SAND: coarse grained, well graded, low plasticity, orange to brown to medium brown; loose; dry; some minor gravels and coarse sands; no odour.
						SC	Clayey SAND: fine to coarse grained, well graded, low plasticity, orange brown; loose; dry; various quartz fragments throughout, rootlets notes; no odour.
0.5		0.1	0.40-0.60 m				
		0.2	0.80-1.00 m			SC	Assumed natural at ~0.4 to 0.8mbgs Silty Clayey SAND: fine to medium grained, low plasticity, orange to brown, mottled red to brown; dry to moist; clay regions throughout, tightly packed.
1.0							
				S 1.20-2.00 m Rec=100%			
1.5							
		0.4	1.80-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB021

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253945.3	Northing (m): 5747622.4
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Gravelly Sandy CLAY (FILL): with medium to coarse grained sand and some coal ash.
0.5			0.40-0.60 m				
			0.80-1.00 m				(FILL): Crushed rock with rubble.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB022

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253948.1	Northing (m): 5747615.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Gravelly Sandy CLAY (FILL): hard; moist; compacted, with medium to coarse grained sand and some coal ash.
						SW	Gravelly SAND (FILL): medium to coarse grained, orange; loose; moist; with crushed rock (bluestone).
0.5			0.40-0.50 m			CH	Silty CLAY: high plasticity, grey; very stiff.
			0.80-1.00 m				
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB023

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253878.6	Northing (m): 5747561.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.1	0.00-0.20 m	0.00-1.20 m Rec=100%		SC	Silty Clayey SAND: fine to coarse grained, well graded, low plasticity, brown to light brown; loose; dry.
						SM	Silty SAND: fine to medium grained, well graded, low plasticity, mottled black; dense; with minor clay, coal present.
0.5			0.60-0.80 m			CL	Assumed natural at ~0.6mbgs Silty Sandy CLAY: fine grained, poorly graded, medium plasticity, dark brown, mottled grey, black; very stiff; dry; coal fragments.
			0.80-1.00 m				
1.0						SM	Clayey Silty SAND: fine grained, low plasticity; dry.
				1.20-2.40 m Rec=75%		CH	Silty CLAY: fine grained, poorly graded, medium to high plasticity, dark to medium brown, mottled; very stiff; no odour.
						SC	Clayey SAND: fine to coarse grained, low plasticity; dry to moist; no odour.
1.5						CL	Sandy CLAY: fine grained, poorly graded, medium plasticity, light grey to mottled orange to brown; very stiff; dry to moist.
			1.80-2.00 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB024

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253894.0	Northing (m): 5747573.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		2.0	0.00-0.20 m	S 0.00-1.20 m Rec=92%		SM	Silty SAND: fine to coarse grained, sub-angular to angular, low plasticity; with some gravels; no odour.
						CL	Silty Sandy CLAY: fine grained, low plasticity, light brown, mottled orange to brown, light grey; stiff; dry to moist; no odour.
		1.9	0.40-0.60 m			CL	Assumed natural at ~0.4mbgs Sandy CLAY: fine grained, poorly graded, low plasticity, light brown, mottled orange to brown, light grey; stiff; dry to moist; increasing sand content; no odour.
0.5							
		1.8	0.80-1.00 m				
1.0						CL	Silty CLAY: fine grained, poorly graded, low plasticity, orange to brown, mottled light grey; very stiff; dry to moist; no odour.
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB025

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253902.5	Northing (m): 5747583.4
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		1.9	0.00-0.20 m	S 0.00-1.20 m		SM	Silty SAND: fine to coarse grained, sub-angular to angular, low plasticity; dry; with some angular to sub-angular gravels; no odour.
						CL	Silty Sandy CLAY: fine to medium grained, low plasticity, light brown, mottled orange to brown; stiff; dry; no odour.
			0.40-0.60 m			CL	Assumed natural at ~0.4mbgs Sandy CLAY: fine grained, poorly graded, low plasticity, light brown to orange to mottled grey; stiff; dry to moist; quartz/sand fragments; no odour.
0.5							
			0.80-1.00 m			CL	Sandy Silty CLAY: fine grained, poorly graded, low plasticity, light grey, mottled orange to brown; very stiff; dry to moist.
1.0							
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB026

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253907.7	Northing (m): 5747520.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		SM	Silty SAND (FILL): fine to coarse grained, well graded, grey, brown, dark brown; dry; with angular gravels; no odour.
0.5			0.40-0.60 m			CH	Silty CLAY: medium to high plasticity, light to medium brown; dry to moist; with fine grained minor sands; no odour.
						SM	SAND: fine grained; cemented sand lens ~0.1m, fine grained sand lens beneath.
1.0			1.00-1.20 m			CH	Natural at ~1.0mbgs Silty CLAY: medium to high plasticity, light to medium brown, mottled orange brown; stiff; dry to moist; no odour.
1.5				S 1.20-2.40 m Rec=75%			
			1.80-2.00 m			CL	Sandy CLAY: fine to medium grained, poorly graded, low to medium plasticity, orange to brown; moist.
2.0						CH	Sandy CLAY: fine grained, high plasticity, medium to dark brown; moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB027

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253905.0	Northing (m): 5747514.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.30 m Rec=77%		GM	Silty Sandy GRAVEL: fine to coarse grained, well graded, sub-angular, grey to brown; dry; no odour.
0.5			0.40-0.60 m			CL	Sandy Silty CLAY: dark brown, mottled grey and orange to brown; firm; dry; with fine to medium grained sand; no odour.
1.0			0.80-1.00 m				
1.5				S 1.30-2.40 m Rec=64%			CONCRETE: with some sand.
2.0			1.80-2.00 m			CH	Natural at ~1.5mbgs Silty CLAY: medium to high plasticity, light brown to grey mottled black, orange to brown; stiff; dry to moist; with minor fine grained sand; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB028

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253916.0	Northing (m): 5747519.0
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=75%		SM	Silty SAND: fine to coarse grained, well graded, grey to dark brown; dry; with sub-angular gravel; no odour.
0.5			0.40-0.60 m			CL	Sandy CLAY: fine to medium grained, well graded, medium plasticity, light brown, orange to brown; firm; quartz fragments; no odour.
			0.80-1.00 m			CL	Sandy CLAY: fine to medium grained, well graded, brown orange, mottled, black; firm; dry to moist; no odour.
1.0			1.20-1.40 m	S 1.20-2.40 m Rec=100%		CH	Natural at ~1.2mbgs Silty Sandy CLAY: fine grained, high plasticity, dark brown, mottled light brown black; stiff; dry to moist; no odour.
1.5							
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB029

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253910.9	Northing (m): 5747512.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.1	0.00-0.20 m	S 0.00-1.20 m Rec=100%		SM	Silty SAND (FILL): fine to coarse grained, well graded, sub-angular, non plastic, grey; loose; dry; concrete and gravel fragments; no odour.
			0.40-0.60 m			SM	Silty SAND: fine to coarse grained, non plastic; loose; dry; no odour.
0.5						CL	Sandy Silty CLAY: fine grained, medium plasticity, brown to grey; stiff; dry.
			0.80-1.00 m			SC	Clayey SAND: fine to medium grained, low plasticity, orange to brown, mottled red, black fragments present; dry to moist; no odour.
1.0							
			1.20-1.40 m	S 1.20-2.40 m Rec=75%		CL	Assumed natural at ~1.2mbgs Silty CLAY: low to medium plasticity, light to medium brown, mottled grey to red; stiff; moist.
1.5							
			1.80-2.00 m				
2.0							Increasing clay content from 2.0mbgs, becoming very stiff.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB030

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 10.80	Top Casing (m AHD): N/A	Easting (m): 253930.9	Northing (m): 5747484.5
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.40 m	S 0.00-1.20 m Rec=83%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, dark grey; firm; moist; with fine to coarse grained sand approximately 20%) and fine to coarse grained gravel (approximately 10%).
			0.40-0.70 m			CL	CLAY: medium plasticity, light grey with black mottling; stiff; moist.
0.5						CL	Sandy CLAY: medium plasticity, orange to brown; stiff; moist; with fine to medium grained sand (approximately 30%).
			0.80-1.10 m			CL	CLAY: medium plasticity, light grey with black mottling; stiff; moist.
1.0						CL	Silty CLAY: light grey with orange mottling; firm; moist; with silt (approximately 30%).
				S 1.20-2.00 m Rec=106%		SP	SAND: fine grained, brown; dense; moist.
1.5			1.70-2.00 m				
						SP	Clayey Silty SAND: fine grained, brown to orange; with silty/clayey matrix (approximately 20%).
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB031

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.80	Top Casing (m AHD): N/A	Easting (m): 253939.9	Northing (m): 5747489.5
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.50 m	S 0.00-1.20 m Rec=83%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, dark grey; dry; with fine to coarse grained sand (approximately 20%), fine to coarse grained gravel (approximately 10%).
0.5						CL	Sandy CLAY: medium plasticity, orange to brown; firm; dry; with firm sand (approximately 30%). Becomes brown to grey from 0.5mbgs. Becomes orange to brown from 0.6mbgs.
			0.80-1.10 m				Becomeslight grey from 0.85mbgs. With black coal fragments and fine to coarse grained gravel (approximately 40%) from 0.9mbgs.
1.0						SP	SAND: fine to medium grained, yellow to brown; loose; moist.
						CL	CLAY: medium plasticity, light brown to light grey; firm; moist.
				S 1.20-2.40 m Rec=58%		SP	SAND: fine to medium grained, yellow to brown; loose; moist.
1.5							
			1.70-2.00 m				
2.0						CL	Sandy CLAY: medium plasticity, light brown to light grey; stiff; moist; with fine grained sand (approximately 30%).
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB033

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 10.80	Top Casing (m AHD): N/A	Easting (m): 253923.5	Northing (m): 5747503.6
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.40 m	S 0.00-1.20 m Rec=83%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, black; firm; moist; with fine grained gravel (approximately 20%) and fine to coarse grained sand (approximately 20%).
0.5							Becomes brown from 0.4mbgs.
						SP	SAND (FILL): fine to medium grained, yellow; moist.
			0.80-1.10 m			GW	Sandy GRAVEL (FILL): fine to coarse grained, black; with fine to coarse grained sand (approximately 40%).
1.0						CL	Sandy CLAY (FILL): medium plasticity, grey with brown mottling; soft; moist; with fine to coarse grained sand (approximately 30%) and fine to coarse grained trace gravel.
						CL	Sandy CLAY: brown with grey mottling; with fine grained sand (approximately 30%).
				S 1.20-2.00 m Rec=88%		SP	SAND: fine to medium grained, yellow to brown; moist.
						SW	Gravelly SAND: fine to coarse grained, black; with fine to medium grained gravel (approximately 30%).
1.5						CL	Sandy CLAY: medium plasticity, brown with light grey mottling; firm; moist; with fine to medium grained sands (approximately 20%).
			1.80-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB034

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.80	Top Casing (m AHD): N/A	Easting (m): 253920.5	Northing (m): 5747513.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		CL	Clayey Silty SAND: fine to coarse grained, low to medium plasticity, light to medium brown; dry; some angular gravels present throughout; no odour.
0.5			0.40-0.60 m			GW	GRAVEL (FILL): gravel/crushed rock segment ~0.03m deep, well graded dry.
			0.80-1.00 m			CL	Natural at ~0.8mbgs Silty Sandy CLAY: medium plasticity, light brown, beige, mottled orange to brown; stiff; black coal present, increasing sand content.
1.0						SC	Silty Clayey SAND: fine to coarse grained, rounded, low plasticity, orange to brown; medium dense; dry to moist; no odour.
1.5				S 1.20-2.40 m Rec=83%			
			1.80-2.00 m			CL	Silty Sandy CLAY: fine to medium grained, medium to high plasticity, orange brown, mottled brown, beige; dry to moist; no odour.
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB035

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.30	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253893.9	Northing (m): 5747522.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		GW	Sandy Silty GRAVEL: fine to coarse grained, well graded, angular, low plasticity, grey; loose; dry; no odour.
			0.40-0.50 m			SW	Silty SAND: well graded, brown, light brown; minor gravels.
0.5							
			0.80-1.00 m			SC	Natural ~0.7mbgs Silty Clayey SAND: fine to medium grained, orange brown, mottled red.
1.0				S 1.00-2.30 m Rec=77%			Increasing clay content from 1.0mbgs.
						SM	Clayey Silty SAND: high plasticity, orange brown; dry; no odour.
1.5						SM	Silty SAND: fine to medium grained, low plasticity, orange to brown; moist; no odour.
			1.80-2.00 m			CL	Silty CLAY: high plasticity, light brown, mottled dark brown, beige; stiff; dry to moist; minor sand content.
2.0							
2.5							Hole Terminated at 2.30 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB037

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 10.00	Top Casing (m AHD): N/A	Easting (m): 253848.9	Northing (m): 5747453.2
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			0.00-0.10 m 0.40-0.50 m	S 0.00-0.50 m Rec=100%		GC	Clayey GRAVEL: medium to coarse grained, poorly graded, orange to brown; with dry to moist clay.
							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite

1.0 1.5 2.0 2.5 3.0 3.5 4.0

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB038

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253758.4	Northing (m): 5747387.3
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
							ROADBASE.
			0.10-0.20 m	0.10-0.50 m Rec=125%		SM	SAND: fine to medium grained, orange; dry to moist; no odour.
			0.40-0.50 m				
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB039

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-09	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253688.1	Northing (m): 5747330.0
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
				As 0.00-0.20 m			ROADBASE.
			0.20-0.30 m	S 0.20-0.50 m		SM	Silty Clayey SAND: fine to medium grained, orange; dry to moist; no odour.
			0.40-0.50 m				
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB040

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 8.50	Top Casing (m AHD): N/A	Easting (m): 253614.1	Northing (m): 5747273.7
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
				As 0.00-0.20 m			ROADBASE.
			0.20-0.30 m	S 0.20-0.50 m		SM	Silty SAND: fine to medium grained, orange; dry to moist; no odour.
			0.40-0.50 m				
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB041

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253808.6	Northing (m): 5747419.5
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040 DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				0.00-0.50 m Rec=100%			ROADBASE.
			0.25-0.30 m			GC	GRAVEL: orange; dry to moist; no odour.
			0.40-0.50 m				
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB042

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-May-19	Date Finished: 08-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 10.00	Top Casing (m AHD): N/A	Easting (m): 253886.9	Northing (m): 5747402.2
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.10 m	S 0.00-0.50 m Rec=100%		GM	GRAVEL: poorly graded, brown; dry to moist; no odour.
			0.40-0.50 m			SC	SAND: well graded, brown/orange; dry to moist; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB043

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Feb-20	Date Finished: 13-Feb-20	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253860.8	Northing (m): 5747344.4
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.0	0.00-0.20 m	S 0.00-1.00 m		CL	Sandy CLAY (FILL): low plasticity, orange to brown with some streaks of red and grey; firm; very sandy, with fine to medium grained sand.
0.5		0.0	0.40-0.60 m				
		0.0	0.80-1.00 m				
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB044

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 14-Feb-20	Date Finished: 14-Feb-20	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253772.3	Northing (m): 5747266.8
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m 0.30-0.50 m	S 0.00-0.50 m		SC	Clayey SAND: coarse grained, brown to red; loose; with low plasticity clay.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:42 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB045

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 14-Feb-20	Date Finished: 14-Feb-20	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 253834.4	Northing (m): 5747268.7
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Sandy Gravelly CLAY (FILL): low plasticity, brown to orange to grey; moist.
0.5			0.40-0.60 m				
			0.80-1.00 m			CH	CLAY: high plasticity, grey with red and light brown streaks; stiff.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB046

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Feb-20	Date Finished: 13-Feb-20	Total Depth (mbgs): 0.60	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 253942.0	Northing (m): 5747351.9
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		1.0	0.00-0.20 m	S 0.00-0.60 m		CL	Sandy Gravelly CLAY (FILL): non plastic, orange to brown; soft; wet.
		2.4	0.40-0.60 m			CH	Silty CLAY: high plasticity, grey with light brown streaks; stiff; moist.
0.5							Hole Terminated at 0.60 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB047

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Feb-20	Date Finished: 13-Feb-20	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253955.7	Northing (m): 5747282.2
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		0.0	0.00-0.10 m	S 0.00-1.00 m		SC	Clayey SAND (FILL): fine to medium grained, brown; loose; moist; with some gravel.
		0.0	0.10-0.30 m			CH	Silty CLAY: high plasticity, grey; firm; moist; with traces of fine grained sandy lenses.
0.5		0.0	0.40-0.60 m			CH	CLAY: high plasticity, grey; stiff; moist.
		0.0	0.80-1.00 m				
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB048

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 14-Feb-20	Date Finished: 14-Feb-20	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253864.9	Northing (m): 5747222.4
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		0.0	0.00-0.10 m	S 0.00-1.00 m		SW	Gravelly SAND (FILL): orange; loose; dry; with white quartz gravel.
		0.0	0.10-0.30 m			CH	Silty CLAY: high plasticity, grey with red and light brown streaks; firm.
0.5		0.0	0.40-0.60 m			CH	CLAY: high plasticity, grey; stiff.
		0.0	0.80-1.00 m				
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB049

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 14-Feb-20	Date Finished: 14-Feb-20	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253838.2	Northing (m): 5747147.4
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m 0.30-0.50 m	S 0.00-0.50 m		CL	Silty CLAY (FILL): low plasticity, white to brown to grey; firm; very silty.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB050

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Feb-20	Date Finished: 13-Feb-20	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253971.4	Northing (m): 5747217.9
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: EHS Support Pty Ltd	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		0.0	0.00-0.05 m	S 0.00-1.00 m		SC	Clayey SAND (FILL): brown; dry.
		0.0	0.10-0.30 m			CH	Silty CLAY: high plasticity, grey with red and light brown streaks; stiff; moist; with some very silty lenses throughout.
0.5		0.0	0.40-0.60 m				
		0.0	0.80-1.00 m				
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB051

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254056.5	Northing (m): 5747221.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		ML	Clayey SILT: low plasticity, brown to orange; stiff; dry; no odour.
0.5			0.40-0.60 m			CH	Silty CLAY: high plasticity, brown to orange, mottled white; stiff; dry to moist; no odour.
			0.80-1.00 m				
1.0			1.00-1.20 m			SP	Natural at 1.0mbgs Clayey SAND: fine to medium grained, poorly graded, light brown to yellow; loose; moist; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB052

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253999.3	Northing (m): 5747146.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m Rec=83%		CL	CLAY: non plastic, light brown to brown; very stiff and hard; dry; no odour.
						CL	CLAY: medium plasticity, brown to dark brown, mottled black; very stiff; dry to moist; no odour.
			0.40-0.60 m			CL	Silty CLAY: medium plasticity, brown to orange; stiff; dry to moist; no odour.
0.5						CH	CLAY: high plasticity, brown to dark brown; stiff; dry to moist; no odour.
			0.80-1.00 m			CL	Assumed natural from 0.7mbgs Clayey SILT: light brown to brown; moist; with fine sands, poorly graded; no odour.
1.0						CH	CLAY: high plasticity, light brown to brown; stiff; dry to moist; no odour.
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB053

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253912.6	Northing (m): 5747086.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=67%		CL	CLAY: non plastic, yellow to orange; hard; dry; no odour.
0.5			0.40-0.60 m			CH	CLAY: high plasticity, brown to red orange; very stiff; dry to moist; no odour.
1.0			0.80-1.00 m			CH	CLAY: high plasticity, dark brown to black, mottled orange; stiff; dry to moist; no odour.
1.5				S 1.20-2.40 m Rec=150%		CL	Silty CLAY: low plasticity, light brown to brown, yellow orange; stiff; dry to moist; no odour.
2.0						SP	SAND.
						CH	CLAY: high plasticity, brown to light brown; soft; moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB054

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253985.2	Northing (m): 5747092.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		CL	Silty CLAY: non plastic, light brown, mottled orange; hard; dry; cemented; no odour.
0.5			0.40-0.60 m			CL	CLAY: low plasticity, brown to light brown, mottled yellow; stiff; dry; no odour.
			0.80-1.00 m			SP	Assumed natural from 0.8mbgs Clayey SAND: fine grained, poorly graded, light brown to light grey; medium dense; dry to moist; no odour.
1.0						SP	Silty SAND: fine grained, poorly graded, yellow to orange; loose; moist; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB055

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254094.5	Northing (m): 5747097.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-2.40 m		CL	Silty CLAY: non plastic, light brown to orange; hard; cemented; no odour.
			0.40-0.60 m			CL	Clayey SILT: low plasticity, brown to orange; stiff; dry to moist; some gravels, fine to medium grained, well graded, rounded.
0.5			0.80-1.00 m				
1.0						CL	Clayey Sandy SILT: fine to medium grained, well graded, rounded, low plasticity, light grey to black; stiff; moist; no odour.
1.5						CH	CLAY: high plasticity, light brown to orange; dry to moist; no odour.
			1.80-2.00 m				
2.0			2.00-2.20 m			SP	Assumed natural from 2.0mbgs Silty Clayey SAND: fine to medium grained, poorly graded, rounded, low plasticity, light brown; medium dense; moist; no odour.
						CL	CLAY: low plasticity, light brown to grey to orange; soft; moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB056

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254145.5	Northing (m): 5747093.9
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		SW	Clayey Silty SAND: fine to medium grained, well graded, rounded, non plastic, light brown to orange; hard; dry.
						CL	Silty CLAY: fine to medium grained, low plasticity, yellow to orange; dry; some sand, well graded; no odour.
			0.40-0.60 m			CH	CLAY: high plasticity, light grey to brown to orange; stiff; dry to moist; no odour.
0.5							
						CL	Silty CLAY: low plasticity, brown to orange; stiff; moist; no odour.
			0.80-1.00 m				
1.0							
				S 1.20-2.40 m Rec=50%		CH	CLAY: high plasticity, light brown to brown, mottled orange; stiff; dry to moist; no odour.
1.5						CL	Silty CLAY: low plasticity, light brown to brown; soft; moist to wet; no odour.
						CH	CLAY: high plasticity, light brown to brown, mottled red; stiff; dry to moist; no odour.
			1.80-2.00 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB057

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254050.8	Northing (m): 5747003.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		CL	Clayey SILT: non plastic, light brown to yellow; hard; dry; cemented; no odour.
			0.40-0.60 m			CL	Silty CLAY: low plasticity, light brown to orange, mottled grey; stiff; no odour.
0.5			0.80-1.00 m			CL	CLAY: low plasticity, light brown to grey, mottled black; stiff; dry to moist; no odour.
1.0				S 1.20-2.40 m Rec=92%			
1.5						CL	Sandy CLAY: low plasticity, dark brown, mottled orange; stiff; dry to moist; no odour.
			1.80-2.00 m			CH	CLAY: high plasticity, dark brown to light brown; stiff; dry to moist; no odour.
2.0						CL	CLAY: low plasticity, light grey to red; stiff; dry to moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB058

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253973.7	Northing (m): 5747033.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		CL	Silty CLAY: non plastic, dark brown, mottled light brown; hard; dry; no odour.
			0.40-0.60 m			CL	Silty CLAY: low plasticity, dark brown; stiff; moist; no odour.
0.5						CL	Silty Sandy CLAY: low plasticity, light brown to dark brown, mottled orange to black; stiff; dry to moist; no odour.
			0.80-1.00 m			CL	Silty CLAY: low plasticity, light brown to brown; stiff; moist; no odour.
1.0							
				S 1.20-2.40 m Rec=92%			
1.5						CH	CLAY: high plasticity, light brown to orange, mottled grey; soft; dry to moist; no odour.
			1.80-2.00 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB061

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 07-Jun-19	Total Depth (mbgs): 3.00	
Ground Surface (m AHD): 6.00	Top Casing (m AHD): N/A	Easting (m): 253668.1	Northing (m): 5747282.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00 m		CH	Silty CLAY: high plasticity, brown; firm.
0.5			0.40-0.60 m			CH	CLAY: high plasticity, grey with red and light brown streaks; firm.
1.0			0.80-1.00 m	S 1.20 m		CL	Silty CLAY: medium plasticity, grey with red and light brown streaks.
1.5						SM	Silty SAND: fine grained, grey to light brown; medium dense; moist.
2.0			1.80-2.00 m			CL	Silty CLAY: medium plasticity, grey with light brown streaks; firm.
2.5				S 2.40 m		CH	CLAY: high plasticity, grey; soft.
3.0			2.80-3.00 m				Hole Terminated at 3.00 m Target depth reached and backfilled with bentonite
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB069

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253957.4	Northing (m): 5747622.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		SW	Gravelly SAND (FILL): medium to coarse grained, light brown to orange; loose; quartz gravels up to 2cm diameter, with traces of coal.
0.5			0.40-0.60 m				
						ML	Clayey SILT: pale brown; very stiff.
1.0			0.80-1.00 m				Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB070

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253961.2	Northing (m): 5747617.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m 0.40-0.60 m 0.80-1.00 m	S 0.00-1.00 m		SW	Gravelly SAND (FILL): medium to coarse grained, light brown to orange; loose; dry; with quartz gravels up to 4cm diameter.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB071

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Oct-19	Date Finished: 04-Oct-19	Total Depth (mbgs): 4.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253986.4	Northing (m): 5747602.0
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=71%		CL	Gravelly Sandy CLAY: medium plasticity, dark grey to brown; moist; with fine grained sands and trace fine gravel.
			0.40-0.60 m				
0.5							COAL: coal lense.
						CH	CLAY: medium to high plasticity, brown to yellow; stiff; moist.
							With grey mottling from 0.7mbgs.
			0.80-1.20 m			SW	SAND: fine to coarse grained, grey; moist.
1.0							
				S 1.20-2.40 m Rec=71%		CL	Sandy CLAY: medium plasticity, brown to yellow with light grey mottling; with fine to medium grained sands (approximately 30%) and trace fine gravel.
1.5							Becomes black from 1.6mbgs.
			1.80-2.00 m				Coal/slick peat layer.
2.0						CL	Sandy CLAY: medium plasticity, brown with grey mottling; with fine to medium grained sands (approximately 20%) and sporadic coal clumps.
				S 2.40-3.40 m Rec=60%			
2.5						GW	GRAVEL: coarse grained; with rock.
						SP	SAND: fine to medium grained, yellow; with trace coarse grained gravel.
3.0			3.00-3.40 m				
				S 3.40-4.00 m Rec=92%			Becomes grey from 3.4mbgs.
3.5							
			3.80-4.00 m				
4.0							Becomes yellow from 4.1mbgs.
							Hole Terminated at 4.20 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB072

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 25-Oct-19	Date Finished: 25-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253992.1	Northing (m): 5747596.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.0	0.00-0.65 m	S 0.00-1.20 m Rec=67%		SP	Gravelly SAND (FILL): fine to medium grained, poorly graded, dark brown with light brown mottling; loose; dry; with fine gravel (approximately 20%).
0.5						CL	Sandy CLAY (FILL): low to medium plasticity, brown / grey; stiff; dry; with fine sand (approximately 20%) and a trace of medium gravel.
		0.0	0.65-0.85 m			CL	Sandy CLAY: low to medium plasticity, orange; very stiff; moist; with fine sand (approximately 20%). Becomes grey with orange mottling from 0.8-0.85mbgs. Becomes light grey with orange mottling from 0.85mbgs.
1.0		0.0	0.90-1.10 m			SW	Gravelly SAND: fine to coarse grained, well graded, black; dense; moist; with fine gravel (approximately 20%) and a clayey matrix. With fine angular gravel (approximately 20%) from 1.3mbgs.
1.5				S 1.20-2.40 m Rec=58%		SP	SAND: fine to medium grained, poorly graded, yellow / orange; dense; moist.
						CH	CLAY: medium to high plasticity, brown; very stiff; moist.
2.0						SW	SAND: fine to coarse grained, well graded, light brown with black mottling; dense; moist.
		0.0	2.20-2.40 m				
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB073

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 25-Oct-19	Date Finished: 25-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253989.9	Northing (m): 5747600.4
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.0	0.00-0.50 m	0.00-1.20 m Rec=79%		SP	Gravelly SAND (FILL): fine to medium grained, poorly graded, brown; dense; dry; with fine to coarse gravel (gap graded, approximately 10%).
						CL	Gravelly Sandy CLAY (FILL): low to medium plasticity, brown; firm; dry; with fine to medium sands (approximately 20%) and a trace of fine gravel..
0.5						SP	Gravelly SAND (FILL): fine to medium grained, poorly graded, brown; dense; dry; with fine to coarse gravel (gap graded, approximately 10%).
		0.1	0.80-1.00 m			CL	Sandy CLAY: low to medium plasticity, light brown with grey and red/brown mottling; firm; moist; with medium grained sand (approximately 20%).
1.0						SC	Clayey SAND: fine to coarse grained, well graded, black; dense; moist; with a clayey matrix (approximately 30%).
				1.20-2.40 m Rec=50%			
1.5						CL	CLAY: medium plasticity, brown / orange; stiff; moist.
		0.0	1.70-2.40 m			SC	Clayey SAND: fine to coarse grained, well graded, black; dense; moist; with a clayey matrix (approximately 30%).
2.0						CL	Sandy CLAY: low to medium plasticity, black; soft; moist to wet; with fine to medium grained sand (approximately 30%).
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB074

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253946.9	Northing (m): 5747625.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		SC	Clayey SAND (FILL): medium to coarse grained; with sub-rounded quartz gravel up to 1cm diameter and crushed rock.
0.5			0.40-0.60 m				
			0.80-1.00 m				
1.0				S 1.00-2.00 m		CL	Silty CLAY: low plasticity, pale brown; very stiff; very silty.
1.5							
			1.80-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB075

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253949.9	Northing (m): 5747634.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Gravelly CLAY (FILL): light brown; with crushed rock and traces of coal ash.
			0.40-0.50 m			CH	CLAY: high plasticity, brown; firm.
0.5							COAL.
			0.90-1.00 m			CL	Silty CLAY: low plasticity, pale brown; very stiff; very silty.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB076

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253954.2	Northing (m): 5747632.0
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Gravelly CLAY (FILL): light brown; compacted with crushed rock.
			0.40-0.60 m			ML	Clayey SILT: pale brown; very stiff.
0.5			0.60-0.70 m				COAL.
			0.80-1.00 m			CL	Silty CLAY: low plasticity, pale brown; very stiff; very silty.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB077

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 0.90	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253959.2	Northing (m): 5747625.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-0.90 m		SW	Gravelly SAND (FILL): medium to coarse grained, light brown to orange; loose; with quartz gravel up to 2cm diameter and coal ash.
						ML	Clayey SILT: pale brown; very stiff.
0.5			0.40-0.60 m				
			0.80-0.90 m			CL	Silty CLAY: grey to pale brown; soft; with some gravel.
1.0							Hole Terminated at 0.90 m Borehole terminated on refusal at 0.9mbgs
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB078

Comments
Refusal on concrete at 0.7mbgs, moved 1.0m away and refusal again at 0.7mbgs

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 0.70	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253969.3	Northing (m): 5747614.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			0.00-0.20 m 0.40-0.60 m	S 0.00-0.70 m		SW	Gravelly SAND (FILL): medium to coarse grained, light brown; moist; with quartz gravel up to 1cm diameter.
1.0							Refusal on concrete at 0.7mbgs Hole Terminated at 0.70 m Borehole terminated on refusal at 0.7mbgs
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB079

Comments
Refusal on concrete at 0.8mbgs. Two further attempts made 1.0m North and 1.0m West of orignal location and also had refusal on concrete.

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Oct-19	Date Finished: 04-Oct-19	Total Depth (mbgs): 0.80	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253974.9	Northing (m): 5747608.3
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-0.80 m Rec=75%		CL	Gravelly Sandy CLAY: grey; moist.
0.5			0.60-0.80 m			SW	SAND: fine to coarse grained, yellow; moist to wet.
1.0							Refusal at 0.8mbgs Hole Terminated at 0.80 m Borehole terminated on refusal at 0.8mbgs
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB080

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253926.9	Northing (m): 5747629.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Sandy Gravelly CLAY (FILL): brown to orange; with quartz gravel and traces of coal.
			0.40-0.50 m				
0.5						ML	Clayey SILT (FILL): grey.
						CL	Sandy Gravelly CLAY (FILL): orange; stiff; with quartz gravel and medium to coarse grained sand.
			0.80-1.00 m			CH	Silty CLAY: high plasticity, orange.
1.0				S 1.00-2.00 m			
							Becomes very silty, brown and moist from 1.2mbgs.
1.5							Becomes wet and soft from 1.5mbgs.
			1.80-2.00 m			ML	Clayey SILT: light brown; firm.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB081

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253928.9	Northing (m): 5747625.9
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Gravelly Sandy CLAY (FILL): low plasticity, dark brown to grey; with quartz gravel, medium to coarse grained sand, some coal ash and crushed rock.
			0.40-0.60 m			CH	CLAY: high plasticity, pale brown; very stiff.
0.5			0.80-1.00 m				
1.0				S 1.00-2.00 m			
						ML	Clayey SILT: grey; stiff.
1.5						CH	Silty CLAY: high plasticity, grey; very stiff.
			1.80-2.00 m			ML	Clayey SILT: orange; stiff; with some fine sands.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB082

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253922.3	Northing (m): 5747609.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		1.9	0.00-0.20 m	S 0.00-1.20 m Rec=75%		SM	Gravelly Silty SAND: well graded, low plasticity, medium to dark brown; loose; dry; with some weathered sub-angular gravels; no odour.
			0.40-0.60 m			CL	Assumed natural at 0.3mbgs Silty Sandy CLAY: fine grained, poorly graded, low plasticity, light brown; stiff; dry to moist; no odour.
1.0			0.90-1.10 m			CH	Silty CLAY: fine grained, poorly graded, medium to high plasticity, medium brown to grey; very stiff; moist; increasing clay content with depth, minor mottling; no odour.
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB084

Comments
Refusal on gravel at 4.0mbgs

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Oct-19	Date Finished: 04-Oct-19	Total Depth (mbgs): 4.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253967.8	Northing (m): 5747633.0
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0			0.00-0.80 m	S 0.00-1.20 m Rec=500%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, light brown to grey; firm; dry; with fine to coarse grained sand (approximately 30%), fine grained gravel (approximately 10%) and traces of medium gravel.
0.5							
1.0			0.90-1.10 m			SP	Gravelly Silty SAND: fine to medium grained, light brown; firm; moist; with silty matrix (approximately 20%) and fine grained gravel (approximately 10%).
1.5				S 1.20-2.40 m Rec=75%		CL	Gravelly Sandy CLAY: low to medium plasticity, brown grey; soft; moist to wet; with medium to coarse grained sand (approximately 10%) and fine grained gravel (approximately 10%).
2.0			1.80-2.00 m			ML	Clayey SILT: grey to brown; stiff; dry; with clayey matrix (approximately 10%).
2.5				S 2.40-3.40 m Rec=100%			
3.0			2.80-3.00 m				Becomes very stiff from 3.0mbgs.
3.5			3.20-3.40 m	S 3.40-4.00 m Rec=0%			Core loss.
4.0							Hole Terminated at 4.00 m Borehole terminated on refusal at 4.0mbgs
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB085

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253975.2	Northing (m): 5747634.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		SC	Clayey SAND (FILL): brown; loose; wet; with gravel and some coal ash.
			0.40-0.60 m				(FILL): crushed rock with compacted clay, brown to grey.
0.5			0.80-1.00 m				
1.0				S 1.00-2.00 m			
1.5			1.80-2.00 m				
2.0						ML	Clayey SILT: low plasticity, pale brown; very stiff.
2.5							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB086

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 03-Oct-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 2.10	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253972.5	Northing (m): 5747627.3
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=75%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, dark brown; moist; with fine to coarse grained sand (approximately 20%) and fine to coarse grained gravel (approximately 10%).
							(FILL): Ballast rock.
						CL	Silty CLAY: low to medium plasticity, brown with grey mottling; firm; moist; with silty matrix (approximately 30%).
0.5			0.55-0.75 m				
						CL	COAL: Coal clump with diesel/oil odour.
						CL	Sandy CLAY: medium plasticity, dark grey to brown; firm; moist; with fine to coarse grained sand (approximately 10%).
1.0			0.90-1.10 m				Silty CLAY: dark brown; stiff; moist; with silty matrix (approximately 20%).
				S 1.20-2.10 m Rec=100%		ML	Clayey SILT: dark brown; stiff; moist; with clayey matrix (approximately 20%).
1.5							Becomes brown from 1.5mbgs.
			1.80-2.00 m				Becomes grey to brown from 1.8mbgs.
2.0							
							Hole Terminated at 2.10 m Borehole terminated on refusal at 2.1mbgs
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB087

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 03-Oct-19	Date Finished: 03-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253976.7	Northing (m): 5747620.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=50%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, black with yellow and light brown mottling; firm; moist; with fine to coarse grained sand (approximately 20%) and fine to coarse grained gravel (approximately 10%).
0.5			0.60-0.80 m				COAL: coal lense.
						CL	Sandy CLAY (FILL): brown to grey with black mottling; with fine to coarse grained sand (approximately 20%) and trace coarse grained gravel.
1.0			0.90-1.10 m				
				S 1.20-2.40 m Rec=79%			With fine to coarse grained gravel (approximately 10%) from 1.2mbgs.
1.5							Becomes brown from 1.7mbgs.
			1.80-2.00 m				
2.0						SW	Clayey SAND (FILL): fine to coarse grained, dark brown; dense; moist; with clayey matrix (approximately 20%). Becomes orange from 2.2mbgs. Becomes brown with fine to coarse grained gravel (approximately 20%) from 2.25mbgs.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB088

Comments
Refusal on first two drilling attempts. Location1 - refusal at 1.5mbgs. Location 2 - refusal at 2mbgs. Location 3 reached 4.0mbgs however hit coal at 2.4mbgs.

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Oct-19	Date Finished: 04-Oct-19	Total Depth (mbgs): 4.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253983.3	Northing (m): 5747622.4
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.70 m	S 0.00-1.20 m Rec=67%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, black; firm; moist; with fine to medium grained sand (approximately 30%) and fine to medium grained gravel (approximately 10%).
0.5						CL	CLAY: medium plasticity, brown to orange; stiff; moist.
			0.80-1.00 m			CL	Sandy CLAY (FILL): medium plasticity, brown to grey; firm; moist; with fine to coarse grained sand (approximately 20%) and trace fine gravel.
1.0							
				S 1.20-2.40 m Rec=100%		CL	Sandy CLAY (FILL): medium plasticity, brown to grey; firm; moist; with fine to coarse grained sand (approximately 30%) and trace fine gravel.
1.5							
			1.80-2.00 m			CH	CLAY: medium to high plasticity, brown; stiff; moist.
2.0						ML	Clayey SILT: brown to grey; moist.
2.5				S 2.40-1.00 m Rec=-29%			COAL: coal layer.
3.0			3.00-3.20 m				
3.5			3.40-4.20 m				
4.0							Hole Terminated at 4.20 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB089

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Oct-19	Date Finished: 04-Oct-19	Total Depth (mbgs): 4.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253980.1	Northing (m): 5747617.4
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.50 m	S 0.00-1.20 m Rec=75%		CL	Gravelly Sandy CLAY: low to medium plasticity, black; firm; dry; with fine to medium grained sand (approximately 30%) and trace fine grained gravel.
0.5						SW	SAND: fine to coarse grained, yellow; dense; dry. Becomes yellow with grey to black mottling from 0.6mbgs.
			0.80-1.00 m			CL	Sandy CLAY: medium plasticity, grey with yellow and black mottling; with fine to medium grained sand (approximately 20%). Becomes black from 0.85mbgs.
1.0							COAL: sticky coal.
						CL	CLAY: medium plasticity, brown; moist; with sporadic coal/peat clumps (approximately 30%).
				S 1.20-2.40 m Rec=75%		SW	SAND: fine to coarse grained, brown to grey; moist to wet.
1.5							
			1.80-2.00 m				Becomes yellow from 1.85mbgs.
2.0							Becomes brown to grey from 2.0mbgs.
				S 2.40-3.40 m Rec=70%			
2.5							
			2.80-3.00 m				
3.0							Becomes yellow from 3.0mbgs.
							Becomes brown to grey from 3.3mbgs.
3.5				S 3.40-4.20 m Rec=88%			
			3.80-4.00 m				
4.0							Becomes light brown to grey from 4.1mbgs.
							Hole Terminated at 4.20 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB090

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253997.0	Northing (m): 5747623.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		SC	Clayey SAND (FILL): medium to coarse grained; compacted with quartz gravel.
0.5			0.40-0.60 m			ML	Clayey SILT: pale brown; very stiff.
1.0			0.80-1.00 m	S 1.00-2.00 m			
1.5						CH	Silty CLAY: high plasticity, brown; very stiff.
2.0			1.80-2.00 m				Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB091

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254000.4	Northing (m): 5747619.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		SC	Clayey SAND (FILL): medium to coarse grained; compacted with quartz gravel up to 2.0cm diameter.
0.5			0.40-0.60 m			ML	Clayey SILT: pale brown; very stiff.
1.0			0.90-1.00 m				Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB092

Comments
In vicinity of former UST.
Assume SB within former backfilled tank pit.

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 4.20	
Ground Surface (m AHD): 10.70	Top Casing (m AHD): N/A	Easting (m): 254045.4	Northing (m): 5747529.4
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.10 m Rec=73%		SC	Silty Clayey SAND: fine to coarse grained, well graded, low plasticity, medium brown; dry; some gravels; no odour.
0.5		0.4	0.40-0.60 m				
		0.3	0.80-1.00 m			CL	Silty CLAY: coarse grained, medium plasticity, medium to dark brown, mottled grey; stiff; moist; course grained sand throughout; no odour.
1.0							
1.5				S 1.10-2.00 m poor recovery Rec=67%		SW	Clayey SAND: fine to coarse grained, well graded, low plasticity, brown, grey; loose; moist to wet; slight hydrocarbon odour.
		1.8	1.80-2.00 m				
2.0				S 2.00-3.20 m poor recovery Rec=42%			
2.5							
		1.0	2.80-3.00 m				
3.0							
				S 3.20-4.20 m poor recovery Rec=50%			
3.5							
		1.2	3.80-4.00 m				
4.0						CH	Natural at ~3.9mbgs Silty CLAY: fine grained, poorly graded, medium to high plasticity, orange to brown, mottled grey; stiff.
							Hole Terminated at 4.20 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB093

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 10.70	Top Casing (m AHD): N/A	Easting (m): 254052.2	Northing (m): 5747535.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0	0.00-0.20 m	S 0.00-1.70 m Rec=59%		CL	Sandy Silty CLAY (FILL): well graded, low plasticity, light brown to brown; soft; dry; with basaltic gravel.
0.5		0	0.40-0.60 m			CH	Silty CLAY: coarse grained, medium to high plasticity, light medium brown, grey regions; stiff; dry to moist; minor coarse sand; no odour.
1.0		0	0.80-1.00 m				
1.5							
2.0		2.0	1.80-2.00 m	S 1.70-2.00 m Rec=233%		CL / CH	Sandy CLAY: fine to coarse grained, medium plasticity, light brown, grey to brown, mottled orange to brown; stiff; dry to moist; no odour. Assumed natural at ~1.8mbgs. Silty CLAY: fine grained, poorly graded, medium to high plasticity, orange to brown mottled grey; stiff; moist; slight odour.
2.5							Hole Terminated at 2.00 m. Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB094

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254031.0	Northing (m): 5747552.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		GC	Gravelly Silty CLAY (FILL): light brown to brown with white (quartz); soft; dry; and basaltic gravel, fine to medium grained, well graded, loose, rounded; no odour.
0.5			0.40-0.60 m				
			0.80-1.00 m				
1.0						CH	CLAY (FILL): high plasticity, light brown to grey to pink; stiff; dry to moist; no odour.
						CL	Silty CLAY (FILL): low plasticity, dark brown; soft; moist; some coarse basalt; no odour.
				S 1.20-2.40 m Rec=83%			Becomes wet from 1.4mbgs, with some woody/fibrous material between 1.3-1.5mbgs.
1.5			1.40-1.60 m			CL	Clayey SILT: low plasticity, dark brown; soft; wet; possibly wet due to removed pipe; no odour.
						CH	Assumed natural from 1.7mbgs CLAY: high plasticity, light brown to brown; stiff; moist; no odour.
2.0			1.80-2.00 m				
						CL	Silty Sandy CLAY: fine grained, poorly graded, light grey; stiff; moist to wet.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB095

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254017.4	Northing (m): 5747569.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		CL	Sandy CLAY FILL: low plasticity, orange to brown; stiff; dry to moist; with gravel, fine to medium grained, well graded, rounded; no odour.
0.5			0.40-0.60 m				
			0.80-1.00 m				
1.0				S 1.20-2.40 m Rec=100%		CL	CLAY: low plasticity, light grey, mottled orange; soft; dry to moist; with gravel, fine to medium grained, well graded, rounded.
1.5							COAL BAND: black; hard; fractured.
						CL	CLAY FILL: low plasticity, orange to grey to brown; stiff; dry to moist; with gravel, fine to coarse grained, angular/rounded, well graded; no odour.
2.0			1.80-2.00 m				
						CL	Silty CLAY FILL?: low plasticity, light brown to brown, mottled orange; stiff; some gravel, medium grained, well graded, rounded.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:43 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB096

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254009.8	Northing (m): 5747583.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=75%		GW	Sandy GRAVEL (FILL): fine to medium grained, well graded, rounded, yellow to orange; loose; dry; no odour.
0.5			0.40-0.60 m			CL	Silty CLAY (FILL): dark brown to brown, mottled orange to grey; stiff; dry; with gravel, fine to medium grained, rounded to sub-rounded, well graded; no odour.
1.0			0.80-1.00 m				
1.5				S 1.20-2.40 m Rec=100%		CL	Clayey SILT (FILL): non plastic, with brown to black fragments (coal); stiff; dry; some gravel, fine grained, well graded, rounded.
2.0			1.80-2.00 m			CL	Assumed natural from 1.7 - 2.4mbgs CLAY: low plasticity, light brown, mottled grey; stiff; dry to moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB097

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.70	Top Casing (m AHD): N/A	Easting (m): 253959.4	Northing (m): 5747528.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=67%		CL	Clayey SILT (FILL): orange to brown; dry; some gravel, fine to medium grained, loose, rounded, well graded; no odour.
0.5			0.40-0.60 m			CL	Silty CLAY (FILL): low plasticity, orange to brown; stiff; dry to moist; some gravel, fine to medium grained, rounded, well graded; no odour.
			0.80-1.00 m				CONCRETE: grey; hard; dry; fractured.
1.0						SW	Clayey Silty SAND (FILL): fine to medium grained, well graded, rounded, low plasticity, dark brown to brown to orange; loose; dry to moist; no odour.
				S 1.20-2.40 m Rec=67%			CONCRETE: grey; hard; dry; fractured.
1.5						SP	Silty SAND: fine to medium grained, poorly graded, sub-rounded, black; loose; wet; no odour.
			1.60-2.00 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB099

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253981.8	Northing (m): 5747526.9
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5				S 0.00-1.20 m Rec=67%		CL	Silty CLAY (FILL): low plasticity, orange to brown; stiff; dry to moist; some gravel, fine grained, rounded, well graded; no odour.
1.0						CH	CLAY (FILL): high plasticity, light brown to brown, mottled dark brown; stiff; dry to moist; some gravel, well graded, rounded.
1.5				S 1.20-2.40 m Rec=67%		SW	Natural at 1.3mbgs Silty Clayey SAND: fine to medium grained, well graded, light brown to orange; dense; moist; no odour.
2.0						CL	Sandy CLAY: low plasticity, red to orange to light brown; stiff; dry to moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB100

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253988.5	Northing (m): 5747515.9
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		CL	Silty CLAY (FILL): low plasticity, dark brown, mottled orange; stiff; dry to moist; with gravel, fine to medium grained, well graded, rounded to sub-rounded; no odour.
0.5			0.40-0.60 m				
			0.80-1.00 m				
1.0						CH	CLAY (ASSUMED FILL): high plasticity, light brown to orange, mottled grey; stiff; dry to moist; no odour.
				S 1.20-2.40 m		SW	Silty SAND (ASSUMED FILL): fine to medium grained, well graded, rounded, orange to yellow; dense; moist; no odour. Concrete with aggregate identified at 1.2-1.25mbgs, 1.4-1.45mbgs, 1.65-1.7mbgs.
1.5							
			1.80-2.00 m			SP	Assumed natural from 1.8mbgs SAND: fine to medium grained, poorly graded, rounded, brown to light brown; dense; moist; no odour.
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB101

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 02-May-19	Date Finished: 02-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253984.6	Northing (m): 5747373.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		.9	0.00-0.20 m	S 0.00-1.20 m Rec=100%		GW	Clayey Sandy GRAVEL: fine to coarse grained, well graded, low plasticity, grey to brown; medium dense; dry; no odour.
0.5			0.40-0.60 m			SC	Silty Clayey SAND: fine grained, low plasticity, light brown to grey; dense; dry; increasing clay content; no odour.
1.0			0.80-1.00 m				
1.5				S 1.20-2.40 m Rec=92%		CL	Sandy Silty CLAY: poorly graded, low to medium plasticity, light brown; stiff; no odour. BECOMES: dark brown, mottled orange to brown to grey, black flecks; with increasing clay content from 1.4mbgs.
2.0			1.80-2.00 m			CH	Silty Sandy CLAY: fine grained, medium to high plasticity, medium brown to grey; stiff; moist; no odour.
2.5							Assumed natural at ~0.4mbgs Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB102

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 02-May-19	Date Finished: 02-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 254007.0	Northing (m): 5747341.0
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		1.0	0.00-0.20 m	S 0.00-1.20 m Rec=100%		CL	Sandy Gravelly CLAY (FILL): fine to coarse grained, well graded, grey to medium brown; stiff; moist; with angular-subangular crushed rock gravel.
			0.40-0.60 m				
0.5						CL	Silty Sandy CLAY (FILL): poorly graded, medium plasticity, brown, black fragments; stiff; dry; no odour.
			0.80-1.00 m				
							(FILL): crushed rock segment, foreign copper wires.
1.0			1.00-1.20 m			CH	Assumed natural at ~1.0mbgs Sandy Silty CLAY: fine grained, poorly graded, medium to high plasticity, medium brown, mottled light grey; stiff; dry to moist; increasing sand content with depth; no odour.
				S 1.20-2.40 m Rec=100%			
1.5							
			1.80-2.00 m				
2.0						SC	Clayey SAND: fine grained, orange brown, mottled brown; moist; no odour.
						CH	Sandy Silty CLAY: medium to high plasticity, brown, mottled light grey, black flecks; stiff; moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB103

Comments
Hand auger refusal at 1.0mbgs, unknown.
Bore filled with perched water to 0.6mbgs.

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 03-Jun-19	Date Finished: 03-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253982.5	Northing (m): 5747400.6
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.:	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By:	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m			(FILL): Crushed rock, dark grey, loose, wet.
						SW	Gravelly SAND (FILL): coarse grained, light brown; loose.
0.5			0.40-0.60 m				
			0.90-1.00 m			CH	Sandy CLAY (FILL?): high plasticity, grey with light brown streaks; soft; wet; with fine sands.
1.0							Hole Terminated at 1.00 m Borehole terminated on refusal at 1.0mbgs
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB104

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253981.2	Northing (m): 5747415.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m		CL	Sandy Gravelly CLAY (FILL): low plasticity, brown to black; firm; with coal ash.
			0.40-0.50 m				
0.5						CL	Sandy CLAY (FILL): low plasticity, light brown; stiff; very sandy with some gravel.
			0.90-1.00 m				
1.0				S 1.00-2.00 m			
						CH	CLAY: high plasticity, grey with light brown streaks; very stiff.
1.5						CL	Silty CLAY: medium plasticity, grey with light brown streaks; firm.
						SC	Clayey Gravelly SAND: medium grained, dark grey; medium dense; with gravels up to 1.0cm diameter, potential water lense.
						CL	Sandy Gravelly CLAY: low plasticity, brown; firm.
2.0			1.90-2.00 m				Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB105

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 03-Jun-19	Date Finished: 03-Jun-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 10.95	Top Casing (m AHD): N/A	Easting (m): 253959.2	Northing (m): 5747419.3
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.:	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By:	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m			(FILL): wet; Crushed rock, dark grey, loose, wet, with sand.
			0.30-0.50 m			GW	Sandy GRAVEL (FILL): orange with white quartz gravel; loose; moist; appears to be roadbase.
0.5						CL	Silty CLAY (POSSIBLE FILL): medium plasticity, white with light brown streaks; firm; with traces of coal.
			0.90-1.00 m				
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB107

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253916.8	Northing (m): 5747538.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-2.00 m	S 0.00-1.20 m Rec=83%		GW	Sandy Silty GRAVEL (FILL): well graded, grey to dark brown; dry; no odour.
0.5			0.40-0.60 m			CL	Sandy Silty CLAY (FILL): fine to medium grained, medium plasticity, dark brown, orange to red mottled; stiff; no odour.
1.0			0.80-1.00 m				Concrete and GRAVEL (FILL): fine grained, grey; hard; dry; fine sand present, fractured.
				S 1.20-2.40 m Rec=92%			Concrete and GRAVEL (FILL): fine grained, grey; hard; dry; fine sand present, fractured.
						SC	Clayey SAND (FILL): fine grained, dark brown; moderate hydrocarbon odour; stained.
1.5			1.40-1.70 m			CL	Sandy Silty CLAY (FILL): fine to medium grained, well graded, black; moist; concrete and gravel fragments; major staining.
2.0			2.20-2.40 m			CH	Natural ar ~1.7mbgs Silty CLAY: fine grained, poorly graded, high plasticity, light brown to grey; stiff; dry to moist; no odour; staining on outside of core from push tube.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB108

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 05-Jun-19	Date Finished: 05-Jun-19	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): 10.93	Top Casing (m AHD): N/A	Easting (m): 253921.6	Northing (m): 5747531.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m		CL	Sandy Gravelly CLAY (FILL): dark brown; with coal.
			0.40-0.60 m				Black staining from 0.4-0.6mbgs.
1			0.80-1.00 m			CH	Sandy Silty CLAY (FILL): high plasticity, grey with light brown streaks; soft; reworked natural?.
				S 1.20-2.40 m			
2			1.80-2.00 m				Black coal ash at 1.8mbgs.
						CH	CLAY: high plasticity, grey; stiff.
				S 2.40-3.60 m		ML	Clayey SILT: grey; very stiff.
3			2.80-3.00 m			CH	Silty CLAY: high plasticity, grey; very stiff.
						CH	CLAY: high plasticity, grey; very stiff.
				S 3.60-4.80 m			
4			3.80-4.00 m				Dark brown, soft, moist lense at 4.1mbgs.
						CL	Silty CLAY: light grey; firm.
5			4.80-5.00 m	S 4.80-6.00 m			
						CH	CLAY: high plasticity, light brown; firm.
6			5.80-6.00 m	S 6.00-7.20 m			
7			6.80-7.00 m			CL	Silty CLAY: low plasticity, pale brown; soft; moist.
				S 7.20-8.00 m		CH	CLAY: high plasticity, grey, light brown.
8			7.80-8.00 m				Hole Terminated at 8.00 m Target depth reached and backfilled with bentonite
9							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB110

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-May-19	Date Finished: 23-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.00	Top Casing (m AHD): N/A	Easting (m): 253891.9	Northing (m): 5747439.4
Hole Dia. (mm): 95	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		SP	Gravelly SAND: poorly graded, sub-rounded, orange; loose; dry; with minor low plasticity fines; no odour.
0.5			0.40-0.60 m				
			0.80-1.00 m			SM	Silty SAND: well graded, sub-rounded, grey to brown; loose; moist; with low plasticity fines.
1.0			1.00-1.20 m			CL	Clayey lens at 0.9-1.0mbgs.
						SM	Silty CLAY: low to medium plasticity, brown; firm; with minor sub-rounded, coarse sands.
				S 1.20-2.40 m Rec=92%			Silty SAND: coarse grained, well graded, sub-angular, grey to brown; moist; no odour. One small piece of black plastic identified at 1.2mbgs.
1.5							
2.0			1.80-2.00 m			SC	Clayey SAND: fine grained.
			2.20-2.40 m				
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB111

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253914.6	Northing (m): 5747619.9
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		2.0	0.00-0.20 m	S 0.00-1.20 m Rec=92%		SM	Silty SAND: coarse grained, rounded, medium brown; loose; dry; clay regions present, with some weathered gravel and silt; no odour.
0.5		2.1	0.40-0.60 m			CL	Sandy Silty CLAY: fine to coarse grained, well graded, low to high plasticity; very stiff; dry; weathered; no odour.
		2.2	0.60-0.80 m			CL	Assumed natural at ~0.6mbgs Sandy CLAY: fine grained, well graded, low plasticity, orange brown, mottled light brown to grey; stiff; dry; no odour.
1.0		2.1	0.80-1.00 m			SC	Clayey SAND: fine to coarse grained, low plasticity, light brown to grey; dense; dry to moist; increasing sand content with depth; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB112

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253917.4	Northing (m): 5747615.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		6.8	0.00-0.20 m	S 0.00-1.20 m Rec=100%		SM	Silty SAND: well graded, low plasticity, dark brown; loose; dry; with some sub-angular weathered gravel; no odour.
0.5		1.9	0.50-0.70 m			SC	Clayey SAND: fine to coarse grained, low plasticity, orange to brown, mottled light brown to grey; medium dense; dry; with some fine silt; no odour.
						CL	Assumed natural at 0.5mbgs
						SP	Sandy CLAY: fine grained, poorly graded, low to medium plasticity, light brown to grey; stiff; dry to moist; no odour.
		2.0	0.80-1.00 m			CL	SAND: medium grained, orange brown.
1.0							Sandy CLAY: fine grained, poorly graded, low to medium plasticity, light brown to grey; stiff; dry; no odour.
						CH	Silty CLAY: fine grained, medium to high plasticity, medium brown, mottled dark brown, some black fragments; stiff; dry; increasing clay content with depth; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: SB113

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.10	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253887.1	Northing (m): 5747516.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		SM	Silty SAND: fine to coarse grained, well graded, grey; dry; with some gravel; no odour.
						SC	Silty Clayey SAND: fine to medium grained, well graded, orange; dry; minor coarse grained sand throughout; no odour.
0.5			0.40-0.60 m				
			0.80-1.00 m			CL	Silty Sandy CLAY: fine to medium grained, low to medium plasticity, orange to brown, mottled grey; dry to moist; no odour. Mottled red @ 0.9mbgs.
1.0				S 1.00-2.10 m Rec=100%		CL	Natrual at ~1.0mbgs Silty Sandy CLAY: poorly graded, medium plasticity, light to medium brown; dry to moist; with fine grained sand.
1.5						CL	Silty CLAY: medium plasticity, dark brown, black fragment; dry to moist; with fine grained sand; no odour.
2.0			1.90-2.10 m			CL	Silty Sandy CLAY: fine grained, medium plasticity, medium to dark brown; stiff; dry to moist; no odour.
							Hole Terminated at 2.10 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB114

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Apr-19	Date Finished: 30-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.80	Top Casing (m AHD): N/A	Easting (m): 253894.6	Northing (m): 5747496.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.0	0.00-0.20 m	S 0.00-1.20 m Rec=92%		SW	Silty SAND: fine to coarse grained, well graded, orange to brown; dry; quartz, cobble sand present; no odour.
0.5			0.40-0.60 m			CL	Sandy Silty CLAY: fine to coarse grained, low plasticity, light brown, grey, mottled black; firm; dry; no odour.
1.0			0.80-1.00 m			CL	Sandy CLAY: well graded, low to medium plasticity, grey to light brown, orange brown, mottled; stiff; dry to moist.
1.5			1.40-1.60 m	1.20-2.40 m Rec=83%		CL CL CH	Silty CLAY: fine grained, medium plasticity, brown mottled; stiff; dry to moist; rootlets,. Sandy CLAY. Assumed natural at 1.4mbgs Silty CLAY: fine grained, medium to high plasticity, light brown, grey, orange to brown mottled, black coal fragments; very stiff; moist; no odour.
2.0			1.80-2.00 m			CL	Sandy Silty CLAY: fine grained, medium plasticity; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB115

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 253900.1	Northing (m): 5747509.2
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=75%		SM	Silty SAND: fine to medium grained, well graded, non plastic, light brown; dense; dry; with some gravel.
						SC	Silty Clayey SAND: fine grained, low to medium plasticity, light brown to beige, mottled orange to brown; dry to moist; no odour.
			0.30-0.50 m			CL	Natural at 0.3mbgs Silty CLAY: medium plasticity, light brown; stiff; dry to moist; no odour.
0.5						CL	Silty Sandy CLAY: medium plasticity, medium brown, mottled orange brown, black fragments; stiff; dry to moist; no odour.
			0.80-1.00 m				
1.0				S 1.20-2.40 m Rec=58%		CL	Silty CLAY: medium plasticity, dark brown, black fragments; stiff; dry to moist; no odour.
1.5						SM	Silty SAND: fine to medium grained, well graded, rounded, orange brown; moist; large segments of sand; no odour.
			1.70-1.90 m				
2.0			2.00-2.20 m			CH	Silty CLAY: fine grained, medium to high plasticity, medium brown, mottled red to orange; dry to moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB118

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 29-Apr-19	Date Finished: 29-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.80	Top Casing (m AHD): N/A	Easting (m): 253929.3	Northing (m): 5747524.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=67%		GC	Sandy Silty GRAVEL: fine to coarse grained, well graded, sub-angular, grey to dark brown; dry; no odour.
			0.40-0.60 m			CL	Sandy CLAY: low plasticity, orange to brown; with fine to medium grained, well graded, rounded sand; no odour.
0.5			0.80-1.00 m			CL	Sandy Silty CLAY: dark brown, mottled orange brown black; stiff; dry to moist; with fine to medium grained, well graded quartz and sand fragments; no odour.
1.0			1.20-1.40 m	S 1.20-2.40 m Rec=92%		CL	Natural at 1.3mbgs Sandy CLAY: medium plasticity, dark brown, mottled black; with fine to medium grained, sub-rounded sand; no odour.
1.5			1.80-2.00 m			CL	Sandy Silty CLAY: medium plasticity, orange to brown, grey; stiff; dry to moist; with fine grained sand; no odour.
2.0							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB119

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253741.4	Northing (m): 5747645.0
Hole Dia. (mm): 50	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=50%		CL	CLAY: low plasticity, orange to brown; soft; dry to moist; no odour.
			0.40-0.60 m				
0.5						CL	CLAY: low plasticity, with coal (black); dry to moist; no odour.
			0.80-1.00 m			SW	SAND: well graded, orange to brown; loose; dry to moist; no odour.
1.0						SP	SAND: poorly graded, with coal (black); dry; no odour.
				S 1.20-2.40 m Rec=50%			
1.5							
			1.80-2.40 m			CL	CLAY: low plasticity, orange to brown, mottled black; dry; no odour.
2.0						CL	CLAY: light grey; loose; moist; some fine sands; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB121

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-May-19	Date Finished: 01-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253808.2	Northing (m): 5747604.6
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.4	0.00-0.20 m	S 0.00-1.20 m Rec=100%		GW	Sandy GRAVEL: fine to coarse grained, well graded, sub-angular, non plastic, grey; loose; dry.
						SM	Silty SAND: fine to coarse grained, rounded, non plastic, orange to brown; loose; dry; cobble sands.
			0.40-0.60 m			CL	Assumed natural at 0.4mbgs Silty Sandy CLAY: fine grained, poorly graded, medium plasticity, dark brown, mottled light brown to grey; stiff; dry to moist.
0.5						SM	Silty SAND: fine to medium grained, dark brown; loose.
			0.80-1.00 m			CL	Silty Sandy CLAY: fine grained, poorly graded, medium plasticity, medium to light brown; stiff; dry to moist.
1.0							
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB122

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-May-19	Date Finished: 01-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 253839.3	Northing (m): 5747670.4
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		1.0		S 0.00-1.20 m Rec=83%		GC	Sandy Silty GRAVEL (FILL): well graded, sub-angular, low plasticity, medium brown; loose; dry; with minor clay; no odour. Increasing clay content with depth.
0.5		1.2				CL	Assumed natural at 0.4mbgs Silty Sandy CLAY: low to medium plasticity, dark brown; stiff; dry; with fine grained, poorly graded clay; no odour.
		1.0				CL	Silty CLAY: low to medium plasticity, light brown; dry; no odour. Hard dry band at 1.0mbgs.
1.0				S 1.20-2.40 m Rec=75%		CH	Silty Sandy CLAY: medium to high plasticity, dark brown, mottled light brown to grey; stiff; increasing clay content with depth.
1.5							
		1.0					
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB125

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-May-19	Date Finished: 01-May-19	Total Depth (mbgs): 3.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253808.0	Northing (m): 5747573.3
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.7	0.00-0.20 m	S 0.00-1.20 m Rec=92%		GP	Sandy GRAVEL: sub-angular, grey; loose; dry; highly weathered.
						CL	Sandy CLAY: fine grained, angular, medium plasticity; sand and weathered gravel and cobbles, quartz.
0.5			0.40-0.60 m				
			0.60-0.80 m			CH	Assumed natural at 0.6mbgs Silty Sandy CLAY: medium to high plasticity, medium dark brown, mottled light brown, black; very stiff; dry; with fine grained, poorly graded sand; no odour.
			0.80-1.00 m				
1.0							Increasing clay content with depth.
				S 1.20-2.40 m Rec=83%		CL	Sandy Silty CLAY: low to high plasticity, orange, brown, mottled light brown; stiff; with fine grained, poorly graded sand; no odour.
1.5							
							Sandy lens ~1.9mbgs (0.05m thick).
2.0			2.10-2.30 m			SC	Clayey SAND: low plasticity, grey; loose; moist (2.1-2.3mbgs); slight hydrocarbon odour; stained.
				S 2.40-3.50 m Rec=109%		CH	Sandy Silty CLAY: high plasticity, medium brown. mottled red, grey; very stiff; dry to moist; no odour.
2.5							
3.0			3.00-3.20 m				
3.5							Hole Terminated at 3.50 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB126

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254013.3	Northing (m): 5747498.5
Hole Dia. (mm): 65	Water Level Initial (mbgs): 1.60	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.3	0.00-0.20 m	S 0.00-4.80 m		GP	Sandy GRAVEL: orange; loose; moist.
						CL	Silty CLAY: low plasticity, light grey; firm; with minor pale red mottling.
0.5		0.1	0.40-0.60 m				
		0.1	0.80-1.00 m				
1.0						SW	SAND: fine to medium grained, well graded, brown; loose; dry; with minor coarse grained sand.
1.5	▽					SM	Sandy SILT: low plasticity, brown; soft; wet.
						CL	Silty CLAY: low plasticity, light grey; firm; minor pale orange and red mottling.
		0.4	1.80-2.00 m				
2.0						ML	SILT: very soft; wet.
						CL	Silty CLAY: low plasticity, light grey; firm; minor pale orange and red mottling.
						SM	Silty SAND: fine grained, poorly graded, dark grey to brown; soft; wet.
2.5							Coal lense at 2.5-2.55mbgs.
						CL	Silty CLAY: low to medium plasticity, grey; stiff; dry to moist.
						CH	CLAY: medium to high plasticity, light grey and pale orange mottled; stiff; moist.
		0.2	2.80-3.00 m				
3.0							
3.5							
							AS ABOVE: but orange with minor grey mottling.
		0.0	3.80-4.00 m				
4.0							
4.5							
							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB127

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254029.7	Northing (m): 5747505.7
Hole Dia. (mm): 65	Water Level Initial (mbgs): 3.00	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.1	0.00-0.30 m	S 0.00-1.20 m Rec=75%			ASPHALT.
						SW	Gravelly SAND: medium to coarse grained, well graded; loose; moist; with sub-rounded quartz gravel.
		0.4	0.40-0.60 m			CL	Silty CLAY: low to medium plasticity, light grey; firm; with pale orange mottling.
0.5							
		0.2	0.80-1.00 m				
1.0						ML	Sandy SILT: low plasticity, brown; soft; moist to wet; with poorly graded, fine grained sand.
				S 1.20-2.40 m Rec=83%		CL	Silty CLAY: low to medium plasticity, light grey; firm; moist to wet; with pale orange mottling.
1.5							
		0.1	1.80-2.00 m				Dark grey band and possible staining from 1.9-2.1mbgs.
2.0							Including mottling from 2.2mbgs.
				S 2.40-3.60 m Rec=100%			
2.5							
		0.0	2.80-3.00 m				
3.0 ▽						CL	Sandy CLAY: low plasticity, orange; soft; wet; with coarse grained sand and some gravel.
						CH	CLAY: medium to high plasticity, mottled orange and grey; stiff; moist to wet.
3.5							
				S 3.60-4.80 m Rec=100%			Mottled red and grey from 3.7mbgs.
4.0							
							Some coarse grained sand from 4.4-4.6mbgs.
4.5							
5.0							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB128

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.05	Top Casing (m AHD): N/A	Easting (m): 254036.7	Northing (m): 5747491.7
Hole Dia. (mm): 65	Water Level Initial (mbgs): 2.00	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7877DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.3	0.10-0.30 m	S 0.00-1.20 m Rec=83%		GW	ASPHALT.
							Sandy GRAVEL (FILL - ROADBASE): grey to brown; angular sand and gravel (basalt), very dense (compact).
		0.3	0.40-0.60 m			CL	Silty CLAY: low plasticity; firm; dry to moist; with some orange to red mottling.
0.5		0.4	0.60-1.00 m				
1.0				S 1.20-2.40 m Rec=83%			Increasing orange and red mottling with depth.
1.5						ML	SILT: grey; very soft; wet.
						CL	CLAY: medium plasticity, mottled orange to brown and grey; stiff; moist.
		0.0	1.80-2.00 m				With fine grained sand from 1.8mbgs.
2.0 ▽						SW	Clayey Silty SAND: fine to coarse grained, well graded, grading brown to light grey; dense.
2.5				S 2.40-3.60 m Rec=100%			
		0.2	2.80-3.00 m			CL	Silty CLAY: medium plasticity, mottled orange and light grey; firm; moist to wet; with fine grained sands. Some coarse gravel from 2.8-3.1mbgs.
3.0							
3.5				S 3.60-4.80 m Rec=100%			Grading to light grey to white from 3.5mbgs.
4.0							
4.5							
5.0							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB129

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.10	Top Casing (m AHD): N/A	Easting (m): 254032.3	Northing (m): 5747480.3
Hole Dia. (mm): 65	Water Level Initial (mbgs): 3.00	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.0	0.00-0.20 m	S 0.00-1.20 m Rec=75%		GW	Sandy GRAVEL (FILL - CRUSHED ROCK): grey to brown; dense; dry to moist.
		0.2	0.40-0.60 m				
0.5							
		0.4	0.80-1.00 m			CL	Silty CLAY: low plasticity, light grey with red to orange mottling; firm; dry to moist.
1.0							
				S 1.20-2.40 m Rec=83%			
1.5						CL	Silty CLAY: low plasticity, grey-brown to red-brown; soft; wet.
						CL	Silty CLAY: low plasticity, brown grading to light brown; soft to firm; moist to wet.
		0.0	1.80-2.00 m				Becoming moist with with depth.
2.0							
						SC	Clayey SAND: fine to coarse grained, well graded, light grey to orange; very dense; dry to moist.
				S 2.40-3.60 m Rec=75%			Grading to sandy clay.
2.5						CL	Sandy CLAY: medium plasticity, mottled orange and light brown; stiff; dry to moist; with fine to coarse grained, well graded sand.
		0.9	2.80-3.00 m				
3.0 ▽						CH	CLAY: medium to high plasticity; firm; moist; with trace fine sand.
3.5				S 3.60-4.80 m Rec=100%			
4.0							
4.5							
							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB130

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.50	Top Casing (m AHD): N/A	Easting (m): 254011.8	Northing (m): 5747476.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): 3.80	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		GW	GRAVEL (FILL).
						CL	Silty CLAY (FILL): low plasticity, light grey; firm; dry to moist.
						SM	Silty SAND: fine to coarse grained, well graded, brown and orange; loose; dry.
0.5			0.40-0.60 m				
			0.80-1.00 m			CL	Silty CLAY: low plasticity, light grey; stiff; moist; with red mottling.
1.0						ML	SILT: brown; dense; dry; with some fine grained sand.
				S 1.20-2.40 m Rec=83%			Some clay with depth.
1.5						CL	Silty CLAY: low plasticity, light grey; stiff; moist; with red mottling.
						CL	Gravelly SILT: brown; loose; dry.
						CL	Silty CLAY: low plasticity, light grey; stiff; moist; with red mottling.
2.0			1.80-2.00 m				
						SC	Assumed backfilled to 2.2mbgs Clayey SAND: medium grained, poorly graded, orange to brown; dense; moist.
2.5				S 2.40-3.60 m Rec=92%		CL	Silty CLAY: low plasticity, dark brown; stiff; dry to moist; increasing clay with depth.
			2.80-3.00 m				Grading to grey with depth.
3.0							COAL.
						CL	CLAY: medium plasticity, light grey; stiff; moist. Some pale orange mottling from 3.0mbgs.
3.5							Increasing moisture with depth.
				S 3.60-4.80 m Rec=75%			
4.0							Wet from 3.78mbgs.
						CH	CLAY: high plasticity, brown, grey and orange; very stiff; moist to wet.
4.5							
5.0							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB132

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.30	Top Casing (m AHD): N/A	Easting (m): 253993.9	Northing (m): 5747480.8
Hole Dia. (mm): 35	Water Level Initial (mbgs): 2.30	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.3	0.10-0.20 m	S 0.00-1.20 m Rec=58%		CL	ASPHALT. Gravelly CLAY (FILL): dark brown; loose; moist.
0.5		0.3	0.40-0.60 m			CL	Silty CLAY (FILL): medium plasticity, pale brown; moist; with minor basalt gravel.
		0.4	0.80-1.00 m				
1.0							CONCRETE.
				S 1.20-2.40 m Rec=42%		CL	Silty CLAY (FILL): medium plasticity, pale brown; moist; with minor basalt gravel.
1.5							CONCRETE: Multiple layers of concrete approximately 10cm thick each - total approximately 0.6m. Poor recovery on concrete..
2.0		0.3	1.90-2.00 m			CL	Silty Sandy CLAY: low plasticity, light grey and pale orange; soft; moist to wet; with fine grained, poorly graded sand.
2.5				S 2.40-3.60 m Rec=83%		SM	Silty SAND: fine grained, poorly graded, dark grey to brown; loose; wet. Becomes pale grey, very loose and saturated from 2.4mbgs.
3.0		0.2	2.80-3.00 m				
3.5							Becoming more firm and grading to moist from 3.4mbgs.
				S 3.60-4.80 m Rec=100%		CL	Silty CLAY: medium plasticity, grey; stiff; moist.
4.0							Grading to light grey and pale orange from 3.8mbgs.
4.5							Grading to grey and orange from 4.1mbgs.
5.0							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB133

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.30	Top Casing (m AHD): N/A	Easting (m): 254003.5	Northing (m): 5747490.4
Hole Dia. (mm): 60	Water Level Initial (mbgs): 1.80	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.1	0.00-0.20 m	S 0.00-1.20 m Rec=58%		SW	Gravelly SAND (FILL): well graded, dark grey; loose; moist.
0.5		0.0	0.40-0.60 m			CL	Sandy CLAY (FILL): low plasticity, orange, grey and brown; firm; moist; with well graded, fine to coarse grained sand. Wet from 0.4-0.6mbgs.
		0.1	0.80-1.00 m				
1.0						SM	Silty SAND (FILL): fine to coarse grained, well graded, brown; loose; wet.
				S 1.20-2.40 m Rec=58%			CONCRETE.
1.5						SP	Silty SAND: fine grained, poorly graded, pale yellow; dense; dry to moist.
						SP	Silty SAND: fine grained, poorly graded, brown; dense; dry to moist.
2.0			1.80-2.00 m			SP	Silty SAND: fine grained, poorly graded, orange; loose; wet.
				S 2.40-3.60 m Rec=67%			
2.5							
3.0		0.2	2.80-3.00 m			CH	CLAY: medium to high plasticity, light grey; stiff; moist to wet; with minor pale orange mottling.
3.5				S 3.60-4.80 m Rec=83%			
4.0							Grading to mottled orange and grey from 4.0mbgs.
4.5							
5.0							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB136

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 10.50	Top Casing (m AHD): N/A	Easting (m): 253663.5	Northing (m): 5747170.9
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: G Bourke	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.30 m	S 0.00-0.50 m		SC	Sandy CLAY: non plastic, brown; dry to moist; no odour.
			0.30-0.50 m			SM	Silty SAND: fine grained, poorly graded, orange to brown; loose; dry; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: SB138

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253794.8	Northing (m): 5746967.7
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-0.50 m		SM	Silty SAND: fine grained, well graded, brown; dry; no odour.
			0.40-0.50 m			CL	CLAY: low plasticity, light brown to brown; stiff; dry; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB139

Comments
Refusal at 3.3mbgs on hard clay
Poor sample from 0-1.2

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 04-Jun-19	Date Finished: 04-Jun-19	Total Depth (mbgs): 3.30	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253961.2	Northing (m): 5747681.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m			(FILL): crushed rock and basalt.
			0.40-0.60 m			CL	Gravelly Sandy CLAY: low plasticity, black to grey; with medium grained sand and coal.
0.5			0.80-1.00 m				
1.0							
							COAL: coal on clay.
1.5						SW	Gravelly SAND: medium to coarse grained; loose; wet; with sub-rounded gravel, very gravelly.
			1.80-2.00 m				
2.0						ML	Clayey SILT: pale brown; stiff.
				S 2.40-3.30 m			
2.5							
			2.80-3.00 m				
3.0							Becoming harder with depth.
							Hole Terminated at 3.30 m Borehole terminated on refusal at 3.3mbgs
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB141

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.87	Top Casing (m AHD): N/A	Easting (m): 253916.7	Northing (m): 5747647.2
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.65 m	S 0.00-1.20 m Rec=67%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, black and dark brown; firm; moist.
0.5						CL	CLAY: medium plasticity, light brown; firm; moist; with trace fine sand.
1.0			0.80-1.10 m				
1.5			1.20-2.10 m	S 1.20-2.40 m Rec=33%		CL	Sandy CLAY: medium plasticity; firm; moist; with fine to medium grained sand (approximately 30%).
2.0						SP	SAND: fine to medium grained, yellow to brown.
2.5							COAL: coal lense.
3.0							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB144

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 06-May-19	Date Finished: 06-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253711.7	Northing (m): 5747629.0
Hole Dia. (mm): 50	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m Rec=92%		GM	Silty GRAVEL: medium grained, well graded, brown, mottled orange; loose; dry; no odour.
						SM	Silty SAND: fine grained, well graded, orange; dry; no odour.
			0.40-0.60 m			CH	CLAY: high plasticity, light brown to orange, mottled grey; stiff; dry to moist; no odour.
0.5							
			0.80-1.00 m			SC	Clayey SAND: well graded, orange; dry; no odour.
1.0						CH	CLAY: high plasticity; no odour.
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB145

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 11.50	Top Casing (m AHD): N/A	Easting (m): 253626.5	Northing (m): 5747128.9
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-0.50 m		GM	Silty GRAVEL: poorly graded, brown; stiff; dry to moist; no odour.
						CH	CLAY: high plasticity, orange, mottled white to red; stiff; dry to moist; no odour.
						CH	CLAY: high plasticity, brown, mottled yellow; stiff; dry; no odour.
			0.40-0.50 m			CL	CLAY: low plasticity, light brown, mottled brown; stiff; dry; no odour.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB146

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 11.50	Top Casing (m AHD): N/A	Easting (m): 253758.3	Northing (m): 5747201.9
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: G Bourke	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.10 m	S 0.00-0.50 m Rec=100%		CL	CLAY: low plasticity, brown; stiff; dry; no odour.
			0.40-0.50 m			SC	Clayey SAND: fine to medium grained, poorly graded, orange to yellow; dry.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB147

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253847.2	Northing (m): 5747097.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=58%		SC	Silty Clayey SAND: well graded, rounded to angular, light brown to brown; loose; dry; some gravel.
			0.40-0.60 m			CL	Silty CLAY: low plasticity, brown, mottled orange; stiff; dry; no odour.
0.5			0.80-1.00 m				
1.0						CL	CLAY: low plasticity, dark brown to brown; stiff; dry; no odour.
				S 1.20-2.40 m Rec=75%		CL	Silty CLAY: low plasticity, dark brown, mottled orange; stiff; dry; no odour.
1.5							
			1.80-2.00 m			CL	CLAY: low plasticity, light brown to yellow to orange, mottled grey; stiff; dry; no odour.
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:44 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB148

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254007.3	Northing (m): 5746942.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		SM	Silty SAND (FILL): fine to medium grained, well graded, rounded, light brown; loose; dry; no odour.
						SM	Silty SAND (FILL): medium grained, well graded, orange to yellow; loose; dry; with rounded quartz; no odour.
						SM	Silty SAND (ASSUMED FILL): fine to medium grained, well graded, red to dark brown; loose; dry; no odour.
0.5			0.40-0.60 m			CL	CLAY: low plasticity, light brown to brown to dark brown, mottled orange to grey; stiff; some gravel, fine to medium grained, rounded, well graded; no odour.
			0.80-1.00 m				
1.0							
				S 1.20-2.40 m Rec=100%		CL	Silty CLAY: low plasticity, orange to brown, mottled grey; stiff; dry; going brown at 2.0mbgs; no odour.
1.5						CH	CLAY: high plasticity, grey; stiff; dry; going brown at 2.0mbgs; no odour.
			1.80-2.00 m				
2.0						CL	Silty CLAY: low plasticity, light brown, mottled orange; stiff; dry; going brown at 2.0mbgs; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB149

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-Apr-19	Date Finished: 24-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.50	Top Casing (m AHD): N/A	Easting (m): 254180.3	Northing (m): 5747089.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=100%		CL	CLAY (FILL): low plasticity, orange to brown, mottled red; stiff; dry; no odour.
			0.40-0.60 m			CL	Silty CLAY (ASSUMED FILL): low plasticity, ornage to brown, mottled grey; stiff; dry; no odour.
0.5						CL	CLAY (ASSUMED FILL): low plasticity, dark brown, mottled ornage, grey; stiff; dry to moist; no odour.
			0.80-1.00 m			SC	Clayey SAND: fine to medium grained, well graded, rounded, dark brown to brown; loose; dry to moist; possible natural.
1.0				S 1.20-2.40 m Rec=83%		CH	CLAY: high plasticity, dark brown; stiff; dry to moist; no odour.
1.5						CH	CLAY: high plasticity, light brown to brown; stiff; moist; some gravel, fine to medium grained, rounded, well graded; no odour.
			1.80-2.00 m			CL	CLAY: medium plasticity, brown to orange, mottled grey; stiff; dry to moist; some gravel, medium grained, rounded, well graded; no odour.
2.0							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB150

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 23-Apr-19	Date Finished: 23-Apr-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254062.0	Northing (m): 5747253.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=83%		GM	Sandy Silty GRAVEL (FILL): fine to medium grained, well graded, rounded to sub-rounded, brown to light brown; loose; dry; no odour.
						CL	Sandy CLAY: low plasticity, brown, mottled orange to black; stiff; dry to moist; some gravel, fine grained, rounded, well graded, coal band 0.4-0.45mbgs.
0.5			0.40-0.60 m				
			0.80-1.00 m			CL	Silty Sandy CLAY: fine to medium grained, low plasticity, brown, mottled orange to black; stiff; dry to moist; some gravel, fine to medium grained, well graded; no odour.
1.0				S 1.20-2.40 m Rec=75%			
1.5						CL	Sandy CLAY: fine grained, low plasticity, brown to black; stiff; dry to moist; no odour.
			1.80-2.00 m				
2.0			2.00-2.20 m			SC	Assumed natural from 2.0mbgs Clayey SAND: fine grained, poorly graded, rounded, ornage to light brown; medium dense; moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB151

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253574.5	Northing (m): 5747276.3
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Hand Auger	Bore Permit #: N/A
Drilled By: K Vincent	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			0.00-0.10 m 0.40-0.50 m	S 0.00-0.50 m Rec=100%		SM	Silty SAND: fine to medium grained, poorly graded, brown; loose; dry; some gravel; no odour.
							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite

1.0 1.5 2.0 2.5 3.0 3.5 4.0

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB152

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 9.50	Top Casing (m AHD): N/A	Easting (m): 253692.6	Northing (m): 5747422.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.10-0.30 m	S 0.00-1.20 m Rec=100%		CL	Gravelly Sandy CLAY (FILL): medium plasticity; firm; with fine to coarse grained sand (approximately 30%) and fine to coarse grained gravel (approximately 10%).
							COAL: coal lense, dry.
0.5			0.40-0.60 m			CL	Gravelly Sandy CLAY (FILL): medium plasticity; firm; dry; with fine to coarse grained sand (approximately 30%) and fine to coarse grained gravel (approximately 10%).
			0.80-1.00 m			CL	Sandy CLAY: medium plasticity, dark brown; dry; with fine to medium grained sand.
1.0							
				S 1.20-2.40 m Rec=100%			
1.5							
			1.80-2.00 m			CL	CLAY: medium plasticity, brown; stiff; dry. Becomes dark brown to grey from 1.8mbgs.
2.0							Becomes moist from 2.1mbgs.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB153

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253626.8	Northing (m): 5747321.4
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.50 m	S 0.00-1.20 m Rec=79%		CL	Gravelly Sandy CLAY (FILL): dry; with fine to medium grained sand (20%), fine to coarse grained gravel (approximately 20%) and traces of brick fragments.
						SM	Silty SAND: fine to medium grained, grey; dense; dry.
0.5			0.50-0.70 m			SP	SAND: fine to medium grained, brown with black mottling; moist. Becomes dark brown with black mottling from 0.65mbgs.
1.0			1.00-1.20 m			CL	CLAY: medium plasticity, brown to grey; stiff; moist.
				S 1.20-2.40 m Rec=83%		SP	SAND: fine to medium grained, dark brown with black mottling; moist.
1.5							
			1.80-2.00 m				
2.0						CL	CLAY: medium plasticity, brown to grey; stiff; moist.
						SP	SAND: fine to medium grained, dark brown with black mottling; moist.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB154

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253666.9	Northing (m): 5747348.6
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.20-0.40 m	S 0.00-1.20 m Rec=83%		CL	Gravelly Sandy CLAY (FILL): medium plasticity; dry; with fine to medium grained sand (approximately 20%) and fine to coarse grained gravel (approximately 20%).
0.5			0.50-0.70 m			CL	Gravelly Sandy CLAY (FILL): black; firm; dry; with fine grained sand (approximately 30%) and fine grained gravel (approximately 10%).
						SM	Silty SAND: fine to medium grained, brown to grey; with silty matrix (approximately 30%).
						SW	SAND: fine to coarse grained, brown with black and orange mottling; dense; dry; with traces of fine gained gravel.
						CL	CLAY: medium plasticity, dark grey to brown; stiff; dry.
1.0			0.90-1.10 m				COAL: coal lense.
						CL	CLAY: medium plasticity, dark grey to brown; stiff; dry.
				S 1.20-2.40 m Rec=92%		SP	Gravelly SAND: fine to medium grained, dark brown with black mottling; moist; with fine to coarse grained gravel (approximately 10%).
1.5							
			1.80-2.00 m				
2.0							Becomes brown from 2.2mbgs.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB155

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 253620.7	Northing (m): 5747370.1
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-0.50 m Rec=100%		SC	Clayey SAND: fine grained, poorly graded, brown; dry; no odour.
						GC	Clayey GRAVEL: medium to coarse grained, poorly graded, orange to brown; dry; no odour.
			0.40-0.50 m				
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB156

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.00	Top Casing (m AHD): N/A	Easting (m): 253626.9	Northing (m): 5747459.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-1.20 m Rec=75%		SW	SAND: fine to coarse grained, yellow; dense; moist.
							Becomes black from 0.3mbgs.
			0.40-0.60 m				Becomes yellow with black mottling from 0.4mbgs.
0.5							Becomes orange from 0.6mbgs.
			0.90-1.10 m				Becomes grey from 0.9mbgs.
1.0							Becomes light orange from 1.1mbgs.
				S 1.20-2.40 m Rec=75%			Becomes light grey from 1.15mbgs.
1.5							Becomes orange from 1.6mbgs.
							Becomes light orange to grey from 1.75mbgs.
						CL	CLAY: medium plasticity, light grey; moist.
2.0			2.00-2.20 m			SW	Gravelly SAND: fine to coarse grained, yellow to grey; with fine to medium grained gravel (approximately 20%).
						CL	Becomes grey from 2.0mbgs.
							Sandy CLAY: medium plasticity, black; firm; moist to wet; with fine to coarse grained sand (approximately 30%).
						SW	SAND: fine to coarse grained, light orange to grey; dense; moist.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB157

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 9.50	Top Casing (m AHD): N/A	Easting (m): 253676.7	Northing (m): 5747429.3
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.40 m	S 0.00-1.20 m Rec=83%		CL	Gravelly Sandy CLAY (FILL): medium plasticity; firm; dry; with fine to coarse grained sand (approximately 30%) and fine to coarse grained gravel (approximately 10%).
0.5			0.40-0.50 m			ML	SILT: grey; moist.
						CL	Sandy CLAY: grey with brown mottling; with fine to medium grained sand (approximately 10%). With fine to coarse grained sand (approximately 30%) from 0.65mbgs.
			0.80-1.00 m			SP	SAND: fine to medium grained, brown to grey; moist.
1.0						CL	Sandy CLAY: medium plasticity, brown to grey; with fine grained sand (approximately 10%). Becomes orange with brown mottling from 1.1mbgs.
				S 1.20-2.40 m Rec=88%			
1.5							Becomes brown to grey from 1.4mbgs.
			1.80-2.00 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB158

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 6.00	Top Casing (m AHD): N/A	Easting (m): 253589.8	Northing (m): 5747170.6
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-1.20 m Rec=83%		CL	CLAY: low plasticity, brown; stiff; dry to moist; no odour.
						CL	CLAY: low to medium plasticity, yellow to orange; stiff; dry to moist; no odour.
0.5			0.40-0.60 m			CL	CLAY: medium plasticity, brown to dark brown, mottled orange; very stiff; dry; no odour.
			0.80-1.00 m				
1.0						CL	CLAY: low plasticity, light brown to brown; stiff; dry to moist; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB159

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 6.00	Top Casing (m AHD): N/A	Easting (m): 253632.0	Northing (m): 5747178.1
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8040DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.10 m	S 0.00-1.20 m Rec=92%		CH	CLAY: high plasticity, brown; stiff; moist; no odour.
						CH	CLAY: high plasticity, orange to brown; stiff; dry to moist; no odour.
0.5			0.40-0.60 m			CL	CLAY: low plasticity, light brown to brown; stiff; dry to moist; no odour.
1.0			0.80-1.00 m			CH	CLAY: high plasticity, light brown going brown; stiff; dry to moist; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB160

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 09-May-19	Date Finished: 09-May-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 7.50	Top Casing (m AHD): N/A	Easting (m): 253681.4	Northing (m): 5747192.6
Hole Dia. (mm): 80	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: G Bourke	Driller's License: N/A	Logged By: K Vincent	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-1.00 m Rec=100%		CH	CLAY: high plasticity, brown, mottled orange; stiff; no odour.
0.5			0.40-0.60 m			CH	CLAY: high plasticity, brown, mottled orange; dry to moist; with sand, fine grained, well graded; no odour.
			0.80-1.00 m			CH	CLAY: high plasticity, brown, mottled orange; stiff; moist; no odour.
1.0							Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB161

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 24-May-19	Date Finished: 24-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 6.00	Top Casing (m AHD): N/A	Easting (m): 253658.3	Northing (m): 5747206.5
Hole Dia. (mm): 94	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.20 m Rec=83%		SC	Sandy CLAY: low plasticity, brown to orange; dry; with fine to coarse grained sands and plant roots; no odour.
			0.20-0.40 m			CL	Silty CLAY: low to medium plasticity, mottled orange; dry; with fine grained, poorly graded sands; no odour.
			0.40-0.60 m			CL	Sandy CLAY: non to low plastic, orange to brown; friable; dry; with fine to medium grained sand; no odour.
0.5			0.60-0.80 m			CL	Sandy Silty CLAY: medium to high plasticity, orange brown; with fine grained, poorly graded, very dense sand.
			0.80-1.00 m				Increasing clay content with depth.
1.0			1.00-1.20 m				Grading to grey.
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB162

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 02-May-19	Date Finished: 02-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 254044.9	Northing (m): 5747359.1
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		1.0	0.00-0.20 m	S 0.00-1.20 m Rec=75%		GC	Clayey Sandy GRAVEL: fine to coarse grained, well graded, light brown, grey; loose; dry; crushed rock; no odour.
			0.40-0.60 m			SM	Silty SAND: fine to coarse grained, well graded, orange to brown; dry; with quartz; no odour.
1.0			0.90-1.10 m			CH	Assumed natural at 0.9mbgs or ~2.0mbgs (unsure if silty sand layer at 1.9-1.95 is fill or natural?) Silty Sandy CLAY: fine grained, high plasticity, light grey to orange brown; very stiff; dry to moist; with fine grained sand; no odour.
				1.20-2.40 m Rec=92%			
2.0			2.00-2.20 m			SM	Silty SAND: dark brown to grey; wood fragments (possible fill).
						CH	Silty CLAY: high plasticity, light brown, mottled dark brown; very stiff; dry to moist; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB163

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 02-May-19	Date Finished: 02-May-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 254077.8	Northing (m): 5747384.5
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=92%		GC	Clayey Sandy GRAVEL: fine to coarse grained, sub-angular, non to low plastic, grey to dark brown; loose; wet; cobble sized rock, fine grained silt present; no odour.
		.1	0.30-0.50 m			SC	Clayey SAND: fine to coarse grained, well graded, orange to brown; loose; moist; no odour.
0.5			0.60-0.80 m			CL	Sandy CLAY: fine grained, low to medium plasticity, light brown, mottled red to brown, dark brown; stiff; moist; silt present; no odour. Assumed natural difficult to ascertain - 0.6 or 0.9mbgs - possibly backfilled/reworked with natural material given variation?
			0.90-1.10 m			ML	Sandy SILT: fine grained, dark brown; overlying clay.
1.0						CH	Silty Sandy CLAY: fine grained, medium to high plasticity, light brown to grey; stiff; no odour.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB164

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 02-May-19	Date Finished: 02-May-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 254036.8	Northing (m): 5747400.8
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.8	0.00-0.20 m	S 0.00-1.20 m Rec=83%		SC	Silty Clayey SAND: fine grained, well graded, dark brown; loose; wet; no odour.
			0.40-0.60 m			SM	Silty SAND: fine to coarse grained, well graded, rounded, light brown; moist; cobble sized; no odour.
0.5						CH	Silty CLAY (FILL?): fine grained, medium to high plasticity, light to dark brown; stiff; moist; wood fragments; no odour.
			0.80-1.00 m				
1.0				S 1.00-2.40 m Rec=79%			
1.5						SW	Clayey SAND: fine to coarse grained, well graded, dark brown; moist; wood fragments; no odour.
						SC	Silty Clayey SAND: fine grained, medium orange brown to dark brown; moist; no odour. Assumed natural at 1.8 or 2.2mbgs
2.0			1.80-2.00 m				
			2.20-2.40 m			SC	Clayey SAND: fine to medium grained, low plasticity, orange brown; moist; increasing clay content with depth; no odour.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB165

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 03-Jun-19	Date Finished: 03-Jun-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): 10.90	Top Casing (m AHD): N/A	Easting (m): 254008.9	Northing (m): 5747409.9
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.:	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By:	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-0.50 m			(FILL): Crushed rock, dark grey, loose, wet with sand.
			0.30-0.50 m			CL	Silty CLAY (FILL): medium plasticity, white light brown streaks; firm; with black coal.
0.5							Hole Terminated at 0.50 m Target depth reached and backfilled with bentonite
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB166

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 02-May-19	Date Finished: 02-May-19	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 11.30	Top Casing (m AHD): N/A	Easting (m): 254030.3	Northing (m): 5747444.7
Hole Dia. (mm): 38	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: K Tawse	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
		0.0	0.00-0.20 m	S 0.00-3.60 m Rec=28%		GC	Clayey Sandy GRAVEL: fine to coarse grained, sub-angular, grey to dark brown; loose; wet; weathered; no odour.
0.5		0.1	0.40-0.60 m			SM	Silty SAND: fine to coarse grained, well graded, rounded, orange to brown with dark brown section.
		0.2	0.80-1.00 m			CH	Silty Sandy CLAY: fine grained, medium to high plasticity, light brown to dark brown, orange brown; soft; variation with fine grained sand.
1.0							
1.5						SM	Silty SAND (POSSIBLE FILL): dark brown. Plastic strand at 1.25mbgs.
		0.1	1.80-2.00 m				Copper wire at 1.75mbgs.
2.0							
2.5						SM	Silty SAND (POSSIBLE FILL): orange brown; wet; foreign material (white plastic?); no odour.
						CL	Sandy Silty CLAY: light brown to dark brown.
		0.0	2.80-3.00 m				Wood section (black) at ~2.9mbgs. Increasing clay and sand with depth.
3.0		0.1	3.20-3.40 m				Natural unable to be determined due to variation and foreign material
3.5							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB167

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254000.1	Northing (m): 5747442.6
Hole Dia. (mm): 35	Water Level Initial (mbgs): 1.80	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.3	0.00-0.20 m	S 0.00-1.20 m Rec=83%		GW	(FILL): Mixed silt, sand, clay and gravel (basalt), moist, stiff.
		0.3	0.40-0.60 m				
0.5							
1.0							
		0.2	1.10-1.30 m			CL	Silty CLAY: medium plasticity, light grey; firm; dry to moist.
				S 1.20-2.40 m Rec=83%		SP	SAND: fine grained, poorly graded, dark grey; loose; dry to moist.
1.5						CL	Sandy CLAY: low plasticity, dark brown and dark grey; stiff; moist.
						SM	Silty SAND: fine grained, well graded, dark brown to grey; loose; dry to moist; with silt and minor clay.
	▽	0.1	1.80-2.00 m			SP	Silty SAND: fine grained, poorly graded, pale yellow; dense; wet.
2.0						CL	Sandy CLAY: low plasticity, brown; soft; with fine to coarse grained, well graded sand.
				S 2.40-3.60 m Rec=83%			
2.5						SM	Silty SAND: fine to coarse grained, well graded, brown; loose; wet.
		0.1	2.80-3.00 m				
3.0							
						CL	CLAY: medium plasticity, light grey and pale orange; stiff; moist to wet.
3.5				S 3.60-4.80 m Rec=92%			
4.0							With some fine grained sands from 4.2-4.4mbgs.
4.5							
							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB168

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 7.50	Top Casing (m AHD): N/A	Easting (m): 253749.5	Northing (m): 5746556.5
Hole Dia. (mm): 90	Water Level Initial (mbgs): 1.90	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: loose; dry; with fine grained, poorly graded saned and roots and leaf litter.
			0.20-0.60 m			CL	Sandy CLAY: low plasticity, grey, orange and brown; stiff; dry; with fine grained, well graded sand.
0.5			0.60-1.00 m				Fine grained sand lense at 0.4mbgs.
							Fine grained sand lense at 0.8mbgs.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			Fine to medium grained sand lense at 1.2mbgs.
1.5			1.50-2.00 m				Becoming moist from 1.5mbgs.
	▽						Fine to coarse grained sand lense at 1.8mbgs.
2.0							Fine grained sand lense at 1.9mbgs. Moist to wet from 1.9mbgs.
							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: SB169

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 8.00	Top Casing (m AHD): N/A	Easting (m): 253768.9	Northing (m): 5746526.9
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		SM	Silty SAND: fine grained, well graded, pale yellow brown; very loose; dry.
			0.20-0.40 m				
0.5						SP	Silty SAND: fine grained, poorly graded, light grey with orange lenses; friable; dry; with minor clay.
			0.60-1.00 m				
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CL	Sandy CLAY: low plasticity, brown with orange mottling; stiff; moist.
						CL	CLAY: medium plasticity, orange with brown mottling; very stiff; dry to moist; with minor coarse sand.
1.5			1.50-2.00 m				
						SP	Silty SAND: fine grained, poorly graded, light grey with orange lenses; friable; dry; with minor clay.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB170

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 5.00	Top Casing (m AHD): N/A	Easting (m): 253860.2	Northing (m): 5746547.3
Hole Dia. (mm): 90	Water Level Initial (mbgs): 1.20	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=80%		OL	Sandy ORGANIC SILT: brown; loose; dry to moist; with tree roots.
			0.20-0.60 m				
0.5						CL	Sandy Silty CLAY: low plasticity, brown; firm; moist; with coarse sand and coal fragments.
			0.60-1.00 m				
						CL	Silty CLAY: medium plasticity, grey and brown; stiff; moist; with some coal and peat.
1.0			1.00-1.50 m	S 1.00-1.00 m			Increasing moisture with depth.
							Becomes moist to wet and soft from 1.2mbgs.
1.5			1.50-2.00 m				
						SW	SAND: medium to coarse grained, well graded; loose; wet; with some coal fragments.
2.0						Pt	PEAT: brown; wet.
							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: SB171

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 5.00	Top Casing (m AHD): N/A	Easting (m): 253924.7	Northing (m): 5746484.8
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: brown; very loose; dry; with tree roots.
			0.20-0.60 m			SM	Silty SAND: fine to coarse grained, well graded, brown and grey; loose; dry; with minor clay.
0.5			0.60-1.00 m				
						SW	SAND: fine to coarse grained, well graded, white to grey; very loose; moist; with quartz.
1.0			1.00-1.50 m	S 1.00-1.00 m		SP	Silty SAND: fine grained, poorly graded, dark brown; loose; moist.
1.5						CL	Sandy CLAY: low plasticity, dark brown; firm; moist; with fine to coarse grained, well graded sand, minor coal and possible peat.
							Core loss, tree root blocked line at 1.5mbgs.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB172

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253853.3	Northing (m): 5746400.0
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		SM	Silty SAND: fine grained, brown; loose; moist; with some organic matter (roots).
			0.20-0.60 m			SC	Clayey SAND: fine grained, well graded, pale brown; loose; dry.
0.5			0.60-1.00 m			CL	Sandy CLAY: low plasticity, mottle pale grey and pale orange; friable; dry; with fine to coarse grained, well graded sand.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CL	CLAY: medium plasticity, light brown; stiff; moist; with minor sand.
1.5			1.50-2.00 m			CL	Sandy CLAY: low to medium plasticity, light grey with red and orange mottling; very stiff; dry to moist; with medium to coarse grained sand.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: SB173

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 22-May-19	Date Finished: 22-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253901.6	Northing (m): 5746405.9
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: brown; loose; moist; with fine grained, poorly graded sand and organic matter (roots).
			0.20-0.60 m			SP	SAND: fine grained, poorly graded, pale brown to white; loose; dry.
0.5			0.60-1.00 m			CL	CLAY: medium plasticity, mottled grey to brown and brown to red; very stiff; dry to moist; with minor coarse sand. Increasng sand with depth.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CL	Silty CLAY: low plasticity, pale grey and pale brown; firm; dry; with some fine grained sand. Large tree root at 1.4mbgs.
1.5			1.50-2.00 m			CL	CLAY: medium plasticity, brown orange with red and grey mottling; stiff; dry to moist.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB174

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 5.00	Top Casing (m AHD): N/A	Easting (m): 254342.1	Northing (m): 5747022.0
Hole Dia. (mm): 95	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%			Organic matter (bark, twigs and leaves).
			0.20-0.60 m			CL	Silty CLAY: medium plasticity, brown; stiff; dry to moist; with minor grey to brown mottling, trace fine sands.
0.5			0.60-1.00 m			CH	CLAY: high plasticity, mottled grey and brown to orange; stiff; moist.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			
1.5			1.50-2.00 m			CL	Silty CLAY: low plasticity, orange; stiff; dry.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB175

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 5.00	Top Casing (m AHD): N/A	Easting (m): 254388.8	Northing (m): 5746903.6
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%			Organic matter (leaves and organic silt).
			0.20-0.60 m			CL	Silty Sandy CLAY: light brown to off white; friable; dry.
0.5			0.60-1.00 m				
						CL	Silty CLAY: low plasticity, brownish orange; firm; dry.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		ML	SILT: low plasticity, brown; friable; dry. Grading to clay from 1.2mbgs.
1.5						CL	Silty CLAY: medium plasticity, mottled orange, brown and light brown; very stiff; dry to moist.
2.0						CL	Silty CLAY: medium plasticity, orange red; very stiff; dry; with some fine grained sand.
							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB176

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 8.00	Top Casing (m AHD): N/A	Easting (m): 254022.8	Northing (m): 5746551.6
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		OL	ORGANIC SILT: with roots.
			0.20-0.60 m			CL	Silty Sandy CLAY: low plasticity, light brown, light grey and pale orange; friable; dry.
0.5			0.60-1.00 m				
							Becomes dry to moist from 0.8mbgs.
							Increasing sand with depth.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			Grading to clayey SAND from 1.0mbgs.
						SC	Clayey SAND: fine to coarse grained, well graded, light grey, light brown and pale orange; dense; dry to moist.
1.5			1.50-2.00 m				
2.0						CL	Sandy CLAY: low plasticity, dark brown; moist; with fine to coarse grained, well graded sand and coal.
							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB177

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254140.8	Northing (m): 5746580.0
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.00 m Rec=100%		OL	ORGANIC SILT: brown; moist.
			0.20-0.60 m			ML	Sandy SILT: brown; loose; dry; with fine to coarse grained sand and tree roots.
0.5						CL	Sandy CLAY: low plasticity, brown; stiff; dry; with coarse grained sand and coal and trace roots.
			0.60-1.00 m			SW	SAND: fine to coarse grained, well graded, off white and pale orange; very loose; dry.
						CL	Sandy CLAY: medium plasticity, dark brown, dark grey and grey; moist; with coal.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			
1.5			1.50-2.00 m				Wet sand lense 1.7-1.8mbgs. Becoming pale brown with less coal from 1.8mbgs.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB178

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253998.0	Northing (m): 5746872.3
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: low plasticity, pale brown; loose; dry; with coarse grained sand and roots.
			0.20-0.60 m			CL	Silty Sandy CLAY: low to medium plasticity, mottled brown, pale brown and orange brown; firm; dry; with fine to coarse grained, well graded sand.
0.5			0.60-1.00 m				
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		SW	Silty SAND: fine to coarse grained, well graded, light grey, light brown and pale orange; loose; dry.
						SW	SAND: fine to coarse grained, well graded; dense; dry to moist; with coal.
							COAL: dense; dry.
1.5			1.50-2.00 m			ML	Sandy CLAY: medium plasticity, grey, orange, brown and black; firm; moist; with coal and fine to coarse grained sand.
						CL	Sandy CLAY: medium plasticity, mottled pale orange and pale grey; firm; moist; with fine grained, poorly graded sand.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB179

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253961.9	Northing (m): 5746819.9
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		SW	Silty SAND: fine to coarse grained, well graded, brown; loose; dry; with leaf litter and roots.
			0.20-0.60 m			CL	Sandy Silty CLAY: light brown, pale orange and light grey; friable; dry; with some fine to coarse grained, well graded sand.
0.5			0.60-1.00 m				
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CH	CLAY: high plasticity, mottled grey and pale brown to orange; stiff; moist.
1.5			1.50-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB180

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 254026.8	Northing (m): 5746808.8
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: light brown; loose; dry; with fine to coarse grained, well graded sand and roots.
			0.20-0.60 m			CL	Silty Sandy CLAY: brown, light brown and light grey; friable; dry; with trace coal.
0.5			0.60-1.00 m				Some pale orange mottling from 0.8mbgs.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CL	Silty CLAY: low plasticity, brown; stiff; dry; with interbedded coal.
1.5			1.50-2.00 m				Trace tree roots at 1.2mbgs.
2.0						CL	Sandy CLAY: low plasticity, grey; firm; moist; with fine grained, poorly graded sand.
							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB181

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254066.5	Northing (m): 5746729.6
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: brown; loose; dry; with tree roots and fine to coarse grained sand.
			0.20-0.60 m				
0.5						CL	Sandy CLAY: low plasticity, brown and grey; firm; dry to moist; with medium to coarse grained sand. Increasing fine grained sand from 0.5mbgs.
			0.60-1.00 m				COAL.
						CL	Silty CLAY: low plasticity, brown; dry to moist; with interbedded coal.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=90%			
						SP	SAND: poorly graded, pale yellow brown; very loose; moist.
						CL	Sandy CLAY: low plasticity; firm; dry to moist; with coal fragments and fine to coarse grained, well graded sand.
1.5			1.50-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB182

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 21-May-19	Date Finished: 21-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254217.9	Northing (m): 5746620.7
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	SILT: brown; loose; dry; some organic matter.
			0.20-0.60 m			CL	Sandy Silty CLAY: low plasticity, light grey and light brown; stiff; dry; with fine to coarse grained, well graded sand and trace coal.
0.5							Trace roots to 0.6mbgs.
			0.60-1.00 m			SW	SAND: fine to coarse grained, well graded, light brown; loose; dry.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			COAL: brown; friable; dry. Grading to dark brown/black from 1.0mbgs.
1.5			1.50-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB183

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254221.4	Northing (m): 5746690.9
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8872DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: pale grey brown; loose; dry; with roots.
			0.20-0.60 m			CL	Silty Sandy CLAY: brown; stiff; dry; with coarse grained sand and coal.
0.5			0.60-1.00 m				
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			COAL: dark brown to black; dense; dry. Becoming moist from 1.2mbgs.
1.5			1.50-2.00 m			SW	SAND: fine to coarse grained, well graded, off-white to pale yellow; dense; dry to moist.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB184

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 14.00	Top Casing (m AHD): N/A	Easting (m): 254144.2	Northing (m): 5746789.0
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8872DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: brown; loose; dry; with fine to coarse grained, well graded sand and roots.
			0.20-0.60 m				
0.5						SW	SAND: fine to coarse grained, well graded, brown; dense; dry; in coal matrix.
			0.60-1.00 m				
						SW	SAND: fine to coarse grained, well graded, pale yellow and off-white; medium dense; with minor silt and clay.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			Becoming moist from 1.2mbgs.
1.5			1.50-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB185

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 14.00	Top Casing (m AHD): N/A	Easting (m): 254242.9	Northing (m): 5746798.1
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8872DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m 0.20-0.60 m 0.60-1.00 m	S 0.00-1.00 m Rec=100%		CL	Sandy Silty CLAY: low plasticity, mottled light brown, dark brown and grey; stiff; dry; with fine to coarse grained, well graded sand. Roots in the top 0.15mbgs.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			COAL: dark brown to black; friable; dry; with trace sands.
1.5			1.50-2.00 m			SW	SAND: fine to coarse grained, well graded, orange, off-white and brown; dry; with some coal.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB186

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254334.4	Northing (m): 5746816.8
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8872DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		CL	Silty CLAY: low plasticity, brown; friable; dry; with organic matter (bulbs and roots).
			0.20-0.60 m				COAL: brown to black; dry; with some well graded sand.
0.5			0.60-1.00 m				
						SW	SAND: fine to coarse grained, well graded, pale yellow; very loose; dry.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			COAL: dark brown; loose; dry; with some coarse grained, sub-rounded sand and trace gravel.
1.5			1.50-2.00 m				
						SW	SAND: fine to coarse grained, well graded, white; loose; moist.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB187

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254263.6	Northing (m): 5746890.3
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 8872DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: brown; loose; dry; with tree roots and trace coarse grained sand.
			0.20-0.60 m			SW	Silty SAND: fine to coarse grained, well graded, brown to dark brown; loose; moist; with some coal fragments.
0.5			0.60-1.00 m				
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			Becomes wet from 0.9-1.2mbgs.
							Moist again beyond 1.2mbgs.
1.5							Increasing coal with depth.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:45 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB188

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 10.50	Top Casing (m AHD): N/A	Easting (m): 254247.3	Northing (m): 5747010.4
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		SW	Silty SAND: fine to coarse grained, well graded, light brown; loose; with tree roots.
			0.20-0.60 m			SW	Silty SAND: fine to coarse grained, well graded, light brown; medium dense; dry to moist.
0.5			0.60-1.00 m			SW	Silty SAND: fine to coarse grained, well graded, light brown; medium dense; dry to moist; with interbedded coal.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			
1.5			1.50-2.00 m				COAL.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB190

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 13.00	Top Casing (m AHD): N/A	Easting (m): 254063.0	Northing (m): 5746596.5
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		OL	ORGANIC SILT.
			0.20-0.60 m			ML	Sandy SILT: light brown; loose; dry; with fine to coarse grained, well graded sand and trace coal roots.
0.5							Increasing sand with depth.
			0.60-1.00 m			SW	SAND: medium to coarse grained, well graded, dark brown to grey; loose; wet.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CL	CLAY: low plasticity, brown, light brown, light grey and pale orange; friable; dry to moist; with fine to coarse grained, well graded sand and trace coal.
							Occasional coarse grained, dry sand lense.
1.5			1.50-2.00 m				
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB191

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 7.00	Top Casing (m AHD): N/A	Easting (m): 254243.0	Northing (m): 5747079.4
Hole Dia. (mm): 90	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy SILT: low plasticity, brown; friable; dry; with roots and leaf litter present.
			0.20-0.60 m				Increasing sand with depth.
						SW	SAND: fine to coarse grained, well graded, light grey; dry.
0.5			0.60-1.00 m				
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%			
1.5			1.50-2.00 m				Becoming moist from 1.4mbgs.
2.0						CH	CLAY: high plasticity, grey; stiff; moist.
							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB192

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 20-May-19	Date Finished: 20-May-19	Total Depth (mbgs): 2.00	
Ground Surface (m AHD): 7.00	Top Casing (m AHD): N/A	Easting (m): 254270.1	Northing (m): 5747188.4
Hole Dia. (mm): 95	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.00 m Rec=100%		ML	Sandy ORGANIC SILT: grey to brown; dry; with fine grained, poorly graded sand. Tree roots in top 0.2mbgs.
			0.20-0.60 m			SW	Silty SAND: fine to coarse grained, well graded, light brown to off-white; dense; dry.
0.5			0.60-1.00 m				Some clay from 0.8mbgs.
1.0			1.00-1.50 m	S 1.00-2.00 m Rec=100%		CL	Silty CLAY: low to medium plasticity, brown; firm; with minor sand.
1.5			1.50-2.00 m				Grading to orange-brown from 1.8mbgs. Increasing fine sand.
2.0							Hole Terminated at 2.00 m Target depth reached and backfilled with bentonite
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB193

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254003.6	Northing (m): 5747655.0
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.45 m	S 0.00-1.20 m Rec=83%		CL	Sandy CLAY (FILL): medium plasticity, light brown to grey; firm; dry; with fine to coarse grained sand (approximately 30%).
0.5			0.45-0.80 m				Becomes dark brown with black mottling from 0.5mbgs. Becomes light brown from 0.6mbgs.
1.0			0.90-1.10 m				
1.5				S 1.20-2.40 m Rec=100%			
2.0			2.00-2.20 m				Becomes brown from 1.8mbgs. Becomes dark brown with sporadic coal fragments and fine to coarse grained gravel (approximately 10%) from 2.2mbgs.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB194

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254009.7	Northing (m): 5747647.1
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.70 m	S 0.00-1.20 m Rec=67%		CL	Gravelly Sandy CLAY (FILL): medium plasticity; firm to stiff; dry; with fine to coarse grained sand (approximately 20%) and fine to coarse grained gravel (approximately 10%).
0.5						CL	CLAY: medium plasticity, brown with light brown mottling; stiff; moist; with some coal fragments (approximately 10%).
			0.80-1.10 m			CL	CLAY: medium plasticity, light brown; firm; moist.
1.0				S 1.20-2.40 m Rec=100%			
			1.30-1.50 m				COAL: coal lense.
1.5						CL	Silty CLAY: medium plasticity, light brown; firm; moist.
			1.80-2.10 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB195

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254023.3	Northing (m): 5747656.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.60 m	S 0.00-1.20 m Rec=42%		CL	Gravelly Sandy CLAY (FILL): medium plasticity, black to dark grey; with fine to coarse grained sand (approximately 10%) and fine to coarse grained gravel (approximately 10%).
0.5						CL	Silty CLAY: medium plasticity, light brown; firm; moist; with silt (approximately 30%) and some coal fragments (approximately 10%).
			0.80-1.20 m				
1.0							COAL: coal lense.
						CL	Silty CLAY: medium plasticity, light brown; firm; moist.
				S 1.20-2.40 m Rec=100%			
1.5							
			1.90-2.20 m				
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: SB196

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): 25.00	Top Casing (m AHD): N/A	Easting (m): 254039.0	Northing (m): 5747669.3
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: N/A	Method: Hand Auger	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-1.00 m Rec=100%		CL	Sandy CLAY: medium plasticity, black with light brown clumps; firm; moist; with fine to medium grained sand (approximately 20%).
0.5			0.40-0.50 m				Becomes light brown with black mottling from 0.4mbgs.
1.0			0.90-1.00 m				Hole Terminated at 1.00 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB197

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 07-Jun-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 253994.2	Northing (m): 5747648.9
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m		CL	Sandy Gravelly CLAY (FILL): low plasticity; soft; wet; with crushed rock.
						CL	Silty CLAY: low plasticity, light brown; very stiff; very silty.
0.5			0.40-0.60 m				
			0.80-1.00 m				
1.0							
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB198

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 07-Jun-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254000.7	Northing (m): 5747642.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m		CL	Sandy Gravelly CLAY (FILL): low plasticity; soft; wet; with crushed rock.
0.5			0.40-0.60 m				
1.0			0.80-1.00 m			CL	Silty CLAY: medium plasticity, light brown; firm.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB199

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 253998.8	Northing (m): 5747662.4
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Hand Auger/Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-1.20 m Rec=33%		SW	Gravelly SAND (FILL): fine to medium grained, brown; loose; dry; with fine to coarse grained gravel and ballast (approximately 20%).
						CL	Gravelly Sandy CLAY (FILL): medium plasticity, dak brown to grey; firm; moist; with fine to coarse grained gravel (approximately 10%).
0.5			0.40-0.50 m				
1.0				S 1.20-2.40 m Rec=42%		CL	Silty CLAY: light brown; firm; moist; with silt (approximately 20%) and some sporadic coal fragments.
1.5							Push Tube terminated at 1.2mbgs
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB200

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 07-Jun-19	Date Finished: 07-Jun-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254015.1	Northing (m): 5747639.8
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m		CL	Sandy Gravelly CLAY (FILL): low plasticity; soft; wet; with crushed rock.
			0.40-0.60 m				
0.5						CL	Silty CLAY: medium plasticity, light brown; firm.
			0.80-1.00 m				
1.0							COAL.
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB201

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254016.7	Northing (m): 5747663.8
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.10 m	S 0.00-1.20 m Rec=75%		CL	CLAY (FILL): medium plasticity, light brown; firm; moist; with some black coal fragments (approximately 10%) and coarse grained gravel.
						CL	Gravelly CLAY (FILL): medium plasticity, dark brown to grey; firm; moist; with fine to coarse grained gravel (approximately 20%).
0.5			0.40-0.70 m			GW	GRAVEL (FILL): fine to coarse grained, grey to blue.
						CL	CLAY (FILL): medium plasticity, brown; firm; moist.
						CL	Gravelly CLAY (FILL): medium plasticity, black with brown mottling; with fine to coarse grained gravel (approximately 10%).
1.0			0.90-1.20 m			CL	CLAY: medium plasticity, light brown; firm; moist.
1.5							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB202

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-Sep-19	Date Finished: 30-Sep-19	Total Depth (mbgs): 1.20	
Ground Surface (m AHD): 15.00	Top Casing (m AHD): N/A	Easting (m): 254029.9	Northing (m): 5747648.8
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: M Launer	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.20 m	S 0.00-1.20 m Rec=100%		CL	Sandy CLAY (FILL): medium plasticity, brown to grey; firm; moist; with fine to coarse grained sand (approximately 30%).
						CL	Silty CLAY: medium plasticity, light brown; firm; moist; with silt (approximately 30%).
0.5			0.40-0.70 m				
			0.80-1.10 m				
1.0							
							Hole Terminated at 1.20 m Target depth reached and backfilled with bentonite
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB203

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 01-Oct-19	Date Finished: 01-Oct-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253812.8	Northing (m): 5747588.0
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: B Steenvoorden	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.60 m	S 0.00-1.20 m Rec=67%		CL	Gravelly Sandy CLAY: medium plasticity; dry; with fine to grained sand (approximately 20%) and fine to coarse grained gravel (approximately 20%).
0.5						SW	Gravelly SAND: fine to coarse grained, grey; dense; dry; with fine to medium grained gravel (approximately 20%).
						CL	Silty CLAY: medium plasticity, grey; firm; moist; with silty matrix (approximately 30%).
			0.80-1.00 m				Becomes black with brown mottling from 0.9mbgs.
1.0				S 1.20-2.40 m Rec=75%			
1.5							
2.0							Becomes black with light brown mottling from 1.9mbgs.
						CL	CLAY: medium plasticity, brown to grey; stiff; moist.
			2.20-2.90 m				COAL: coal lense, sticky.
						CL	CLAY.
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB204

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 14.00	Top Casing (m AHD): N/A	Easting (m): 253814.3	Northing (m): 5747730.1
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: W Dillon	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0				S 0.00-1.20 m Rec=83%		MH	Sandy SILT (FILL): brown; dry; with fine grained sand approximately 10% and some gravels up to 50mm.
0.5						CL	CLAY (FILL): low plasticity, brown with pink specs; firm; dry.
1.0							Becomes dark brown to black with specs of white, soft and dry to moist with some organic material (coal) from 1.0mbgs.
1.5				S 1.20-2.40 m Rec=83%			Becomes pale grey, firm and dry from 1.6mbgs.
2.0							SUSPECTED ASH: fine grained, dark grey to grey; dry.
2.5				S 2.40-3.60 m Rec=100%		SM	Silty SAND: fine grained, well graded, brown with minor pale grey and yellow; loose; dry; with trace coarse grained sand (<5%) and moderate cementation.
3.0							
3.5							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Drilling Log
Soil Bore ID: SB205

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 3.40	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253727.7	Northing (m): 5747676.6
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=79%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sands (approximately 20%).
						CL	CLAY: low plasticity, dark brown; firm; dry.
0.5							COAL.
							SUSPECTED ASH: grey; dense; dry.
							Becomes grey to brown from 0.7mbgs.
							Becomes light brown to grey from 0.9mbgs.
1.0							Becomes dark brown from 1.0mbgs.
						CL	CLAY: low plasticity, brown; stiff; moist. Becomes grey from 1.15mbgs. Becomes grey with orange mottling from 1.2mbgs.
				S 1.20-2.40 m Rec=83%			
1.5							
2.0							Becomes orange from 2.0mbgs.
				S 2.40-3.40 m Rec=100%			
2.5							Becomes grey from 2.7mbgs.
3.0							Becomes grey with orange mottling from 3.1mbgs.
3.5							Hole Terminated at 3.40 m Target depth reached and backfilled with bentonite
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB206

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253730.4	Northing (m): 5747670.7
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=75%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: low plasticity, light brown; firm; dry.
0.5							COAL.
						CL	CLAY: low plasticity, light brown; firm; dry.
1.0							SUSPECTED ASH: grey.
				S 1.20-2.40 m Rec=92%			Becomes light grey from 1.1mbgs.
1.5							Becomes dark brown from 1.45mbgs.
						CL	CLAY: orange; stiff; dry.
2.0							Becomes brown from 1.7mbgs.
2.5				S 2.40-3.60 m Rec=100%			Becomes grey with orange mottling from 2.4mbgs.
3.0							Becomes red to brown from 2.8mbgs.
3.5							Becomes yellow from 3.55mbgs.
4.0							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB207

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-09	Total Depth (mbgs): 3.10	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253746.7	Northing (m): 5747663.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=92%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: low plasticity, dark brown; firm; dry.
							Becomes light brown from 0.35mbgs.
0.5							With interbedded coal clumps from 0.5mbgs.
							Becomes light brown from 0.7mbgs.
1.0							Becomes light brown with dark brown mottling from 0.9mbgs.
				S 1.20-2.40 m Rec=67%			Becomes light brown with brown mottling from 1.2mbgs.
1.5							
2.0							COAL.
						CL	CLAY: low plasticity, dark brown with light brown mottling; firm; dry.
2.5				S 2.40-3.10 m Rec=100%			SUSPECTED ASH: light grey.
							Becomes dark brown from 2.65mbgs.
						CL	CLAY: low plasticity, brown; stiff; dry.
3.0							Becomes orange from 2.85mbgs.
							Becomes brown from 2.95mbgs.
							Hole Terminated at 3.10 m Target depth reached and backfilled with bentonite
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB208

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 3.10	
Ground Surface (m AHD): 11.00	Top Casing (m AHD): N/A	Easting (m): 253754.3	Northing (m): 5747667.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=83%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: low plasticity, dark brown; firm; dry. Becomes light grey with interbedded brown layers from 0.35mbgs. Becomes light brown with interbedded brown layers from 0.45mbgs. Becomes light brown from 0.6mbgs. Becomes dark brown from 0.7mbgs. Becomes light brown from 0.75mbgs.
0.5							
1.0							COAL.
				S 1.20-2.40 m Rec=67%		CL	CLAY: low plasticity, dark brown; firm; dry. Becomes light brown from 1.6mbgs.
1.5							COAL.
						CL	CLAY: low plasticity, light brown with interbedded brown layers; firm; dry.
2.0							
				S 2.40-3.10 m Rec=100%			SUSPECTED ASH: grey. Becomes light grey from 2.6mbgs. Becomes very light grey to white from 2.75mbgs.
2.5							Becomes dark brown from 2.9mbgs.
3.0						CL	CLAY: low plasticity, brown to red; firm; dry. Becomes grey to brown from 3.0mbgs.
							Hole Terminated at 3.10 m Target depth reached and backfilled with bentonite
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB209

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 4.10	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253754.9	Northing (m): 5747677.9
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=75%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: low plasticity, dark brown; firm; dry.
0.5							COAL.
						CL	CLAY: low plasticity, dark brown; firm; dry.
1.0							COAL: dry.
				S 1.20-2.40 m Rec=50%			
1.5							
							Interbedded with light brown, dry clay from 1.9mbgs.
2.0						CL	CLAY: low plasticity, light brown; firm; dry.
							COAL.
2.5				S 2.40-3.40 m Rec=80%		CL	CLAY: low plasticity, light brown; firm; dry.
							SUSPECTED ASH: dark grey.
3.0							Becomes light grey and dry from 3.2mbgs.
				S 3.40-4.10 m Rec=100%			Becomes light grey with brown mottling from 3.5mbgs.
3.5							Becomes light grey from 3.65mbgs.
						CL	Sandy CLAY: low plasticity, grey with brown to ornage mottling; stiff; moist.
4.0							
							Hole Terminated at 4.10 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB210

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 3.40	
Ground Surface (m AHD): 10.00	Top Casing (m AHD): N/A	Easting (m): 253707.8	Northing (m): 5747659.7
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=83%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: medium plasticity, brown to grey with red mottling; stiff; moist.
0.5							SUSPECTED ASH: light grey.
							Becomes grey from 0.7mbgs.
1.0							Becomes light grey from 0.7mbgs.
							Becomes brown to grey from 1.05mbgs.
				S 1.20-2.30 m Rec=100%		CL	CLAY: medium plasticity, light brown to orange; stiff; dry.
1.5							Becomes brown to orange with grey mottling from 1.6mbgs.
2.0							Becomes brown from 2.1mbgs.
2.5				S 2.30-3.40 m Rec=100%			
3.0							
3.5							Hole Terminated at 3.40 m Target depth reached and backfilled with bentonite
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB211

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 2.40	
Ground Surface (m AHD): 9.00	Top Casing (m AHD): N/A	Easting (m): 253693.6	Northing (m): 5747651.4
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=92%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: low plasticity, dark brown to grey; firm; dry.
0.5							SUSPECTED ASH: brown to grey. Becomes light grey from 0.35mbgs. Becomes very light grey to white from 0.5mbgs.
1.0				S 1.20-2.40 m Rec=100%		CL	CLAY: medium plasticity, brown to orange; stiff; dry. Becomes light orange from 1.2mbgs.
1.5							Becomes brown to red from 1.5mbgs.
2.0							
2.5							Hole Terminated at 2.40 m Target depth reached and backfilled with bentonite
3.0							
3.5							
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB212

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 08-Nov-19	Date Finished: 08-Nov-19	Total Depth (mbgs): 3.40	
Ground Surface (m AHD): 8.00	Top Casing (m AHD): N/A	Easting (m): 253667.8	Northing (m): 5747631.7
Hole Dia. (mm): 65	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: P Matheson	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=83%		CL	Sandy CLAY: low plasticity, black; stiff; moist; with sand (approximately 20%).
						CL	CLAY: low plasticity, dark brown; firm; dry.
0.5							Becomes brown from 0.5mbgs.
							Becomes orange to brown, medium plasticity, stiff and moist from 0.65mbgs.
1.0				S 1.20-2.40 m Rec=83%			Becomes grey with brown to orange mottling from 1.25mbgs.
1.5							With interbedded grey patches from 1.7mbgs.
2.0							
2.5				S 2.40-3.40 m Rec=80%			
3.0							
3.5							Hole Terminated at 3.40 m Target depth reached and backfilled with bentonite
4.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB213

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 14.00	Top Casing (m AHD): N/A	Easting (m): 253864.6	Northing (m): 5747678.4
Hole Dia. (mm): 60	Water Level Initial (mbgs): 3.20	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0				S 0.00-1.20 m Rec=83%		CL	Gravelly Sandy CLAY (FILL): light brown; stiff; dry.
0.5							
							COAL (FILL): dark brown; dry.
1.0							
				S 1.20-2.40 m Rec=75%		CL	Silty CLAY (FILL): low plasticity, dark grey to black with light brown inclusions; firm; moist.
1.5							
							Increasing moisture with depth.
2.0							
						SP	Silty SAND: fine grained, poorly graded, grey to dark grey; moist.
2.5				S 2.40-3.60 m Rec=83%			With possible ash from 2.3-2.8mbgs.
3.0	▽						Becomes wet from 3.0mbgs.
							Becomes light grey to brown from 3.2mbgs.
3.5						CL	Sandy CLAY: medium plasticity, brown; stiff; dry.
							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB214

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 11.10	Top Casing (m AHD): N/A	Easting (m): 253787.9	Northing (m): 5747622.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: W Dillon	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0				S 0.00-1.20 m Rec=83%		ML	Clayey SILT (FILL): low plasticity, brown; soft; moist; with some gravel up to 50mm (basalt). Becomes black and brown with some sand (approximately 10%) from 0.1mbgs.
						CL	CLAY (FILL): low plasticity, pink to brown; soft; dry to moist; with some fine grained sand (approximately 10%) and gravel gravel up to 10mm. Becomes white and dark brown with no sand from 0.3mbgs.
0.5						CL	CLAY (FILL): low plasticity, dark bown to black with specs of pale white; soft; moist.
1.0							Becomes dark brown with pale pink and yellow specs from 1.1mbgs.
				S 1.20-2.40 m Rec=83%			
1.5							
2.0							
2.5						SM	Silty SAND: fine to medium grained, well graded, sub-rounded, grey; loose; moist; weak to moderate cementation.
						CH	CLAY: high plasticity, brown and grey; stiff; moist.
3.0							
3.5							Becomes brown, grey and red from approximately 3.4mbgs.
							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB215

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 11.10	Top Casing (m AHD): N/A	Easting (m): 253767.6	Northing (m): 5747646.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: W Dillon	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0				S 0.00-1.20 m Rec=83%		CL	Silty CLAY (FILL): low plasticity, brown; soft; dry to moist; with trace gravel approximately 10mm (<5%).
0.5							With some firm, stiff material from 0.6mbgs.
1.0						CL	CLAY (FILL): medium to high plasticity, dark brown, grey, pink and yellow; firm; moist.
1.5				S 1.20-2.40 m Rec=83%			
2.0							Becomes predominantly dark brown (organic material), soft and moist from 2.2mbgs.
2.5				S 2.40-3.60 m Rec=100%		ML	Sandy SILT: non plastic; dry to moist; with fine grained, loose sand. Becomes dark grey to yellow with orange mottling with sub-angular gravels up to 10mm from 2.6mbgs.
3.0						CH	CLAY: high plasticity, grey and orange; stiff; moist; with trace sand.
3.5							With some red material from 3.5mbgs.
4.0							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB216

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253820.1	Northing (m): 5747670.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: W Dillon	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0		0.2		S 0.00-1.20 m Rec=83%		CL	Silty CLAY (FILL): low plasticity, brown; firm to stiff; with minor sub-angular gravel up to 10mm (<10%).
						CL	CLAY (FILL): low plasticity, dark brown to black with specs of white; soft to firm; moist; with some organic material (coal).
1				S 1.20-2.40 m Rec=83%			Yellow silty band from 1.3-1.4mbgs. Becomes dark brown with pink and yellow specs, low to medium plasticity and firm to stiff from 1.4mbgs.
2				S 2.40-3.60 m Rec=75%			Becomes pink and pale grey from 2.4mbgs.
3							SUSPECTED ASH: fine grained, well graded, light grey to off-white; very loose. Becomes grey from 3.0mbgs. Becomes pale grey from 3.1mbgs.
4				S 3.60-4.80 m Rec=92%		CH	CLAY: high plasticity, brown, grey and red; stiff; dry to moist.
5							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite
6							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB217

Comments

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 4.80	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253822.0	Northing (m): 5747650.3
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: W Dillon	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0				S 0.00-1.20 m Rec=75%		ML	Sandy SILT (FILL): low plasticity, brown; dry; with loose sand and fine to course grained, rounded quartz gravel up to 30mm (<5%) (basalt).
						CL	CLAY (FILL): low plasticity, black brown; soft to firm; dry to moist; with some coal.
							Becomes pale grey and brown from 0.6mbgs.
1							Becomes dark brown with pink specs and moist with some loose organic material from 1.0mbgs.
				S 1.20-2.40 m Rec=58%			
2							Becomes predominantly pink with low to medium plasticity from 2.0mbgs.
				S 2.40-3.60 m Rec=83%			SUSPECTED ASH: fine grained, grey and pale grey; very loose; dry.
3						CH	CLAY: high plasticity, grey and orange; stiff to very stiff; moist; with fine to coarse grained sand (approximately 10%) and rounded quartz.
				S 3.60-4.80 m Rec=100%			
4							Becomes orange from 4.0mbgs.
5							Hole Terminated at 4.80 m Target depth reached and backfilled with bentonite
6							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB218

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 12-Mar-20	Date Finished: 12-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 13.50	Top Casing (m AHD): N/A	Easting (m): 253870.9	Northing (m): 5747651.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: W Dillon	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0				S 0.00-1.20 m Rec=75%		CL	Silty CLAY: low plasticity, brown to grey with orange patches; firm; moist; with fine to medium grained sand (<10%) and sub-angular basalt and rounded quartz gravel up to 20mm (<5%).
						CL	CLAY (FILL): low to medium plasticity, brown with pink patches; firm to stiff; dry to moist.
0.5							
1.0							
1.5				S 1.20-2.40 m Rec=83%			With some yellow and pink material from 1.7mbgs.
2.0							SUSPECTED ASH: fine grained, grey; very loose; dry. Becomes pale grey from 1.9mbgs. Becomes off-white from 2.1mbgs.
2.5				S 2.40-3.60 m Rec=92%		SM	Silty SAND: fine grained, well graded, brown and yellow; loose; dry.
3.0						SC	Clayey SAND: fine to coarse grained, pale grey with orange mottling; moderately cemented with low plasticity clay and fragments of coarse, sub-rounded quartz.
3.5							
4.0							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB219

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Mar-20	Date Finished: 13-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 14.00	Top Casing (m AHD): N/A	Easting (m): 253870.5	Northing (m): 5747688.6
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0				S 0.00-1.20 m Rec=33%		GM	Sandy Silty GRAVEL (FILL) CRUSHED ROCK: grey to brown; dry.
0.5						CL	Silty CLAY (FILL): medium plasticity, brown; dense; dry; with some pale brown inclusions.
1.0				S 1.20-2.40 m Rec=83%			
1.5							COAL.
2.0							SUSPECTED ASH: fine to medium grained, grey, grading to light grey; dry; with some quartz sand grains. Grading to wet with depth.
2.5				S 2.40-3.60 m Rec=100%		CL	Sandy CLAY: low plasticity, pale orange; stiff; moist to wet.
3.0						CH	CLAY: medium to high plasticity, light grey and pale orange; stiff; moist.
3.5							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB220

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Mar-20	Date Finished: 13-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 14.00	Top Casing (m AHD): N/A	Easting (m): 253828.7	Northing (m): 5747733.0
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.0						CL	Gravelly Sandy CLAY (FILL): low plasticity, brown; firm; moist.
0.5						ML	SILT (FILL): off-white; dry.
						CL	CLAY AND COAL INTERBEDDED (FILL): brown to dark brown; loose; dry to moist.
1.0							
1.5							
2.0						CL	CLAY (FILL): low plasticity, pale brown; firm; moist.
2.5							SUSPECTED ASH: light grey; loose; dry; with some thick clay fill lenses.
3.0						CL	Sandy CLAY: low plasticity, brown and orange; firm; moist.
3.5						CL	Silty CLAY: medium plasticity, orange; stiff; dry to moist.
4.0							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: SB221

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Mar-20	Date Finished: 13-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253784.0	Northing (m): 5747721.7
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						CL	Silty CLAY (FILL/TOPSOIL): grey brown; loose; dry.
							SUSPECTED ASH: light grey; loose; dry.
0.5							
1.0						SC	Clayey SAND: fine to coarse grained, well graded, orange; dense; dry.
1.5							
2.0							
2.5						CL	Sandy CLAY: low plasticity, pale grey; dry to moist; with orange and red sandy lenses.
3.0							
3.5							
							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SB222

Comments

Project: Anglesea Power Station	Client: Alcoa of Australia Limited		
Location: Power Station		Project No.: AUS##C02697	
Date Started: 13-Mar-20	Date Finished: 13-Mar-20	Total Depth (mbgs): 3.60	
Ground Surface (m AHD): 12.00	Top Casing (m AHD): N/A	Easting (m): 253730.9	Northing (m): 5747685.5
Hole Dia. (mm): 60	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: SWD	Drill Rig: Geoprobe 7822DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: S Ward	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0							TOPSOIL.
0.5							SUSPECTED ASH: light grey; loose; dry.
1.0						SC	Clayey SAND: fine to coarse grained, well graded, orange; dense; dry.
1.5							
2.0							
2.5						CL	Sandy CLAY: low to medium plasticity; stiff; moist.
3.0							
3.5							
4.0							Hole Terminated at 3.60 m Target depth reached and backfilled with bentonite
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS059

Comments
Very stiff natural clay at 0.3m, unable to progress core

Surface water 0.2m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.30	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253741.2	Northing (m): 5747308.4
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m	Sd 0.00-0.30 m		ML	Clayey SILT: light brown; very soft.
			0.05-0.15 m			CH	CLAY: high plasticity, grey with red and orange mottling.
			0.15-0.30 m				
0.2							
							Refusal at 0.3mbgs with petrol driven ram Hole Terminated at 0.30 m Terminated on refusal at 0.3mbgs
0.4							
0.6							
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS060

Comments
Surface water 0.9m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.60	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253628.6	Northing (m): 5747160.6
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.05 m 0.05-0.15 m 0.15-0.30 m 0.30-0.50 m	Sd 0.00-0.60 m		SM	Silty SAND: dark brown; loose; with coarse sands, minor gravels and traces of coal.
0.4						CH	CLAY: high plasticity, grey with red and light brown mottling.
0.6							Hole Terminated at 0.60 m
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS062

Comments
Surface water 0.3m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253679.0	Northing (m): 5747231.8
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m 0.05-0.15 m	Sd 0.00-0.40 m		ML	Clayey SILT: brown to black; very soft; with coal.
0.2			0.15-0.30 m 0.30-0.50 m			CH	CLAY: high plasticity, grey with orange and red mottling; very stiff.
0.4							Refusal at 0.4mbgs with petrol driven picket driver Hole Terminated at 0.40 m Terminated on refusal at 0.4mbgs
0.6							
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS063

Comments
Surface water 0.3m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253787.6	Northing (m): 5747334.6
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m	Sd 0.00-0.50 m		ML	Clayey SILT: dark brown to grey; very soft; with some gravel.
			0.05-0.15 m			SW	Gravelly SAND: dark to grey to black; loose; with some coal.
			0.15-0.30 m				
0.2						CH	CLAY: high plasticity, grey; very stiff.
0.4						CL	Sandy CLAY: low plasticity, light brown with red mottling; very stiff.
							Hole Terminated at 0.50 m
0.6							
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS064

Comments
Surface water 0.3m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253849.3	Northing (m): 5747394.2
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m	Sd 0.00-0.50 m		ML	Clayey SILT: dark brown; very soft; with organic matter.
			0.05-0.15 m			CL	Sandy CLAY: low plasticity, light brown with red mottling; firm; with fine grained sand.
			0.15-0.30 m				
0.2							Some coal and coarse gravel throughout.
			0.30-0.50 m				
0.4							
							Hole Terminated at 0.50 m
0.6							
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS065

Comments
Insufficient recovered volume from 0.15m for PSD bag samples

Surface water 0.3m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-May-19	Date Finished: 30-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253850.5	Northing (m): 5747478.5
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.05 m 0.05-0.15 m 0.15-0.30 m	Sd 0.00-0.50 m		SW	Gravelly SAND: dark brown to grey; very loose; with some crushed rock and organic matter.
0.2			0.30-0.50 m			SW	Gravelly SAND: coarse grained, dark brown; loose; with some quartz gravels.
0.4						ML	Clayey SILT: dark brown; very soft.
0.6							Hole Terminated at 0.50 m
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS066

Comments
Surface water 0.3m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-May-19	Date Finished: 30-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253858.4	Northing (m): 5747429.7
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.05 m 0.05-0.15 m 0.15-0.30 m 0.30-0.50 m	Sd 0.00-0.50 m		ML	Clayey SILT: dark brown; very soft.
0.2						CL	Angular; thin lense of black organic matter at 0.2m. Sandy CLAY: low plasticity, light brown with red mottling; with occasional black vesicular gravels.
0.4							
0.6							Hole Terminated at 0.50 m
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS067

Comments
Very soft sediment below 0.3m.
Unable to get sufficient recovery for sample.
Unable to find base of sediment with 1.2m core liners. Sediment is at least 1m thick.
Surface water 0.5m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-May-19	Date Finished: 30-May-19	Total Depth (mbgs): 1.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253802.1	Northing (m): 5747550.4
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			0.00-0.05 m 0.05-0.15 m 0.15-0.30 m	Sd 0.00-0.50 m		OL	ORGANIC SILT: black; very soft; wet; with coal fragments.
0.2							
0.4							
0.6							CORE LOSS.
0.8							
1.0							Hole Terminated at 1.00 m
1.2							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS068

Comments
Surface water 0.4m above sediment

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 30-May-19	Date Finished: 30-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253787.1	Northing (m): 5747530.0
Hole Dia. (mm): 45	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m	Sd 0.00-0.50 m		OL	ORGANIC SILT: pale brown; mostly roots.
						OL	ORGANIC SILT: non plastic, dark grey to brown; very soft; wet.
			0.05-0.15 m				
			0.15-0.30 m				
0.2							Abundant roots to approximately 0.2m with some roots present to depth.
			0.30-0.50 m				Becomes very soft below approximately 0.3m, difficult to recover sample.
0.4							Sandy gravel coal lenses throughout.
							Hole Terminated at 0.50 m
0.6							
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:46 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS134

Comments
SS134 and SS135 have been assessed to represent 'soil' locations based on current ground conditions in the former sewage ponds

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253568.4	Northing (m): 5747218.1
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: D White	Driller's License: N/A	Logged By: D White	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m	Sd 0.00-0.50 m		ML	Sandy SILT: brown; very soft; with fine grained sands.
			0.05-0.15 m			SM	Silty SAND: fine to medium grained, light grey with orange oxidised zones; dense.
			0.15-0.30 m				
0.2							
			0.30-0.50 m				
0.4							
							Hole Terminated at 0.50 m
0.6							
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:47 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

EHS Support

Drilling Log
Soil Bore ID: SS135

Comments
SS134 and SS135 have been assessed to represent 'soil' locations based on current ground conditions in the former sewage ponds

No surface water, sparse vegetation

Project: Anglesea Power Station		Client: Alcoa of Australia Limited	
Location: Power Station		Project No.: AUS##C02697	
Date Started: 31-May-19	Date Finished: 31-May-19	Total Depth (mbgs): 0.60	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 253617.9	Northing (m): 5747210.2
Hole Dia. (mm): 150	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: N/A	Drill Rig: N/A	Method: AMS Core	Bore Permit #: N/A
Drilled By: M Reynolds	Driller's License: N/A	Logged By: M Reynolds	Checked By:

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			0.00-0.05 m	Sd 0.00-0.60 m		CL	Silty CLAY: medium plasticity, orange to brown; soft; wet; with roots and some kangaroo faeces scattered across ground surface.
			0.05-0.15 m			CH	CLAY: medium to high plasticity, orange to brown; firm; wet; with trace plant roots.
			0.15-0.30 m				
0.2						SM	Silty SAND: fine grained, poorly graded, pale grey; loose; moist to wet.
			0.30-0.50 m			SM	Silty SAND: fine grained, poorly graded, pale grey with pale orange oxidised zones; loose; moist to wet.
0.4							No oxidised zones from 0.4m.
0.6							Water accumulated at base of hole Hole Terminated at 0.60 m
0.8							
1.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB GLB Log EHS-AU GROUNDWATER WELL AUS##C02697_ANGLESEA POWER STATION.GPJ <<DrawingFile>> 28/9/2020 11:47 10.00.01.07 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.00.5 2019-05-10

Form GW4
April 1991

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

115867

BORE CONSTRUCTION LICENCE NO.

Report on site A B C

Name of Plant Operator D. WHITE

Bore Owner R.W.C.

Date Commenced 28/1/93 Date Completed 8/4/93 Total Depth 495.70 (m)

Was Bore Abandoned? Y/N ✓ If Yes, state method

OFFICE USE ONLY

BORE NUMBER K-35

GOVERNMENT RIG NUMBER 35/93/01

BORE USES 1 2

ADJACENT BORE (If present)

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY MUD	0	294.6	200.03											
" "	294.6	495.7	158.75											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL					CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
				0	248.5	127.0	S/JOINT							
✓				248.5	359	101.6	S/LINE							
	✓			359	362	~~101.6~~		SCREENS		101.6			JOHNSON	
✓				362	368.5	101.6	S/LINE							

WELL HEAD FITTINGS — Casing shoe Y/N — Bullnose/endcap Y/N

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material – C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
	✓				0	495.7						
✓					368.5	383.5	10	45				
		✓			355				RUBBER SLEEVE	165.1000		

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR	55000 G/HR	62.00			G/L		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ✓ No — If yes From 0 (m)

Have water samples been taken? Yes No — To 495.7 (m)

Samples taken by – Bore Owner Driller ✓ Project Geologist

Driller's Name D. WHITE Driller's Licence No.

Driller's signature Date 8/4/93

8. DRILLER'S LOG

Material	From (m)	To (m)
TOP SOIL	0	.3
SANDY CLAY	.3	2.7
SANDS	2.7	6.3
BROWN CLAY	6.3	25
SANDS	25	29.5
COAL & BROWN CLAY BANDS	29.5	93.2
SANDS	93.2	104.6
COAL	104.6	107.5
SANDY CLAY & QUARTZ	107.5	114
SANDS & CLAYS	114	129.5
BANDS OF COAL, SANDY CLAY	129.5	190.4
SANDSTONE	190.4	196.5
SANDS	196.5	199.08
CORE - SAND	199.08	200.55
SAND	200.55	206.7
COAL	206.7	207.5
SAND	207.5	213.8
SANDY CLAY & BANDS OF COAL	213.8	231.8
COAL & SANDS	231.8	254.2
GRAVELS	254.2	256
SANDY CLAY & BANDS OF COAL	256	272.4
MARL	272.4	294.6
QUARTZ HARD	294.6	289.08
CLAY STONE & SILTSTONE	289.08	318.00
COAL	318	321
SAND & COAL	321	364
SANDSTONE HARD	364	369
SANDSTONE & COAL	369	401.26
SOFT & HARD BLACK SAND	401.26	494.
CLUEY WHITE SANDSTONE	494	495.7

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

Form GW4
April 1991

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

115868

BORE CONSTRUCTION LICENCE NO.

Report on site A B C

RECEIVED 28 MAY 1993 WATER UNIT ADMINISTRATION 590 COLLINS ST. MELB.

OFFICE USE ONLY

BORE NUMBER K55

GOVERNMENT RIG NUMBER 39/93/02

BORE USES 1 2

ADJACENT BORE (If present)

Name of Plant Operator D. WHITE

Bore Owner R. W. C.

Date Commenced 4/5/93 Date Completed 26/5/93 Total Depth 245.40 (m)

Was Bore Abandoned? Y/N N If Yes, state method

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY MUD	0	237.90	200.0250											
" "	237.90	245.40	187.3250											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL Type				From (m)	To (m)	CASING Size (mm)	Material	SCREENS/SLOTS Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	OFFICE USE ONLY Lithology
CA	SC	SL	OH											
✓				0	51.70	215.9	S/LINE							
✓				39.00	178.00	168.2750	S/LINE							
	✓			178	184	~~0~~		S/STEEL	149.225	152.04	.160			
✓				184	191	168.2750	S/LINE							

WELL HEAD FITTINGS — Casing shoe Y/N — Bullnose/endcap Y/N

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
	✓				0	245.4						
✓					191	201	20	153				
		✓			39	40			J-LATCH	168.2750		

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIRLIFT	2.5	120			70.00		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ✓ No — If yes From 0 (m) To 245.4 (m)

Have water samples been taken? Yes ✓ No

Samples taken by – Bore Owner Driller ✓ Project Geologist

8. DRILLER'S LOG

Material	From (m)	To (m)
TOP SOIL	0	.3
CLAY	.3	8
SAND	8	16
SANDY CLAY	16	26.5
SANDY COAL	26.5	38
COAL	38	63.9
NO RETURN	63.9	99.9
CORE NO.1 NO REC.	99.9	101.4
~~101.4~~	~~153.9~~	
NO RETURN	101.4	201.9
SILTY CLAY, COAL CORE NO.2	201.9	203.4
NO RETURN	203.4	243.9
SILT & CLAY STONE CORE NO.3	243.9	245.4

Driller's Name D. WHITE Driller's Licence No.

Driller's signature [signature] Date 28/5/93

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

Form GW4
April 1991

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

116459

BORE CONSTRUCTION LICENCE NO.

Report on site A ☐ B ☐ C ☐ ☐

Name of Plant Operator DENNIS WHITE

Bore Owner R.W.C.

Date Commenced 9/8/93 Date Completed 19/8/93 Total Depth 253.00 (m)

Was Bore Abandoned? Y/N ☑ If Yes, state method

OFFICE USE ONLY

BORE NUMBER K 55

GOVERNMENT RIG NUMBER 35/93/05

BORE USES 1 2

ADJACENT BORE (If present)

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY MUD	0	253	203.2 ~~200mm~~											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL						CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type														
	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
☑				0	243	168·2750								
	☑			243	246	~~168~~		STAINLESS	158"	168"	.6		JOHNSON	
☑				246	253	168·2750								

WELL HEAD FITTINGS Casing shoe Y/N ☑ Bullnose/endcap Y/N ☑

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material – C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
	☑				0	253						

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR-LIFT	4	170		2½HR FLOWING			

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ☐ No ☑ If yes From ..... (m) To ..... (m)

Have water samples been taken? Yes ☐ No ☑

Samples taken by – Bore Owner ☐ Driller ☐ Project Geologist ☐

8. DRILLER'S LOG

Material	From (m)	To (m)
93/01 SAME AS		

Driller's Name D. WHITE Driller's Licence No.

Driller's signature Date 19/8/93

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

Form GW4
April 1991

Rural Water Commission of Victoria
WATER ACT 1989

BORE COMPLETION REPORT

BORE CONSTRUCTION LICENCE NO. 12176B

Report on site A [ ] B [ ] C [ ] [ ]

OFFICE USE ONLY
BORE NUMBER 12176B
GOVERNMENT RIG NUMBER 3-94-49
BORE USES 1 [ ] 2 [ ]
ADJACENT BORE (If present) [ ]

Name of Plant Operator BRENDEN CLARK

Bore Owner R.W.C

Date Commenced 16/6/94 Date Completed 23/6/94 Total Depth 133.50 (m)

Was Bore Abandoned? Y/N [N] If Yes, state method ANGLESEA

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY	0	133.50	200											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL T	SC	SL	OH	From (m)	To (m)	CASING Size (mm)	Material	SCREENS/SLOTS Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	OFFICE USE ONLY Lithology
✓				60	91	168	STEEL S/LINE							
✓				79.90	100.72	100	STEEL W/PIPE							
	✓			100.72	103.85	90	STAINLESS	STAINLESS	90	112	0.038	N	Johnson	
✓				103.85	116.95	90	STEEL S/LINE							
	✓			116.95	120.08	90	STAINLESS	STAINLESS	90	112	0.038	N	Johnson	
WELL HEAD FITTINGS ✓				120.08	133.50	100	STEEL W/PIPE	168MM LOCKING CAP					Casing shoe Y/N [ ]	Bullnose/ endcap Y/N [Y]

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material – C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)

4. WELL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR	1		5		77.70		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes [✓] No [ ] If yes From 3 (m)
Have water samples been taken? Yes [✓] No [ ] To 133 (m)
Samples taken by – Bore Owner [ ] Driller [✓] Project Geologist [ ]

Driller's Name BRENDEN CLARK Driller's Licence No. 466

Driller's signature Brenden Clark Date 1/7/94

RWC COPY – To be sent to RWC within 7 days of completion of bore.

8. DRILLER'S LOG

Material	From (m)	To (m)
TOP SOIL	0	1
RED CLAY	1	3
WHITE & RED CLAY	3	17
BROWN CLAY COAL	17	87.5
COAL	87.5	92
MEDIUM GRAVEL	92	110
WHITE CLAY	110	112
CEMENTED GRAVEL CLAY	112	128
WEATHERED GREY SLATE	128	

RECEIVED 11 JUL 1994 RWC INFORMATION CENTRE 590 TURNER ST. PT. MELB.

Form GW4
April 1991

Rural Water Commission of Victoria
WATER ACT 1989

BORE COMPLETION REPORT

BORE CONSTRUCTION LICENCE NO. [ ]

Report on site A [ ] B [ ] C [ ] [ ]

Name of Plant Operator A. DICKSON

Bore Owner R.W.C.

Date Commenced 12/7/94 Date Completed 3/8/94 Total Depth 400. (m)

Was Bore Abandoned? Y/N [N] If Yes, state method

OFFICE USE ONLY

BORE NUMBER 122149

GOVERNMENT RIG NUMBER 6-94 [29]

BORE USES 1 [ ] 2 [ ]

ADJACENT BORE (If present) [ ]

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
rotary mud	0	122	279											
	122	400	200											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL Type CA	SC	SL	OH	From (m)	To (m)	CASING Size (mm)	Material	SCREENS/SLOTS Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	OFFICE USE ONLY Lithology
✓				400	393.5	101	Steel							
	✓			393.5	380.5	101	S/steel	screen's			.089		Johnson	
✓				380.5	358.5	101	Steel				.089		Johnson	
	✓			358.5	355.5	101	S/steel	screen						
✓				355.5	352	101	steel							
				352	349	101	S/steel	screen			.038		Johnson	
				349	113.43	101	steel							
				113.43	456	219	steel							

WELL HEAD FITTINGS ✓ pressure cap 1.3 Above gnd Casing Shoe Y/N [N] Bullnose/ endcap Y/N [Y]

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
✓					0	122	92	18404				
		✓			at 240	at 240			two Rubber seals			
		✓			115	113.43			J Latch Seal Assembly.			

RECEIVED 15 AUG 1994 RWC ADMINISTRATION 136 TURNER ST. PT. MELB.

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
air-lift	9				Flowing 9 l/s.		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes [✓] No [ ] If yes From 300. (m) To 400. (m)

Have water samples been taken? Yes [✓] No [ ]

Samples taken by – Bore Owner [ ] Driller [✓] Project Geologist [ ]

8. DRILLER'S LOG

Material	From (m)	To (m)
grey clay	0	1
silty sand	1	5
brown clay	5	10.5
silty clay with blue black specs	10.5	16.5
fine sand	16.5	22
coal	22	30.5
clay grey brown	30.5	33
coal	33	49
lignous clay	49	61
sand bands coal clay etc	61	124
coal	124	135
fine sand + clay bands	135	172
silty clay coal + sand.	172	204
hard stuff	204	300
sand	300	315
lignous clay coal + sands	315	400.

Driller's Name A.W. DICKSON Driller's Licence No. 471

Driller's signature Andrew W Dickson Date 12/8/94.

RWC COPY – To be sent to RWC within 7 days of completion of bore.

113470

Form GW4
April 1991

Rural Water Commission of Victoria
WATER ACT 1989

BORE COMPLETION REPORT

BORE CONSTRUCTION LICENCE NO.

Report on site A B C

Name of Plant Operator BRENDEN CLARK

Bore Owner R.W.C

Date Commenced 6/10/92 Date Completed 13/10/92 Total Depth 202.20 (m)

Was Bore Abandoned? Y/N [N] If Yes, state method

OFFICE USE ONLY
BORE NUMBER 113470
GOVERNMENT RIG NUMBER 3.92.43
BORE USES 1 2
ADJACENT BORE (If present)

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROT - MUD	0	125	200											
	125	177	171.4											
	177	202	165.1											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL				CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type CA	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
✓				T.60	192	108	STEEL							
	✓			192	195	90	STAINLESS	STAINLESS STEEL	90	102	0.05	N	JOHNSON	
✓				195	202.20	108	STEEL							

WELL HEAD FITTINGS 6" LOCKING CAP

Casing shoe Y/N [ ] Bullnose/endcap Y/N [Y]

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)

DATA EXTRACTED

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR	0.063		5 HRS				

5. DRILLER'S PUMPING TEST

UNKNOWN

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes [✓] No [ ] If yes From ..... (m) To ..... (m)

Have water samples been taken? Yes [✓] No [ ]

Samples taken by – Bore Owner [✓] Driller [ ] Project Geologist [ ]

8. DRILLER'S LOG

Material	From (m)	To (m)
TOP SOIL SANDY	0	30
RED MOTTLED CLAY	30	3.00
WHITE MOTTLED CLAY	3.00	8.00
YELLOW MOTTLED CLAY	8.00	16.00
GREY CLAY HARD BANDS	16.00	53.00
COAL MEDIUM SAND + CLAY	53.00	97.00
LIGHT BROWN CLAY + SAND	97.00	107.00
WHITE CLAY SAND	107.00	112.00
BROWN CLAY COAL BANDS	112.00	119.00
MEDIUM SANDS	119.00	120.00
WHITE + BROWN CLAY CEMENTED GRAVEL	120.00	150.00
MEDIUM SAND - COAL + HARD CLAY	150.00	198.00
BLUEY GREY MUDSTONE	198.00	

DATA EXTRACTED

Driller's Name B. CLARK Driller's Licence No. 466

Driller's signature Brenden Clark Date 23/10/92

RWC COPY – To be sent to RWC within 7 days of completion of bore.

115869

Form GW4
April 1991

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

RECEIVED - 2 JUL 1993

BORE CONSTRUCTION LICENCE NO. [ ]

Report on site A [ ] B [ ] C [ ] [ ]

Name of Plant Operator D. WHITE

Bore Owner R. W. C.

Date Commenced 7/6/93 Date Completed 1/7/93 Total Depth 167.20 m

Was Bore Abandoned? Y/N [✓] If Yes, state method

OFFICE USE ONLY

BORE NUMBER K-55

GOVERNMENT RIG NUMBER 35/9703

BORE USES 1 [ ] 2 [ ]

ADJACENT BORE (If present) [ ]

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY MUD	0	167.20	200.025											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL					CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type CA	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
[ ]	[ ]	[ ]	[ ]	0	117.4	168.275								
[✓]	[ ]	[ ]	[ ]	~~60~~ 120	127	101.6								
[ ]	[✓]	[ ]	[ ]	127	130	101.6	STAINLESS	STAINLESS	88.9	101.6	.20 TH			
[ ]	[ ]	[ ]	[ ]	130	137	101.6								
[ ]	[ ]	[ ]	[ ]											

WELL HEAD FITTINGS — Casing shoe Y/N [ ] Bullnose/endcap Y/N [✓]

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
[ ]	[✓]	[ ]	[ ]	[ ]	0	167.20						
[✓]	[ ]	[ ]	[ ]	[ ]	137	147	10	202				
[ ]	[ ]	[✓]	[ ]	[ ]	60.50	~~62.00~~						
[ ]	[ ]	[ ]	[ ]	[ ]								

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR LIFTING	7	120			93.00		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes [✓] No [ ] If yes From 0 (m)

Have water samples been taken? Yes [✓] No [ ] To 167.2 (m)

Samples taken by – Bore Owner [ ] Driller [✓] Project Geologist [ ]

8. DRILLER'S LOG

Material	From (m)	To (m)
TOP SOIL	0	.4
CLAY	.4	28
SILTY CLAY	28	43
CLAY & COAL (MARL)	43	84.4
NO RETURN	84.4	99.7
CLAY & COAL (MARL) CORE 1	99.7	101.2
CLAY & COAL (MARL)	101.2	124.2
FINE SANDS	124.2	136
GRAVELS	136	139
SILT	139	148
CLAY	148	153.5
HARD BLUEY WHITE CLAY	153.5	165.7
HARD BLUEY WHITE CLAY CORE 2	165.7	167.2

Driller's Name DENNIS WHITE Driller's Licence No.

Driller's signature [signature] Date 1/7/93

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

Form GW4
April 1991

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

116458

BORE CONSTRUCTION LICENCE No. A ☐ B ☐ C ☐

RECEIVED
15 SEP 1993

Report on site

OFFICE USE OFFICE

DRILLER'S BORE NUMBER
196 TURNER ST.
BT MELB
GOVERNMENT RIG NUMBER 7.93.08
BORE USES 1 2
ADJACENT BORE (If present)

Name of Plant Operator BRENDEN CLARK

Bore Owner R.V.C

Date Commenced 24/8/93 Date Completed 26/8/93 Total Depth 116.00 (m)

Was Bore Abandoned? Y/N ☐ If Yes, state method

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (While drilling, measurements taken from natural surface)								OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY	0	116	200											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL					CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
✓	☐	☐	☐	0	100	101	PVC							
☐	☐	✓	☐	100	112	101	PVC	PVC	101	114	0.062			
✓	☐	☐	☐	112	116	101	PVC							
☐	☐	☐	☐											
☐	☐	☐	☐											

WELL HEAD FITTINGS

Casing shoe Y/N ☐ Bullnose/endcap Y/N ✓

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
☐	☐	✓	☐	☐	100				RUBBER	200		
☐	☐	☐	☐	☐								
☐	☐	☐	☐	☐								
☐	☐	☐	☐	☐								

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR	0.632		10		77.60		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ☐ No ✓ If yes From ..... (m)

Have water samples been taken? Yes ✓ No ☐ To ..... (m)

Samples taken by – Bore Owner ☐ Driller ✓ Project Geologist ☐

8. DRILLER'S LOG

Material	From (m)	To (m)
TOP SOIL	0	50
ORANGE GRAVELLY CLAY	50	3.00
RED + WHITE CLAY	3.00	11.00
YELLOW CLAY	11.00	17.50
BROWN SILTY CLAY	17.50	25.00
BROWN COAL	25.00	67.00
CEMENTED SAND CLAY	67.00	82.00
COAL LARGE GRAVEL	82.00	95.00
LIGHT YELLOW CLAY	95.00	100
MEDIUM TO LARGE SAND	100	112
COAL	112	

Driller's Name BRENDEN CLARK Driller's Licence No. 466

Driller's signature Brenden Clark Date 27/8/93

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

Form GW4
April 1991

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

116459

BORE CONSTRUCTION LICENCE NO.

Report on site A ☐ B ☐ C ☐ ☐

Name of Plant Operator DENNIS WHITE

Bore Owner R.W.C.

Date Commenced 9/8/93 Date Completed 19/8/93 Total Depth 253.00 (m)

Was Bore Abandoned? Y/N ☑ If Yes, state method

OFFICE USE ONLY

BORE NUMBER K 55

GOVERNMENT RIG NUMBER 35/93/05

BORE USES 1 2

ADJACENT BORE (If present)

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROTARY MUD	0	253	203.2 ~~200mm~~											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL						CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type														
	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
☑				0	243	168·2750								
	☑			243	246	~~168~~		STAINLESS	158"	168"	.6		JOHNSON	
☑				246	253	168·2750								

WELL HEAD FITTINGS Casing shoe Y/N ☑ Bullnose/endcap Y/N ☑

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material – C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
	☑				0	253						

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR-LIFT	4	170		2½HR FLOWING			

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ☐ No ☑ If yes From ..... (m) To ..... (m)

Have water samples been taken? Yes ☐ No ☑

Samples taken by – Bore Owner ☐ Driller ☐ Project Geologist ☐

8. DRILLER'S LOG

Material	From (m)	To (m)
93/01 SAME AS		

Driller's Name D. WHITE Driller's Licence No.

Driller's signature Date 19/8/93

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

116460

Rural Water Commission of Victoria

WATER ACT 1989

BORE COMPLETION REPORT

BORE CONSTRUCTION LICENCE NO. [ ]

Report on site A [ ] B [ ] C [ ] [ ]

OFFICE USE ONLY

BORE NUMBER [ ]

GOVERNMENT RIG NUMBER 7-93-09

BORE USES 1 [ ] 2 [ ]

ADJACENT BORE (If present) [ ]

ie of Plant Operator .....

re Owner R.W.C.

Date Commenced 13/9/93 Date Completed 5/11/93 Total Depth 304 (m)

Was Bore Abandoned? Y/N [ ] If Yes, state method .....

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
Mud Rotary	0	304	200											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL					CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type CA	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
✓				0	6.5	219	STEEL							
✓				6.5	98	168	STEEL							
✓				90	186	101	STEEL							
	✓			174	180	~~101~~		STAINLESS	100	104	.05		SURESCREEN	

WELL HEAD FITTINGS — Casing shoe Y/N [ ] Bullnose/endcap Y/N [ ]

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material – C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)
✓					198	186						

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIRLIFT							

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ✓ No [ ] — If yes From ..... (m) To ..... (m)

Have water samples been taken? Yes [ ] No [ ]

Samples taken by – Bore Owner [ ] Driller [ ] Project Geologist [ ]

Driller's Name ..... Driller's Licence No. .....

Driller's signature ..... Date ...../...../.....

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

8. DRILLER'S LOG

Material	From (m)	To (m)
YELLOW CLAY	0	.80
RED + WHITE CLAY	.80	8.00
FINE SAND	8.00	12.00
GREY CLAY	12.00	62.00
MEDIUM SAND + CLAY	62.00	72.00
COAL + SAND	72.00	112.00
COARSE SAND - GRAVEL	112.00	124.00
COARSE GRAVEL + CLAY	124.00	154.00
LIMESTONE	154.00	232.00
WHITE + GREY CLAY	232.00	304.00

119347

Form GW4
April 1991

Rural Water Commission of Victoria
WATER ACT 1989

BORE COMPLETION REPORT

BORE CONSTRUCTION LICENCE NO.

Report on site A B C

OFFICE USE ONLY
BORE NUMBER
GOVERNMENT RIG NUMBER 7-93 10
BORE USES 1 2
ADJACENT BORE (If present)

Name of Plant Operator S. TURNER

Bore Owner R.W.C

Date Commenced 17/11/93 Date Completed 2/12/93 Total Depth 226 (m)

Was Bore Abandoned? Y/N [N] If Yes, state method

1. DRILLING AND WATER INTERSECTION DETAILS

DRILLING TECHNIQUE				WATER INTERSECTIONS (while drilling, measurements taken from natural surface)									OFFICE USE ONLY	
Method	From (m)	To (m)	Bit Diam (mm)	From (m)	To (m)	Test method	Static level (m)	Estimated yield (l/sec)	Draw down (m)	Casing at test (m)	Depth at test (m)	EC at 25°C (µS/cm)	Water sample label number	Lithology
ROT MUD	0	130	200	[illegible]	[illegible]	[illegible]								
	130	226	149/133											

2. CASINGS (CA) SCREENS (SC) SLOTS (SL) OPEN HOLE (OH)

GENERAL					CASING		SCREENS/SLOTS						OFFICE USE ONLY
Type CA	SC	SL	OH	From (m)	To (m)	Size (mm)	Material	Material	Inner diam (mm)	Outer diam (mm)	Aperture (mm)	Filter Y/N	Trade name	Lithology
✓				0	18	152.4	S/LINE							
				18	197	101.6	W/PIPE							
				197	200	101.6	S/LINE	STAINLESS STEEL	76.2	101.6	0.076	N	JOHNSON	

WELL HEAD FITTINGS HINGED BORE CAP

Casing shoe Y/N Bullnose/endcap Y/N

3. CEMENT (C) BENTONITE (B) SEALS (S) PACKERS (P) GRAVEL (G)

Material C	B	S	P	G	From (m)	To (m)	Cement (bags)	Water (litres)	Seal/Packer type	Outer diam of seal (mm)	Artificial Gravel Packing Method of placement	Gravel size mesh passing (mm)

4. FINAL BORE DEVELOPMENT

Method	Yield (l/sec)	Draw down (m)	Pumping time	Recovery time	Final Static Level (m)	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number
AIR	.05				32		

5. DRILLER'S PUMPING TEST

Method	Static level (m)	Yield (l/sec)	Pumping level (m)	Draw down (m)	Pumping time	Recovery time	EC at 25°C (µS/cm)	OFF. USE ONLY Water sample label number

6. IF NOT A DRILLED BORE

Type	Length (m)	Width (m)	Diam (m)	Lining material	From (m)	To (m)

7. SAMPLES

Have material samples been taken? Yes ✓ No — If yes From 0 (m)
Have water samples been taken? Yes ✓ No — To 226 (m)
Samples taken by – Bore Owner Driller ✓ Project Geologist

Driller's Name S. TURNER Driller's Licence No. 474

Driller's signature [signature] Date / /

LICENSEE'S COPY – To be sent to Licencee within 7 days of completion of bore.

8. DRILLER'S LOG

Material	FROM m	TO m		From (m)	To (m)
WHITE CLAY	0	10	GREY + WHITE CLAY	90	93
SAND, COAL	10	12	SAND COURSE	93	95
COAL OILY	12	13	COAL	95	96
SAND GRAVELS	13	18	GREY CLAY	96	122
LIGHT BROWN CLAY	18	41	SAND COURSE	122	127
SAND	41	43	GREY CLAY	127	132
GREY CLAY	43	45	SAND COURSE	132	140
COAL	45	47	GREY CLAY	140	155
SAND COURSE	47	51	GREY CLAY + COAL BANDS	155	160
GREY CLAY	51	66			
SAND COURSE	66	69	GREY CLAY	160	226
GREY CLAY	69	72			
COAL	72	74			
GREY CLAY	74	79			
COAL	79	80			
SAND COURSE	80	86			
LIGHT BROWN CLAY	86	88			
GREY CLAY	88	90			

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P14

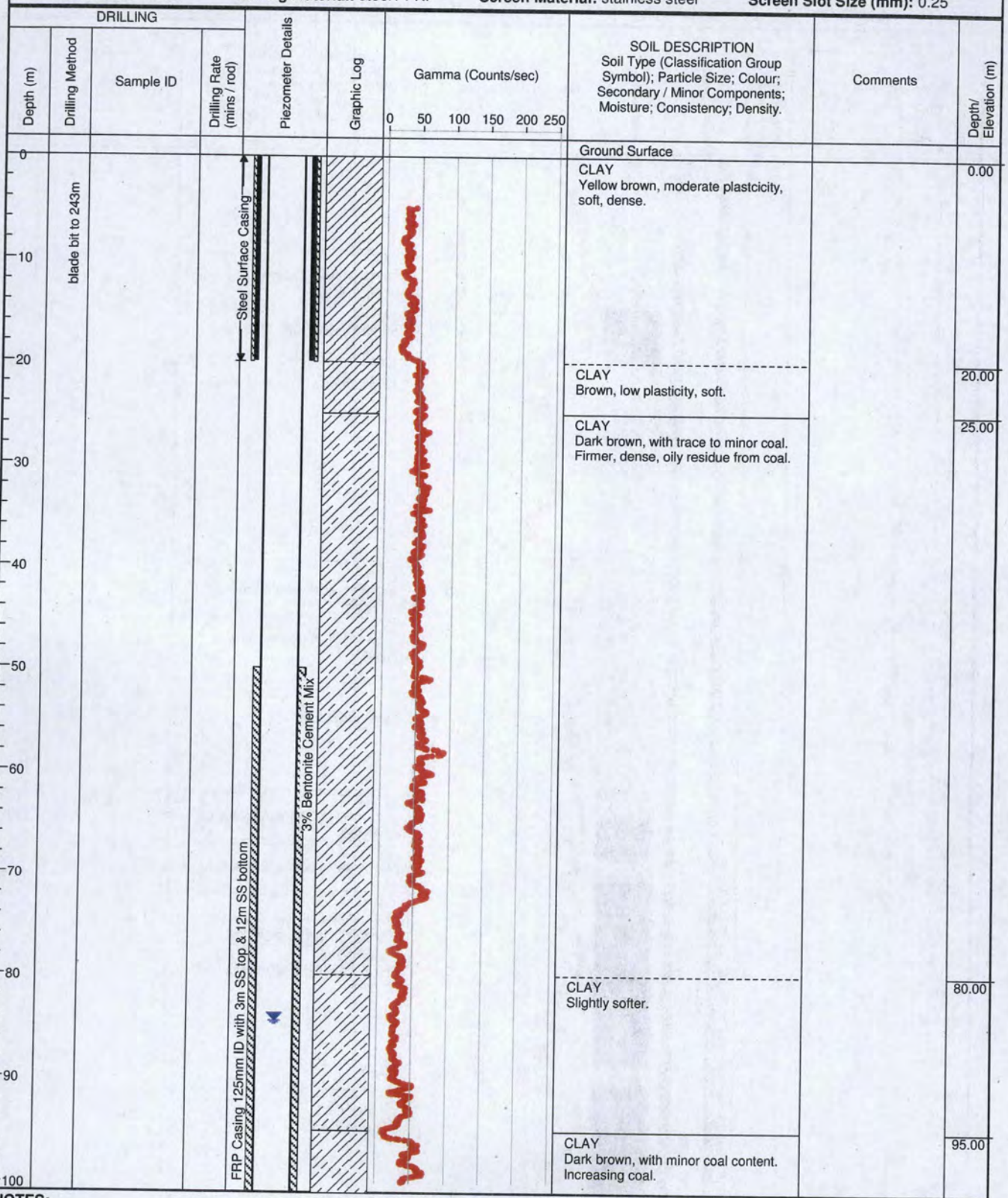
Page: 1 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Anglesea Water Reclamation Plant
Date Drilled: 18/05/2010 **to:** 09/07/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 570.3
Diameter (mm): pilot 6"

Easting: 255,524
Northing: 5,745,565
Grid Ref: MGA 94 (Zone 55)
Collar RL:
Logged by: DJM **Checked by:** JSM

B.C.L. No.: WLE046293 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P14

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
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Drilling Co.: Sides
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B.C.L. No.: WLE046293 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25

DRILLING: Depth (m)	DRILLING: Drilling Method	DRILLING: Sample ID	DRILLING: Drilling Rate (mins / rod)	Piezometer Details	Graphic Log	Gamma (Counts/sec) 0 50 100 150 200 250	SOIL DESCRIPTION (Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.)	Comments	Depth/ Elevation (m)
110				FRP Casing 125mm ID with 3m SS top & 12m SS bottom			CLAY Some red brown clay with minor coal, low plasticity, gritty.		110.00
							COAL Increased coal content, less clay.		115.00
120							CLAY Dark brown, with minor coal content.		120.00
130									
140							CLAY Light grey, plastic, soft to firm, with some coal.		140.00
							CLAY Brown, griity, with increased coal content. slightly more clay.		145.00
150									
160							SAND Grey, medium grained, subangular, minor coal.		162.00 164.00
							COAL Dark brown / black, with some clay, griity.		168.00 170.00
170							SAND Grey, medium to coarse grained, subangular quartz, minor coal.		
180							Clayey COAL Brown clayey coal. Increasing coal content.		188.00
							CLAY Brown, plastic, dense.		190.00
190							Clayey COAL Dark brown, clayey coal.		
200									200.00

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: P14

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
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Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
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Diameter (mm): pilot 6"

Easting: 255,524
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Grid Ref: MGA 94 (Zone 55)
Collar RL:
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B.C.L. No.: WLE046293 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25

Depth (m)	Drilling Method	Sample ID	Drilling Rate (mins / rod)	Piezometer Details	Graphic Log	Gamma (Counts/sec) 0 50 100 150 200 250	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Comments	Depth/ Elevation (m)
210							CLAY Light brown / grey, with some coal.		
							Clayey COAL Dark brown caley coal.		204.00
							slightly more clay.		
			15				COAL Dark brown / black, light weight, low strength, flat smooth planar cleavage.		214.00
220									216.00
			50				SAND Brown, fine grained.		
							Clayey SAND Becoming clayey sand, with minor to some coal.		222.00
			50				Decreasing sand and increasing clay content.		
230									228.00
			55				CLAY Dark brown, with minor coal and trace sand. Increasing coal.		
							Plastic clay.		
240			23						
	changed to medium rock roller bit						Increasing coal to 244m.		
			45						
250									
			15				COAL Dark black / brown, with minor medium grained sand.		252.00
									254.00
			20				Clayey SAND Increasing fine sand and clayey sand, with coal.		258.00
260									260.00
			15				COAL Black, light weight, low strength.		
							Clayey SAND Increasing fine sand and clayey sand, with coal		266.00
270			25						
							SAND Grey / brown, fine to medium grained, subrounded to subangular.		270.00
			20				Clayey SAND Increasing coal and clay, with minor coarse sand.		272.00
280									278.00
			25				SAND Predominantly fine sand.		280.00
							CLAY Dark brown, plastic.		284.00
			20				Clayey SAND Mostly subangular, coarse, becoming slightly cleaner with more sand.		
290									290.00
			18				Sandy CLAY Dark brown, with some coal, gritty.		
							Clayey SAND Mostly grey / brown, clayey fine sand, with no coal.		
300			22	FRP Casing 125mm ID with 3m SS top & 12m SS bottom					300.00

NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

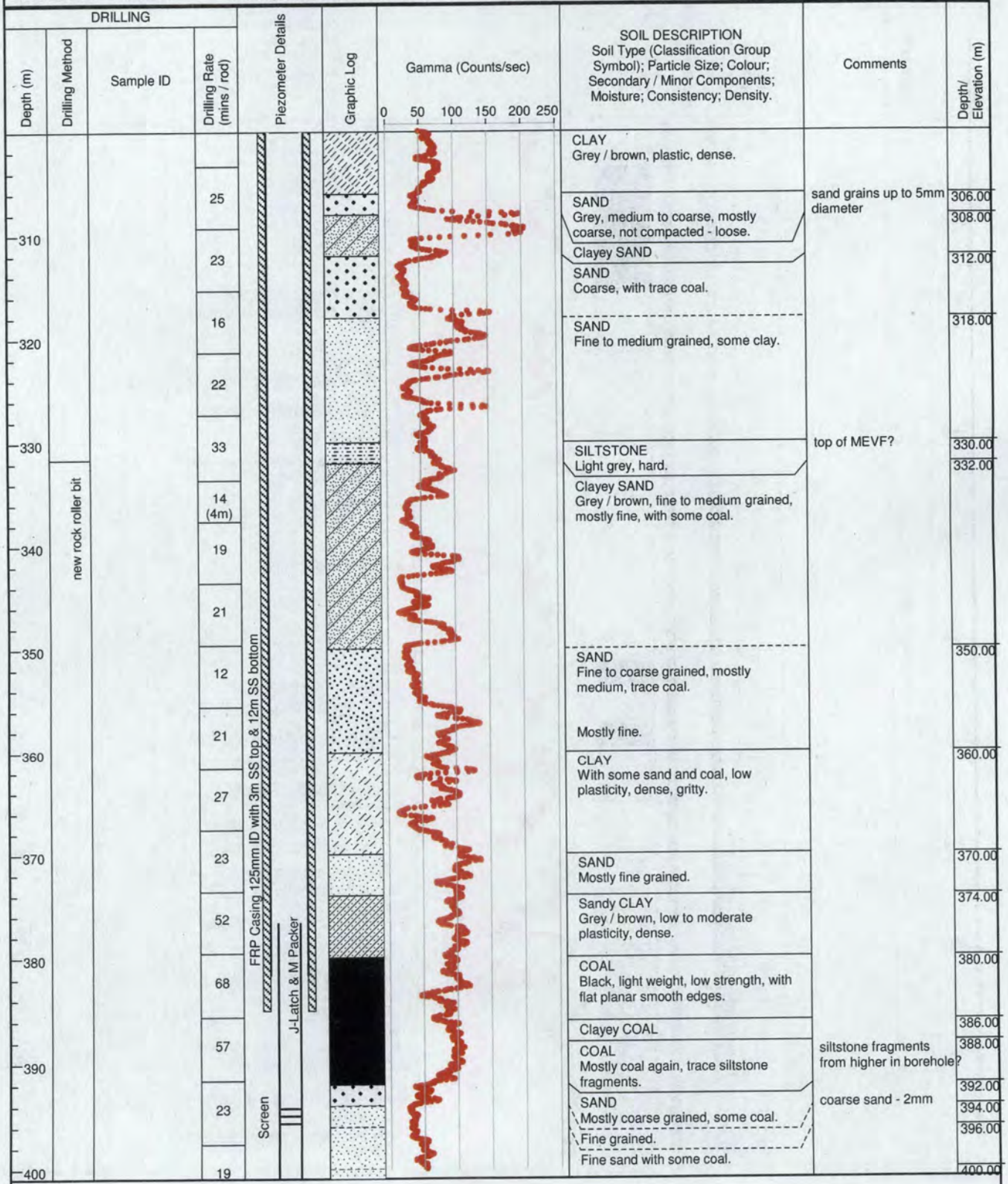
Bore No.: P14
Page: 4 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Anglesea Water Reclamation Plant
Date Drilled: 18/05/2010 **to:** 09/07/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 570.3
Diameter (mm): pilot 6"

Easting: 255,524
Northing: 5,745,565
Grid Ref: MGA 94 (Zone 55)
Collar RL:
Logged by: DJM **Checked by:** JSM

B.C.L. No.: WLE046293 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25



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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: P14

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Anglesea Water Reclamation Plant
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Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
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Northing: 5,745,565
Grid Ref: MGA 94 (Zone 55)
Collar RL:
Logged by: DJM **Checked by:** JSM

B.C.L. No.: WLE046293 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25

Depth (m)	Drilling Method	Sample ID	Drilling Rate (mins / rod)	Piezometer Details	Graphic Log	Gamma (Counts/sec) 0 50 100 150 200 250	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Comments	Depth/ Elevation (m)
							SAND Grey / brown, fine grained, consistent, well sorted.		
410			16						
			33				Sandy CLAY Dark brown, low plasticity, sandy, coaly clay, gritty.		410.00
420			32				Becoming slightly sandier.		
			35				SAND Grey / brown, fine grained. Slightly more clay.		422.00
430	new hard rock roller bit		90	80mm ID Schedule 40 316 Stainless Steel Casing			COAL Black, flat smooth edges, low strength, light weight.	hard drilling, changed to hard rock roller bit	430.00 432.00
			40				CLAY With minor sand and coal.		434.00
440			97				SAND Fine grained with minor clay and coal. Clayey SAND Medium to coarse grained, with clay.		438.00 440.00
			36	Screen			Clayey SAND Fine grained, dense clayey sand. Clayey fine to medium sand.	sandstone ground up by rock roller bit?	
450			169				Sandy CLAY Dark grey / brown coaly sandy clay. Gritty, with minor pale grey siltstone.		452.00
			60				Clayey SAND Clayey coal and sand.		456.00 458.00
460			70				SAND Grey / brown, fine grained, with minor clay. Feels dense.	fine grained sandstone ground up by rock roller bit?	
470			116				Clayey SAND Brown, fine, with clay and coal.		470.00
			56				CLAY Brown, moderate plasticity, dense, coaly, with minor brown compacted clay - mudstone.		474.00 476.00 478.00
480			45				Brown, dense, sandy clay. Clayey sand, mostly fine.		482.00 484.00
			27	Screen			SAND Grey / brown, fine to coarse, mostly medium, minor clay and coal. Increasing clay content.		488.00
490			105	12m Sump			SAND Grey, mostly coarse subangular quartz, trace coal and clay. Brown, clayey, coaly sand, f - c.		494.00 497.00
500							Brown, fine sandy clay, dense, l - mp. BASEMENT	bedrock	499.00

NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P14

Page: 6 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Anglesea Water Reclamation Plant
Date Drilled: 18/05/2010 **to:** 09/07/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 570.3
Diameter (mm): pilot 6"

Easting: 255,524
Northing: 5,745,565
Grid Ref: MGA 94 (Zone 55)
Collar RL:
Logged by: DJM **Checked by:** JSM

B.C.L. No.: WLE046293 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25

DRILLING: Depth (m)	Drilling Method	Sample ID	Drilling Rate (mins / rod)	Piezometer Details	Graphic Log	Gamma (Counts/sec) 0 50 100 150 200 250	SOIL DESCRIPTION	Comments	Depth/ Elevation (m)
			117				BASEMENT Some fine to medium sand, coal, and clay washing in from higher in borehole, but also some pale grey hard siltstone.		
			143						
510			102						
			110						
520			120				Some pale grey clay.		
			182				Fine to medium sand and coal washing in, but also some hard blue / grey pieces bedrock.		
530			150						
			102 (5m)				Blue / grey dense clay and few bedrock pieces off drill bit when pulled up from 541m.	new rock roller bit	
540			112				Some coal wasing in, with dark grey clay and pale grey hard bedrock pieces.		
			190						
550			195						
			214				Increasing amount of blue /grey bedrock pieces amongst coal and clay (washing in).		
560									
							total depth @ 570.3m		570.30
570									
580									
590									
600									600.00

NOTES:

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BOREHOLE LOG
HYDROGEOLOGICAL

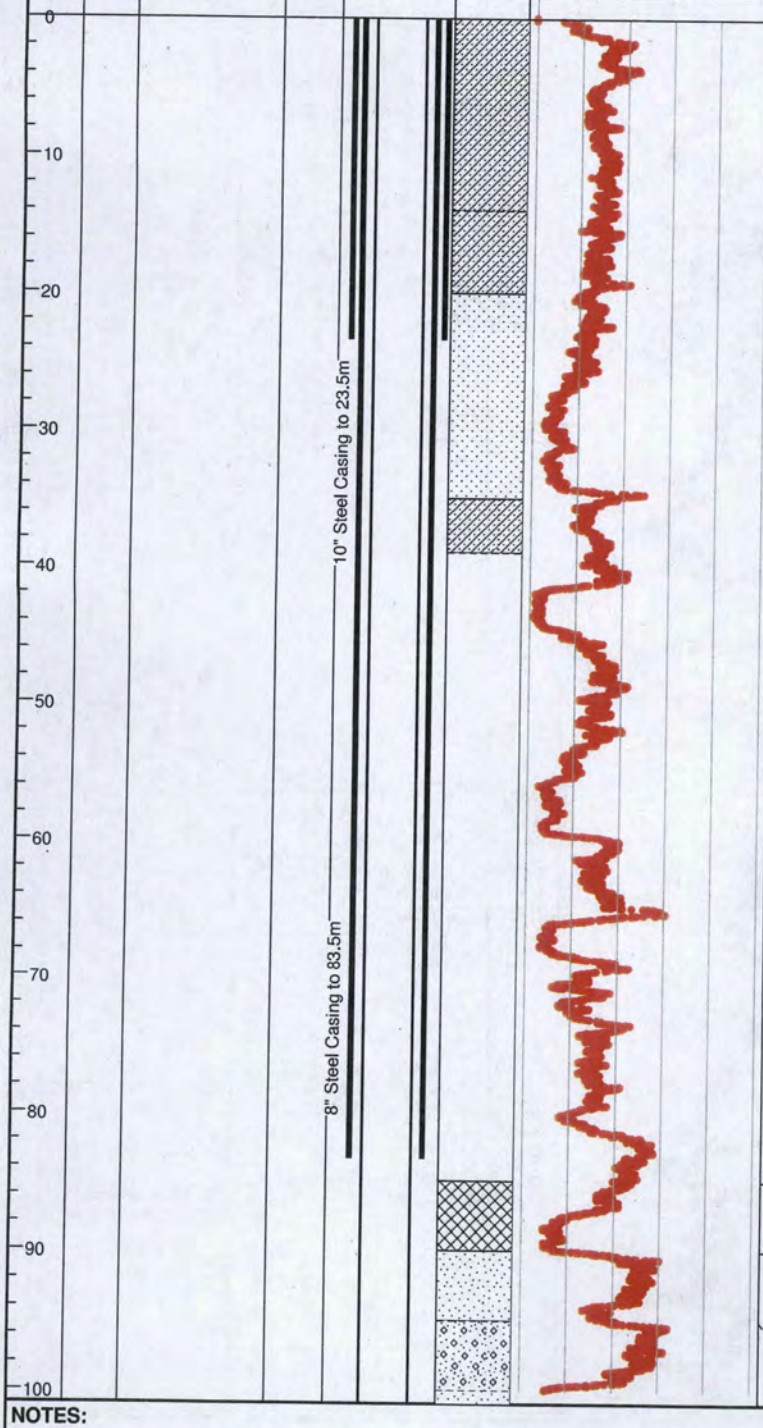
Bore No.: P15
Page: 1 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Mt Ingoldsby Road
Date Drilled: 15/07/2010 **to:** 20/08/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 530
Diameter (mm): pilot 6"

Easting: 250,122
Northing: 5,744,773
Grid Ref: MGA 94 (Zone 55)
Collar RL:
Logged by: DJM **Checked by:** JSM

B.C.L. No.: WLE046292 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25 - 0.35



SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Comments	Depth/ Elevation (m)
Ground Surface		
Sandy CLAY Pink / orange / white, dense, with some coarse sand and gravel. With less sand.		0.00
Some hard dark grey rock pieces - just crushed rock from pad falling in.		14.00
SAND Light grey, fine sand, well sorted, very consistent, loose, like beach sand.		20.00
Sandy Ligneous CLAY Dark red / brown, minor coal, with some hard pieces fine grained blue / green siltstone / mudstone.		35.00
LOST CIRCULATION		39.00
CEMENT Mostly cement, some fine sand.		85.00
SAND Grey, salt and pepper appearance, fine to medium, mostly fine, with tiny black coal fragments.		90.00
Coarser, darker, fine to coarse, increasing coal, minor green s/stone.		95.00
		100.00

NOTES:

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: P15

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Job No.: 31/25123/04
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Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 530
Diameter (mm): pilot 6"

Easting: 250,122
Northing: 5,744,773
Grid Ref: MGA 94 (Zone 55)
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B.C.L. No.: WLE046292 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25 - 0.35

DRILLING									
Depth (m)	Drilling Method	Sample ID	Drilling Rate (mins / rod)	Piezometer Details	Graphic Log	Gamma (Counts/sec) 0 50 100 150 200 250	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Comments	Depth/ Elevation (m)
							As above, less coarse.		
							COAL Dark black / brown, hard, light weight, oily residue.		105.00
110									
120							Sandy COAL With some fine sand.		120.00
130							LOST CIRCULATION		130.00
140									
150									
							SAND Grey, medium to coarse, mostly medium, with minor gravel.		156.00
160							Coarser, mostly coarse sand to gravel, subrounded quartz.		158.00
							Mostly fine to medium.		162.00
							Fine to coarse, mostly fine to medium, consistent.		164.00
170									
							Gravelly SAND Coarse sand to gravel, with some hard pieces dark grey brown rock (falling in from above?), and pale orange clay.		174.00
180							SAND Grey, fine to medium, mostly fine, with minor clay content.	Hard fine sandstone ground up by drill bit?	178.00
190									
200									

125mm ID FRP & 3m SS top & 44m SS bottom

NOTES:

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: P15
Page: 3 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Mt Ingoldsby Road
Date Drilled: 15/07/2010 **to:** 20/08/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 530
Diameter (mm): pilot 6"

Easting: 250,122
Northing: 5,744,773
Grid Ref: MGA 94 (Zone 55)
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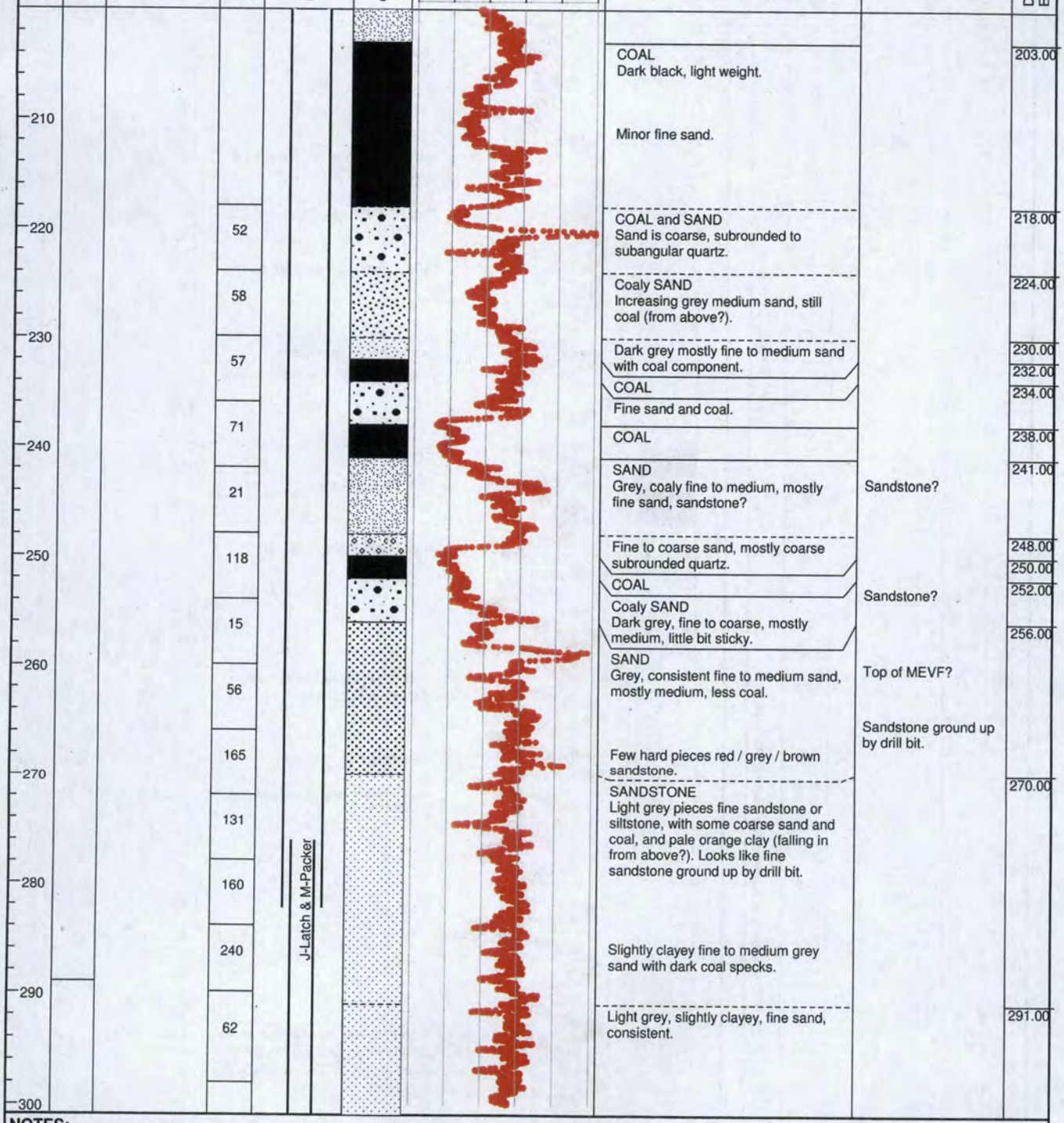

SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Comments	Depth/ Elevation (m)
COAL Dark black, light weight. Minor fine sand.		203.00
COAL and SAND Sand is coarse, subrounded to subangular quartz.		218.00
Coaly SAND Increasing grey medium sand, still coal (from above?).		224.00
Dark grey mostly fine to medium sand with coal component.		230.00 232.00
COAL Fine sand and coal.		234.00
COAL		238.00
SAND Grey, coaly fine to medium, mostly fine sand, sandstone?	Sandstone?	241.00
Fine to coarse sand, mostly coarse subrounded quartz.		248.00 250.00
COAL	Sandstone?	252.00
Coaly SAND Dark grey, fine to coarse, mostly medium, little bit sticky.		256.00
SAND Grey, consistent fine to medium sand, mostly medium, less coal. Few hard pieces red / grey / brown sandstone.	Top of MEVF? Sandstone ground up by drill bit.	
SANDSTONE Light grey pieces fine sandstone or siltstone, with some coarse sand and coal, and pale orange clay (falling in from above?). Looks like fine sandstone ground up by drill bit. Slightly clayey fine to medium grey sand with dark coal specks.		270.00
Light grey, slightly clayey, fine sand, consistent.		291.00

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P15

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Mt Ingoldsby Road
Date Drilled: 15/07/2010 **to:** 20/08/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 530
Diameter (mm): pilot 6"

Easting: 250,122
Northing: 5,744,773
Grid Ref: MGA 94 (Zone 55)
Collar RL:
Logged by: DJM **Checked by:** JSM

B.C.L. No.: WLE046292 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25 - 0.35

Depth (m)	Drilling Method	Sample ID	Drilling Rate (mins / rod)	Piezometer Details	Graphic Log	Gamma (Counts/sec) 0 50 100 150 200 250	SOIL DESCRIPTION (Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.)	Comments	Depth/ Elevation (m)
			57	80mm ID SS Casing			Slightly more coal.		302.00
			40						
310			39				Sandy CLAY Brown / grey, with some fine sand.	Top of LEVF?	310.00
							Clayey SAND As above, with decreasing clay content, some harder pieces grey / brown siltstone.		314.00
			21						318.00
320							SAND Brown / grey, fine, consistent.		
			18						328.00
							Fine to coarse, mostly fine with some coarse subrounded quartz.		
330			15				Brown / grey, fine, consistent		330.00
			27						
							COAL		339.00
340							With some fine sand.		341.50
			33				COAL		
							Coaly SAND Coaly sand / sandy coal mix.		346.00
			36						
350									
			40						
							SAND Dirty brown / grey, fine to medium grained, with some coal.		358.00
360			26						
							Increasing coal.		368.00
			30				SAND Grey / brown, fine to medium grained, consistent.		
370									
			29						
				1m 0.25mm Aperture Screens 363 - 364m & 385 - 386m					
			36						
380									
			31						
390			26				Fine to coarse, mostly medium, with some subrounded coarse quartz.		392.00
									394.00
			33				Grey / brown, fine to medium grained, consistent		
400									

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: P15
Page: 5 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Mt Ingoldsby Road
Date Drilled: 15/07/2010 **to:** 20/08/2010

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Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 530
Diameter (mm): pilot 6"

Easting: 250,122
Northing: 5,744,773
Grid Ref: MGA 94 (Zone 55)
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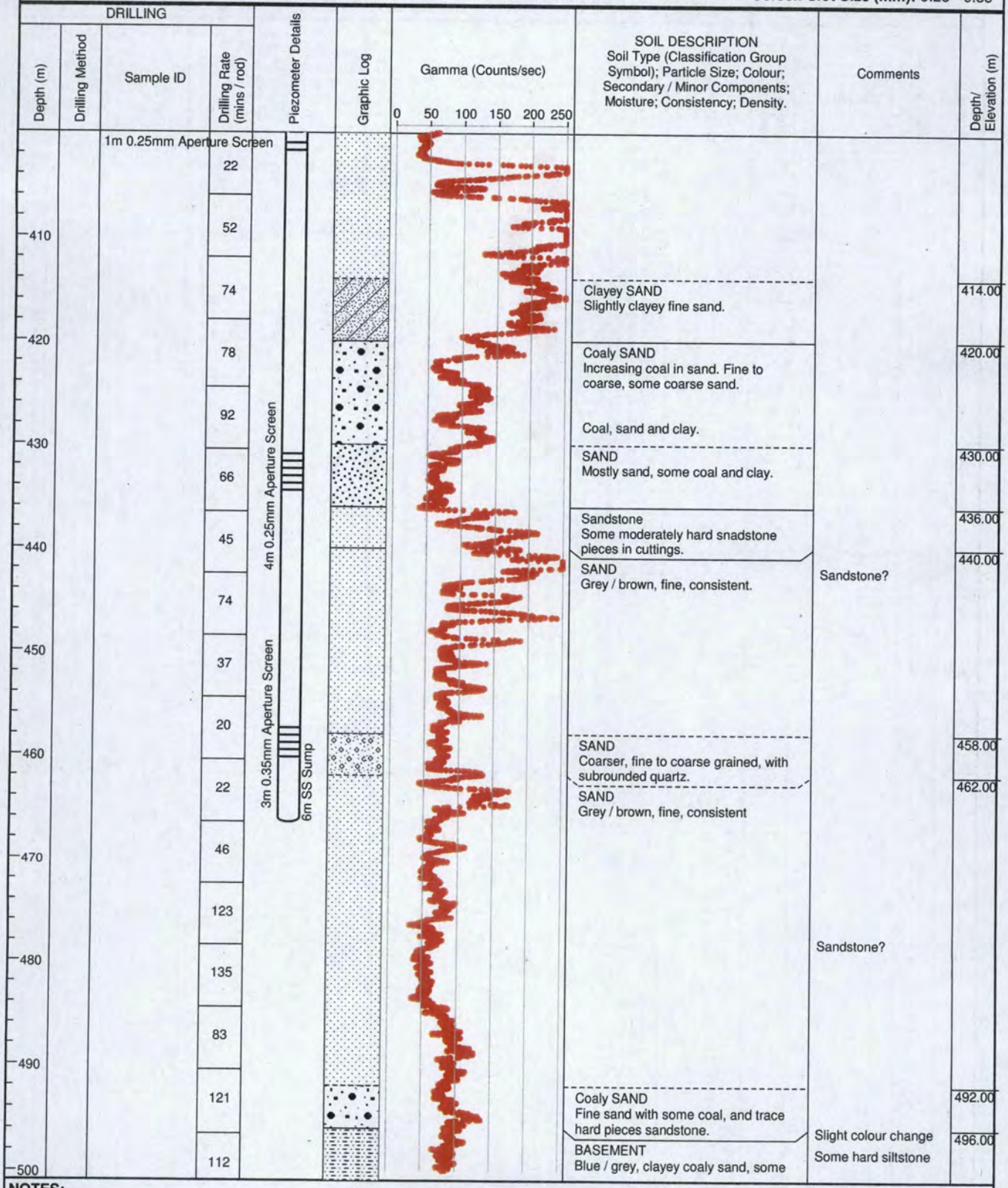
B.C.L. No.: WLE046292 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25 - 0.35



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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P15
Page: 6 of 6

Client: Barwon Water
Project: Anglesea Deep Obs Bores
Job No.: 31/25123/04
Location: Mt Ingoldsby Road
Date Drilled: 15/07/2010 **to:** 20/08/2010

Drilling Co.: Sides
Driller: Jarrod Freeman
Rig Type:
Total Depth (m): 530
Diameter (mm): pilot 6"

Easting: 250,122
Northing: 5,744,773
Grid Ref: MGA 94 (Zone 55)
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B.C.L. No.: WLE046292 **Casing Material:** steel / FRP **Screen Material:** stainless steel **Screen Slot Size (mm):** 0.25 - 0.35

DRILLING				Piezometer Details	Graphic Log	Gamma (Counts/sec)	SOIL DESCRIPTION	Comments	Depth/ Elevation (m)
Depth (m)	Drilling Method	Sample ID	Drilling Rate (mins / rod)			0 50 100 150 200 250	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.		
							As above, slightly blue / grey, salt & pepper appearance, sandy clay with coal.		501.00
			120				Pale blue / grey, hard pieces fine sandstone / siltstone, with some coal.		506.00
510			366						
			382				Mostly fine sand and coal, salt & pepper appearance, may be falling in or coming off bore walls, with minor pale blue / grey fine grained sandstone.		516.00
520			280						
			240						
530							end of hole at 530m.		530.00
540									
550									
560									
570									
580									
590									
600									600.00

NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P6

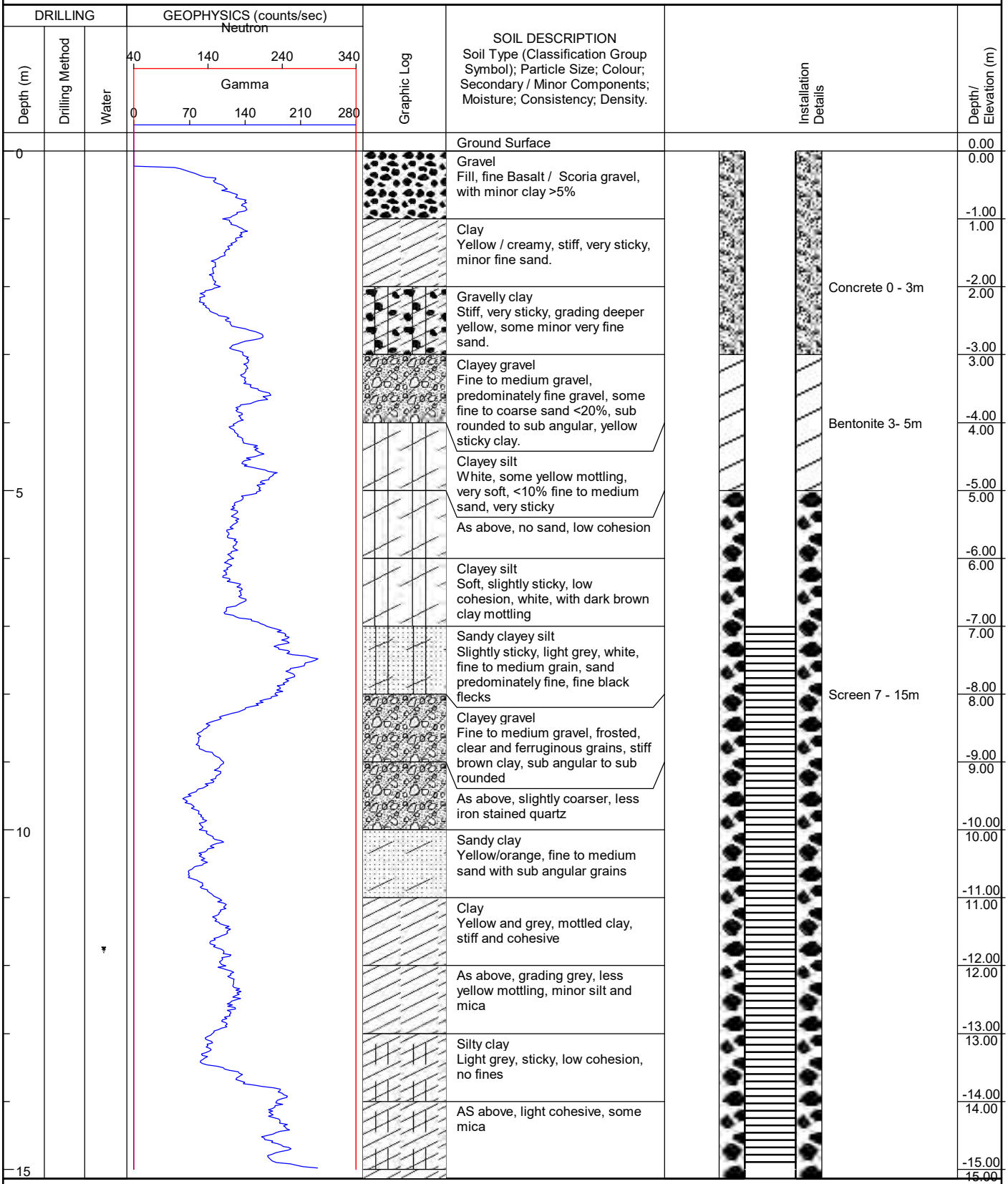
Page: 1 of 3

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea, Denham track
Date Drilled: 20/08/2009 **to:** 20/08/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Mark Adams
Rig Type: Edson
Total Depth (m): 35
Diameter (mm): 142

Easting: 245612
Northing: 5746408
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

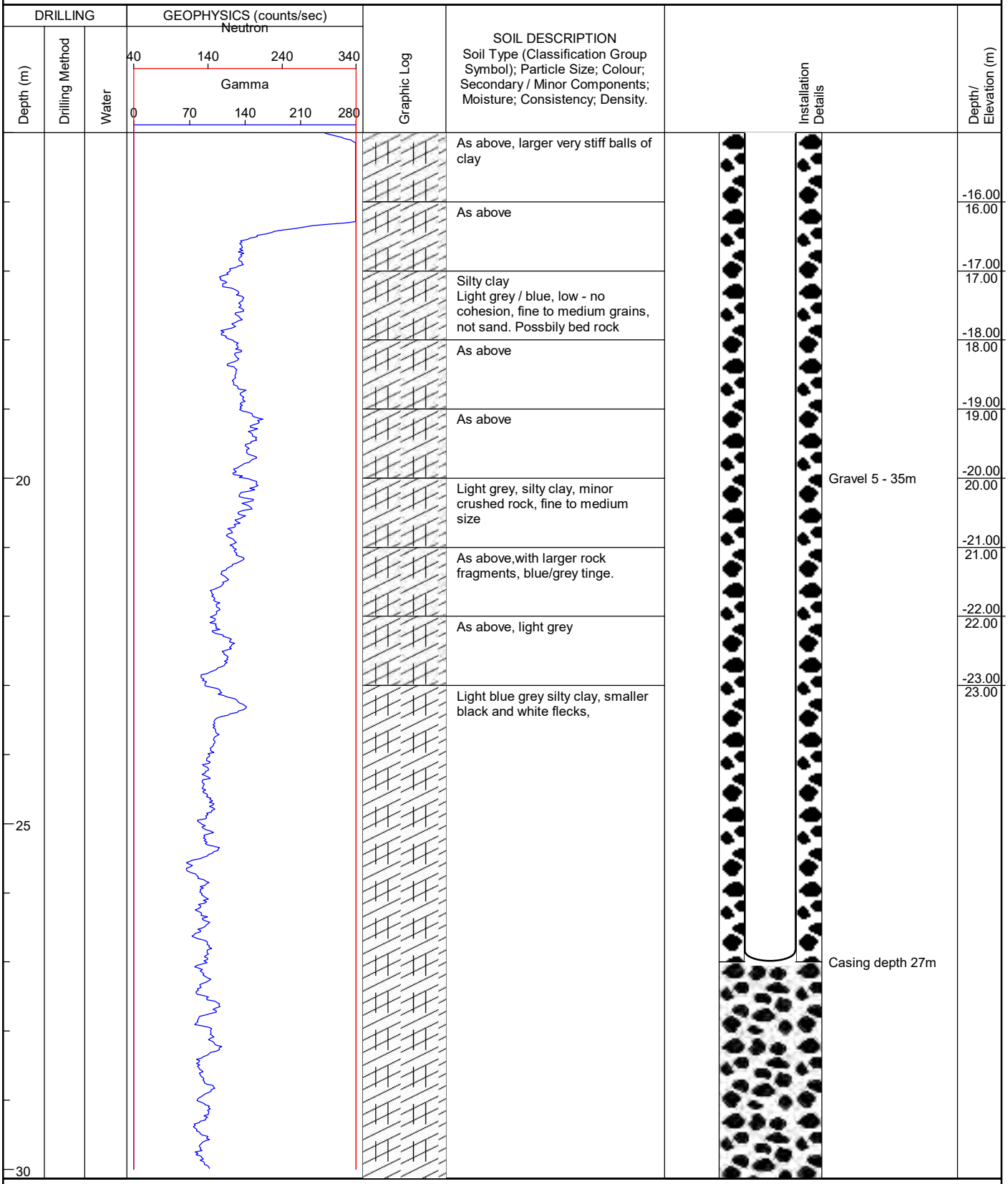
Bore No.: P6
Page: 2 of 3

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea, Denham track
Date Drilled: 20/08/2009 **to:** 20/08/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Mark Adams
Rig Type: Edson
Total Depth (m): 35
Diameter (mm): 142

Easting: 245612
Northing: 5746408
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

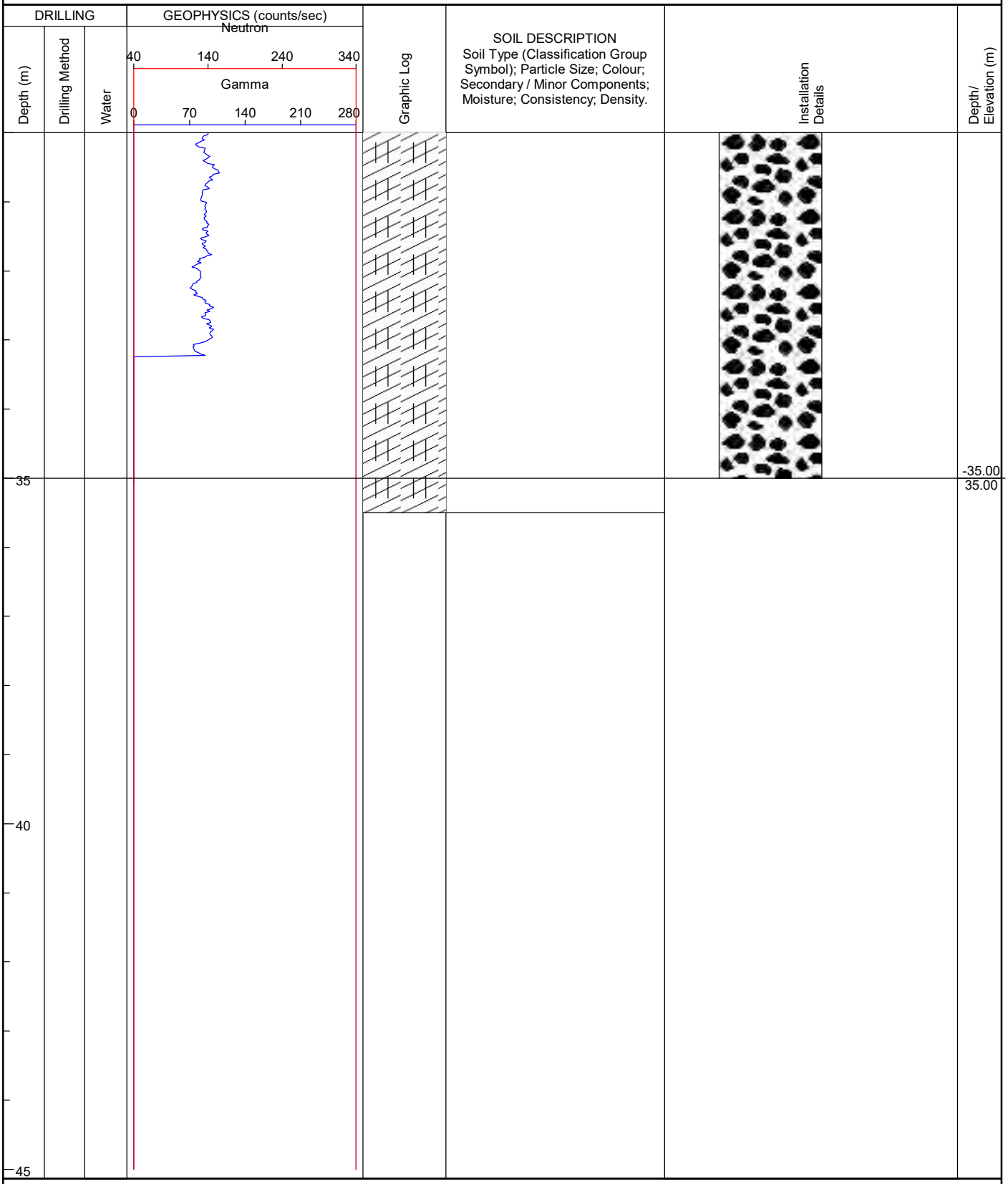
Bore No.: P6
Page: 3 of 3

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea, Denham track
Date Drilled: 20/08/2009 **to:** 20/08/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Mark Adams
Rig Type: Edson
Total Depth (m): 35
Diameter (mm): 142

Easting: 245612
Northing: 5746408
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P12

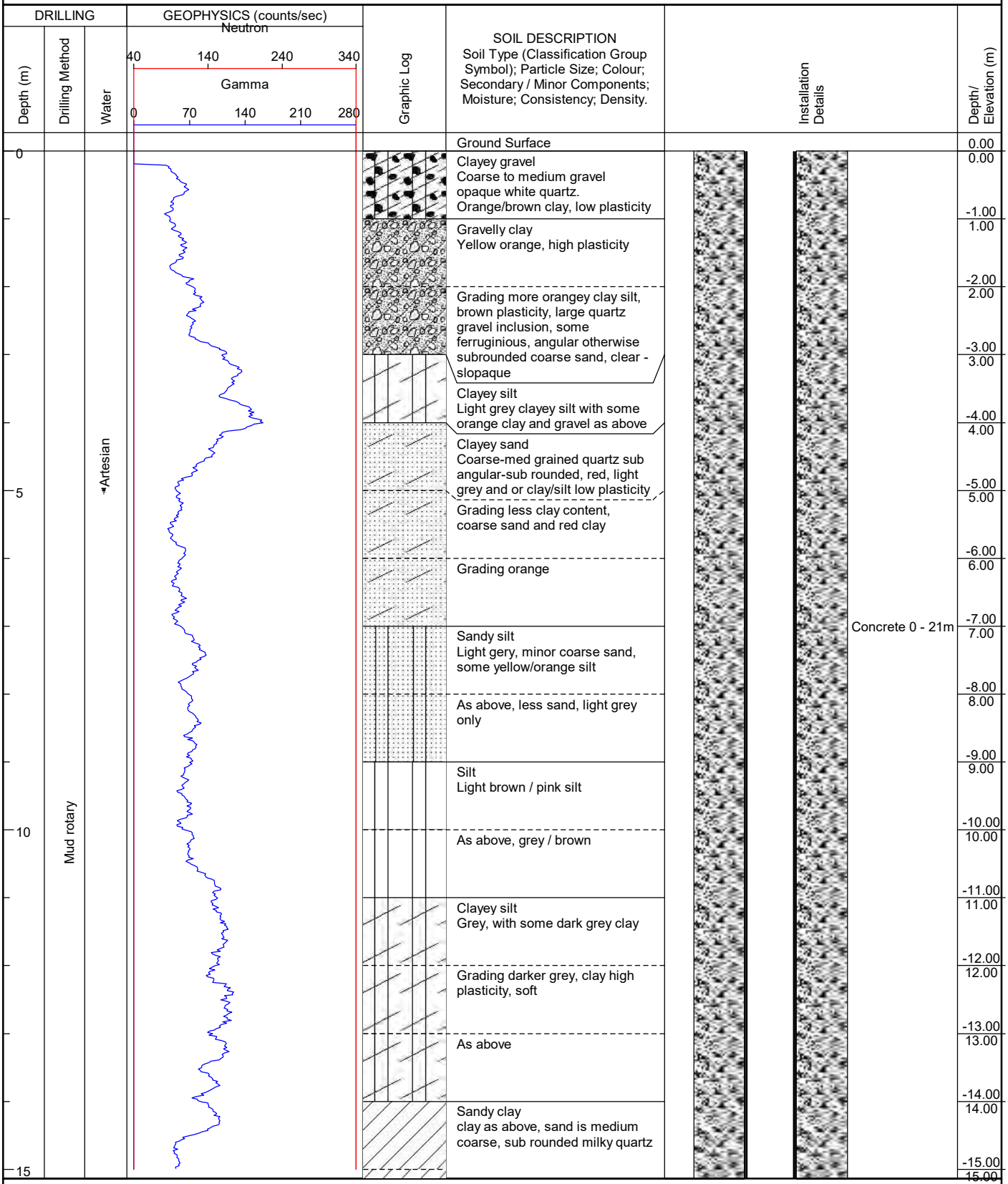
Page: 1 of 11

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

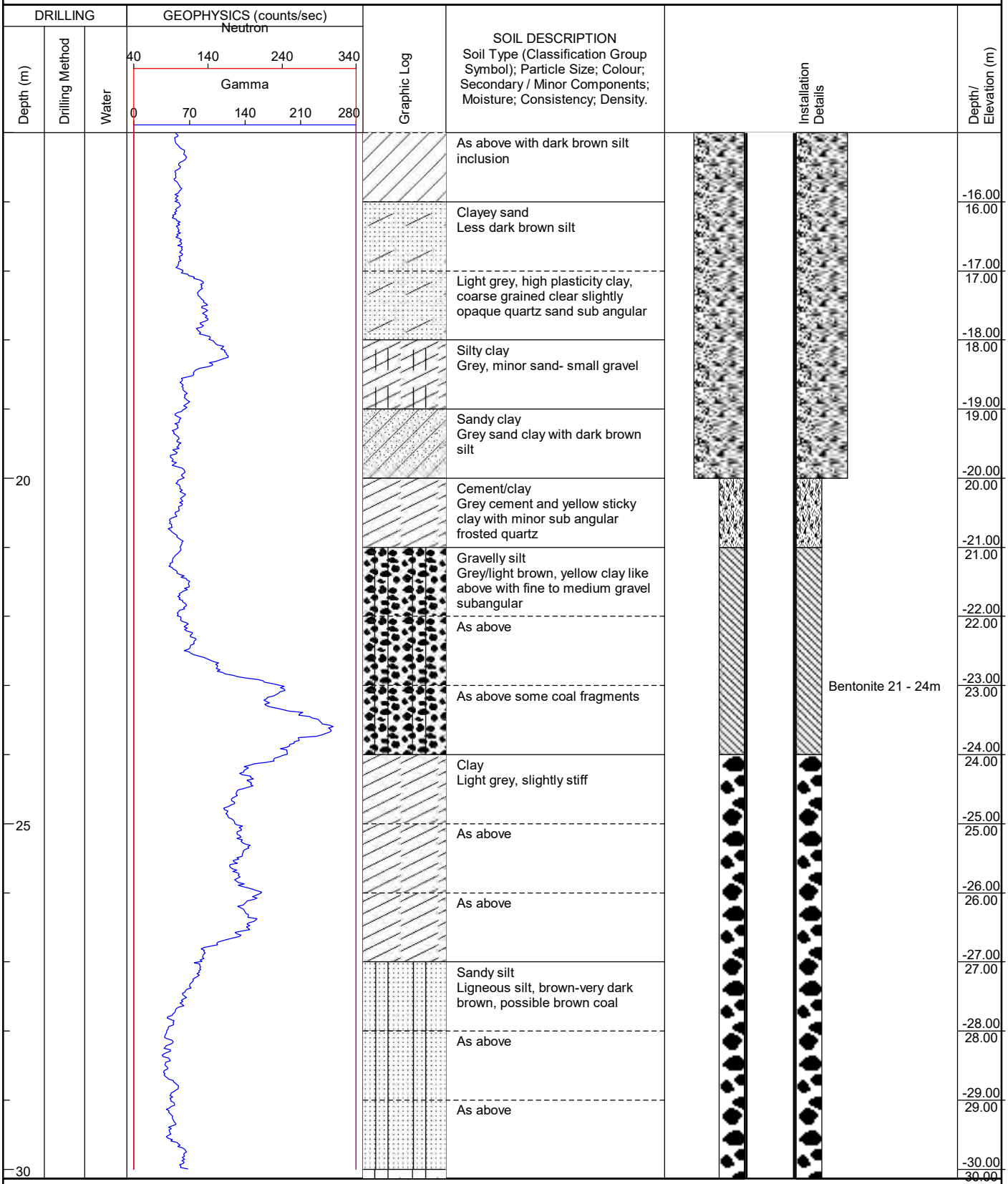
Bore No.: P12

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

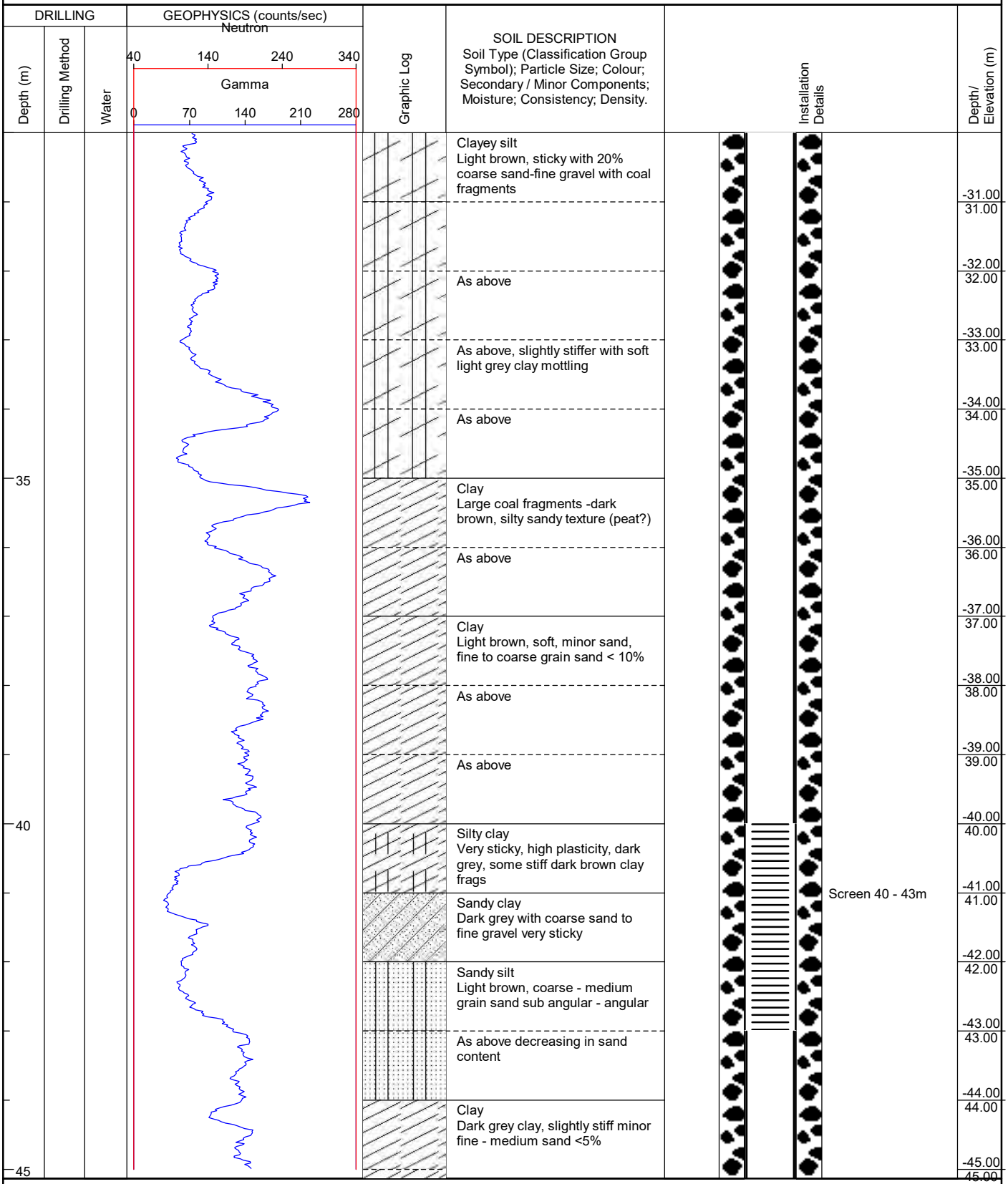
Bore No.: P12
Page: 3 of 11

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

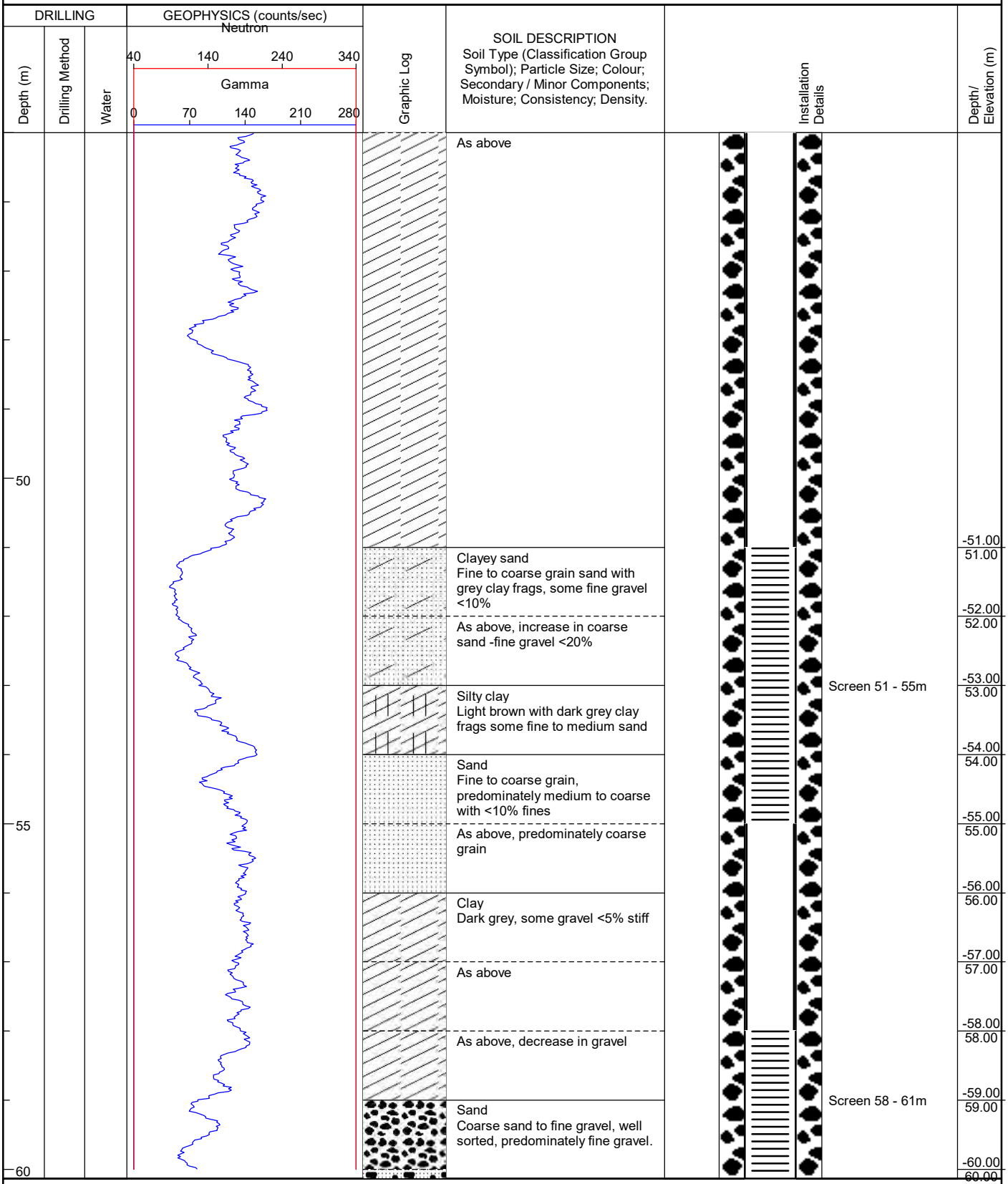
Bore No.: P12

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

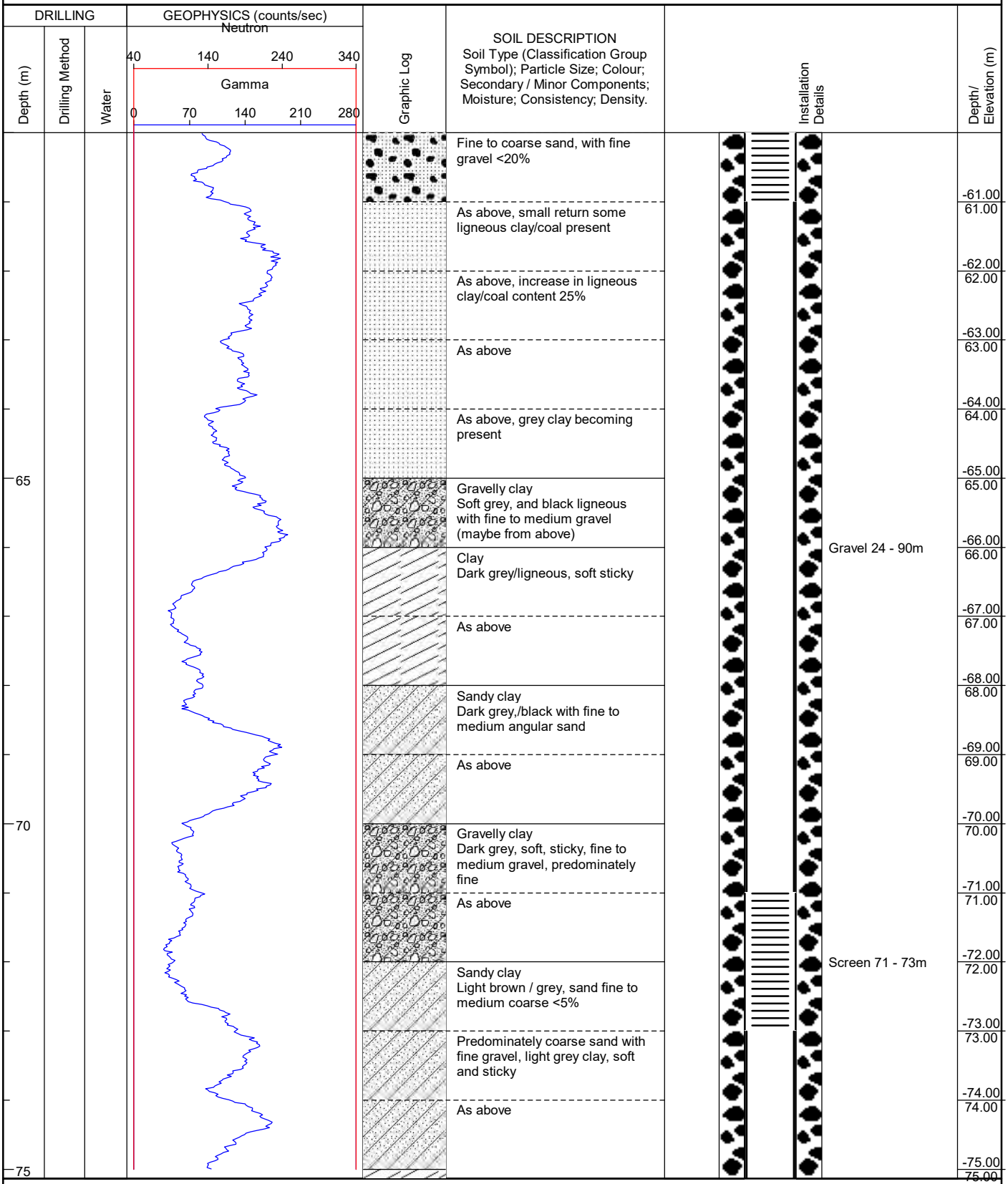
Bore No.: P12

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

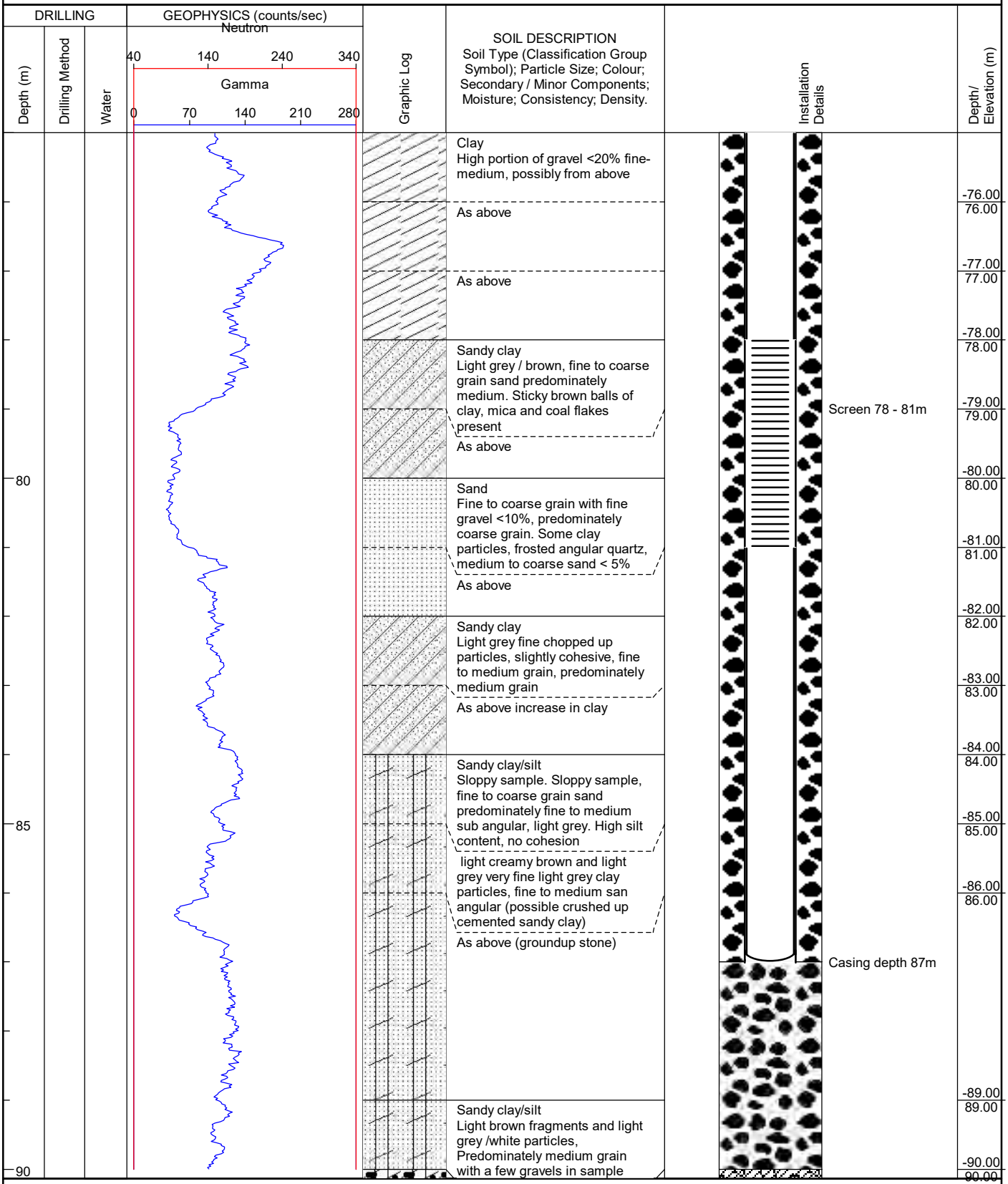
Bore No.: P12
Page: 6 of 11

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

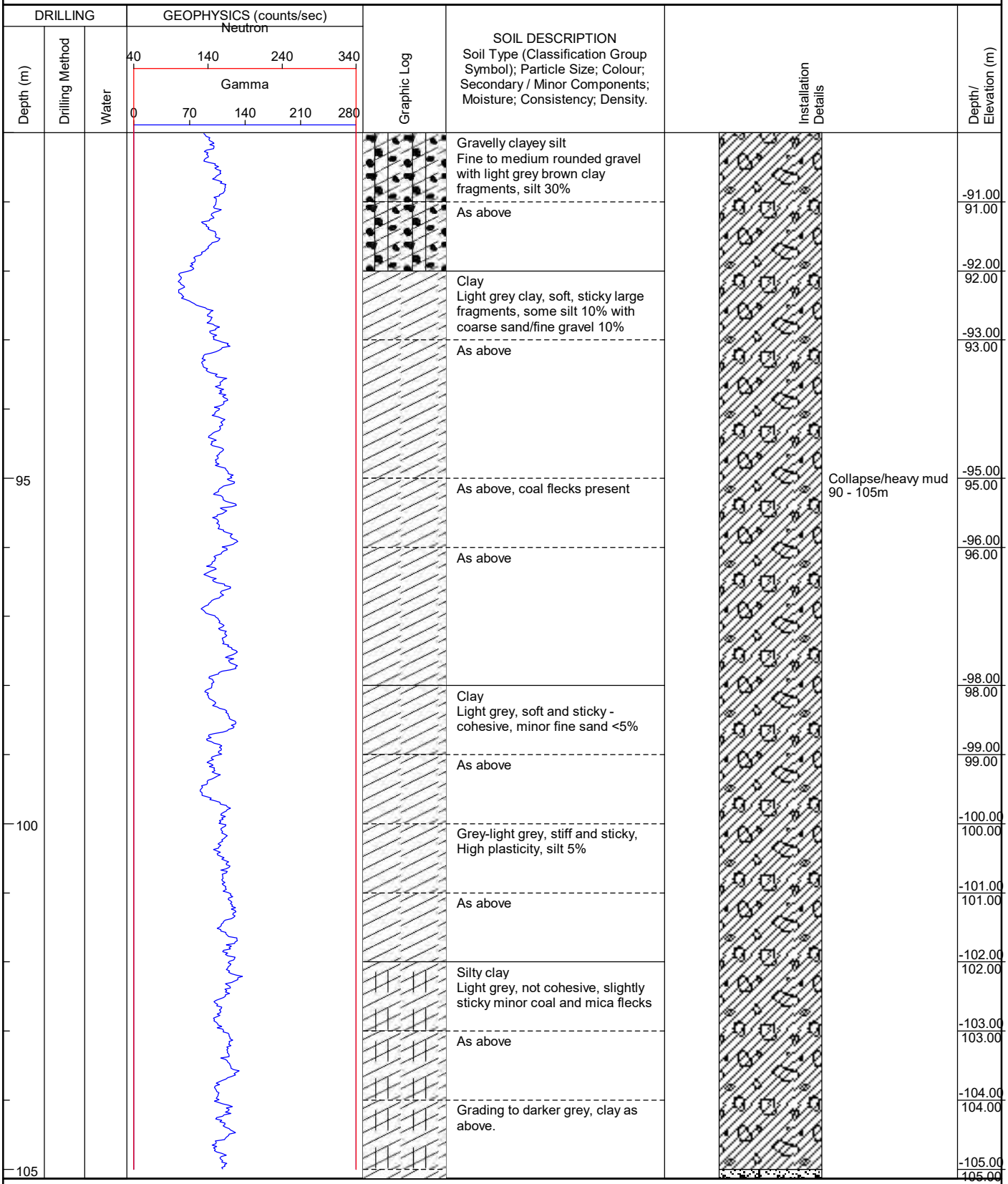
Bore No.: P12
Page: 7 of 11

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

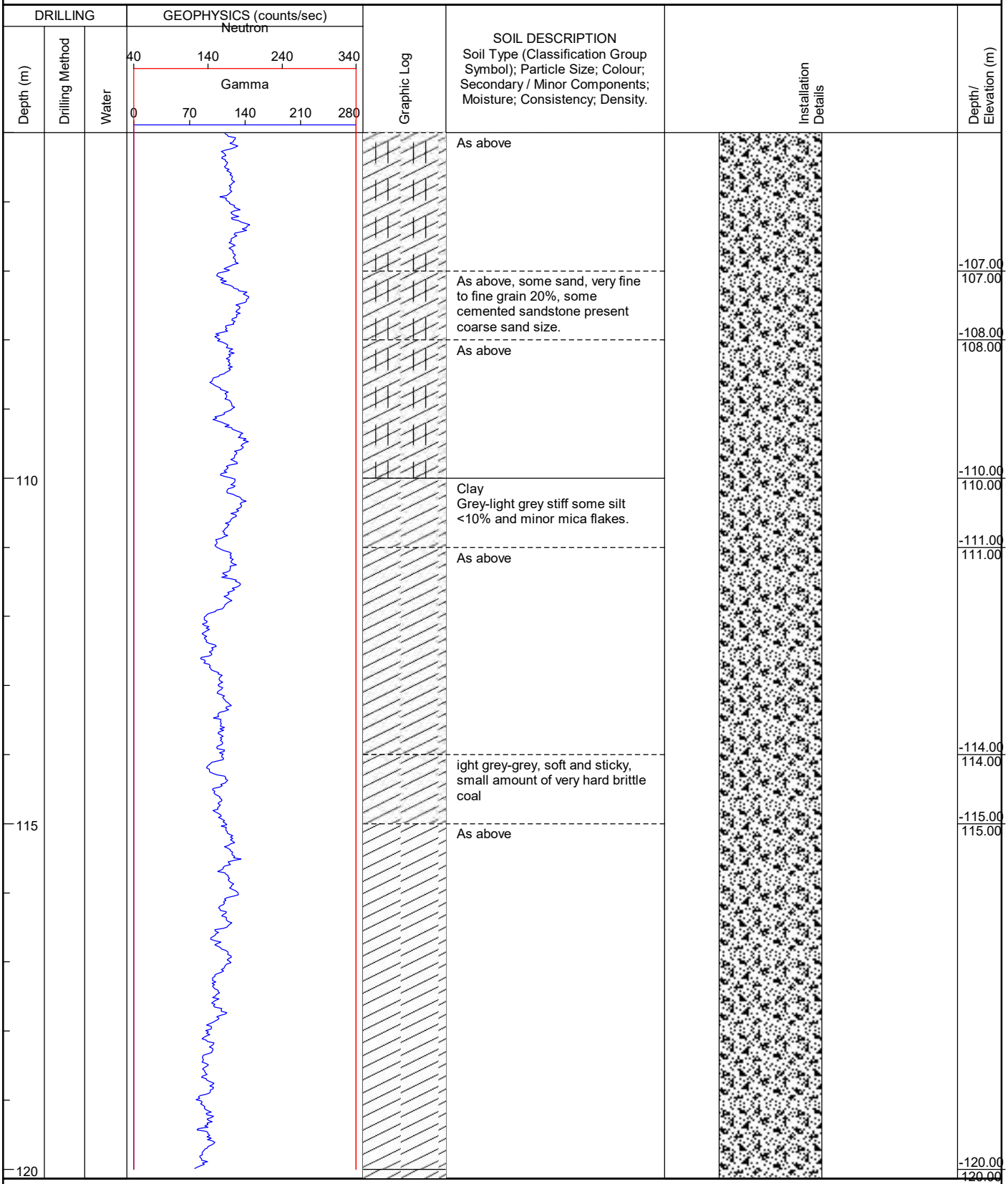
Bore No.: P12
Page: 8 of 11

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

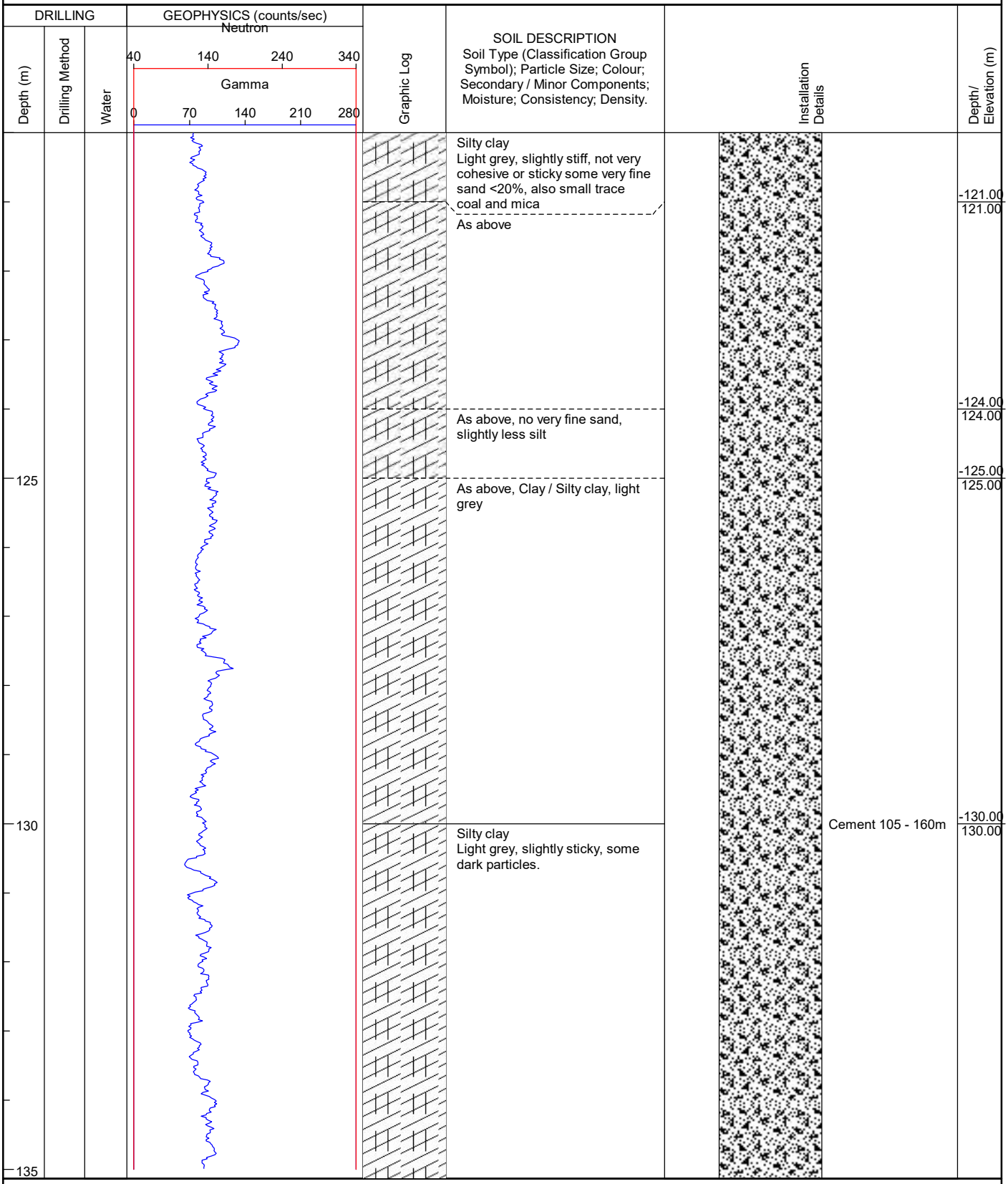
Bore No.: P12
Page: 9 of 11

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

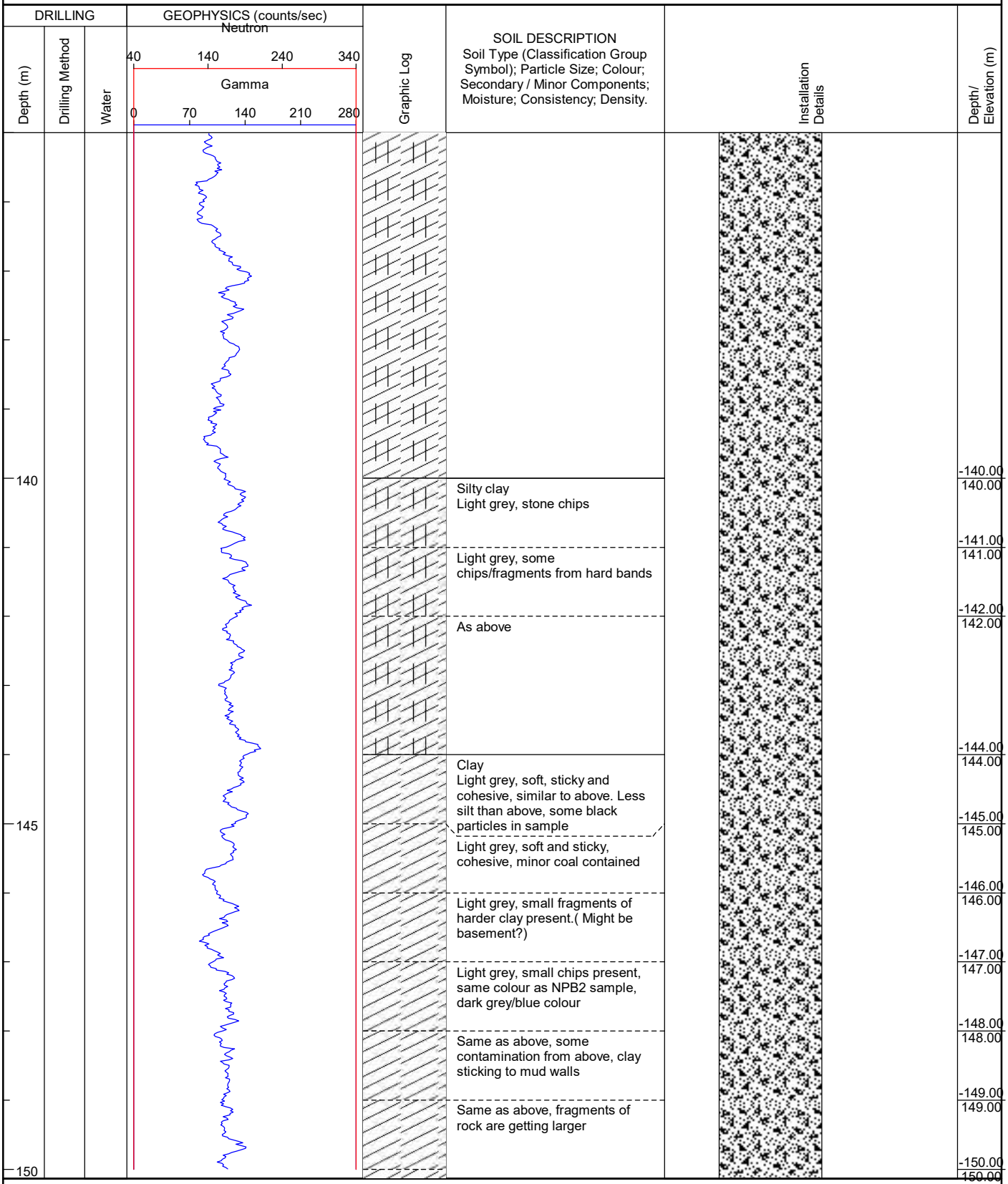
Bore No.: P12

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

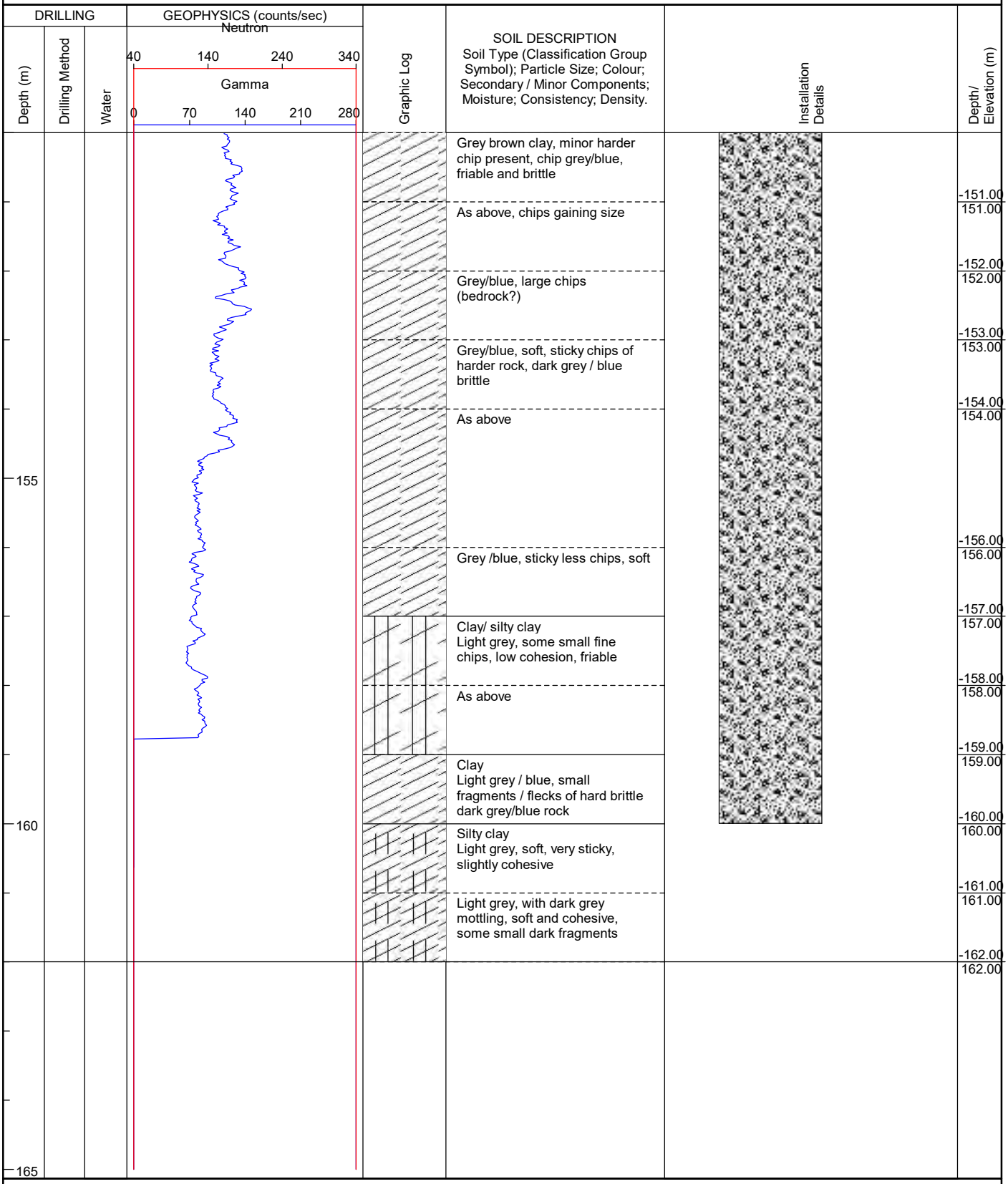
Bore No.: P12

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 22/07/2009 **to:** 30/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m): 162
Diameter (mm): 142

Easting: 253034
Northing: 5750238
Grid Ref:
Collar RL:
Logged by: BKM/DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** PVC **Screen Material:** PVC MS **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

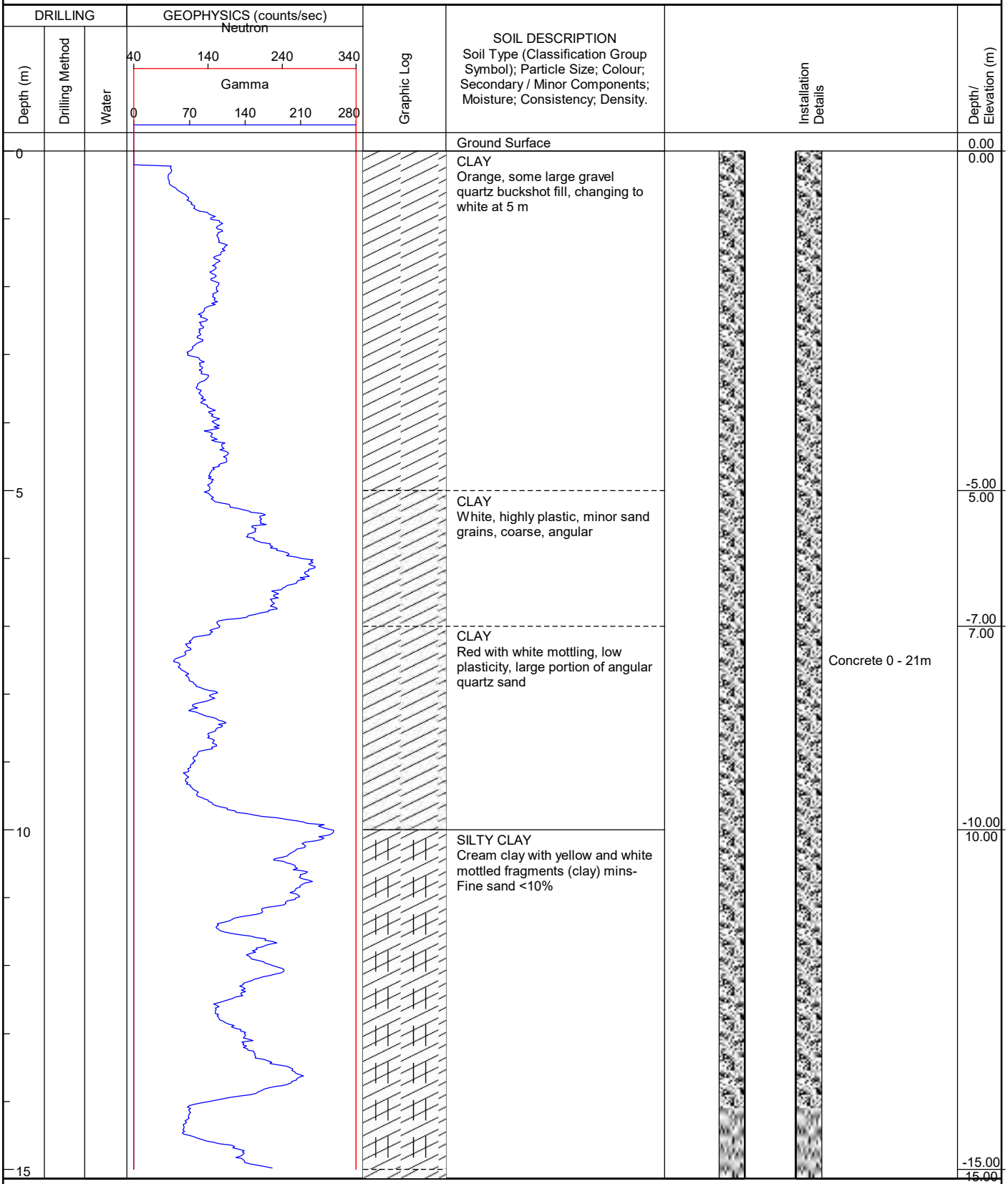
Bore No.: P13

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

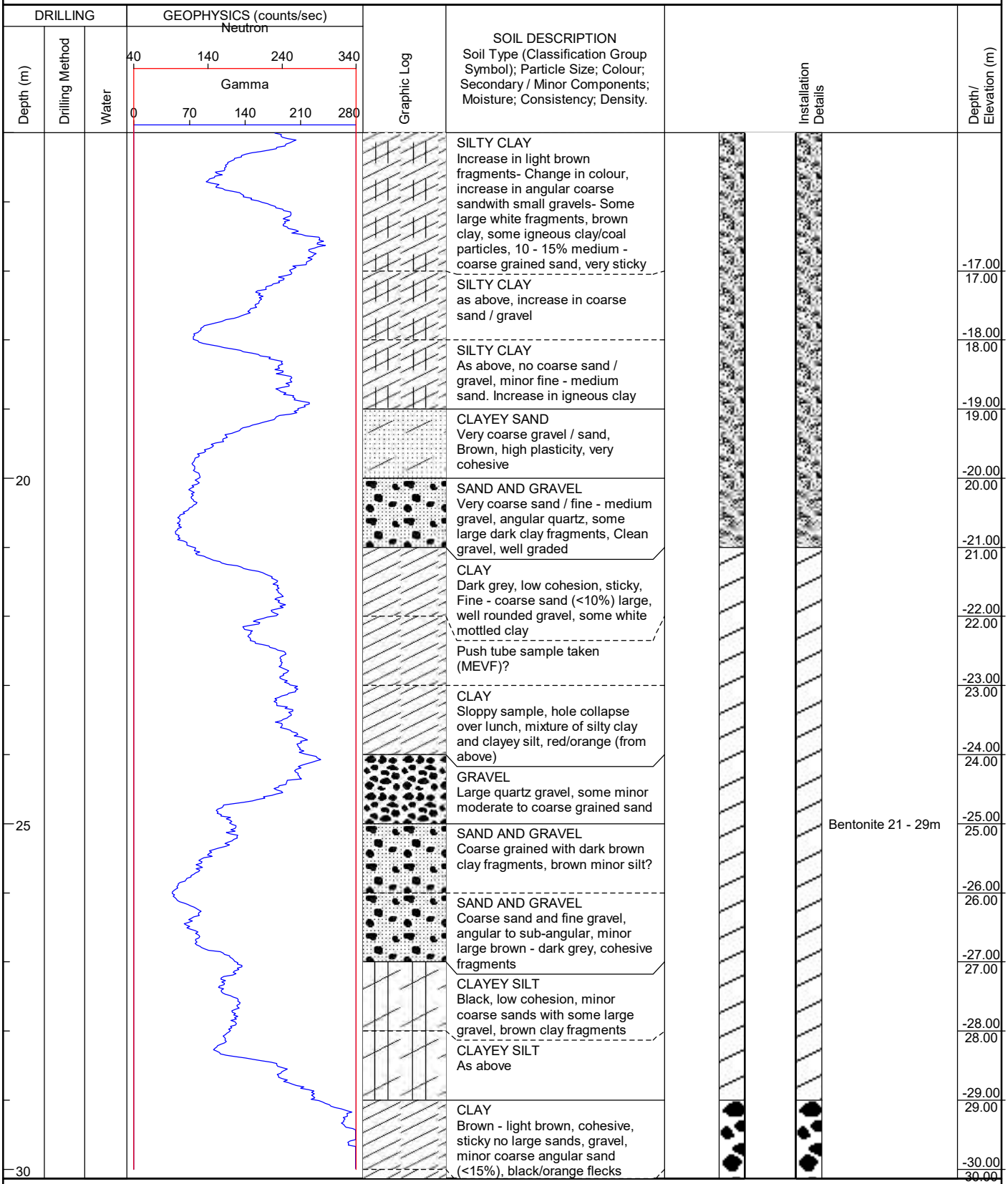
Bore No.: P13
Page: 2 of 10

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

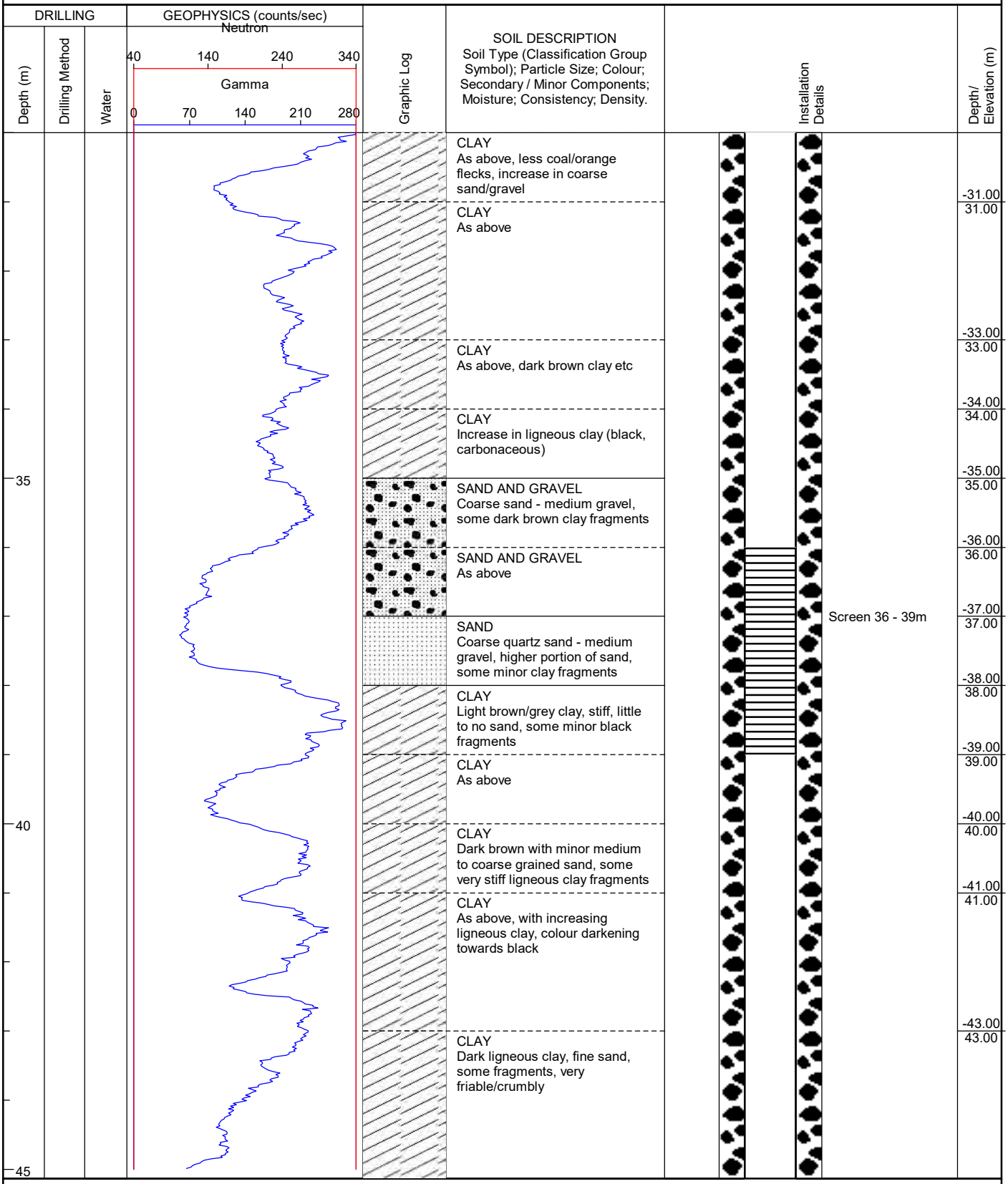
Bore No.: P13

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

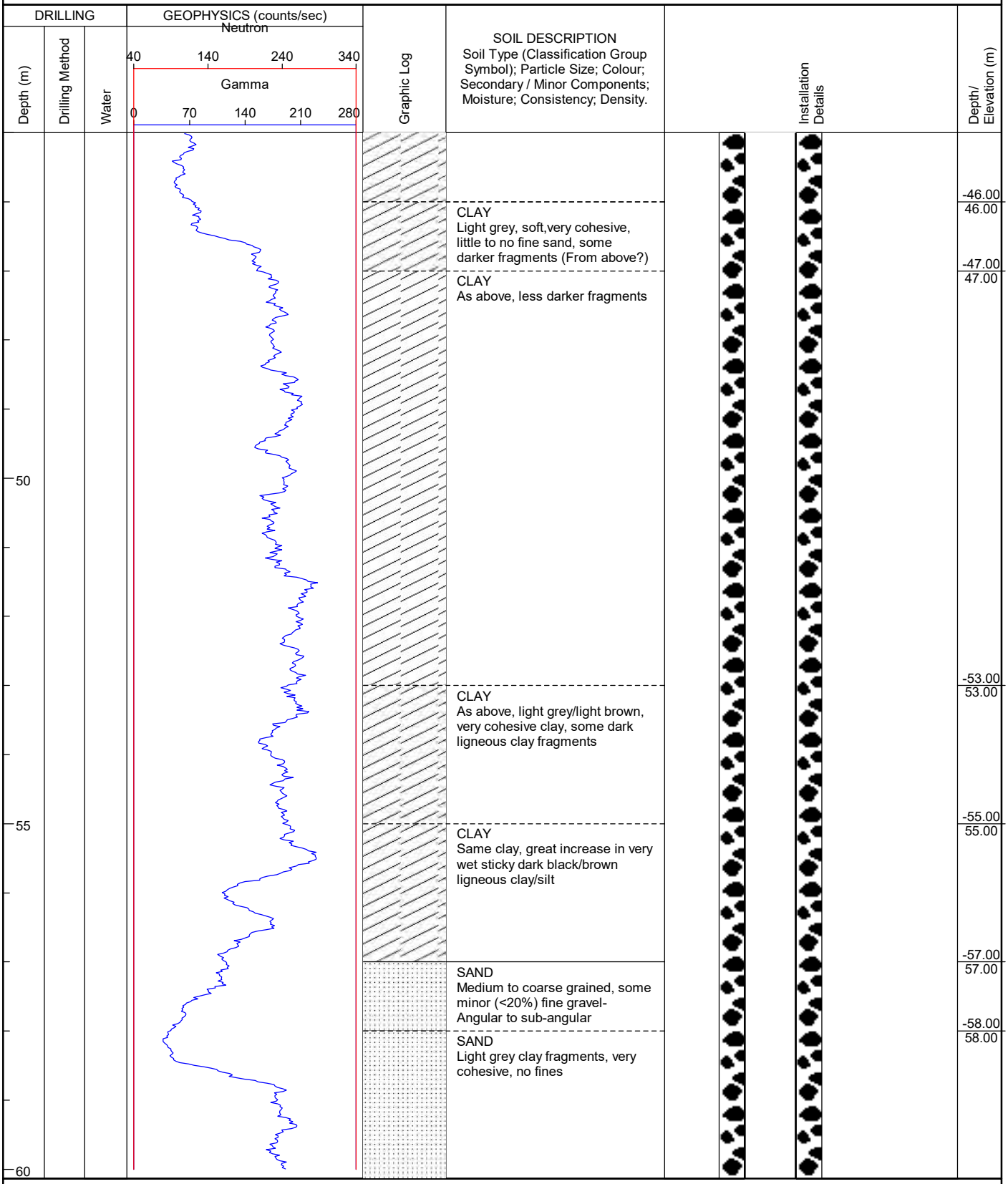
Bore No.: P13
Page: 4 of 10

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

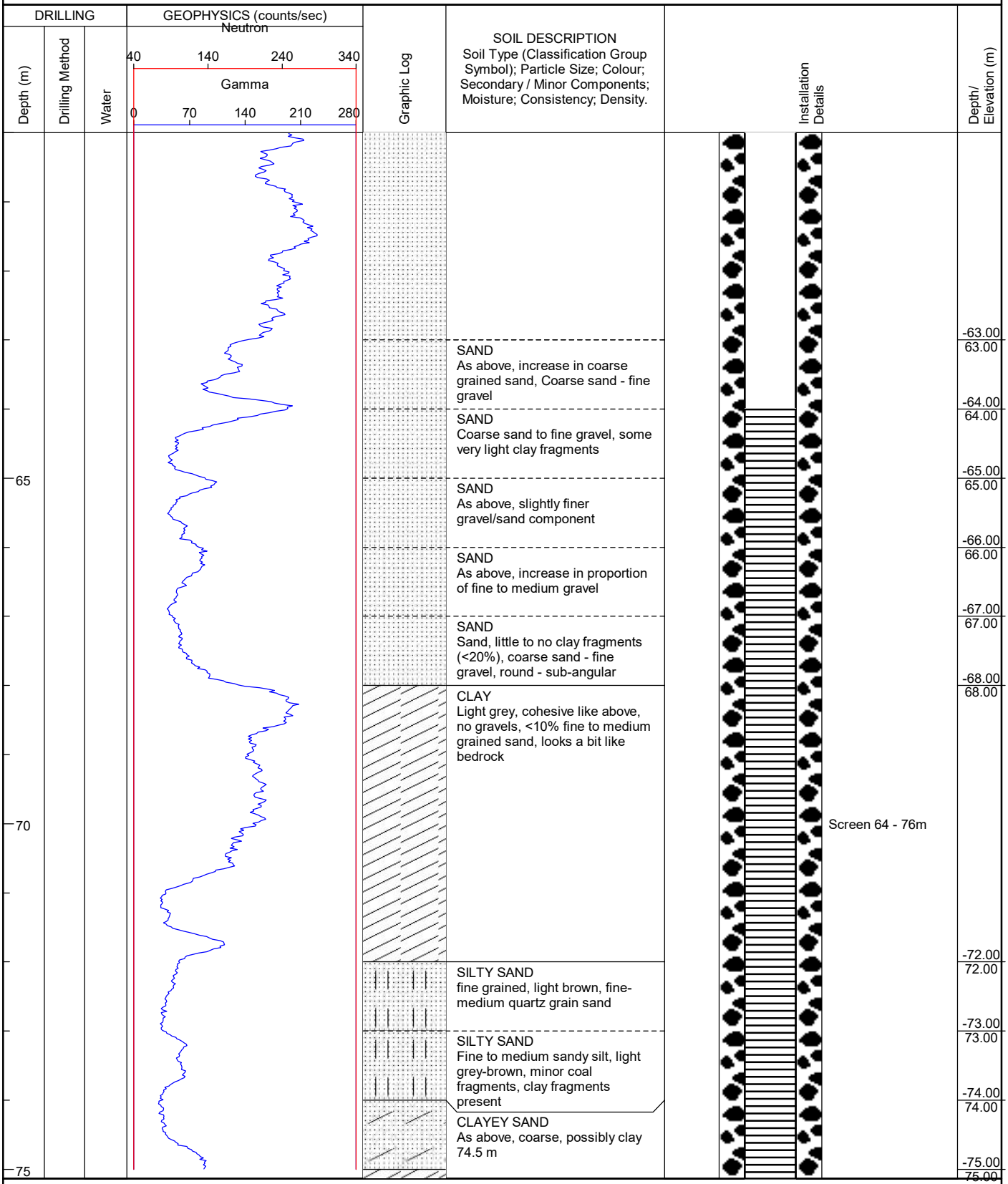
Bore No.: P13

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



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BOREHOLE LOG

HYDROGEOLOGICAL

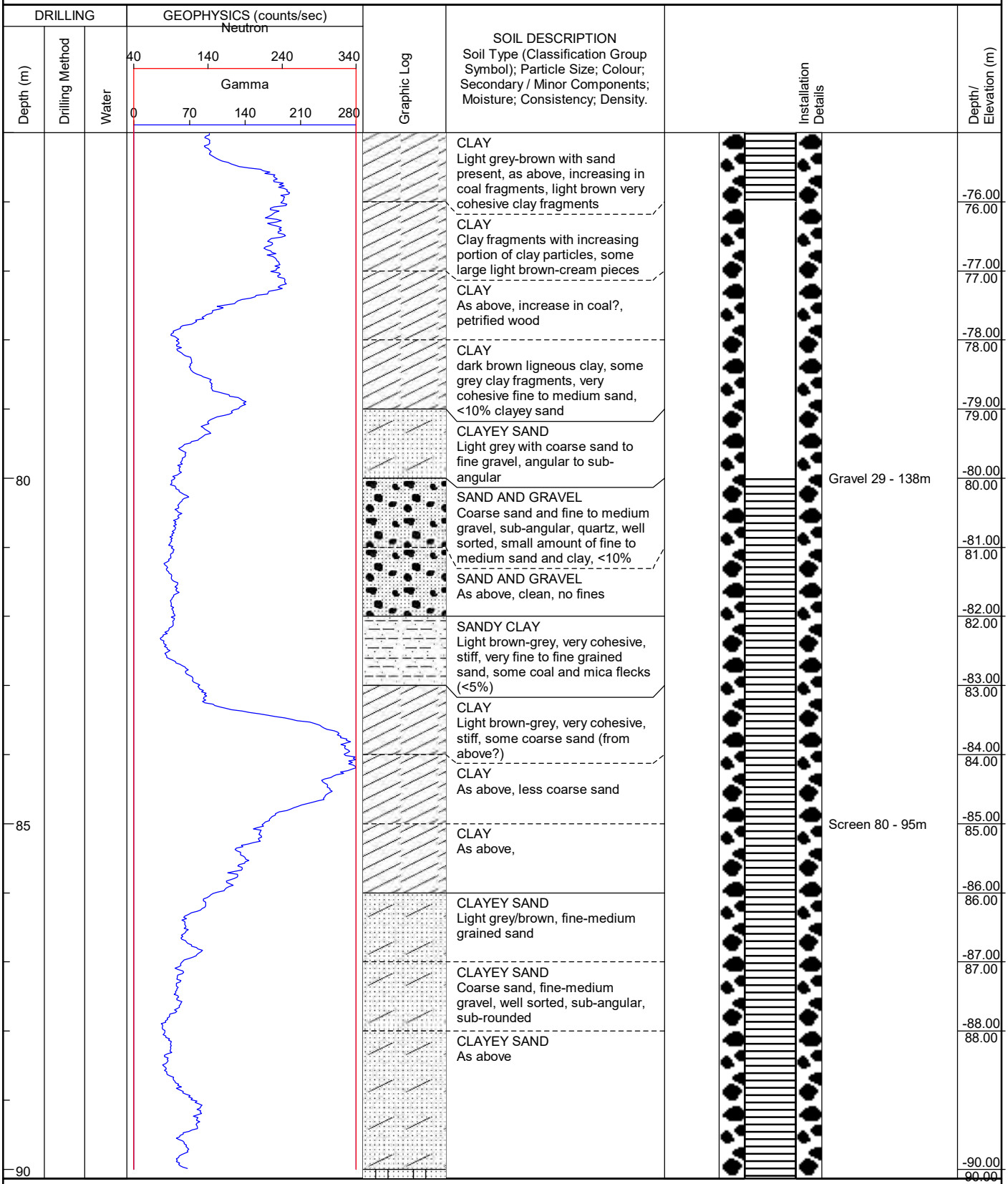
Bore No.: P13

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



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BOREHOLE LOG

HYDROGEOLOGICAL

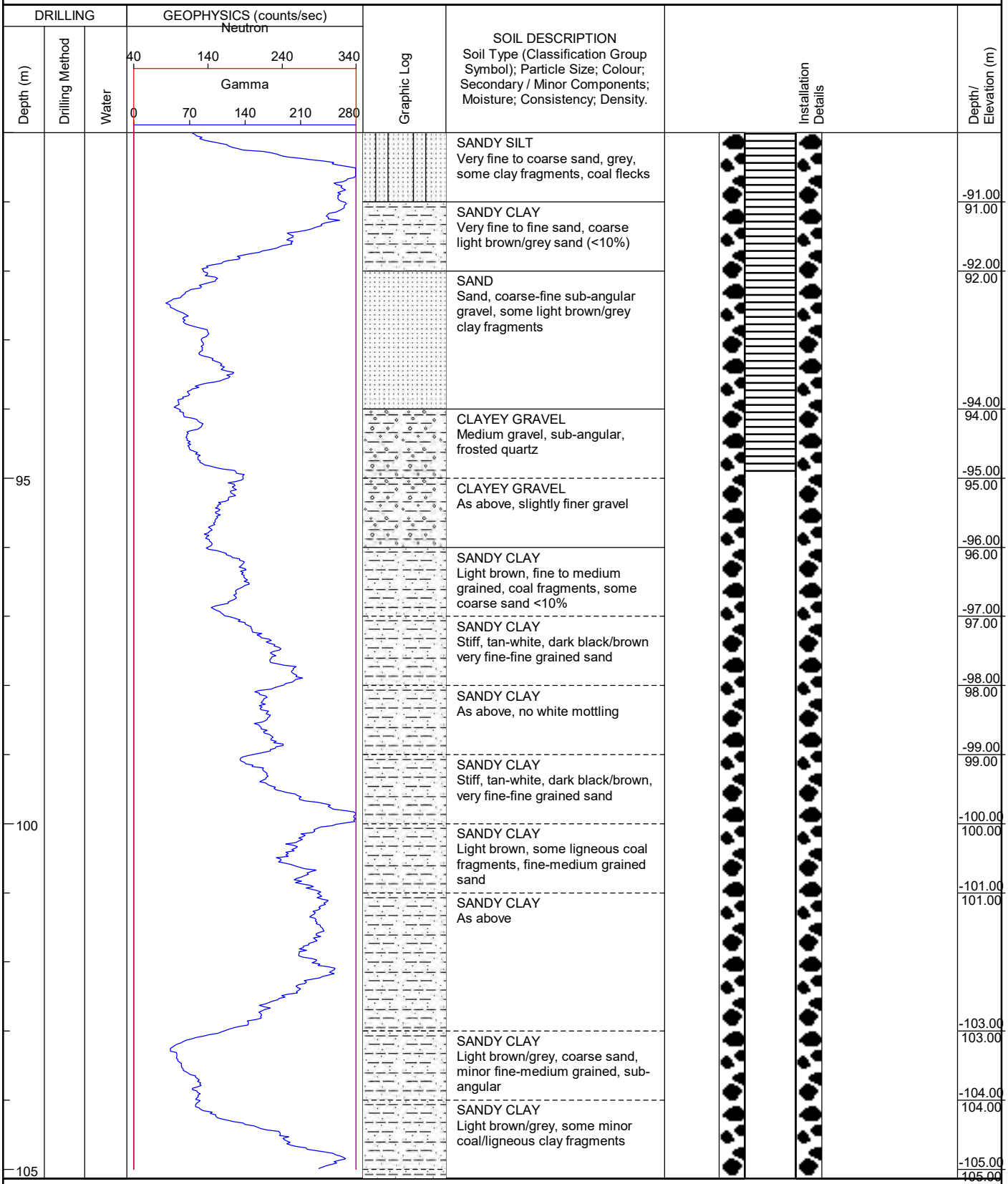
Bore No.: P13

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

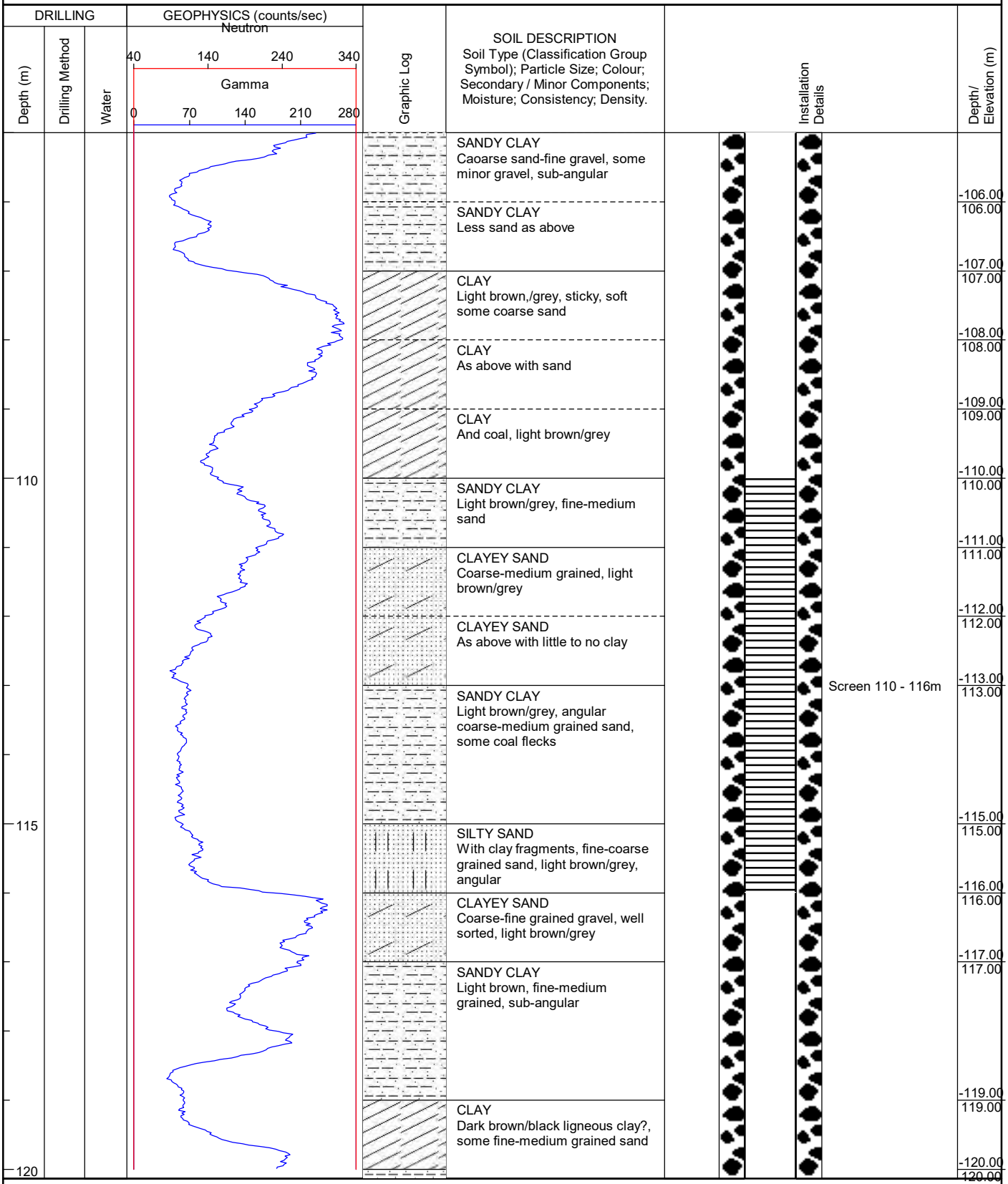
Bore No.: P13

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

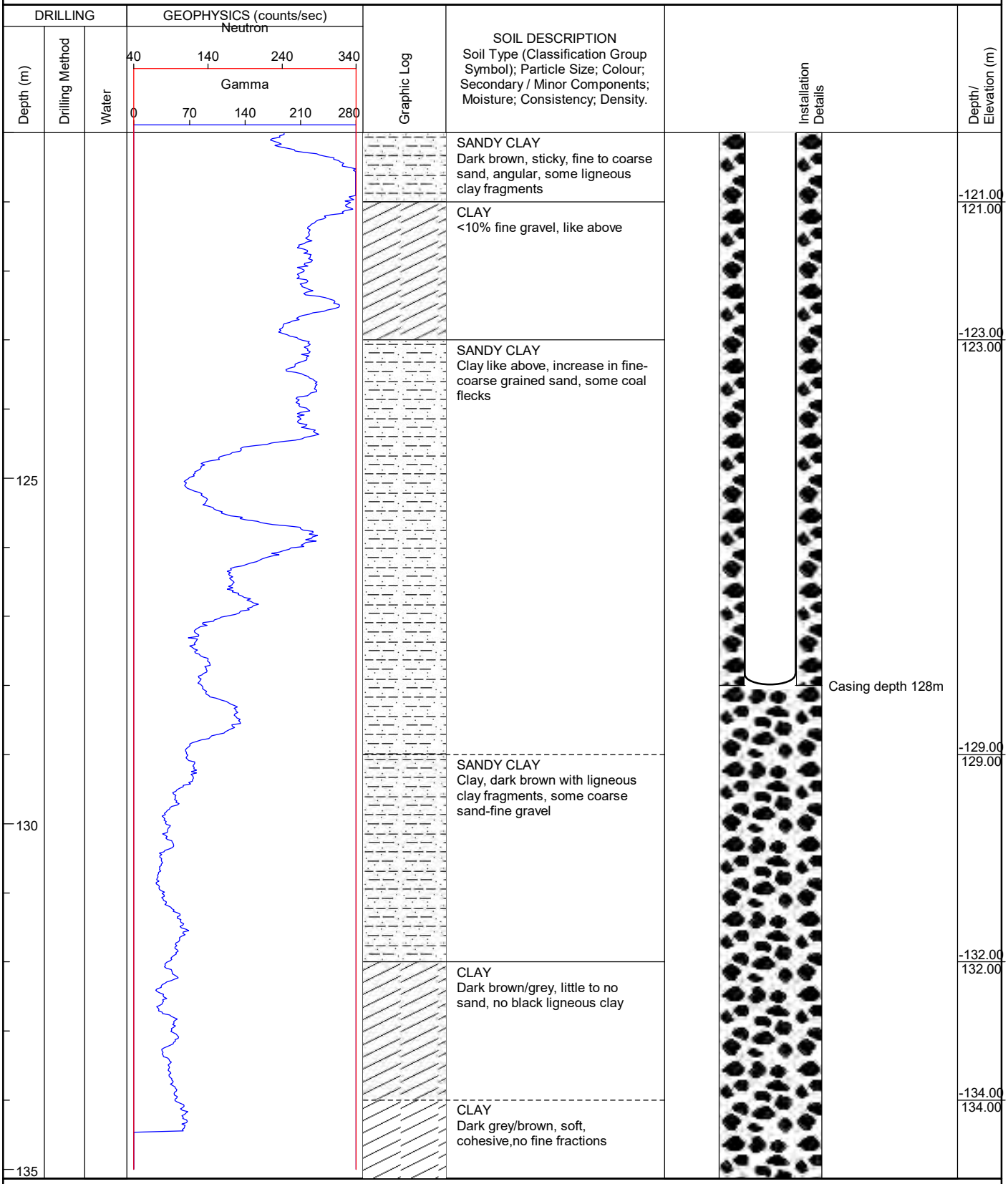
Bore No.: P13
Page: 9 of 10

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P13
Page: 10 of 10

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 07/07/2009 **to:** 08/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 138
Diameter (mm): 142

Easting: 246746
Northing: 5753530
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4

DRILLING			GEOPHYSICS (counts/sec)	Graphic Log	SOIL DESCRIPTION	Installation Details	Depth/ Elevation (m)
Depth (m)	Drilling Method	Water	Neutron 40 140 240 340; Gamma 0 70 140 210 280		Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.		
							-136.00 136.00
					SANDY CLAY As above, sand fraction is fine to coarse grained, predominantly fine with ligneous clay fragments		
140							
145							
150							-150.00 150.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P13a

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 10/07/2009 **to:** 10/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 28
Diameter (mm): 142

Easting: 0
Northing: 0
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4

Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40–340 / Gamma 0–280	Graphic Log	SOIL DESCRIPTION (Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.)	Installation Details	Depth/ Elevation (m)
					Ground Surface		0.00
0					Sandy clay Orange clay with basalt rock fill		0.00
					As above		-1.00 1.00
					Clay Orange -red, sticky, minor coarse sand		-2.00 2.00
					As above		-3.00 3.00
					Clayey gravel Fine to medium subangular, orange, clay	Grout 0 - 7m	-4.00 4.00
5					As above		-5.00 5.00
					Clay White/creamy, soft, sticky, very cohesive, coal flecks		-6.00 6.00
					As above, some orange clay, mottling		-7.00 7.00
					Clay Yellow/orange, some white/cream clay mottling, very soft, minor fine to medium grain sand <5%	Bentonite 7 - 9m	-8.00 8.00
					As above, increase white/cream clay fragments		-9.00 9.00
10					Sandy clay Light brown/yellow, fine to medium grain sand, with clay mottling, sub angular, coarse sand <5%		-10.00 10.00
					As above		-11.00 11.00
					Cream/white, sticky cohesive, some coal fragments, sand fine to medium with less <5%, coarse sand grain		-12.00 12.00
					As above		-13.00 13.00
					As above, coarse grain sand <15%		-14.00 14.00
15							-15.00 15.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P13a

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Australian Automotive Research Center
Date Drilled: 10/07/2009 **to:** 10/07/2009

Drilling Co.: K H Adams and sons Drilling
Driller: Phill Hammet
Rig Type: Edson
Total Depth (m): 28
Diameter (mm): 142

Easting: 0
Northing: 0
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4

Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth/ Elevation (m)
					Clayey sand Fine to medium, angular, 50% quartz, 50% light yellow/orange/red, ferruginous sands. Clay - white, soft and very sticky		-16.00 16.00
					Clayey sand Clay as above, coarse, fine gravel, quartz still, fine to medium yellow ferruginous grains of sand.	Screen 15 - 21m	-17.00 17.00
					As above with angular frosted quartz		-18.00 18.00
					Sandy clay Less sand, 20% sand, Medium to coarse, ligneous coal fragments		-19.00 19.00
					Clay Dark brown with coal/ligneous clay fragments, some coarse sand, frosted quartz		-20.00
20		▼			Sand/gravel Coal and ligneous clay fragments present, sub angluar - sub rounded, well sorted	Gravel 9 - 27m	20.00 -21.00
					Sandy clay Brown, soft, very sticky, cohesive, some silt. Fine to medium grain sand, fine gravel, frosted quartz		21.00 -22.00
					Clay as above, minor sand, fine to medium, <10%		22.00 -23.00
					Clay Dark brown cohesive, slightly stiff, very fine to medium sand <5%		23.00 -24.00
					As above		24.00
25					Sand Clay fragments, fine to coarse, sand with minor <10% fine gravel	Screen 24 - 27m	-25.00 25.00
					Clean medium to coarse with fine gravel angular-subangular,		-26.00 26.00
					Sandy clay Dark brown and ligneous	Casing depth 27m	-27.00 27.00
					EOH		-28.00 28.00
30							

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

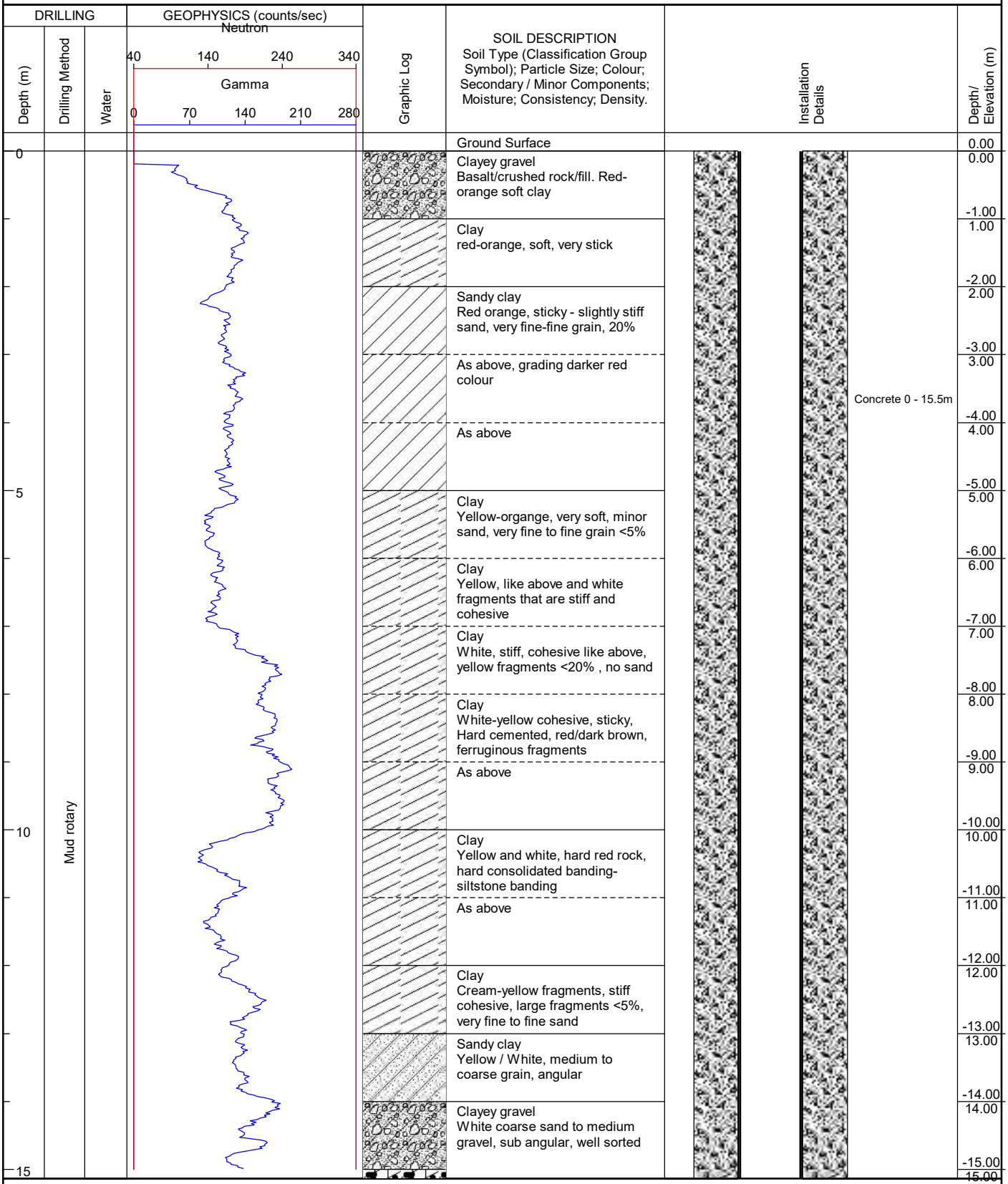
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

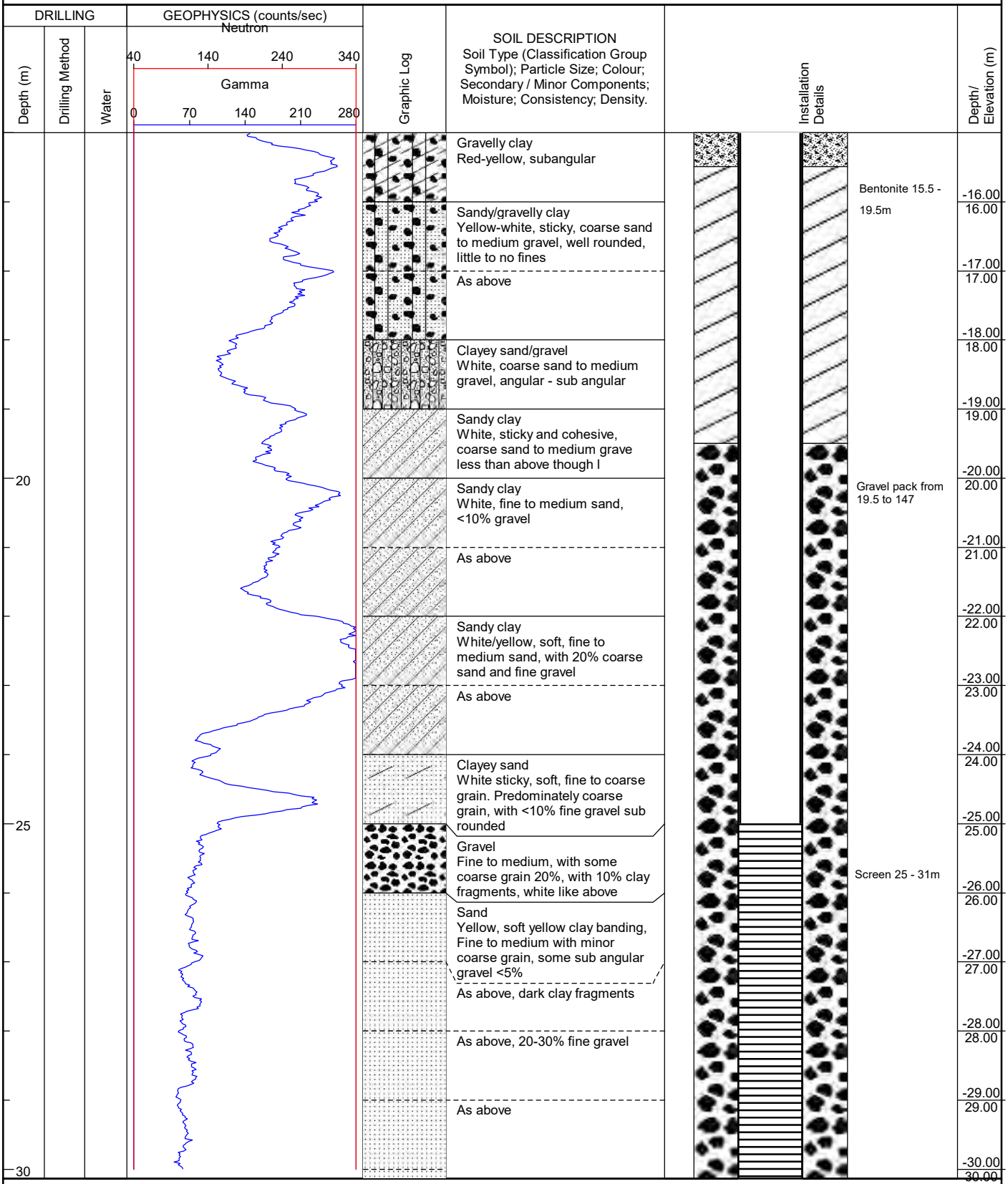
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

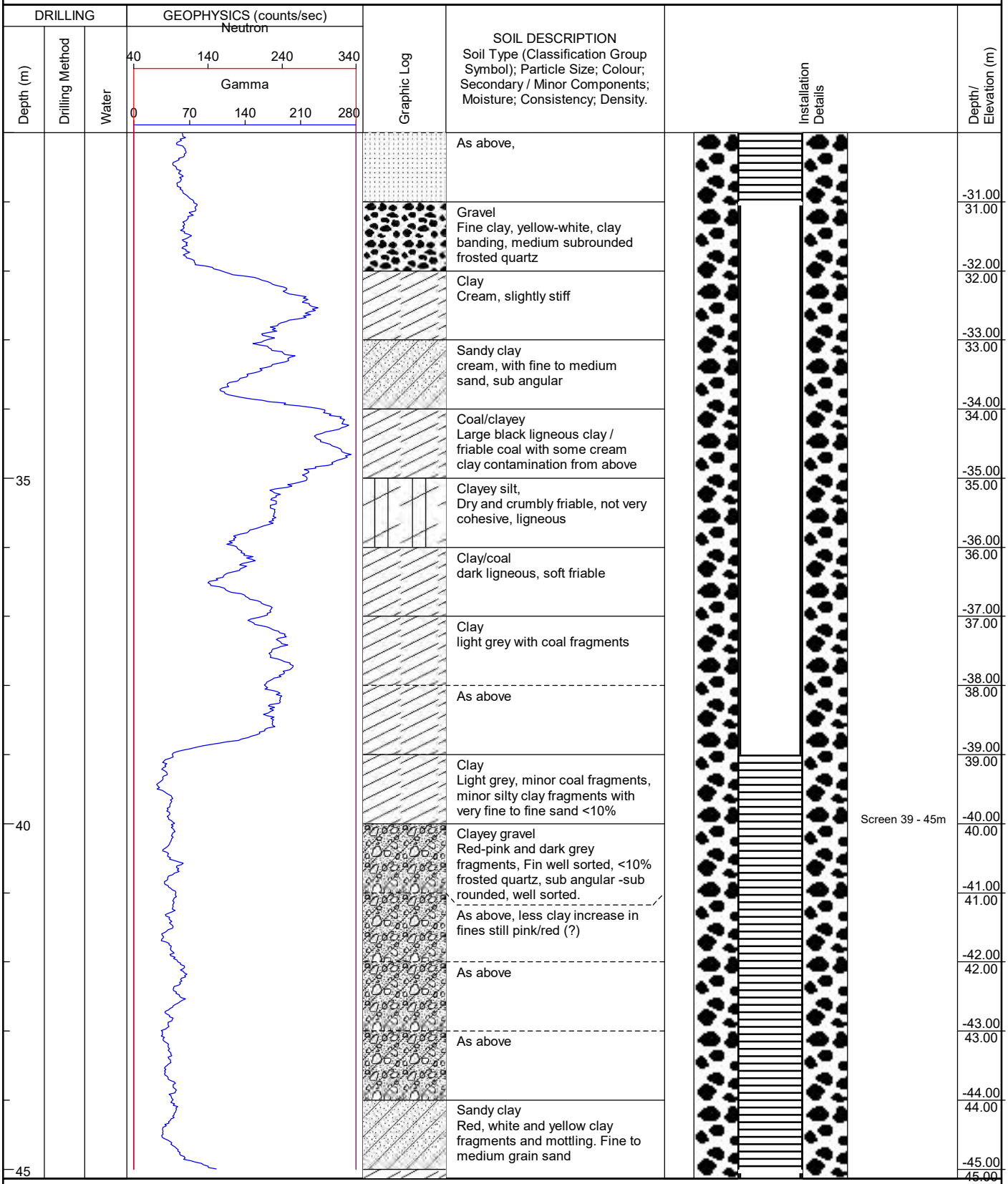
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

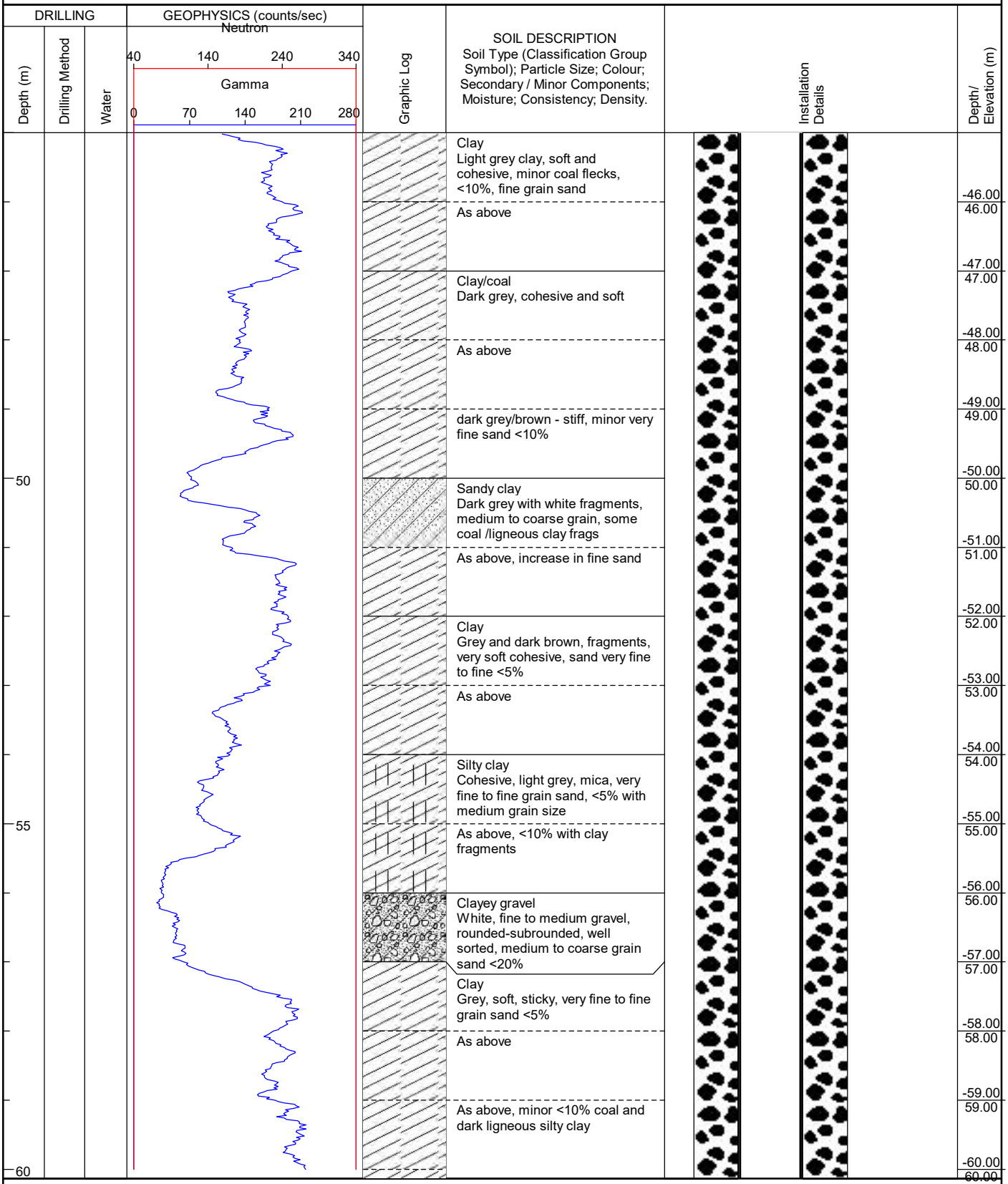
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

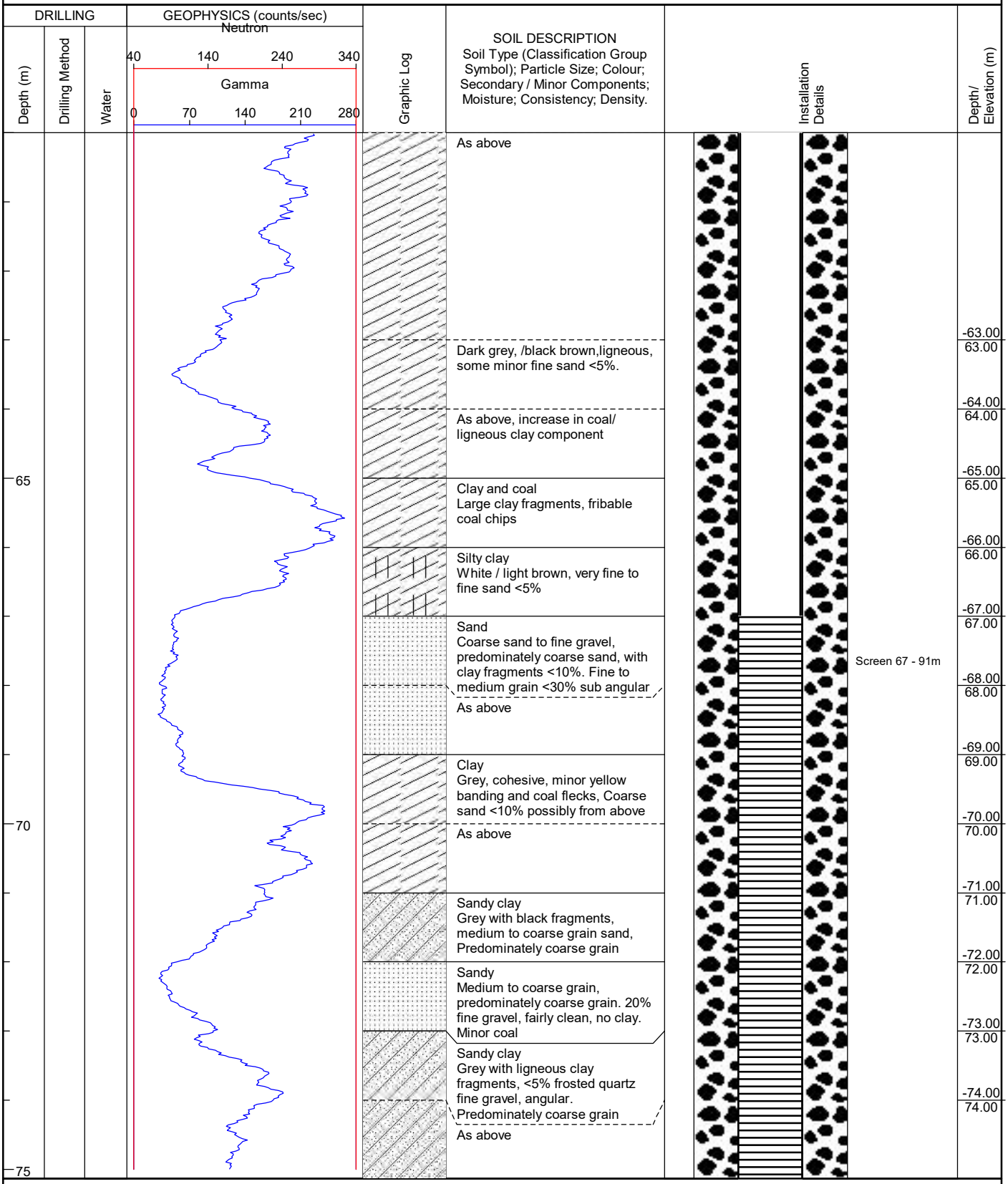
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

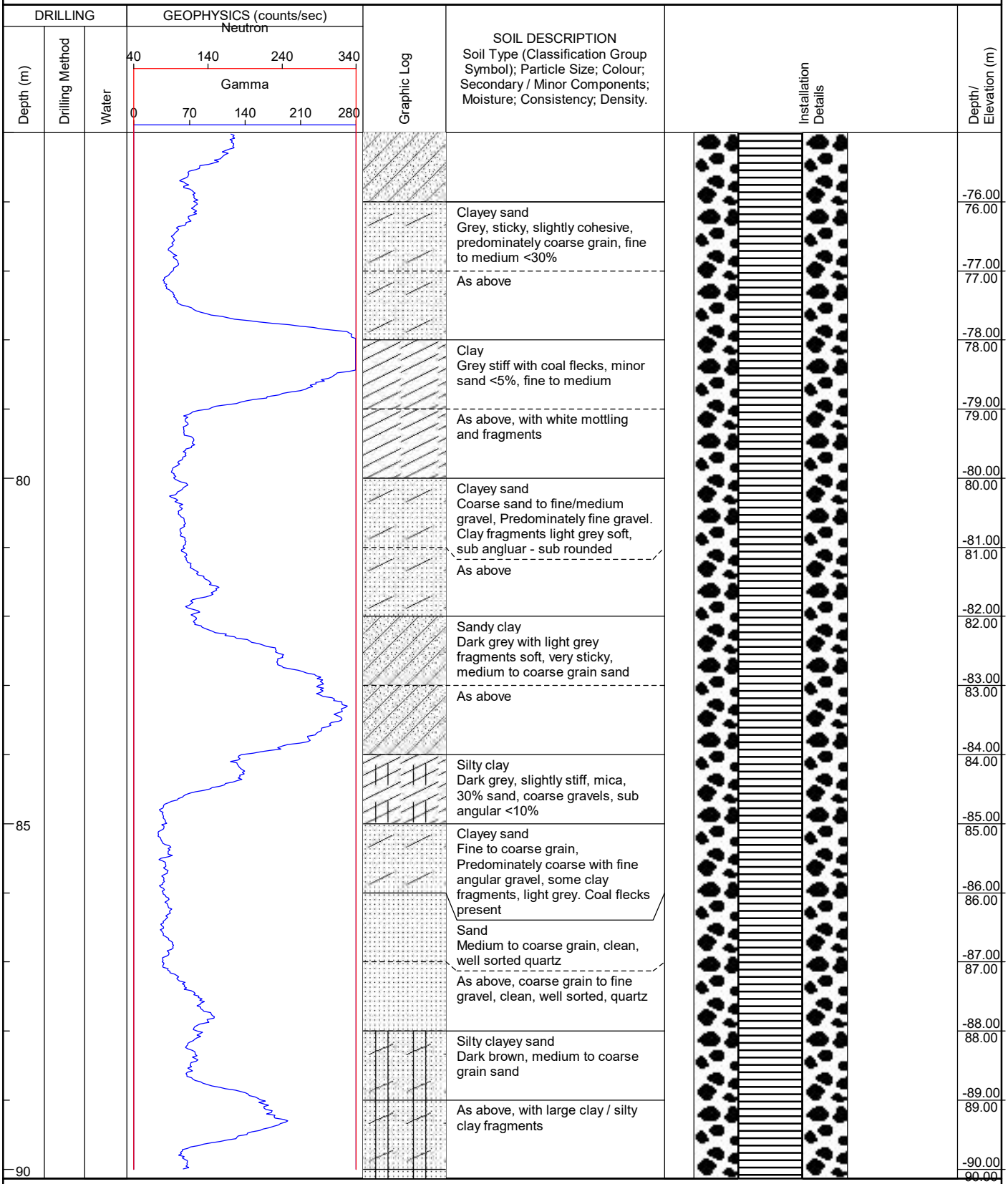
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG
HYDROGEOLOGICAL

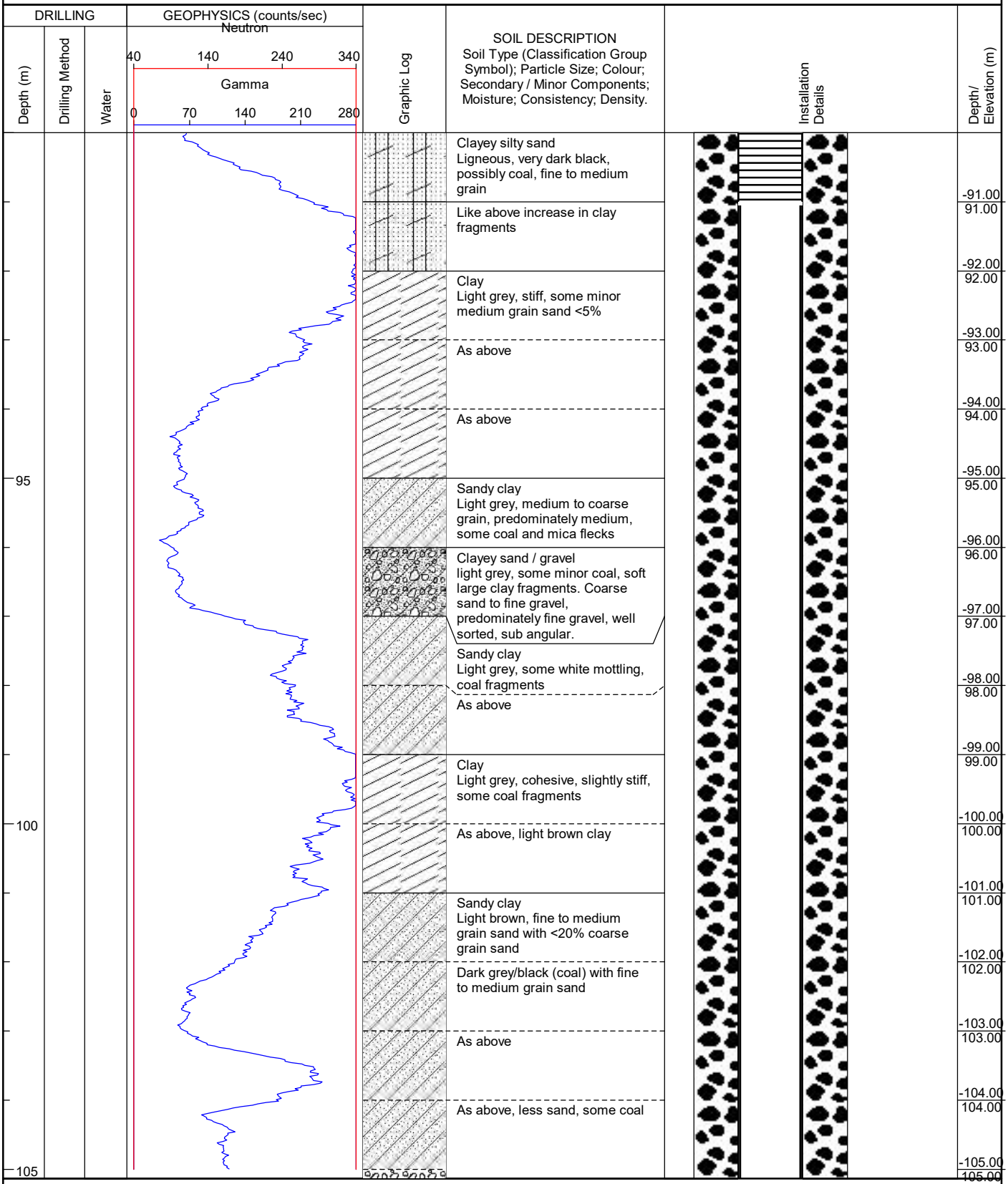
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

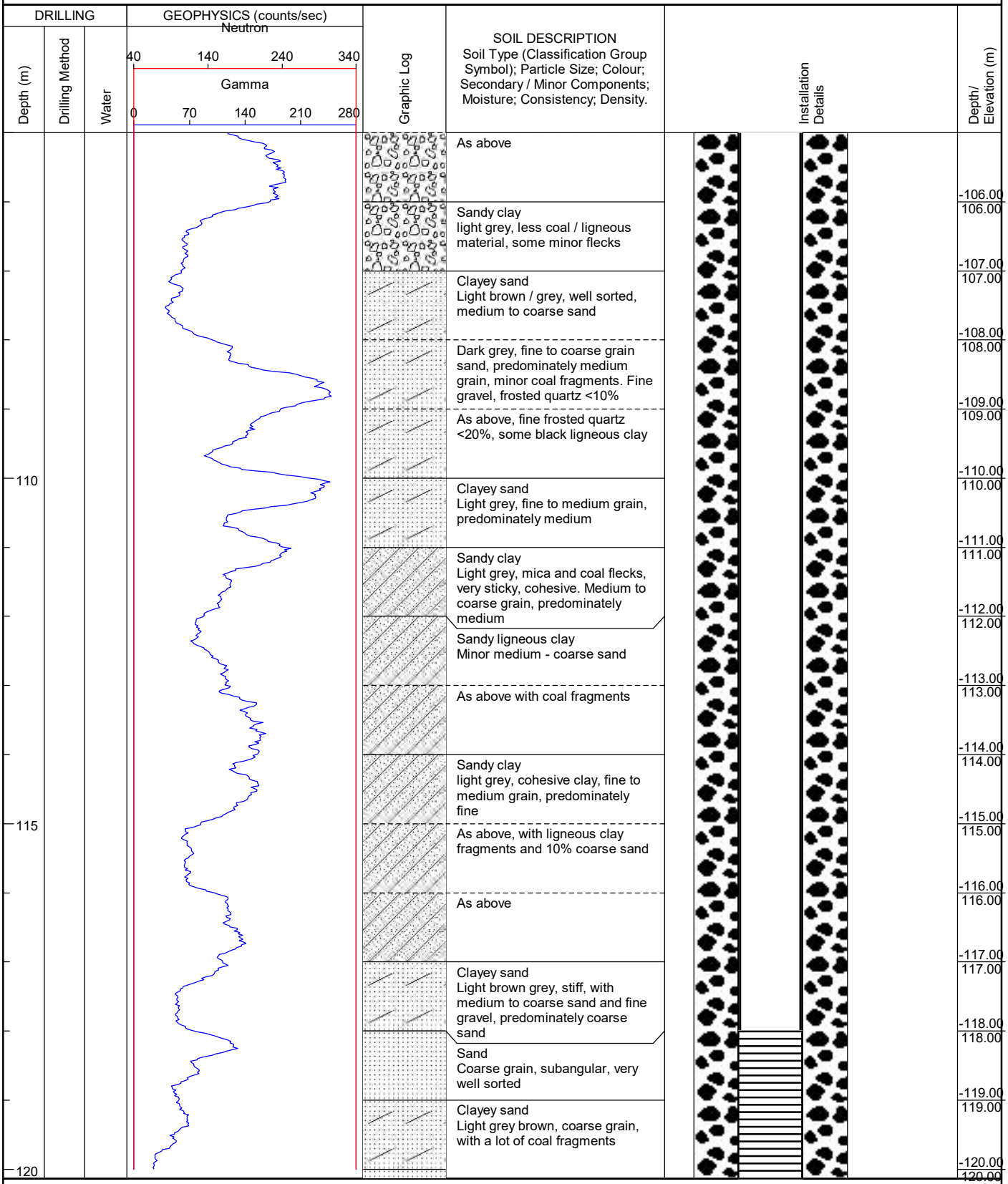
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

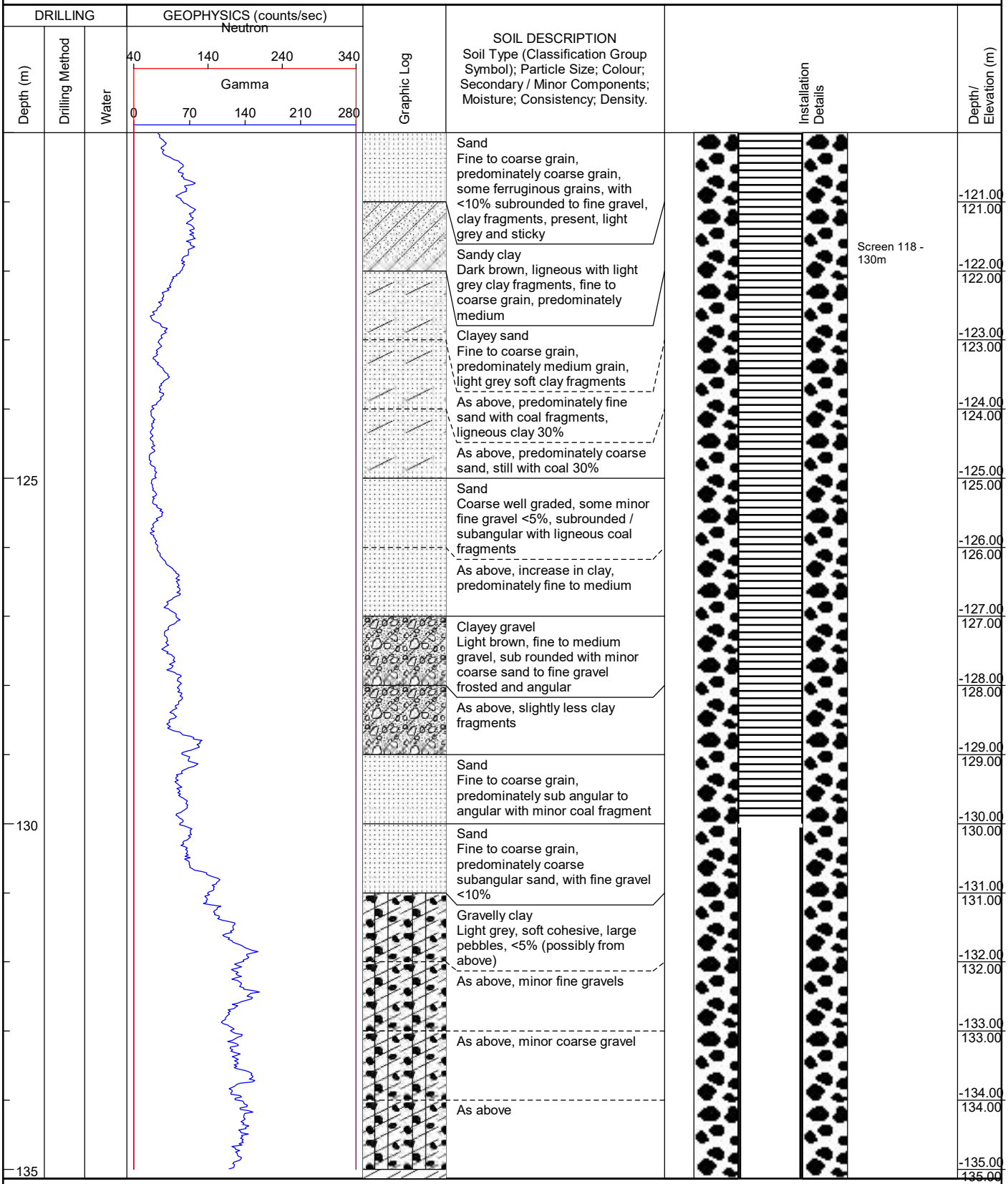
Bore No.: P3b

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4



NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: P3b
Page: 10 of 10

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 31/20640/05
Location: Anglesea Lower Swamp
Date Drilled: 14/07/09 **to:** 17/07/09

Drilling Co.: K H Adams and sons Drilling
Driller: Phil Hammet
Rig Type: Edson
Total Depth (m):
Diameter (mm): 142

Easting: 247166
Northing: 5752941
Grid Ref:
Collar RL:
Logged by: DK **Checked by:**

B.C.L. No.: 9037905 **Casing Material:** 50mm PN12 **Screen Material:** 50mm PN18 **Screen Slot Size (mm):** 0.4

DRILLING			GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280		SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth / Elevation (m)
Depth (m)	Drilling Method	Water		Graphic Log			
					Clay Light grey, some stiff fragments, some harder siltstone/claystone banding		-136.00 136.00
					As above		-137.00 137.00
					As above		
140						Casing depth 142m	
145						Collapse back to 147m	
					As above, increase in silt, fragments are small, less clay, still light grey, slight blue tinge, possibly basement.		-148.00 148.00
						End of Hole 150m	
150							-150.00 150.00

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG GW1

HYDROGEOLOGICAL

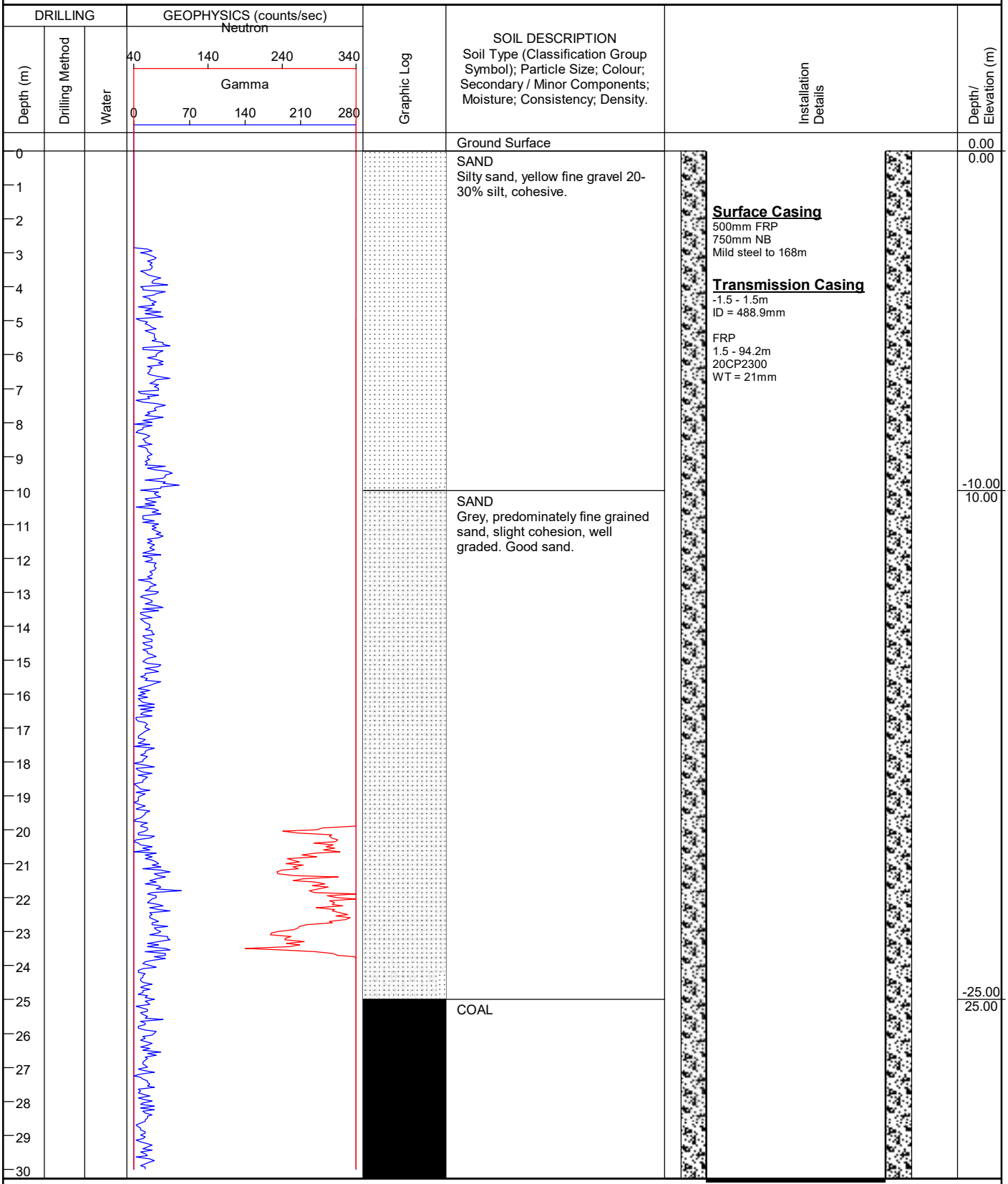
Bore No.: GW1

Client: Barwon Water
Project: Anglesea Borefields Project
Job No.: 31/21424/01
Location: Anglesea
Date Drilled: 15/09/2008 **to:**

Drilling Co.: Drilltec
Driller: Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): 668.4
Diameter (mm): 880 - 400

Easting: 252651
Northing: 5745939
Grid Ref: MGA 94, Zone 55
Collar RL: 52.07 (GL)
Logged by: JSM / MJO **Checked by:** JSM

B.C.L. No.: 9035749 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.6



NOTES: ap. = aperture ; ID = Inside Diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG GW1

HYDROGEOLOGICAL

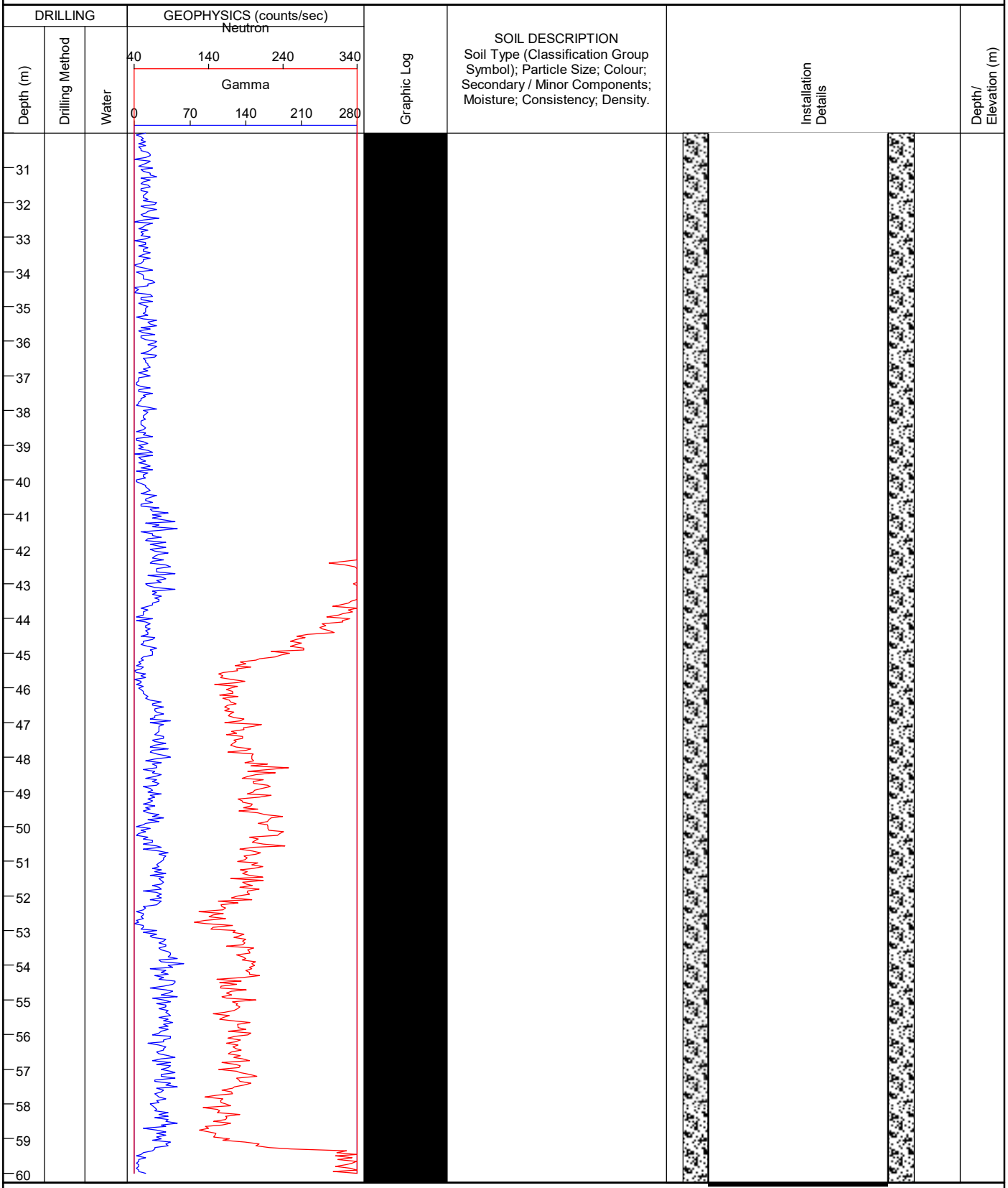
Bore No.: GW1

Client: Barwon Water
Project: Anglesea Borefields Project
Job No.: 31/21424/01
Location: Anglesea
Date Drilled: 15/09/2008 **to:**

Drilling Co.: Drilltec
Driller: Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): 668.4
Diameter (mm): 880 - 400

Easting: 252651
Northing: 5745939
Grid Ref: MGA 94, Zone 55
Collar RL: 52.07 (GL)
Logged by: JSM / MJO **Checked by:** JSM

B.C.L. No.: 9035749 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.6



NOTES: ap. = aperture ; ID = Inside Diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG GW1

HYDROGEOLOGICAL

Bore No.: GW1

Client: Barwon Water
Project: Anglesea Borefields Project
Job No.: 31/21424/01
Location: Anglesea
Date Drilled: 15/09/2008 **to:**

Drilling Co.: Drilltec
Driller: Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): 668.4
Diameter (mm): 880 - 400

Easting: 252651
Northing: 5745939
Grid Ref: MGA 94, Zone 55
Collar RL: 52.07 (GL)
Logged by: JSM / MJO **Checked by:** JSM

B.C.L. No.: 9035749 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.6

Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth / Elevation (m)
61							
62							
63							
64							
65							-65.00 / 65.00
66					SAND Fine to medium grain, Predominately sand, 10% coarse grain sand. Dark grey-black coal fragments.		
67							
68							
69							
70							-70.00 / 70.00
71					SAND Fine-Coarse grain sand, predominately coarse grain quartz and feldspar. Minor gravel, Light grey, quartz.		
72							
73							
74							
75							-75.00 / 75.00
76					As above		
77							
78							
79							
80							-80.00 / 80.00
81					SAND Fine to medium grained, cemented quartz, feldspar light grey. Some coarse gravel, quartz up to 10mm. Silty.		
82							
83							
84							
85							-85.00 / 85.00
86					SAND/GRAVEL Gravelly sand, Sandy gravely. Dakry grey / black. Poorly sorted coal fragments, sub rounded quartz and feldspar gravel 2-4mm.		
87							
88							
89							
90							-90.00 / 90.00

NOTES: ap. = aperture ; ID = Inside Diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG GW1

HYDROGEOLOGICAL

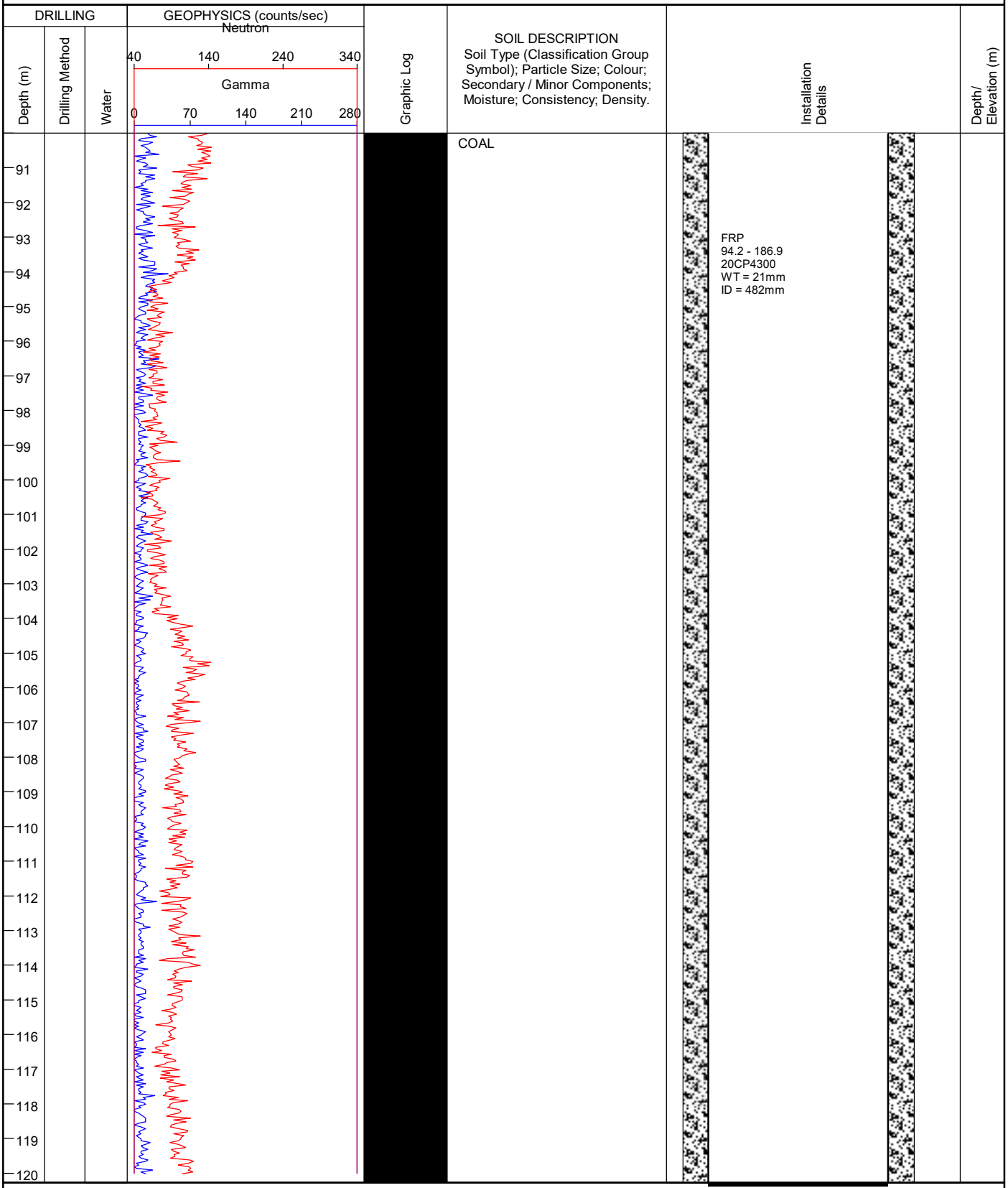
Bore No.: GW1

Client: Barwon Water
Project: Anglesea Borefields Project
Job No.: 31/21424/01
Location: Anglesea
Date Drilled: 15/09/2008 **to:**

Drilling Co.: Drilltec
Driller: Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): 668.4
Diameter (mm): 880 - 400

Easting: 252651
Northing: 5745939
Grid Ref: MGA 94, Zone 55
Collar RL: 52.07 (GL)
Logged by: JSM / MJO **Checked by:** JSM

B.C.L. No.: 9035749 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.6



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BOREHOLE LOG GW1

HYDROGEOLOGICAL

Bore No.: GW1

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Project: Anglesea Borefields Project
Job No.: 31/21424/01
Location: Anglesea
Date Drilled: 15/09/2008 **to:**

Drilling Co.: Drilltec
Driller: Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): 668.4
Diameter (mm): 880 - 400

Easting: 252651
Northing: 5745939
Grid Ref: MGA 94, Zone 55
Collar RL: 52.07 (GL)
Logged by: JSM / MJO **Checked by:** JSM

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DRILLING: Depth (m), Drilling Method, Water

GEOPHYSICS (counts/sec): Neutron 40 140 240 340; Gamma 0 70 140 210 280

Graphic Log

SOIL DESCRIPTION
Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.

Installation Details

Depth / Elevation (m)

121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150

-130.00
130.00

SAND (Based on 140m sample)
Fine to coarse grained sand. Dark grey / black. coal fragments. Poorly sorted, predominately coarse grained sand, quartz and feldspar.

-140.00
140.00

SAND
Medium, well sorted quartz sand, light grey and white. 1-2% dark greenish grey mudstone fragments 2-3mm.

-145.00
145.00

SAND
Medium to coarse quartz and calcite sand, sub rounded to sub angular. Mudstone and light greenish grey and hard consolidated. Coal.

-150.00
150.00

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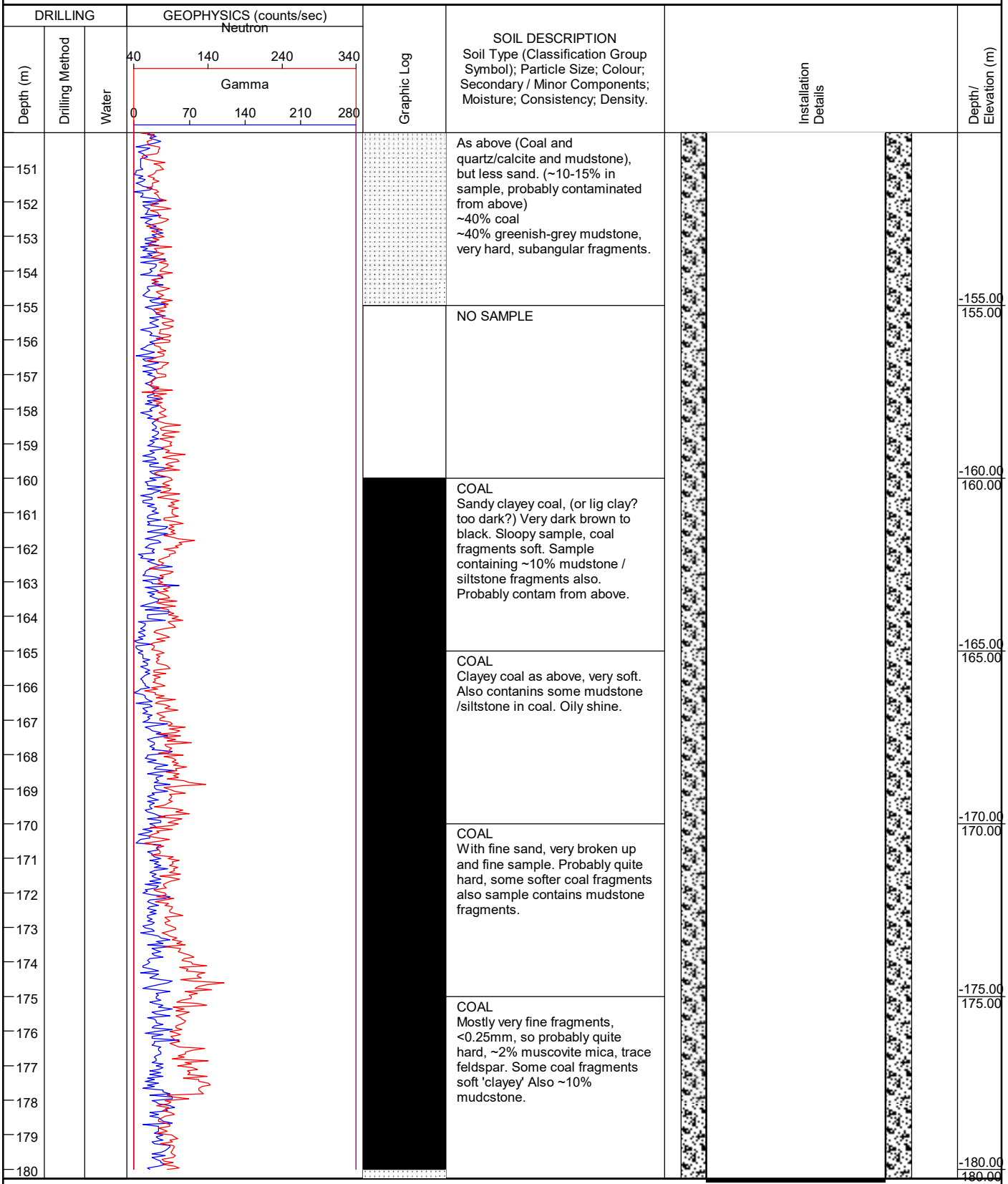

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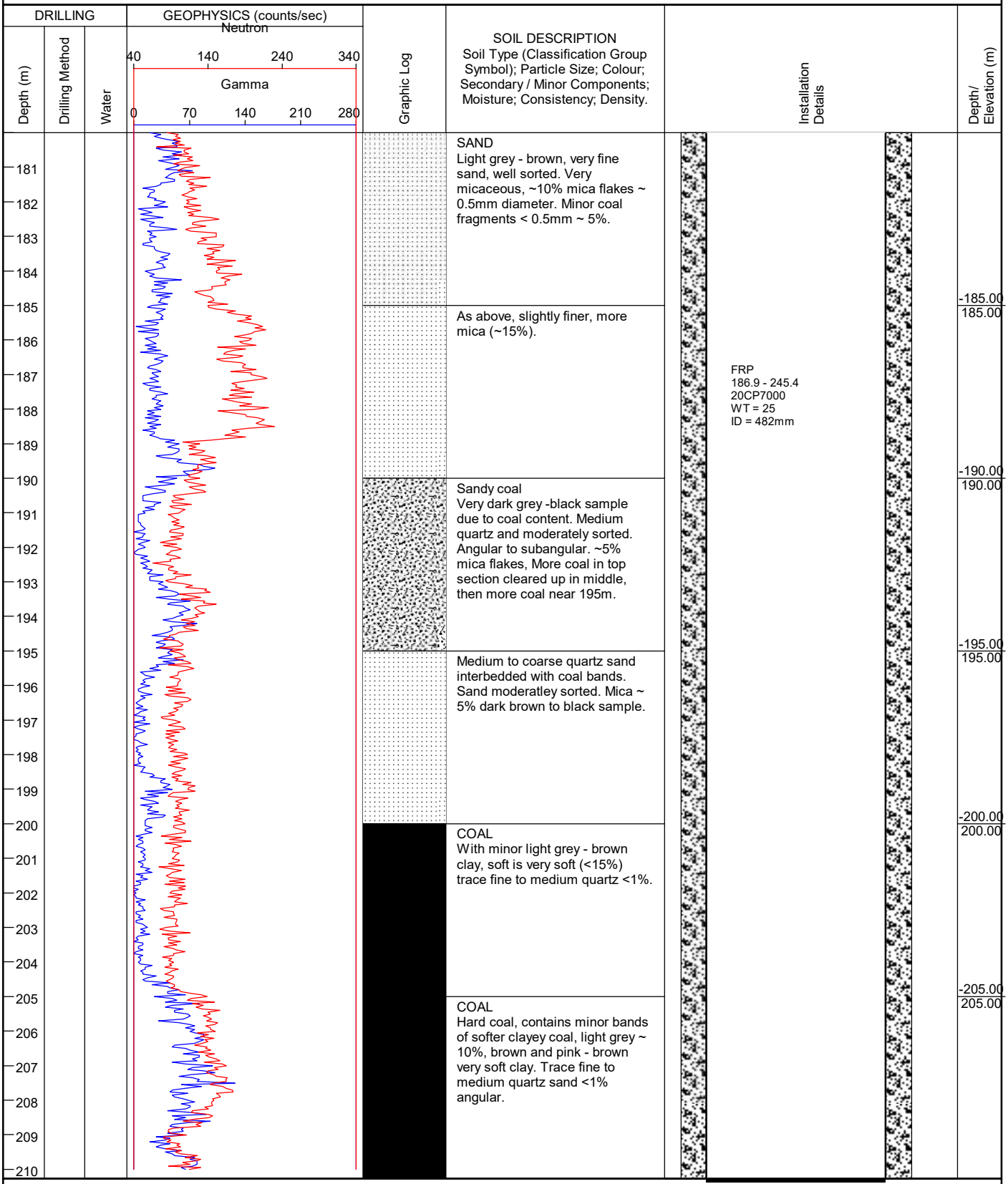

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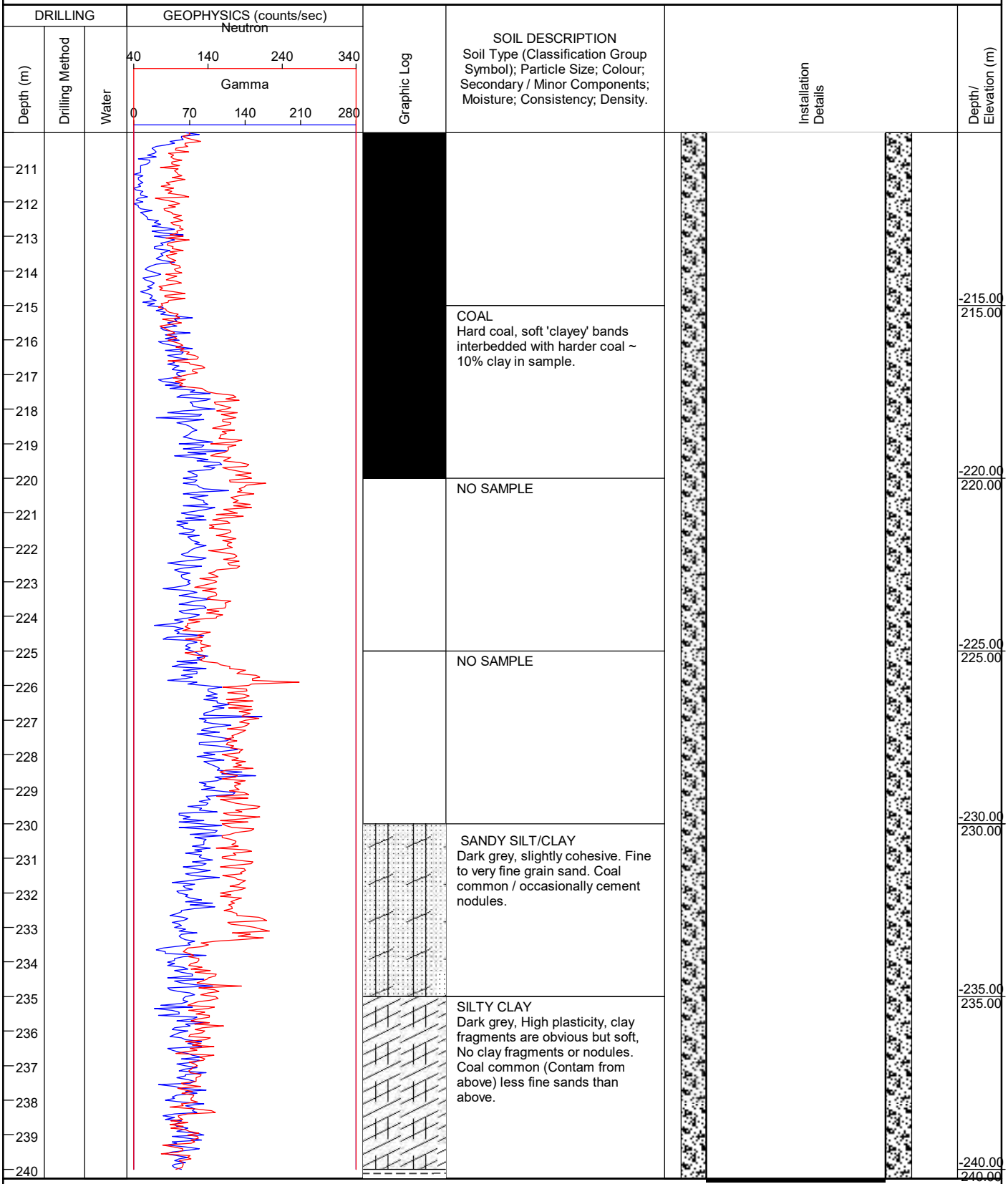

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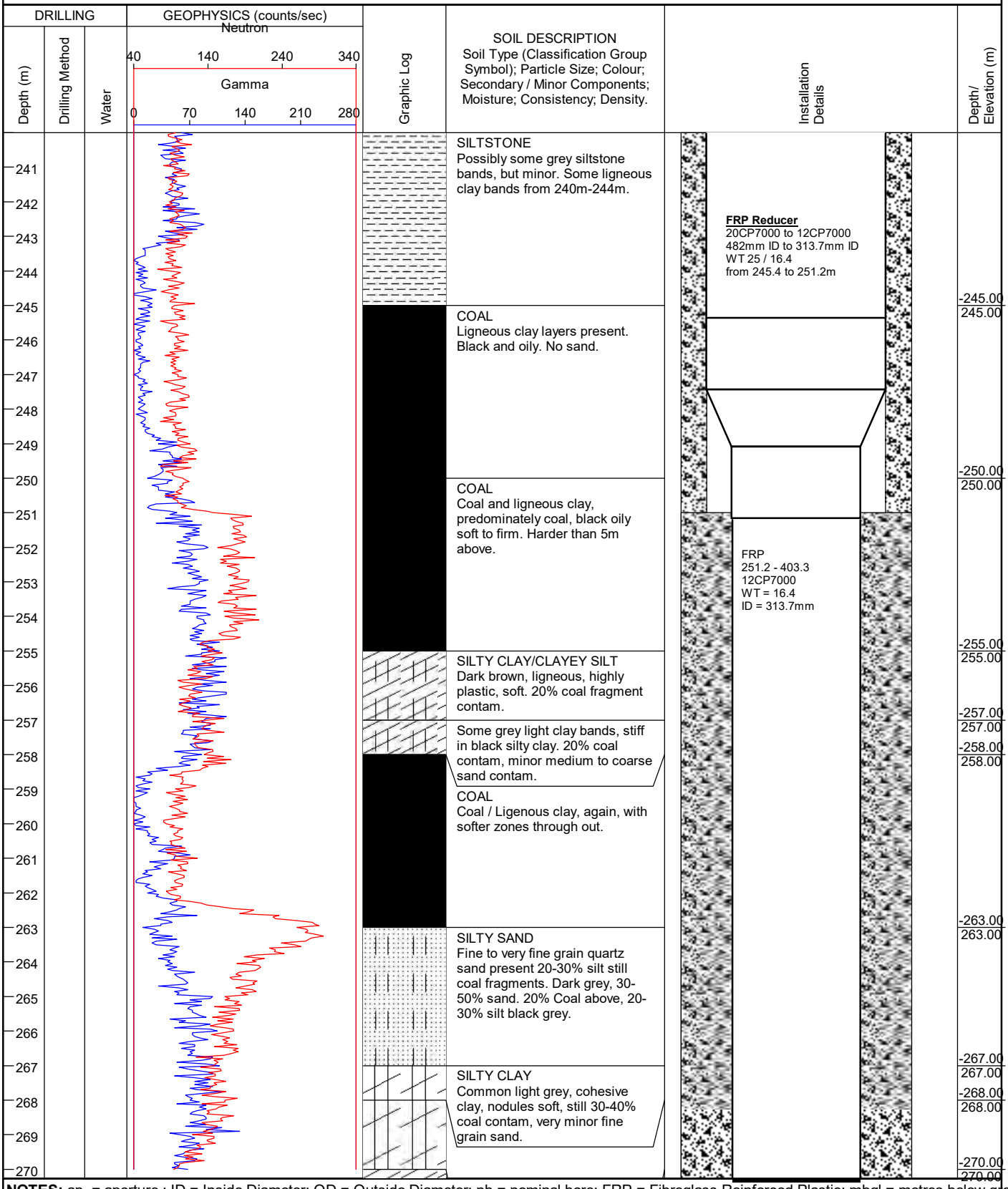

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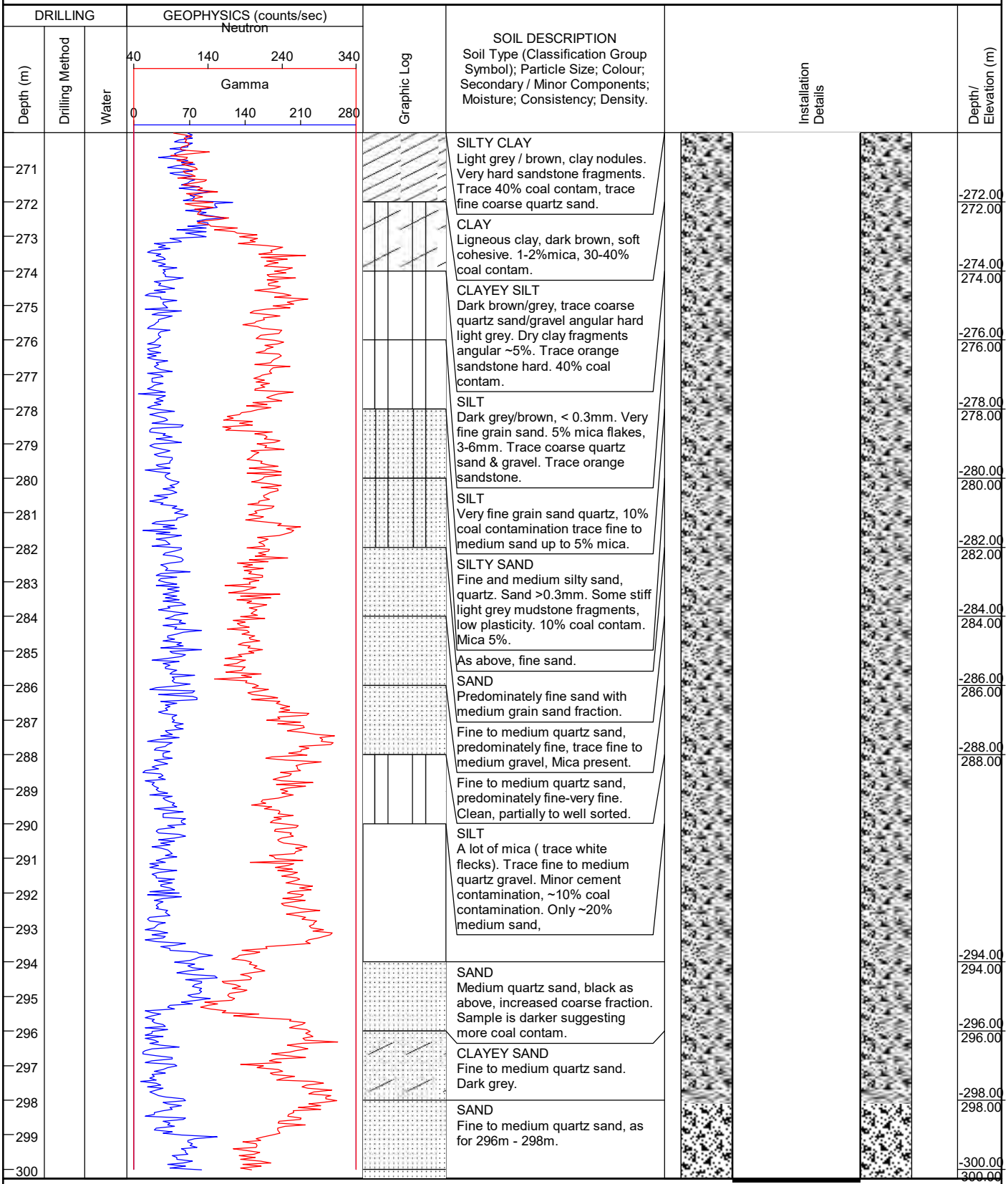

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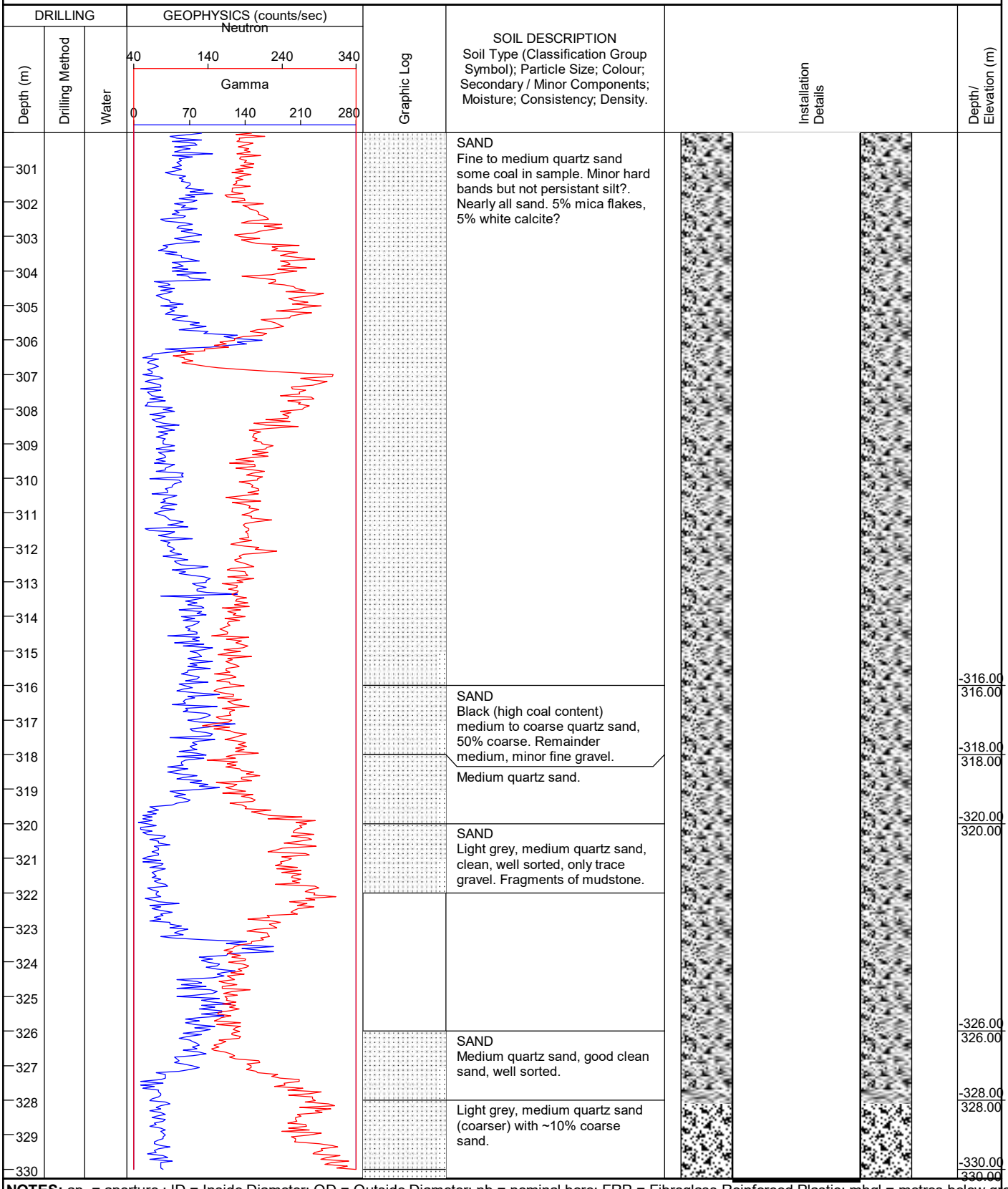

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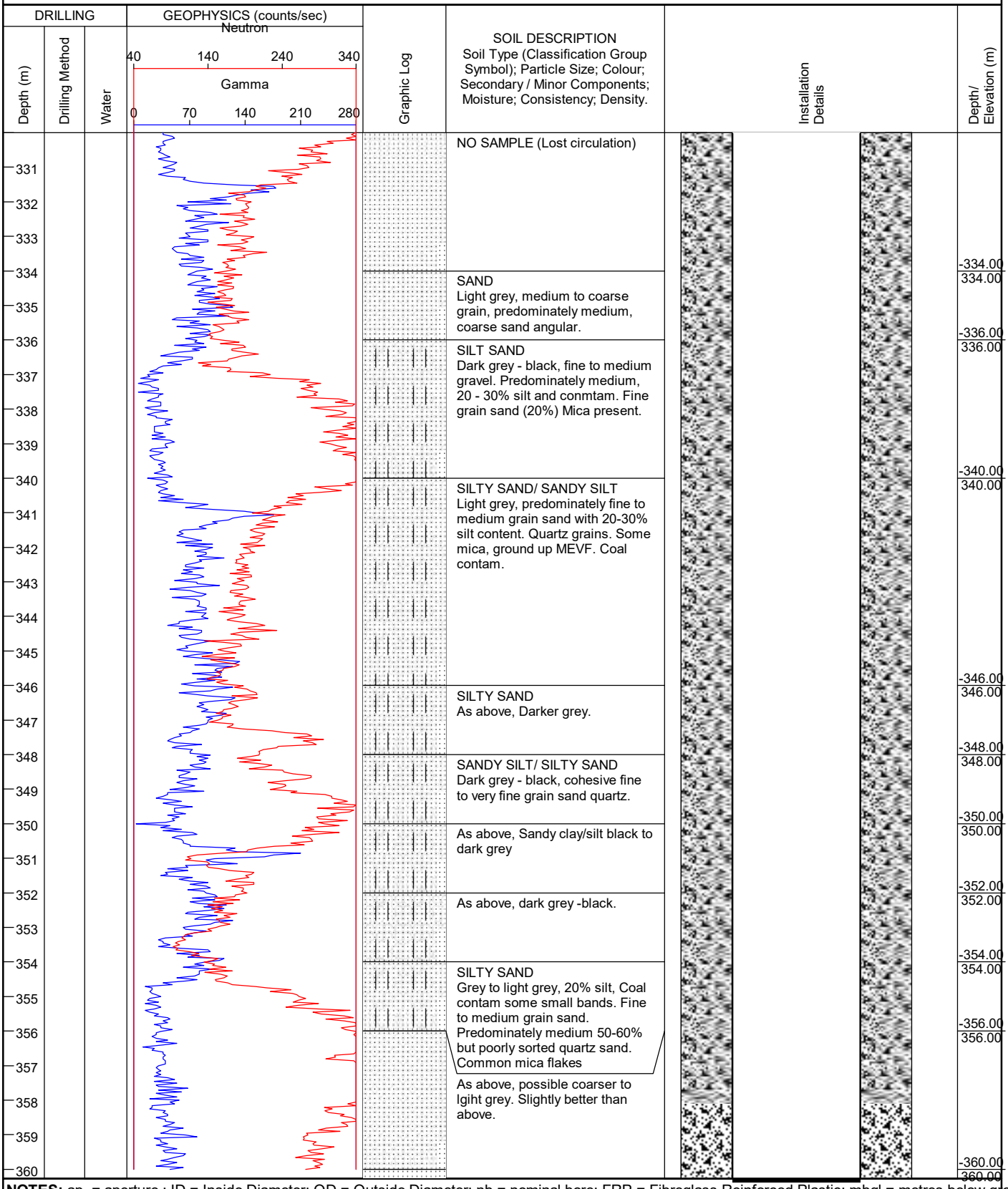

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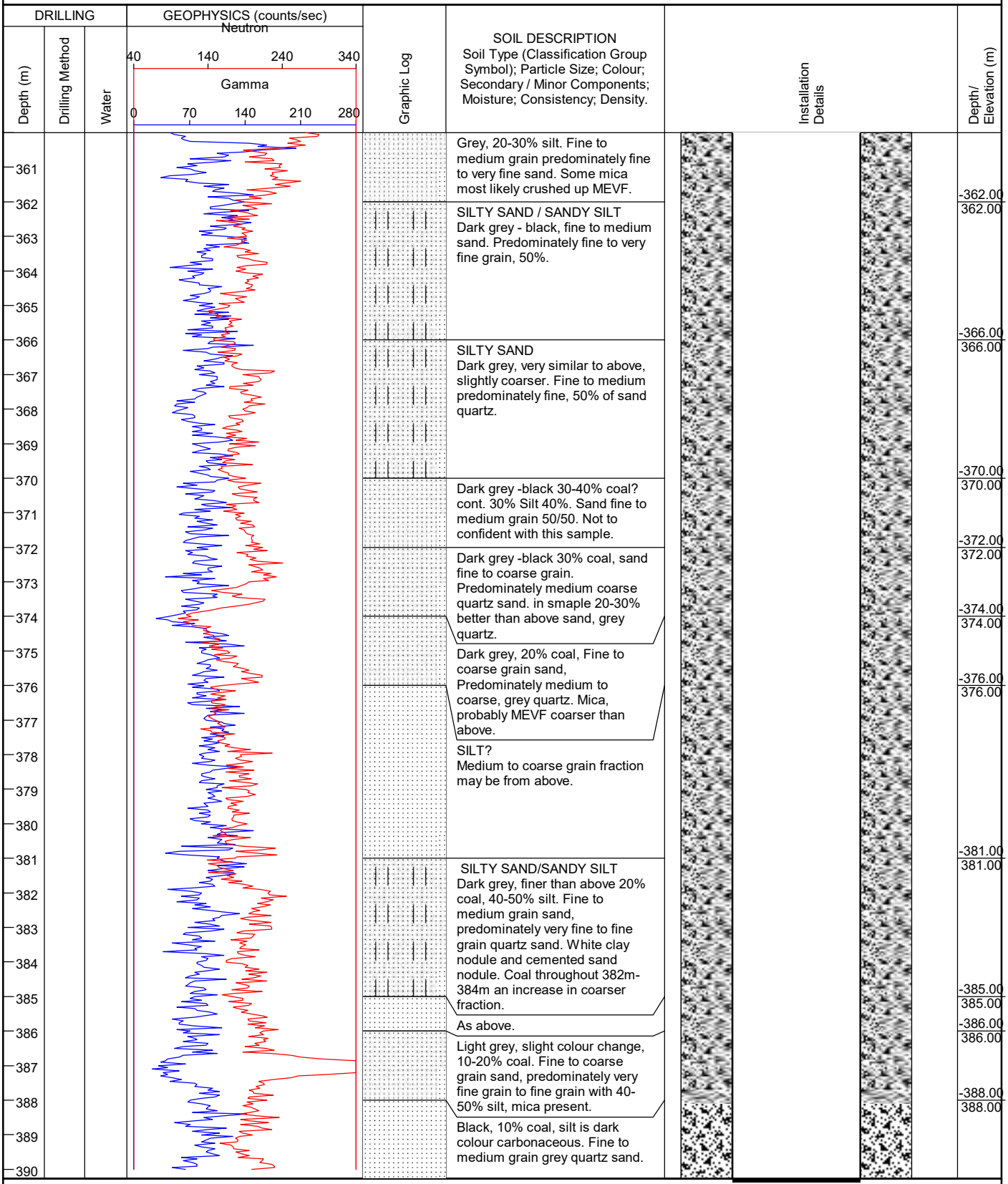

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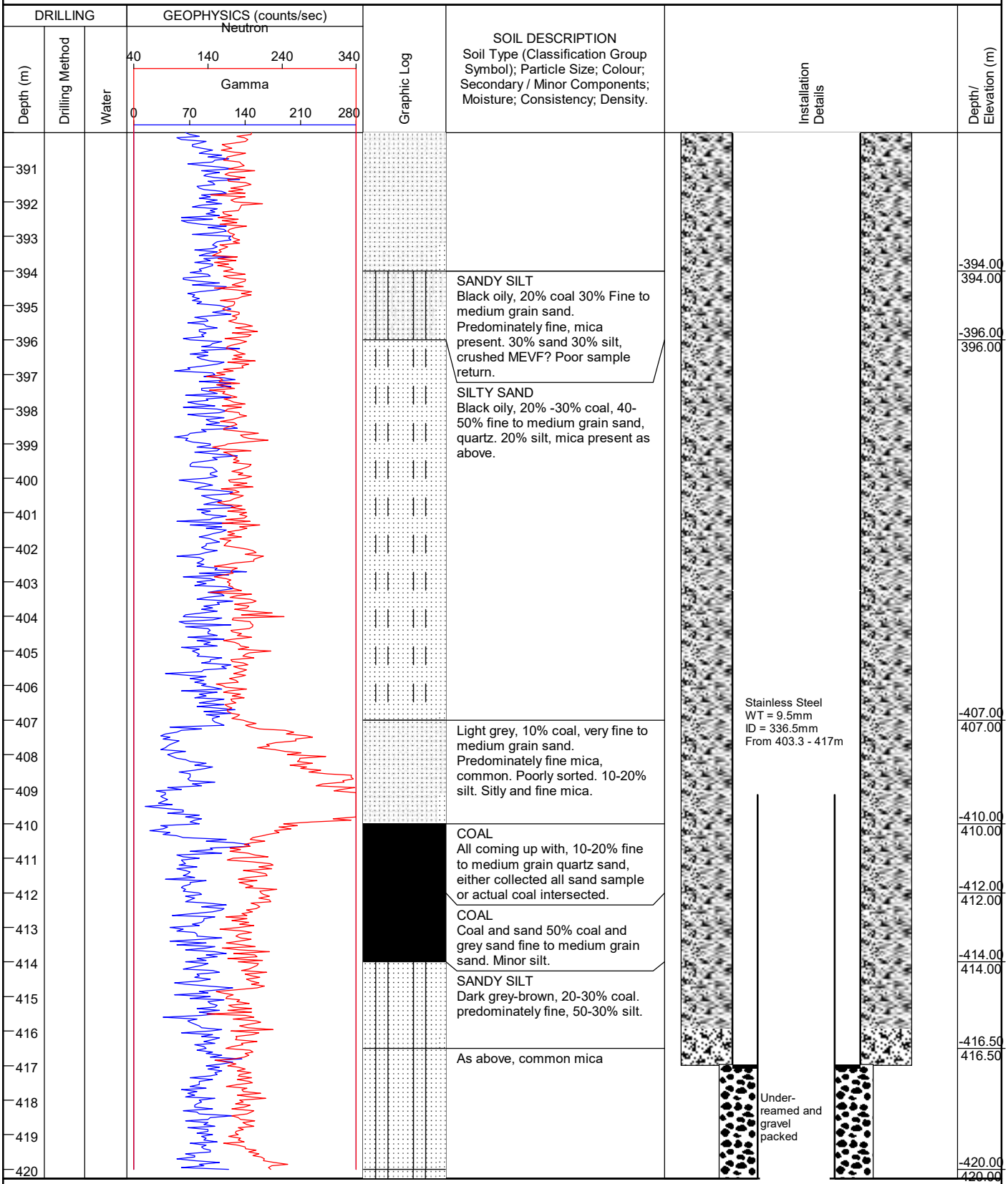

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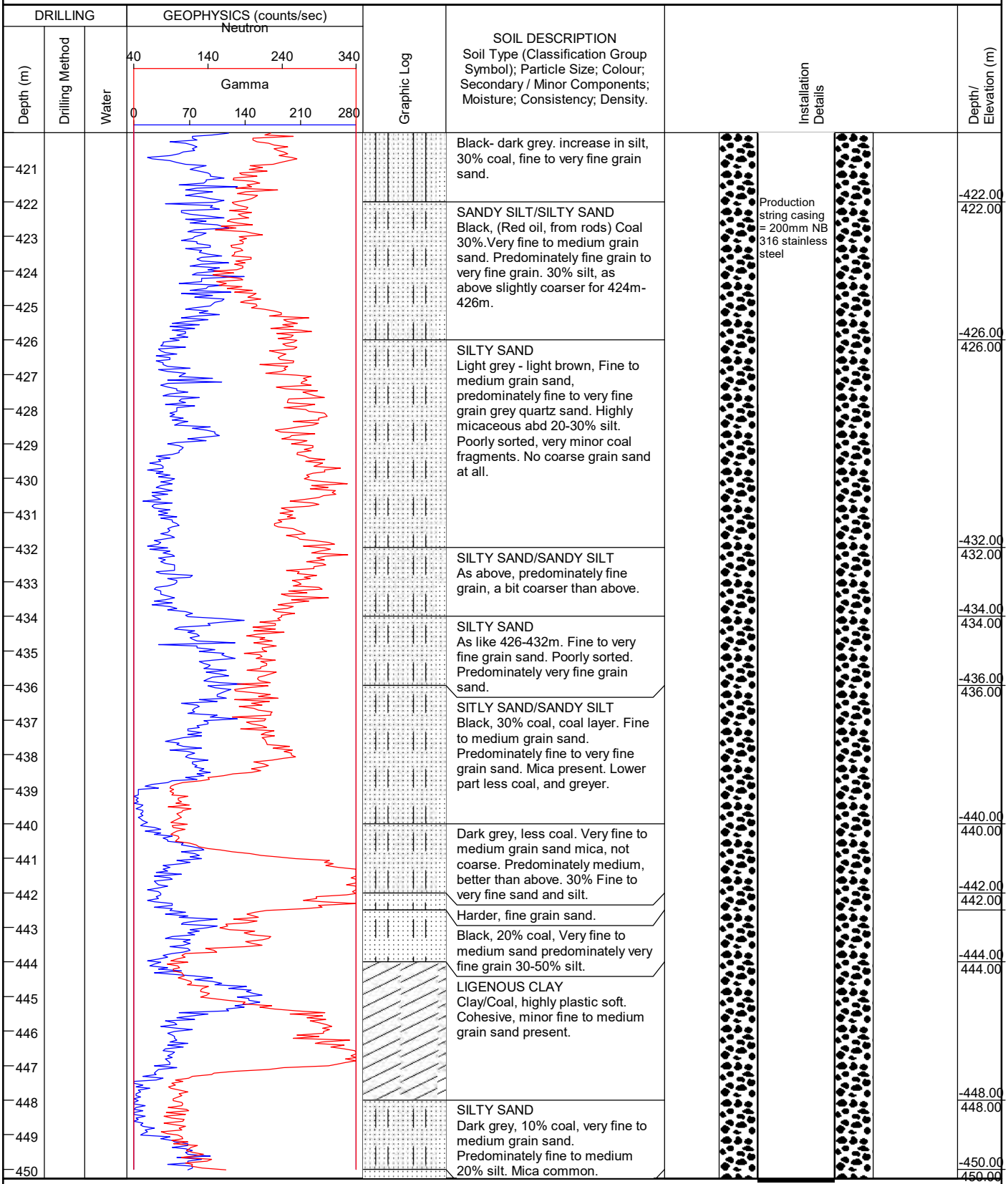

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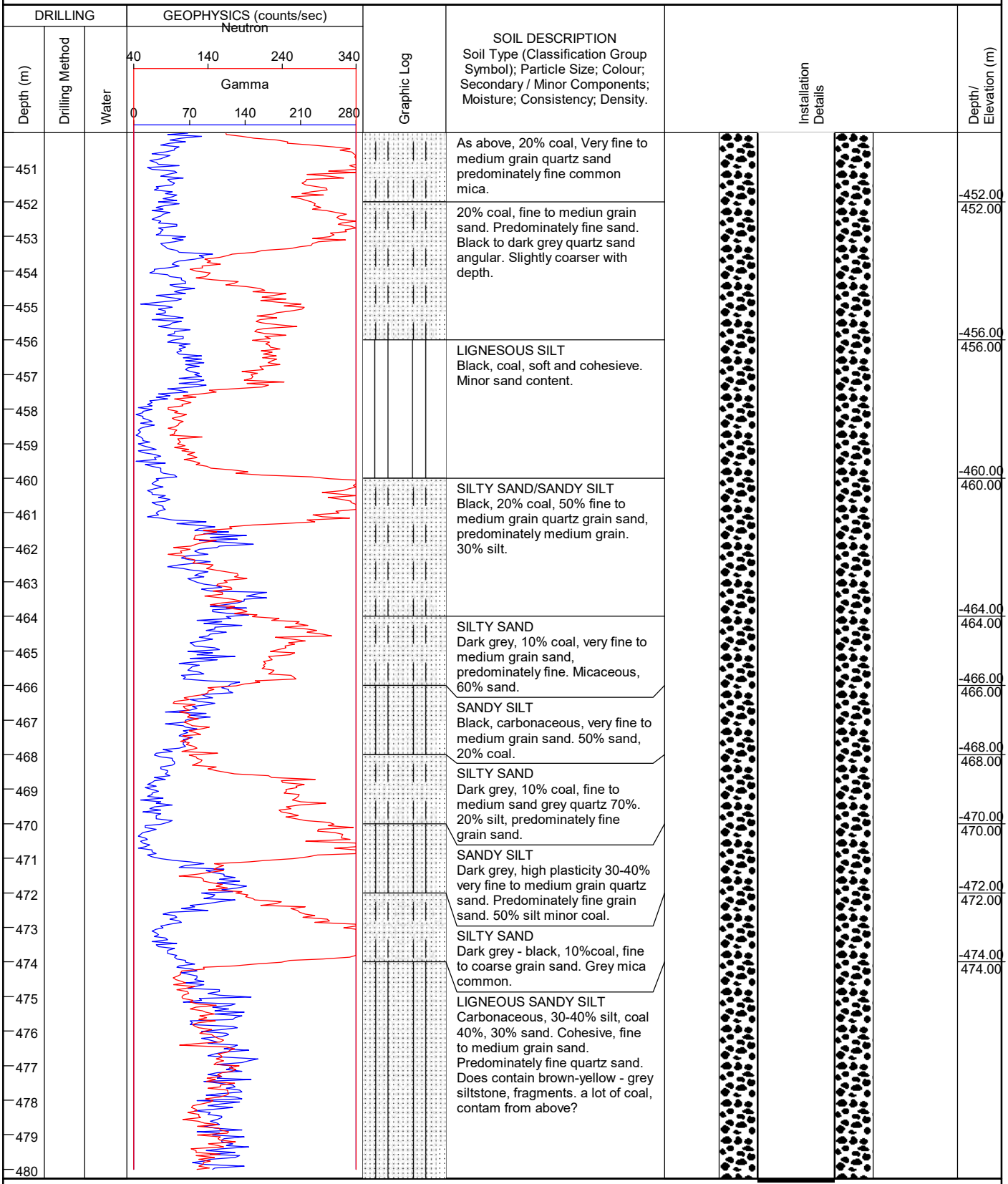

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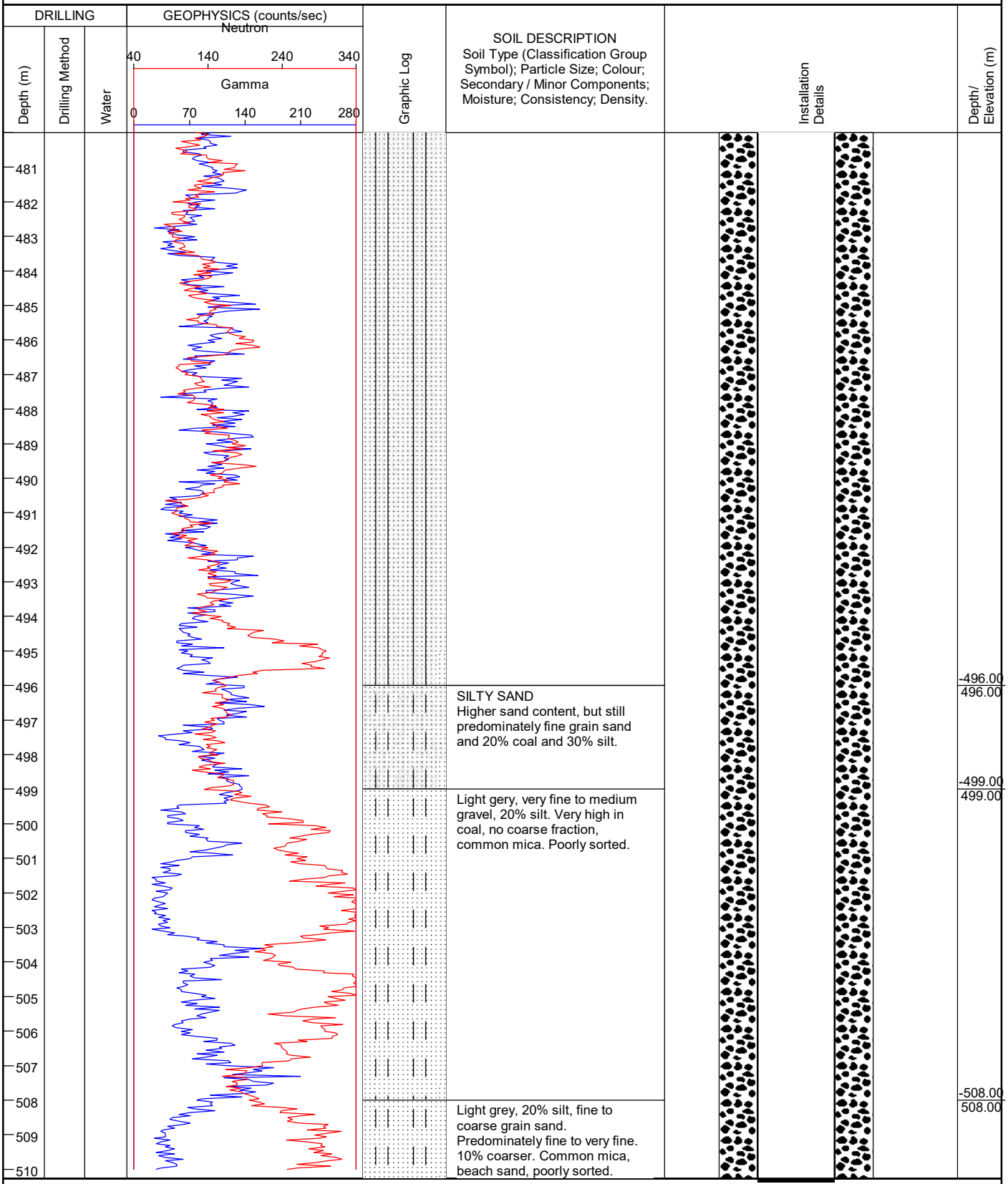

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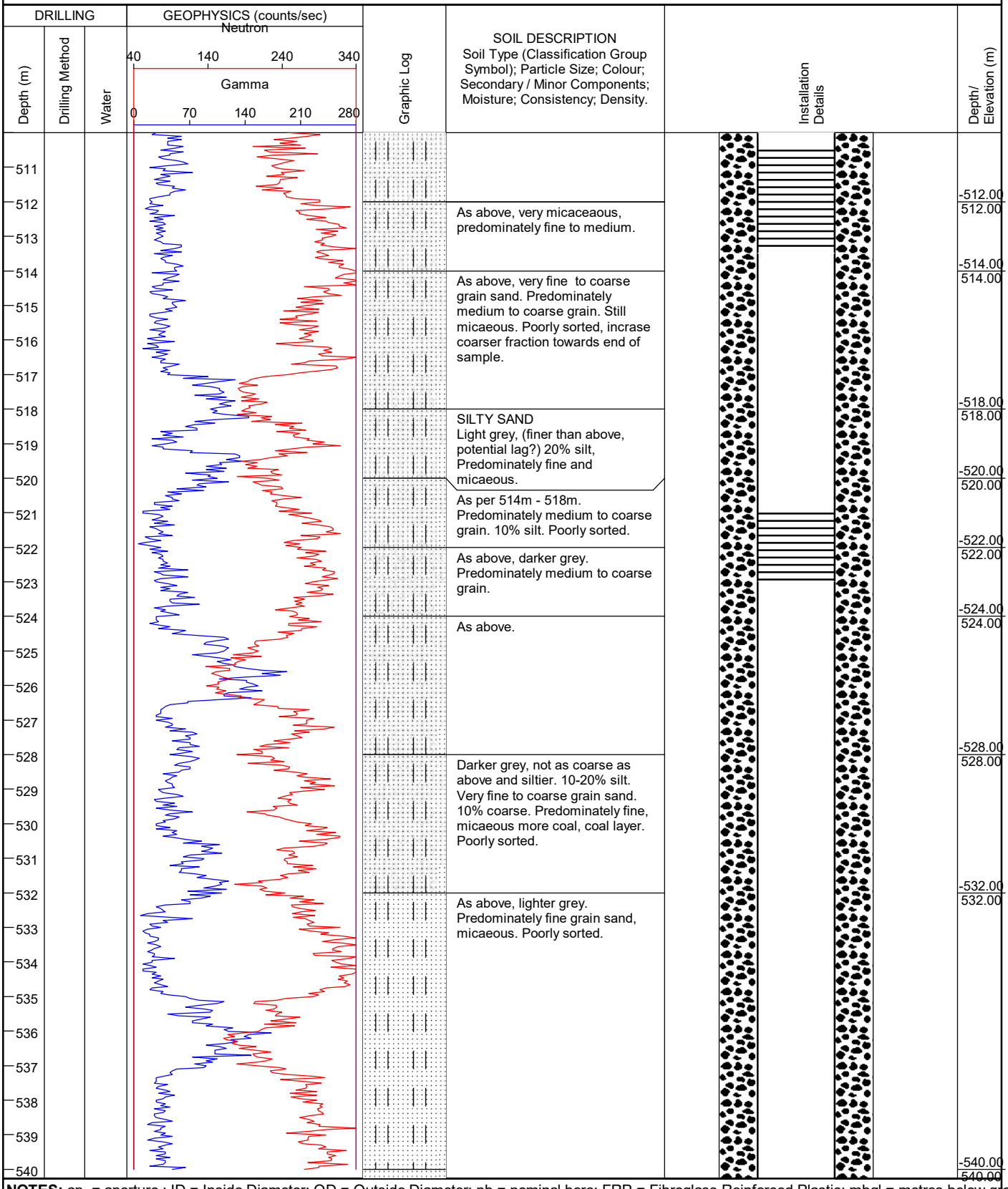

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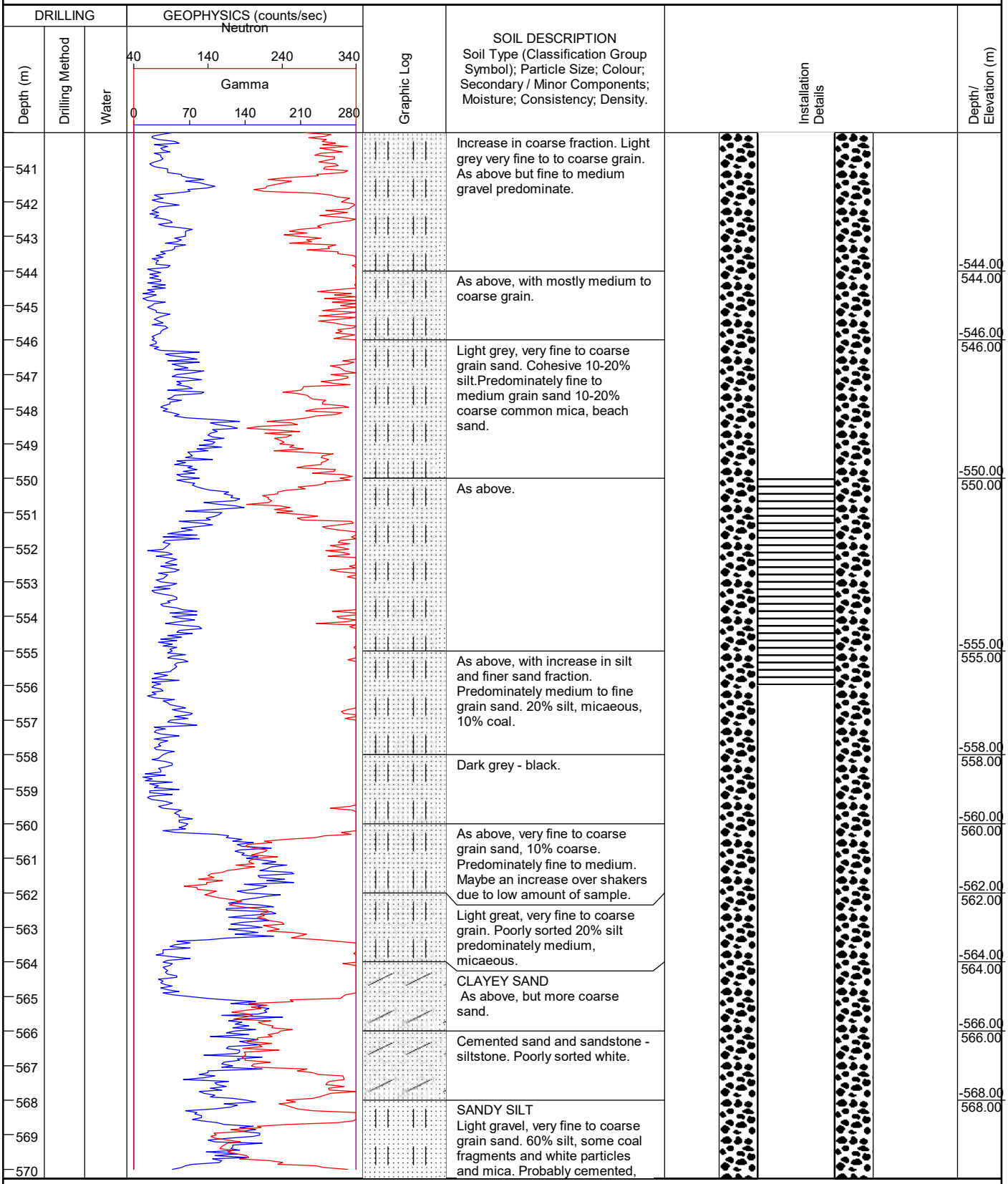

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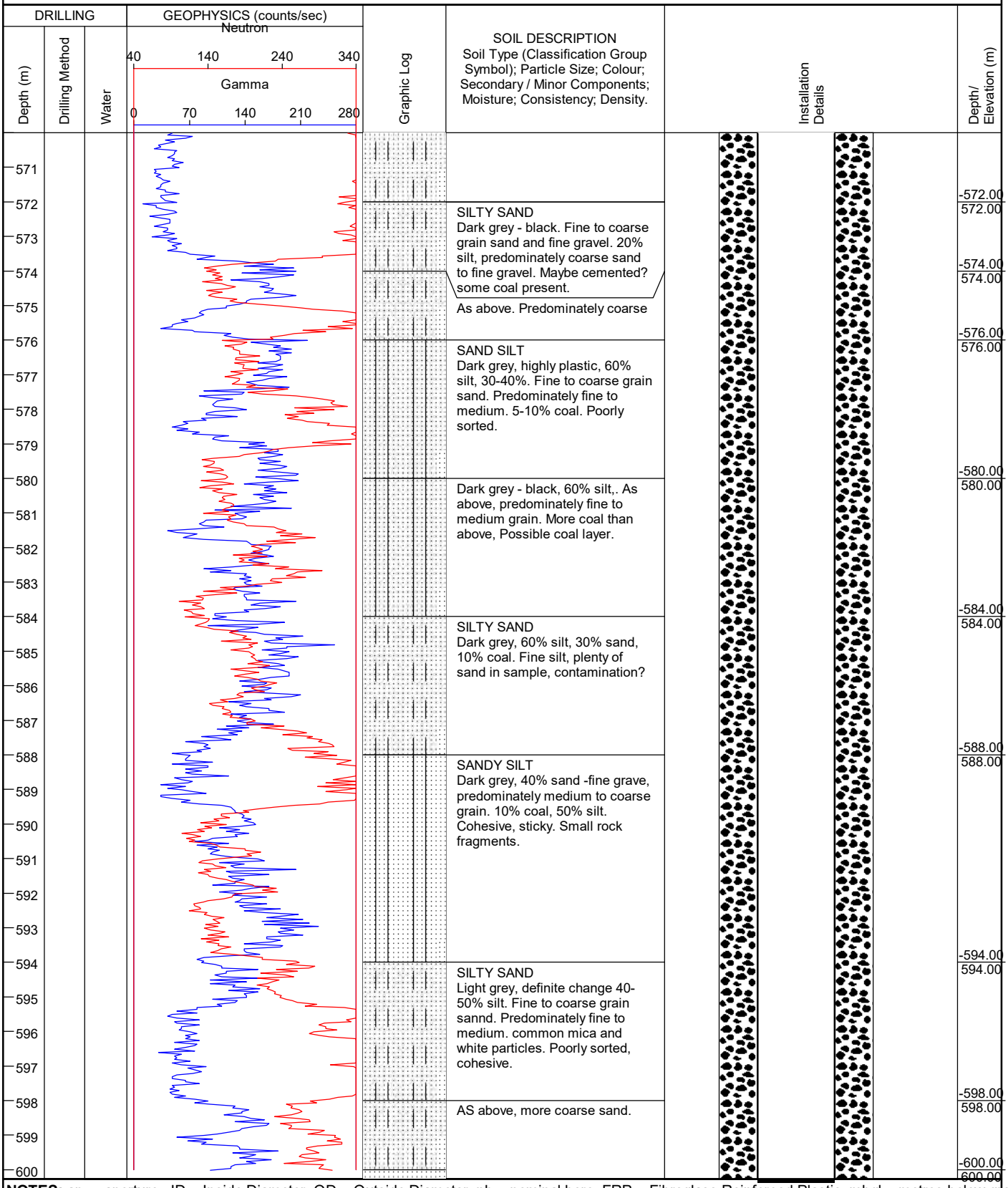

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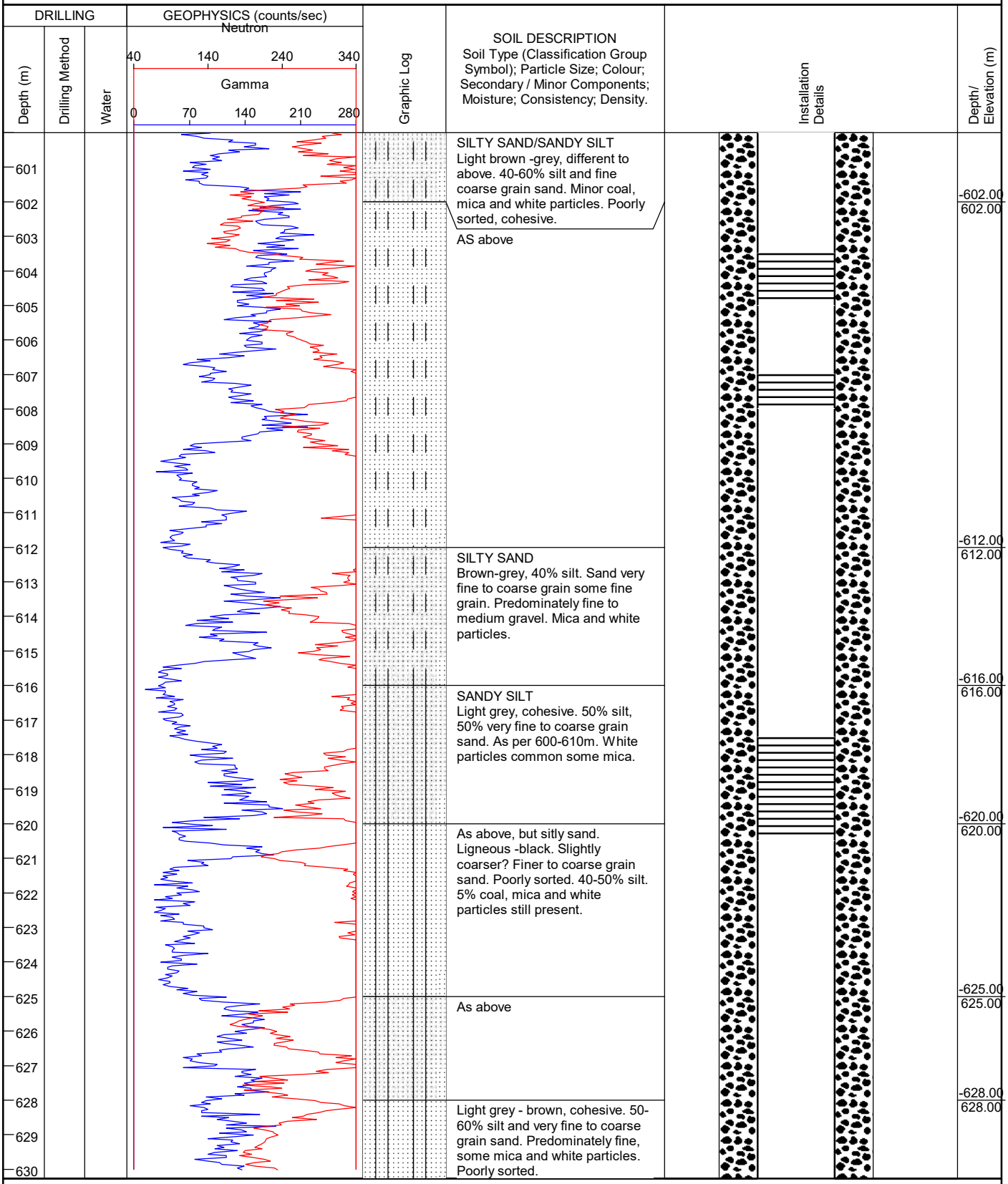

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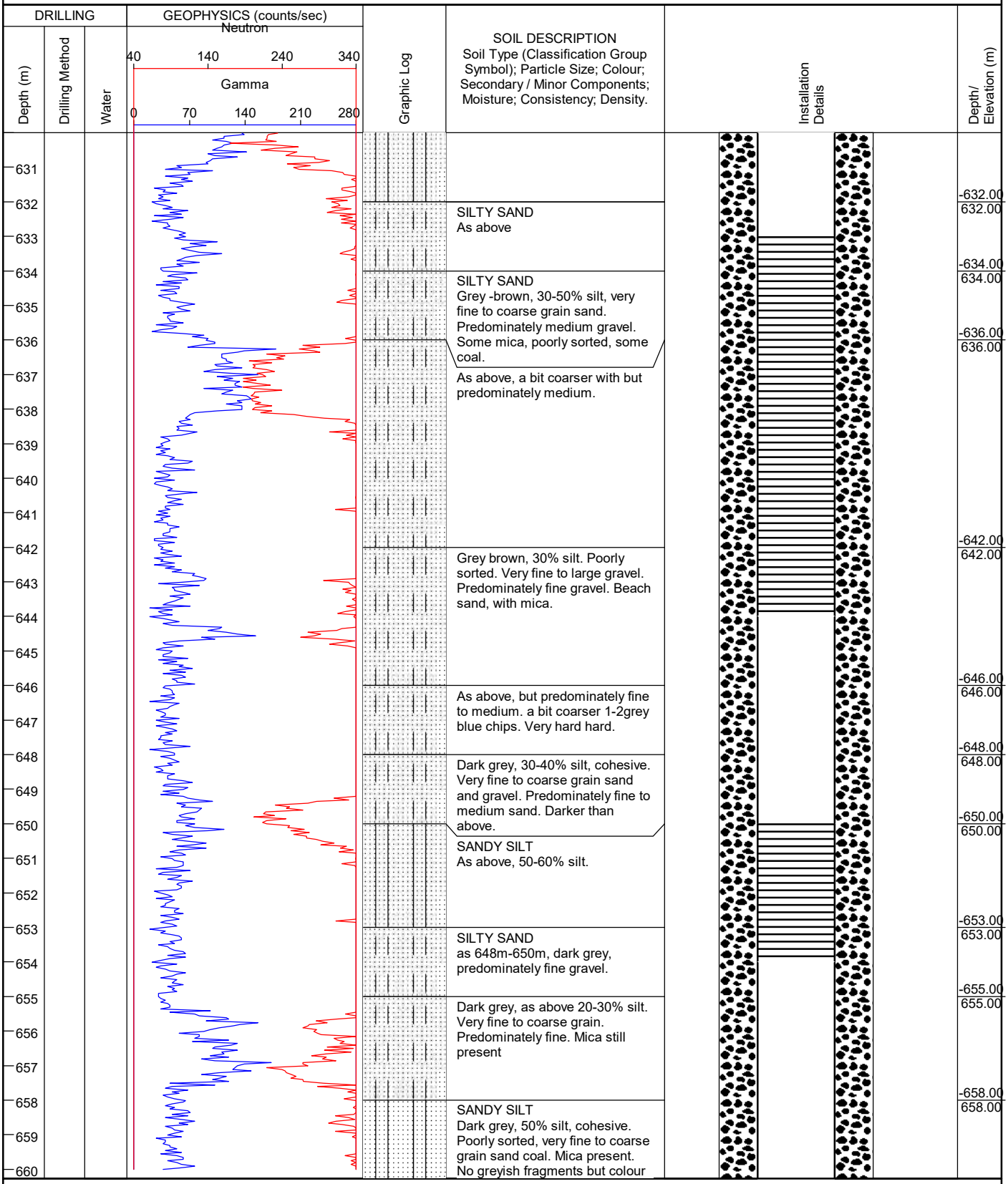

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GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG GW1

HYDROGEOLOGICAL

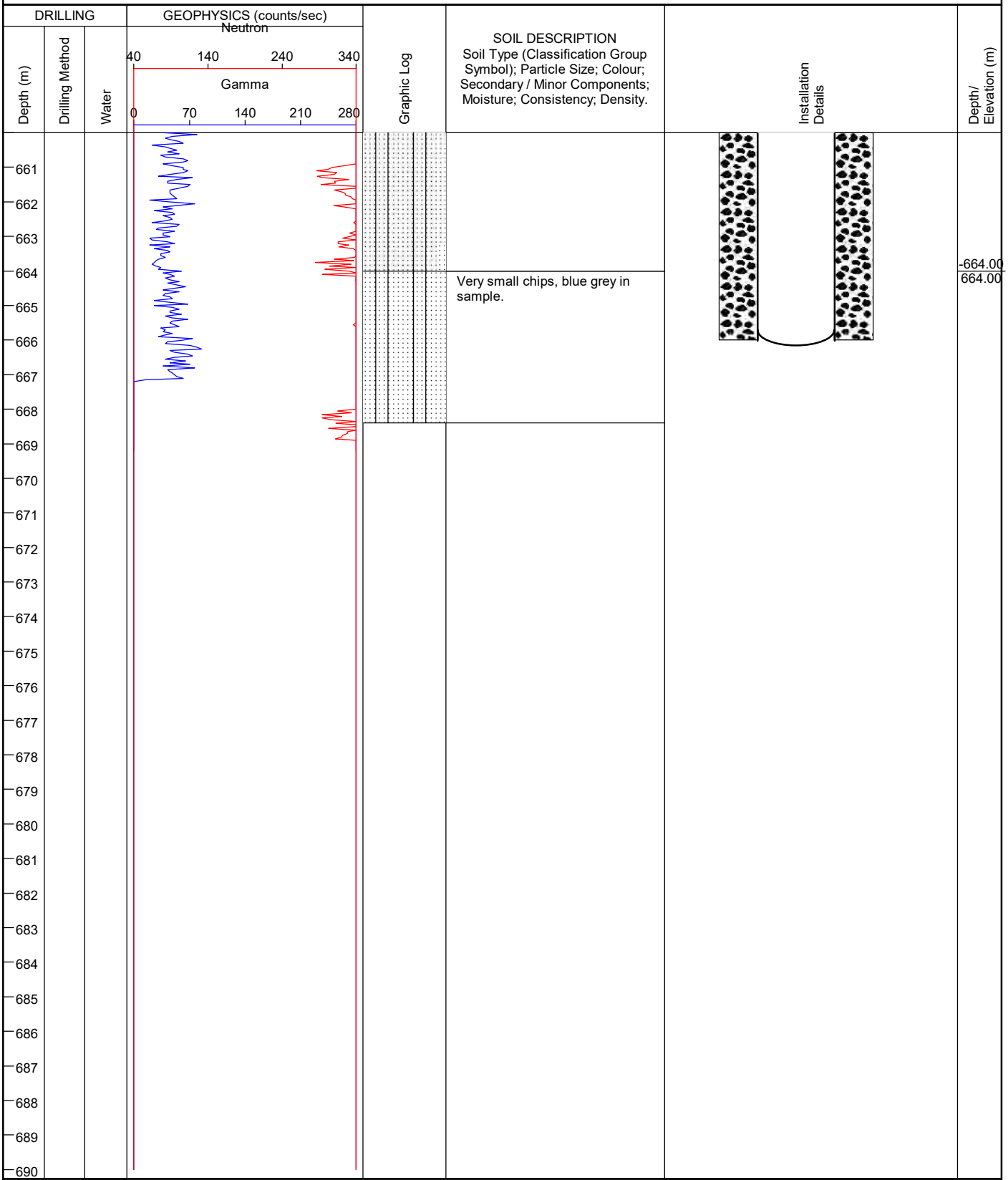
Bore No.: GW1

Client: Barwon Water
Project: Anglesea Borefields Project
Job No.: 31/21424/01
Location: Anglesea
Date Drilled: 15/09/2008 **to:**

Drilling Co.: Drilltec
Driller: Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): 668.4
Diameter (mm): 880 - 400

Easting: 252651
Northing: 5745939
Grid Ref: MGA 94, Zone 55
Collar RL: 52.07 (GL)
Logged by: JSM / MJO **Checked by:** JSM

B.C.L. No.: 9035749 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.6



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HYDROGEOLOGICAL

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Job No.: 31/21424/01
Location: Anglesea
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Logged by: JSM / MJO **Checked by:** JSM

B.C.L. No.: 9035749 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.6

DRILLING			GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth / Elevation (m)
Depth (m)	Drilling Method	Water					
691							
692							
693							
694							
695							
696							
697							
698							
699							
700							-700.00 / 700.00
701							
702							
703							
704							
705							
706							
707							
708							
709							
710							
711							
712							
713							
714							
715							
716							
717							
718							
719							
720							

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW2

Page: 1 of 24

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312349207
Location: Messmate track
Date Drilled: 15/11/2010 **to:** 24/02/2012

Drilling Co.: Drilltec
Driller: Craig Gordon
Rig Type: Bourne2000
Total Depth (m): 707.3
Diameter (mm): 500 - 200 (casing)

Easting: 55251850
Northing: 5744700
Grid Ref:
Collar RL: 120m (approximate)
Logged by: JSM **Checked by:** JM

B.C.L. No.: WLE046288 **Casing Material:** FRP and S/Steel **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.4 - 0.6

Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 190 340 490 600 / Gamma 0 50 100 150 200	Graphic Log	SOIL DESCRIPTION (Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.)	Installation Details	Depth/ Elevation (m)
					Ground Surface		
0	Mud rotary and reverse circulation				**DEMONS BLUFF FORMATION:** CLAY Brown, high plasticity, firm, definite coal seams / ligneous clays through this area	DBF **Surface Casing:** Steel 750mm NB to 210m **Transmission Casing:** FRP **500mm FRP casing** 500mm NB diameter 0 - 344mbgl ID = 482mm **Wall Thickness:** 2 - 92.3m = 17.4mm 20cp2300 92.3 - 183.7 = 21mm 20cp4300 183.7-332.6 = 25mm 20cp7000 332.6-344.2 = 26mm 20cp8000 **400mm FRP Casing** 400mm NB diameter 349.8-477.4 mbgl ID=393mm **Wall Thickness:** 351 - 362 = 21.4mm 16cp8000 362 - 478 = 23mm 16cp10000 349.8-361.4=21.4mm 16cp8000 361.4-477.4m= 23.0mm 16cp10000	0.00
30							30.00

NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW2

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DRILLING			GEOPHYSICS (counts/sec)	Graphic Log	SOIL DESCRIPTION	Installation Details	Depth/ Elevation (m)
Depth (m)	Drilling Method	Water	Neutron 40 190 340 490 600; Gamma 0 50 100 150 200		Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.		
31					CLAY Dark brown, high plasticity, soft clay, Demons Bluff Formation, some minor ligneous clay, very sticky		
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
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57							
58							
59							
60							

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BOREHOLE LOG

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DRILLING: Depth (m), Drilling Method, Water

GEOPHYSICS (counts/sec): Neutron 40 190 340 490 600; Gamma 0 50 100 150 200

Graphic Log

SOIL DESCRIPTION: Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.

Installation Details

Depth/ Elevation (m)

61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90

85.00 Sandy CLAY
Brown/ browny orange, high plasticity, firm-soft, fine sand in clay matrix

90.00

NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

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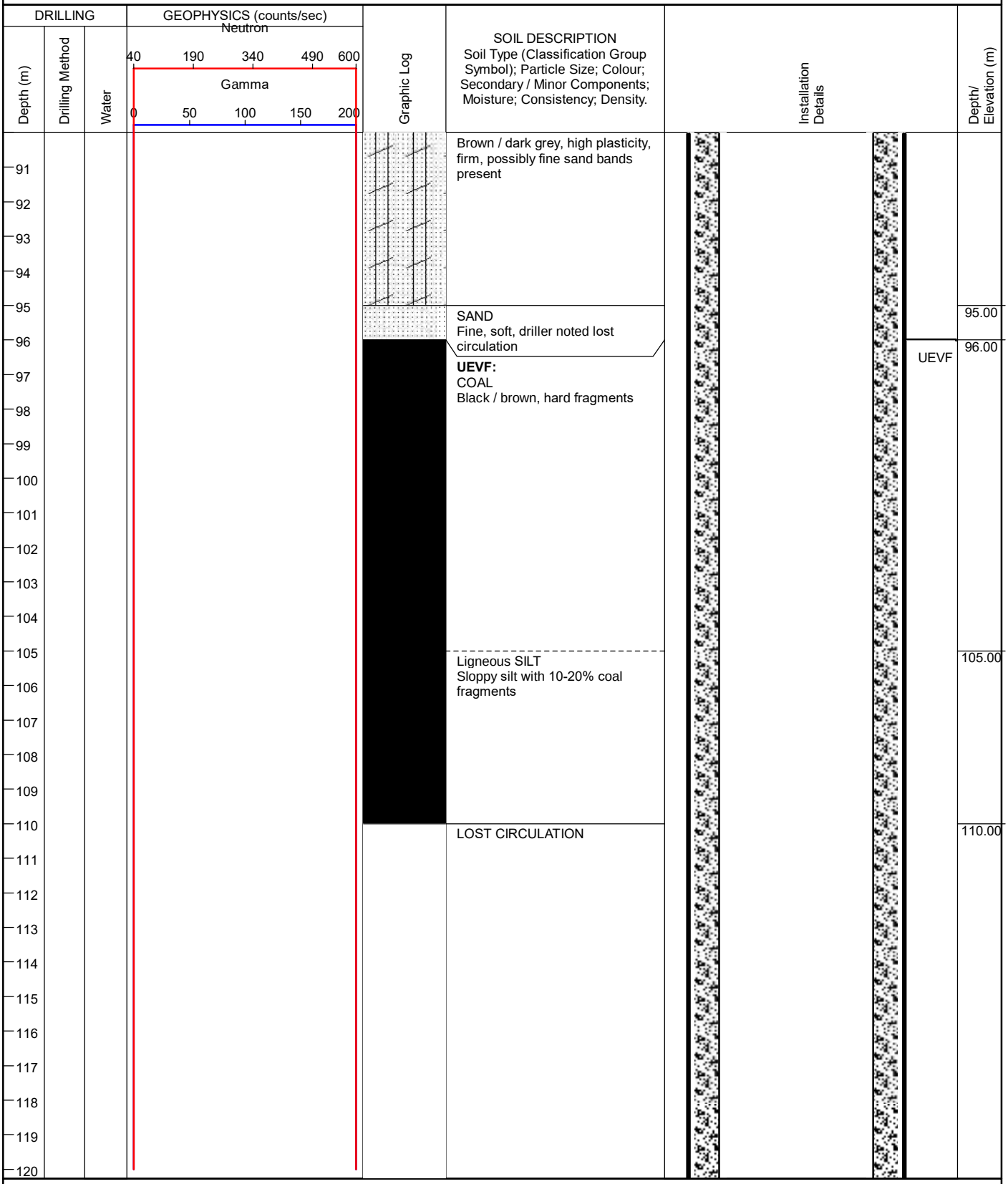

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BOREHOLE LOG

HYDROGEOLOGICAL

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Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 190 340 490 600 / Gamma 0 50 100 150 200	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth/ Elevation (m)
121							
122							
123							
124							
125							
126							
127							
128							
129							
130					Gravelly CLAY Grey, firm with orange / yellow siltstone chips in a clayey matrix, 5-10% coal, this may be the harder layer the casing hit, also grey cement chips (20%) from 1st cement job		130.00
131							
132							
133							
134							
135					Gravelly Ligneous CLAY As above, but 20-30% coal fragments, 20% orange / yellow siltstone fragments plus common cement chips, all in a clay matrix, high plasticity, soft		135.00
136							
137							
138							
139							
140					Sandy COAL Black coal with 20% fine-medium grained quartz sand present, there is probably a sand band present		140.00
141							
142							
143							
144							
145					COAL Black, firm - hard		145.00
146							
147							
148							
149							
150							150.00

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BOREHOLE LOG
HYDROGEOLOGICAL

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Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 190 340 490 600 / Gamma 0 50 100 150 200	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth/ Elevation (m)
151					COAL and SAND Black coal, firm - hard, grey / brown fine-medium grained quartz sand, predominately fine, fine sand layer, 30% sand and 70% coal		
152							
153							
154							
155					50% sand and 50% coal, fine - medium grained sand, poorly sorted, predominately medium, grey / brown, some mica, definite sand zone in this 5m		155.00
156							
157							
158							
159							
160					SAND Grey, quartz and feldspar fine - coarse grained sand, poorly sorted predominately medium,10% silt		160.00
161							
162							
163							
164							
165					Grey, fine - coarse grained sand, predominately quartz coarse - medium grained, 5% silt, minor coal fragments		165.00
166							
167							
168							
169							
170					COAL/Ligneous CLAY and Gravelly SAND 60% coal and ligneous clay, 40% fine - coarse grained sand, 10% gravel, poorly sorted quartz, gravel zone		170.00
171							
172							
173							
174							
175					COAL and Sandy GRAVEL Perhaps heavier material is representative, 40% black coal, 60% sandy gravel, fine gravel, quartz and feldspar		175.00
176							
177							
178							
179							
180		3/4/12 with other 4 bores pumping					180.00

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: GW2
Page: 7 of 24

Client: Barwon Water
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DRILLING			GEOPHYSICS (counts/sec)			SOIL DESCRIPTION		
Depth (m)	Drilling Method	Water	Neutron 40 190 340 490 600 / Gamma 0 50 100 150 200	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth/ Elevation (m)
181					COAL Geophysical log indicates Coal 173-196m		
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196					LOST CIRCULATION		196.00
197							
198							
199							
200							
201							
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205							
206							
207							
208							
209							
210							

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BOREHOLE LOG
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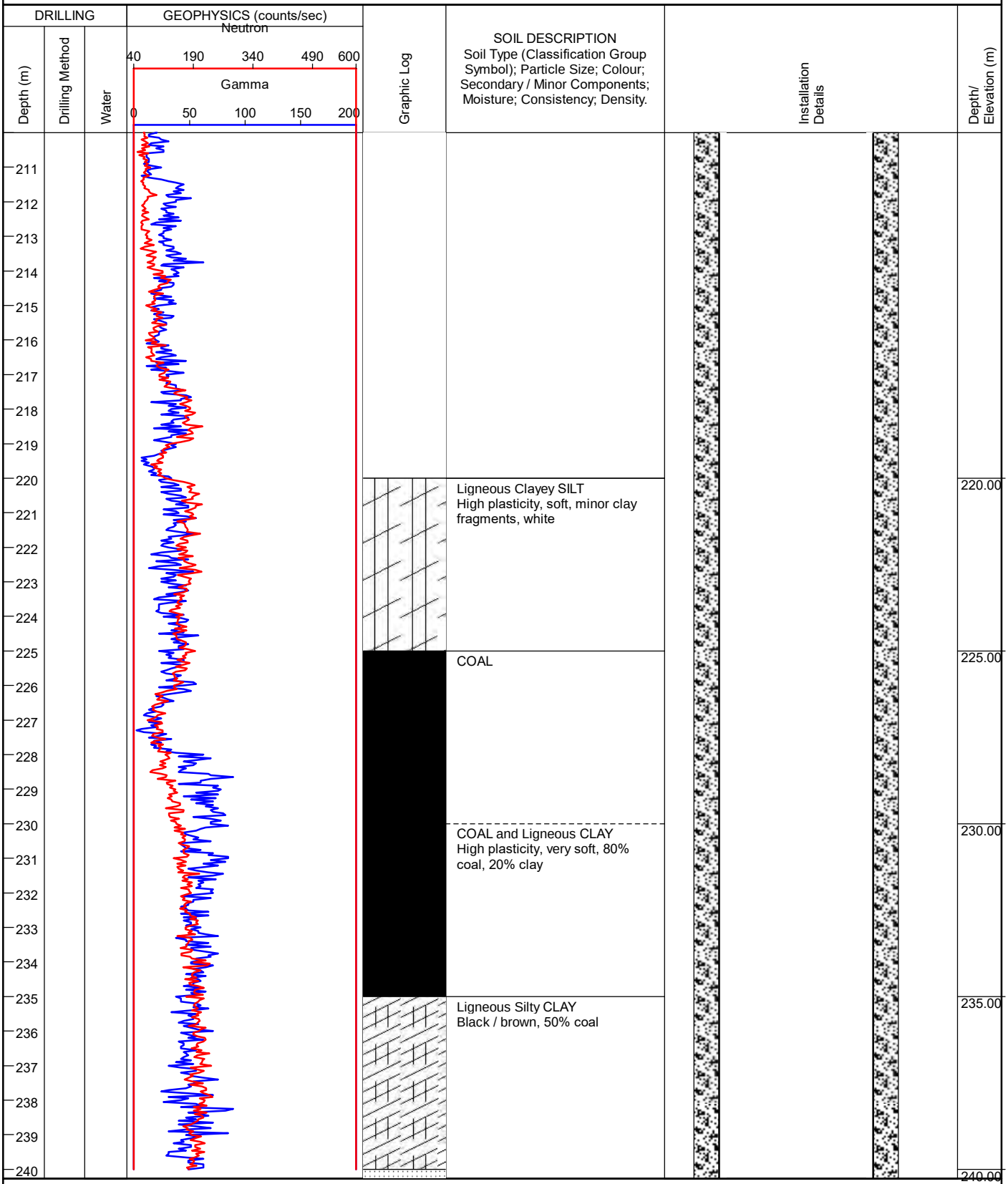

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BOREHOLE LOG

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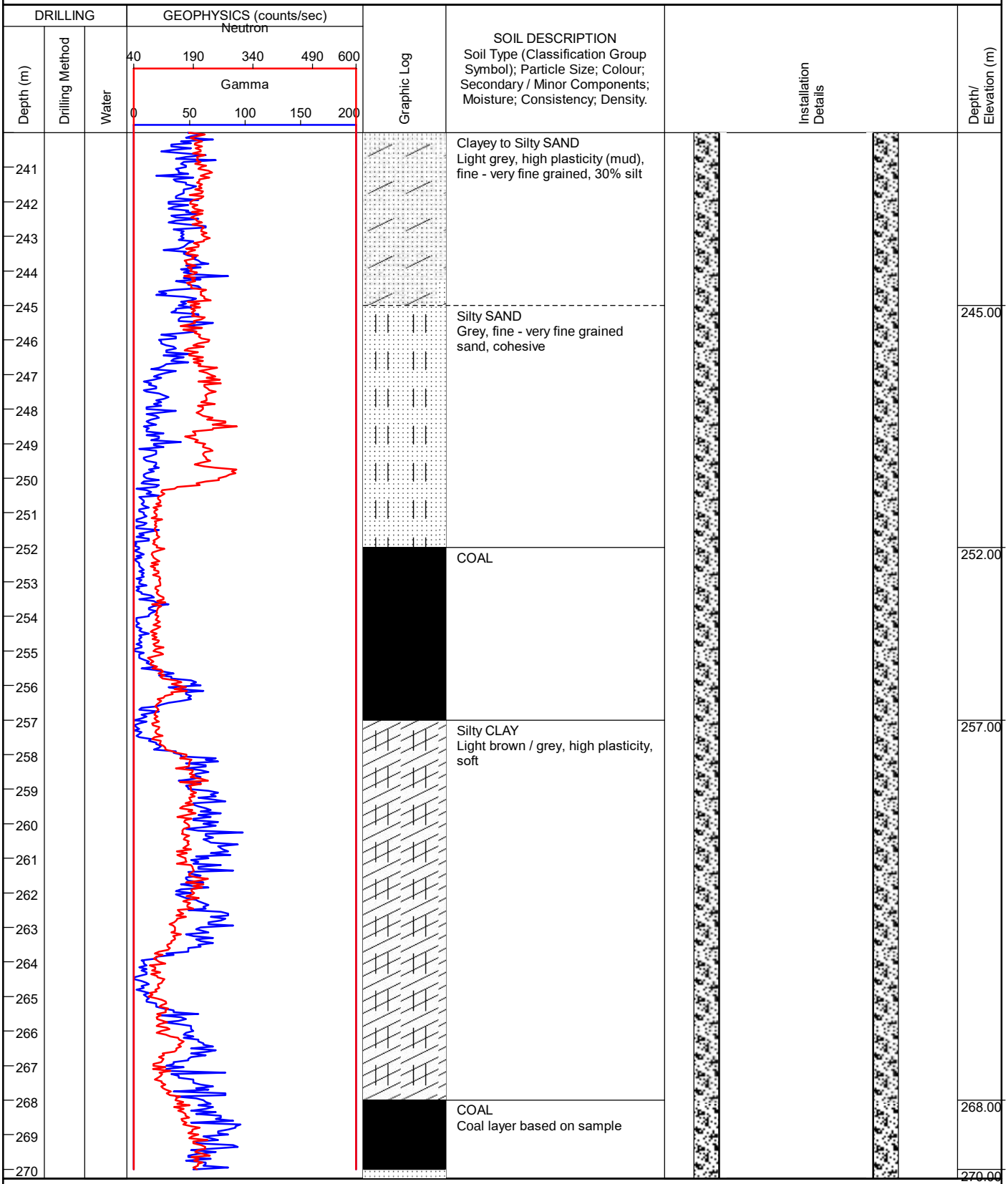

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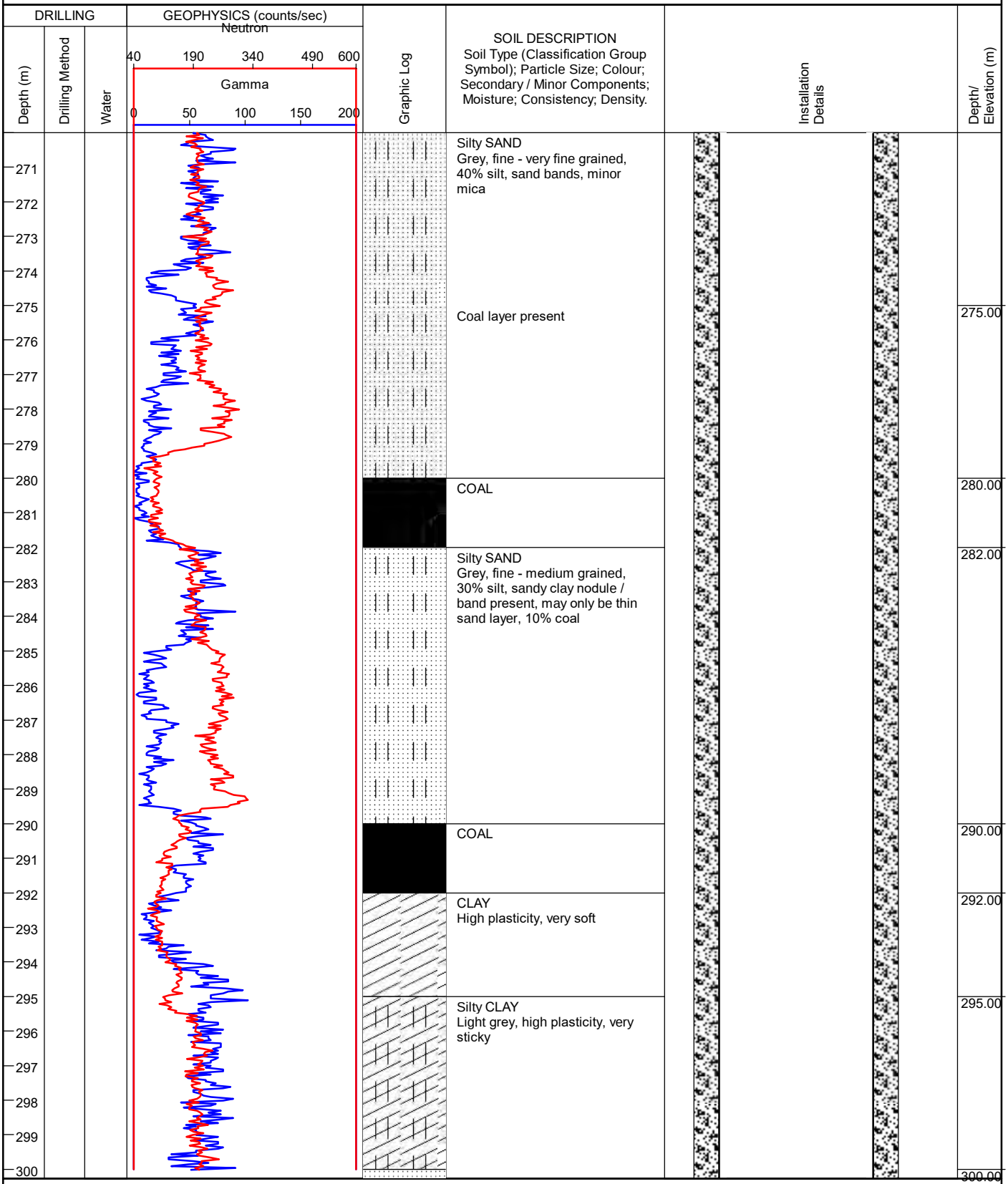

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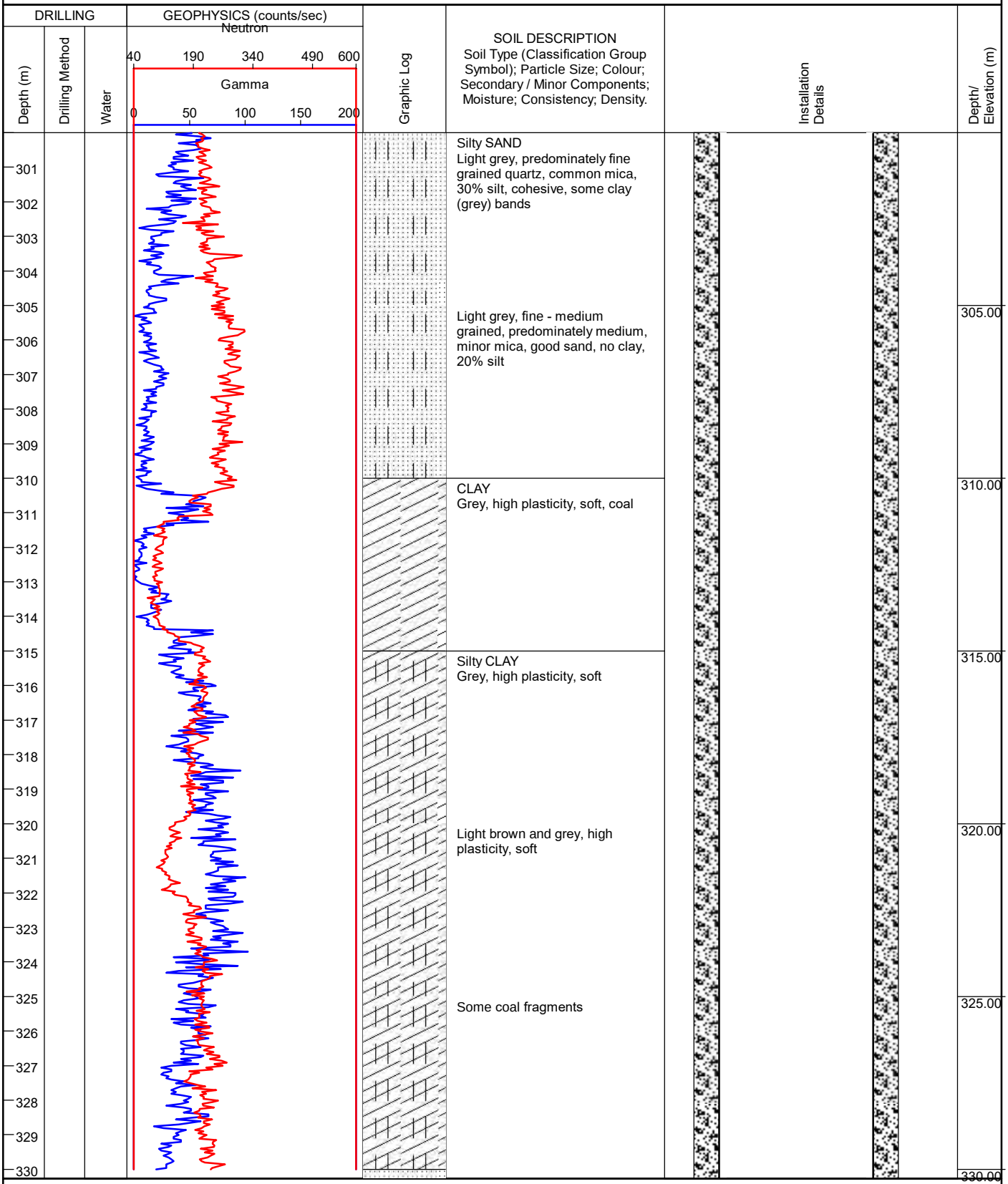

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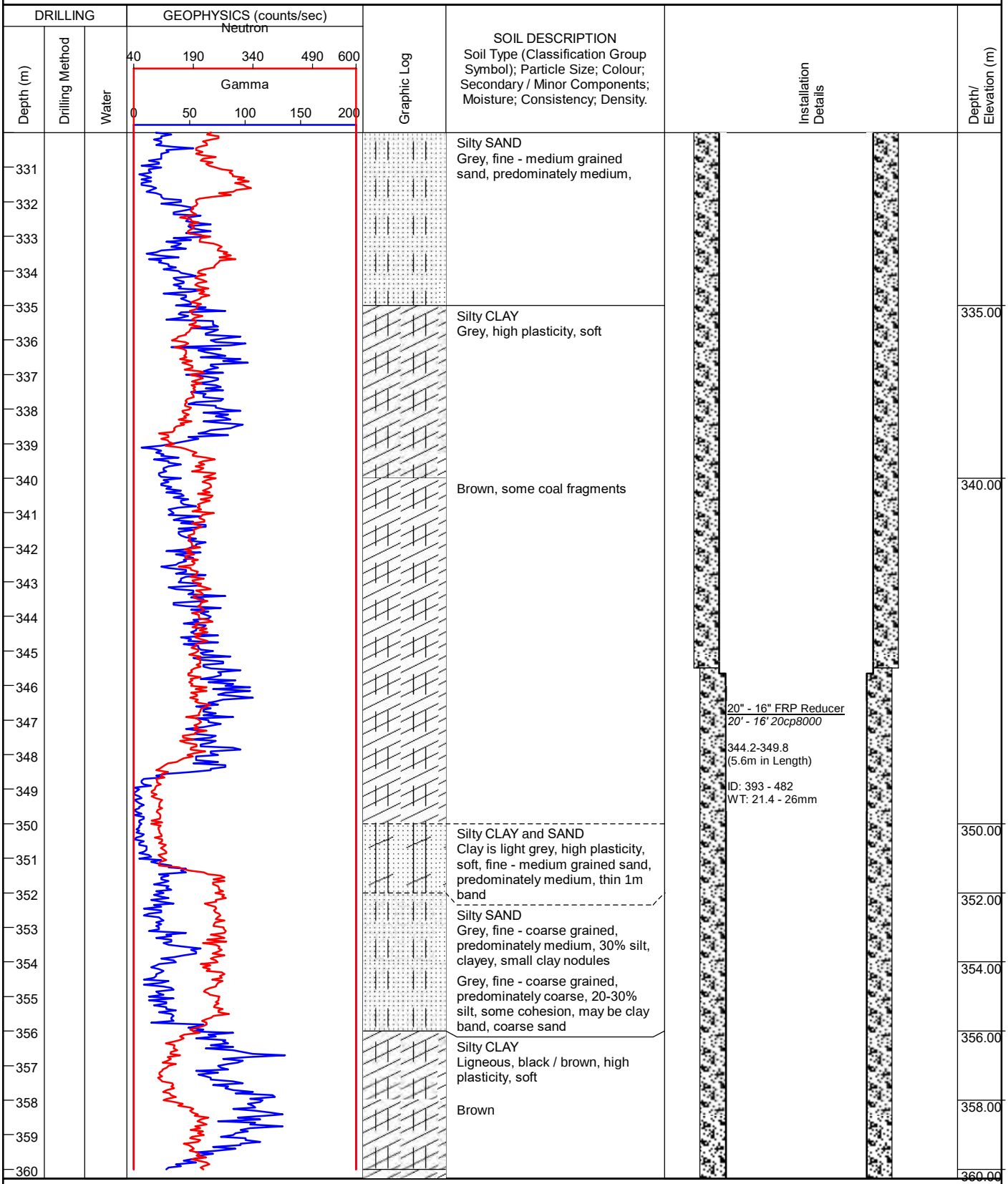

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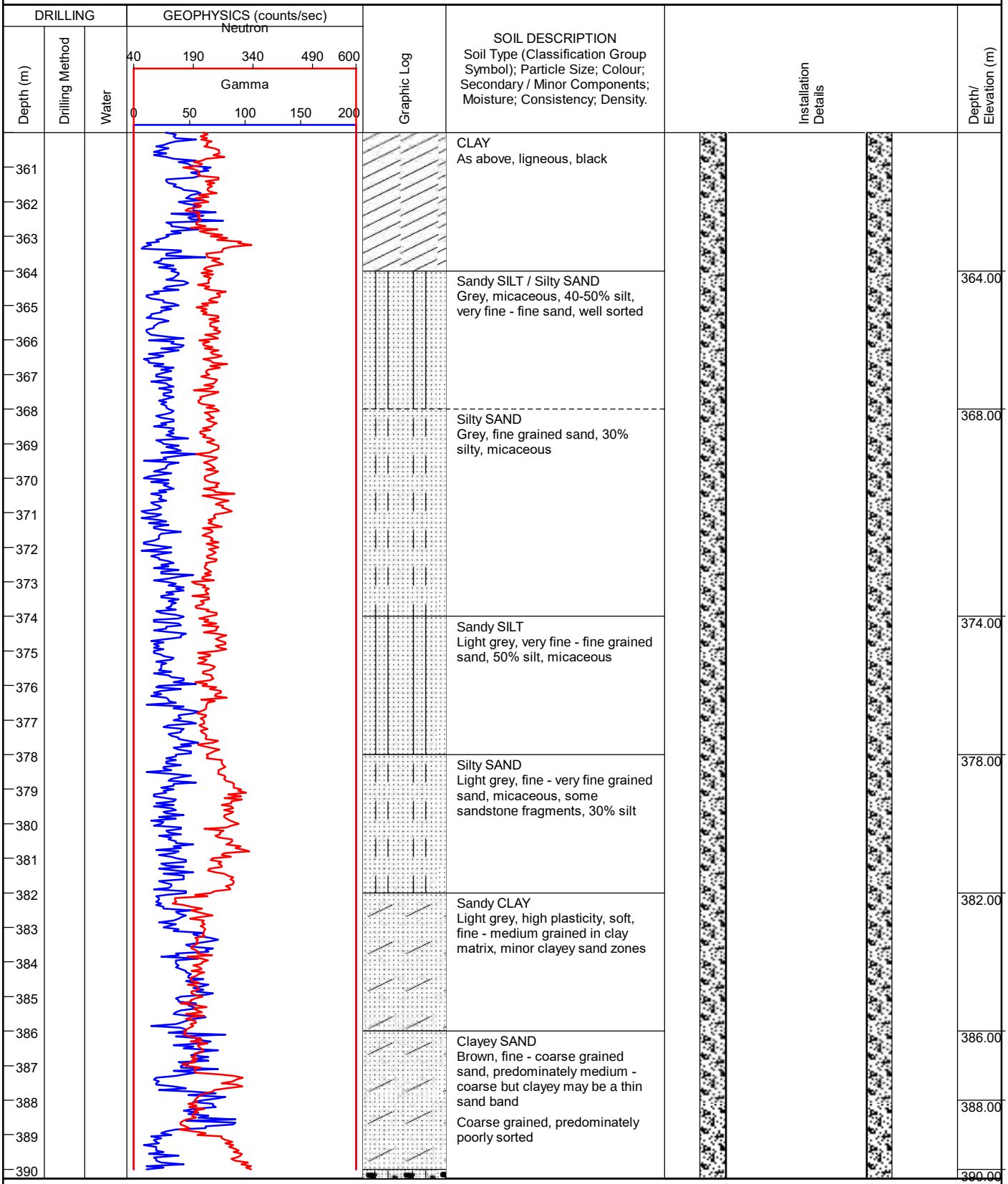

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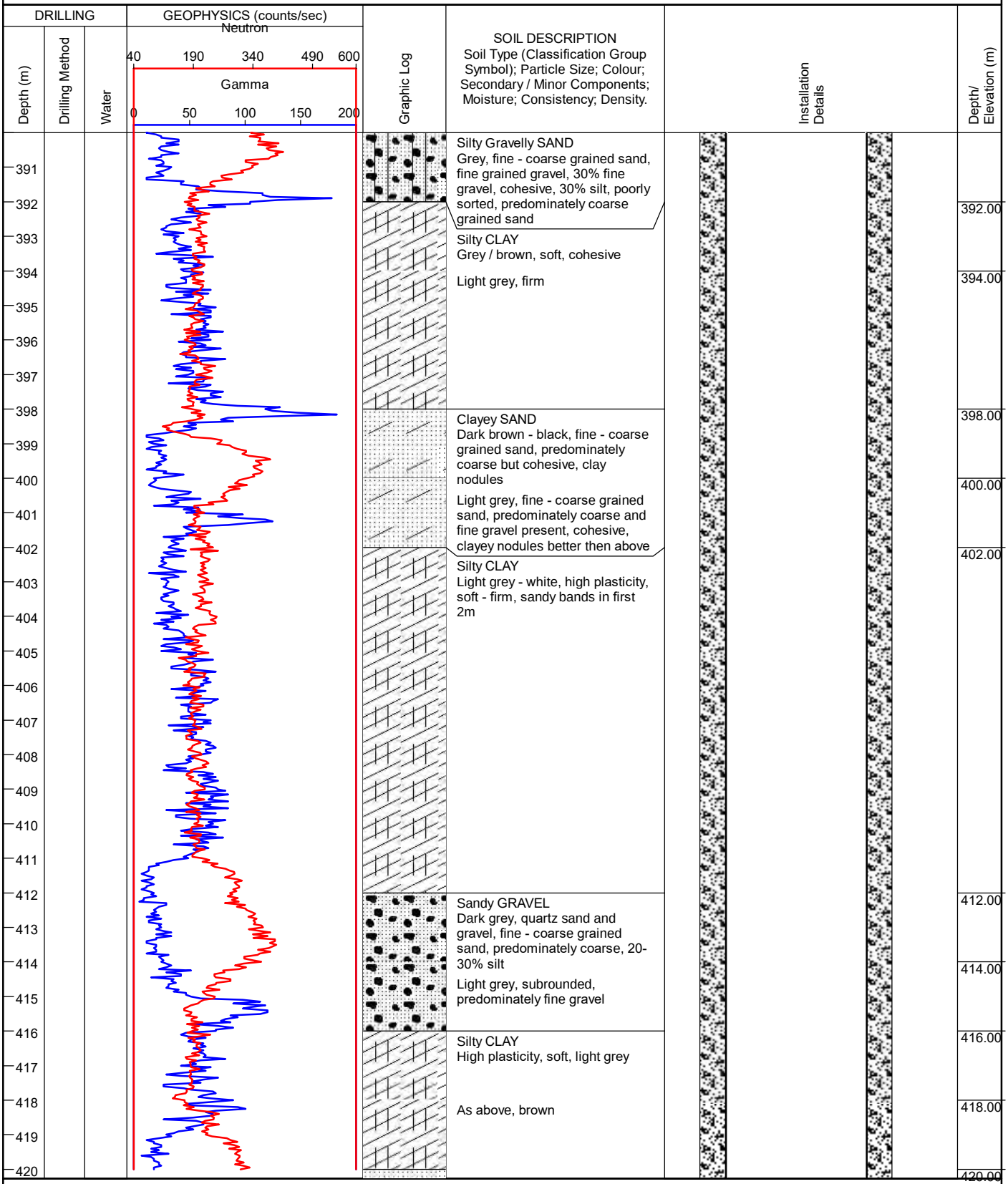

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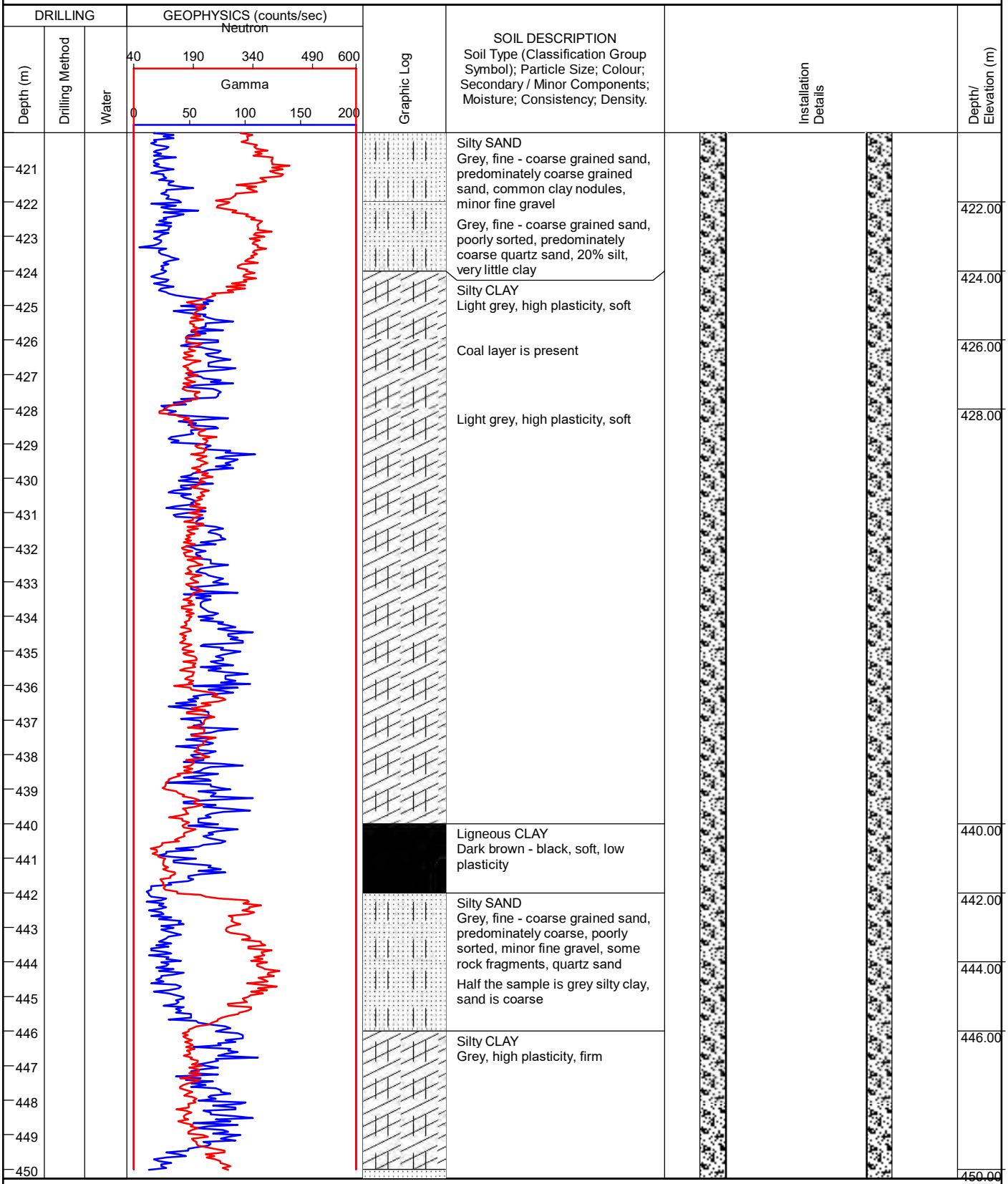


NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

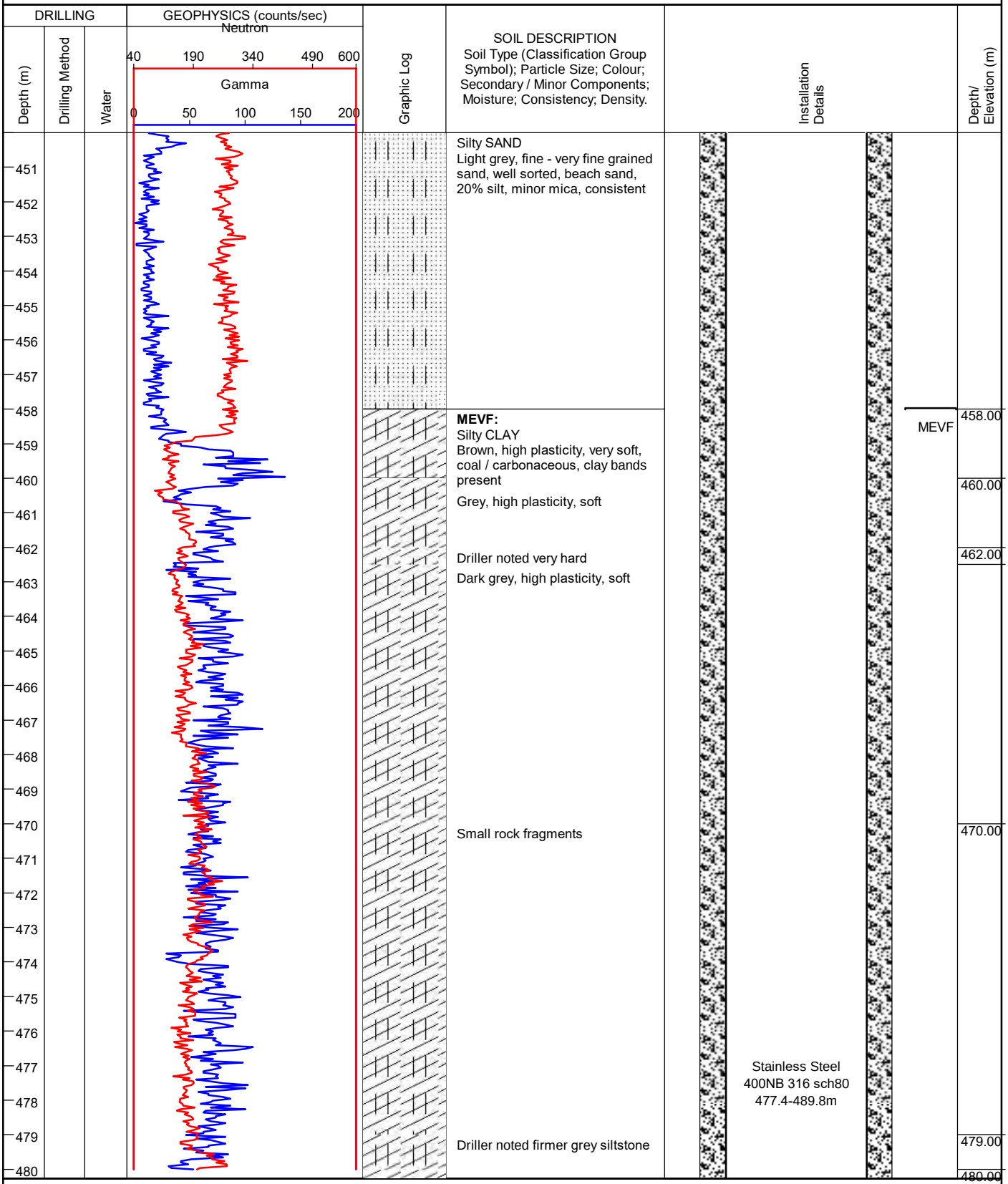
Bore No.: GW2

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312349207
Location: Messmate track
Date Drilled: 15/11/2010 **to:** 24/02/2012

Drilling Co.: Drilltec
Driller: Craig Gordon
Rig Type: Bourne2000
Total Depth (m): 707.3
Diameter (mm): 500 - 200 (casing)

Easting: 55251850
Northing: 5744700
Grid Ref:
Collar RL: 120m (approximate)
Logged by: JSM **Checked by:** JM

B.C.L. No.: WLE046288 **Casing Material:** FRP and S/Steel **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.4 - 0.6



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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW2

Client: Barwon Water
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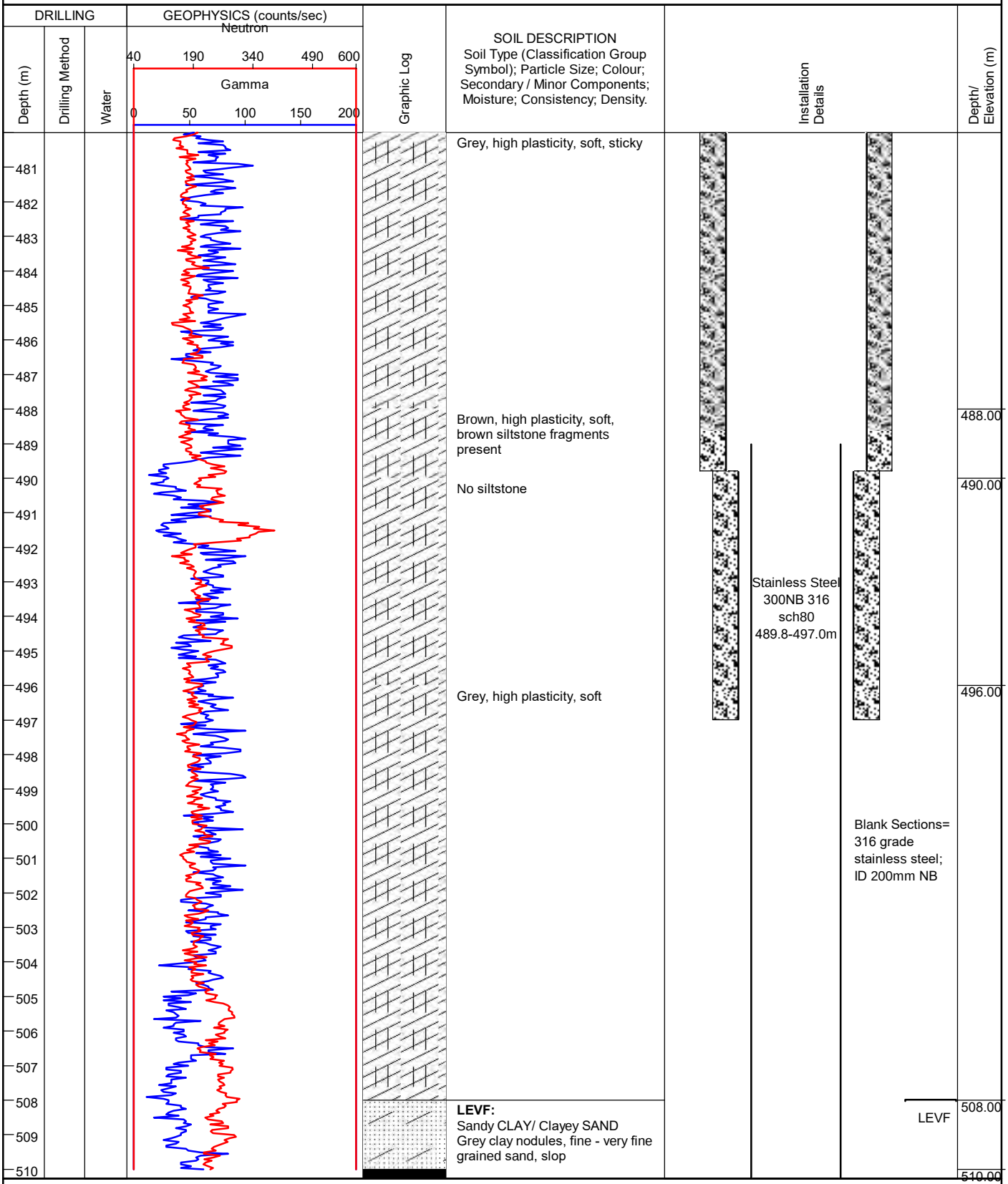

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW2

Client: Barwon Water
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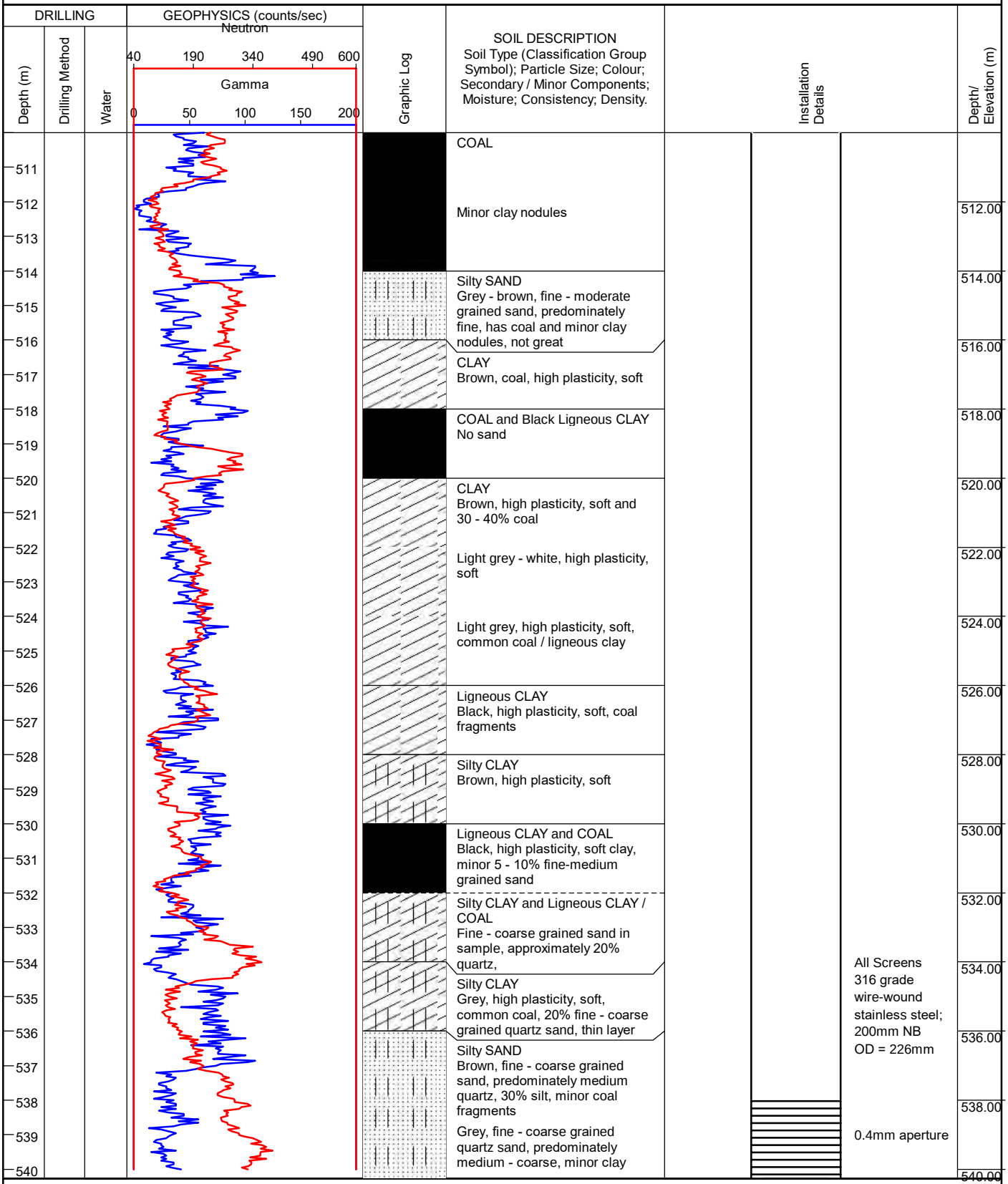

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW2

Page: 19 of 24

Client: Barwon Water
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Job No.: 312349207
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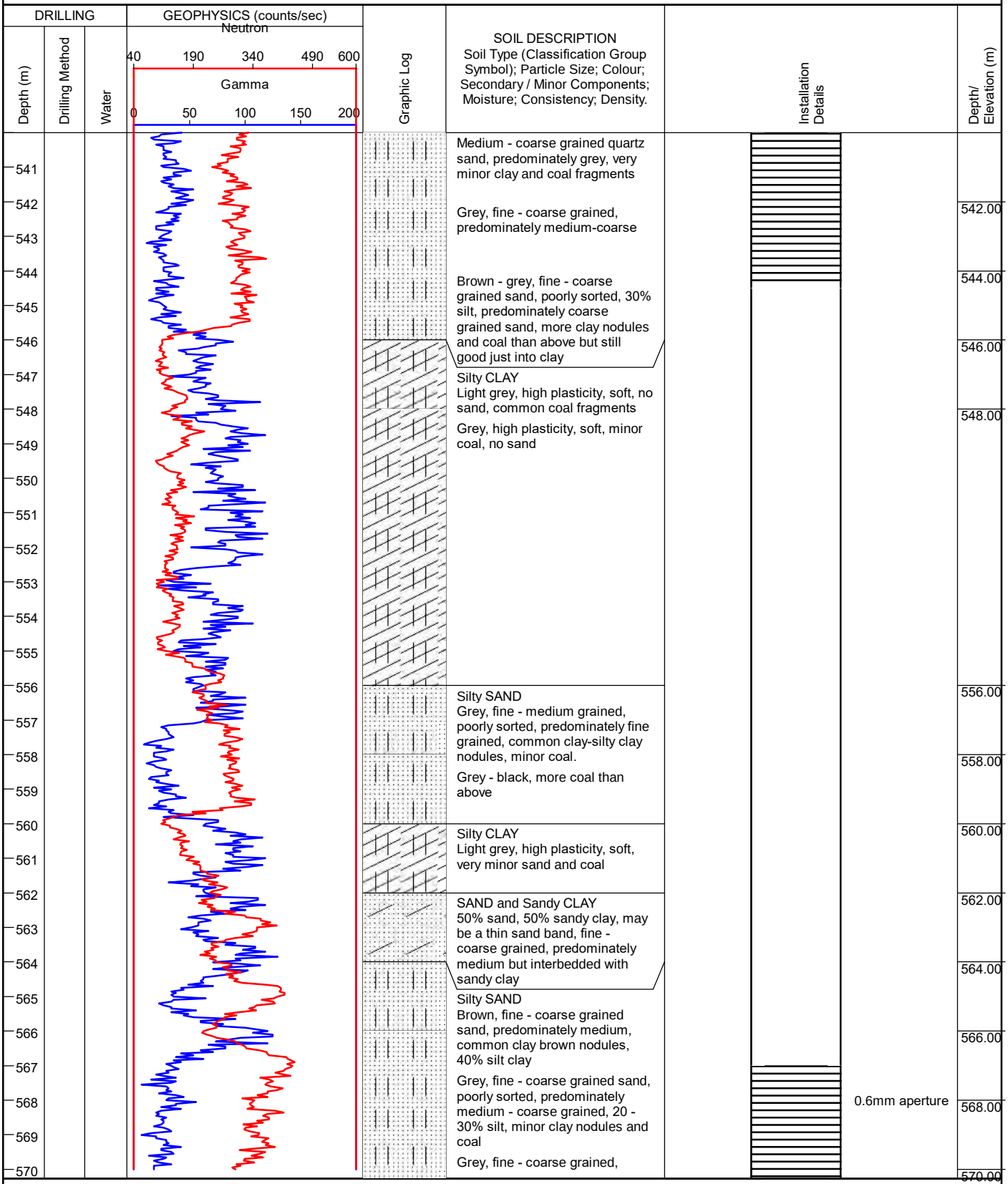

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: GW2

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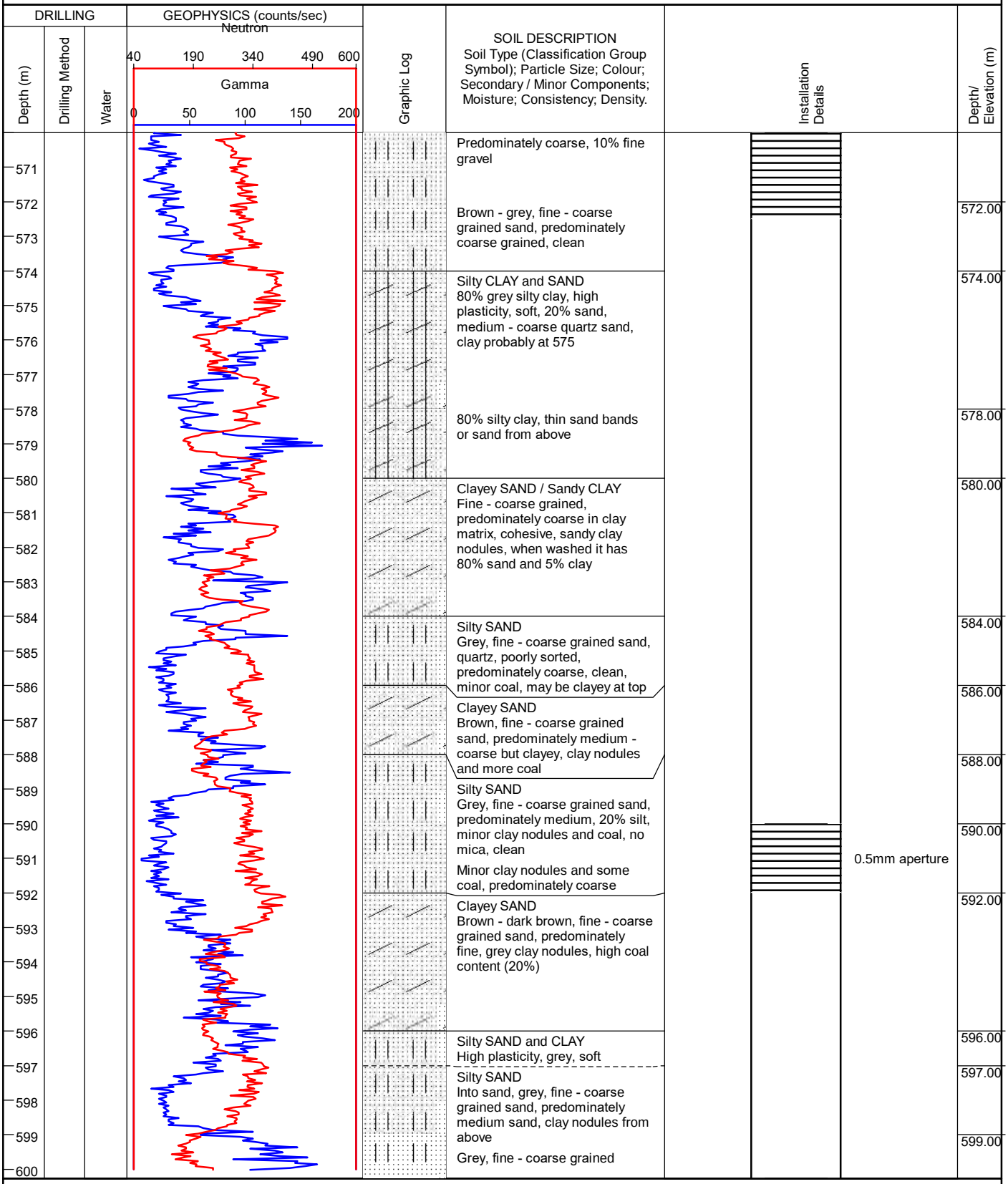

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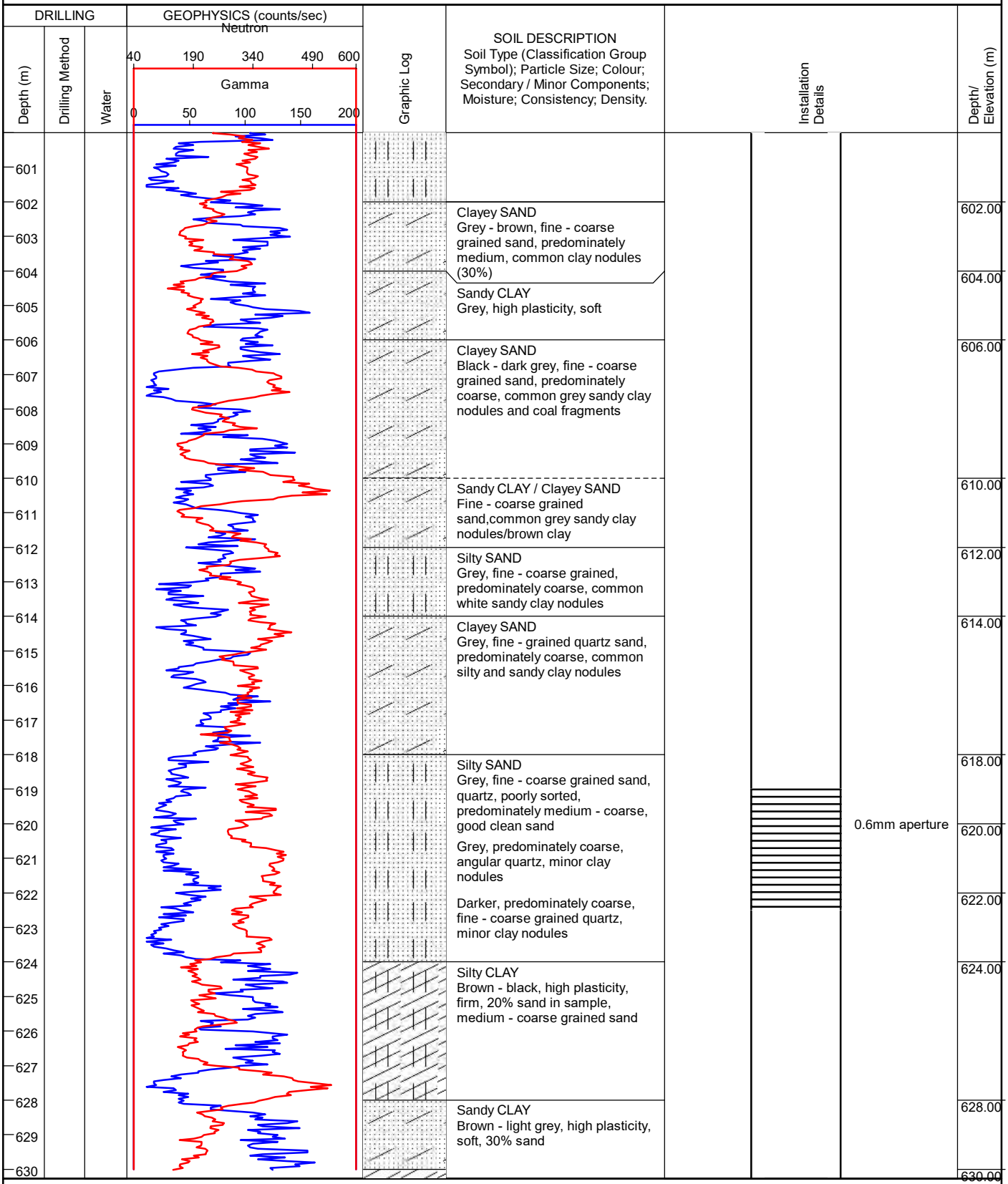

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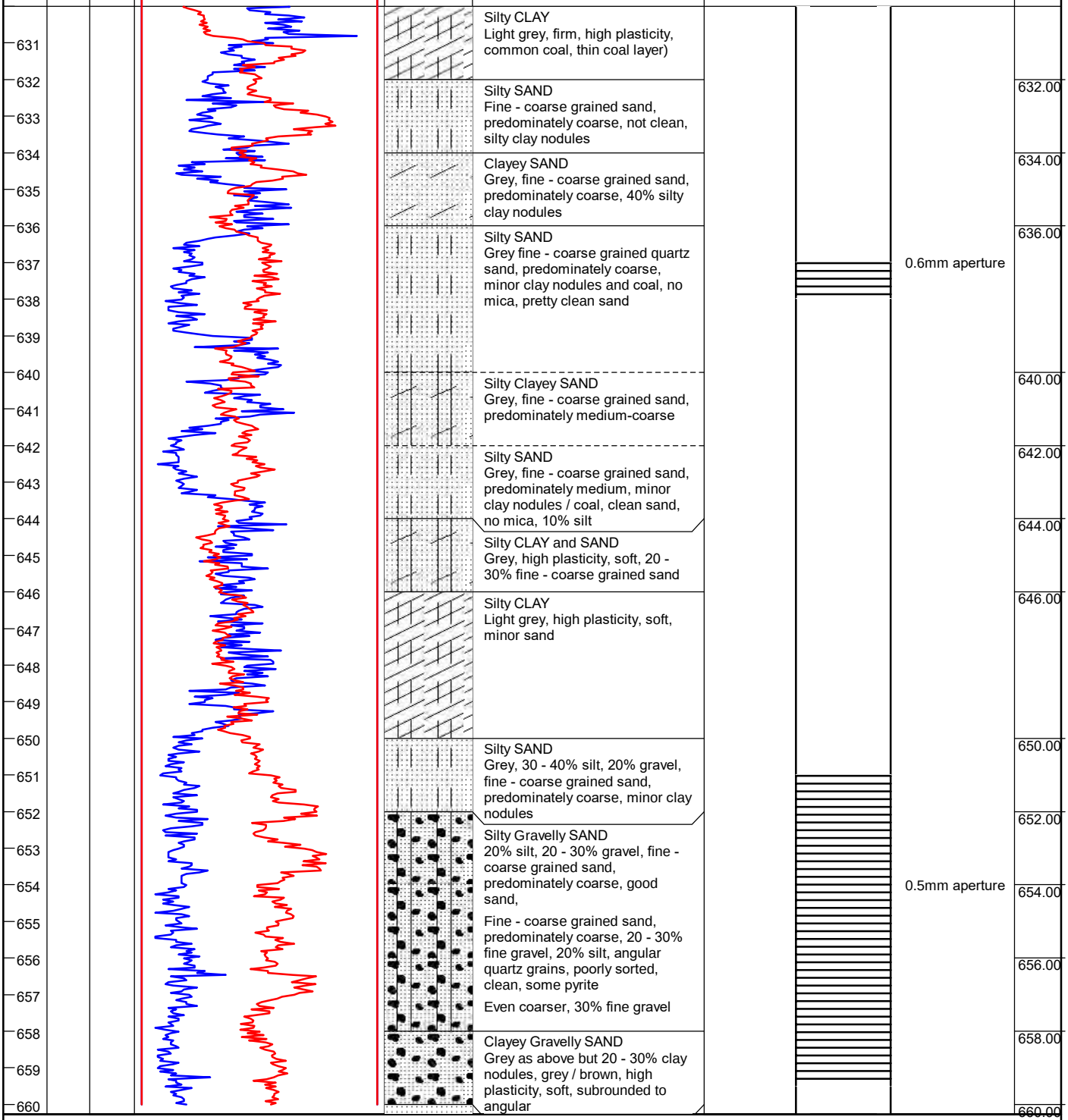

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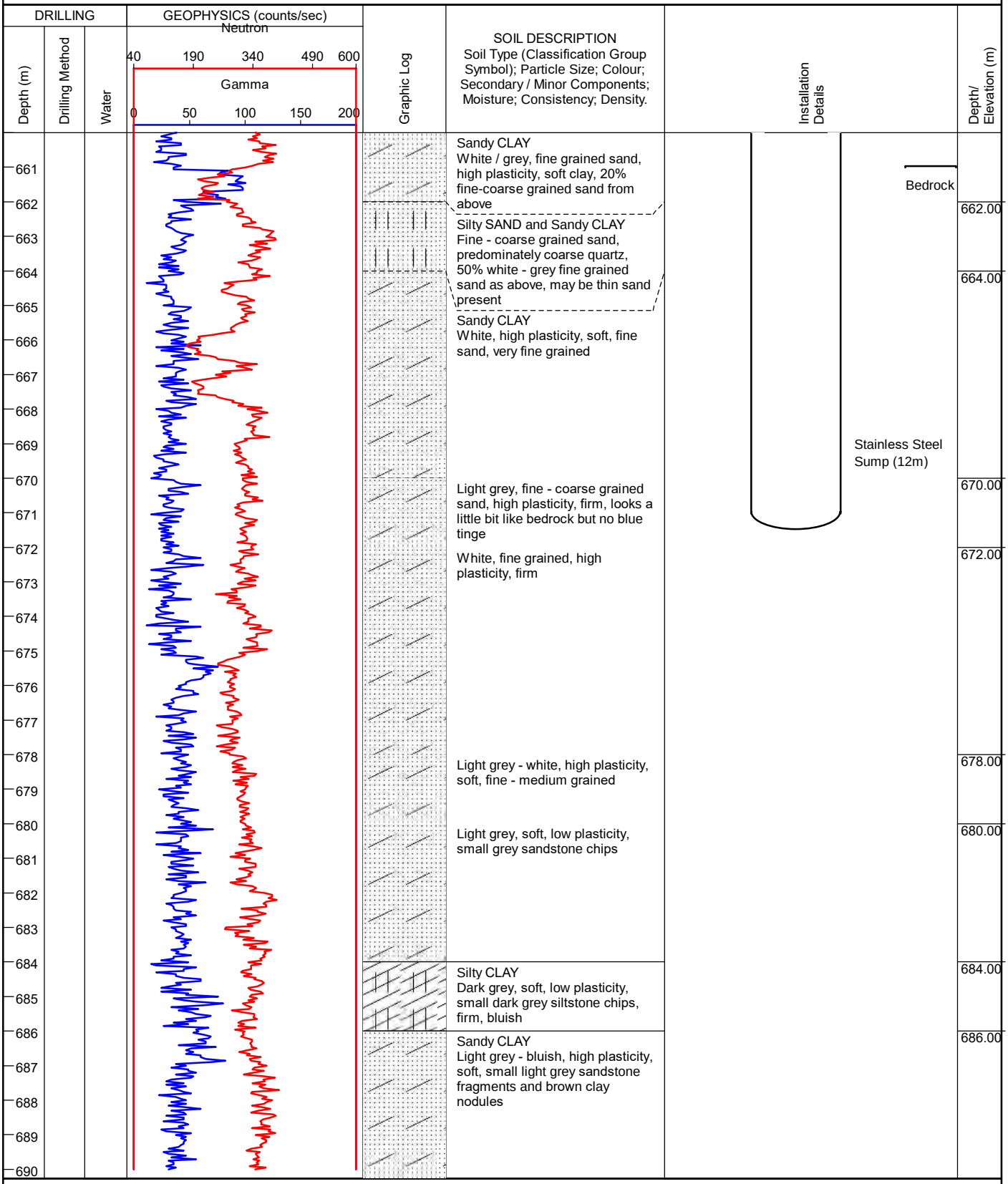

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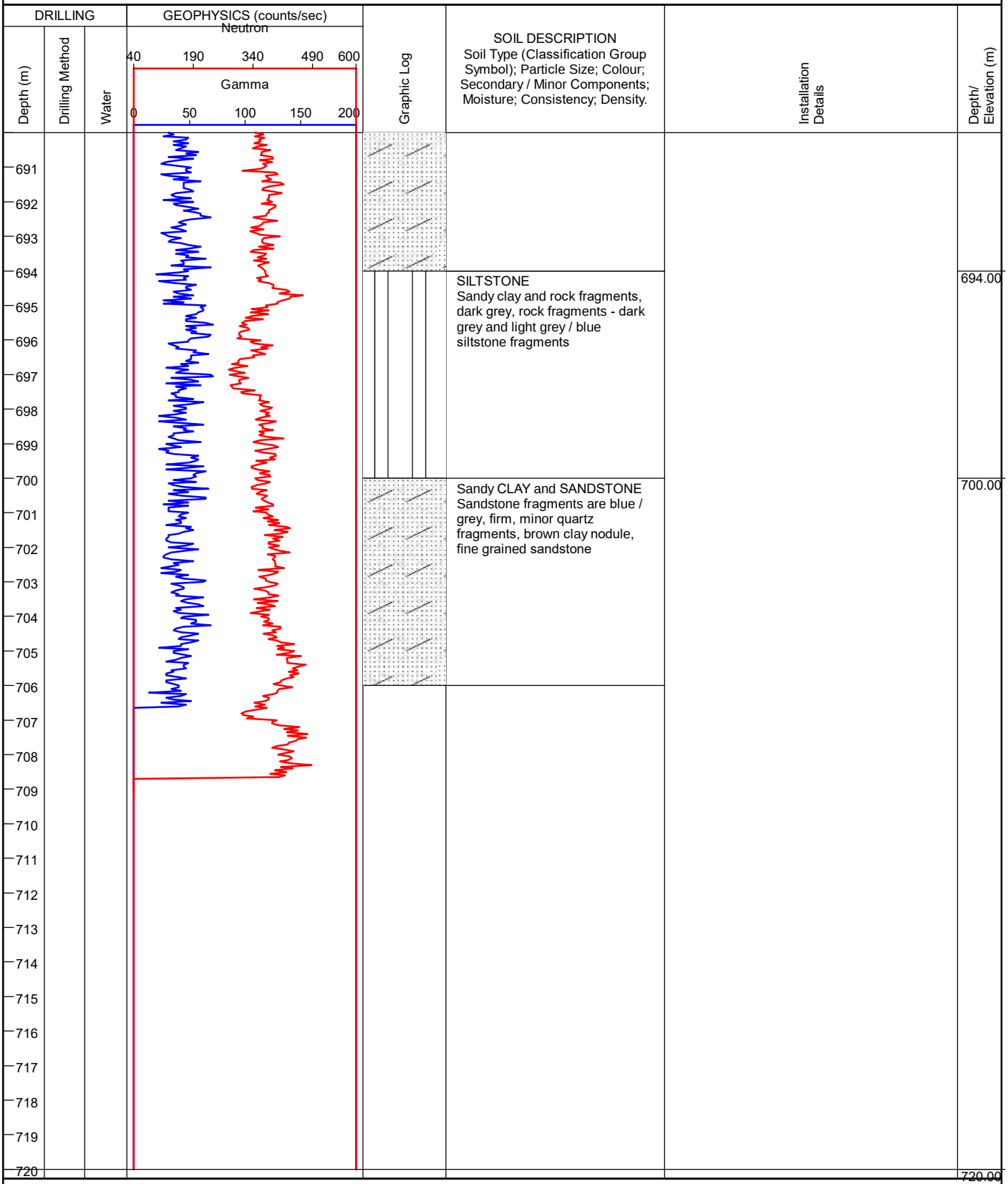

NOTES:

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW3

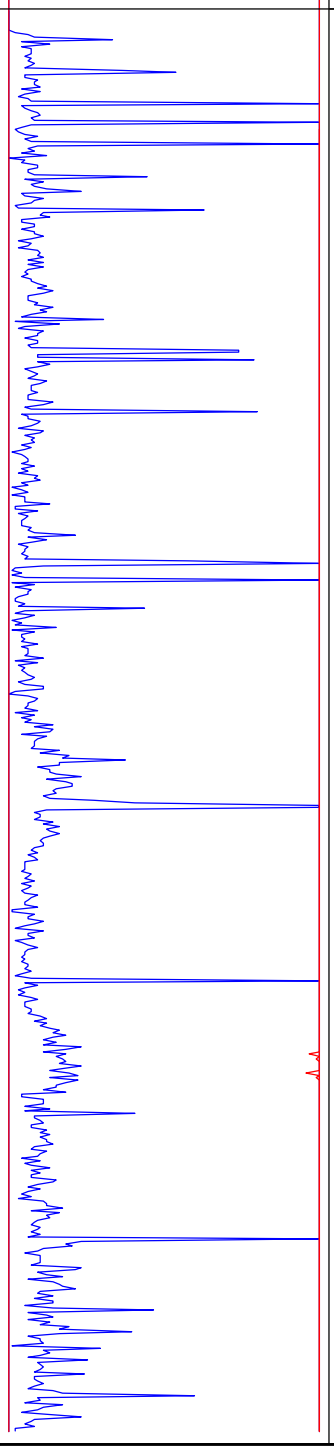
Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Site 3
Date Drilled: 1/05/2010 **to:** 22/10/2010

Drilling Co.: Drilltec
Driller: Aaron Frood
Rig Type: Bourne2000
Total Depth (m): 613
Diameter (mm): 880 - 445

Easting: 253462
Northing: 5745995
Grid Ref:
Collar RL: 40.7 (GL)
Logged by: DK / JSM **Checked by:** JSM

B.C.L. No.: 9037906 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.8

DRILLING			GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth / Elevation (m)
Depth (m)	Drilling Method	Water					
					Ground Surface		
0					Pilot Rig. No samples taken		0.00
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							



Surface Casing:
Mild steel
750mm NB to 118m

Transmission Casing
Stainless steel
-2.4 - 0.23m
ID = 488.9mm

500mm FRP casing
500mm nb OD

0-243.7mbgl
ID=482mm

Wall thicknesses
0 - 92.4m = 17.4mm
20cp2300

92.4 - 185.0m = 21.0mm
20cp4300

185.0 - 243.7m =25.0mm
20cp7000

NOTES: ap. = aperture; ID = Inside diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW3
Page: 2 of 21

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Site 3
Date Drilled: 1/05/2010 **to:** 22/10/2010

Drilling Co.: Drilltec
Driller: Aaron Frood
Rig Type: Bourne2000
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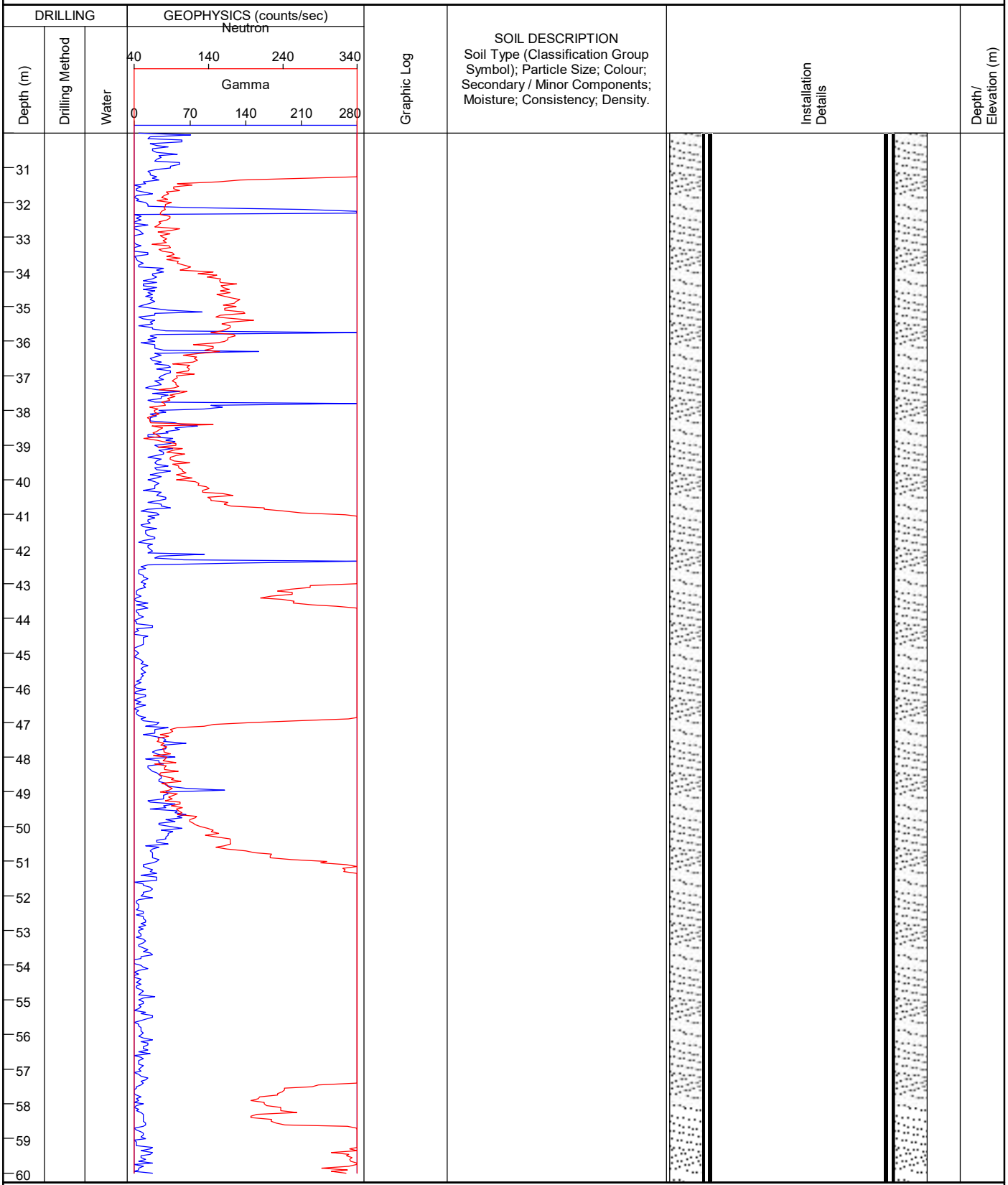

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BOREHOLE LOG

HYDROGEOLOGICAL

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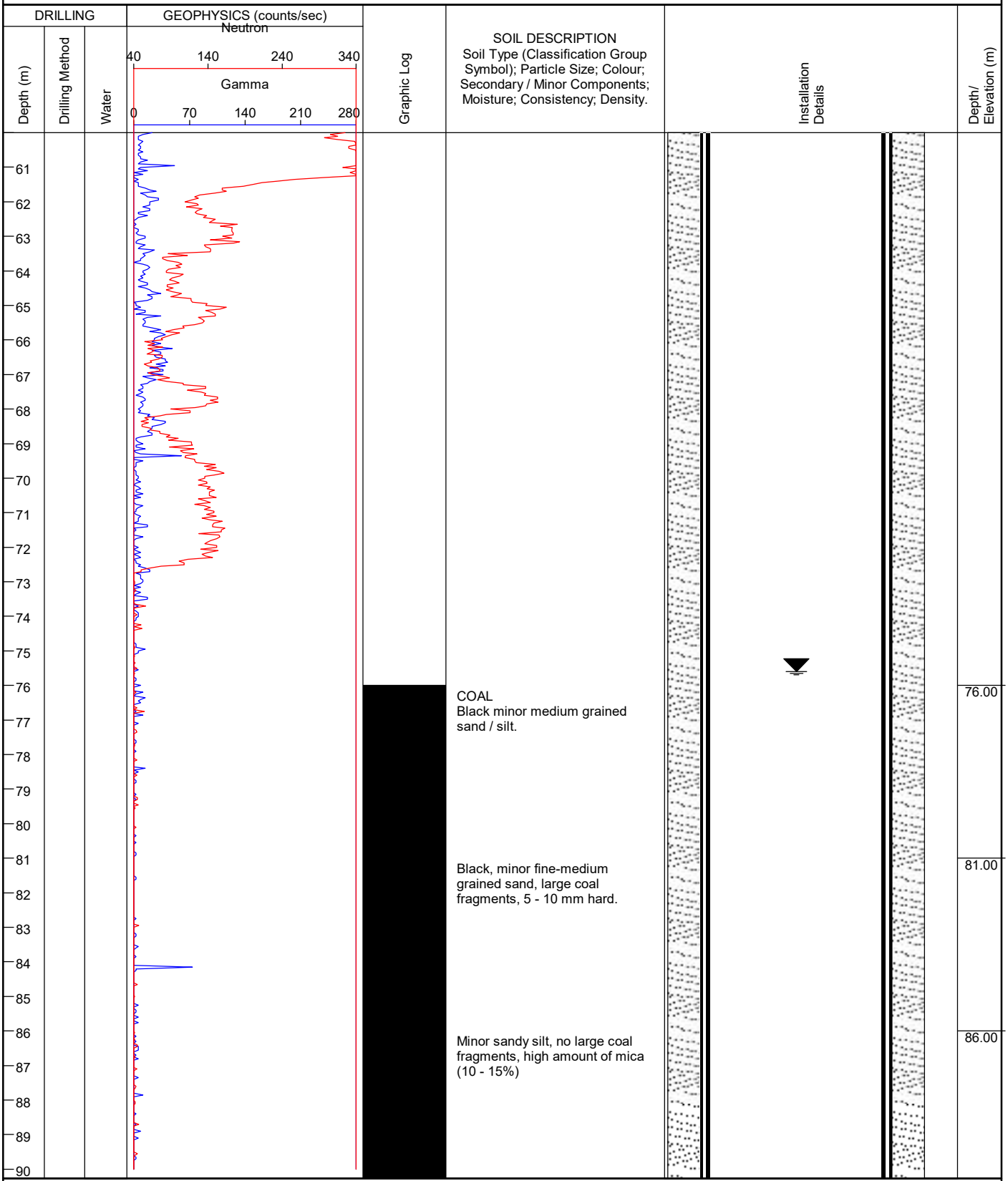

NOTES: ap. = aperture; ID = Inside diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW3
Page: 4 of 21

Client: Barwon Water
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B.C.L. No.: 9037906 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.8

Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth / Elevation (m)
91					Increase in friable coal fragments (3 - 6 mm)		91.00
92							
93							
94							
95							
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							

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HYDROGEOLOGICAL

Bore No.: GW3

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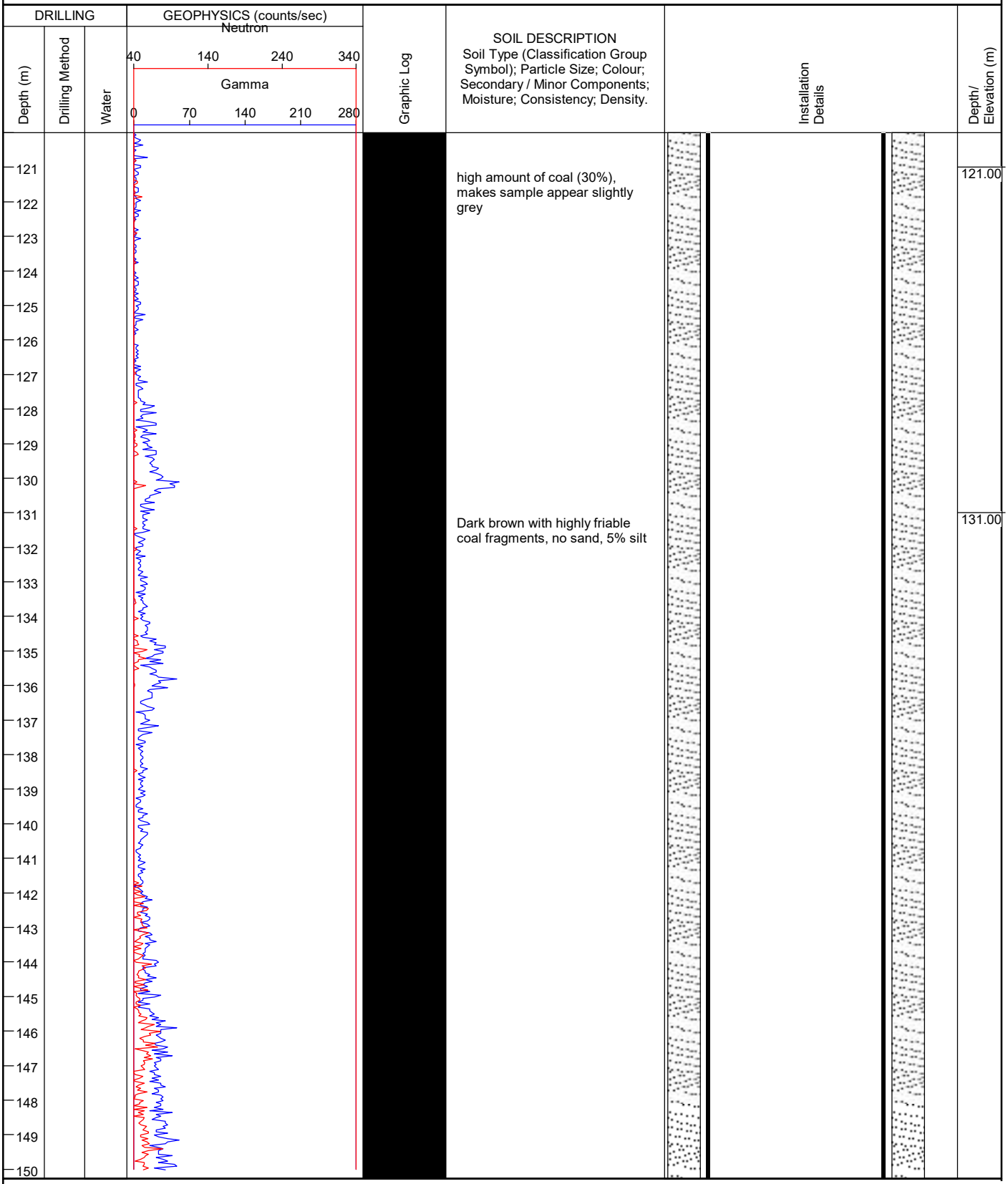

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HYDROGEOLOGICAL

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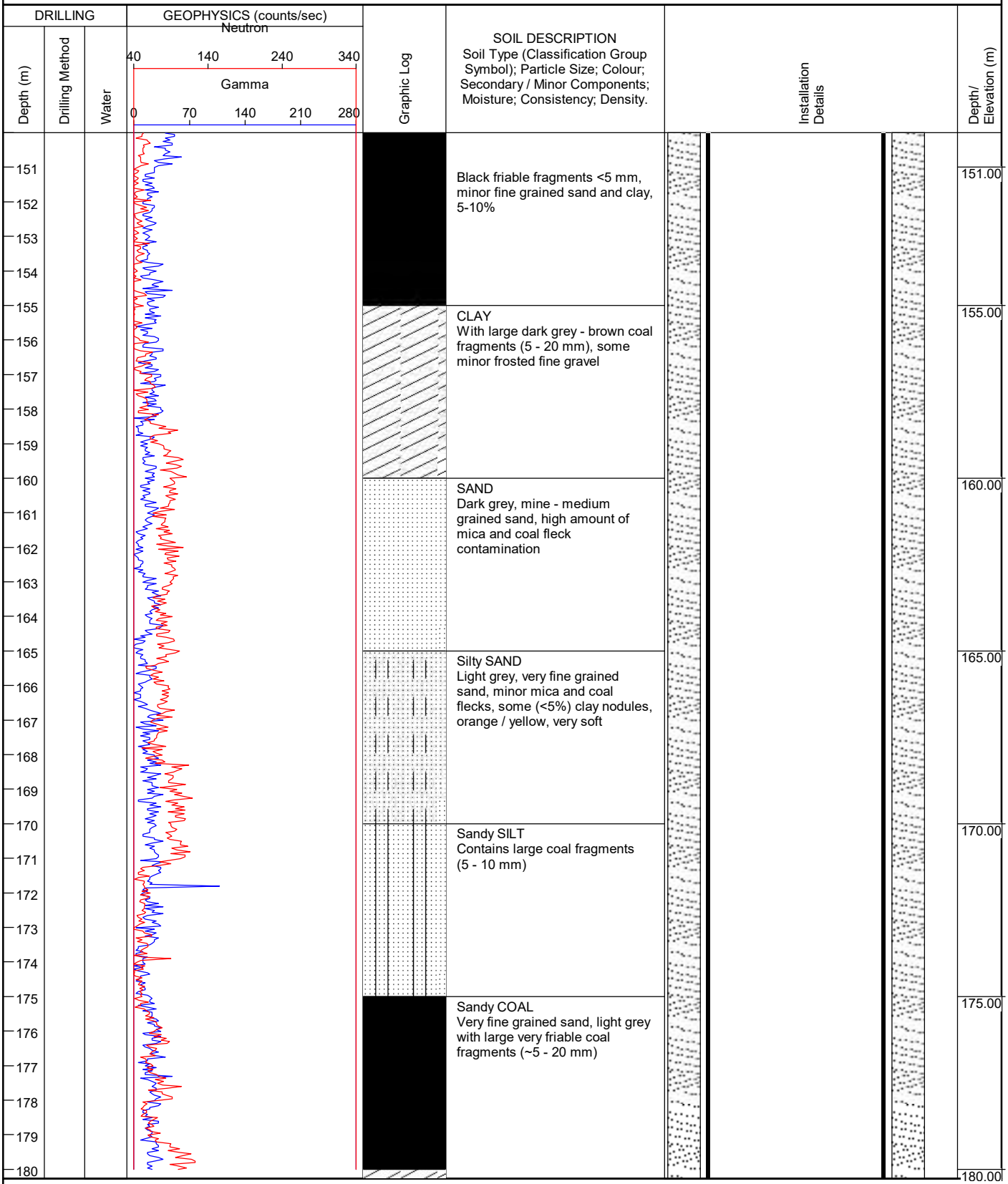

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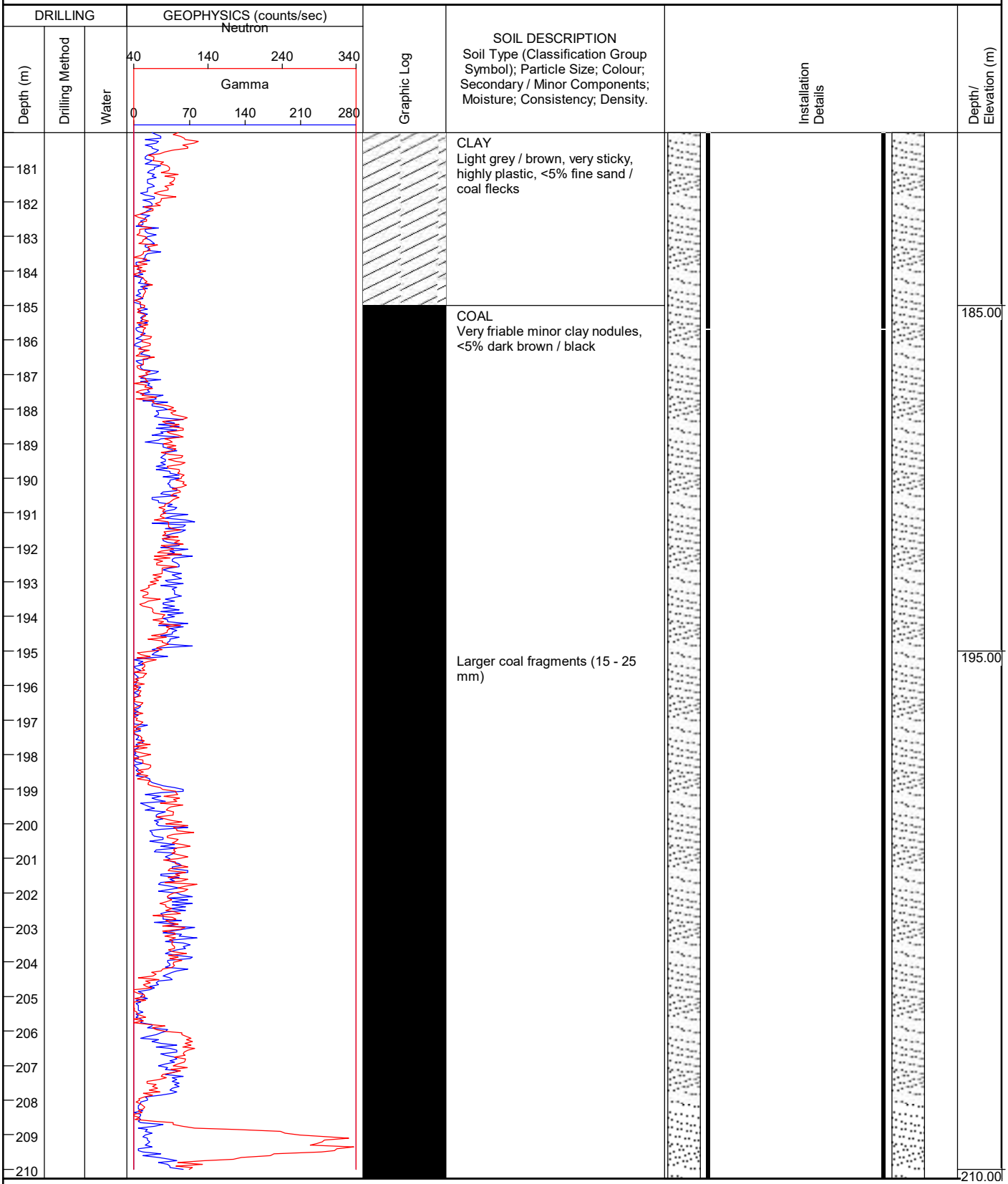

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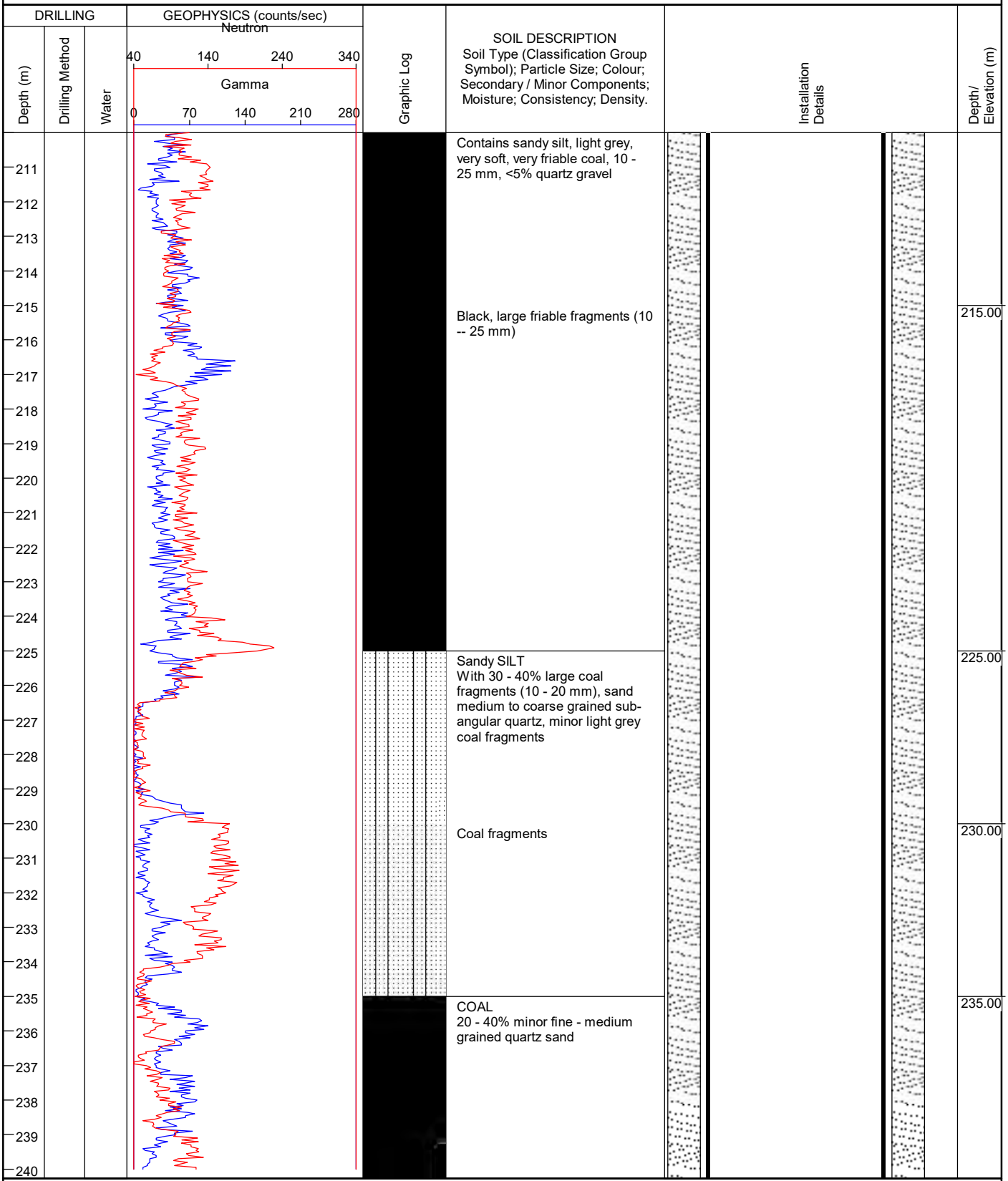

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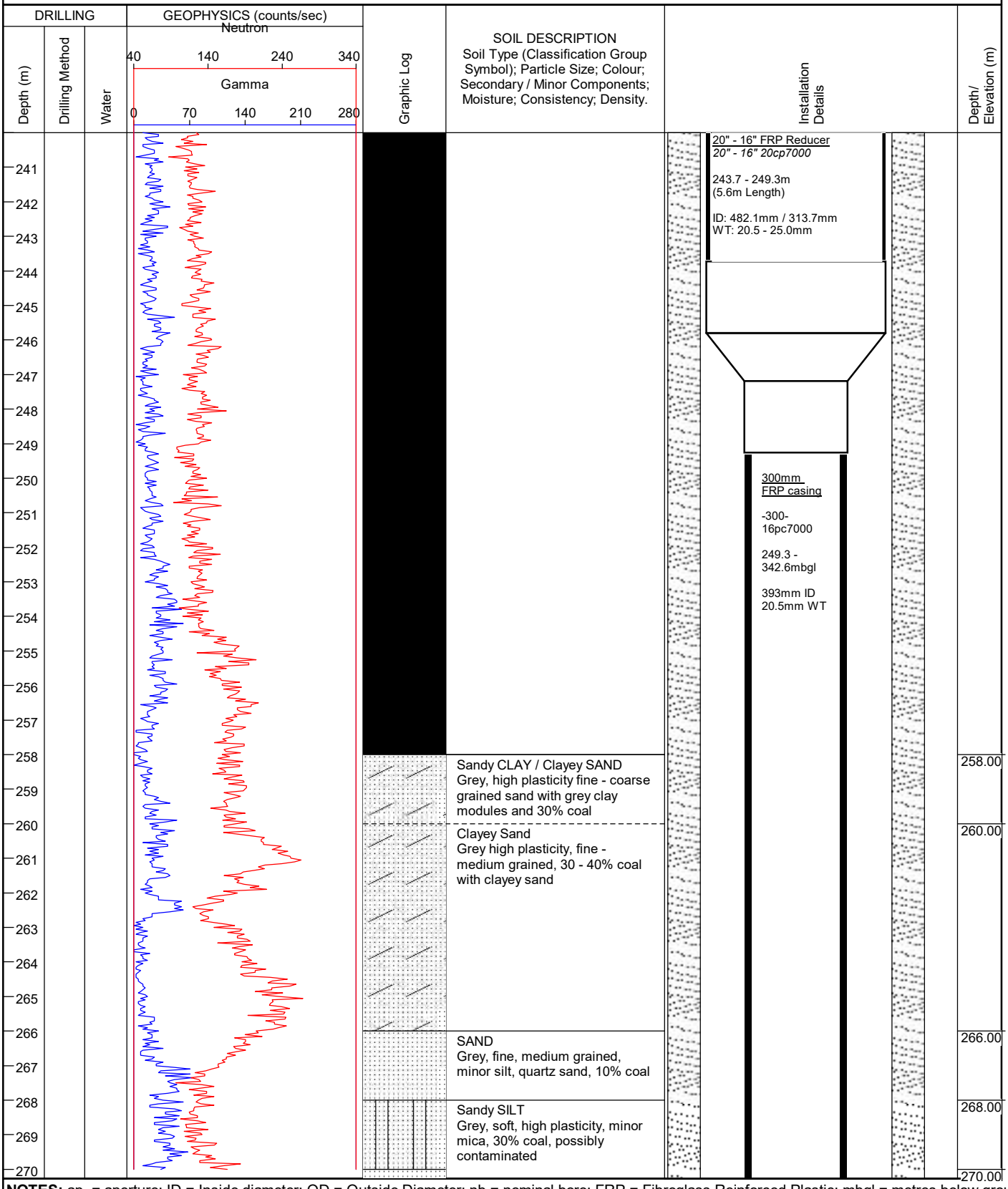

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BOREHOLE LOG

HYDROGEOLOGICAL

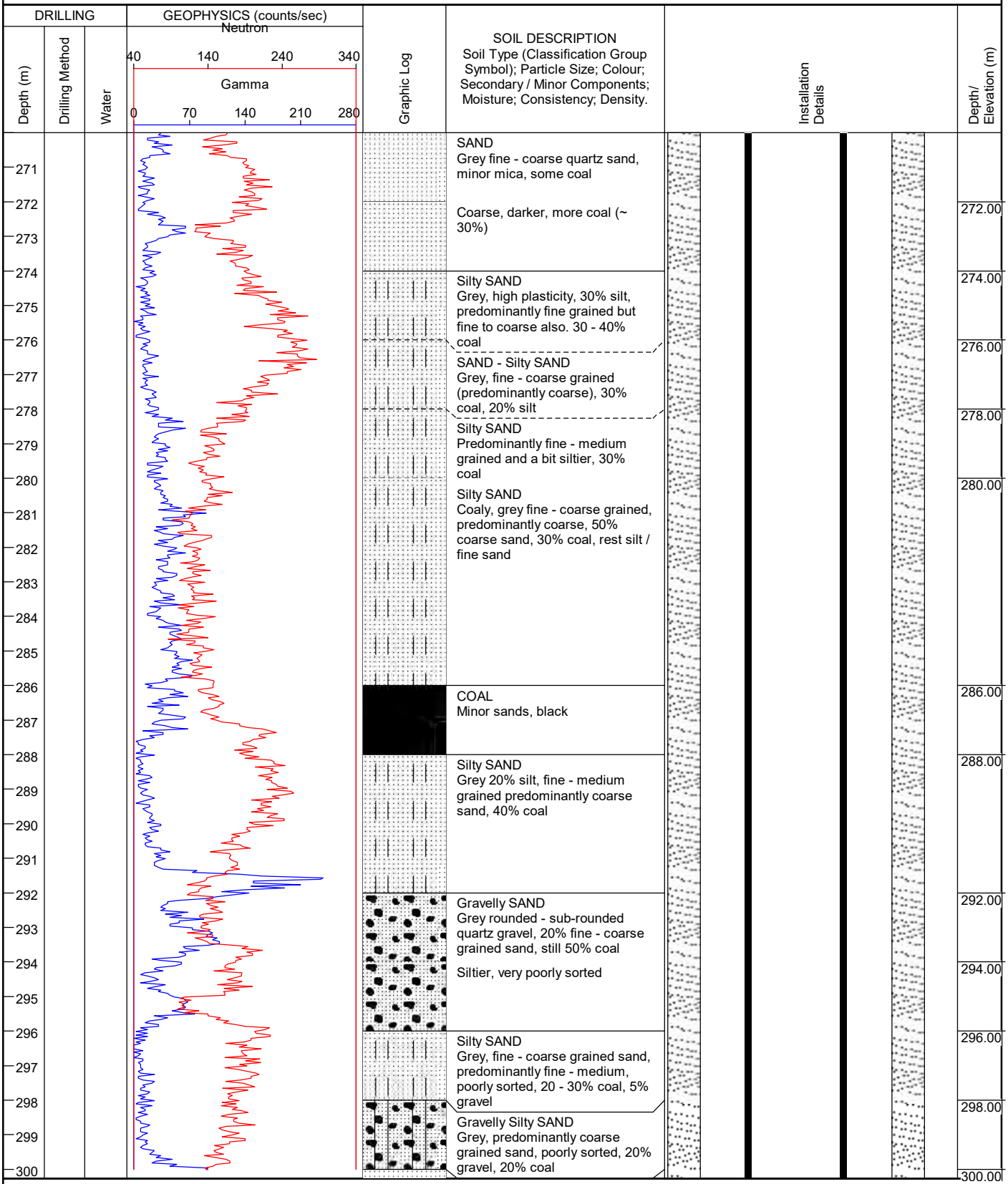
Bore No.: GW3
Page: 10 of 21

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Site 3
Date Drilled: 1/05/2010 **to:** 22/10/2010

Drilling Co.: Drilltec
Driller: Aaron Frood
Rig Type: Bourne2000
Total Depth (m): 613
Diameter (mm): 880 - 445

Easting: 253462
Northing: 5745995
Grid Ref:
Collar RL: 40.7 (GL)
Logged by: DK / JSM **Checked by:** JSM

B.C.L. No.: 9037906 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.8



NOTES: ap. = aperture; ID = Inside diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

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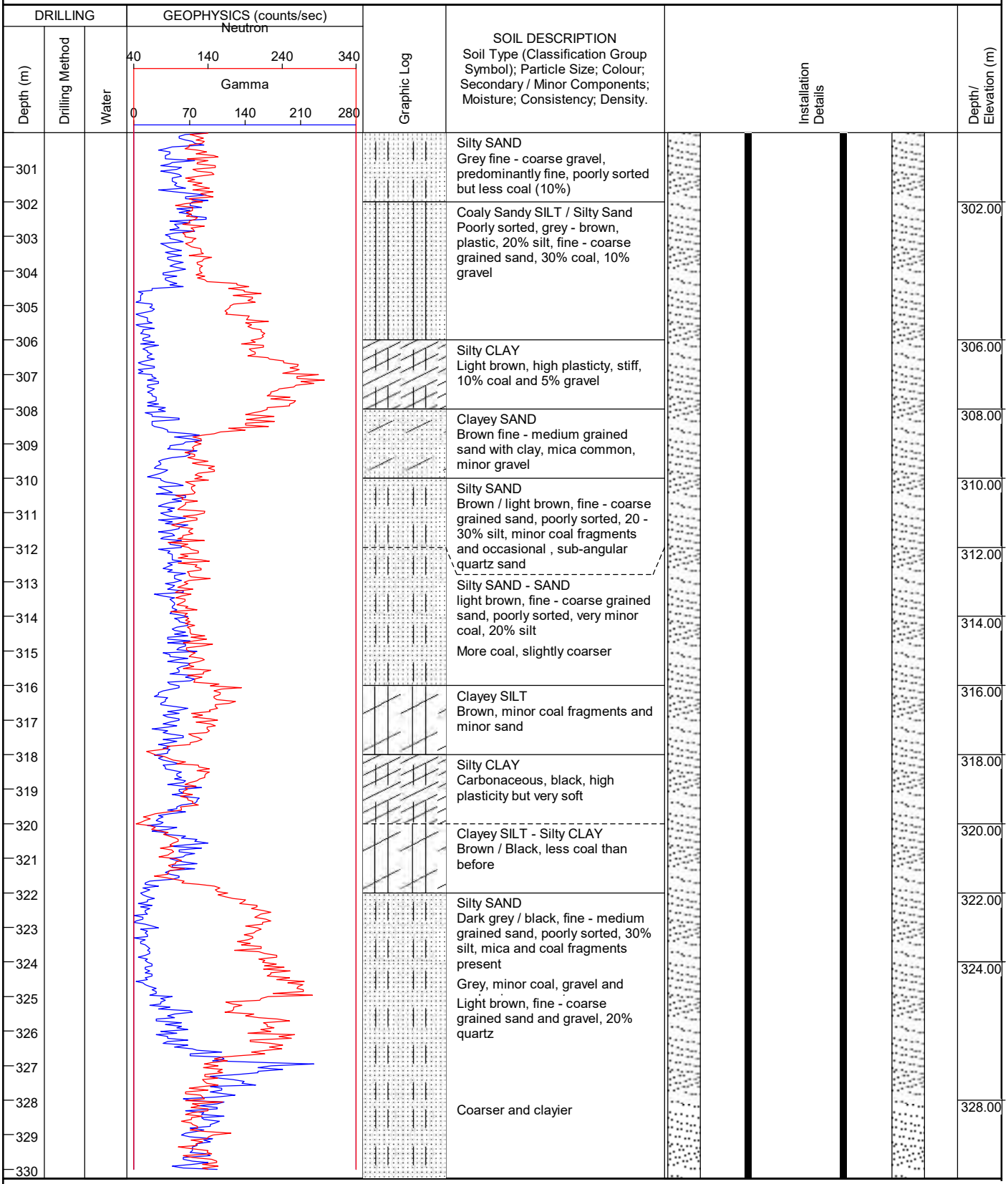

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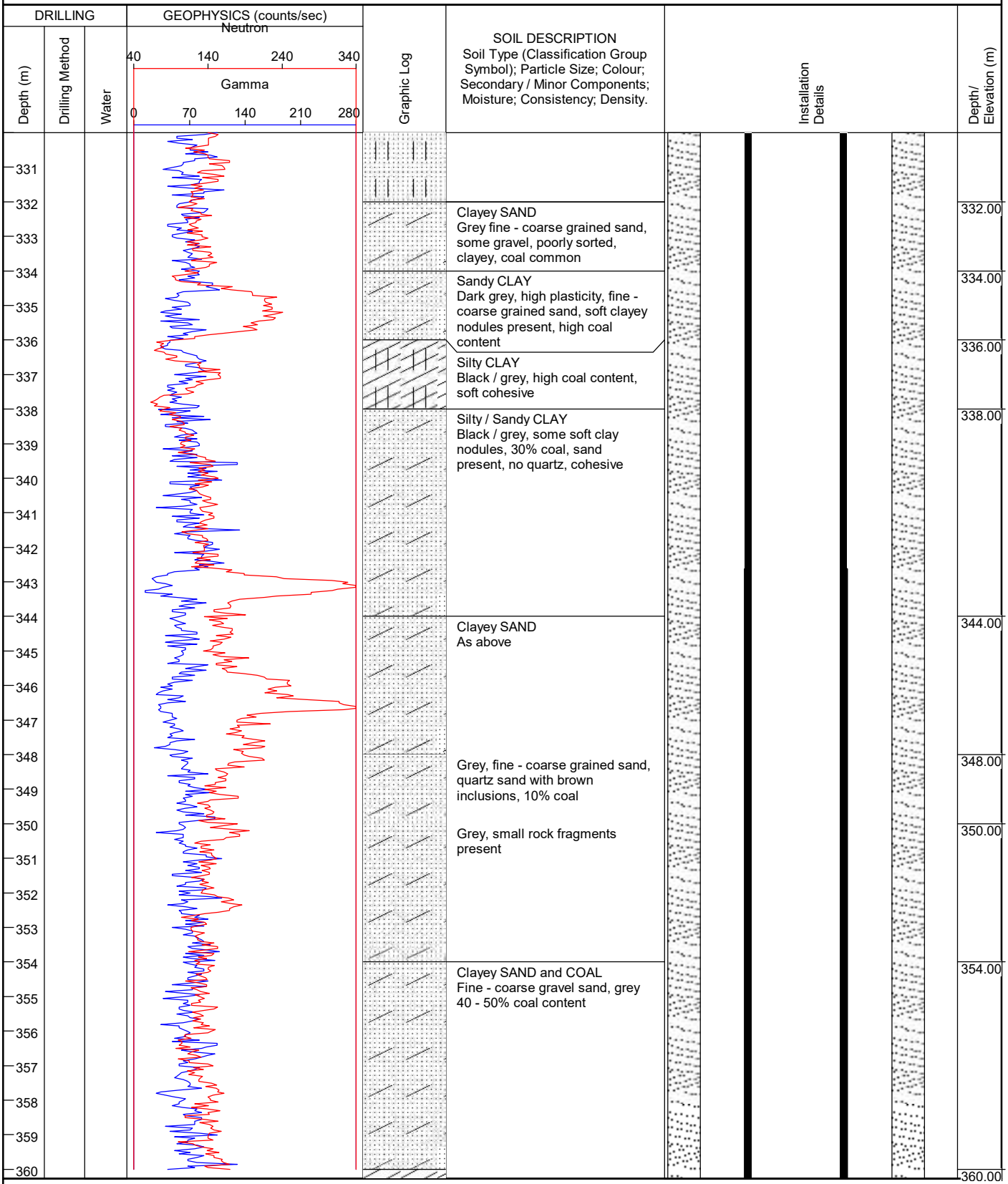

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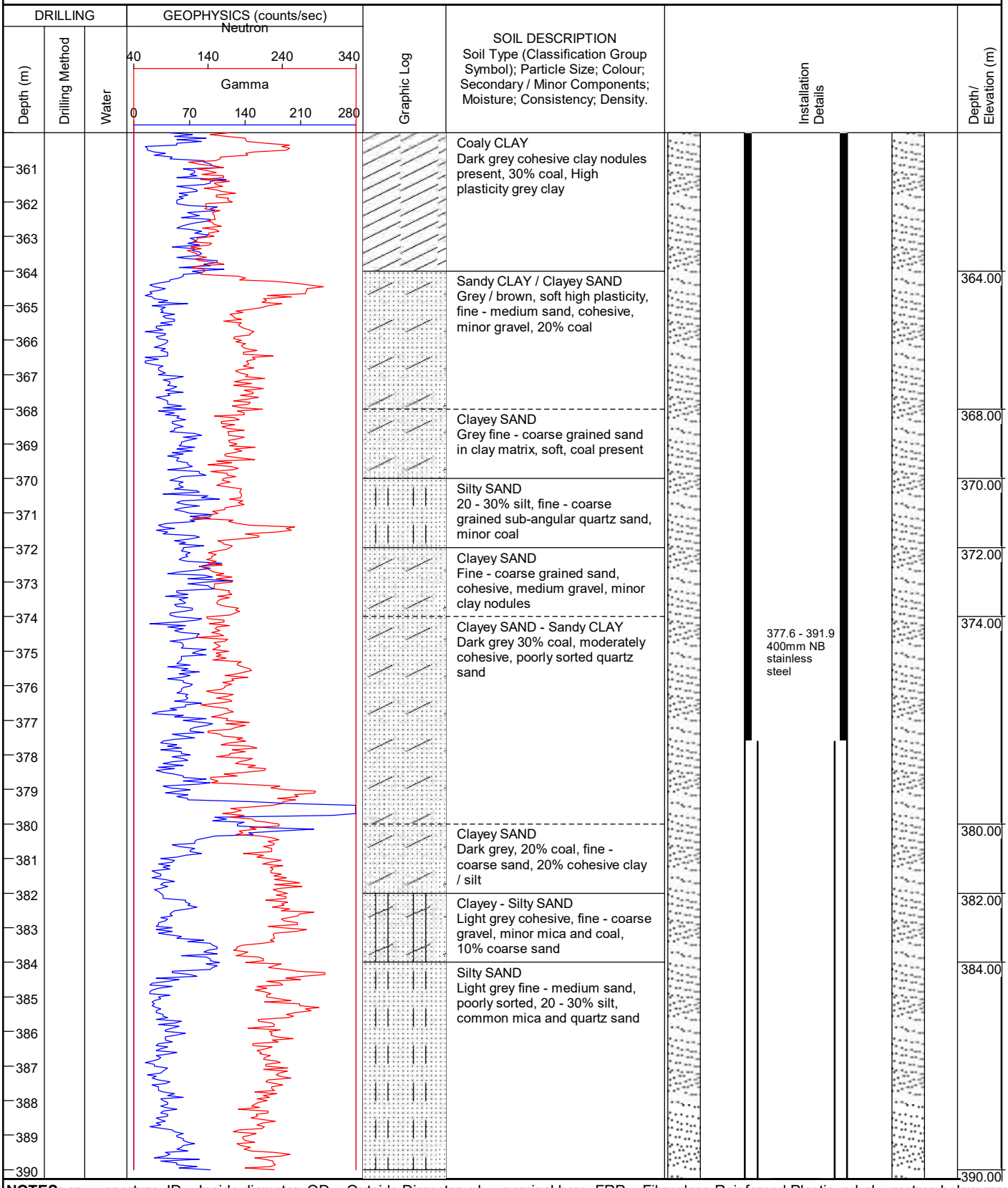

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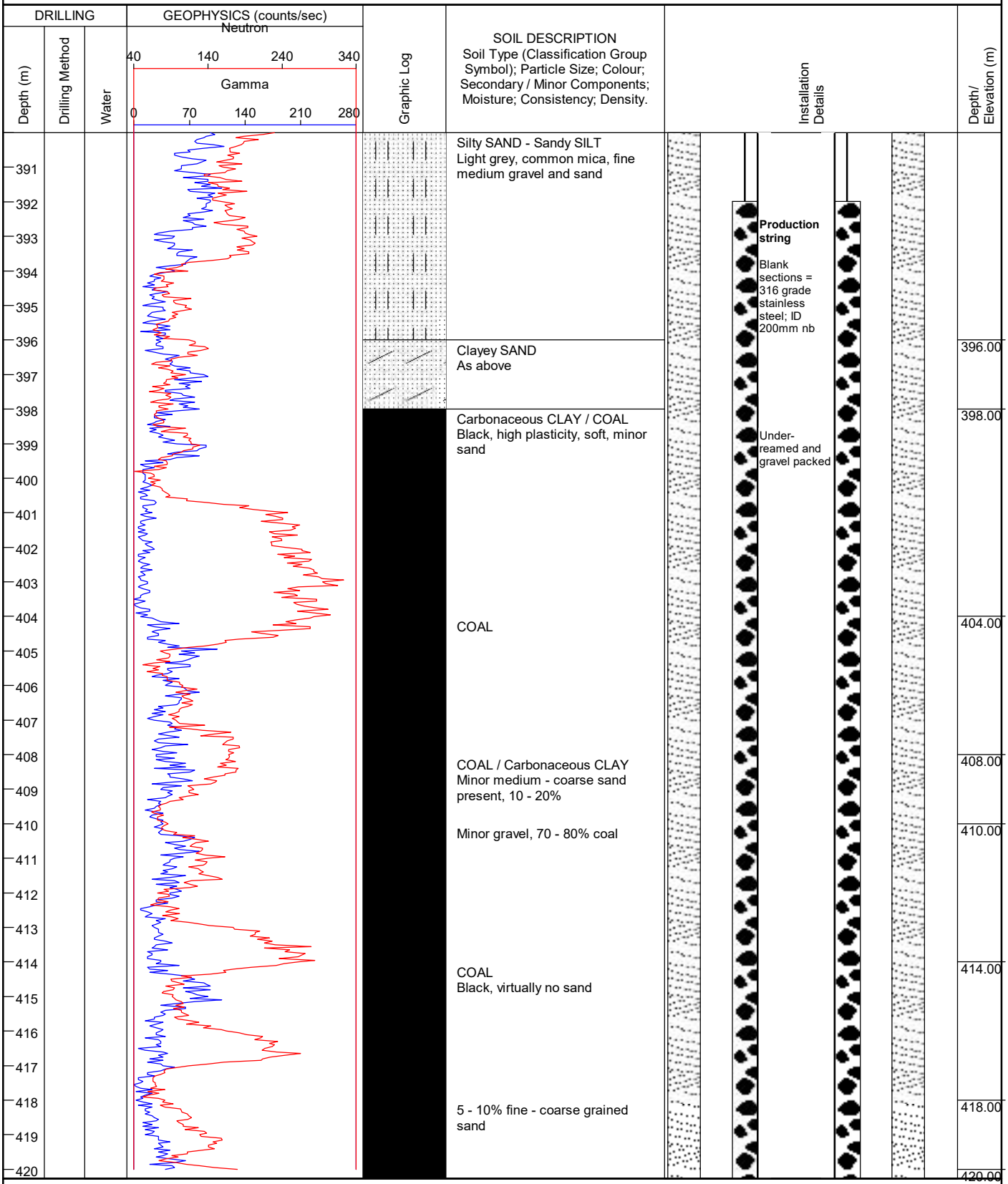

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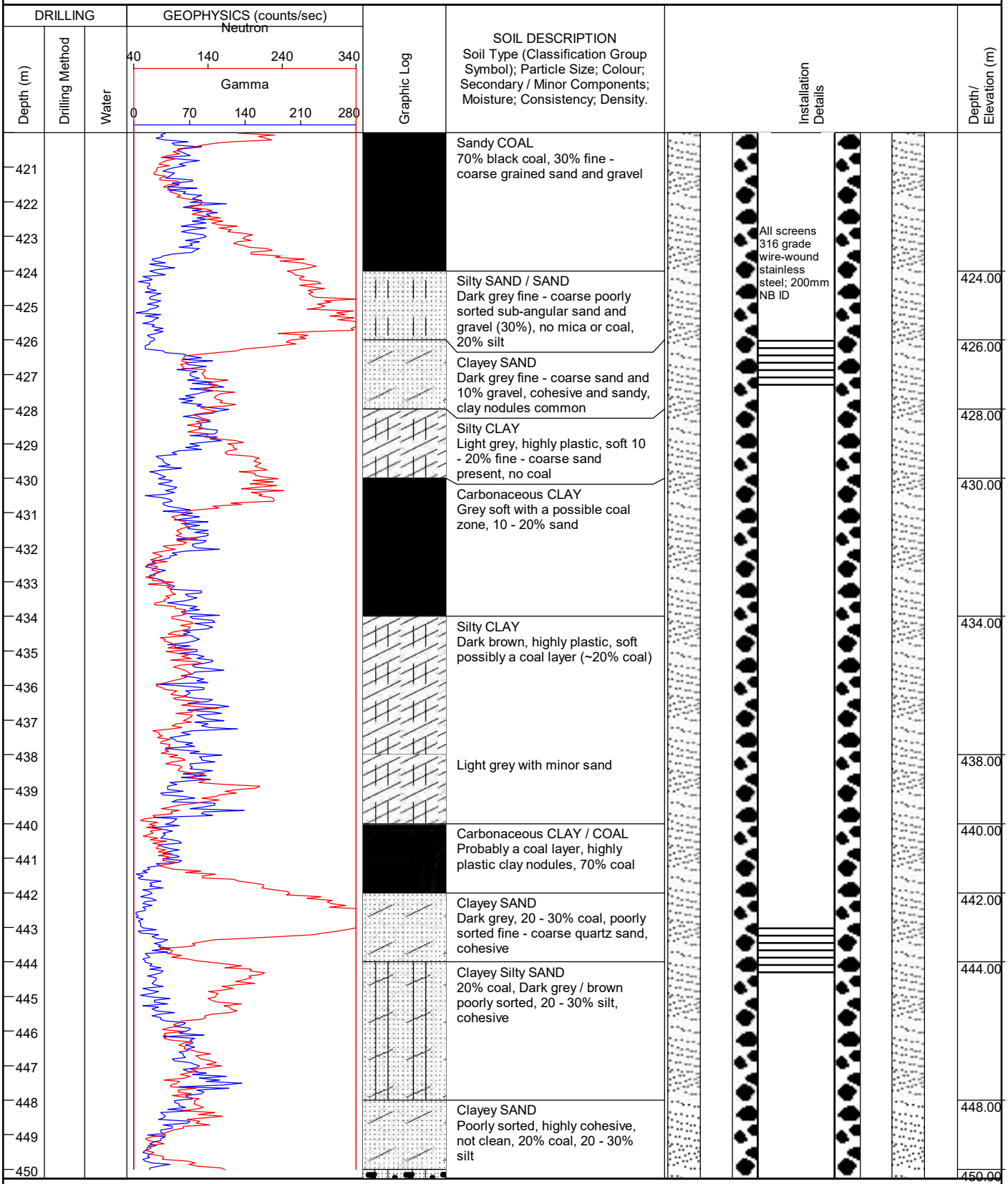

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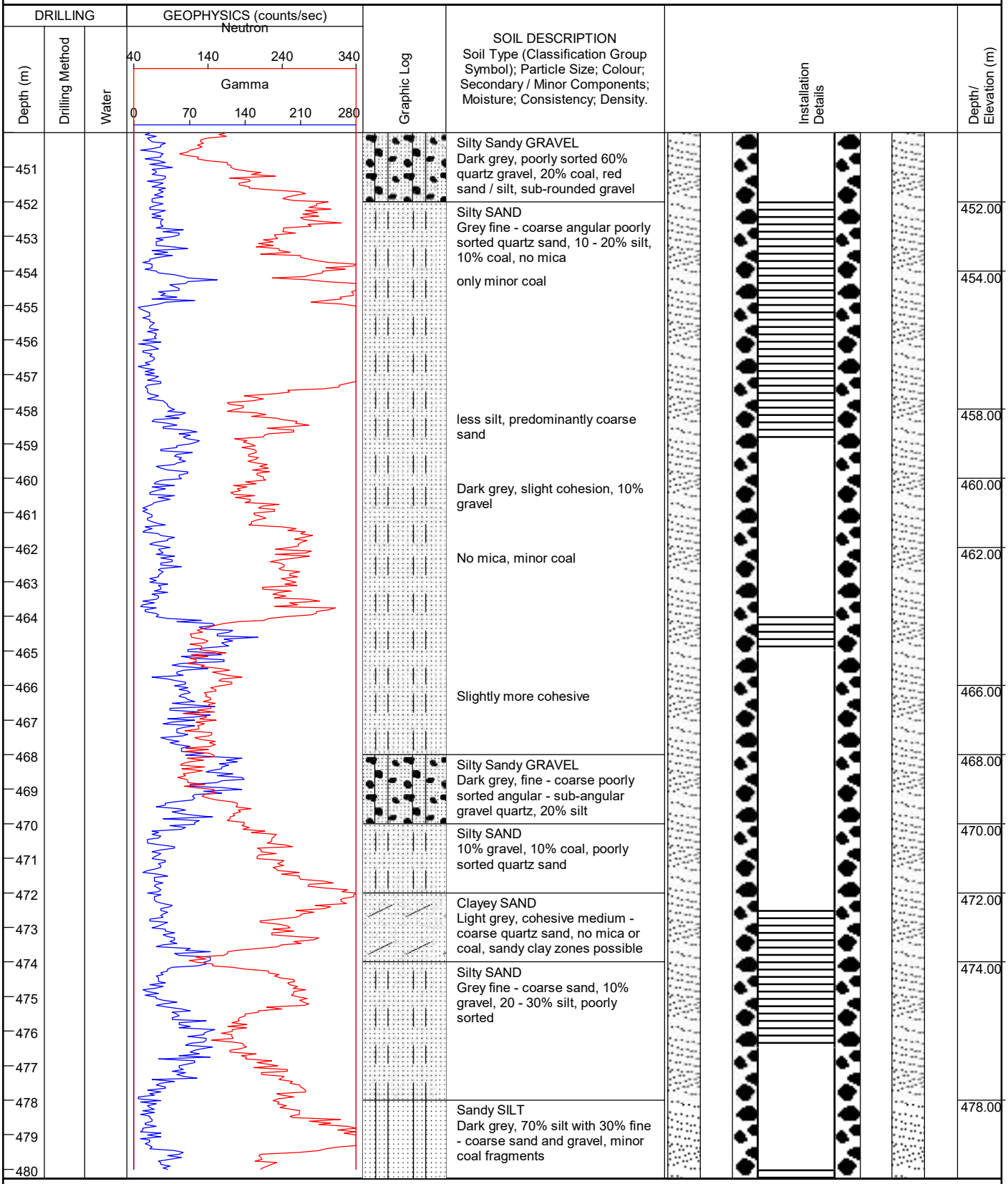

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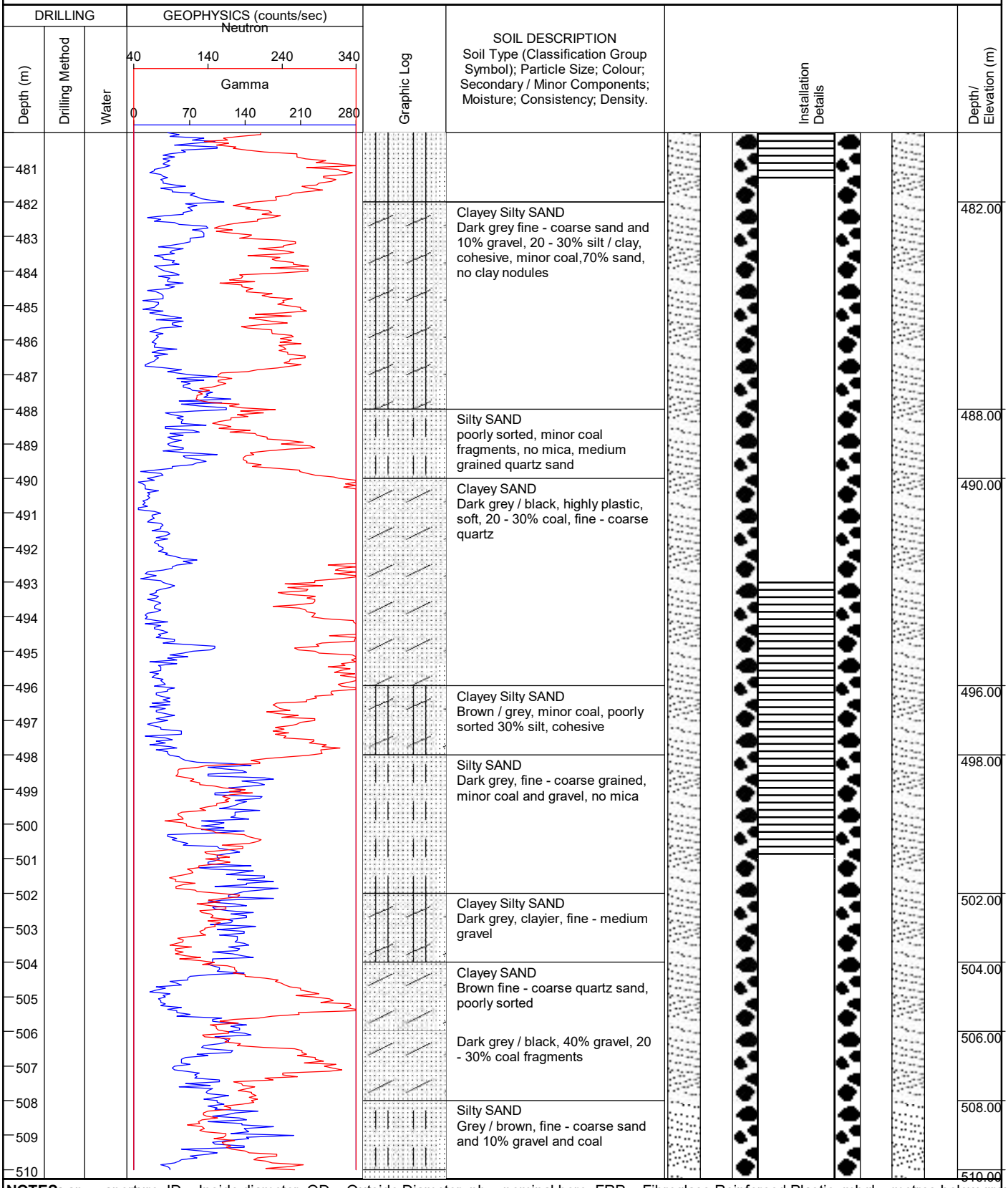

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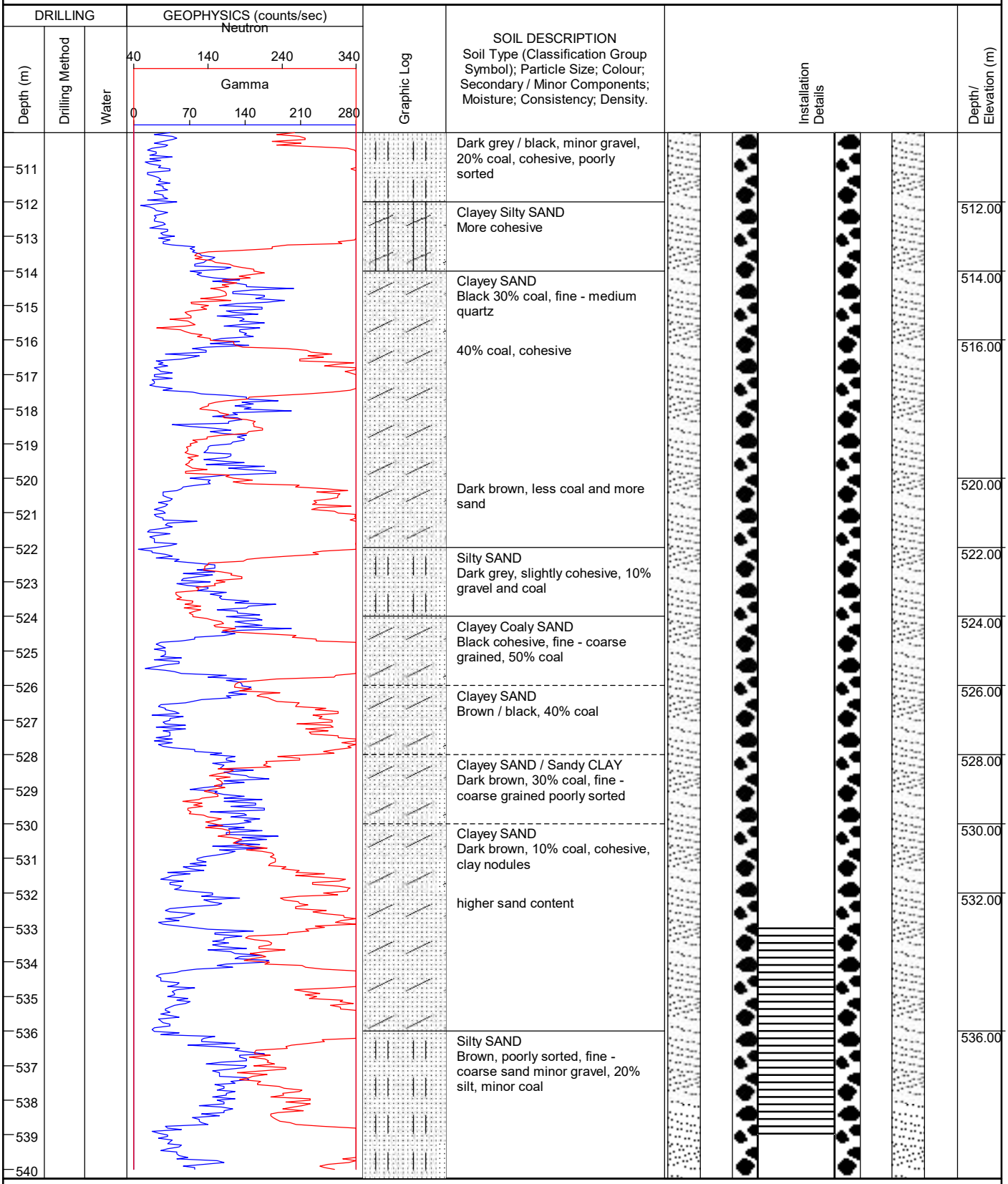

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HYDROGEOLOGICAL

Bore No.: GW3
Page: 19 of 21

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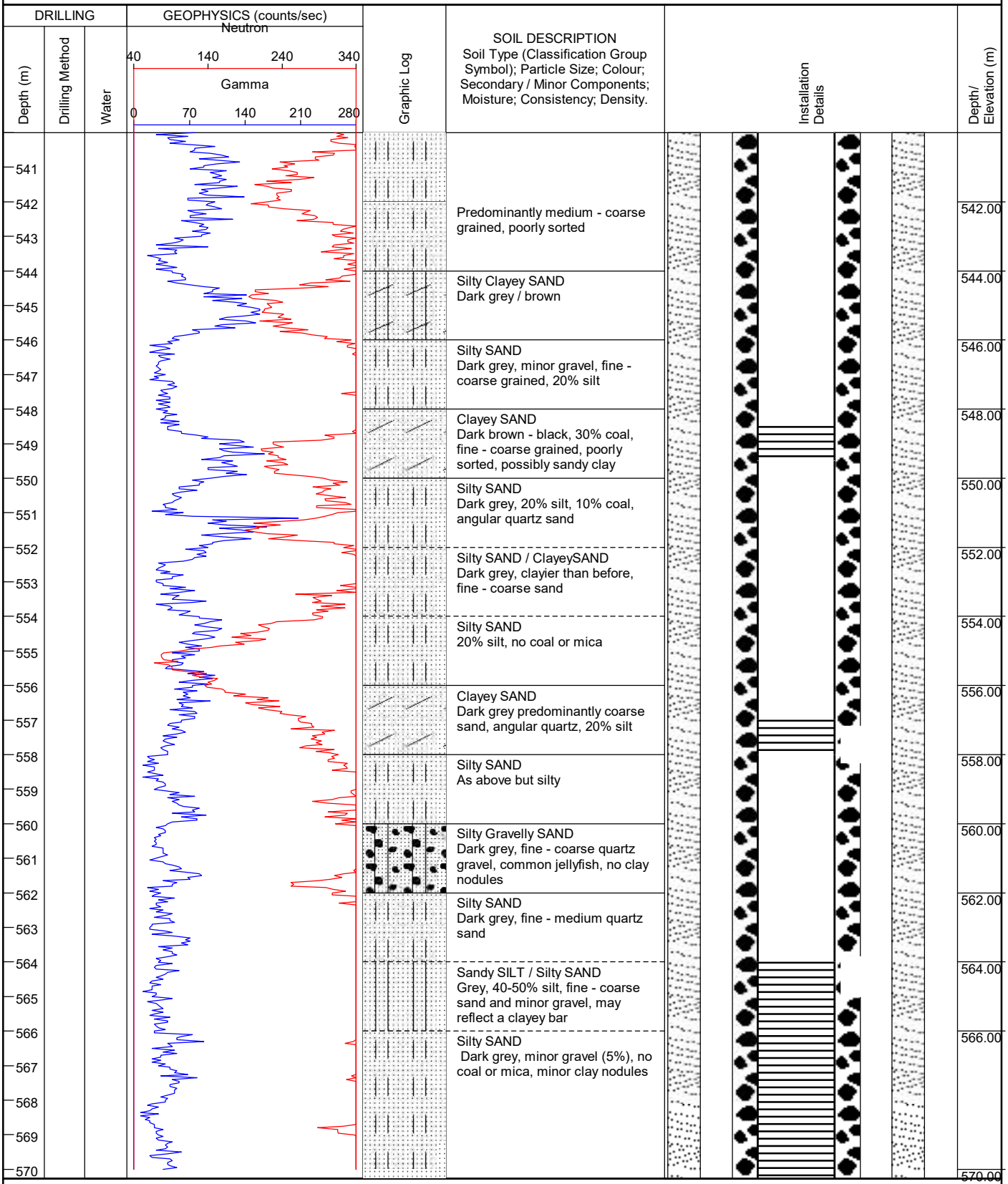

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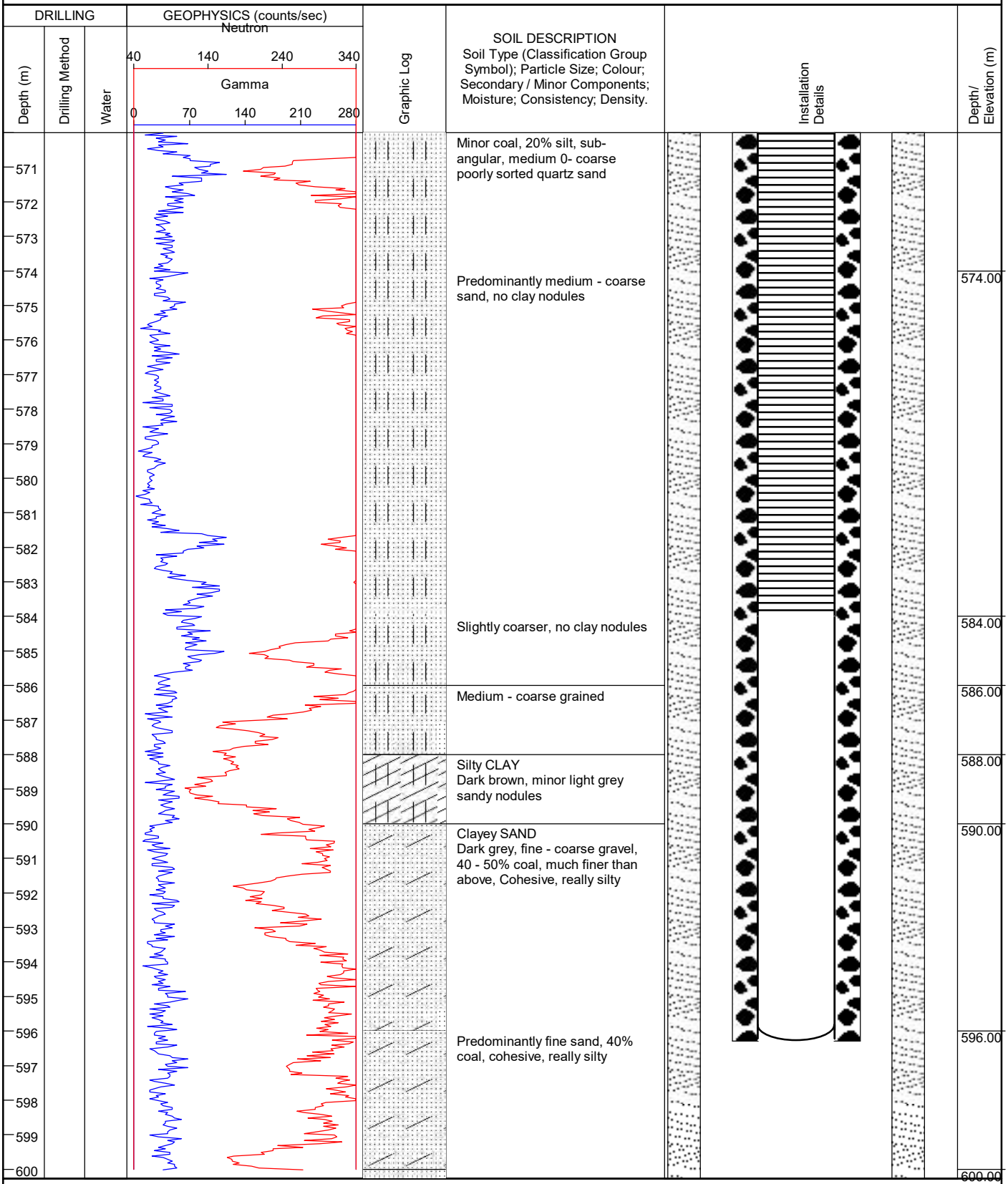

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| DRILLING | | | GEOPHYSICS (counts/sec) | | |

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW4

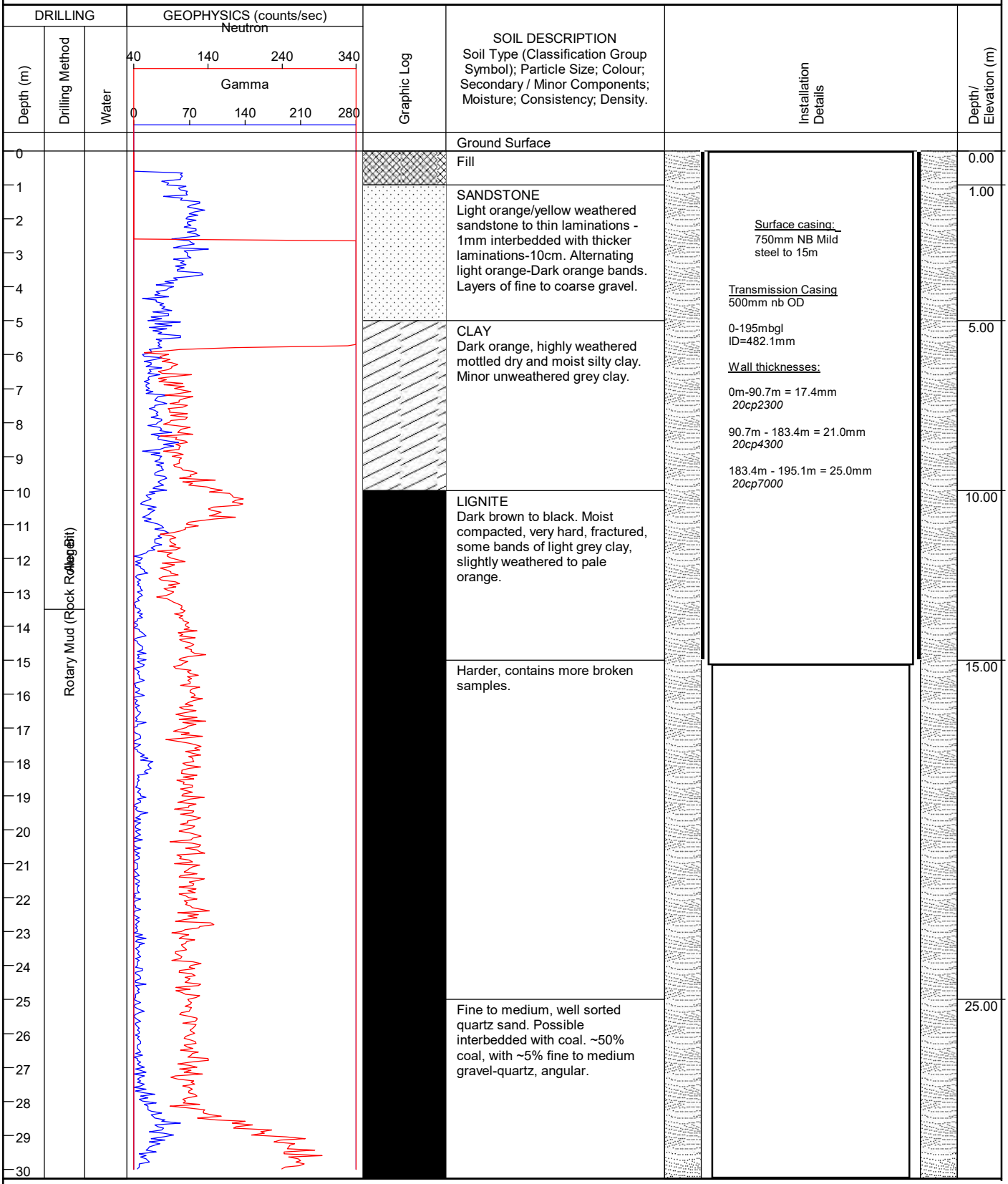
Page: 1 of 17

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Pony Club, Anglesea
Date Drilled: 03/03/08 **to:** 06/05/2008

Drilling Co.: Drilltec
Driller: Jarrod Freeman
Rig Type: Bourne 1800
Total Depth (m): 510
Diameter (mm): 820 - 250mm

Easting: 254271
Northing: 5746465
Grid Ref: MGA 94, Zone 55
Collar RL: 3.57 (GL)
Logged by: MO **Checked by:** JSM

B.C.L. No.: 9031314 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.3 - 0.5mm



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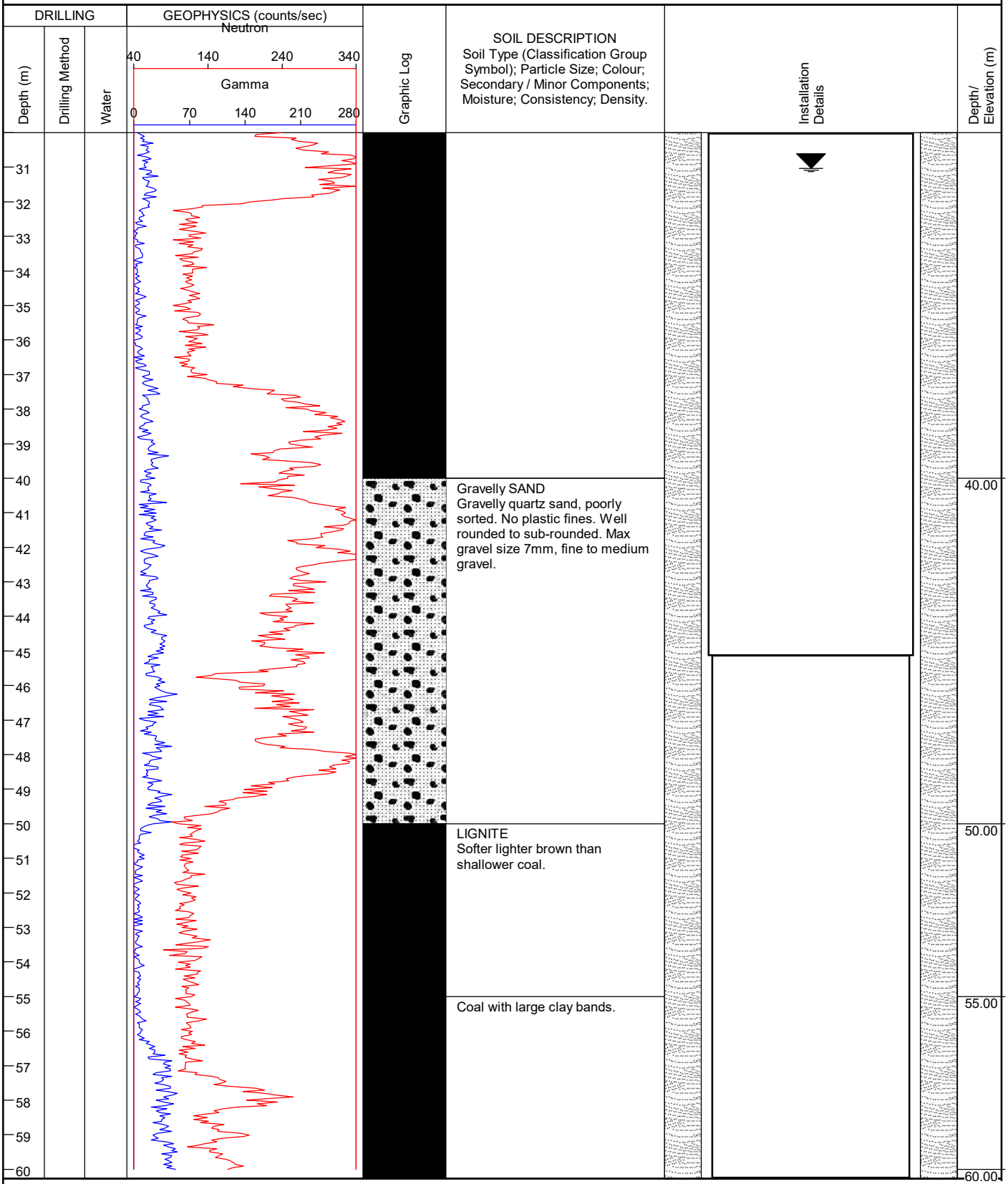

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Bore No.: GW4

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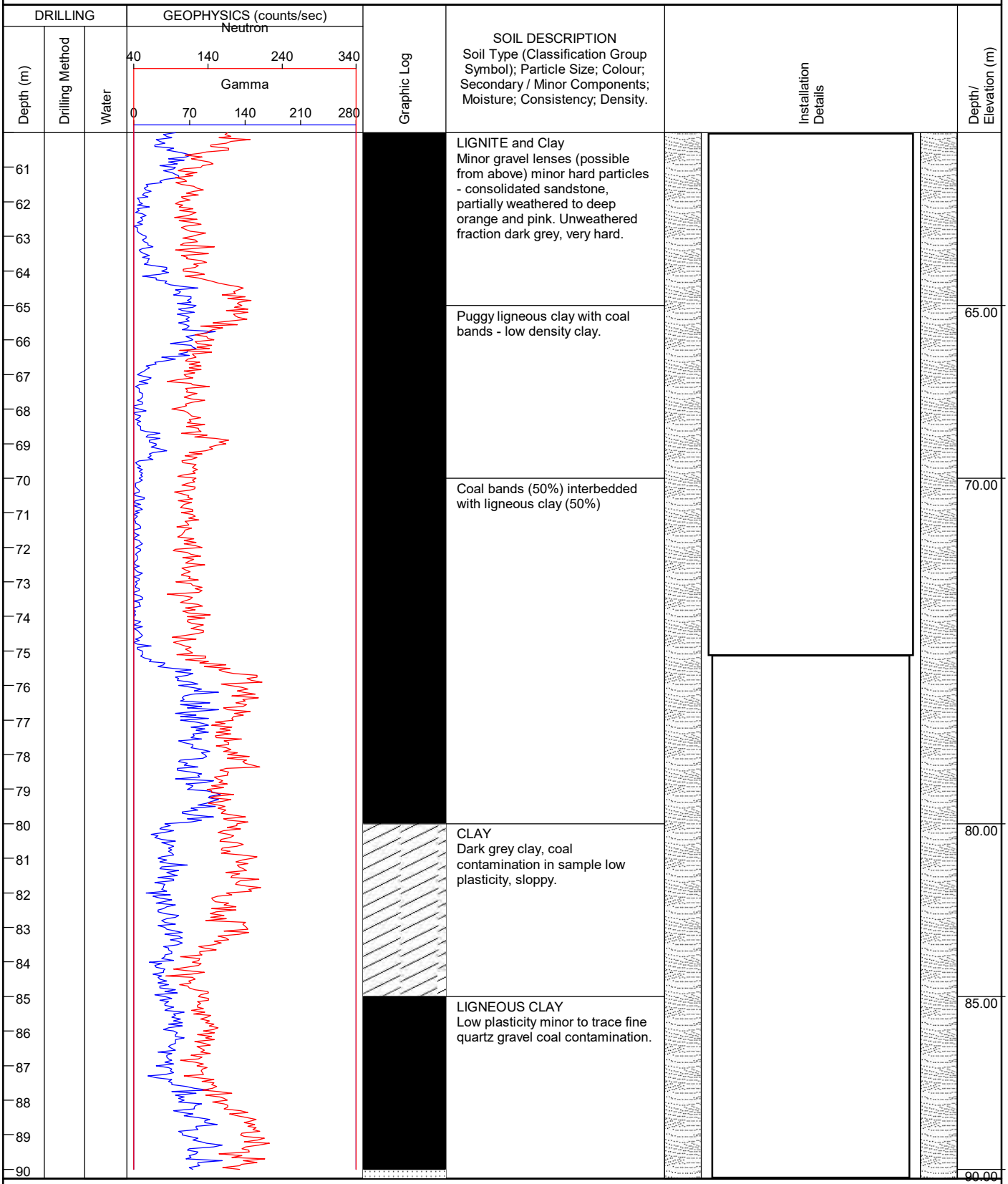

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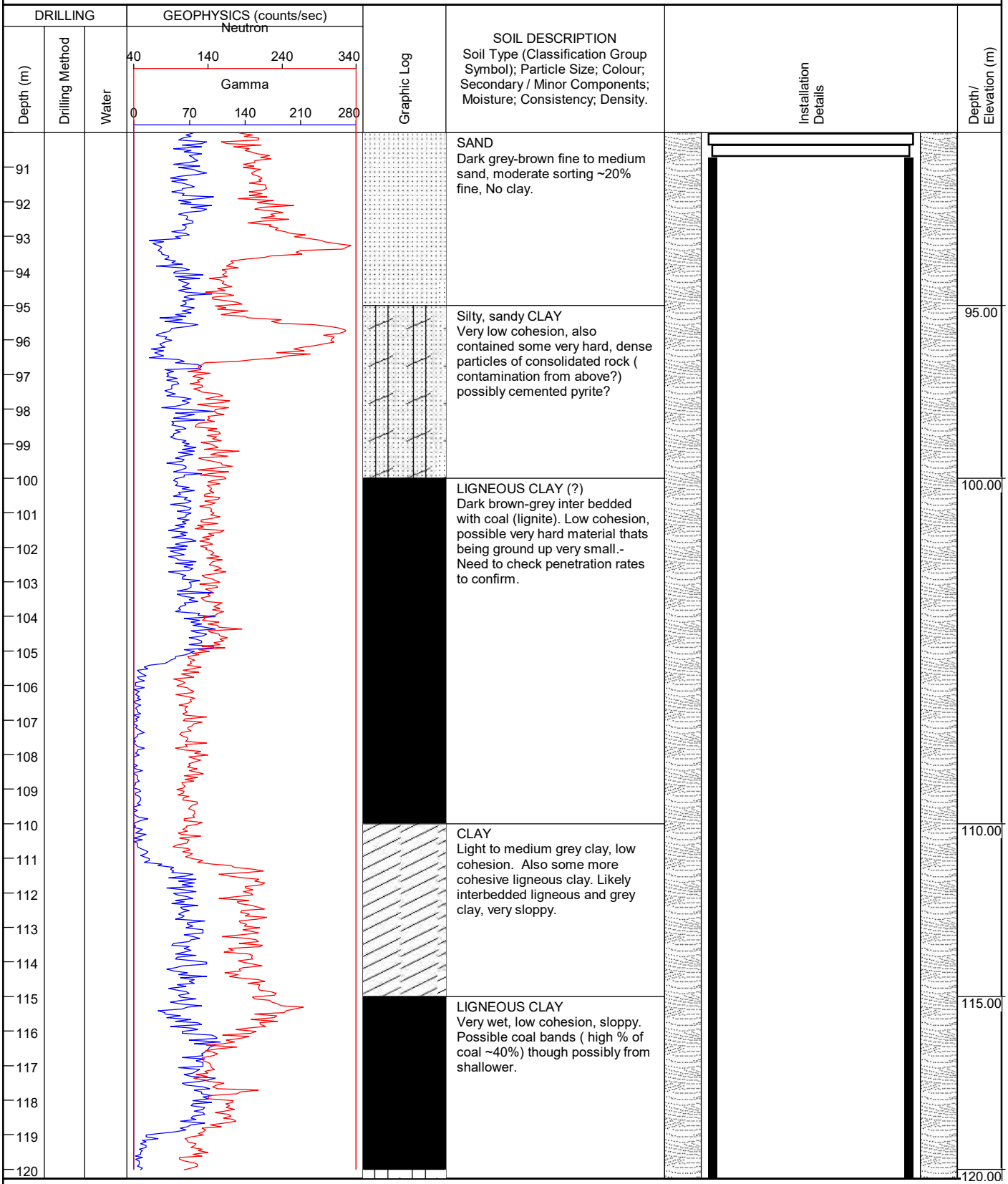

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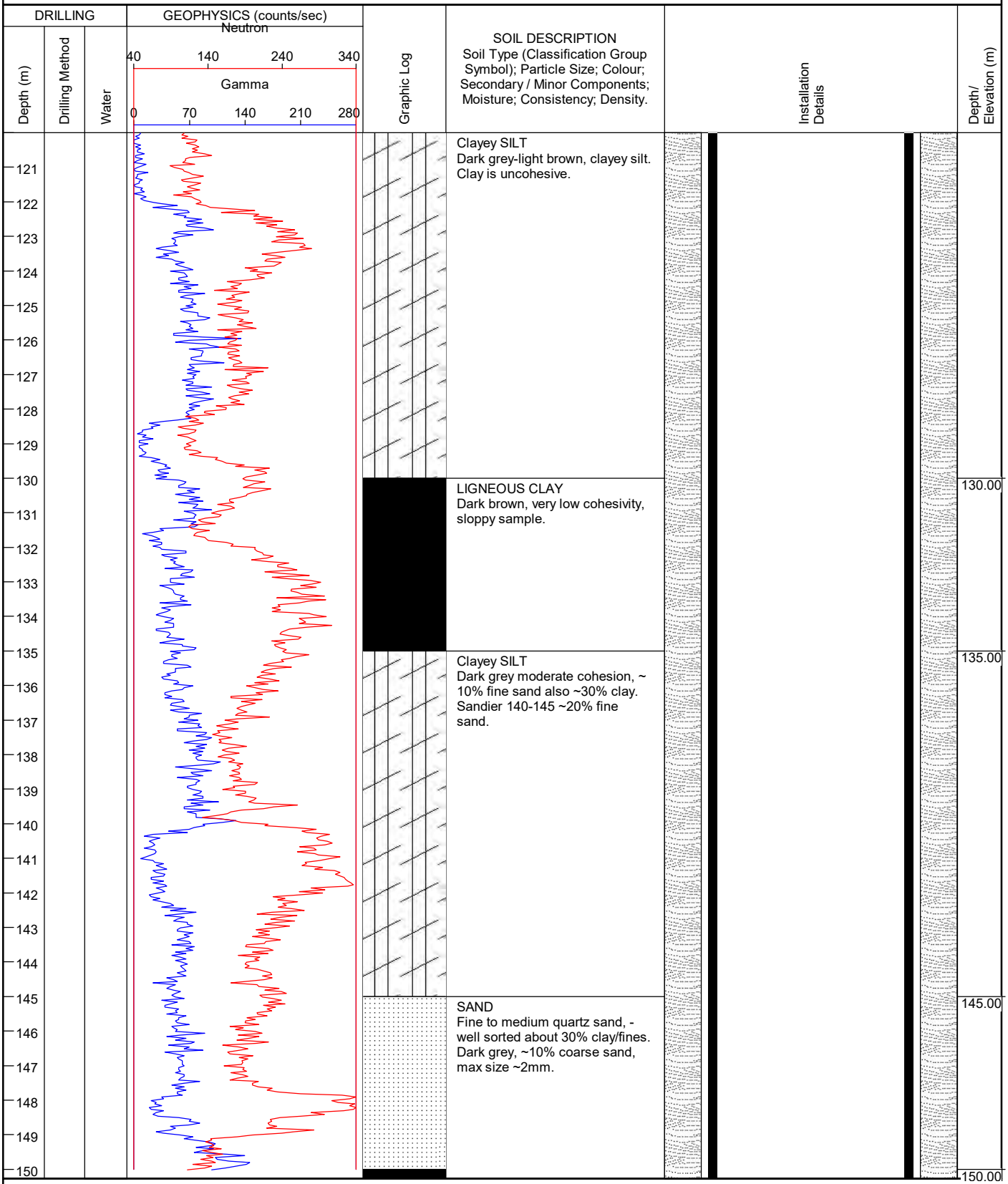

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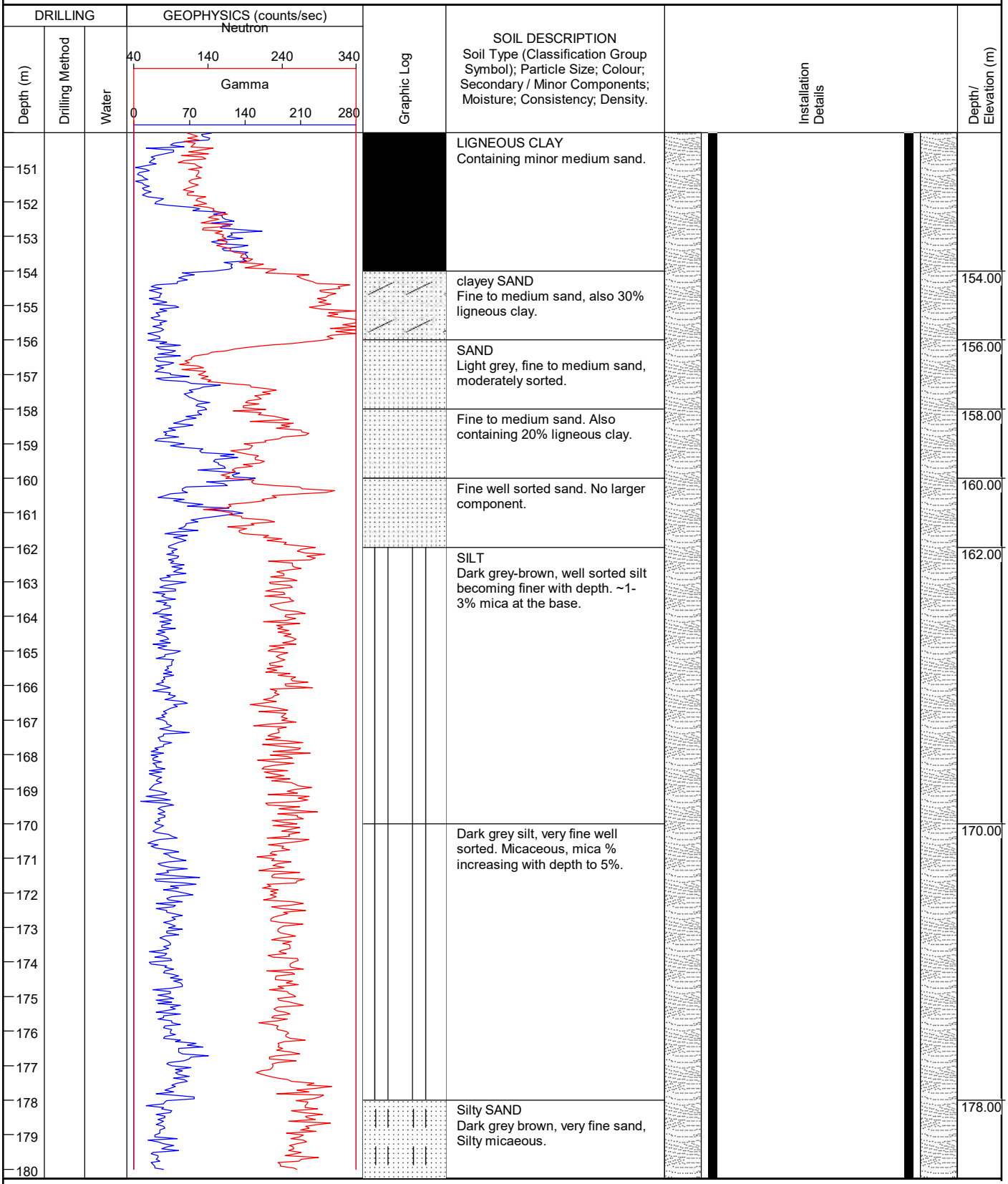

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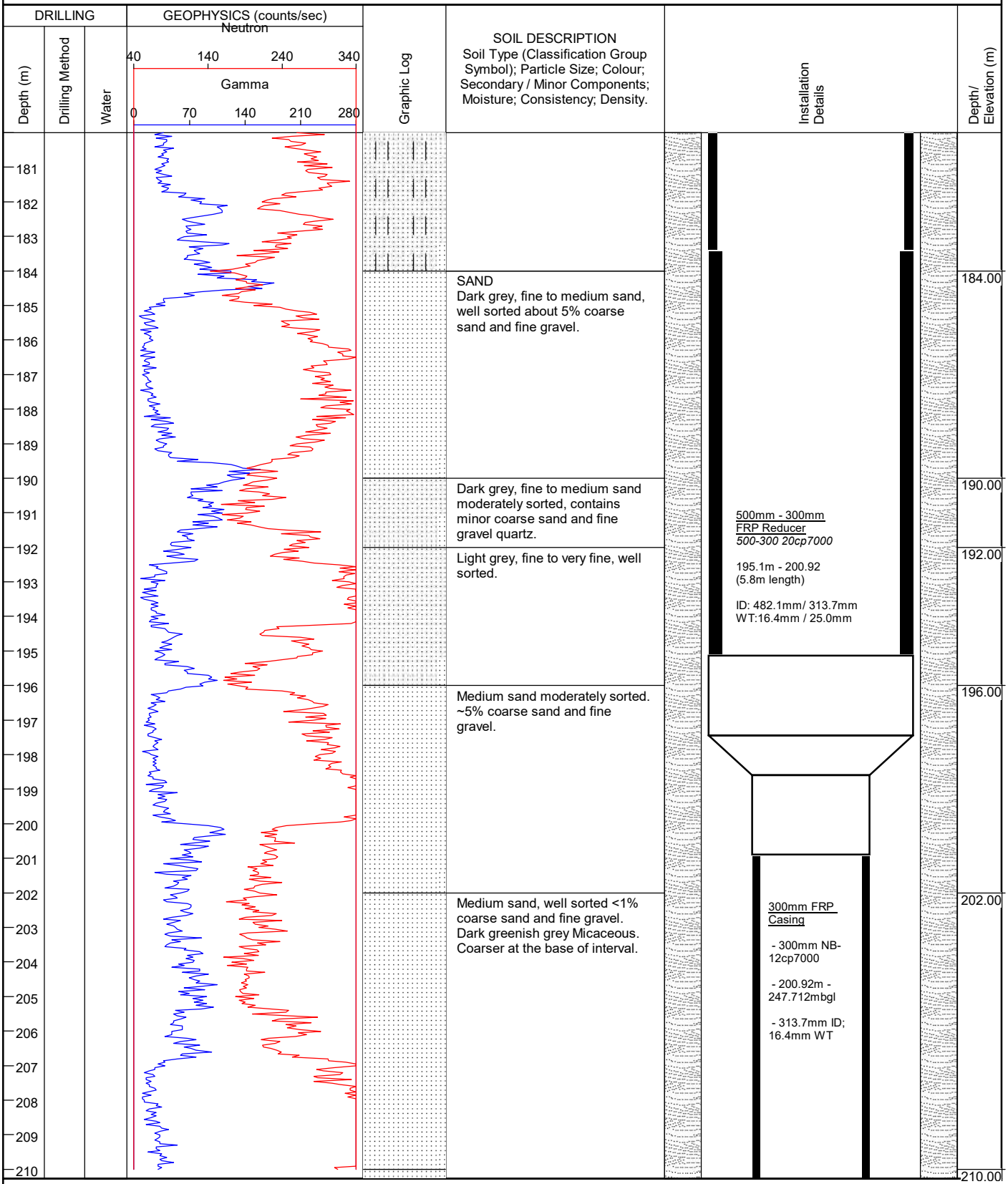

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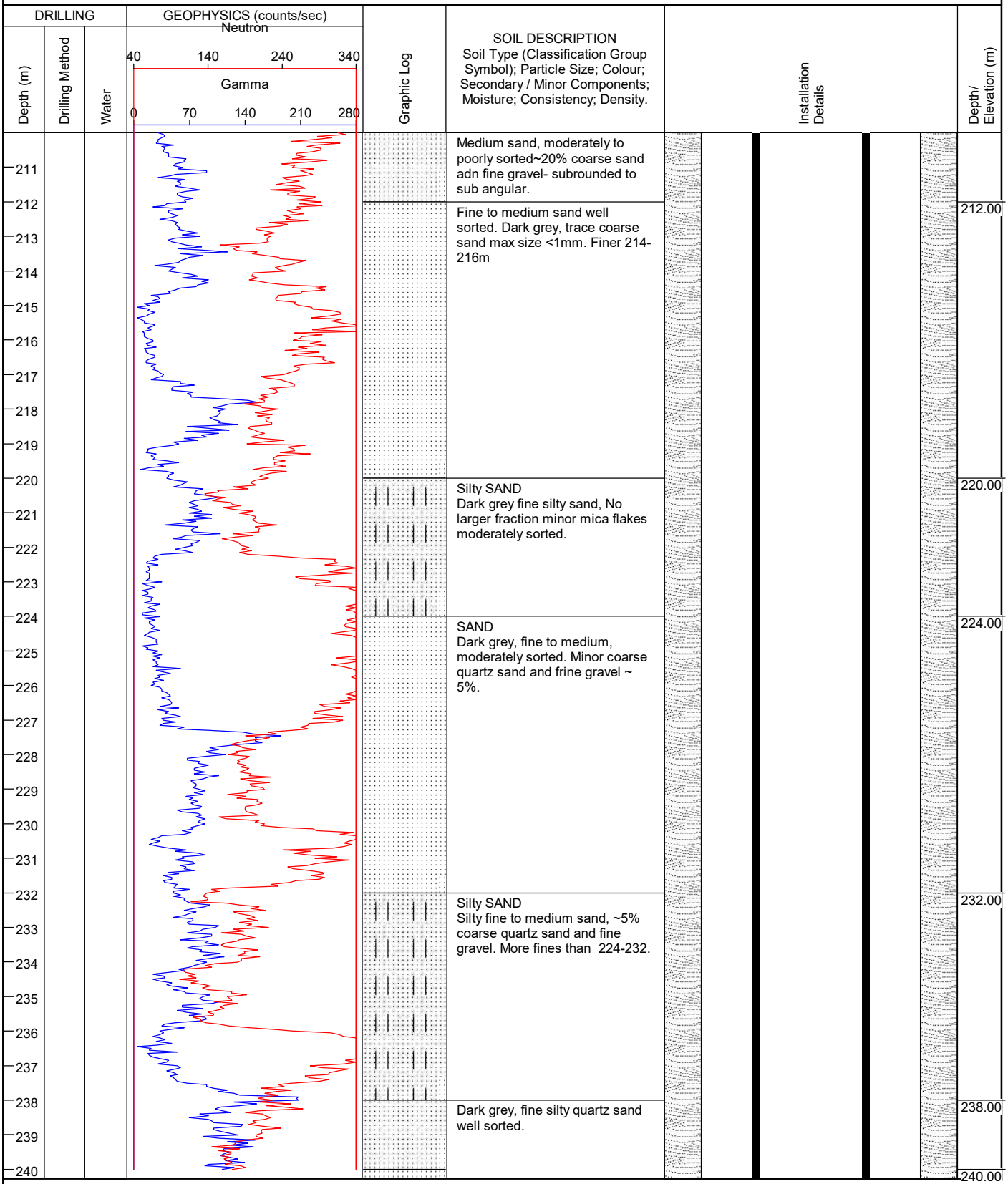
Logged by: MO **Checked by:** JSM

B.C.L. No.: 9031314 **Casing Material:** FRP **Screen Material:** 316 Stainless Steel **Screen Slot Size (mm):** 0.3 - 0.5mm



NOTES: ap. = aperture ; ID = Inside Diameter; OD = Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW4

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Pony Club, Anglesea
Date Drilled: 03/03/08 **to:** 06/05/2008

Drilling Co.: Drilltec
Driller: Jarrod Freeman
Rig Type: Bourne 1800
Total Depth (m): 510
Diameter (mm): 820 - 250mm

Easting: 254271
Northing: 5746465
Grid Ref: MGA 94, Zone 55
Collar RL: 3.57 (GL)
Logged by: MO **Checked by:** JSM

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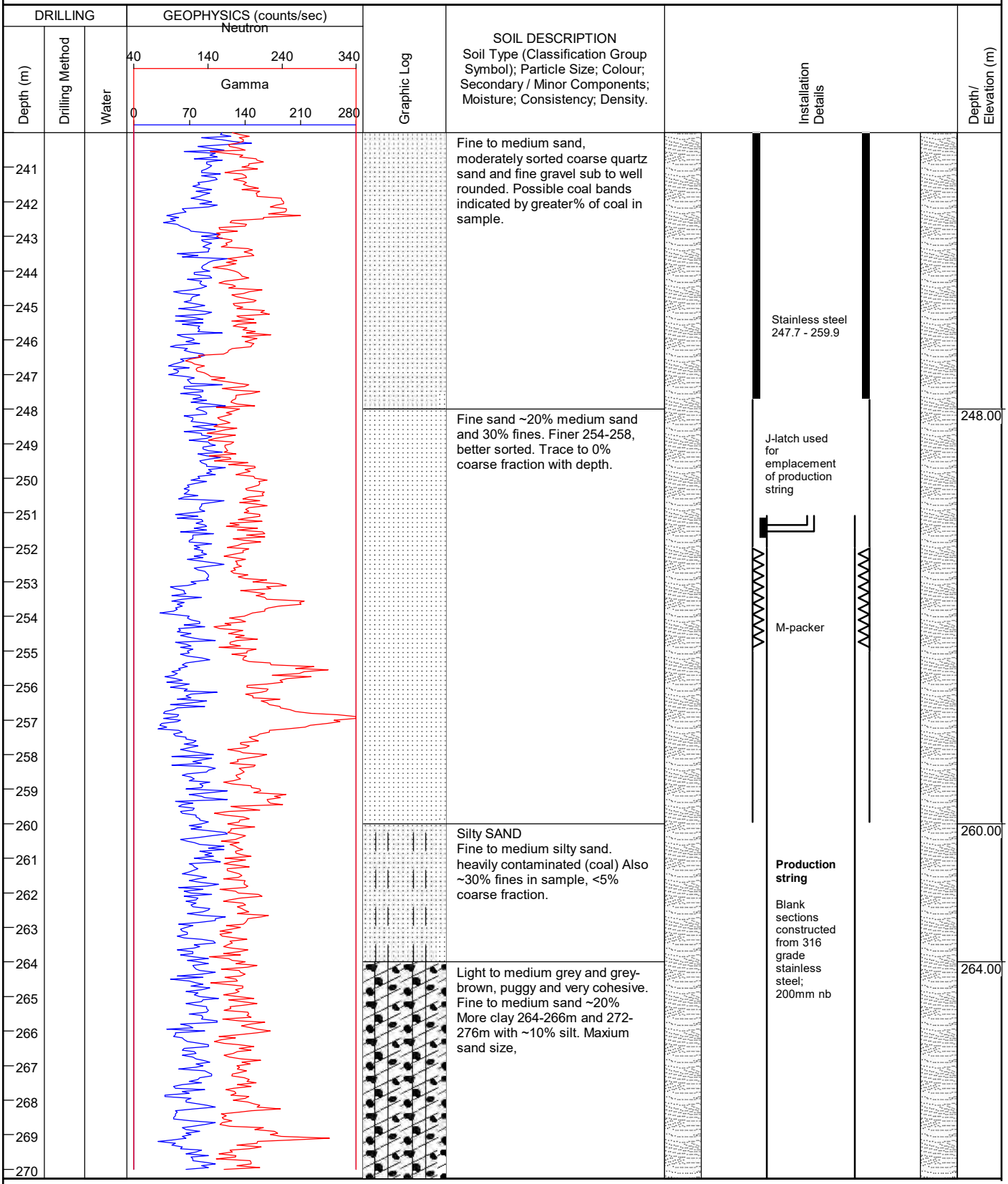

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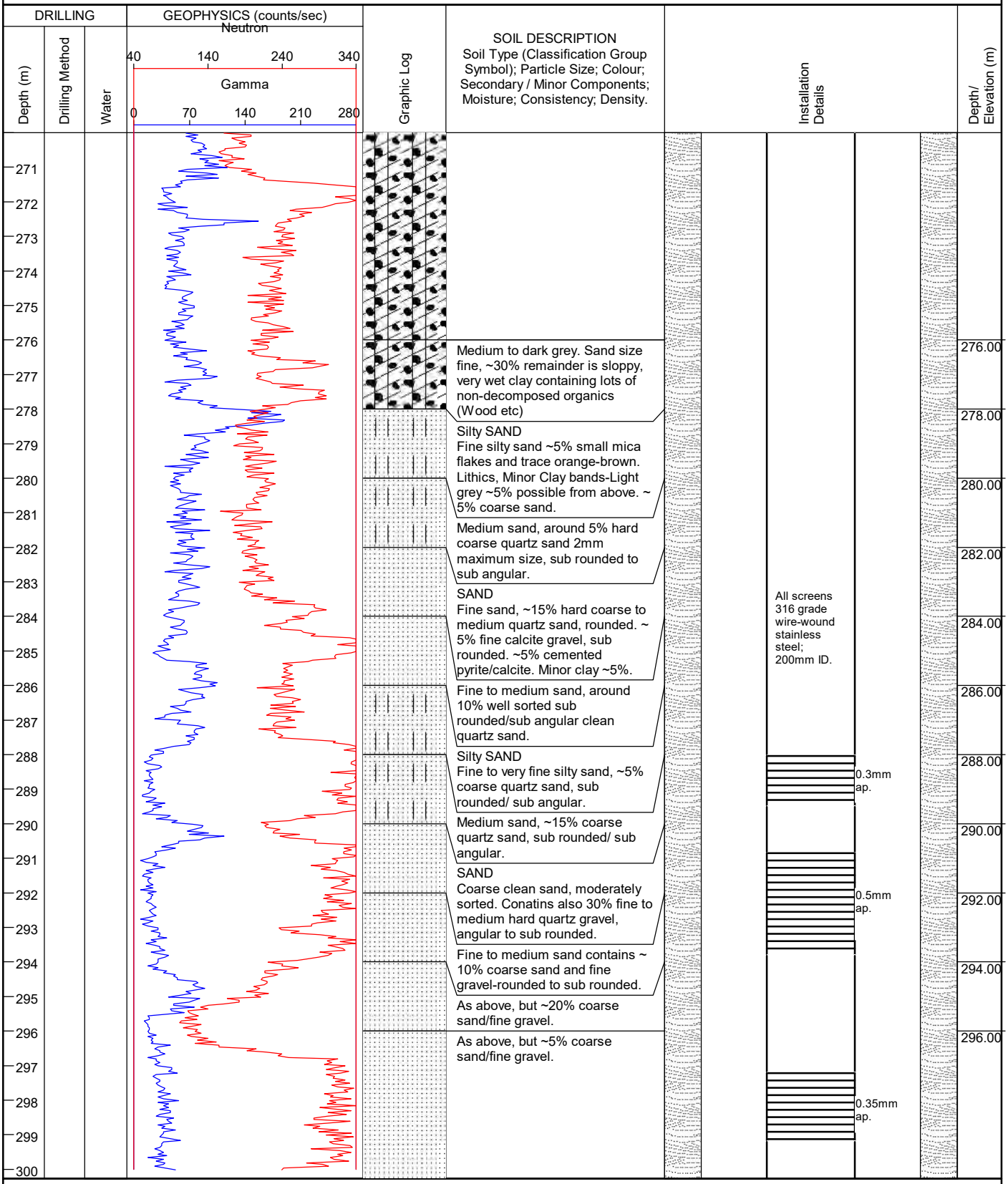

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW4

Page: 11 of 17

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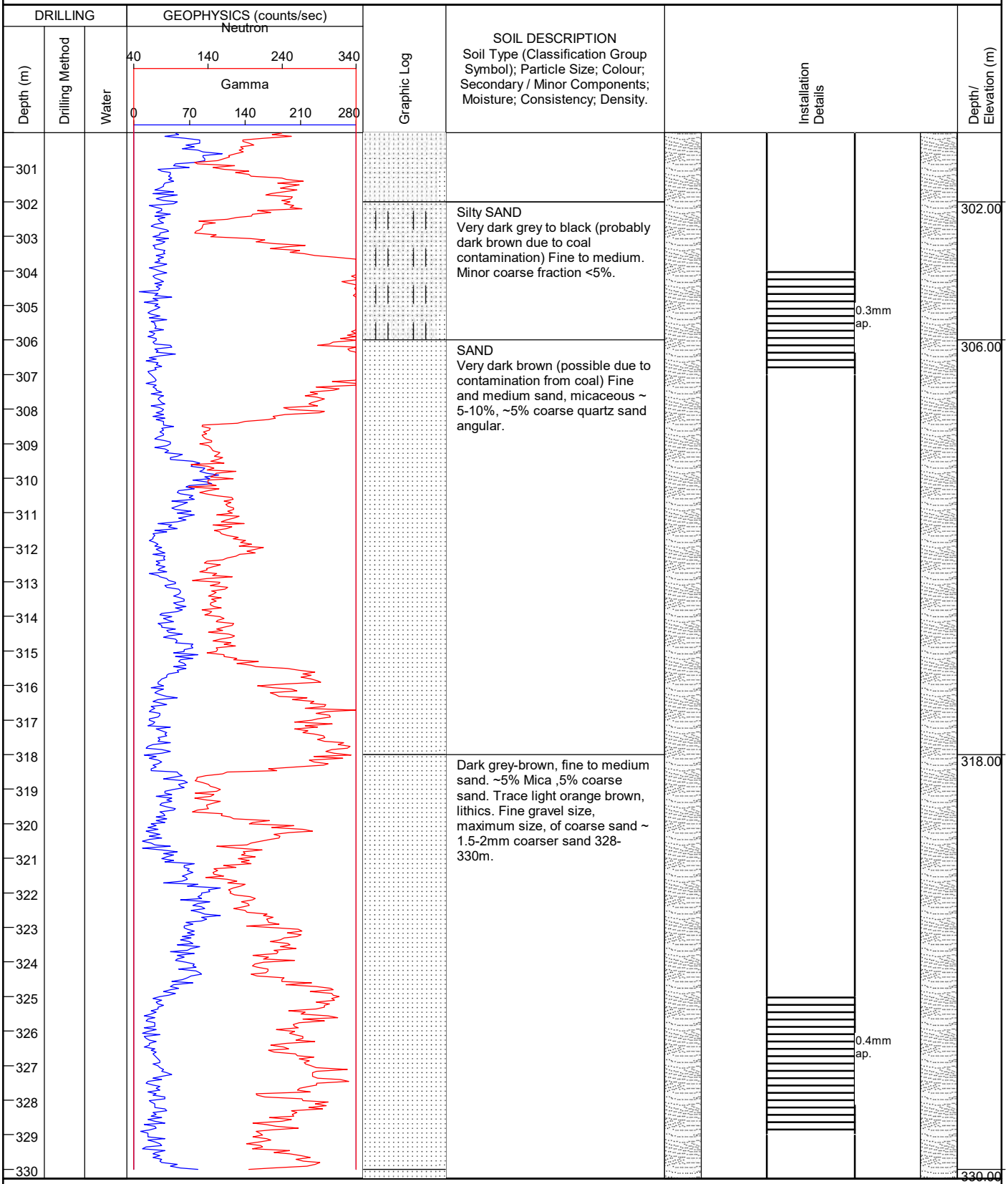

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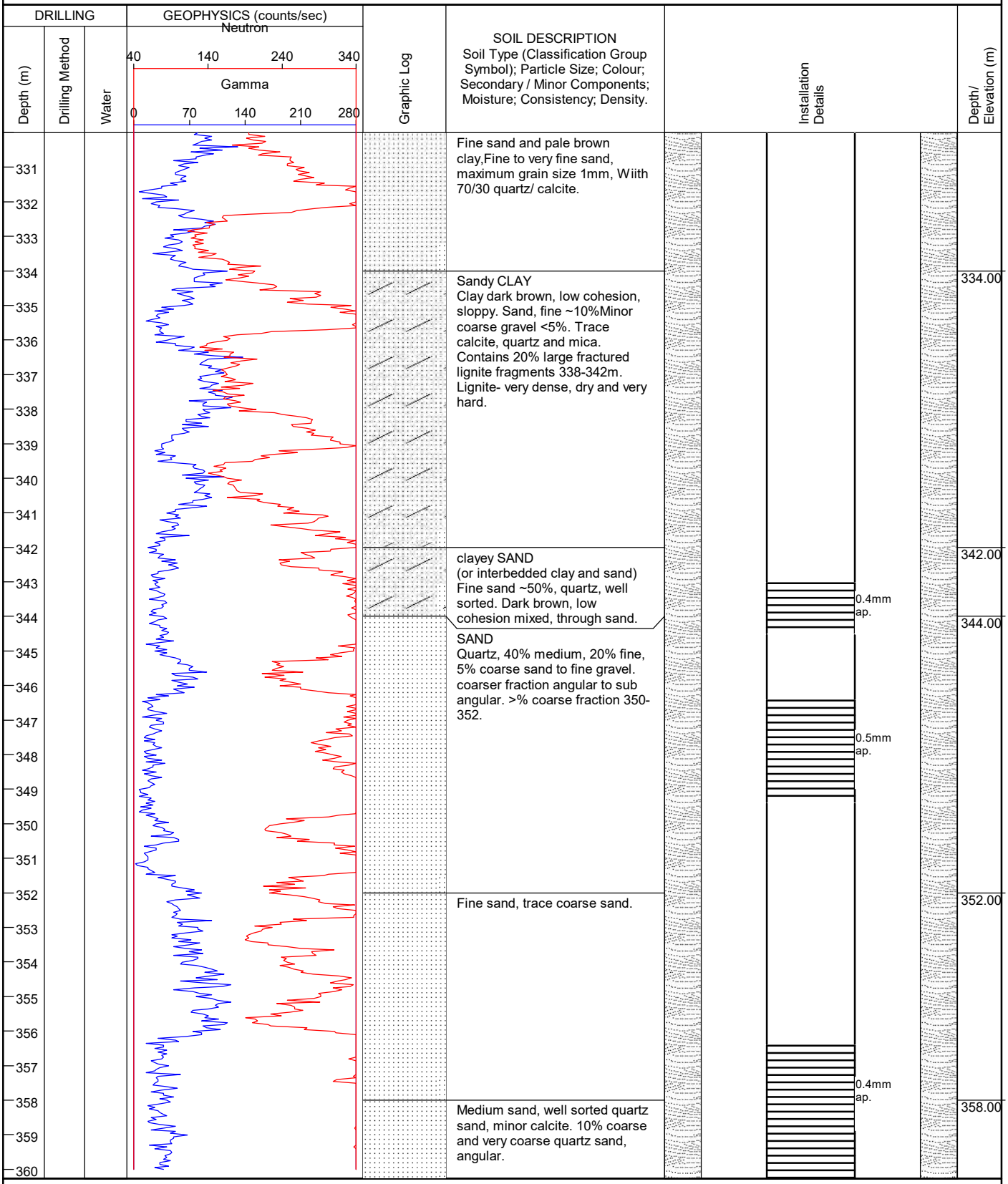

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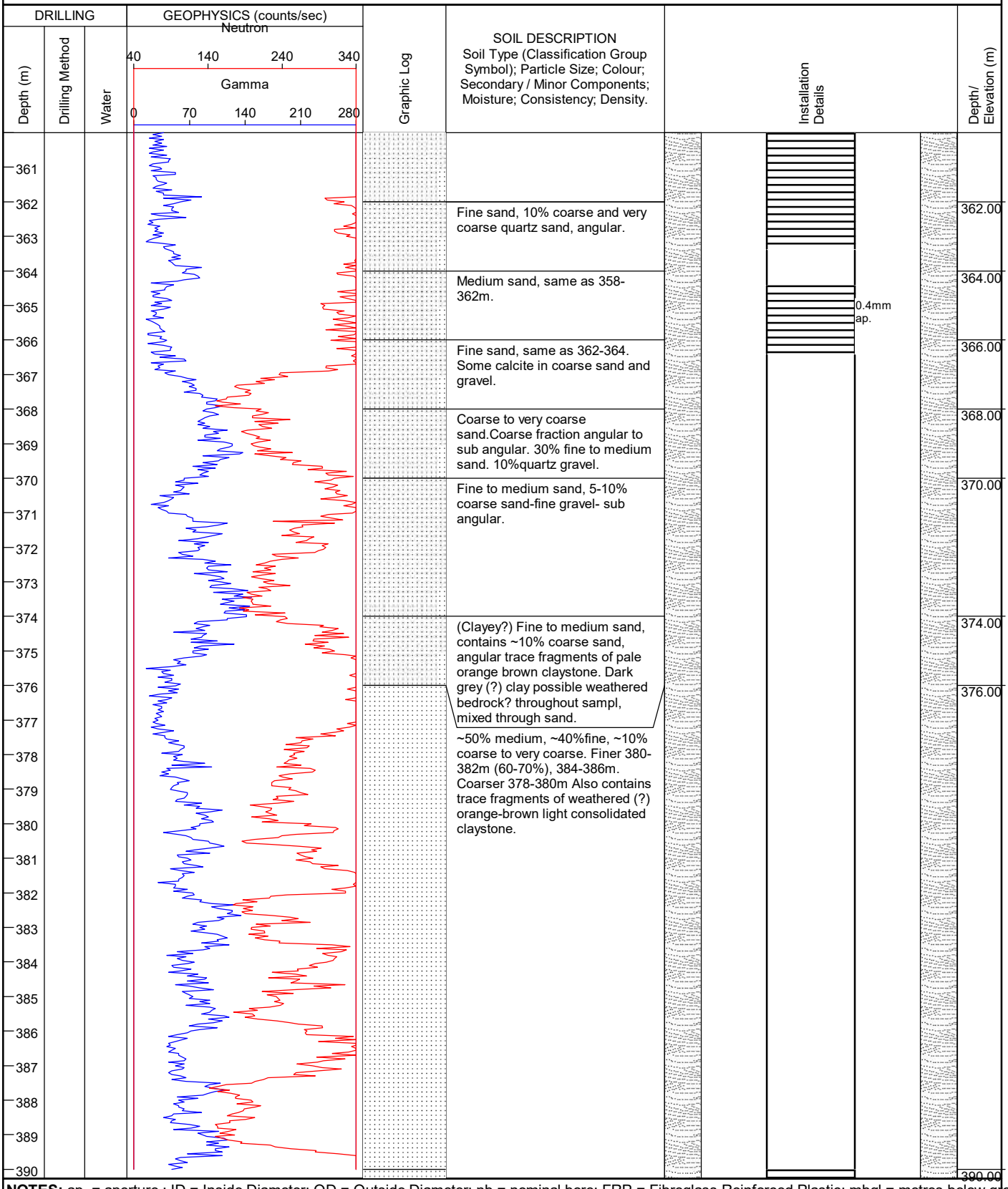

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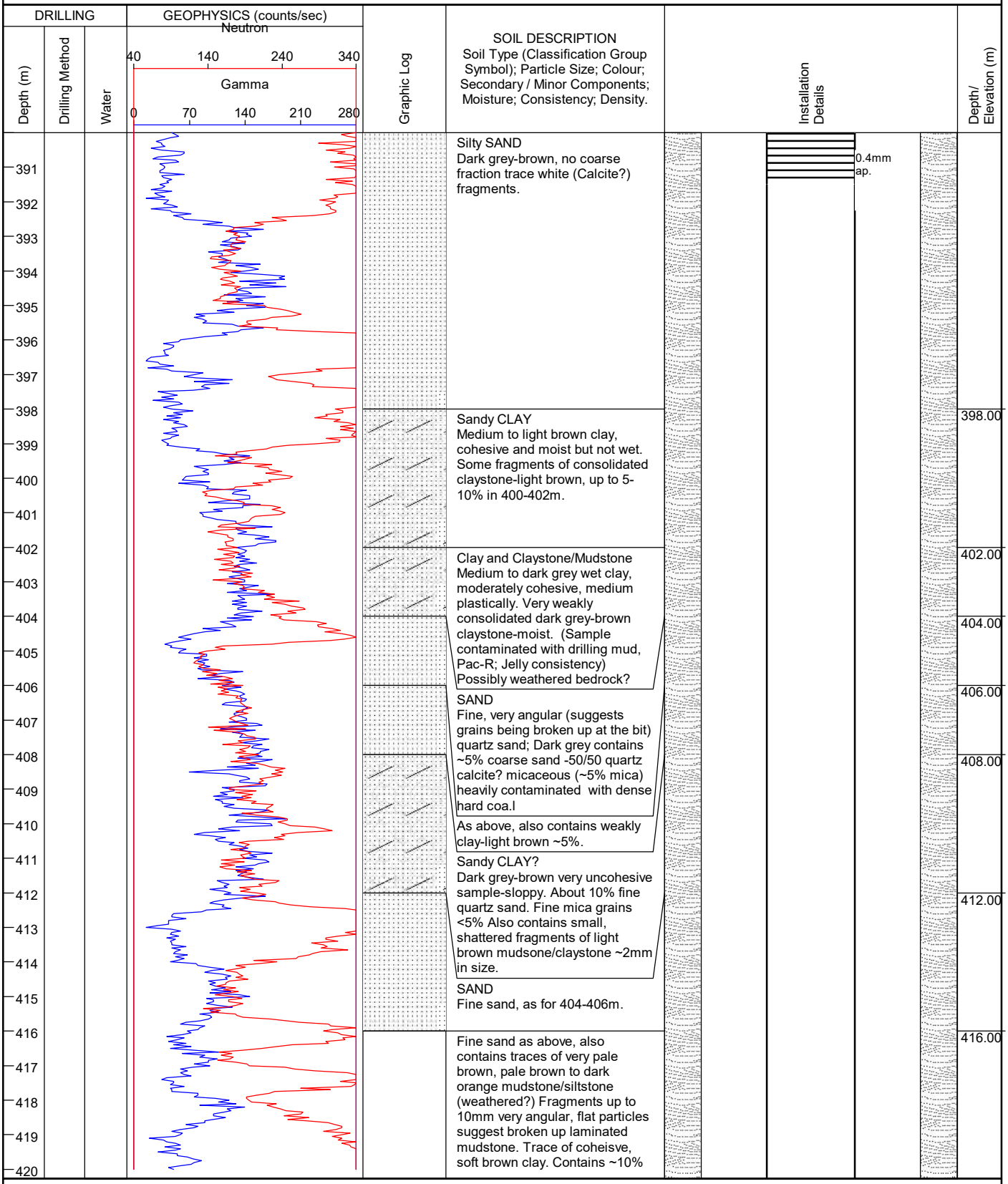

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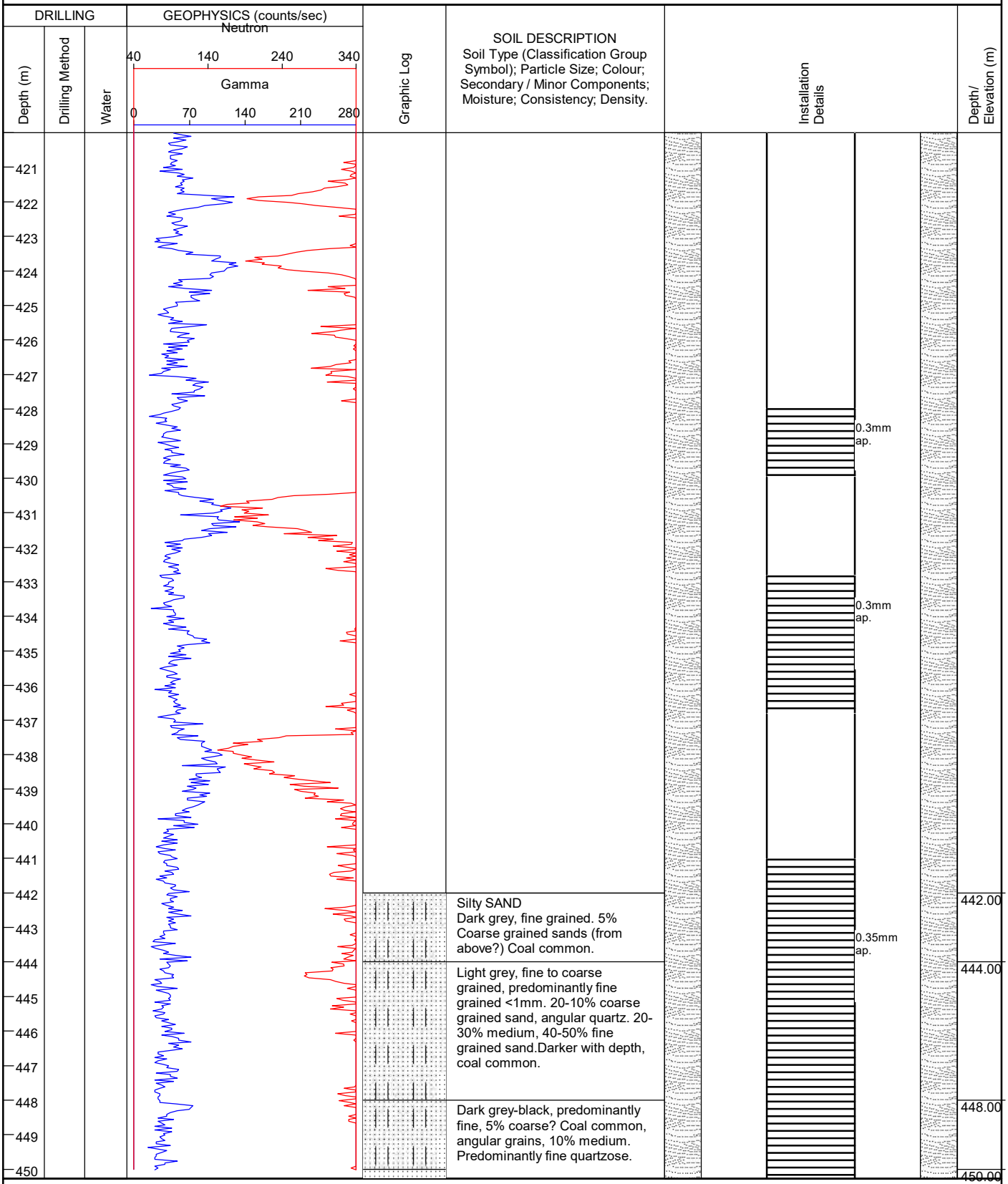

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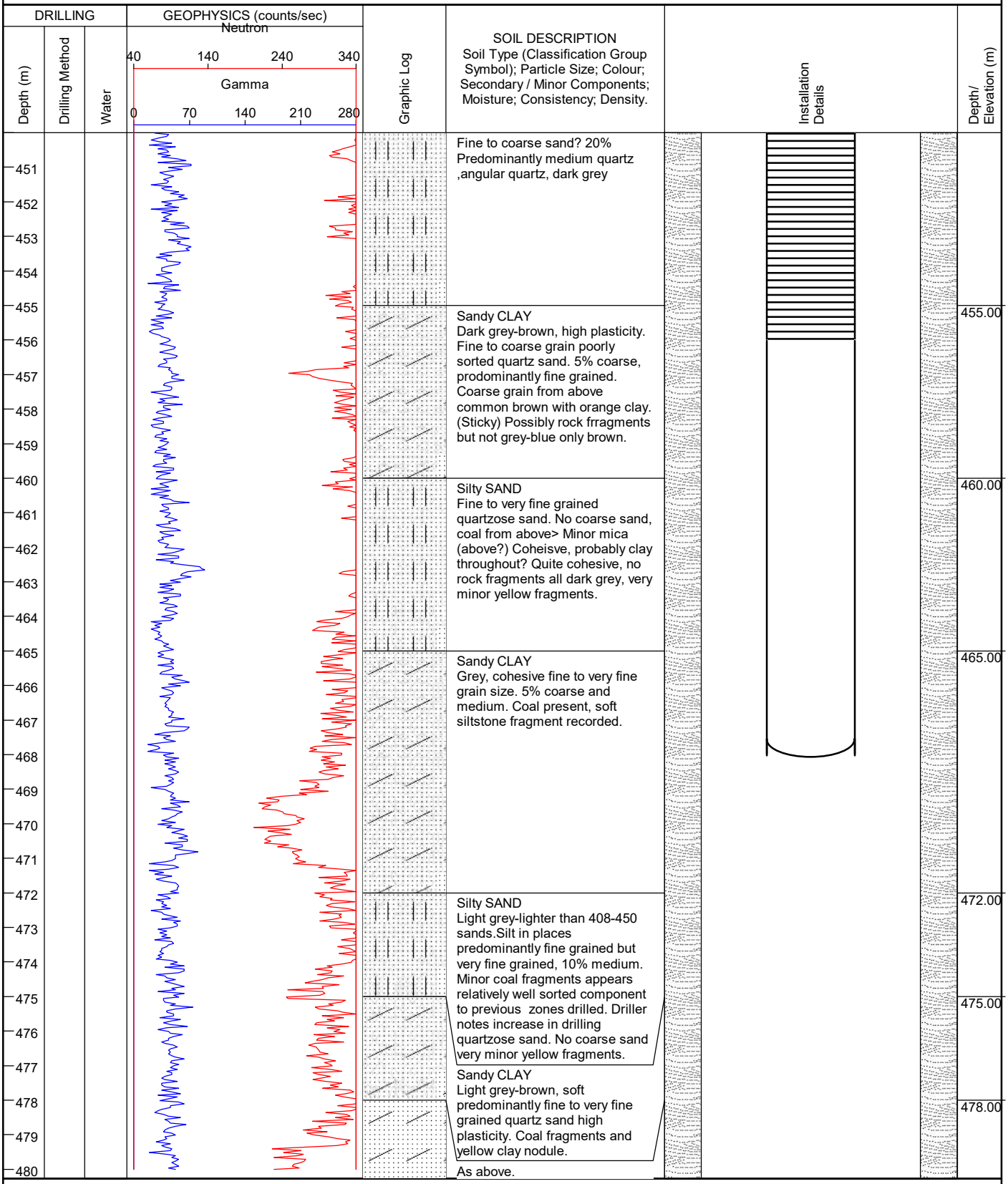

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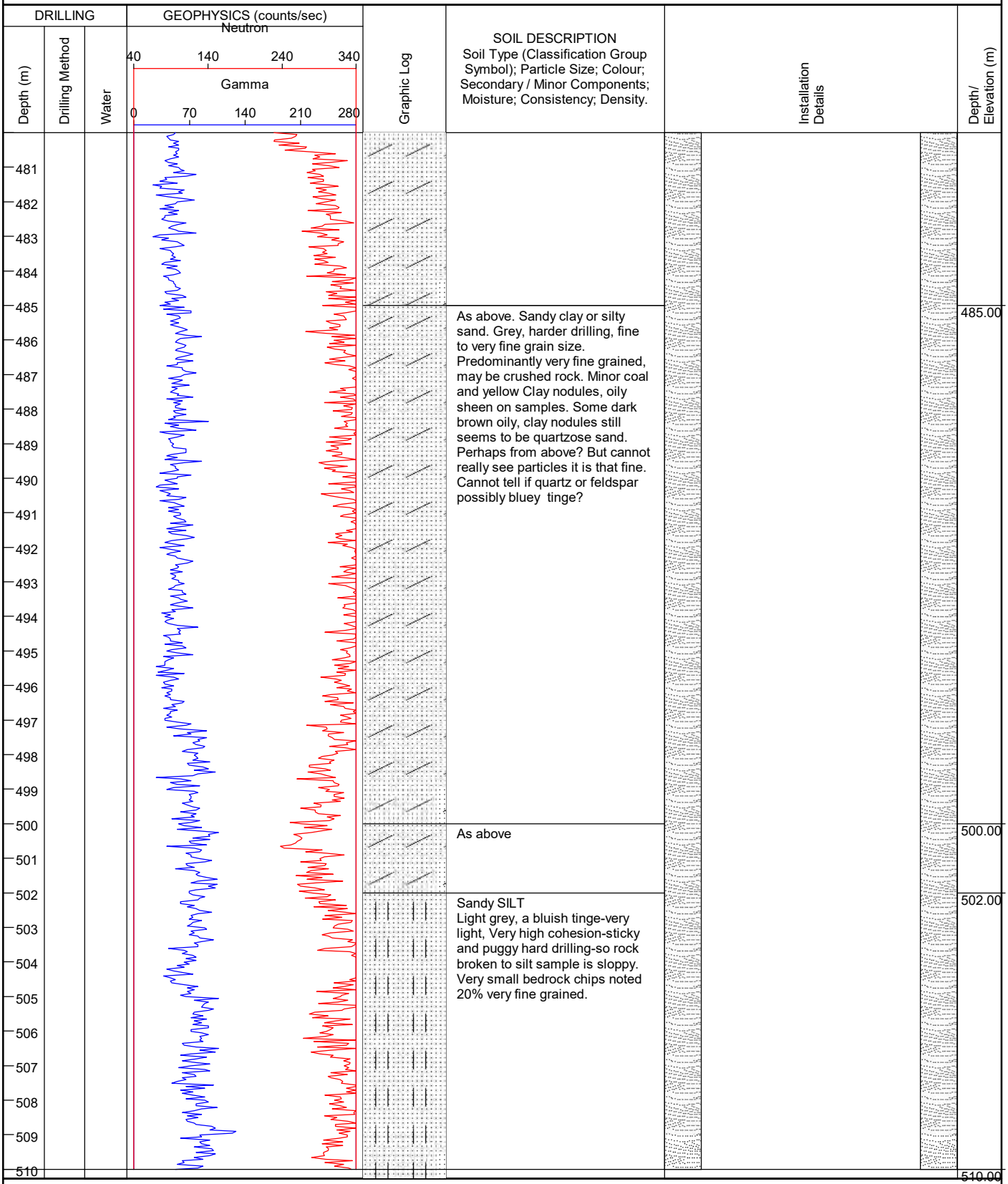

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BOREHOLE LOG
HYDROGEOLOGICAL

Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

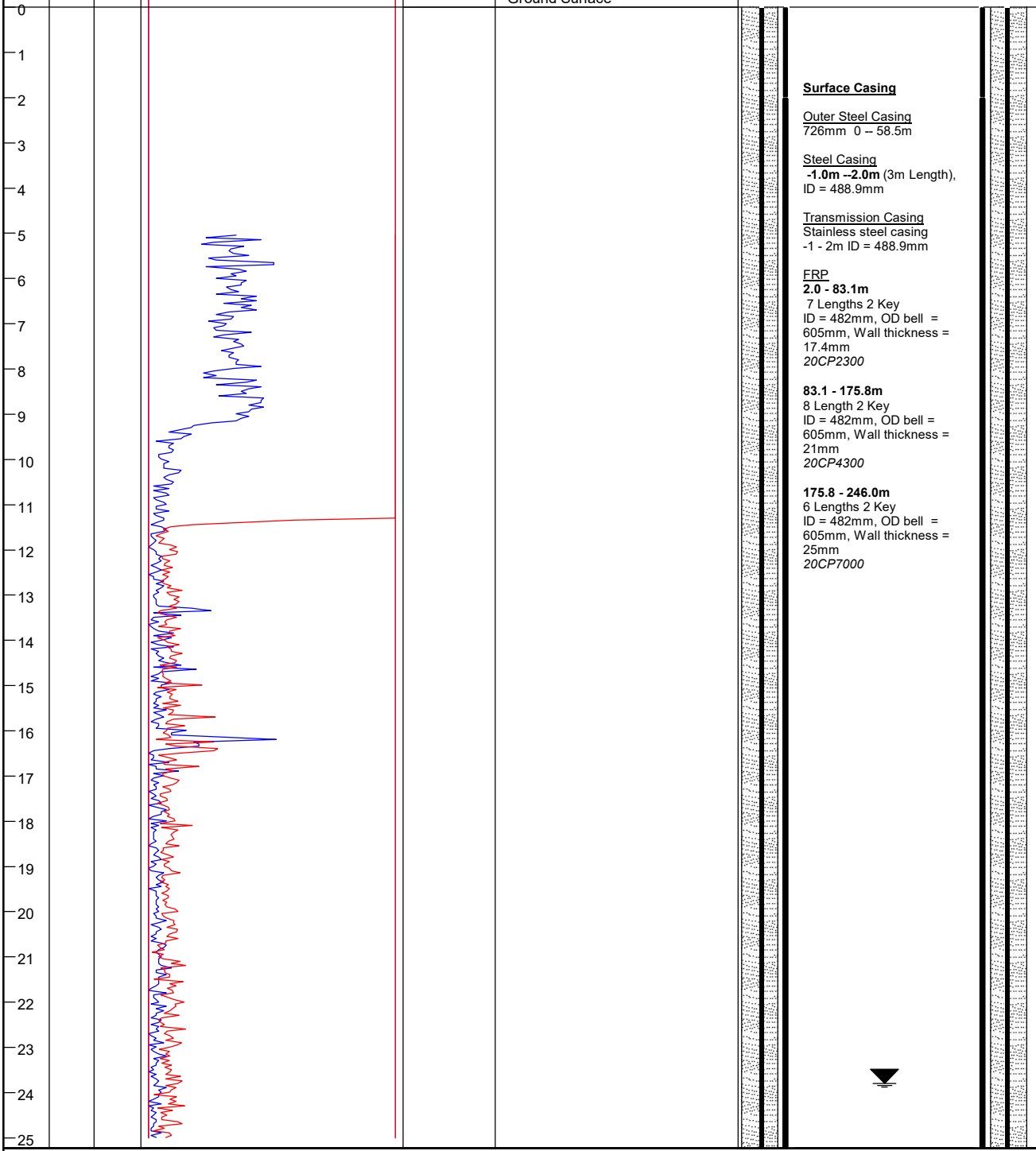
Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6

DRILLING | GEOPHYSICS (counts/sec) | Graphic Log | SOIL DESCRIPTION | Installation Details | Depth/ Elevation (m)

Depth (m) | Drilling Method | Water | Neutron 40 140 240 340 | Gamma 0 70 140 210 280 | Graphic Log | Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density. | Installation Details | Depth/ Elevation (m)

Ground Surface — 0.00



0.00

Surface Casing

Outer Steel Casing
726mm 0 -- 58.5m

Steel Casing
-1.0m --2.0m (3m Length),
ID = 488.9mm

Transmission Casing
Stainless steel casing
-1 - 2m ID = 488.9mm

FRP
2.0 - 83.1m
7 Lengths 2 Key
ID = 482mm, OD bell = 605mm, Wall thickness = 17.4mm
20CP2300

83.1 - 175.8m
8 Length 2 Key
ID = 482mm, OD bell = 605mm, Wall thickness = 21mm
20CP4300

175.8 - 246.0m
6 Lengths 2 Key
ID = 482mm, OD bell = 605mm, Wall thickness = 25mm
20CP7000

NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW5
Page: 2 of 26

Client: Barwon Water
Project: Anglesea Borefield Project
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Driller: Craig Gordon, Aaron Frood
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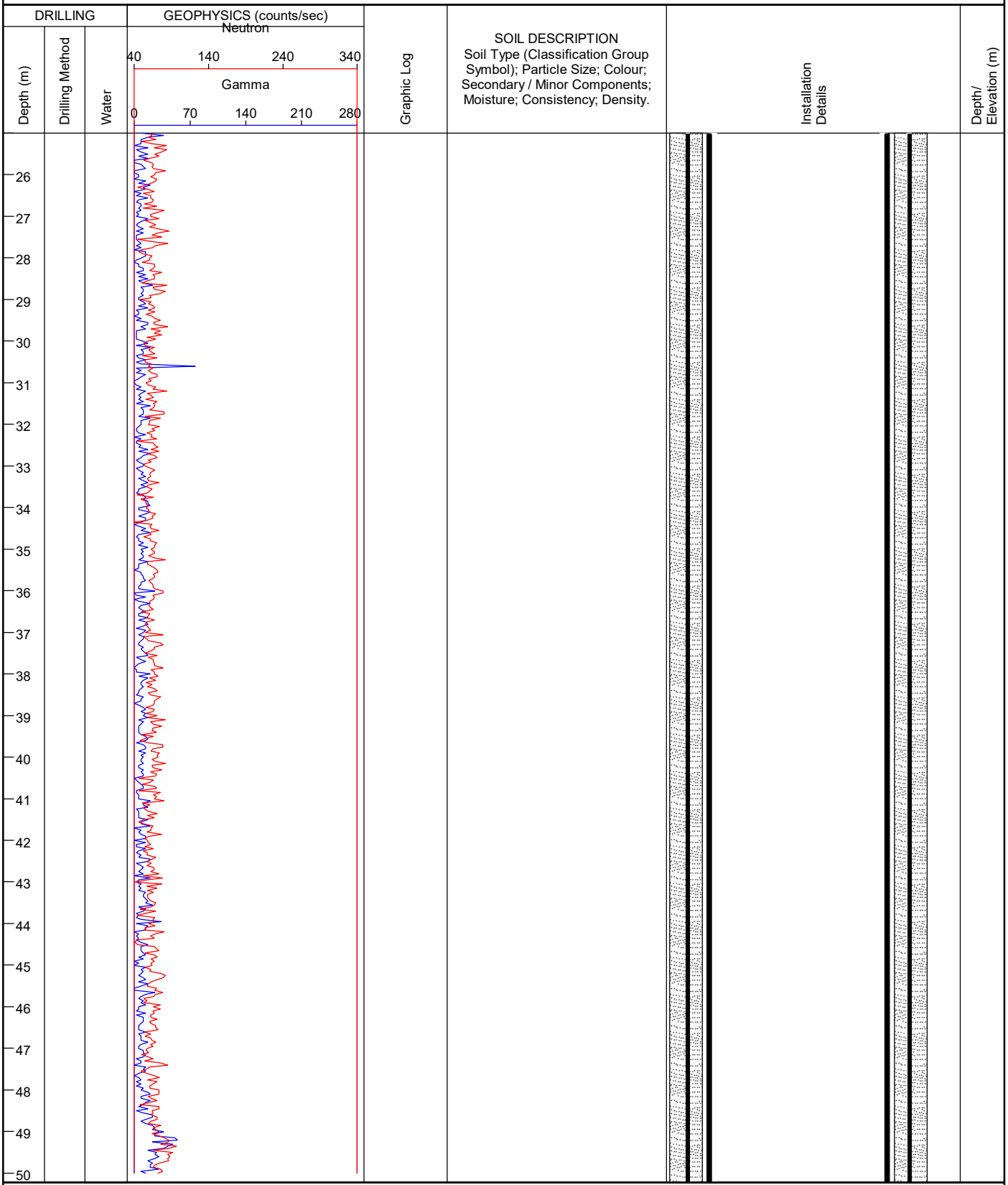

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HYDROGEOLOGICAL

Bore No.: GW5
Page: 3 of 26

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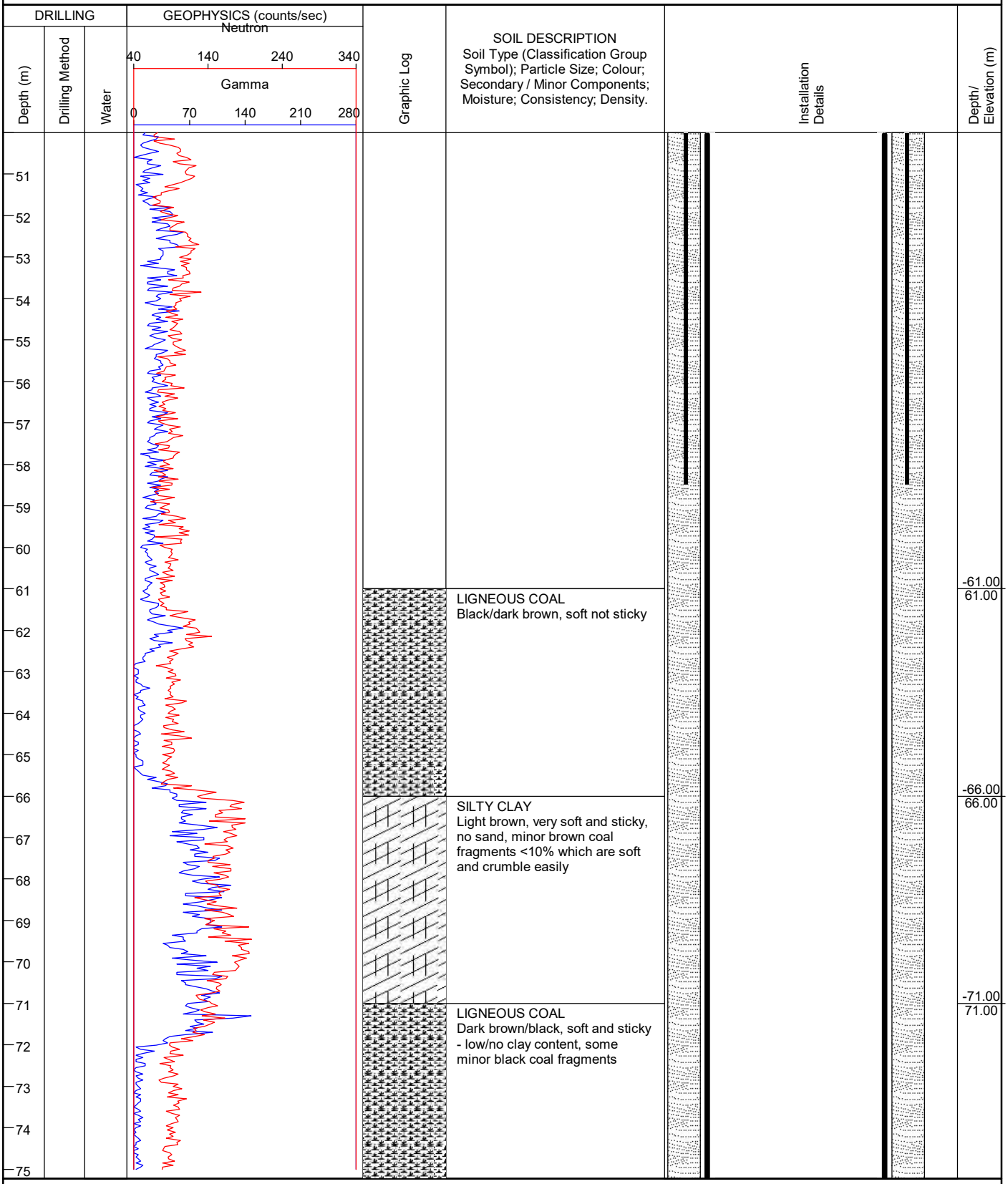

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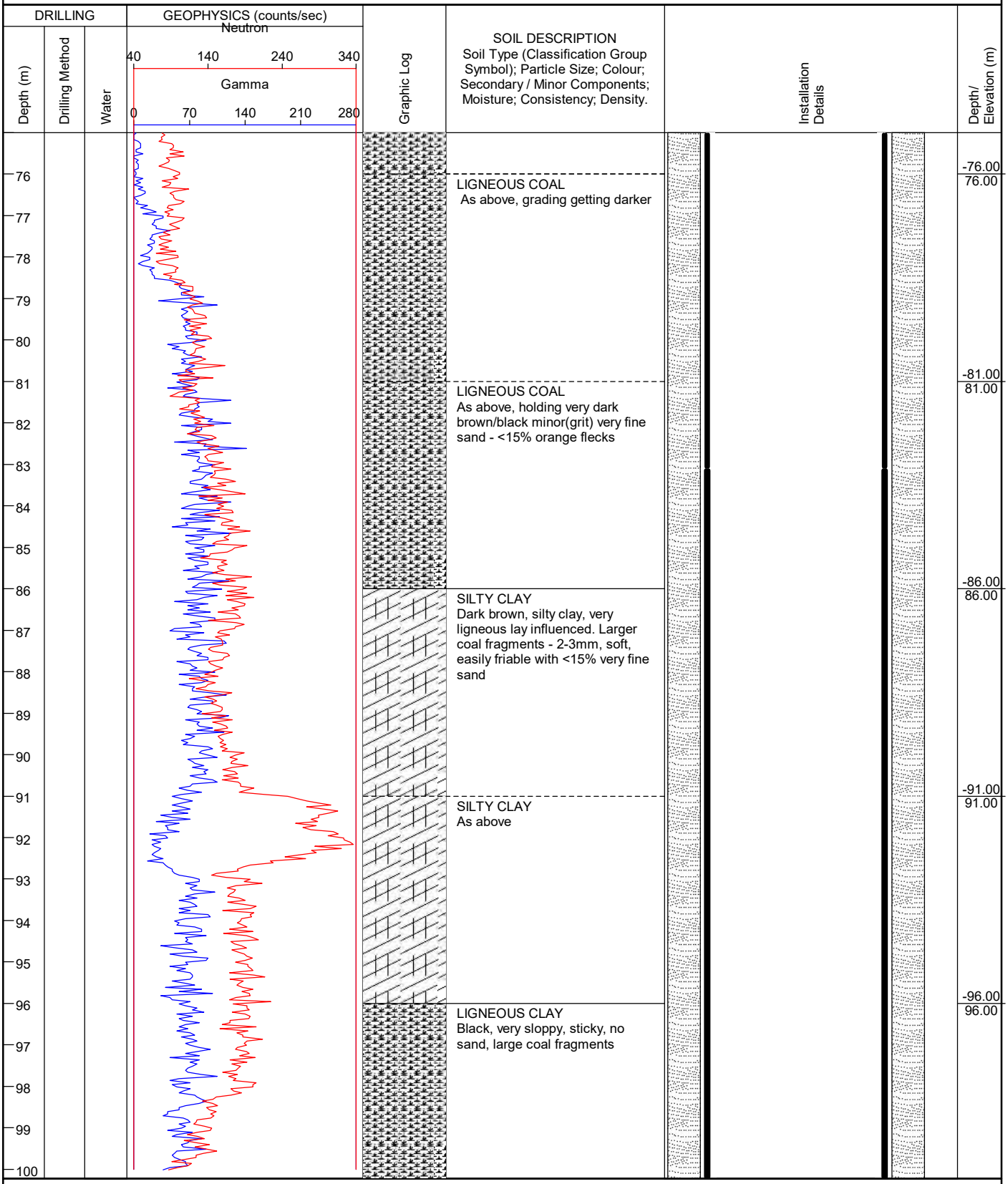

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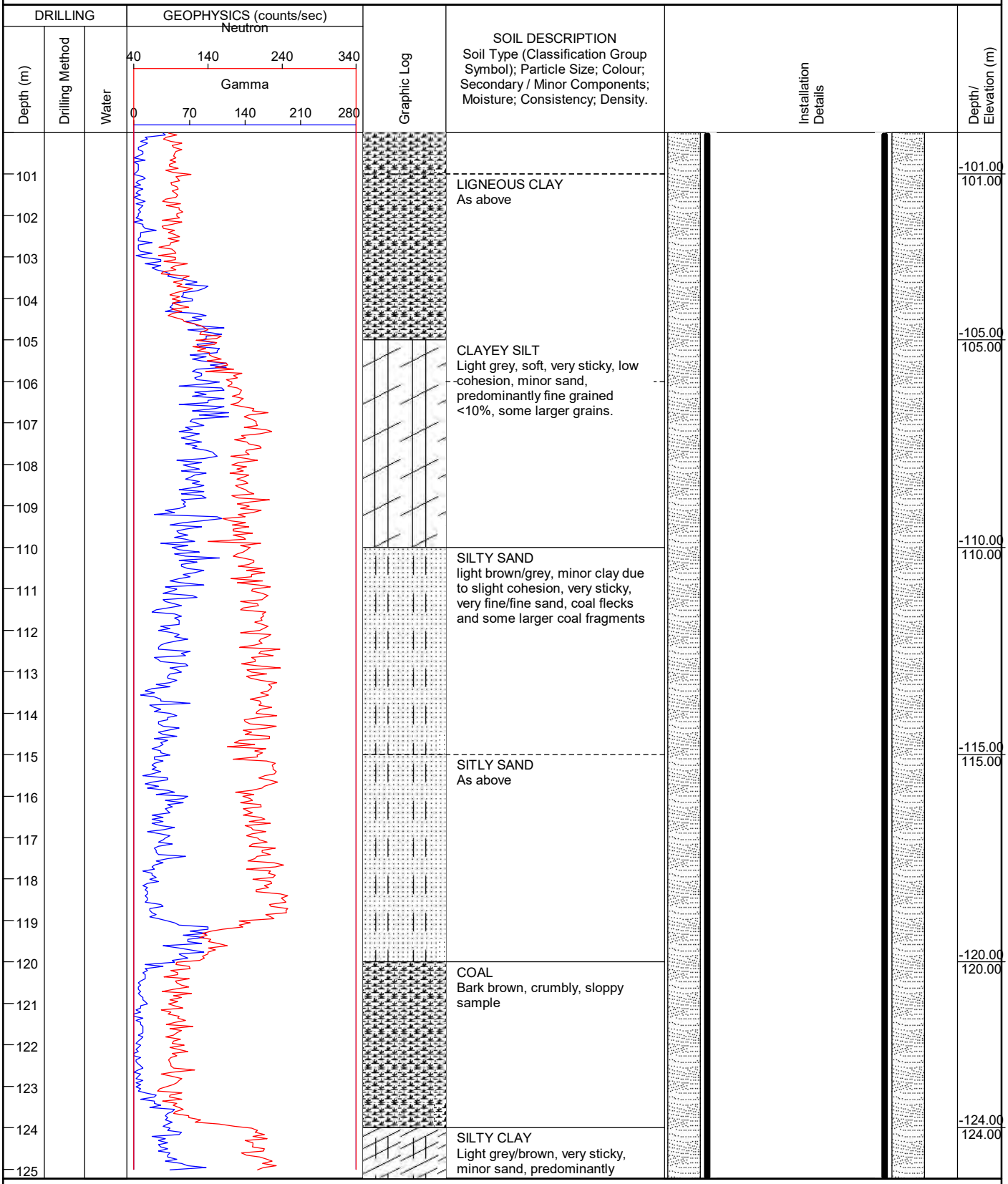

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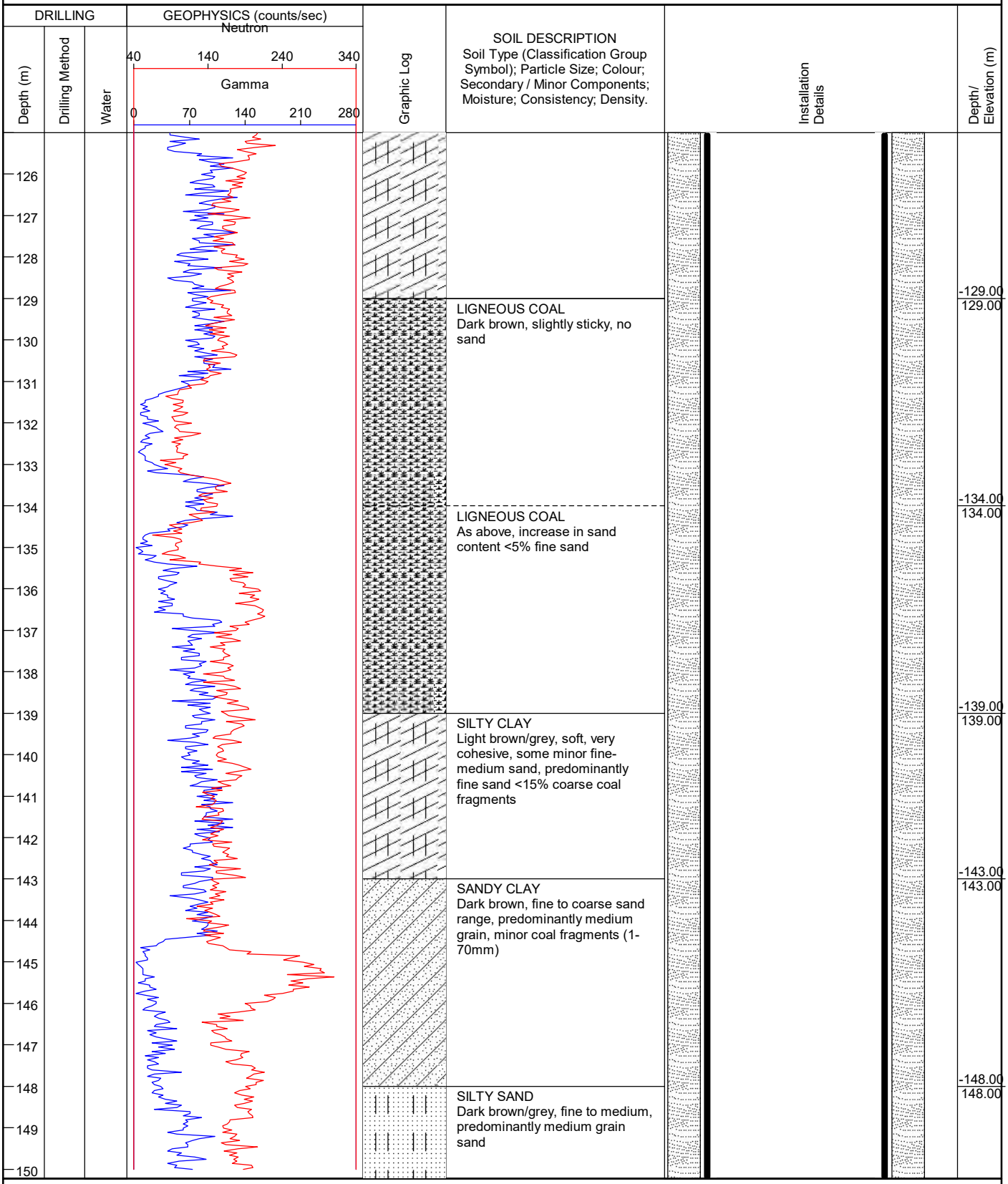

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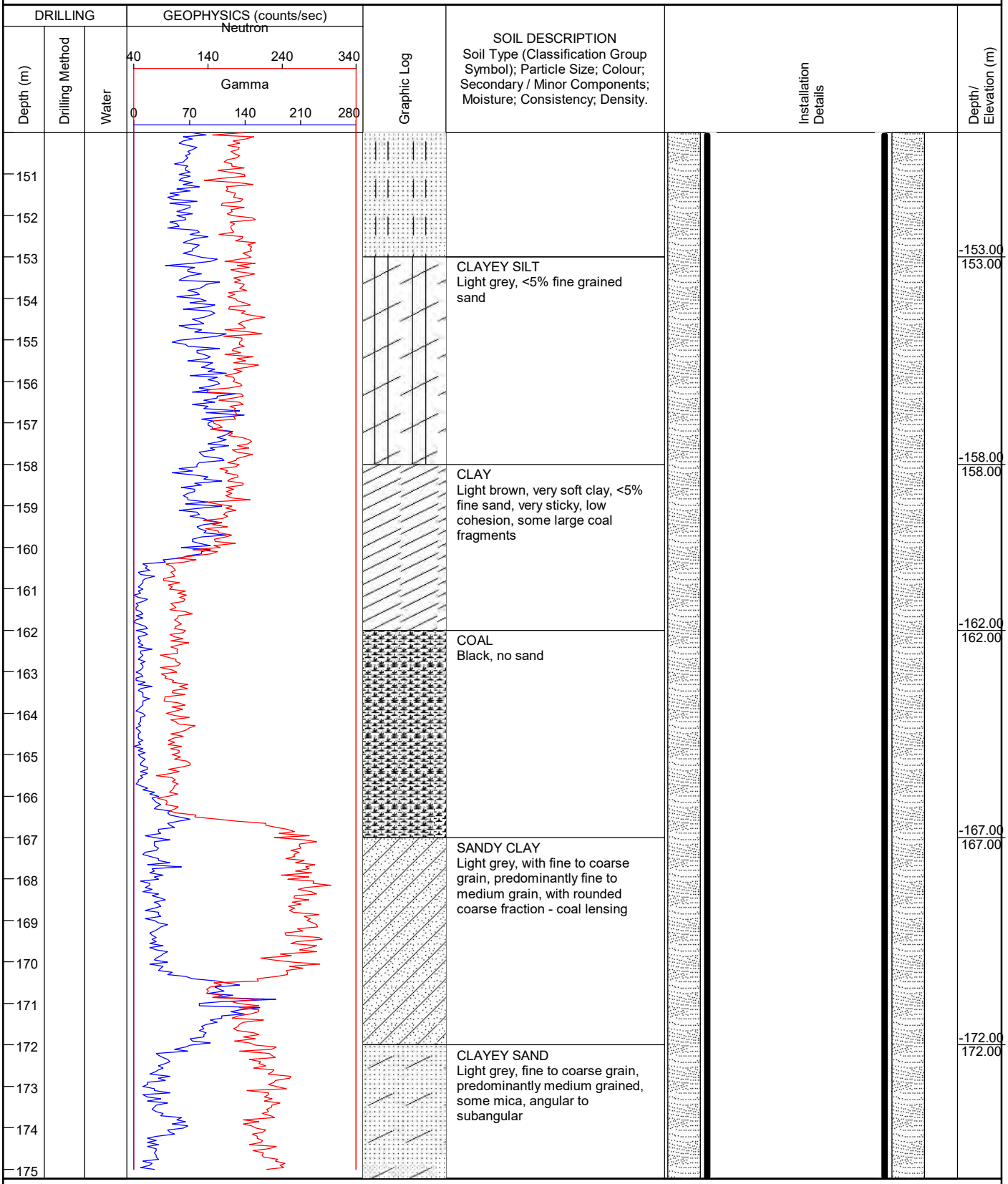

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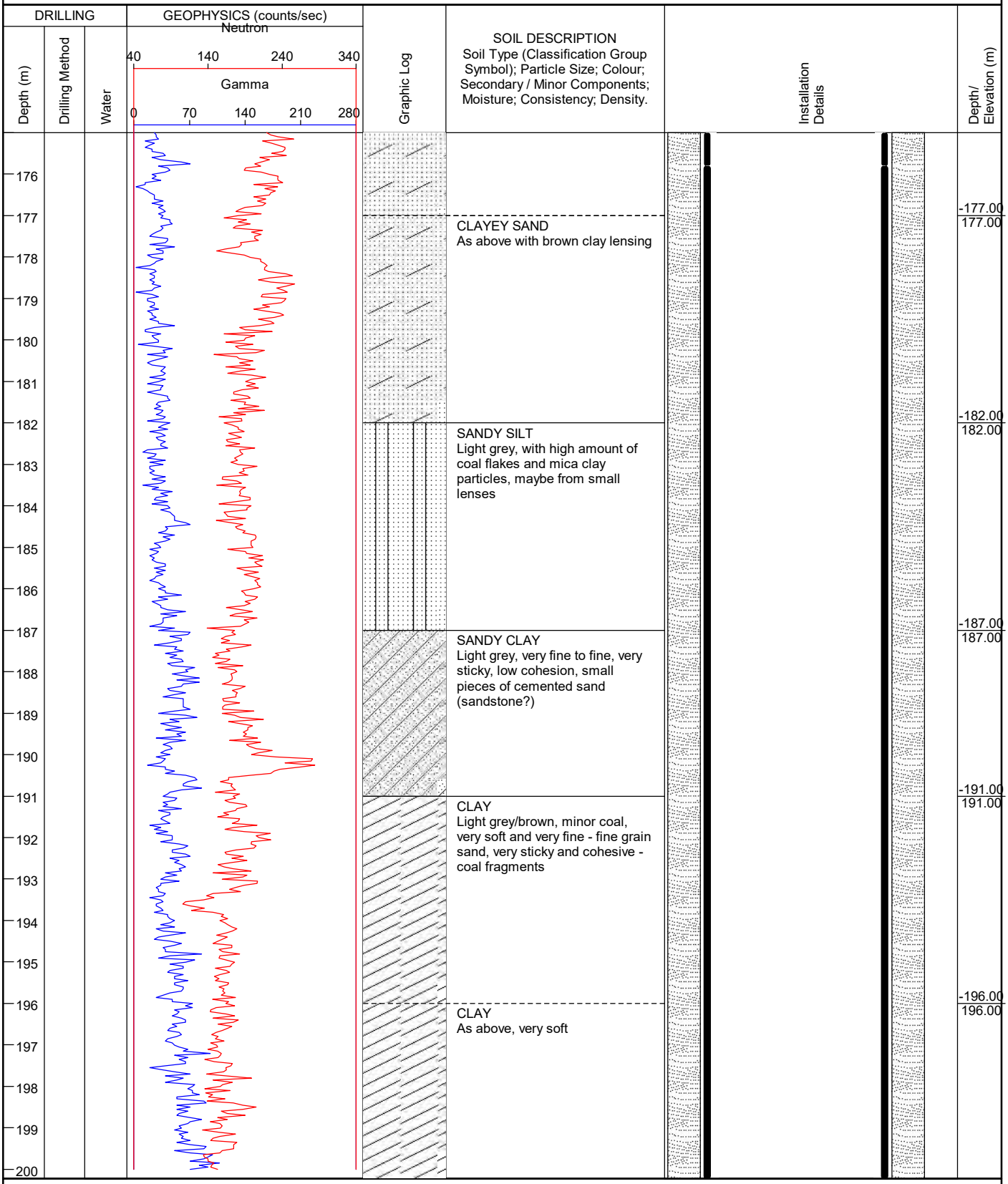

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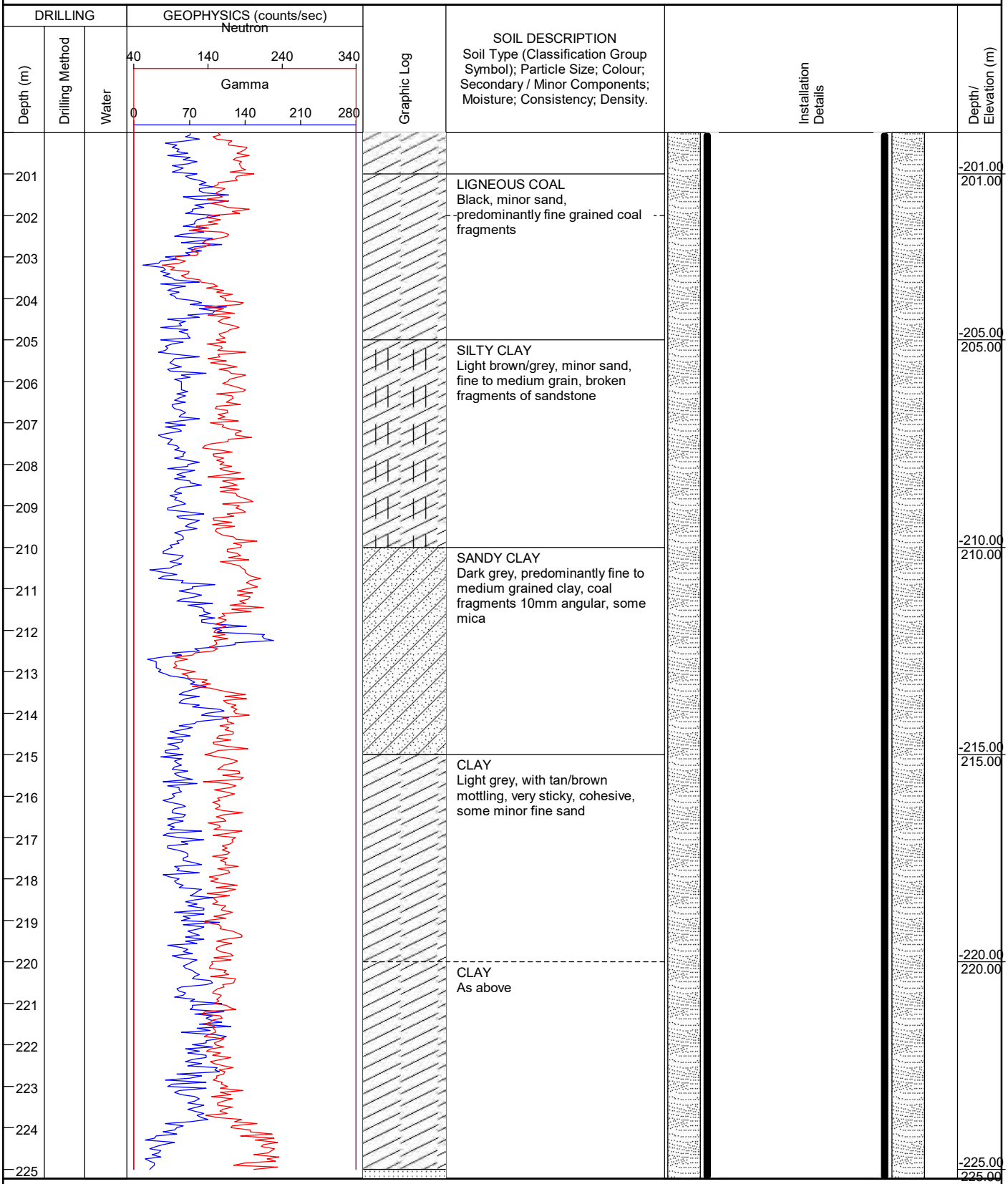
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

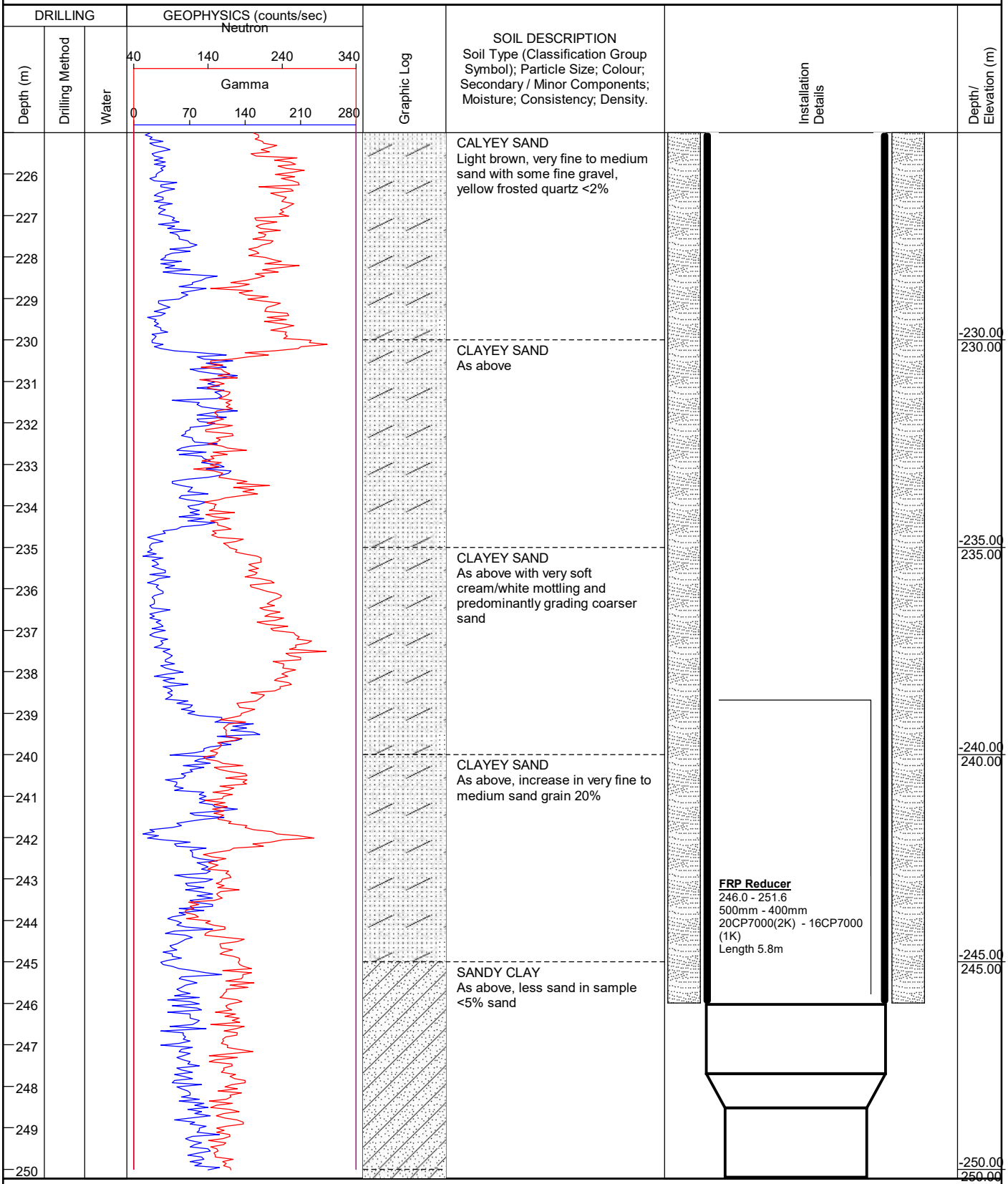
Bore No.: GW5
Page: 10 of 26

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

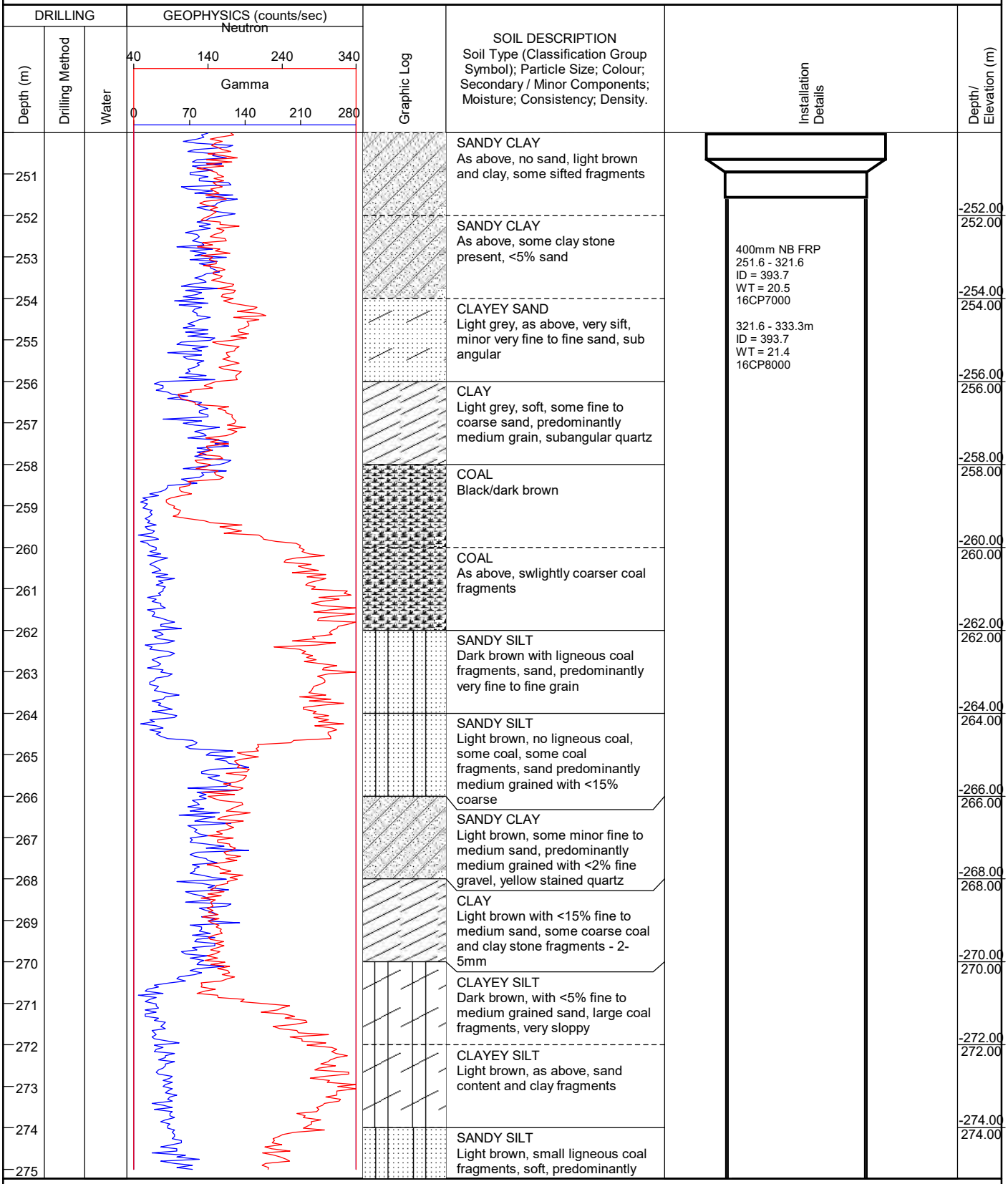
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

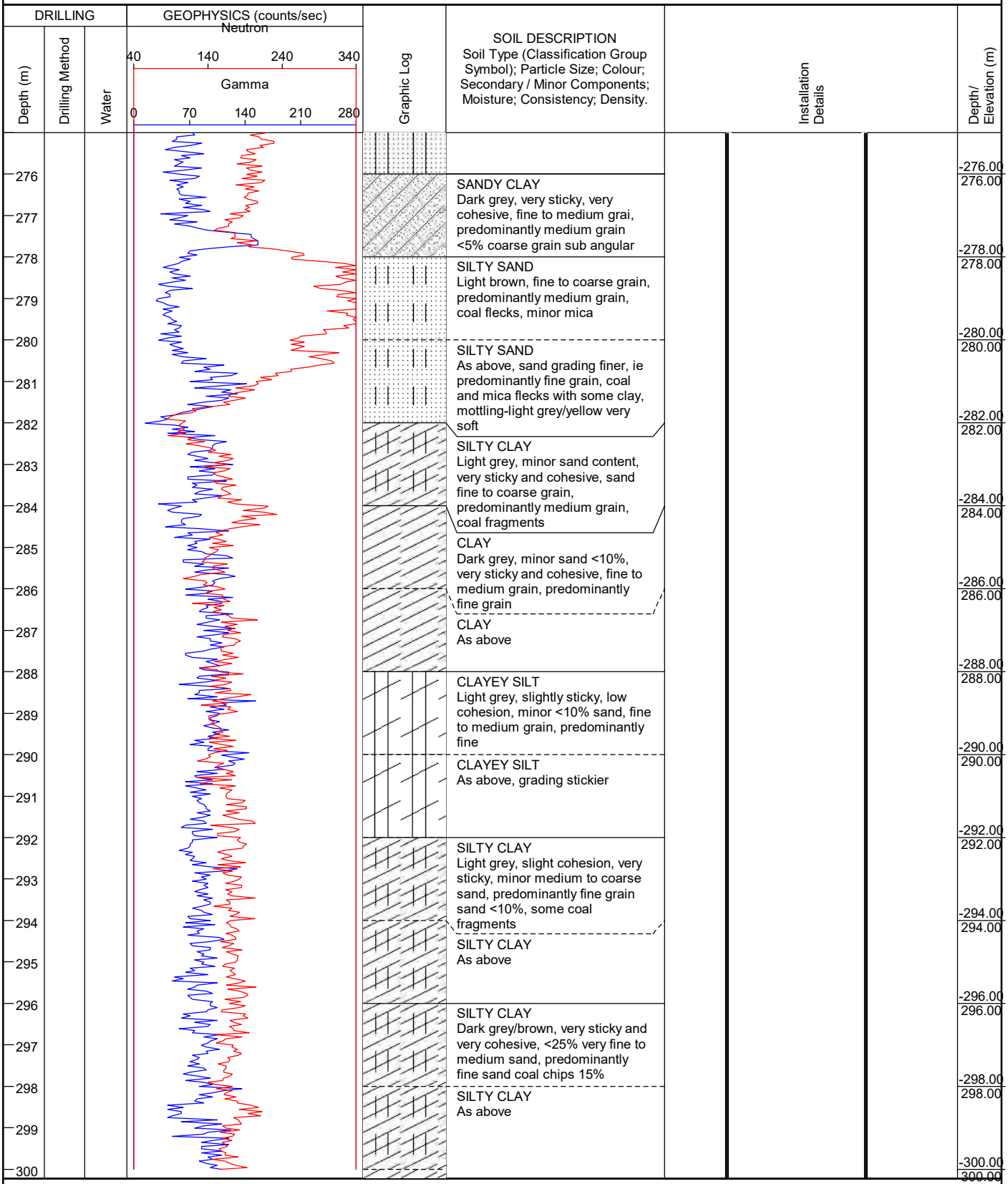
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

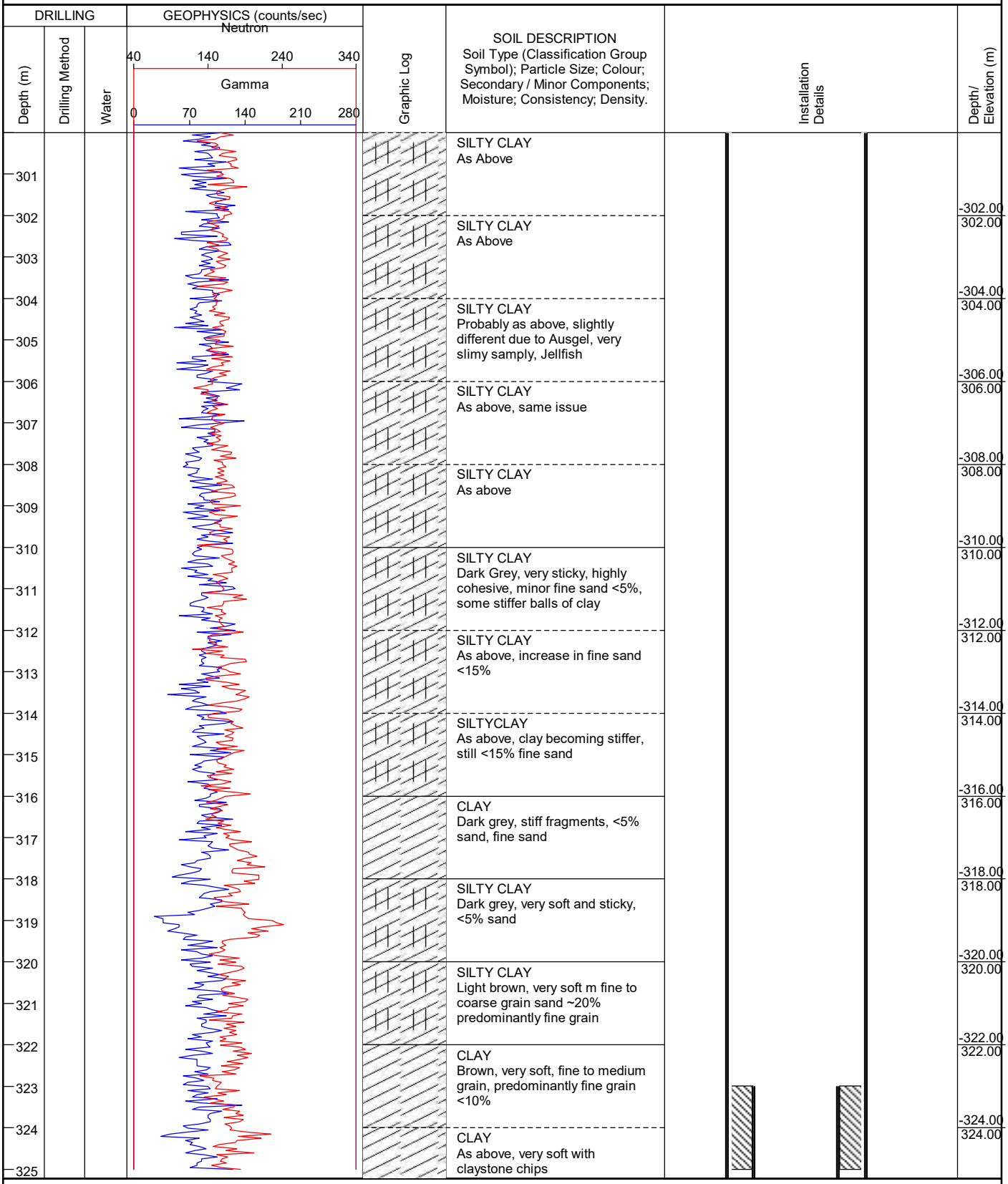
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

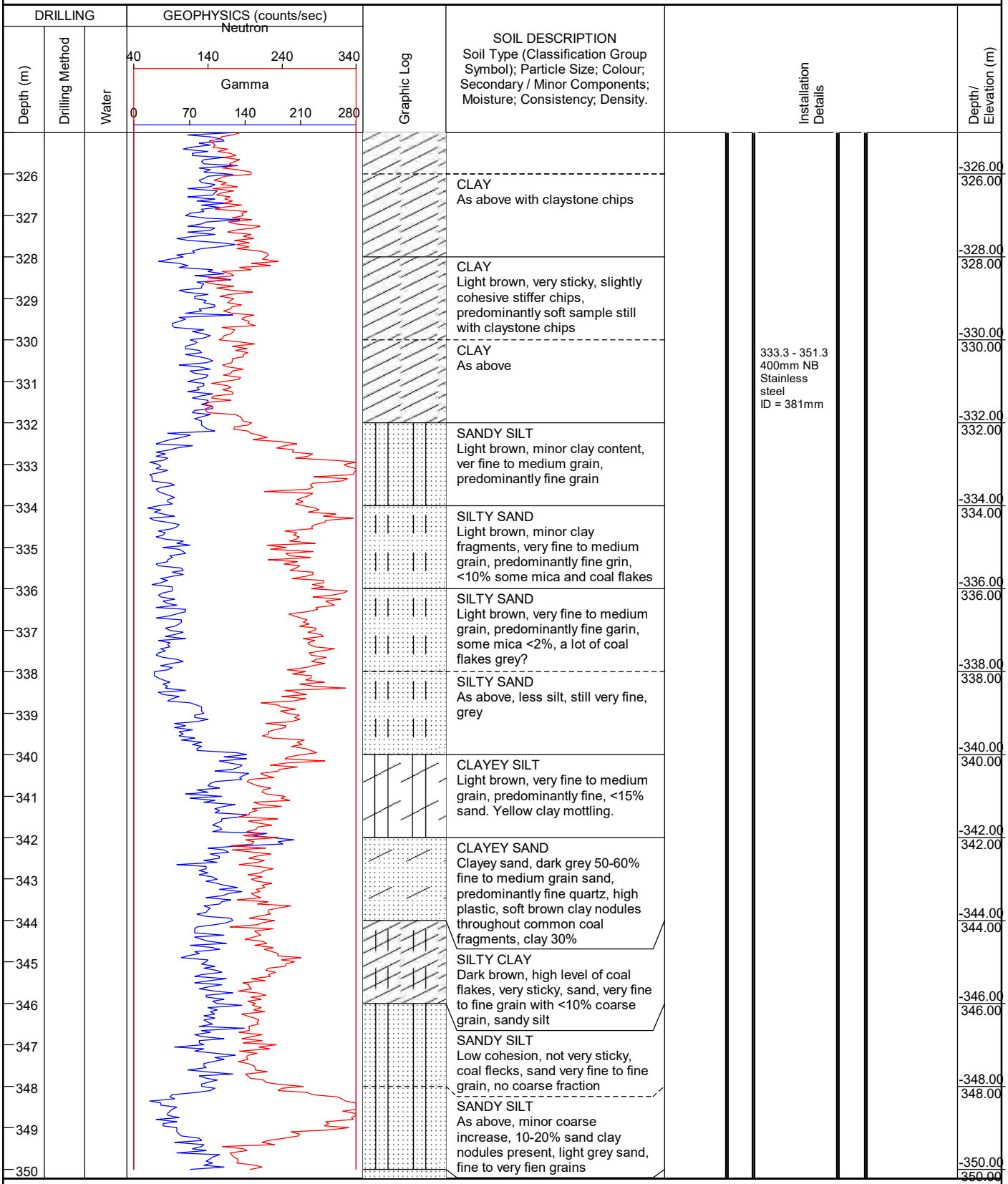
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

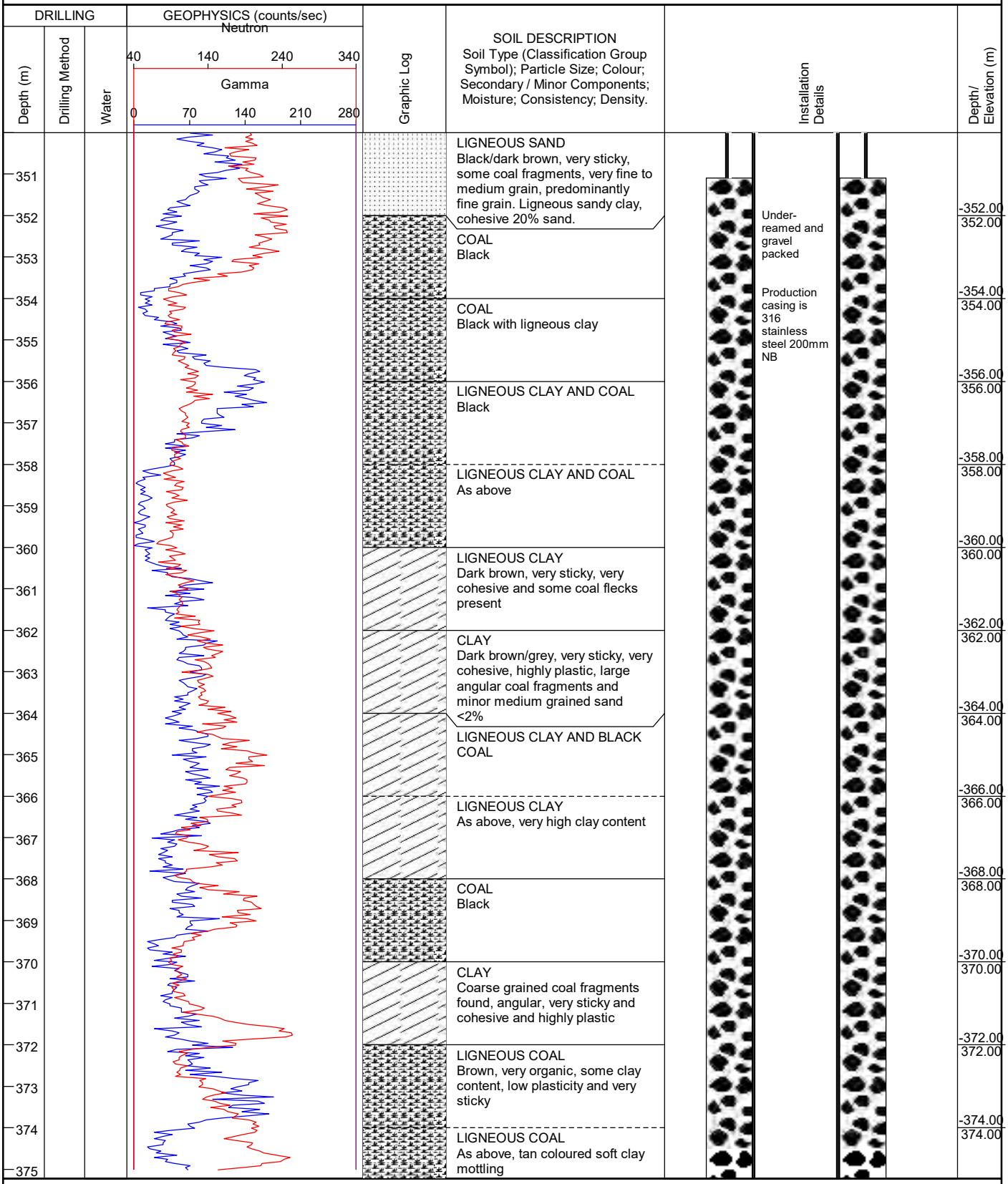
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

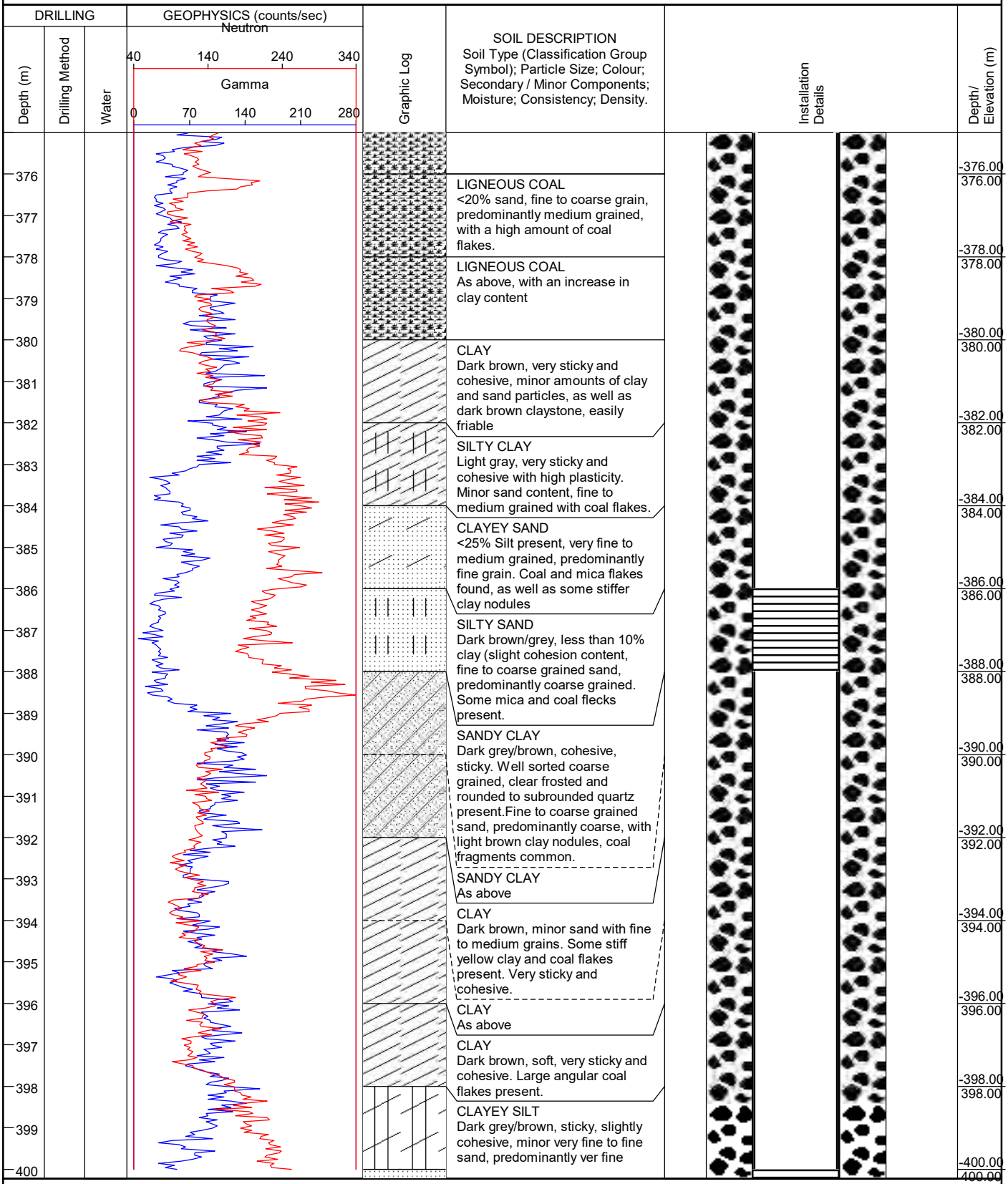
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

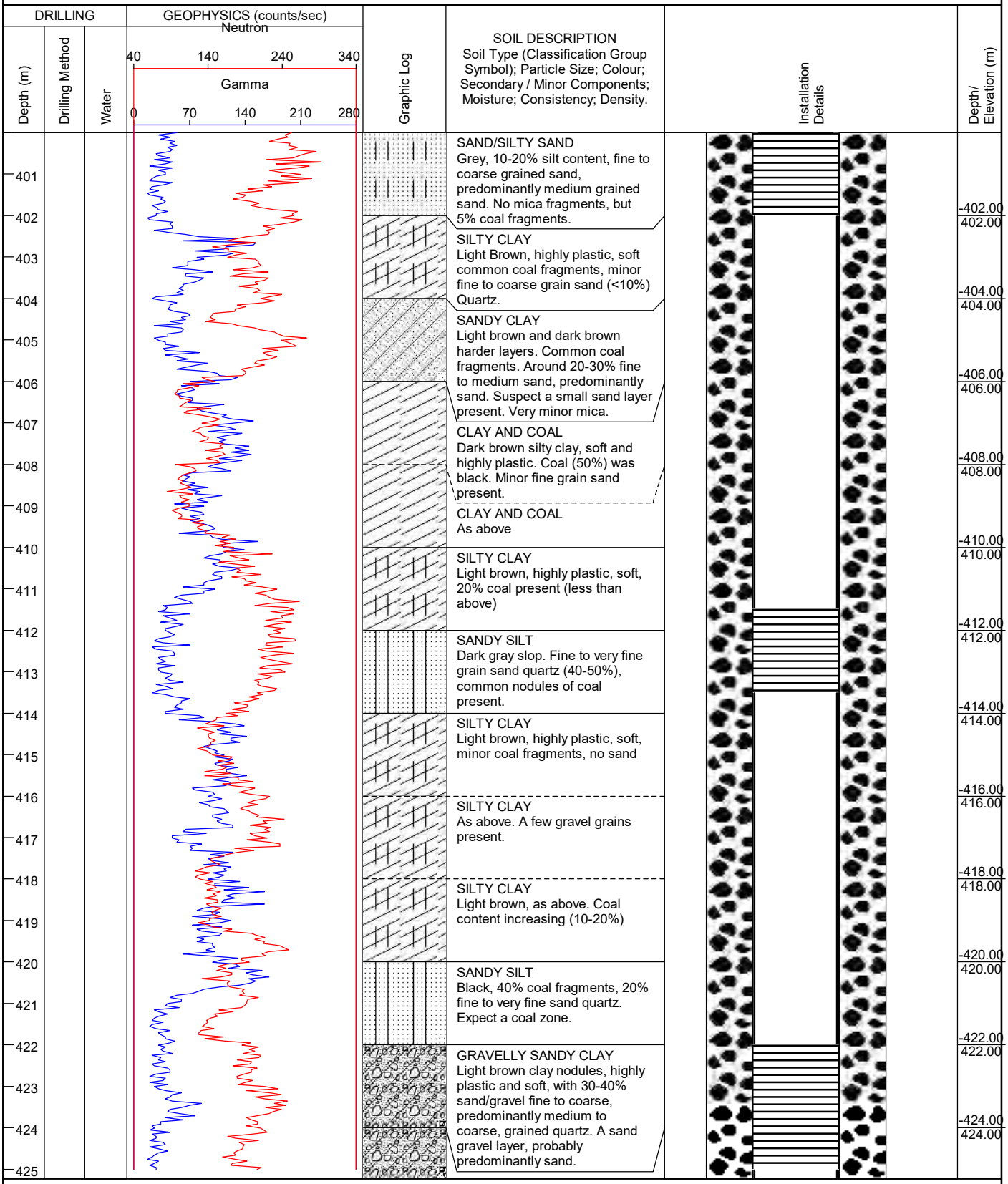
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

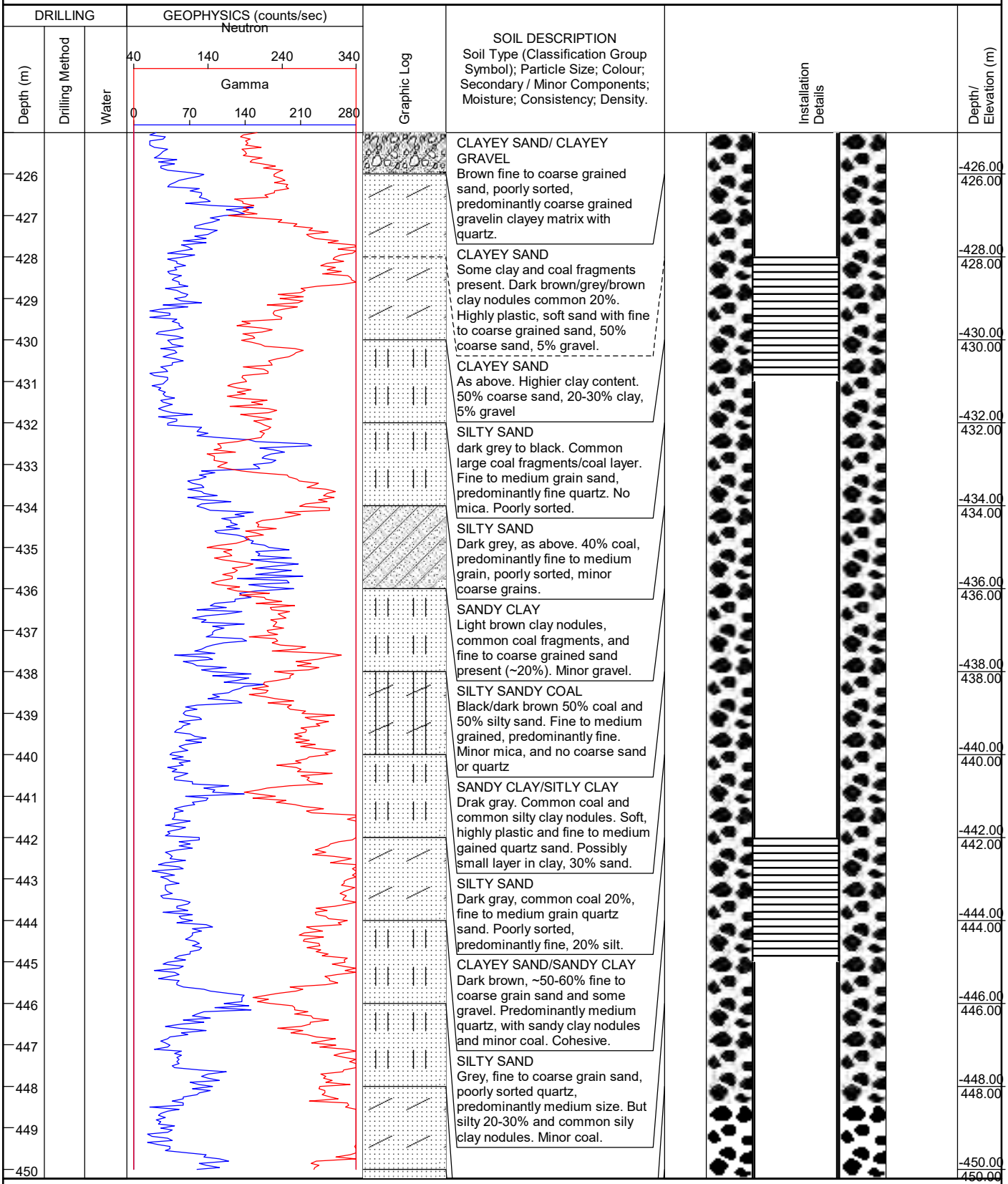
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

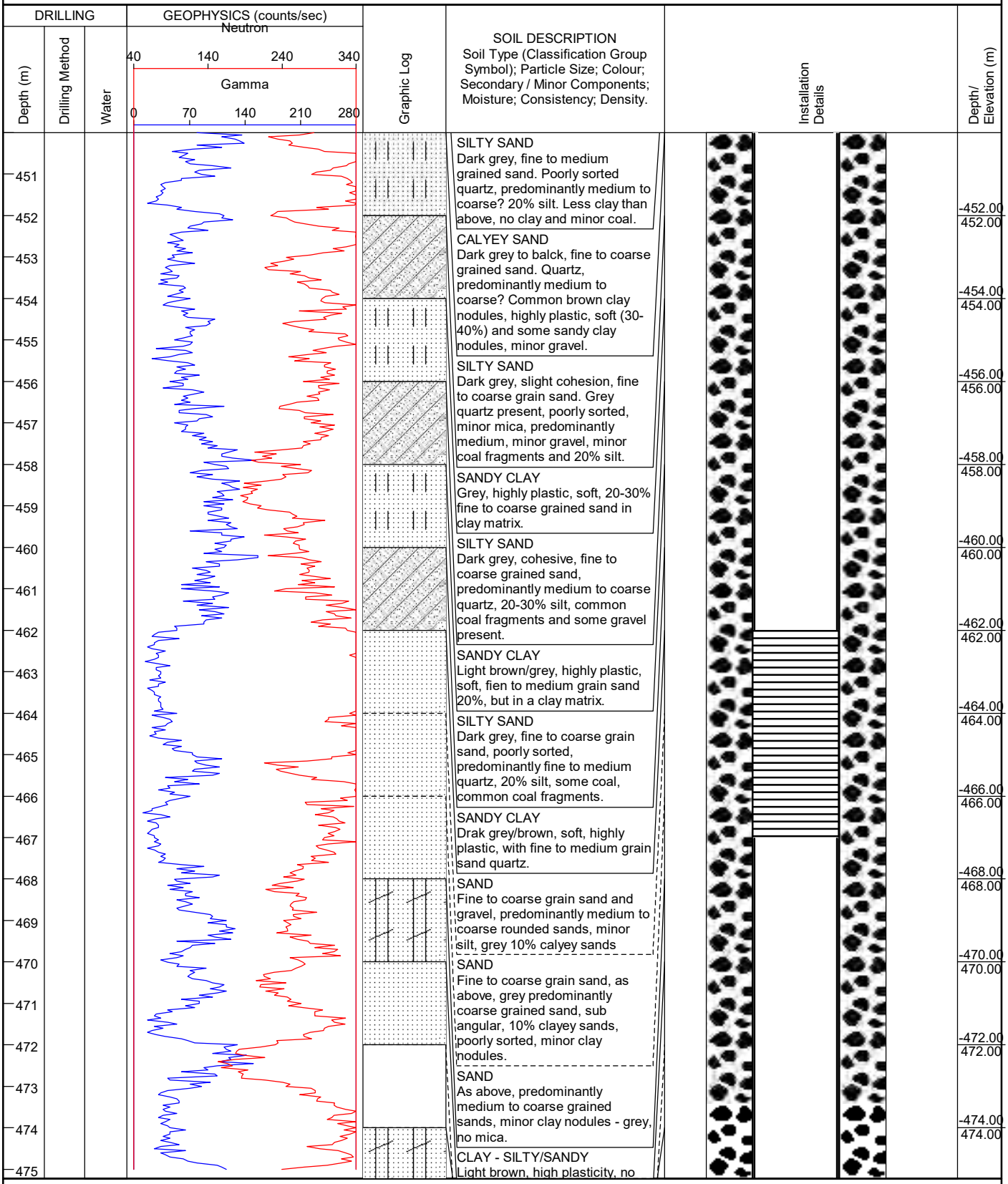
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

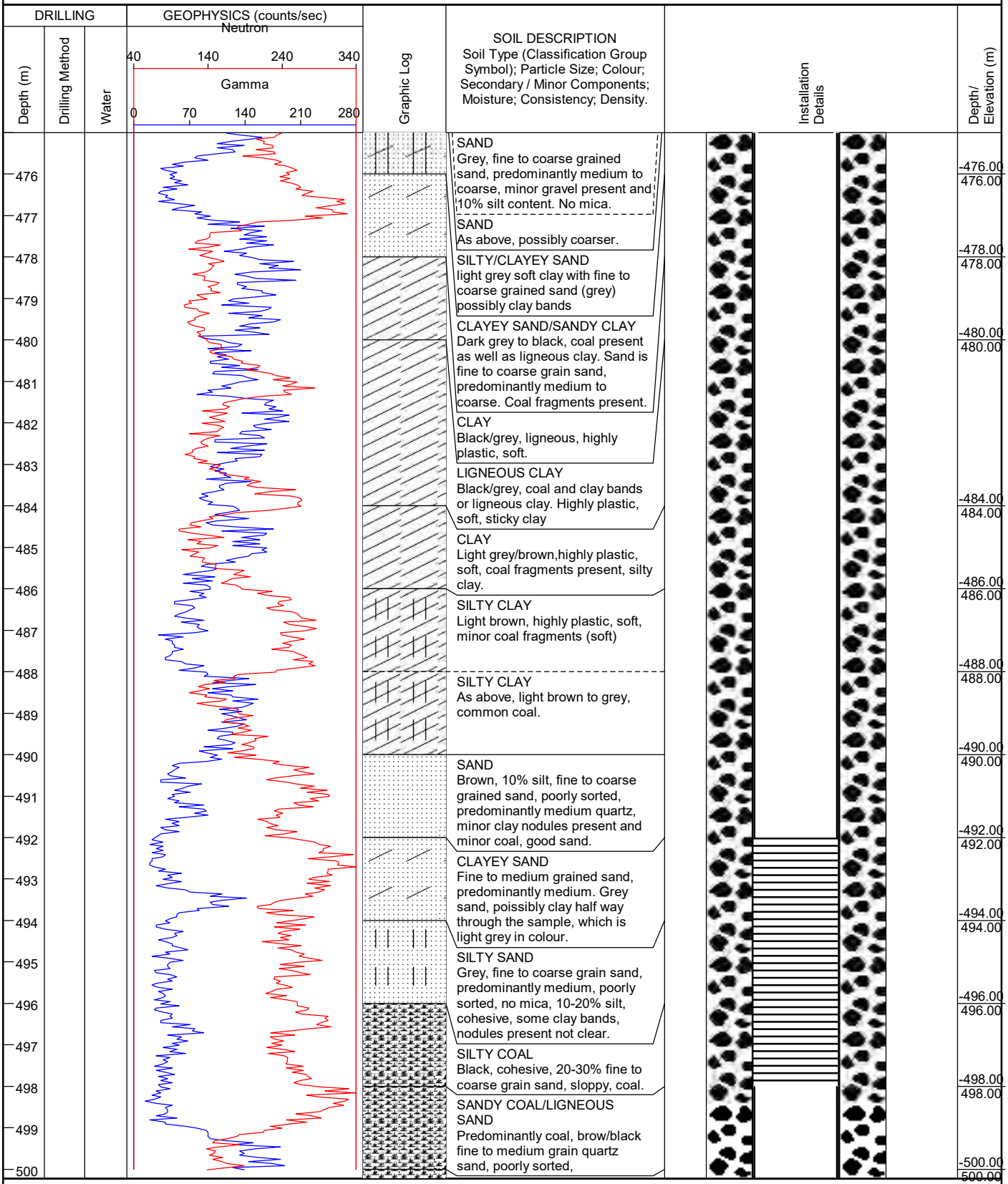
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

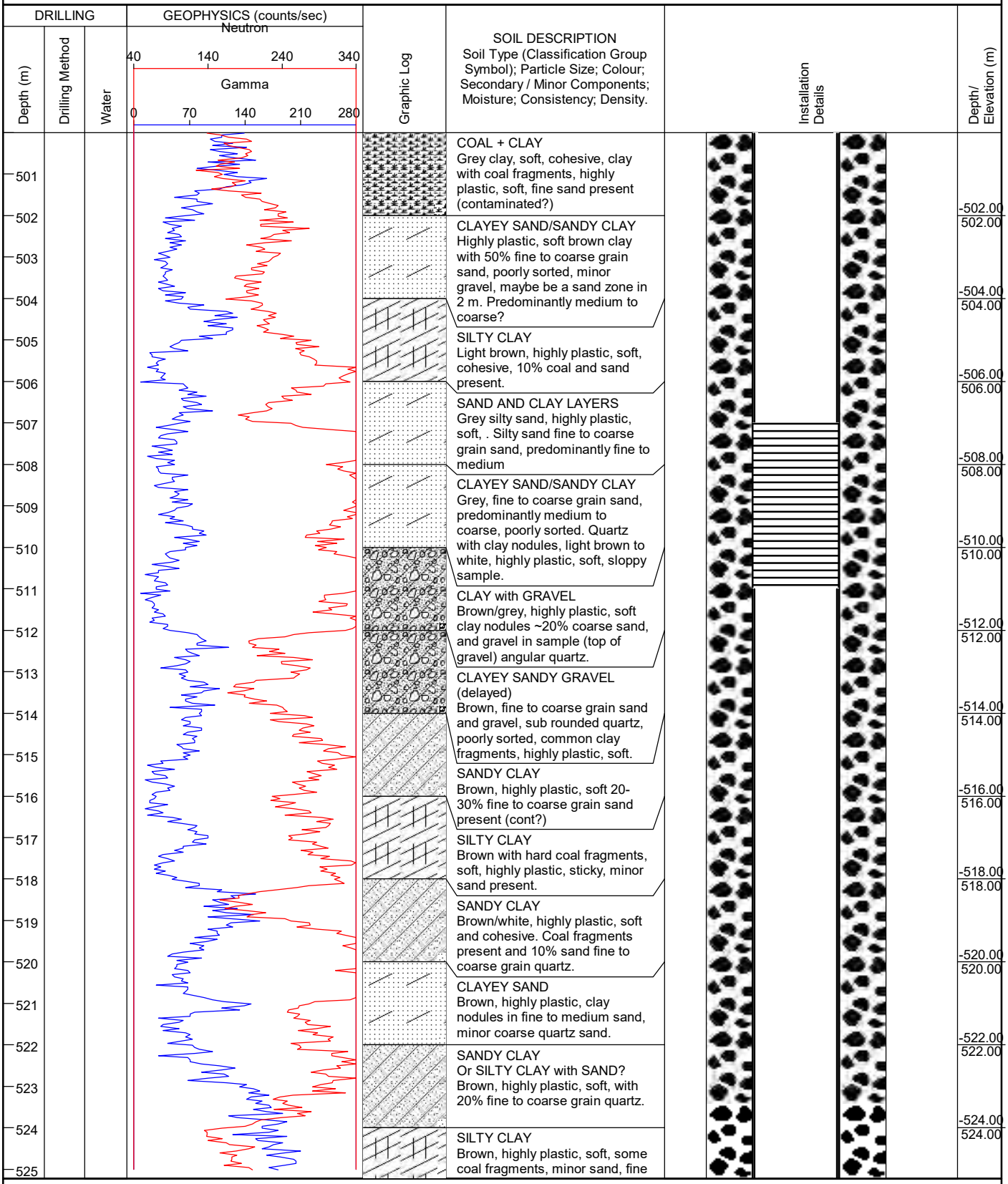
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

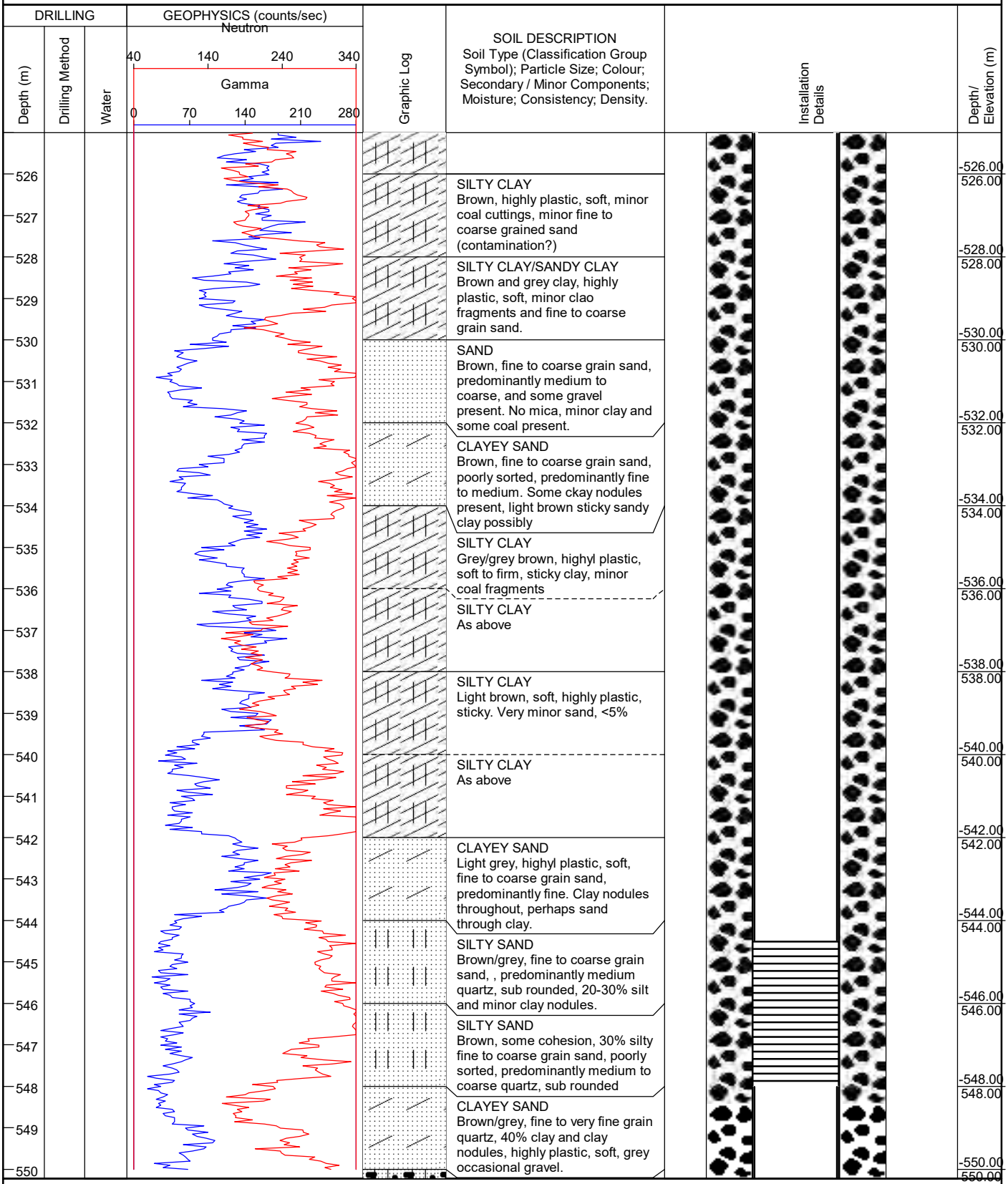
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

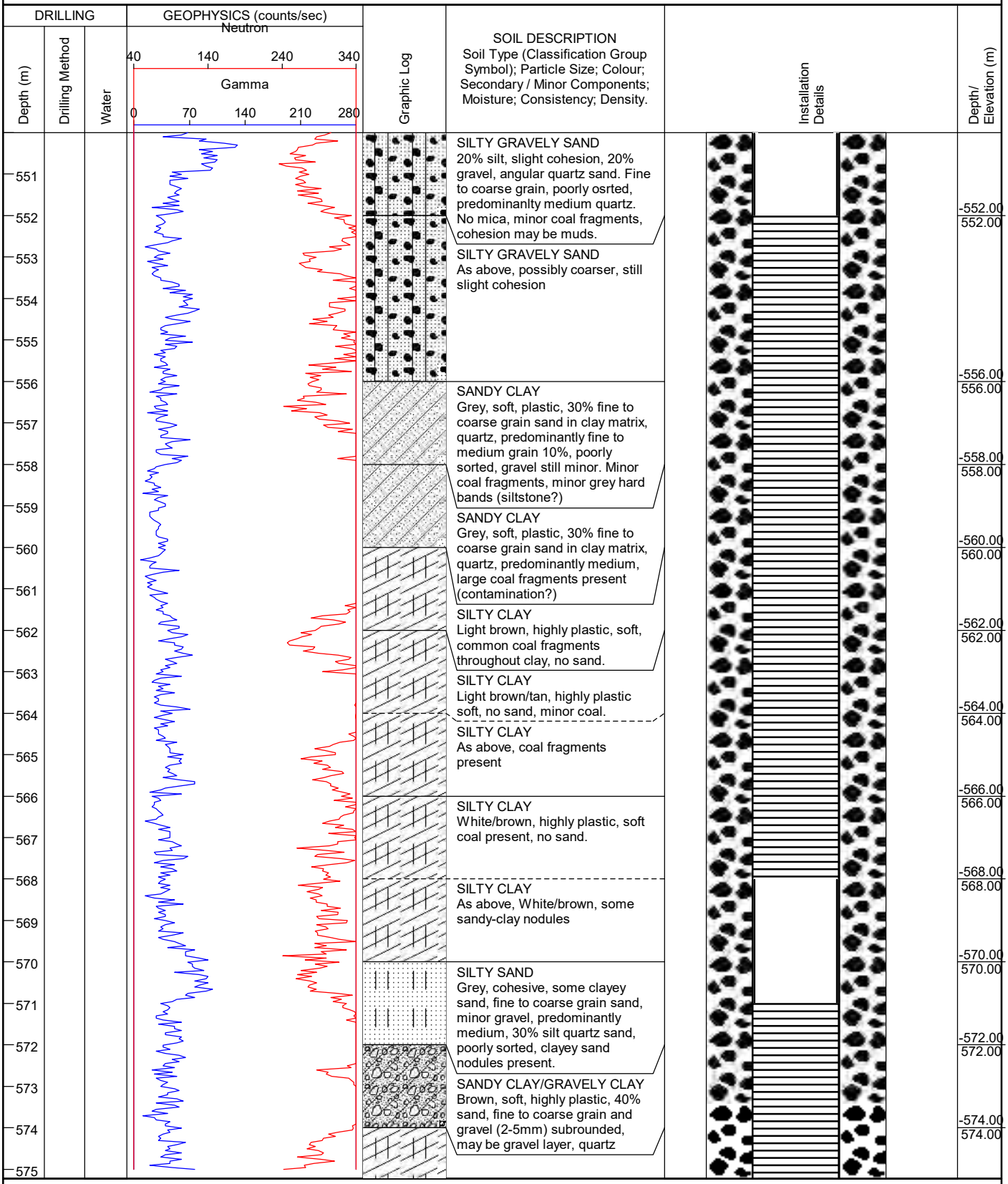
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

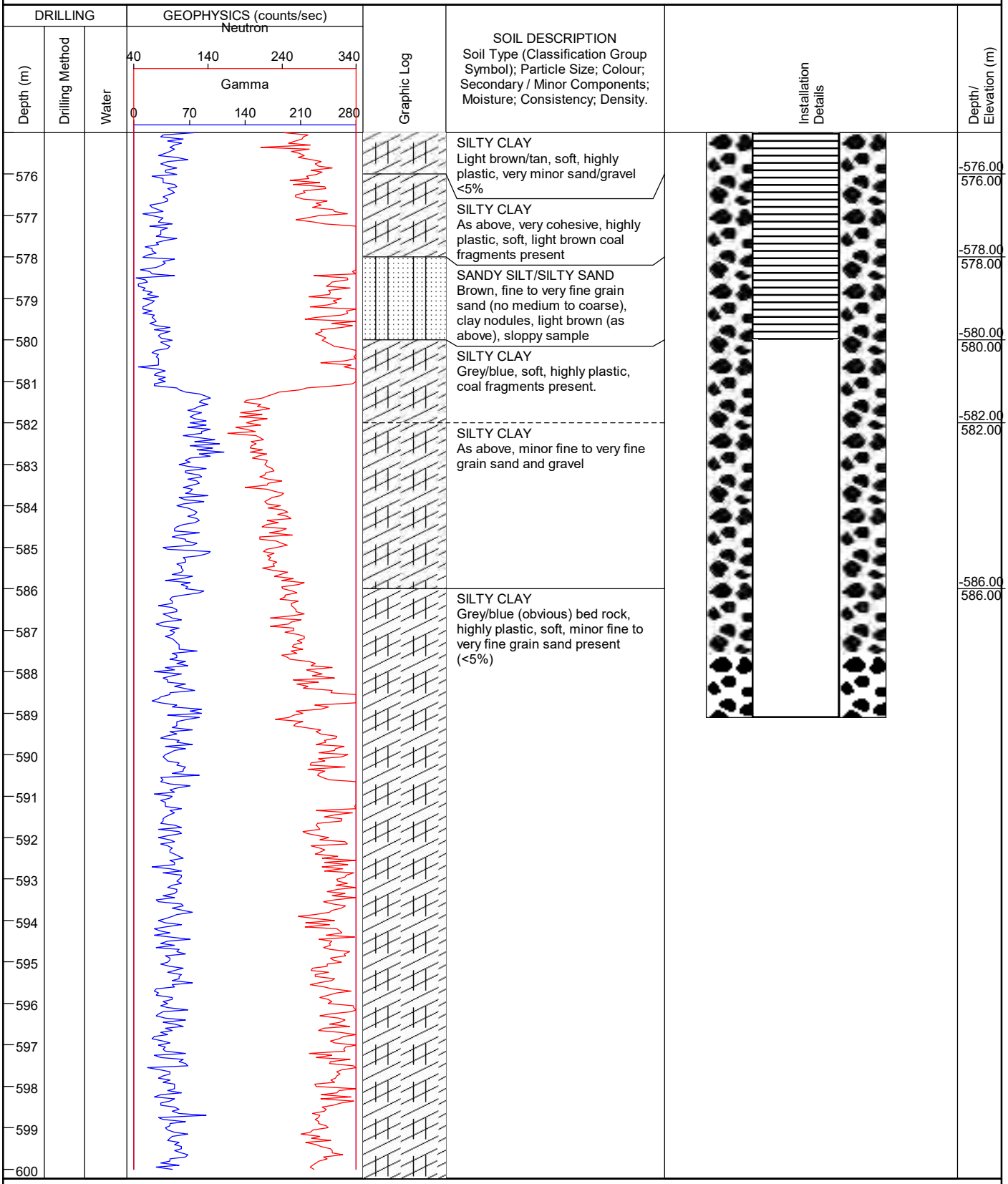
HYDROGEOLOGICAL

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

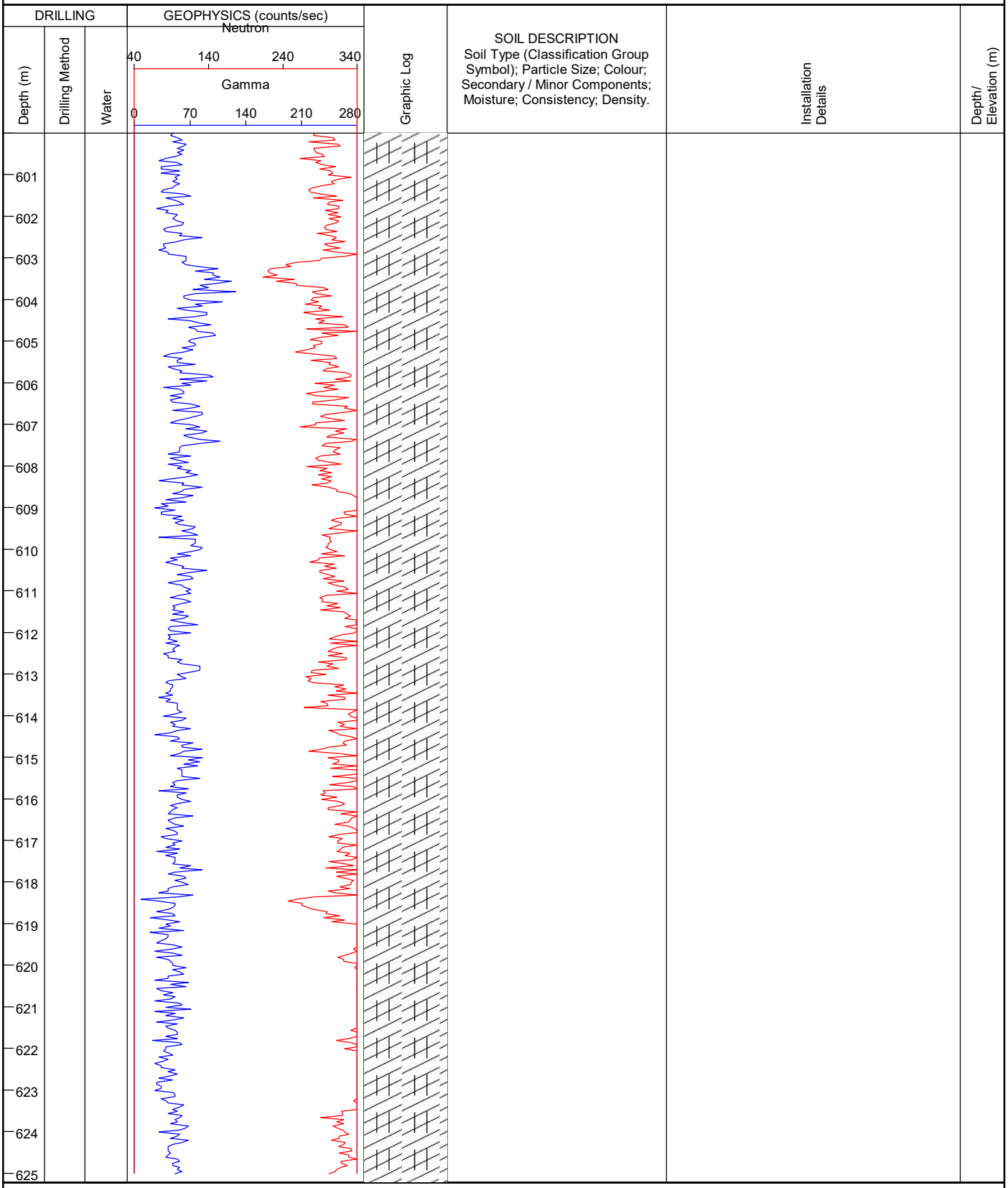
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

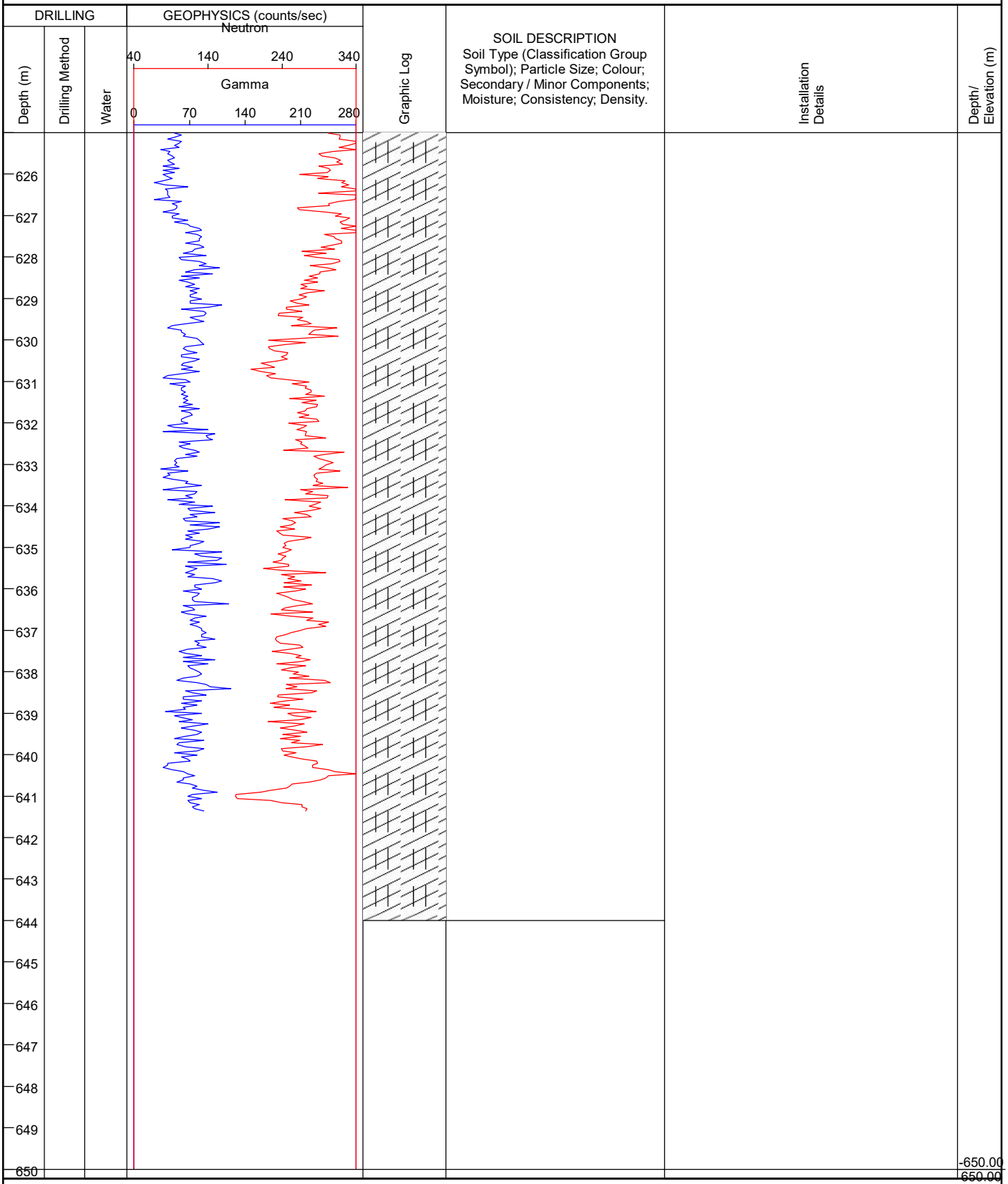
Bore No.: GW5

Client: Barwon Water
Project: Anglesea Borefield Project
Job No.: 3121424
Location: Anglesea
Date Drilled: 13/10/2009 **to:** 29/01/2010

Drilling Co.: DrillTec
Driller: Craig Gordon, Aaron Frood
Rig Type: Bourne
Total Depth (m): 644
Diameter (mm): 880 - 450

Easting: 250880
Northing: 5745681
Grid Ref: MGA 94, Zone 55
Collar RL: 45.18 (GL)
Logged by: JSM / DK **Checked by:** JSM

B.C.L. No.: 9038314 **Casing Material:** FRP **Screen Material:** 316 stainless steel **Screen Slot Size (mm):** 0.6



NOTES: GHD orginal ID = SPB5. For construction summary refer to GW5 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW6

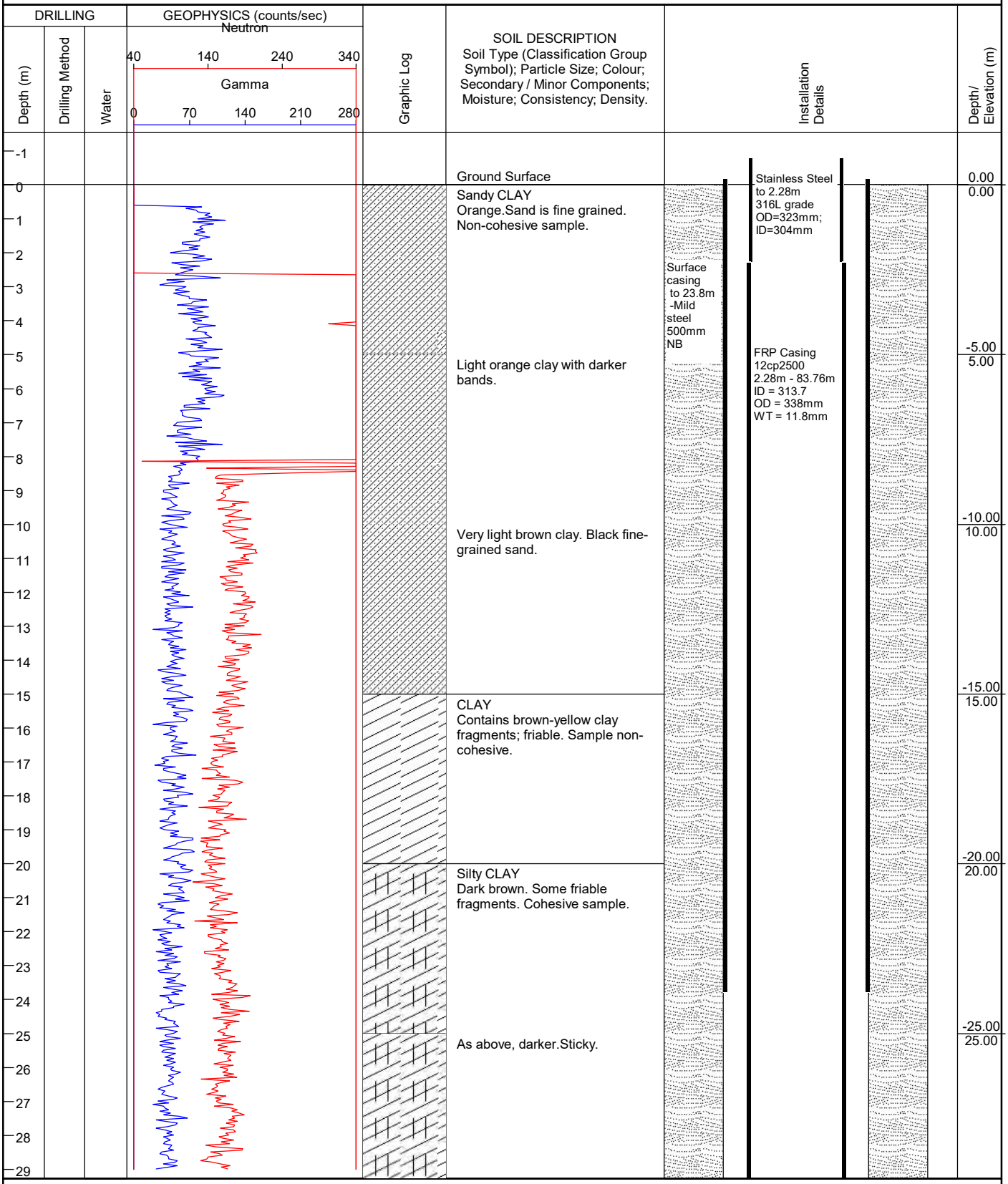
Page: 1 of 11

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Basin
Date Drilled: 11/05/08 **to:** 20/06/2008

Drilling Co.: Drilltec
Driller: Jarrod Freeman / Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): pilot hole to 318; cased to 264m
Diameter (mm):

Easting: 254480
Northing: 5751261
Grid Ref: MGA 94, Zone 55
Collar RL: 103.6 (GL)
Logged by: DJK / JSM **Checked by:** JSM

B.C.L. No.: 9031316 **Casing Material:** FRP / SS **Screen Material:** Stainless steel **Screen Slot Size (mm):** 0.25-0.6mm



NOTES:
ap. = aperture; ID = Inside Diameter; Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level
GHD original ID = NPB1. For construction summary refer to GW6 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

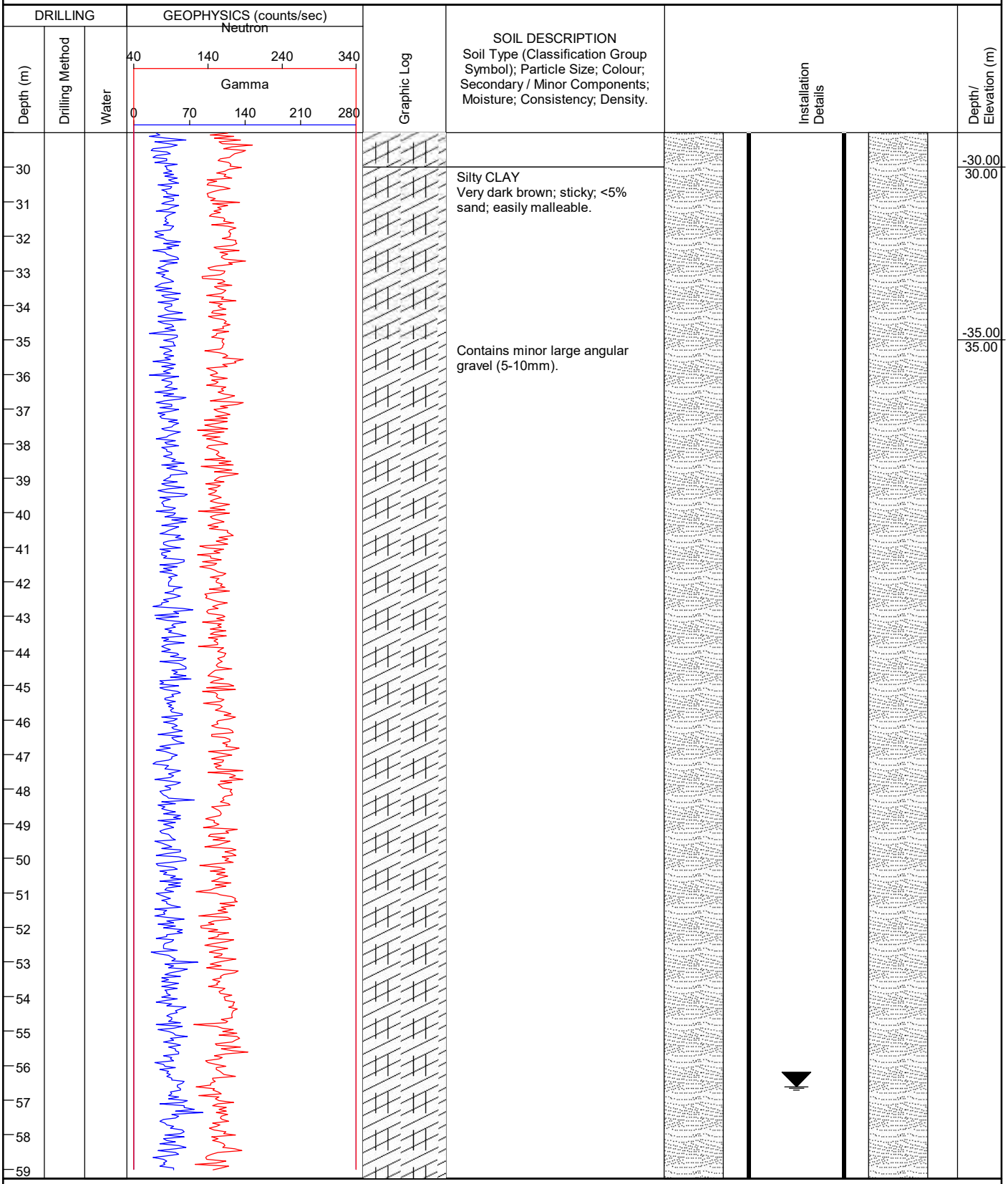
Bore No.: GW6

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Basin
Date Drilled: 11/05/08 **to:** 20/06/2008

Drilling Co.: Drilltec
Driller: Jarrod Freeman / Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): pilot hole to 318; cased to 264m
Diameter (mm):

Easting: 254480
Northing: 5751261
Grid Ref: MGA 94, Zone 55
Collar RL: 103.6 (GL)
Logged by: DJK / JSM **Checked by:** JSM

B.C.L. No.: 9031316 **Casing Material:** FRP / SS **Screen Material:** Stainless steel **Screen Slot Size (mm):** 0.25-0.6mm



NOTES: ap. = aperture; ID = Inside Diameter; Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level
GHD original ID = NPB1. For construction summary refer to GW6 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

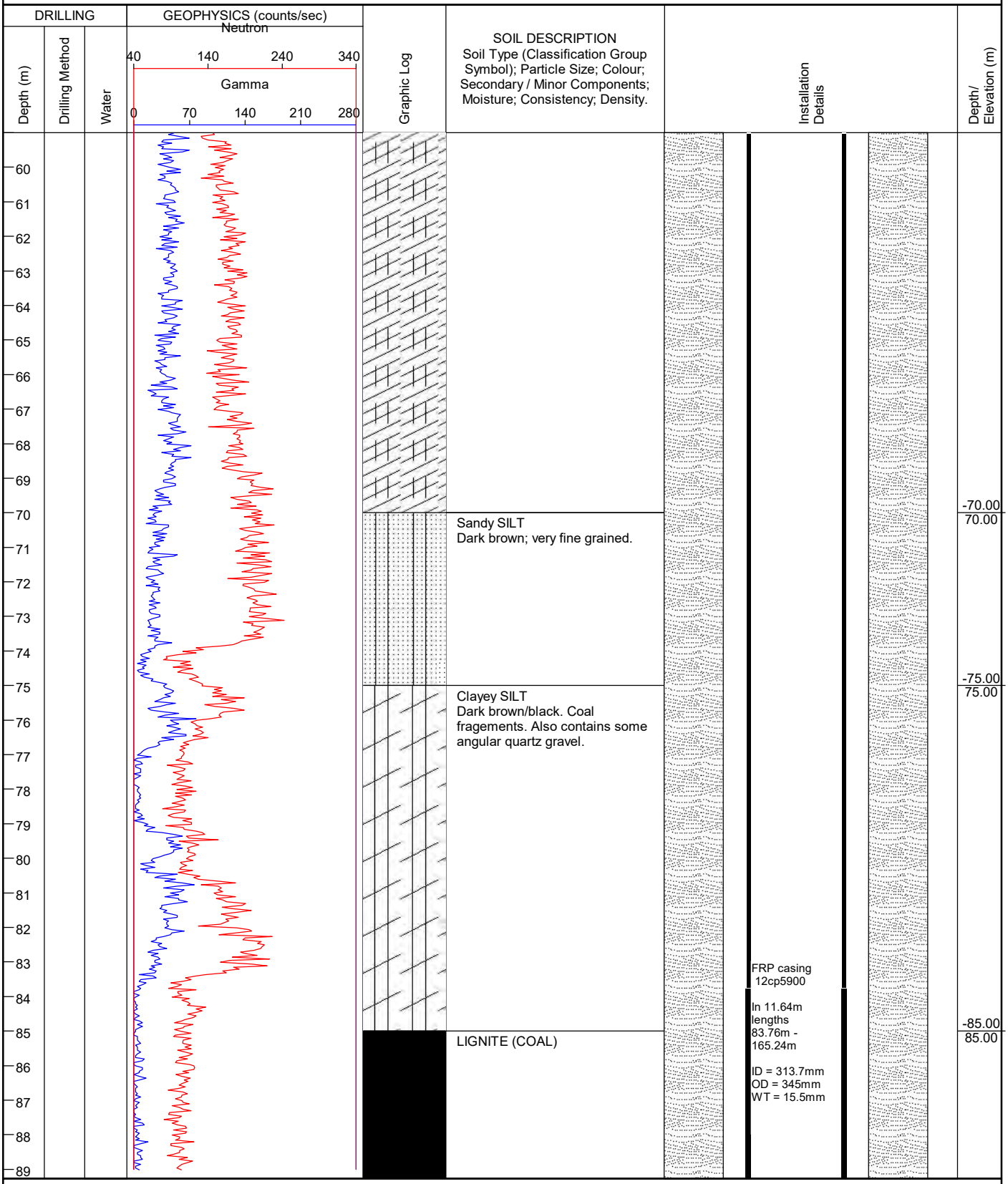
Bore No.: GW6

Client: Barwon Water
Project: Anglesea B.F Drilling Supervision
Job No.: 312142401
Location: Basin
Date Drilled: 11/05/08 **to:** 20/06/2008

Drilling Co.: Drilltec
Driller: Jarrod Freeman / Rodney Briggs
Rig Type: Bourne 2000
Total Depth (m): pilot hole to 318; cased to 264m
Diameter (mm):

Easting: 254480
Northing: 5751261
Grid Ref: MGA 94, Zone 55
Collar RL: 103.6 (GL)
Logged by: DJK / JSM **Checked by:** JSM

B.C.L. No.: 9031316 **Casing Material:** FRP / SS **Screen Material:** Stainless steel **Screen Slot Size (mm):** 0.25-0.6mm



NOTES: ap. = aperture; ID = Inside Diameter; Outside Diameter; nb = nominal bore; FRP = Fibreglass Reinforced Plastic; mbgl = metres below ground level

GHD original ID = NPB1. For construction summary refer to GW6 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

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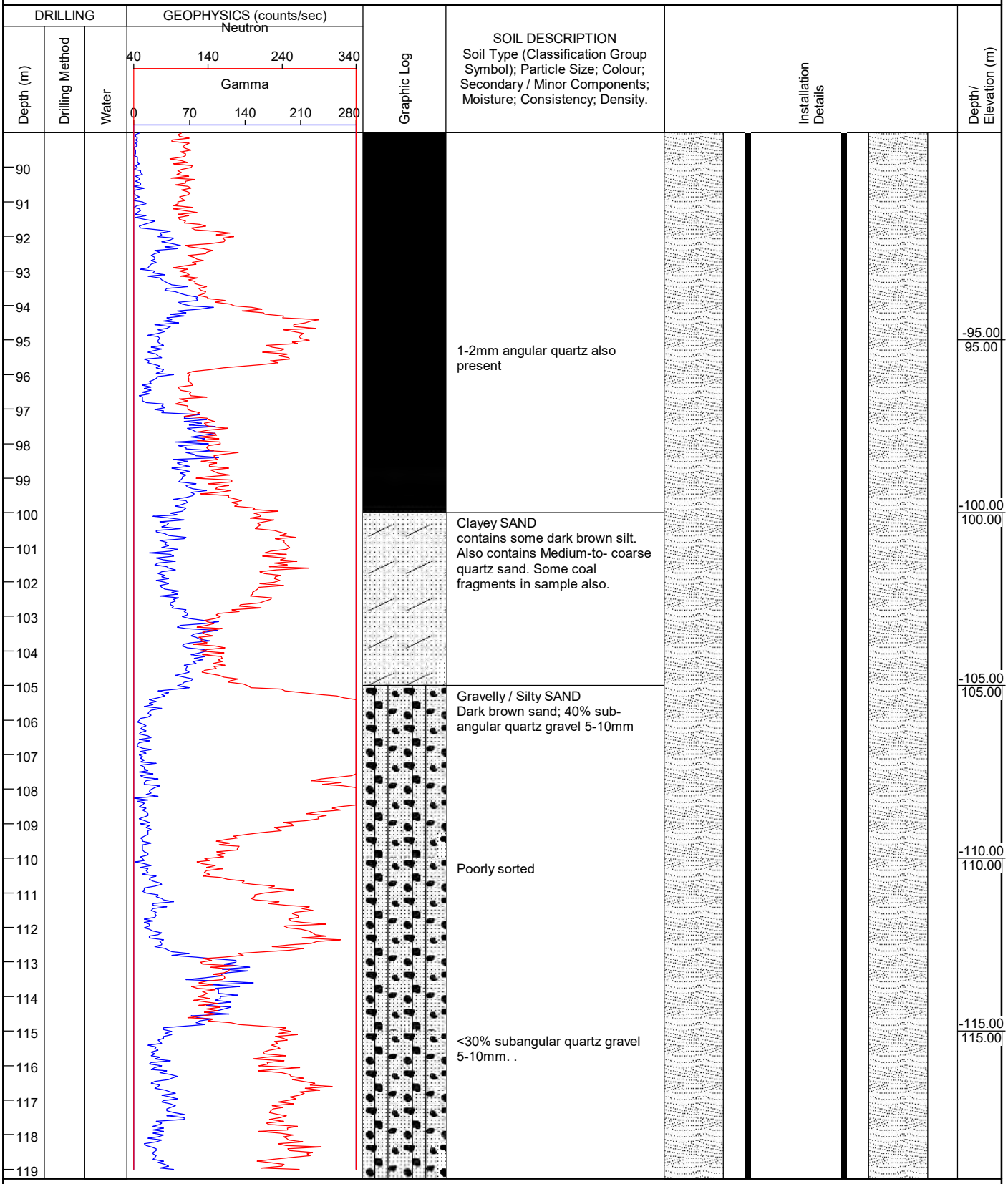

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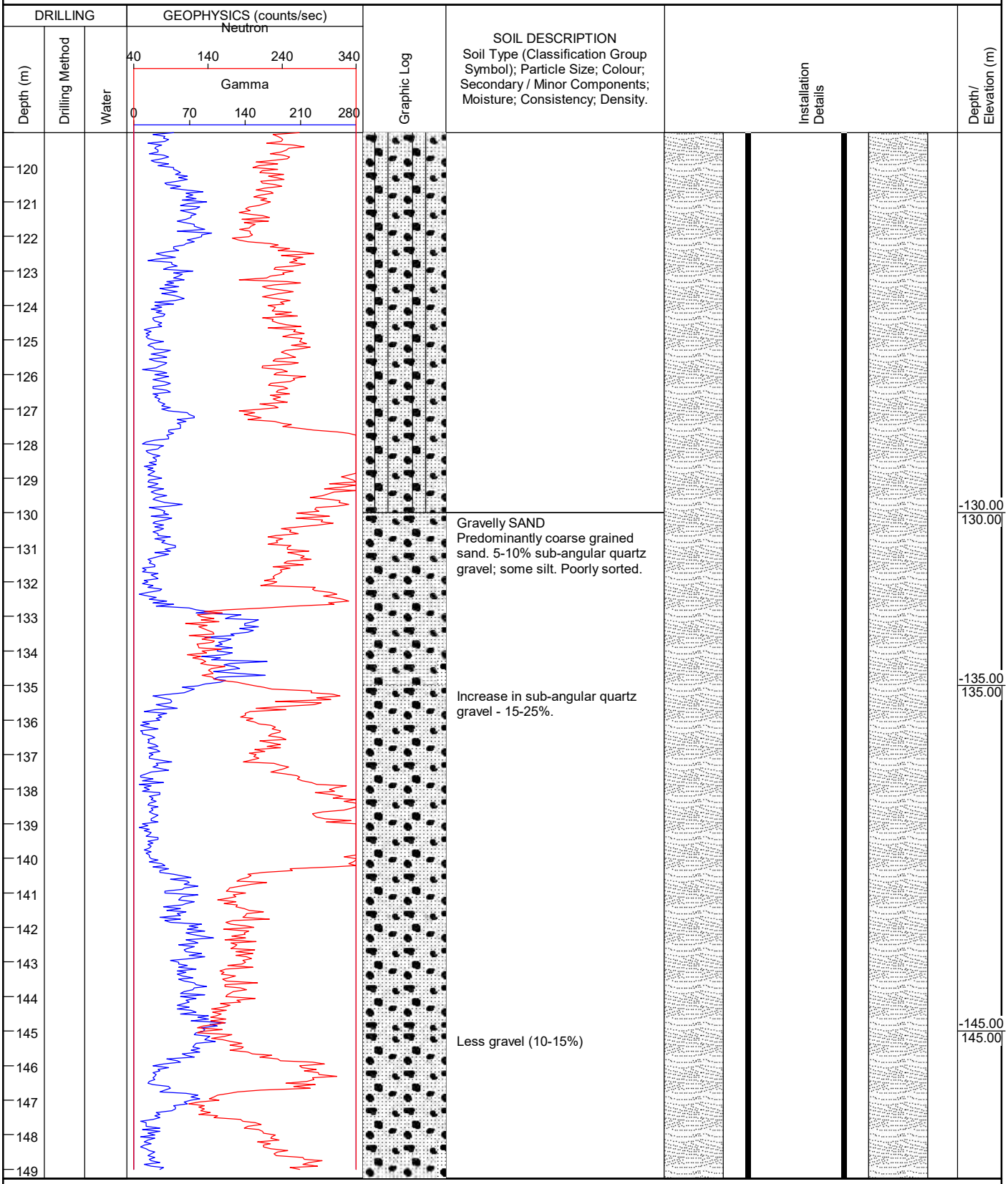

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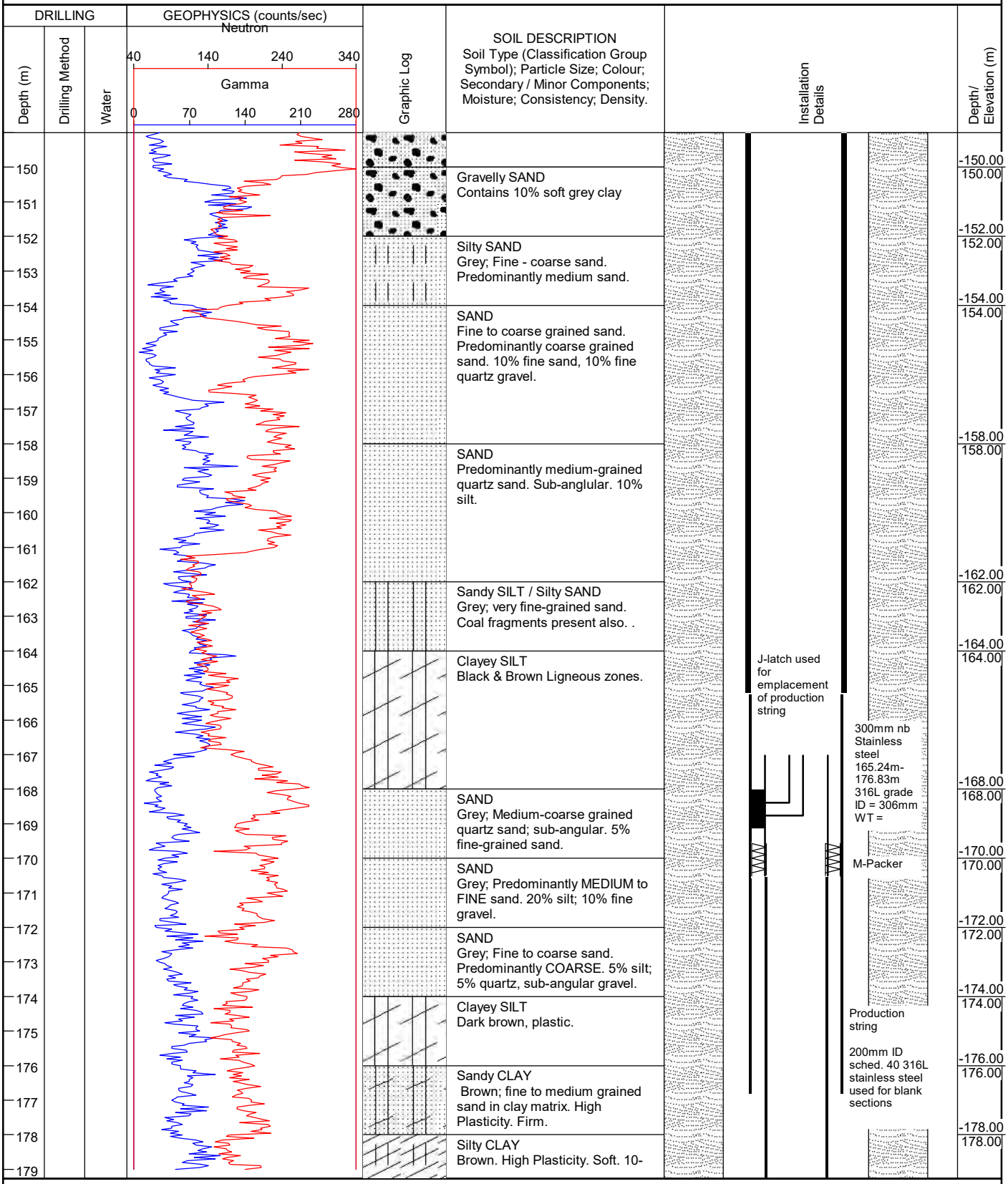

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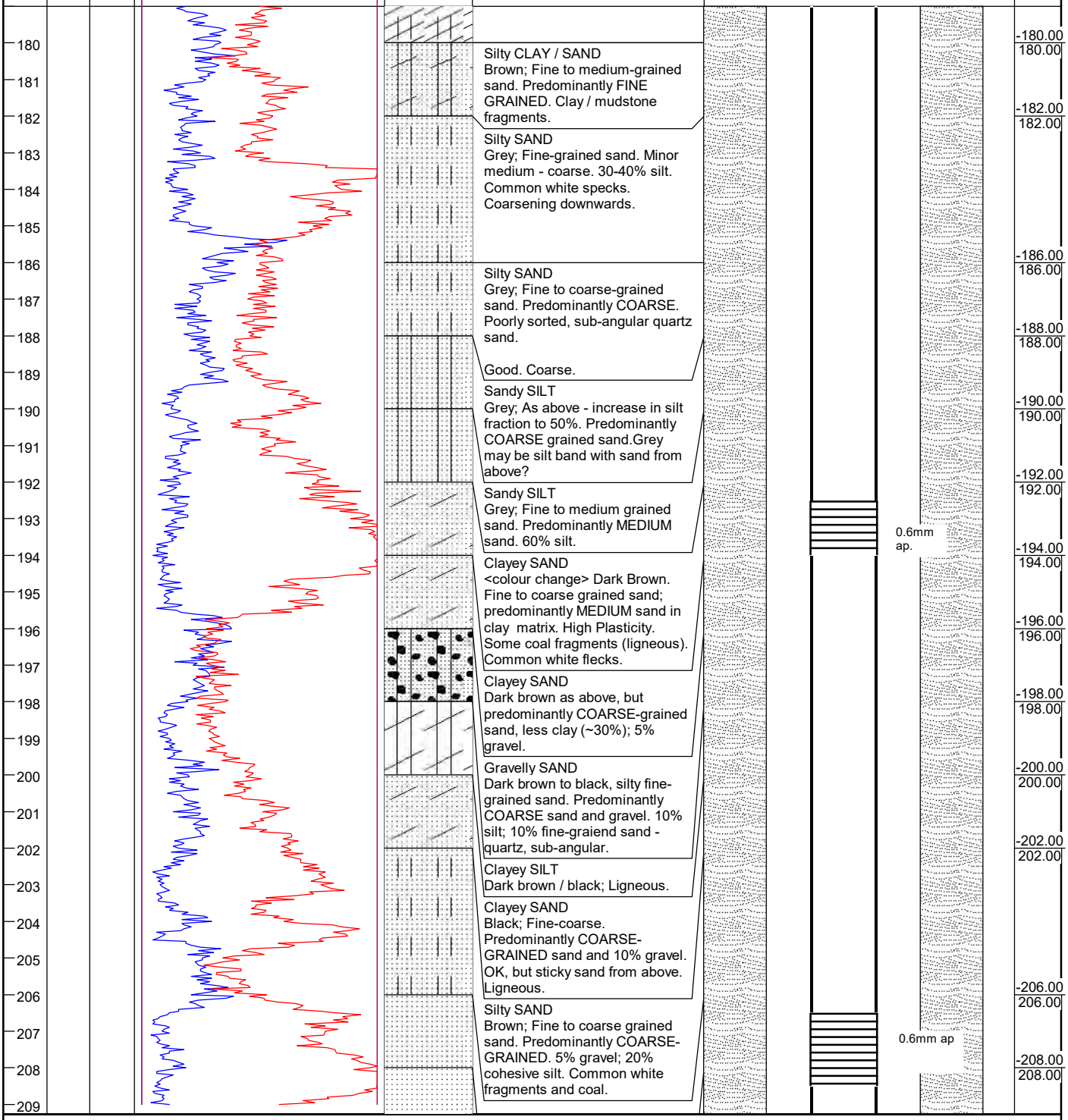

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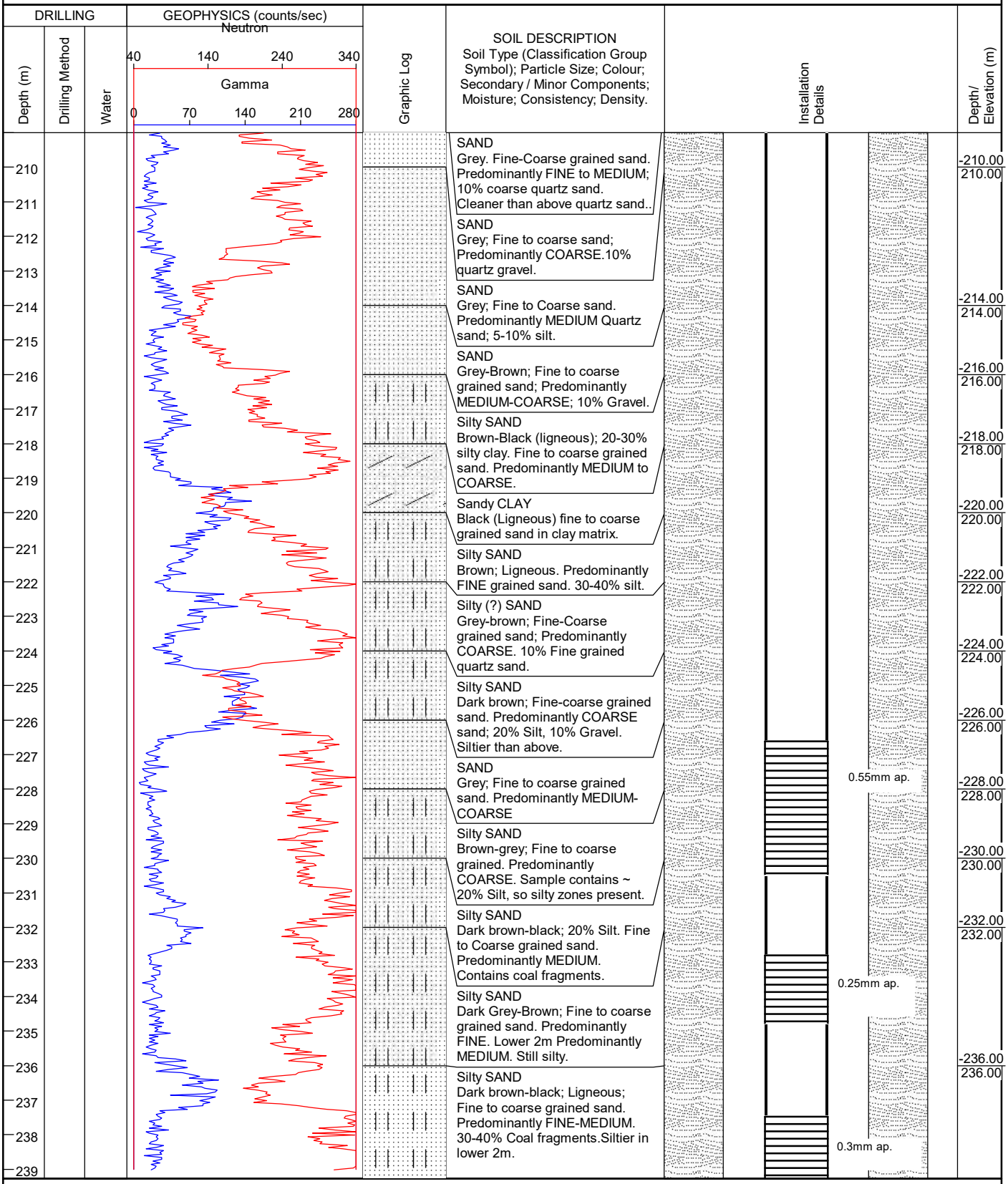

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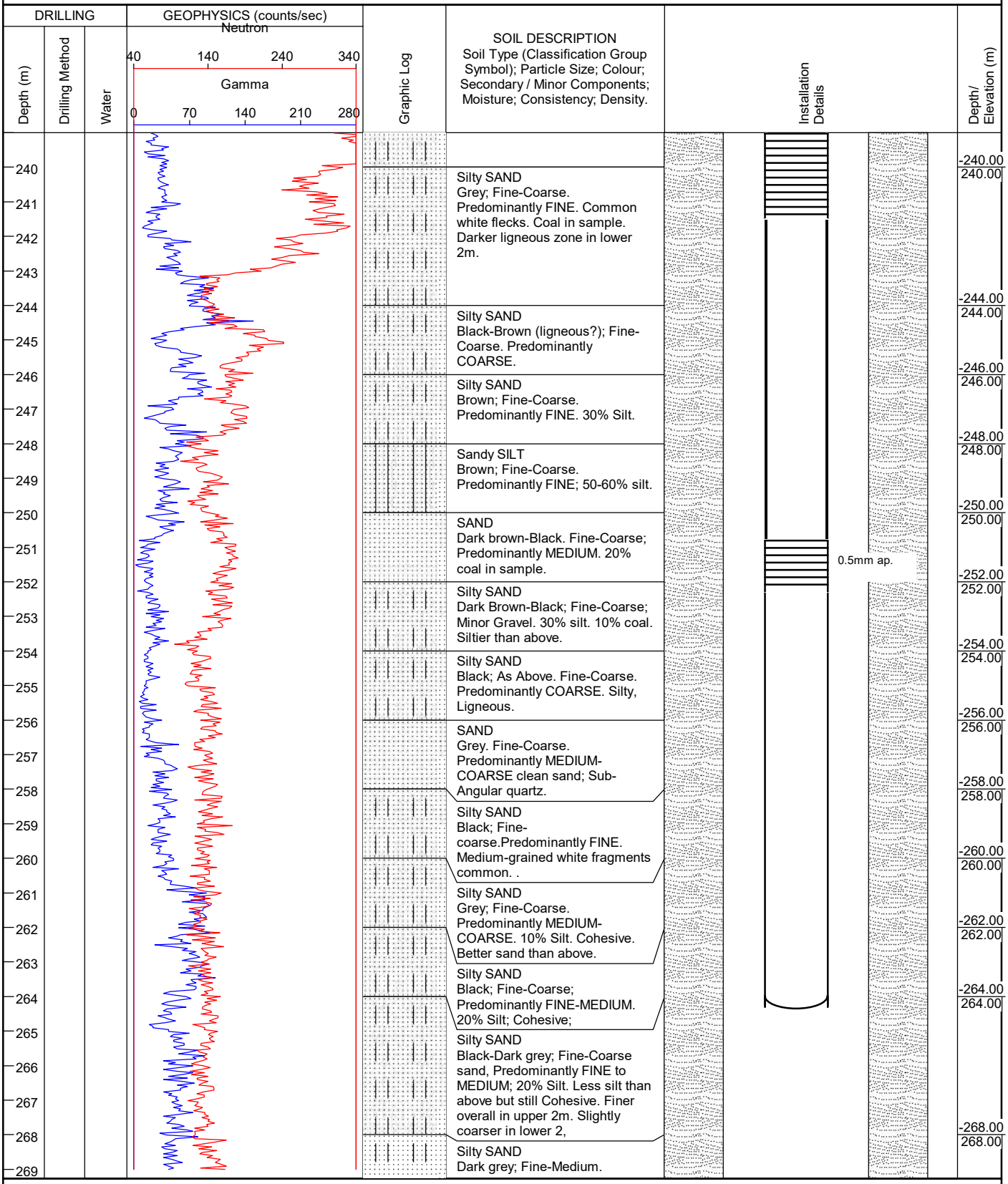

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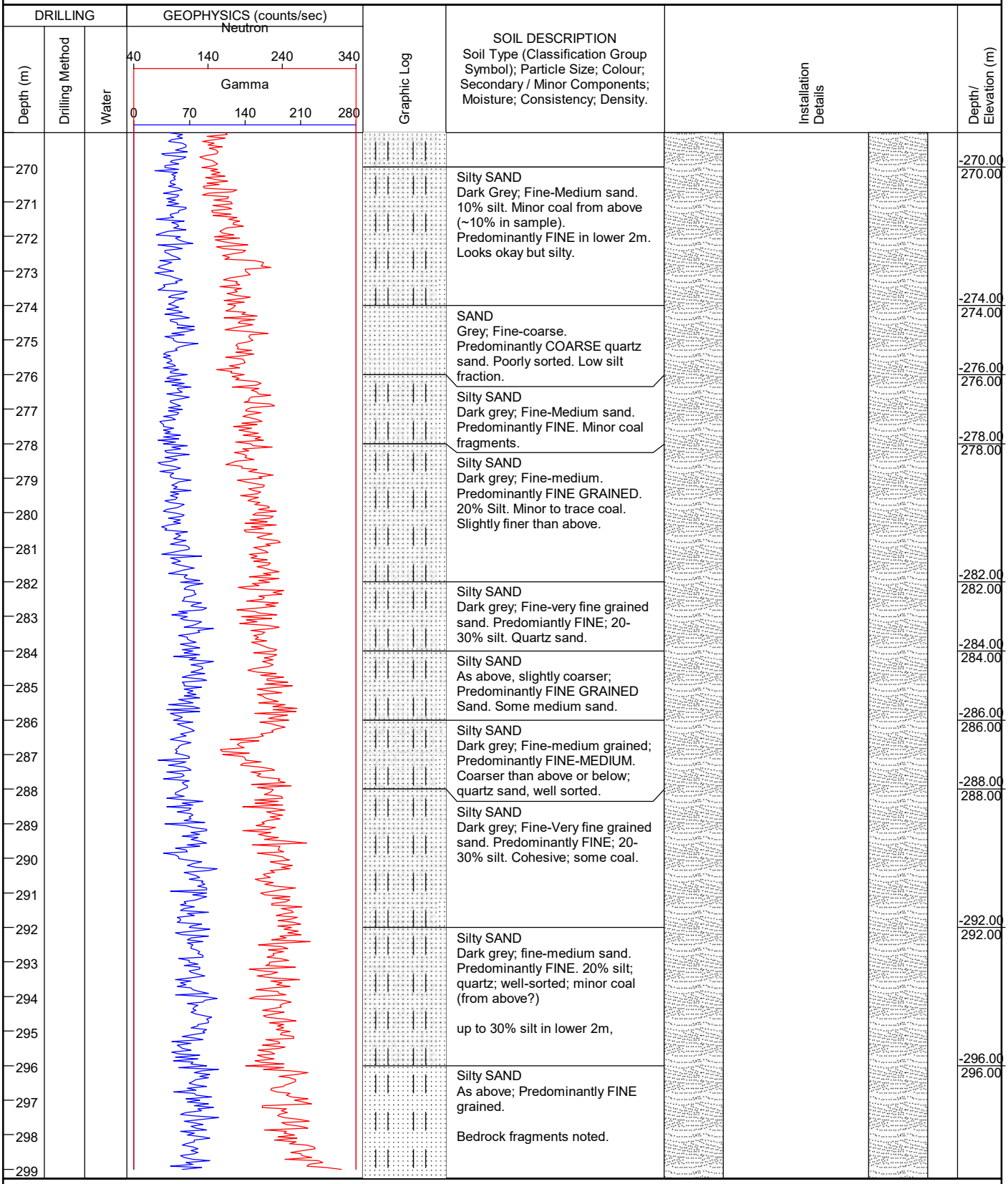

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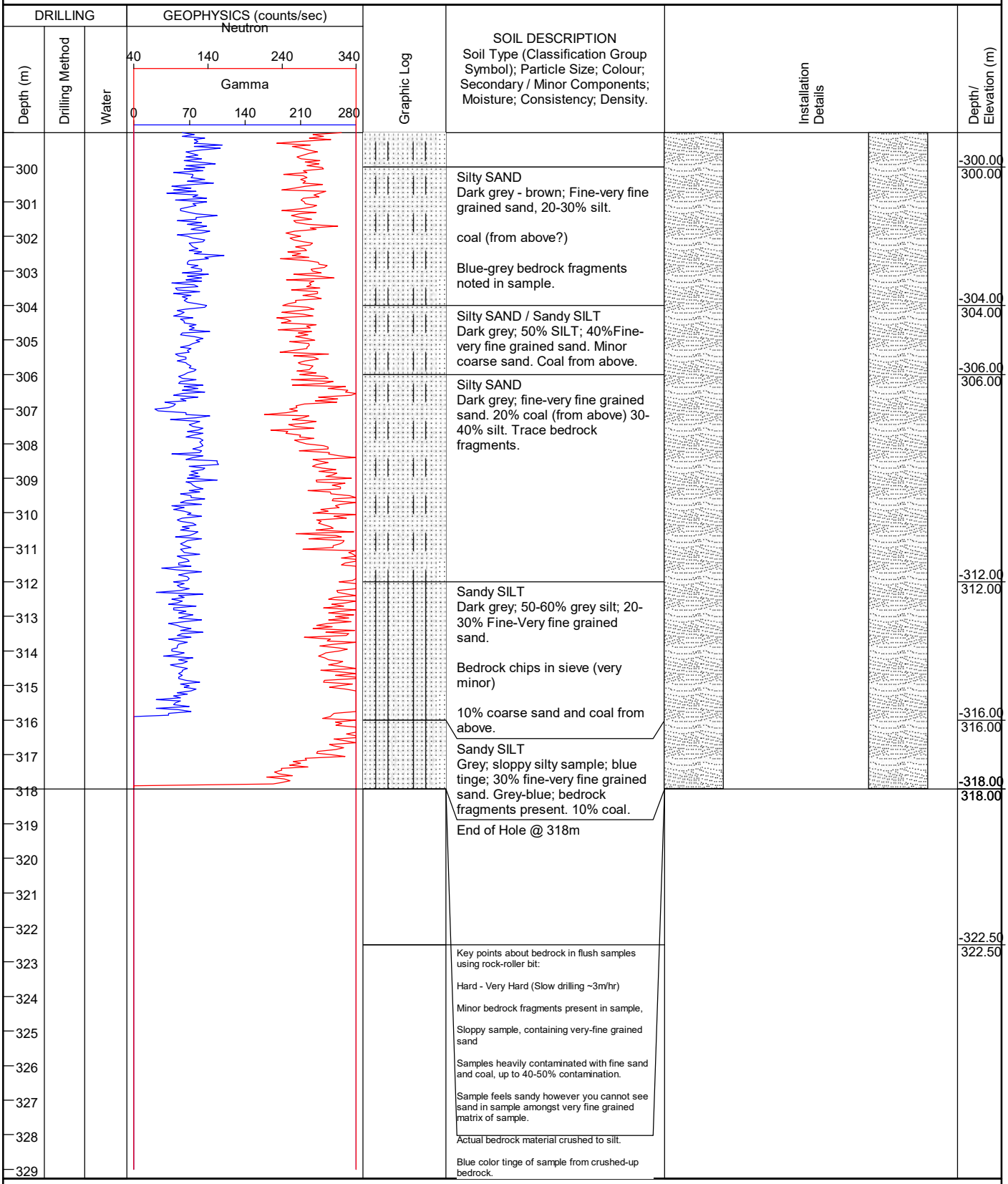

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6

Depth (m)	Drilling Method	Water	GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION	Installation Details	Depth/ Elevation (m)
-1						Stainless Steel to 2.6m 316L grade OD=323mm; ID=304mm	
0					Ground Surface SILTY CLAY Yellow orange, red and white mottling, Highly plastic, soft.	Surface casing to 108m -mild steel 500mm NB FRP casing 12cp2300 2.6m - 95.7 ID = 313.7 OD = 338mm WT = 11.8mm	0.00
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							

NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW7

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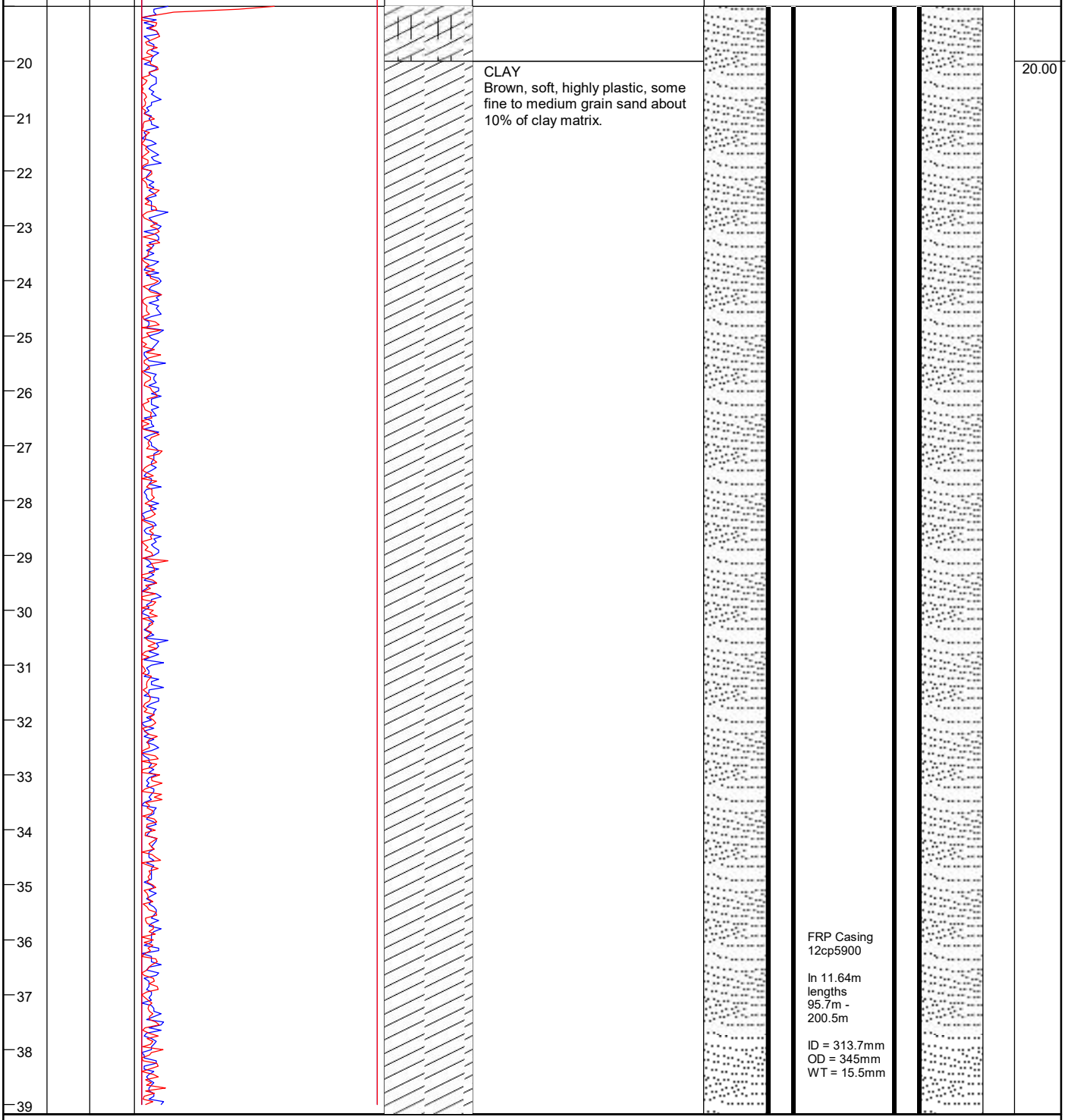
DRILLING | GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280 | Graphic Log | SOIL DESCRIPTION: Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density. | Installation Details | Depth / Elevation (m)



20.00

CLAY
Brown, soft, highly plastic, some fine to medium grain sand about 10% of clay matrix.

FRP Casing
12cp5900

In 11.64m lengths
95.7m - 200.5m

ID = 313.7mm
OD = 345mm
WT = 15.5mm

NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

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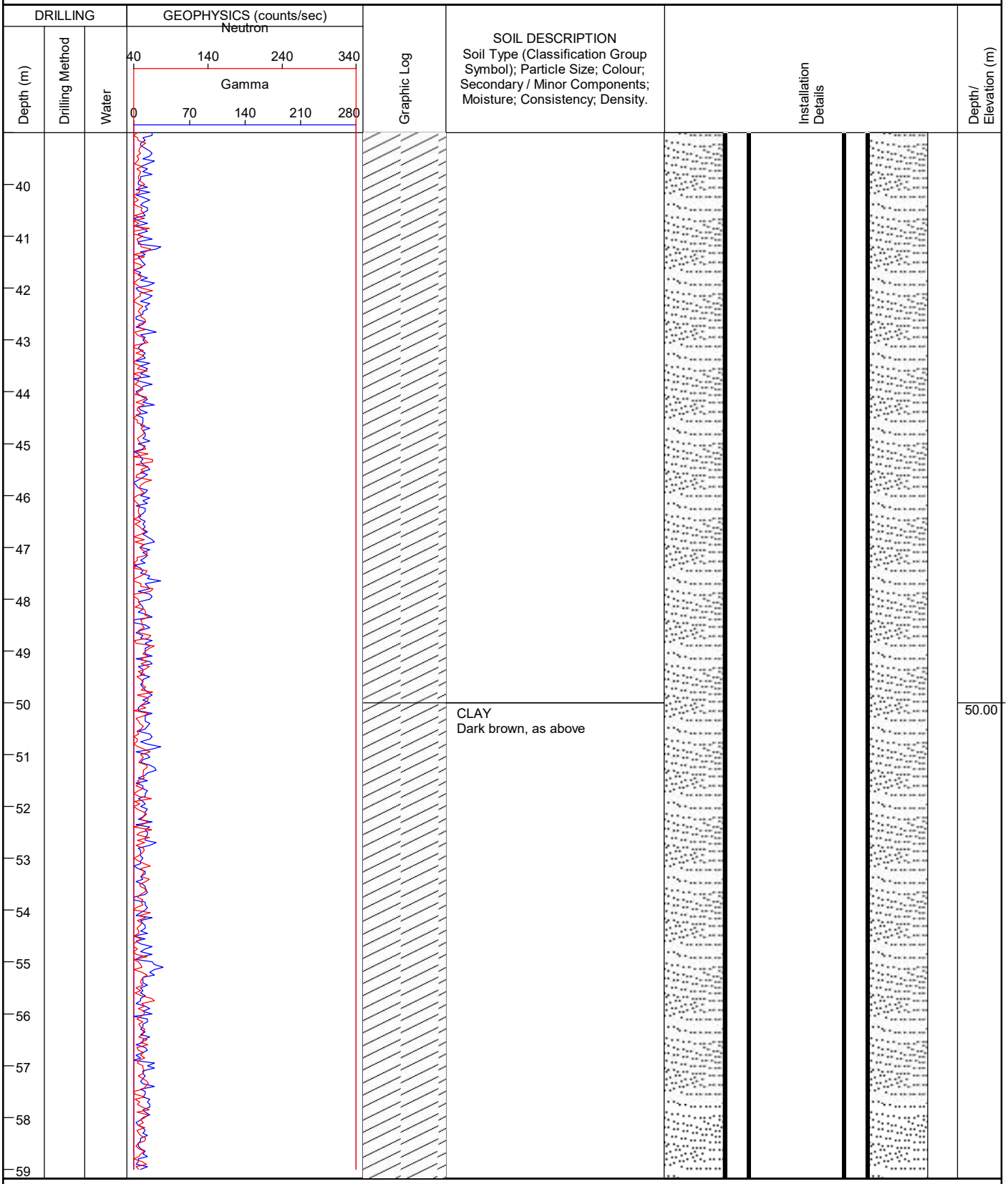

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BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW7
Page: 4 of 18

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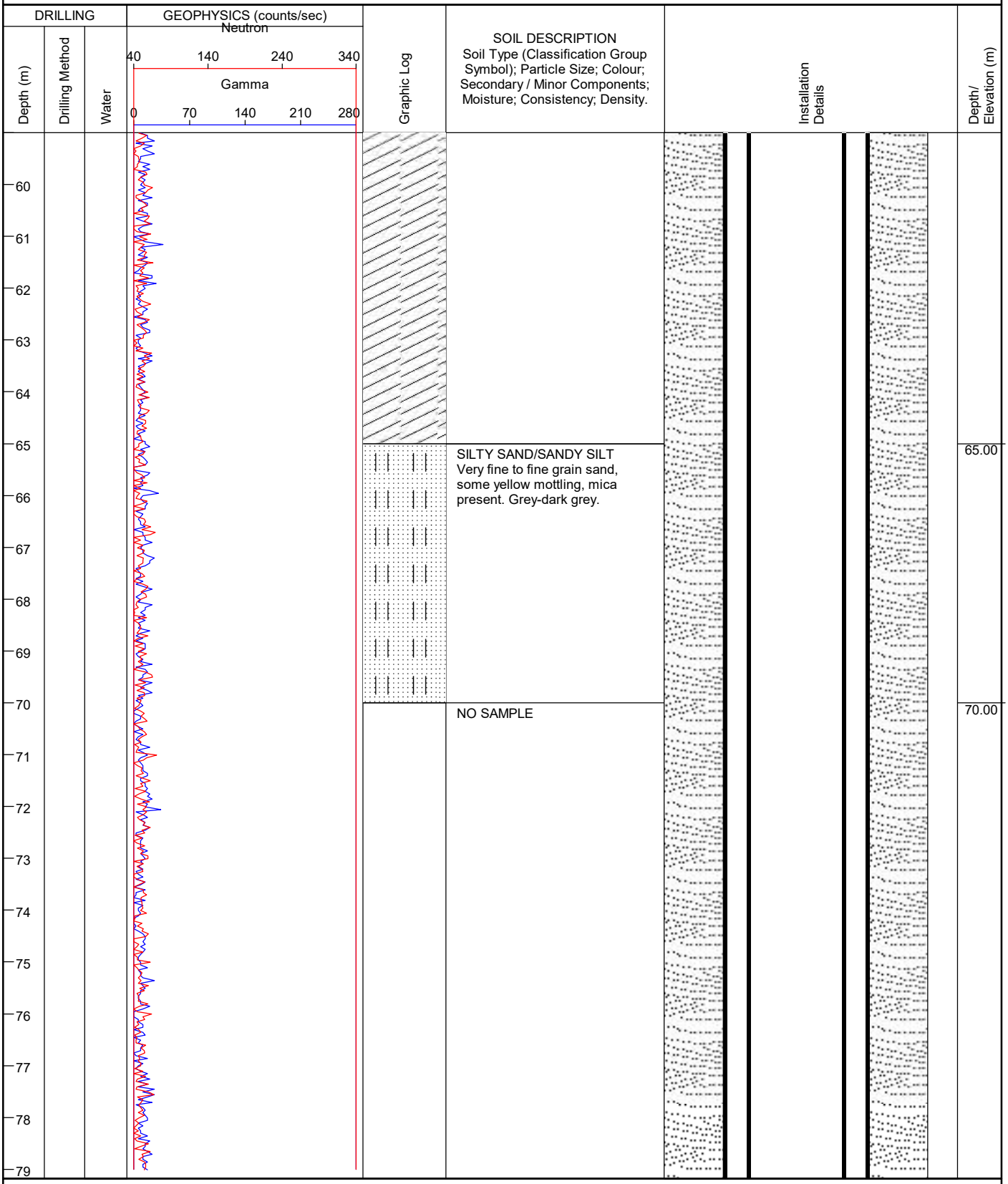

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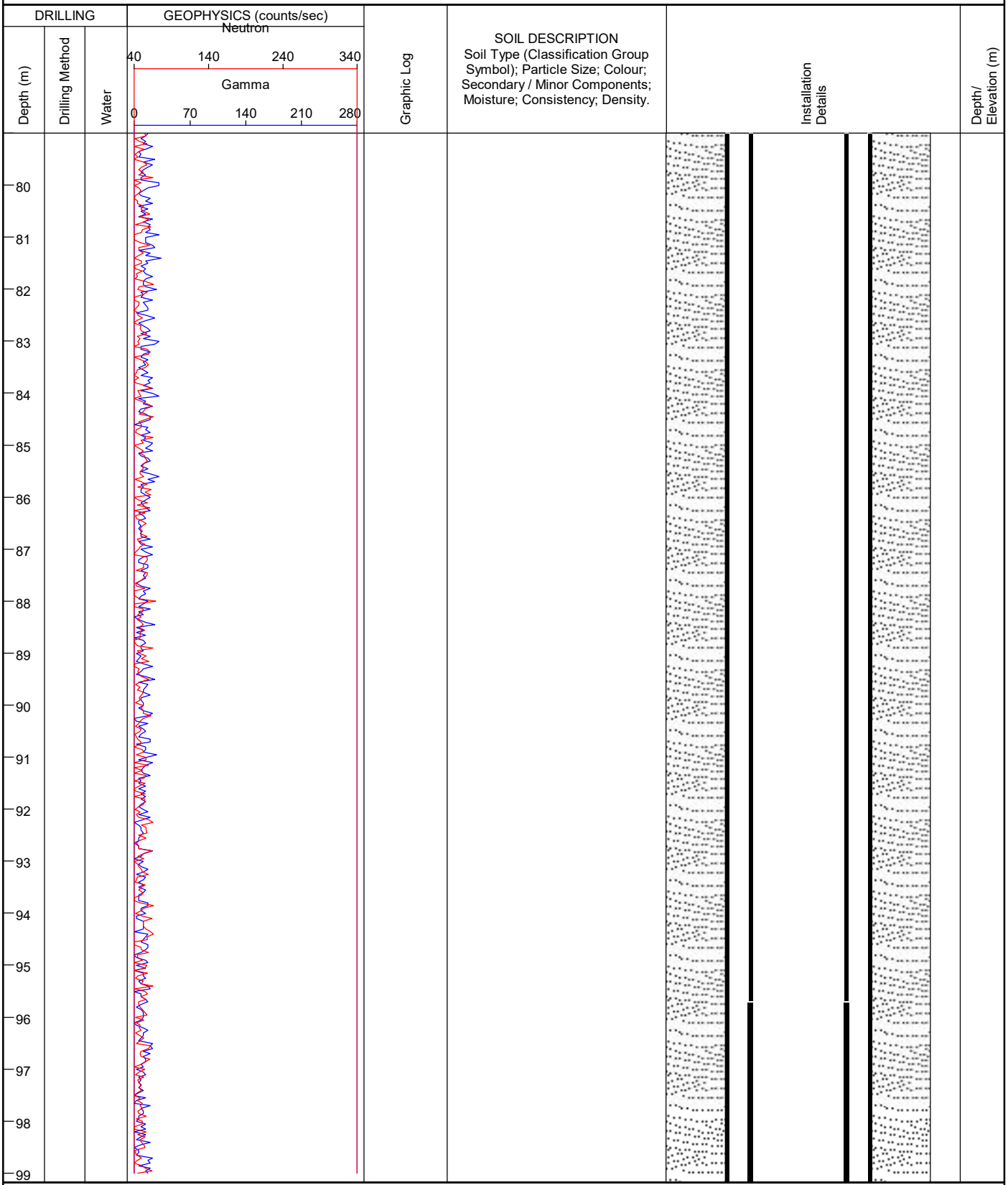

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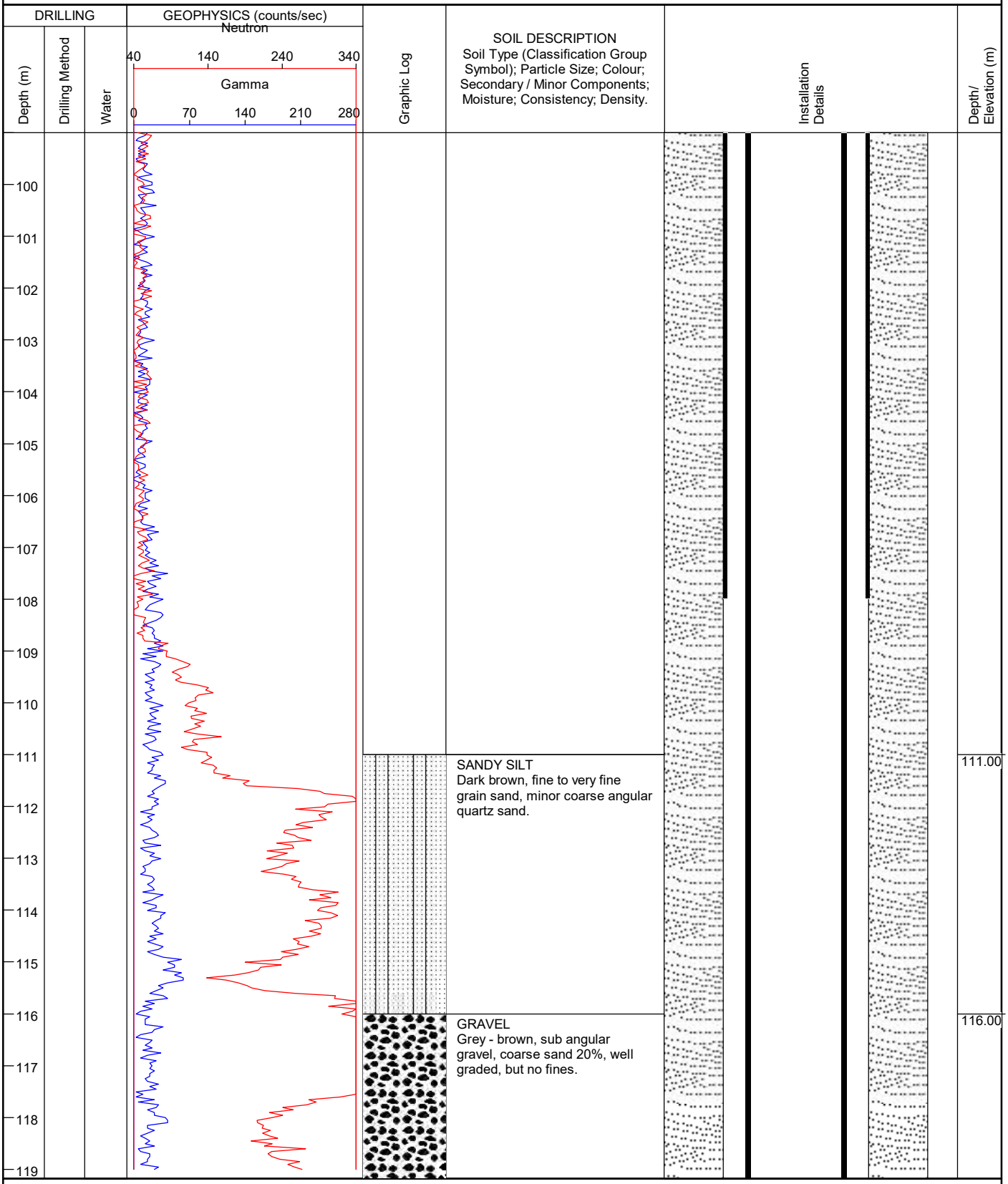

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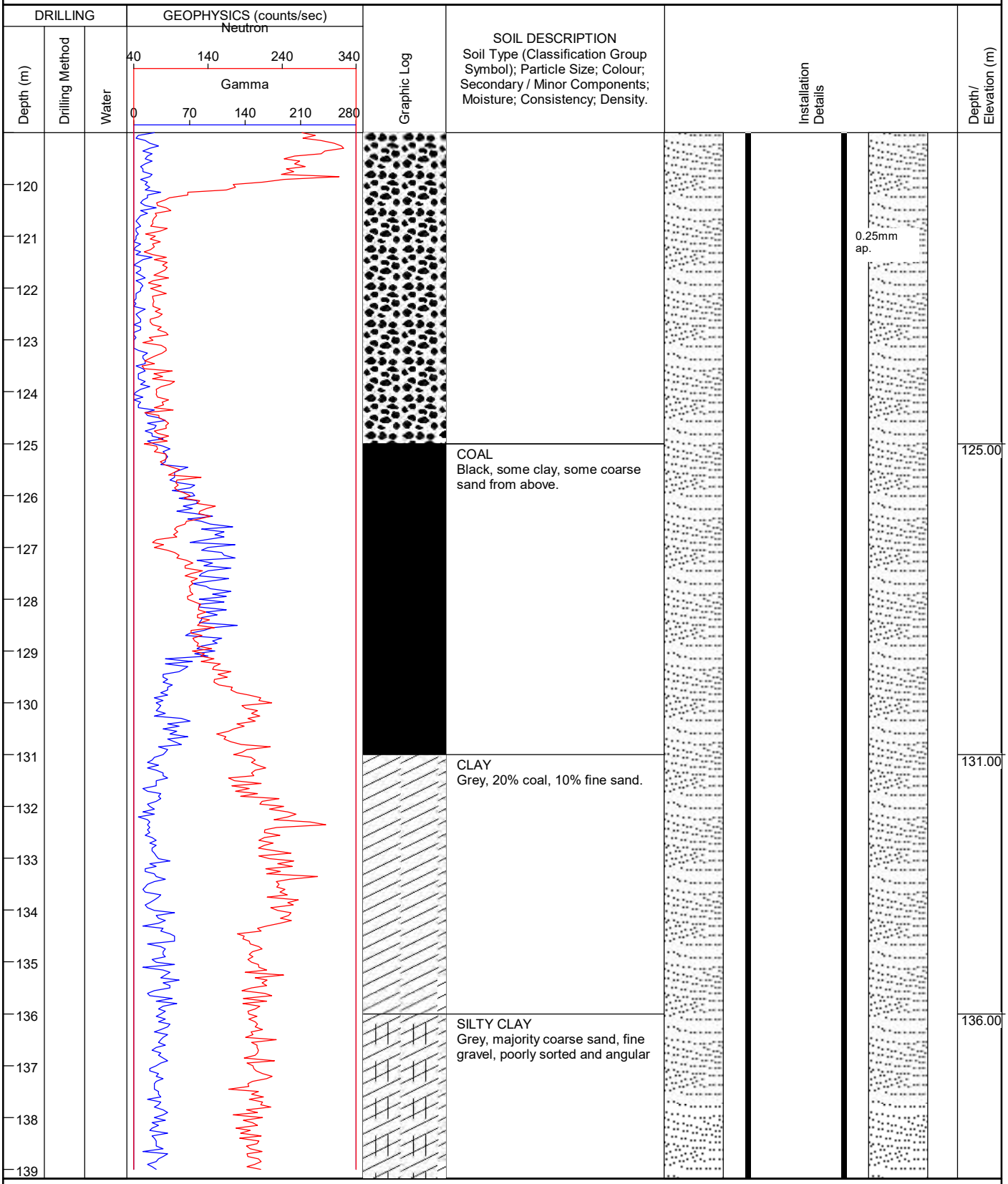

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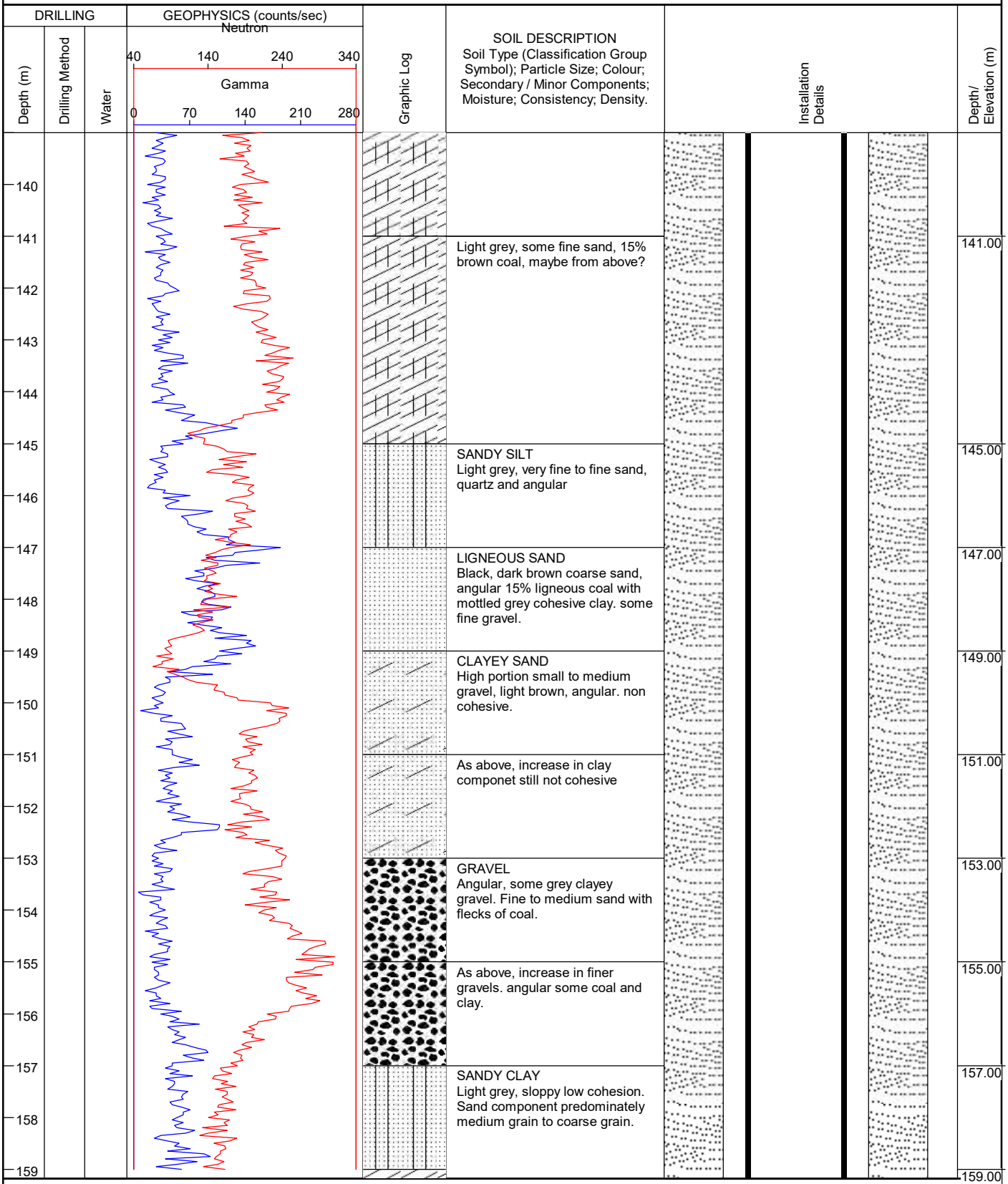

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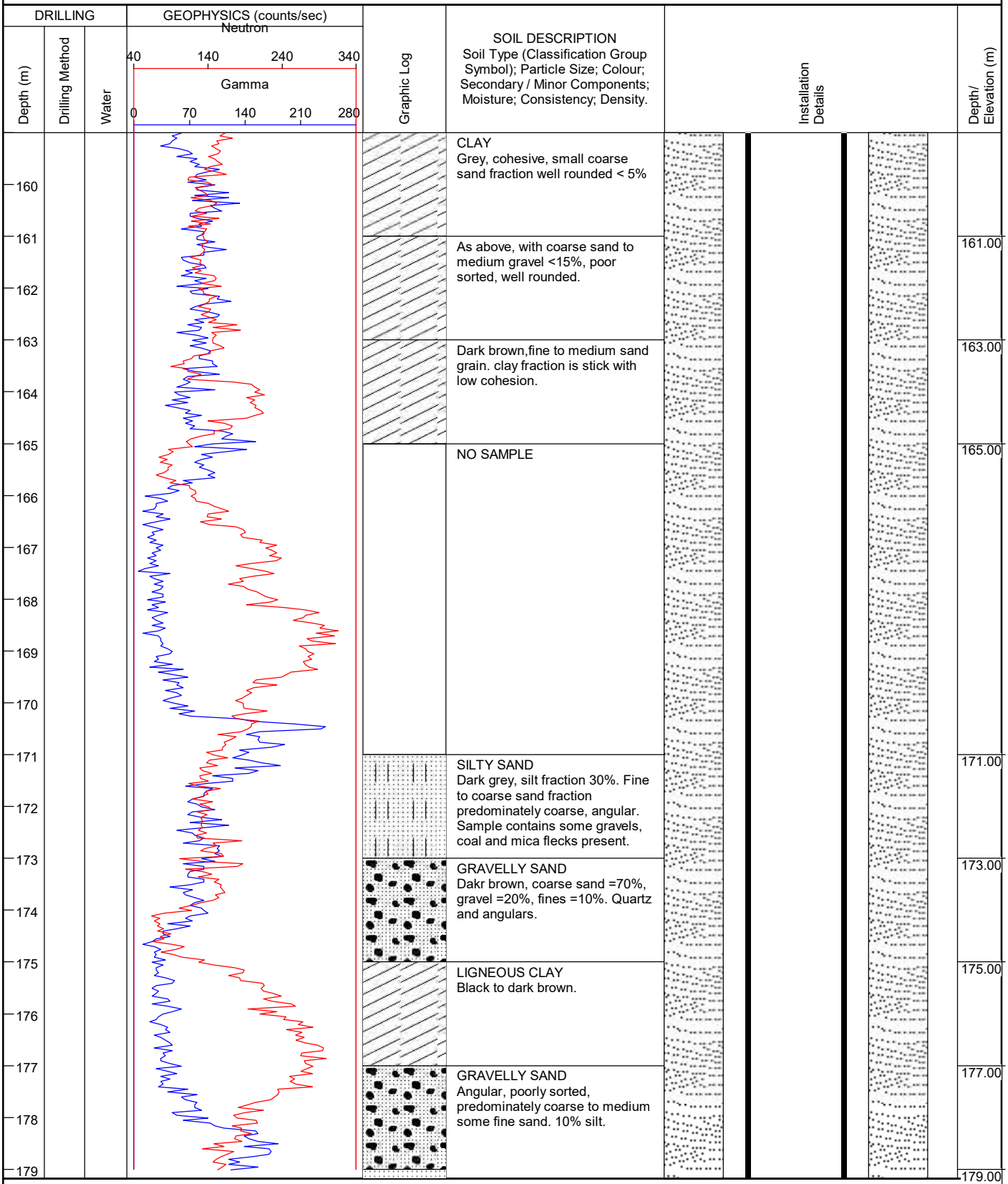


NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

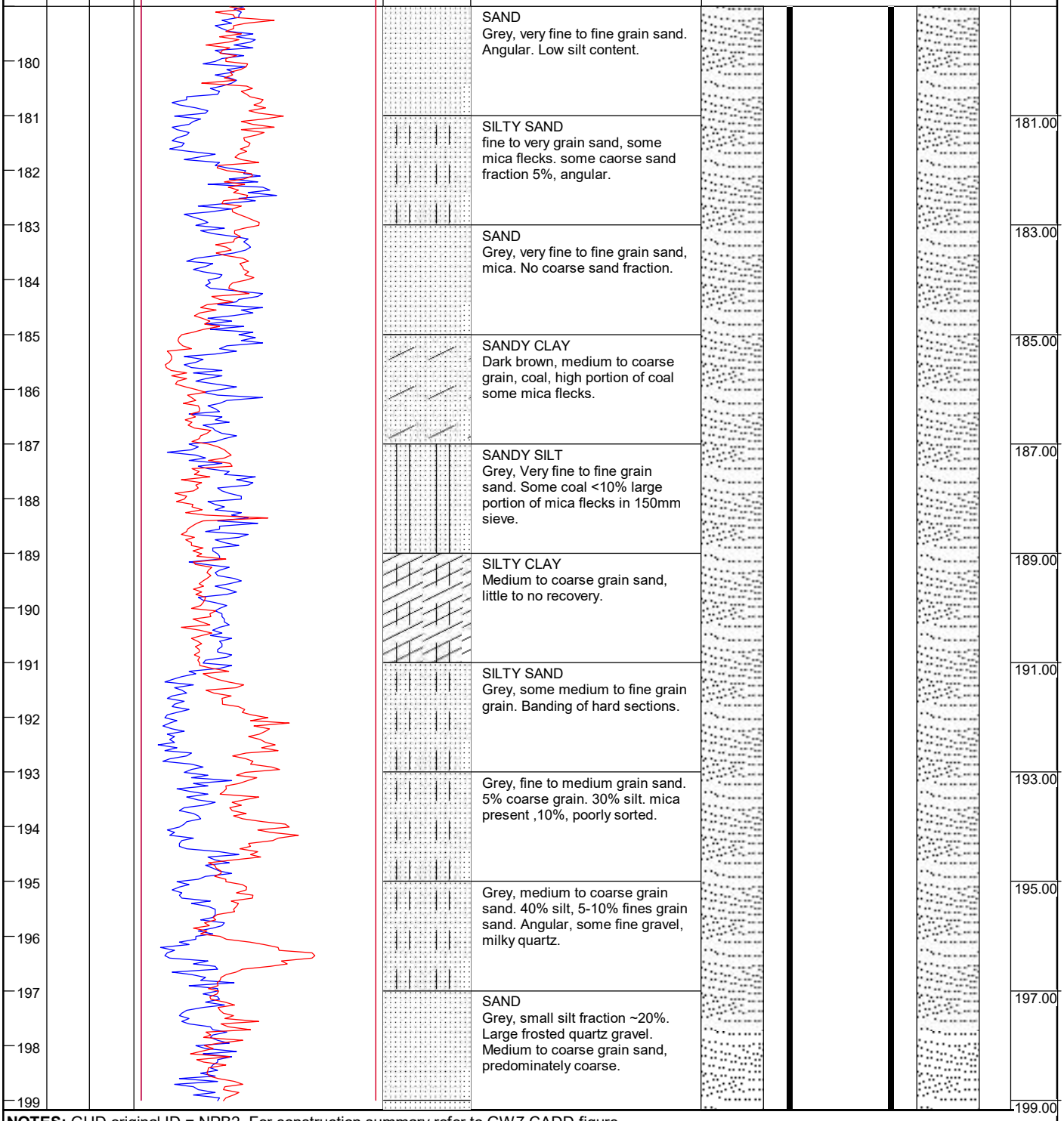
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG
HYDROGEOLOGICAL

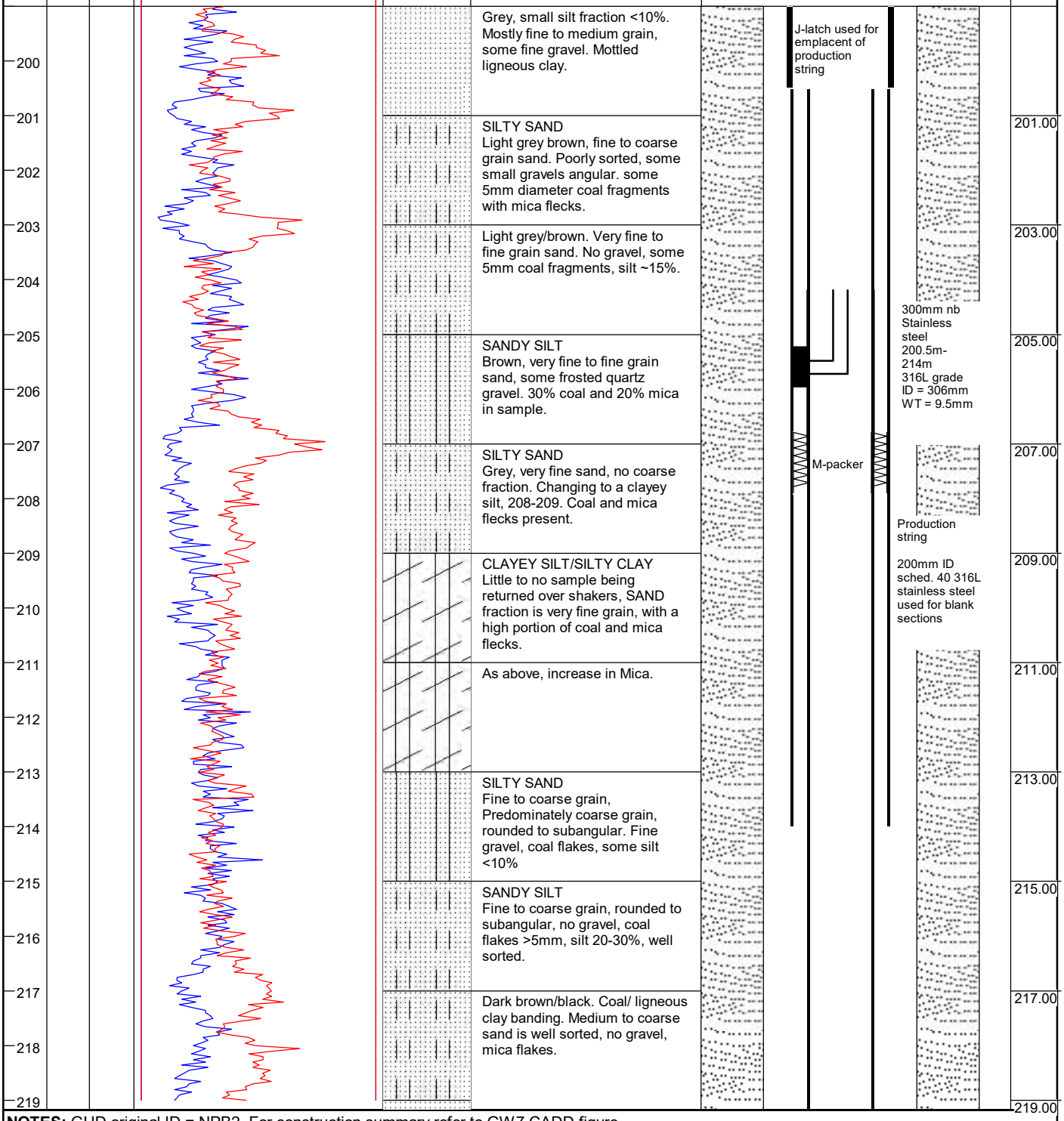
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

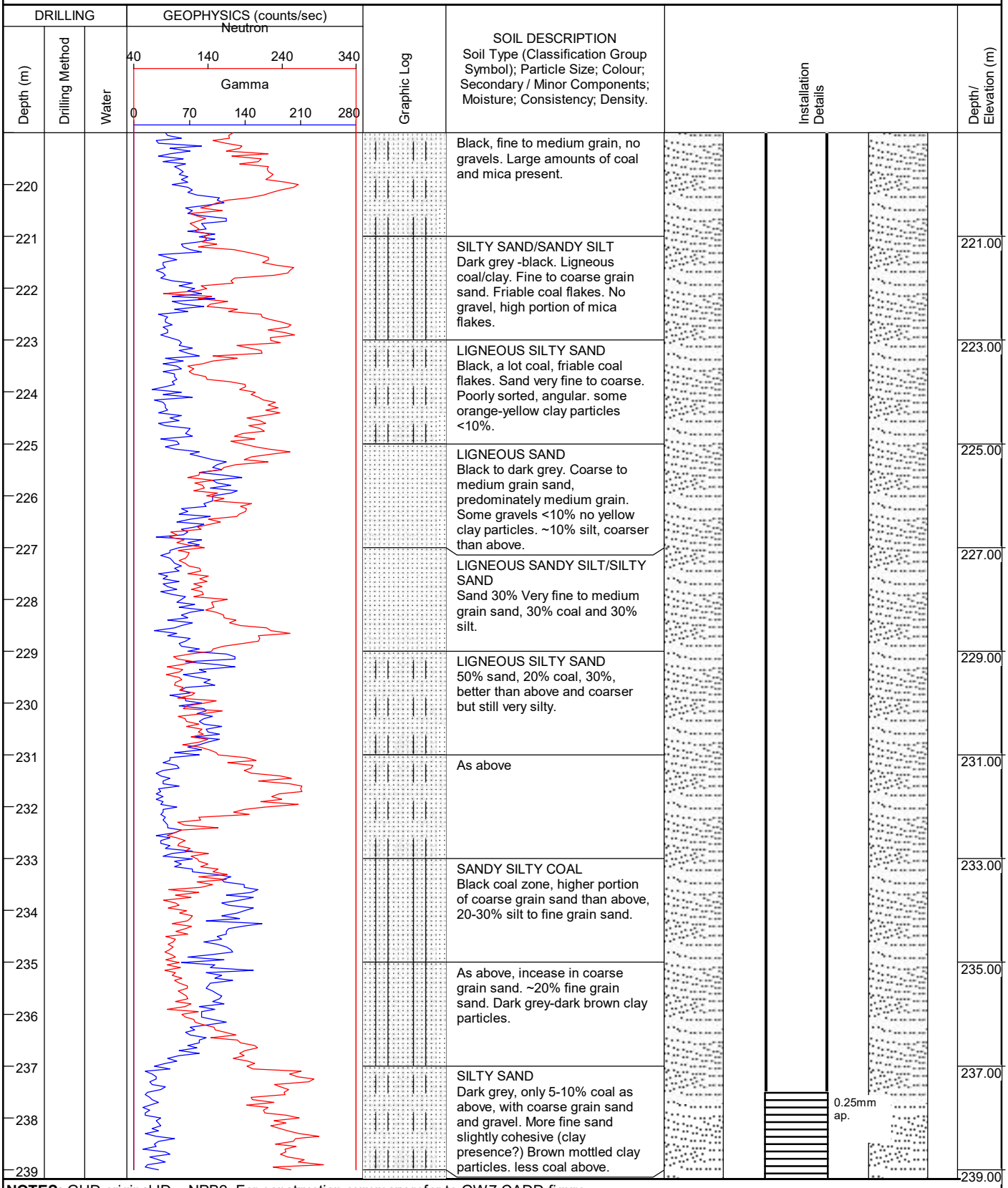
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

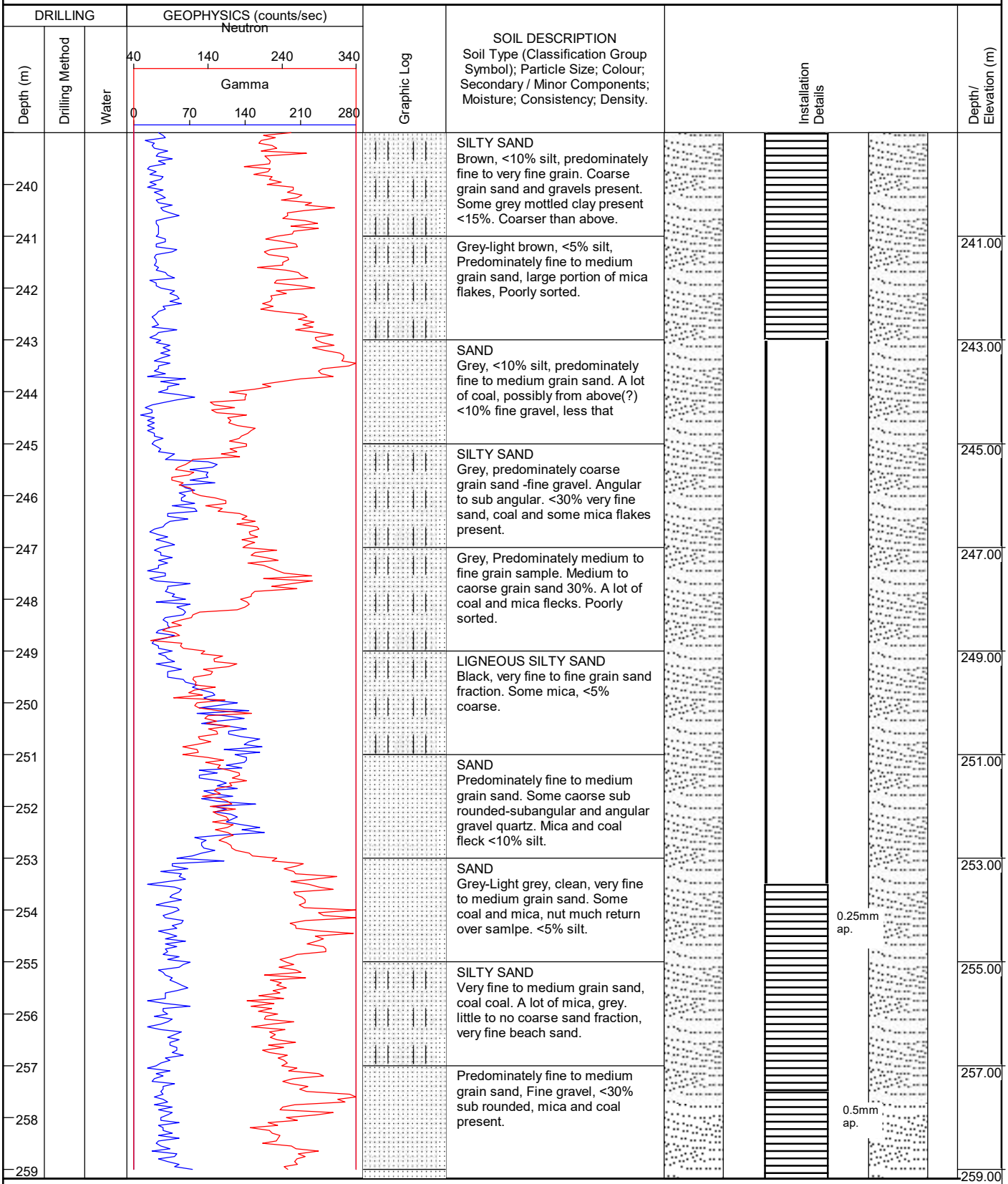
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

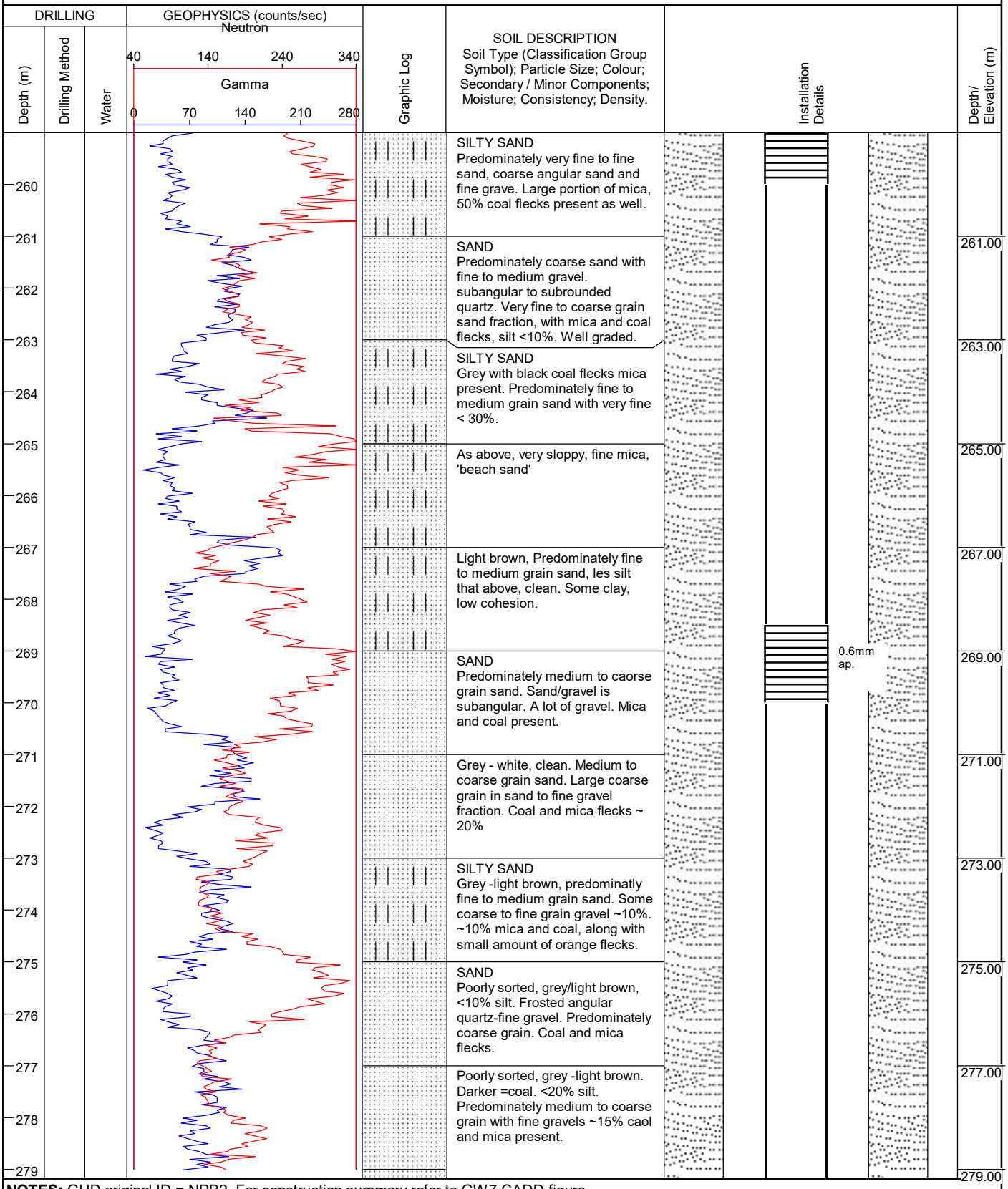
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

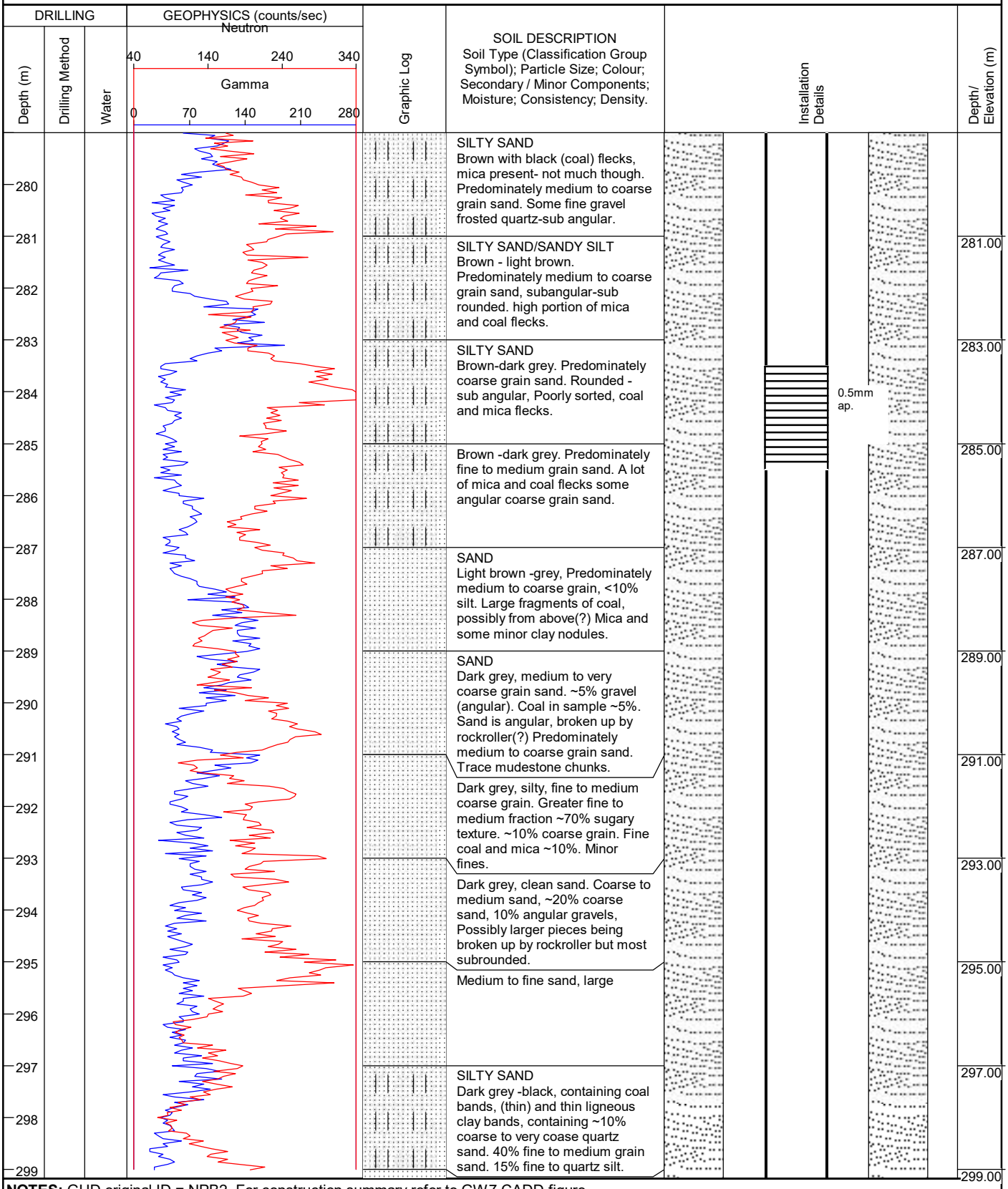
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

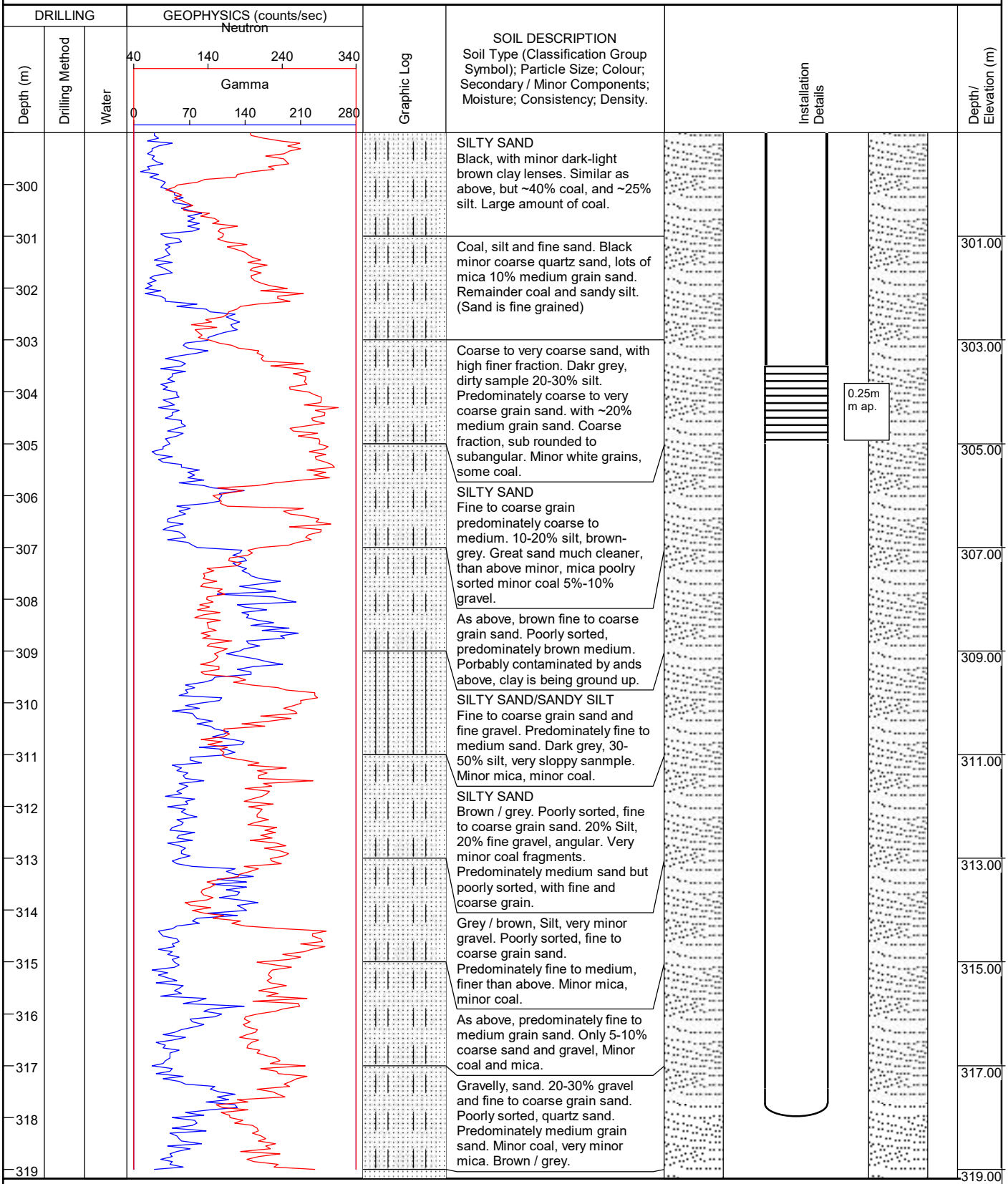
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

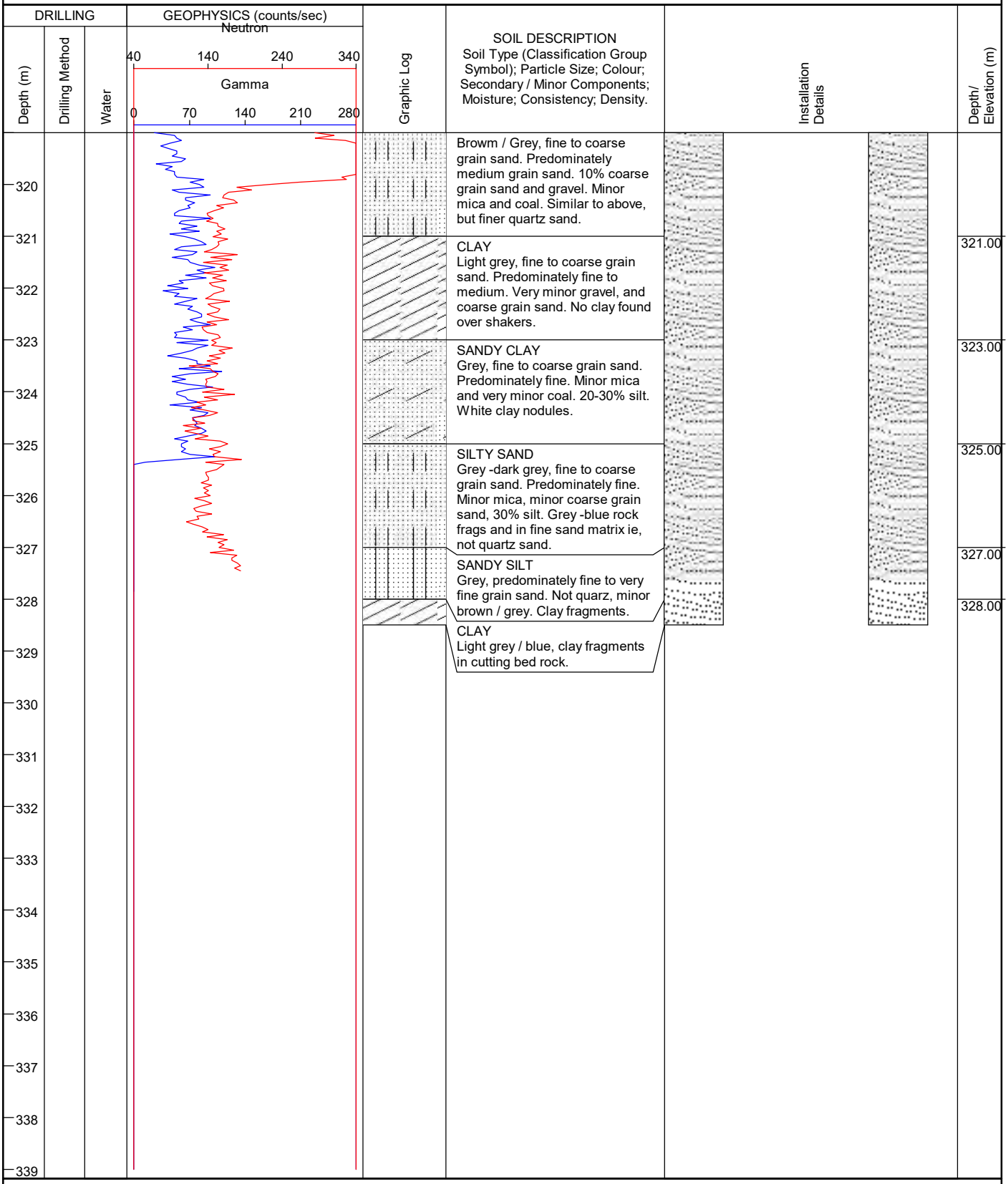
Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6



NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

BOREHOLE LOG

HYDROGEOLOGICAL

Bore No.: GW7

Client: Barwon Water
Project: Anglesea Borefields
Job No.: 31/23492/01
Location: Anglesea
Date Drilled: 12/05/2009 **to:** 23/07/2009

Drilling Co.: Drilltec
Driller: Darren
Rig Type: 2G5 Denver Gardener
Total Depth (m): 628.5
Diameter (mm): 550 - 250

Easting: 252767
Northing: 5752088
Grid Ref: MGA 94, Zone 55
Collar RL: 109.96 (GL)
Logged by: DK **Checked by:** JSM

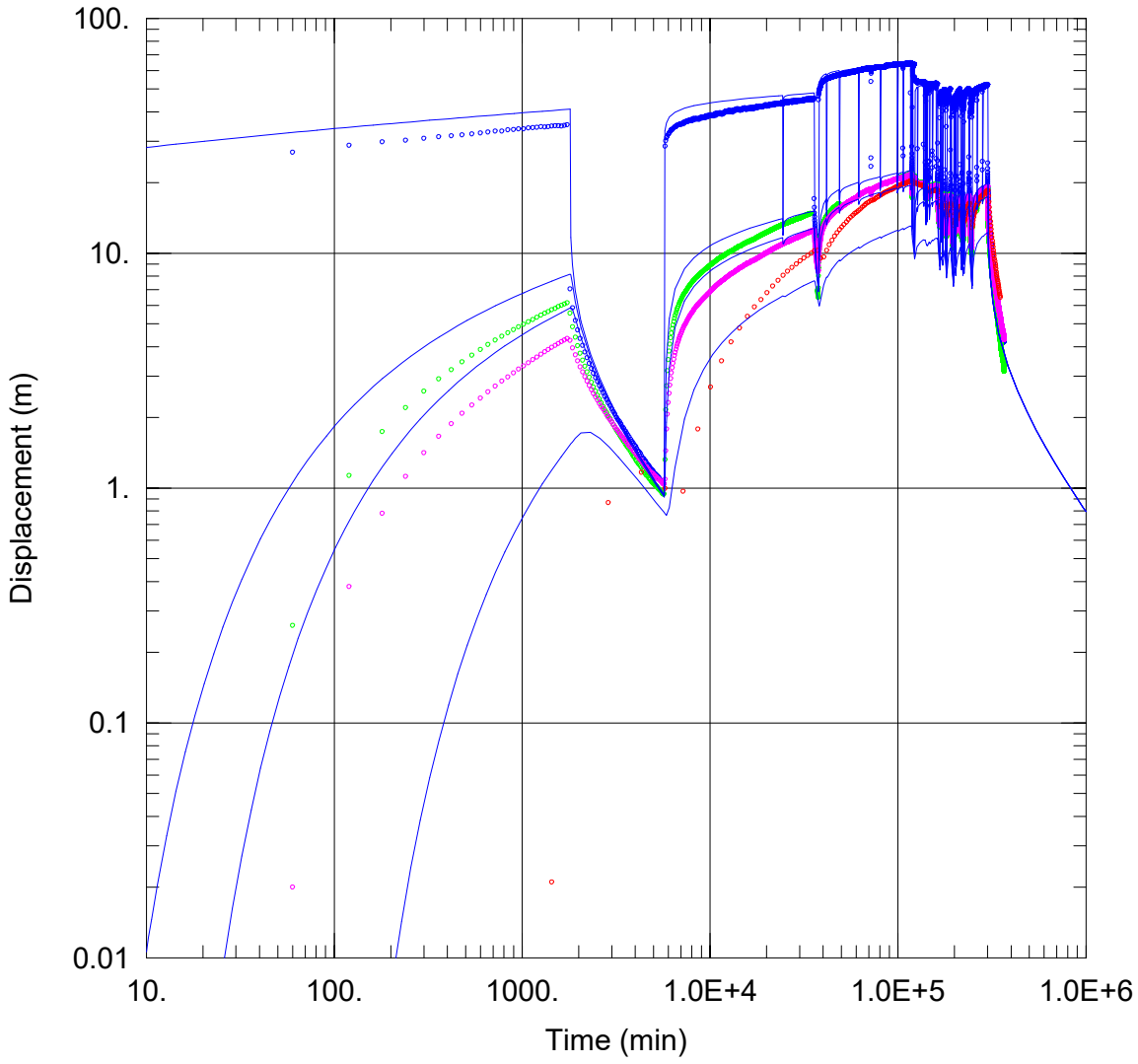
B.C.L. No.: 9035751 **Casing Material:** FRP/SS **Screen Material:** Stainless Steel **Screen Slot Size (mm):** 0.25 - 0.6

DRILLING			GEOPHYSICS (counts/sec) Neutron 40 140 240 340 / Gamma 0 70 140 210 280	Graphic Log	SOIL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components; Moisture; Consistency; Density.	Installation Details	Depth / Elevation (m)
Depth (m)	Drilling Method	Water					
340							
341							
342							
343							
344							
345							
346							
347							
348							
349							
350							350.00
351							
352							
353							
354							
355							
356							
357							
358							
359							

NOTES: GHD original ID = NPB2. For construction summary refer to GW7 CADD figure

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993.

Appendix G AQTESolve Outputs



12-MONTH PUMPING TEST

Data Set: C:\...\Alcoa Anglesea_SB2, WB14, WB15, WB16.aqt
Date: 02/04/22 Time: 13:42:38

PROJECT INFORMATION

Company: EHS Support
Client: Alcoa of Australia
Project: AUS##C03371_2021
Location: Anglesea
Test Well: MW16
Test Date: 13 May 2021

AQUIFER DATA

Saturated Thickness: 72. m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WB16	253504	5747188

Observation Wells

Well Name	X (m)	Y (m)
WB16	253504	5747188
WB14	253671	5747343
WB15	253857	5747075
SB2 (Barwon Water)	254260	5746445

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 111.7 m^2/day S = 0.0002252

Appendix H Laboratory Permeability Results

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL202009048
Client:	EHS Support		
Client address:	PO Box 297, Port Melbourne, VIC, 3207		
Project ID:	772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	(CL) CLAY, low plasticity, brown		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	55.50
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

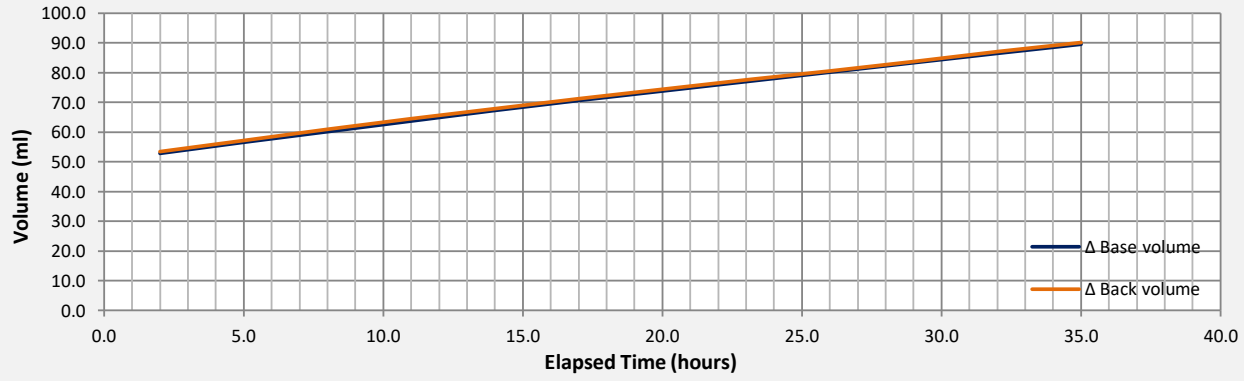
Specimen before testing		Compaction Details	
Height [H] (mm)	63.3	**Method**	-
Diameter [D] (mm)	63.3	**Material retained on 19mm sieve (g):**	-
[D]:[H]	1:1	**Optimum Moisture Content:**	-
Mass (g)	350.5	**Maximum Dry Density (t/m^3):**	-
Moisture Content:	17.9%	**Target moisture content to OMC:**	-
Dry Density (t/m^3):	1.49	**Target dry density relative to MDD:**	-
Assumed Porosity (%)	43.7%	**Laboratory Moisture Ratio:**	-
Assumed Pore Volume (mL)	87.1	**Laboratory Density Ratio:**	-

Pre-test photo

Post-test photo

Permeability test details

Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	61.2%
Saturation B value:	97%
Confining Pressure (kPa):	2152
Inlet Pressure (kPa):	1510
Outlet Pressure (kPa):	1490
Mean effective stress (kPa):	652
Hydraulic Head (kPa):	20
Moisture content after test:	26.4%
Permeability: (m/s)	**3E-09**



Notes: Specimen prepared from a u63 tube sample, subsampled from a larger core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 16/09/20

Cert. Ref.: 1772660-038-001_MB7_2009048_TRM20-0581_PERM_R20056426 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL202009047
Client:	EHS Support		
Client address:	Po Box 297, Port Melbourne VIC 3207		
Project ID:	1772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	(CI) Sandy CLAY, medium plasticity, black, fine to medium grained sand		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	37.00
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

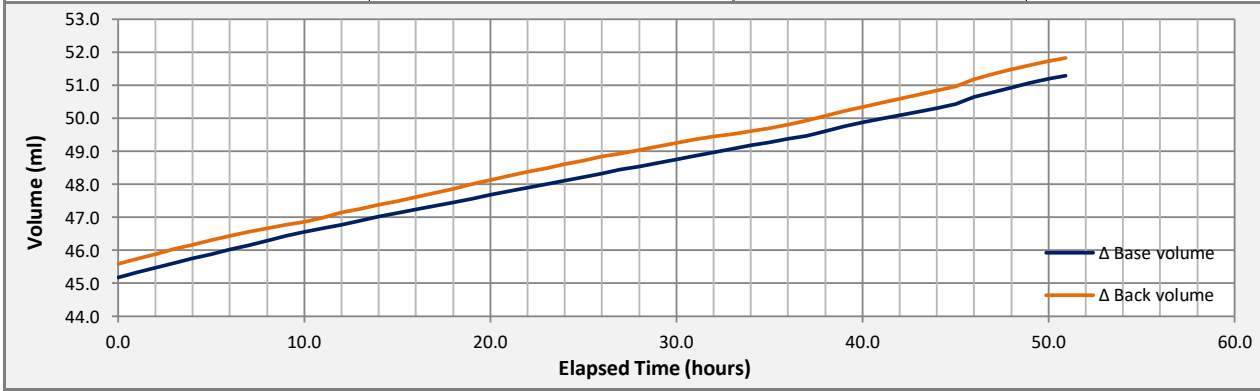
Specimen before testing		Compaction Details	
Height [H] (mm)	63.5	**Method**	-
Diameter [D] (mm)	63.3	**Material retained on 19mm sieve (g):**	-
[D]:[H]	1:1	**Optimum Moisture Content:**	-
Mass (g)	318.2	**Maximum Dry Density (t/m^3):**	-
Moisture Content:	5.3%	**Target moisture content to OMC:**	-
Dry Density (t/m^3):	1.51	**Target dry density relative to MDD:**	-
Assumed Porosity (%)	39.5%	**Laboratory Moisture Ratio:**	-
Assumed Pore Volume (mL)	78.8	**Laboratory Density Ratio:**	-

Pre-test photo

Post-test photo

Permeability test details

Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	20.4%
Saturation B value:	98%
Confining Pressure (kPa):	2212
Inlet Pressure (kPa):	1805
Outlet Pressure (kPa):	1795
Mean effective stress (kPa):	412
Hydraulic Head (kPa):	10
Moisture content after test:	22.7%
Permeability: (m/s)	**7E-10**



Notes: Specimen prepared from a u63 tube sample, subsampled from a larger undisturbed core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 30/09/20

Cert. Ref.: 1772660-038-001_MB7_2009047_TRM20-0581_PERM_R20057065 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL2020090410
Client:	EHS Support		
Client address:	PO Box 297, Port Melbourne VIC 3207		
Project ID:	772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	COAL, black		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	-
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

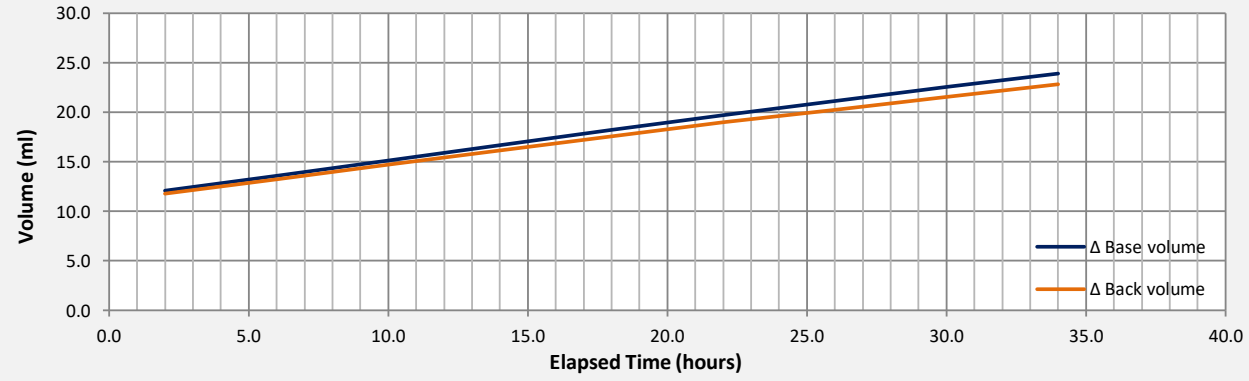
Specimen before testing	
Height [H] (mm)	63.2
Diameter [D] (mm)	63.4
[D]:[H]	1:1
Mass (g)	218.5
Moisture Content:	100.3%
Dry Density (t/m^3):	0.55
Assumed Porosity (%)	76.2%
Assumed Pore Volume (mL)	151.8

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	72.1%
Saturation B value:	100%
Confining Pressure (kPa):	2257
Inlet Pressure (kPa):	1505
Outlet Pressure (kPa):	1495
Mean effective stress (kPa):	757
Hydraulic Head (kPa):	10
Moisture content after test:	97.4%
Permeability: (m/s)	**2E-09**



Notes: Specimen prepared from a u63 tube sample , subsampled from a larger undisturbed core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** NL
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **25/09/20**

Cert. Ref.: 1772660-038-001_MB7_20090410_TRM20-0581_PERM_R20056885 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER

Test request #:	TRM20-0581	**Lab sample ID:**	LMEL2020090411
Client:	EHS Support		
Client address:	PO Box 297, Port Melbourne VIC 3207		
Project ID:	1772660-038-00	**Project reference:**	
Project name:	EHS Support - Permeability Testing		
Project reference:			
Specimen description:	(ML) SILT, low plasticity, brown		

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Exporatory Hole	**MB7**
Sample depth (m):	140.00
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

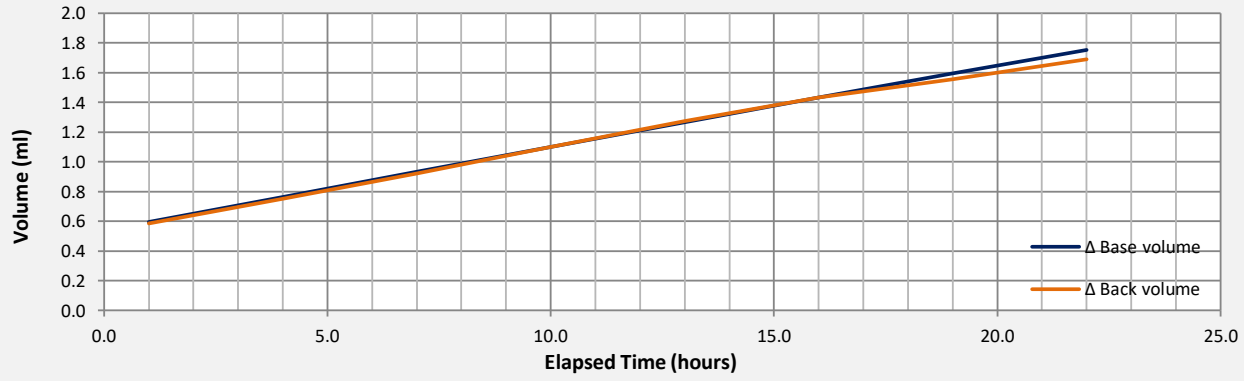
Specimen before testing	
Height [H] (mm)	56.7
Diameter [D] (mm)	63.1
[D]:[H]	1:0.9
Mass (g)	356.0
Moisture Content:	17.3%
Dry Density (t/m^3):	1.71
Assumed Porosity (%)	32.9%
Assumed Pore Volume (mL)	58.4

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	90.1%
Saturation B value:	100%
Confining Pressure (kPa):	1996
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	996
Hydraulic Head (kPa):	20
Moisture content after test:	19.2%
Permeability: (m/s)	**1E-10**



Notes: Specimen prepared from a u63 tube sample, subsampled from a larger core sample provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 21/09/20

Cert. Ref.: 1772660-038-001_MB7_20090411_TRM20-0581_PERM_R20056616 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL [PAGE 1 OF 1]

Nick Lobb - Senior Technician

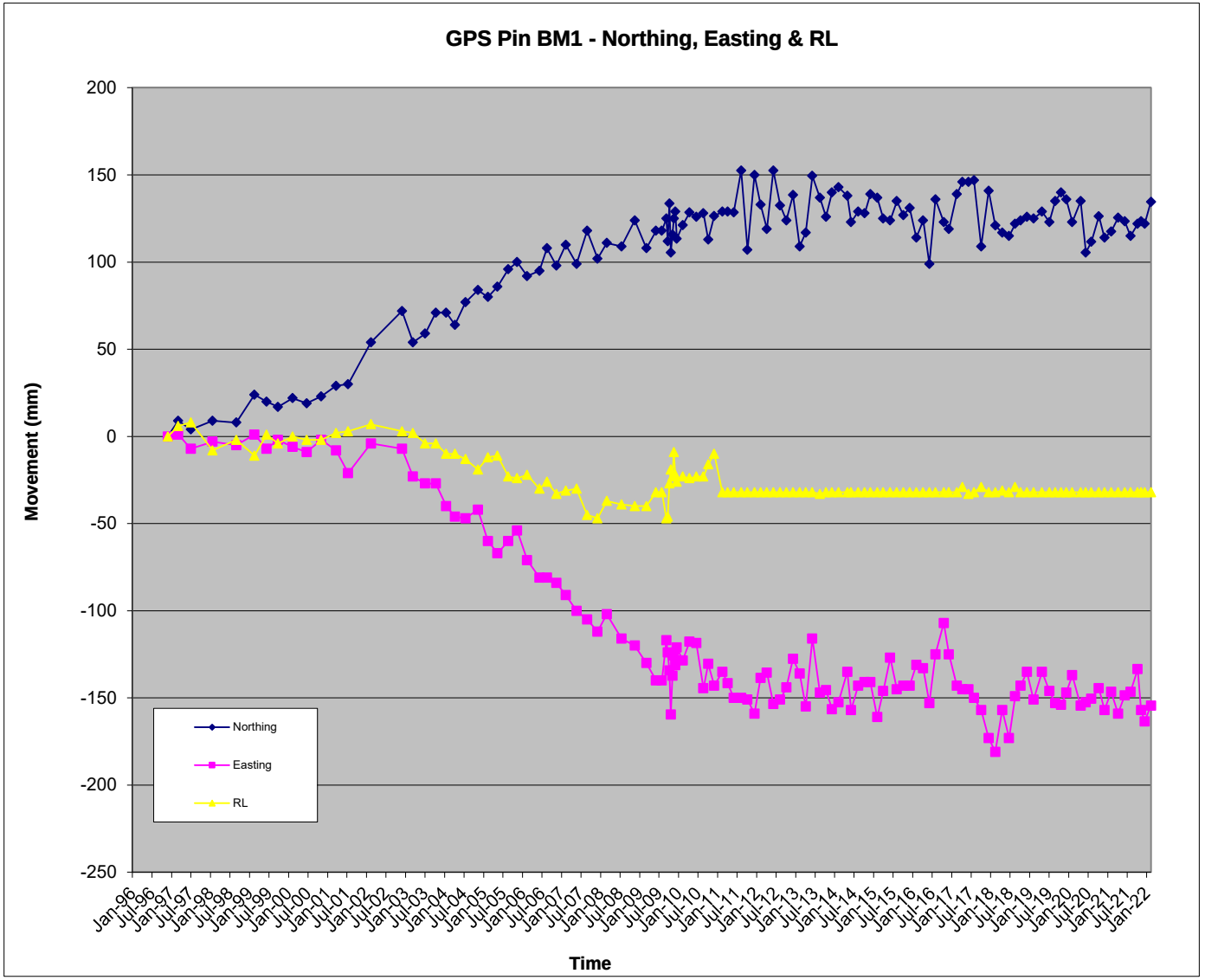
Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

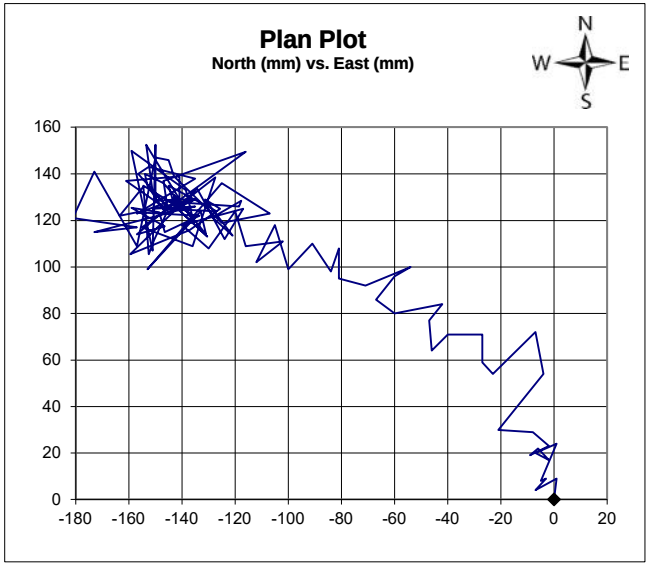
Sample ID	Depth interval		E	N	Classification	Lithology- Hydro	Moisture content (%)	Dry density (t/m3)	Assumed porosity (%)	Kv (m/sec)	Kv (m/d)	Pre-test	Post-test
ANG-21-0181	1.5-1.9	In Mine DBF	252551.00	5746311.00	Silty CLAY	dark brown - dark grey, medium plasticity, soft, some ash, trace coal fragments	27.3	1.55	41.6	8E-10	6.91E-05		
ANG-21-0184	0.05-0.45	In Mine DBF	252611.00	5746335.00	?	?	10.3	2.02	23.7	2E-10	1.73E-05		
ANG-21-0185	4-4.4	In Mine DBF	252611.00	5746335.00	CLAY	dark brown - black, medium to high plasticity, soft, moist, with very fine silt content (possible ash). Increasing silt content with depth	22.3	1.59	40.1	0.000000009	7.78E-04		
ANG-21-0187	3-3.4	In Mine DBF	252655.00	5746326.00	Silty CLAY	brown-dark brown, medium to high plasticity, soft to firm, moist, with trace ash and coal fragments at 3 m	32.9	1.42	48.3	0.000000001	8.64E-05		

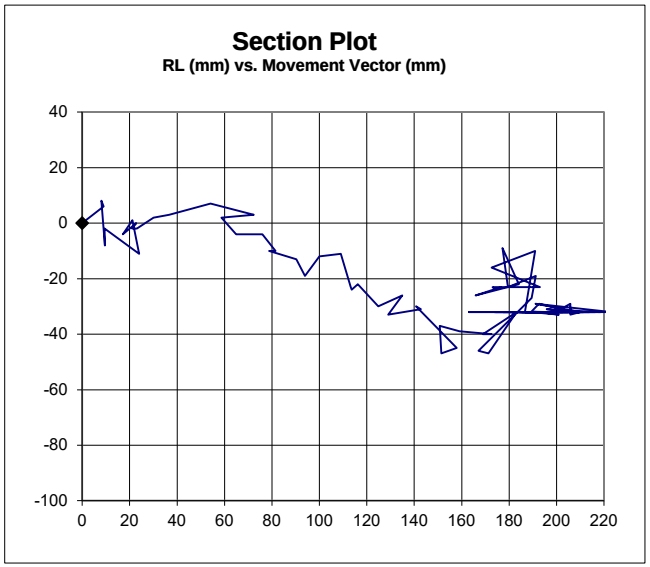
ANG-21-0189	0.2-0.6	In Mine DBF	252671.00	5746393.00	Sandy CLAY	brown to pale brown, low to medium plasticity, fine to coarse grained subangular sands, poorly graded	9.9	2.04	23.1	4E-10	3.46E-05		
ANG-21-0191	5-5.4	In Mine DBF	252671.00	5746393.00	CLAY	brown-dark brown, medium to high plasticity, soft, moist	20.1	1.61	39.3	0.000000002	1.73E-04		
UEVF MB07	140	UEVF Inter	251862.3	5747106.2	Silty CLAY	low plasticity, brown	17.3	1.71	32.9	1E-10	8.64E-06		
UEVF MB07	55.5	UEVF Inter	251862.3	5747106.2	CLAY	low plasticity, brown	17.9	1.49	43.7	0.000000003	2.59E-04		

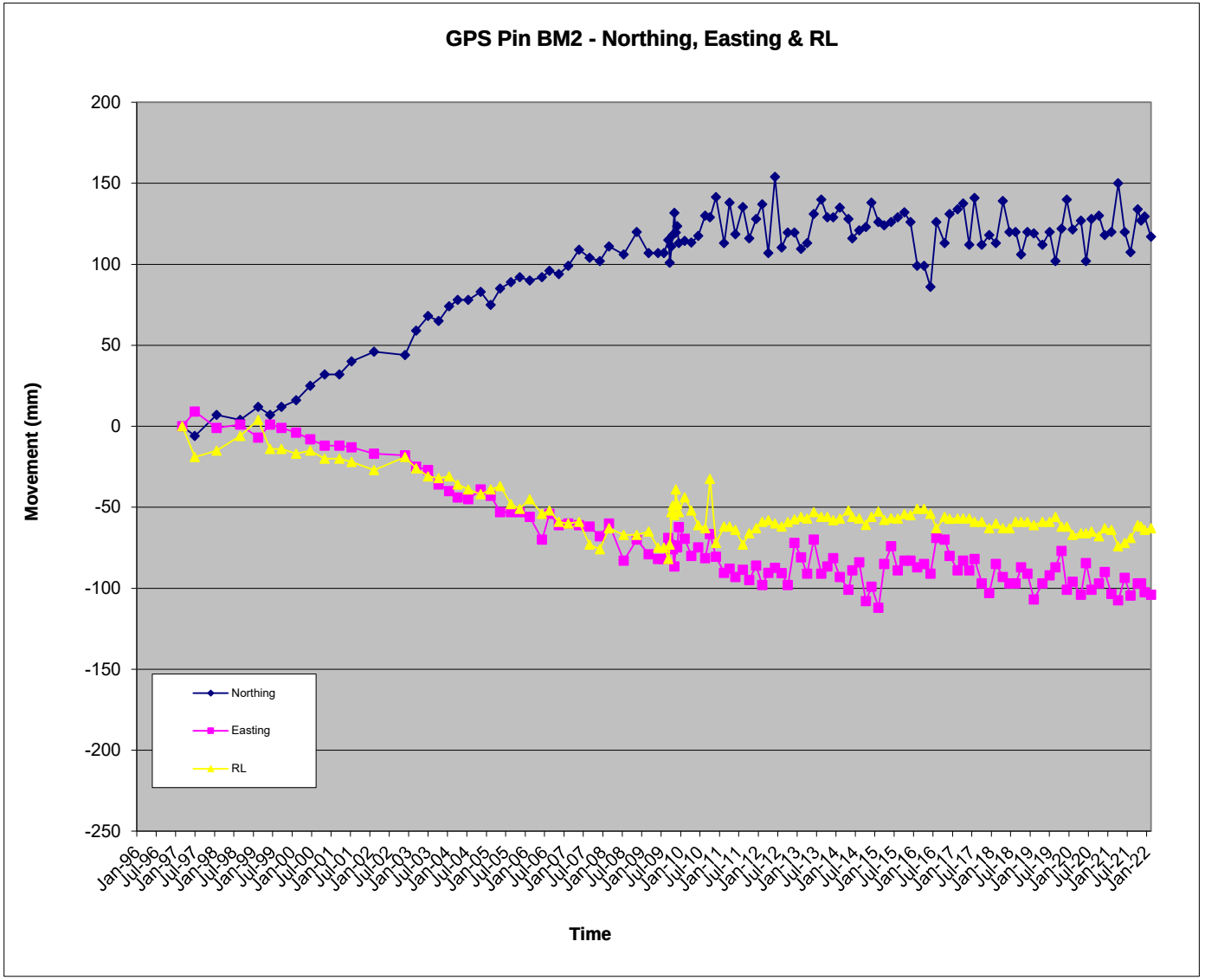
UEVF MB07	37	UEVF Inter	251862.3	5747106.2	Sandy CLAY	medium plasticity, black, fine to medium grained sand	5.3	1.51	39.5	7E-10	6.05E-05		
UEVF MB07	62	UEVF Inter	251862.3	5747106.2	COAL, black	COAL, black	97.4	0.55	76.2	0.000000002	1.73E-04		

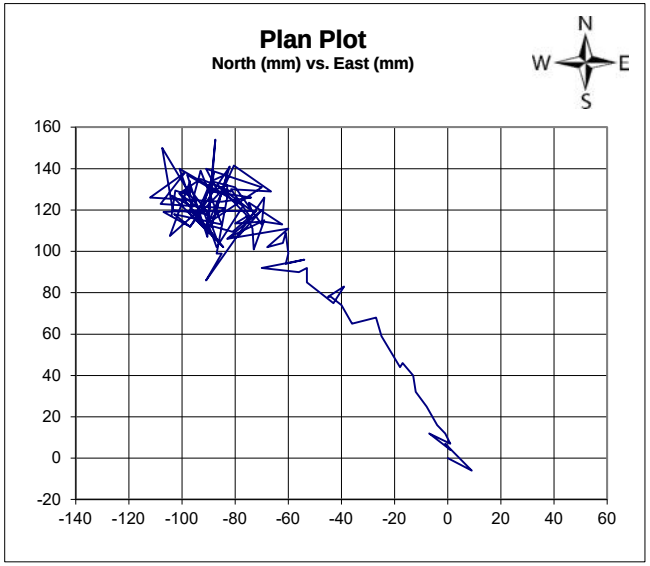
Appendix I Subsidence Monitoring

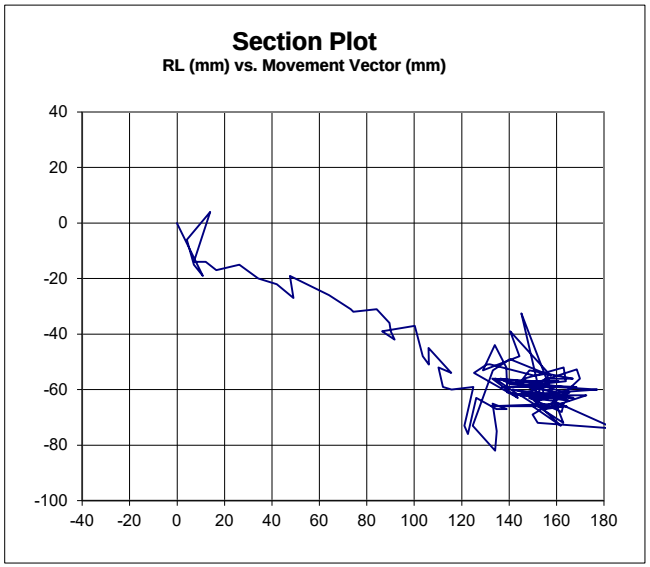

GPS Pin BM1 - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL

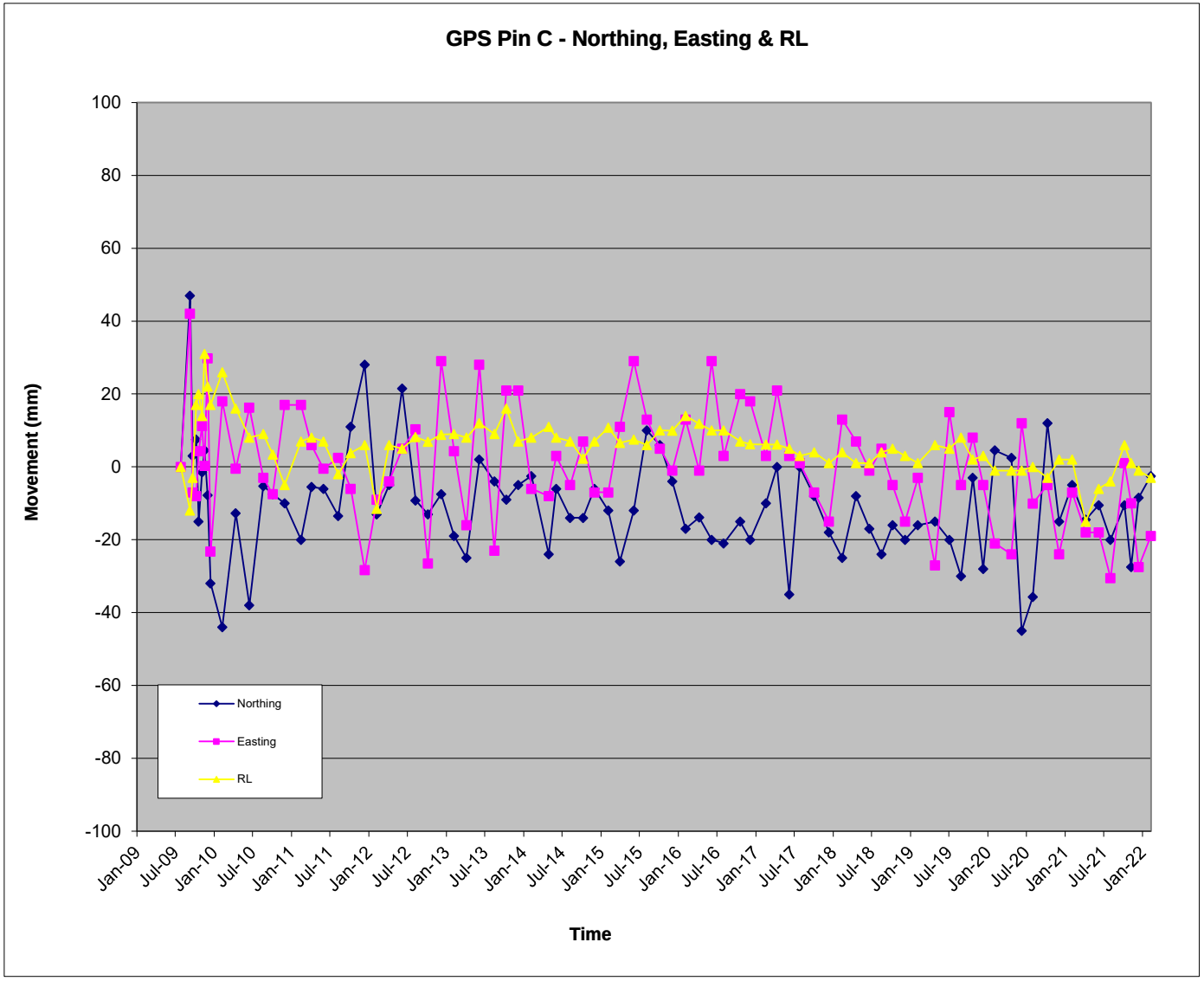

Plan Plot
North (mm) vs. East (mm)
N
W
E
S

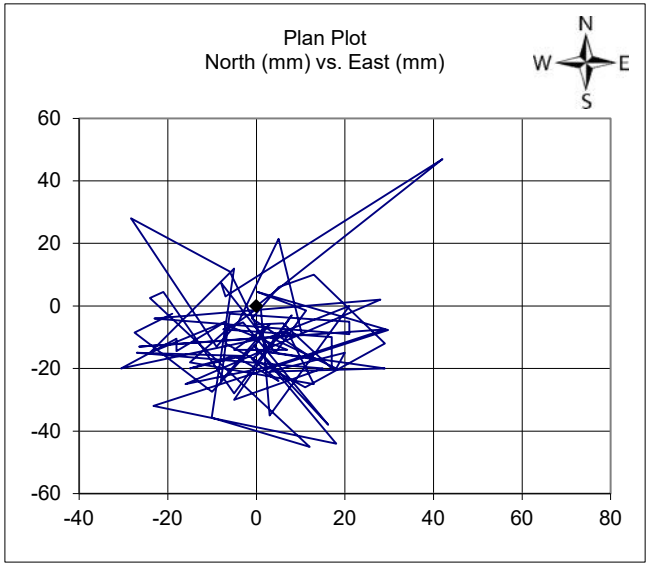

Section Plot
RL (mm) vs. Movement Vector (mm)

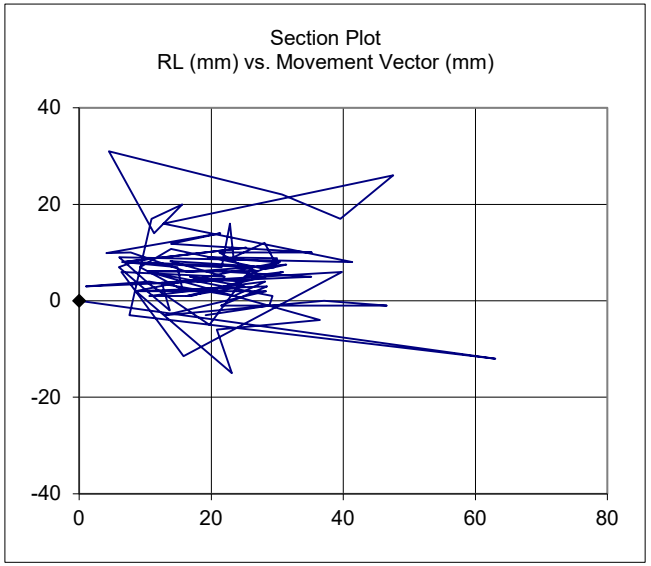

GPS Pin BM2 - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL

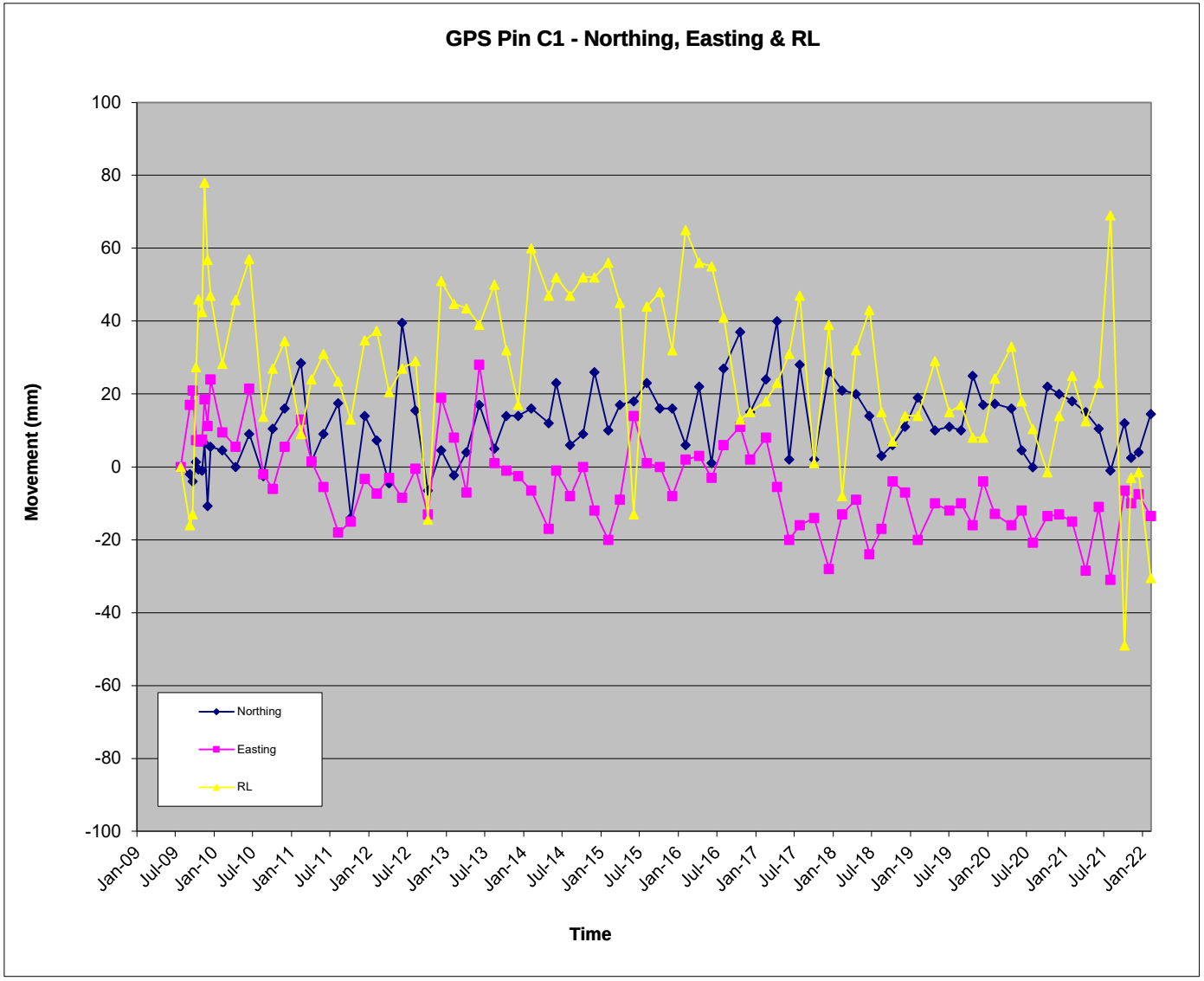

Plan Plot
North (mm) vs. East (mm)
N
W
E
S

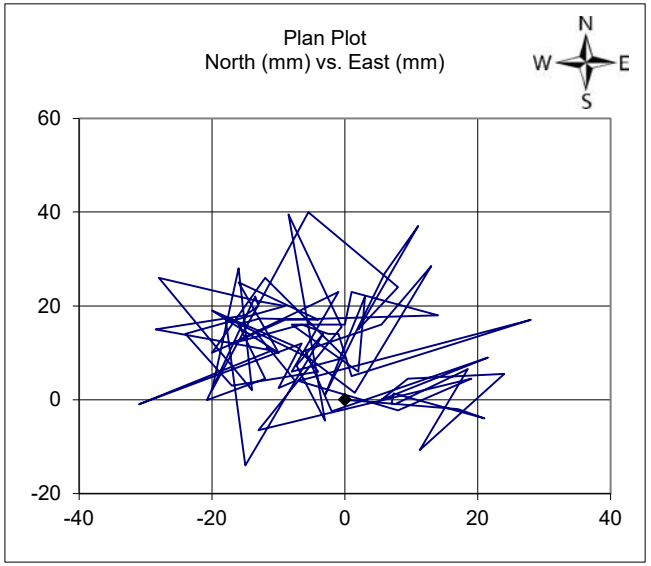

Section Plot
RL (mm) vs. Movement Vector (mm)

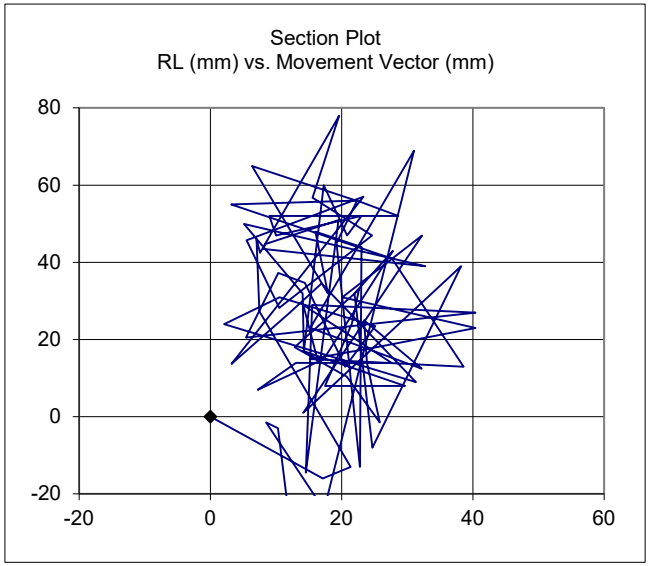

GPS Pin C - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

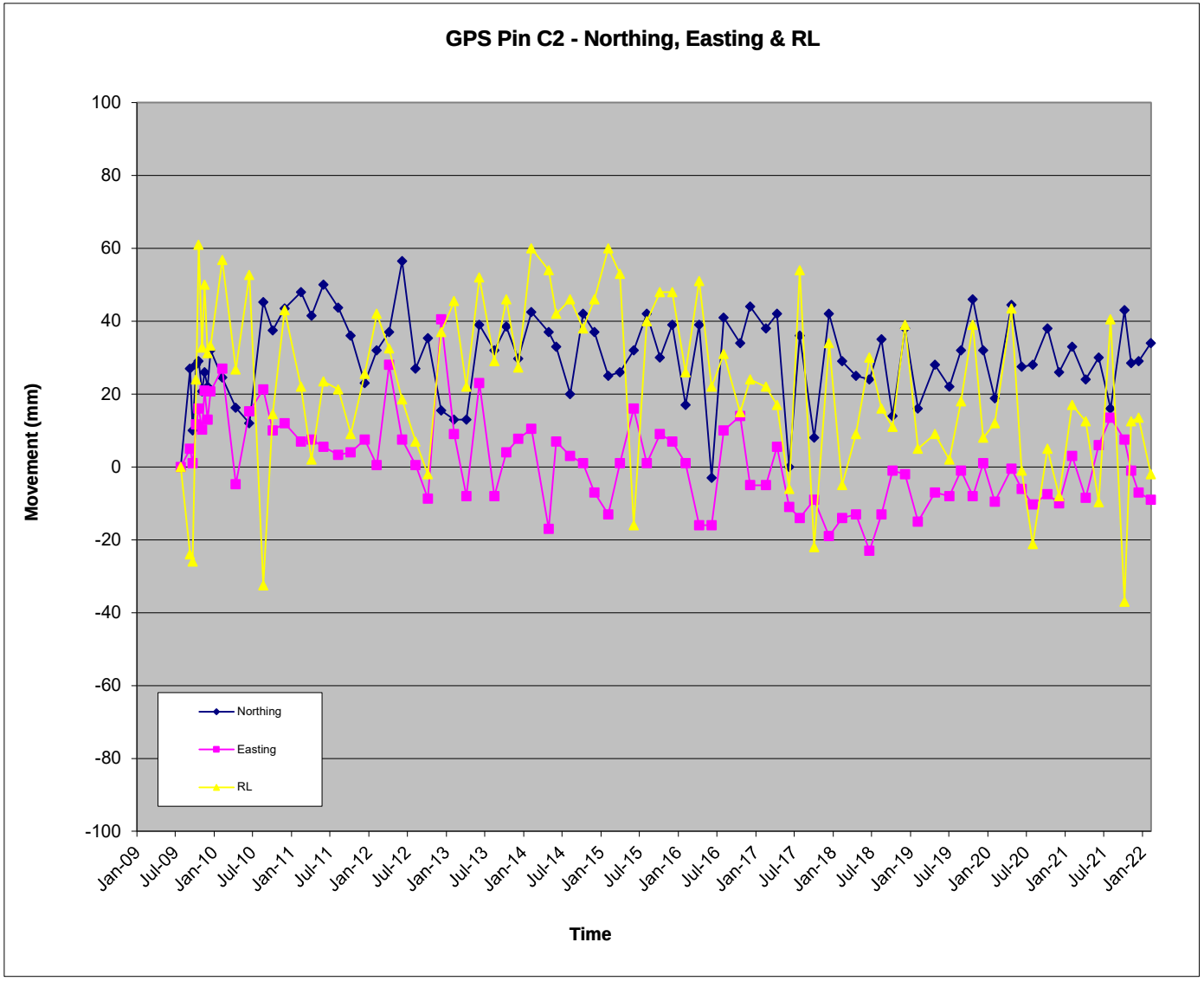

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
60
40
20
0
-20
-40
-60
-40
-20
0
20
40
60
80

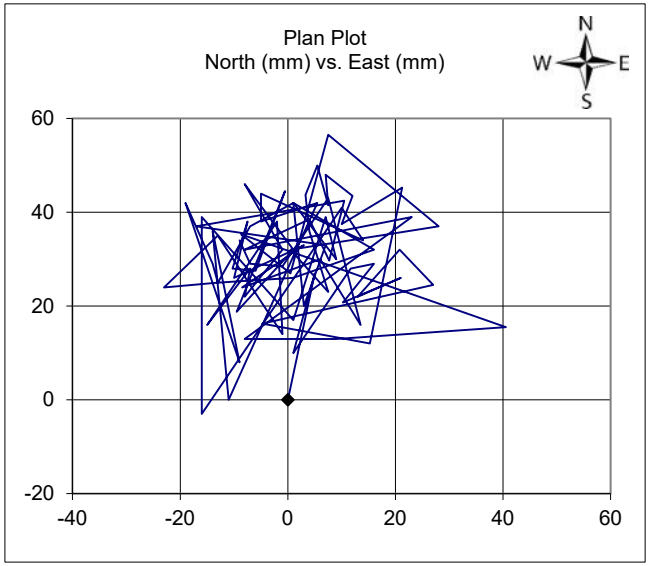

Section Plot
RL (mm) vs. Movement Vector (mm)
40
20
0
-20
-40
0
20
40
60
80

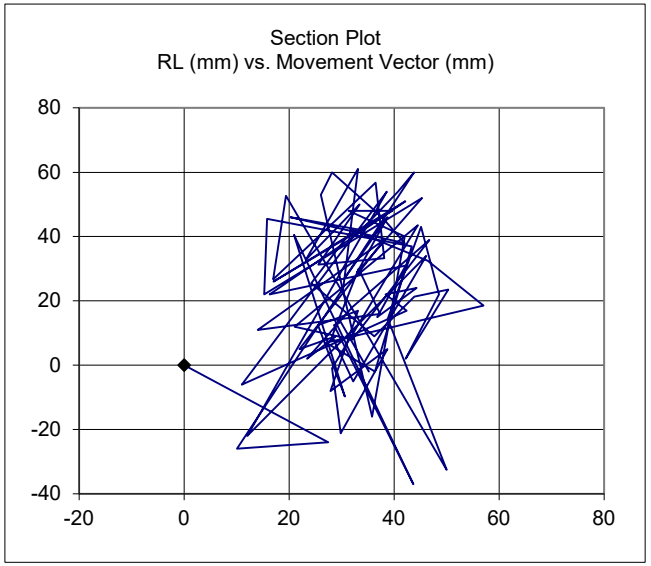

GPS Pin C1 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

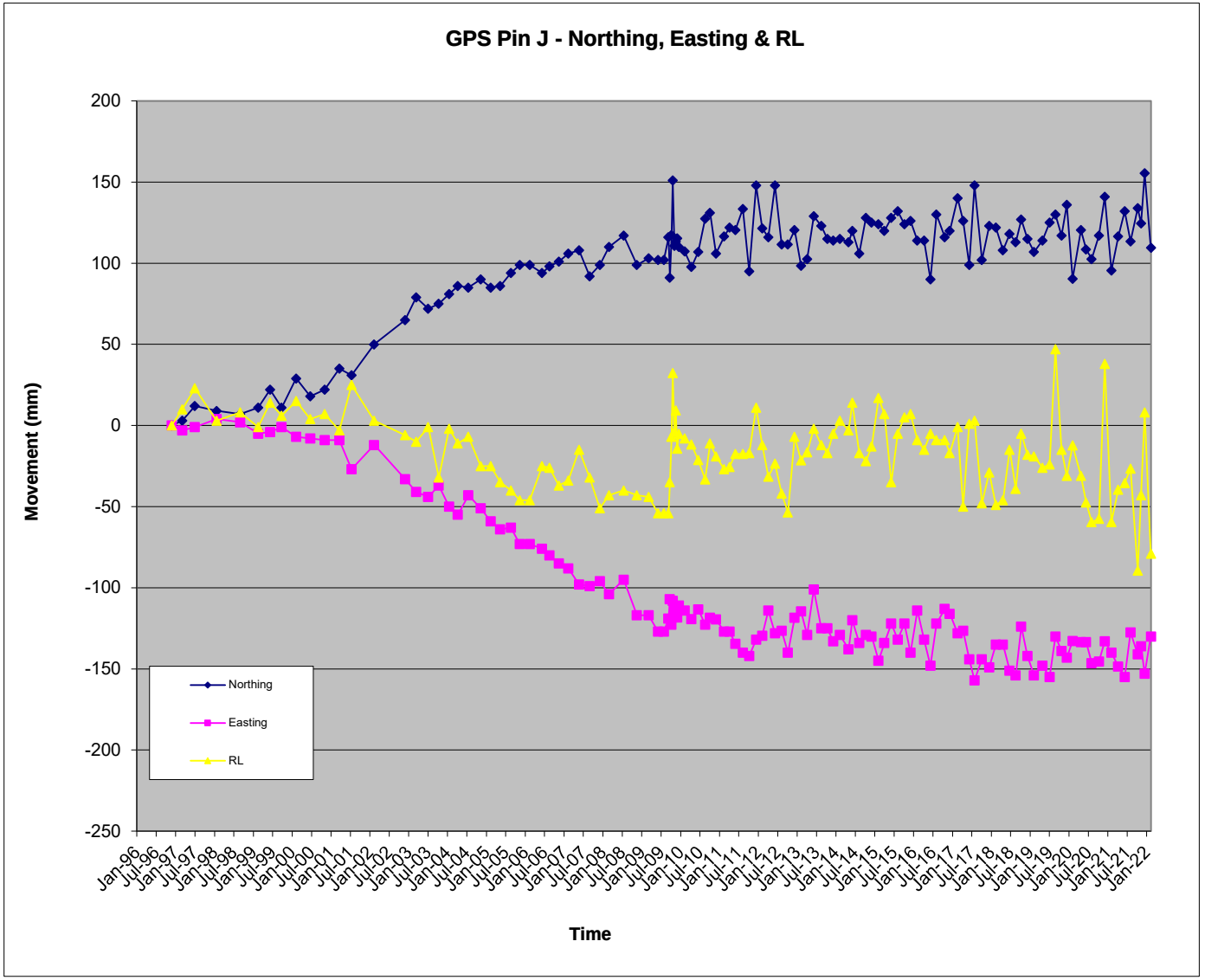

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
60
40
20
0
-20
-40
-20
0
20
40

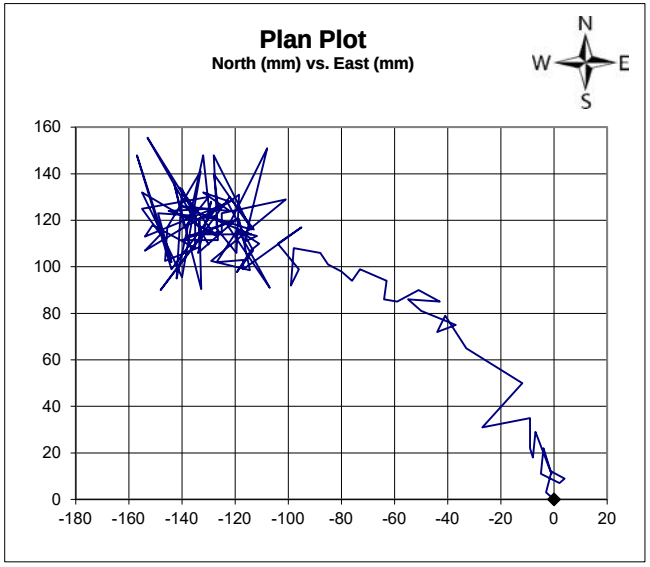

Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-20
0
20
40
60

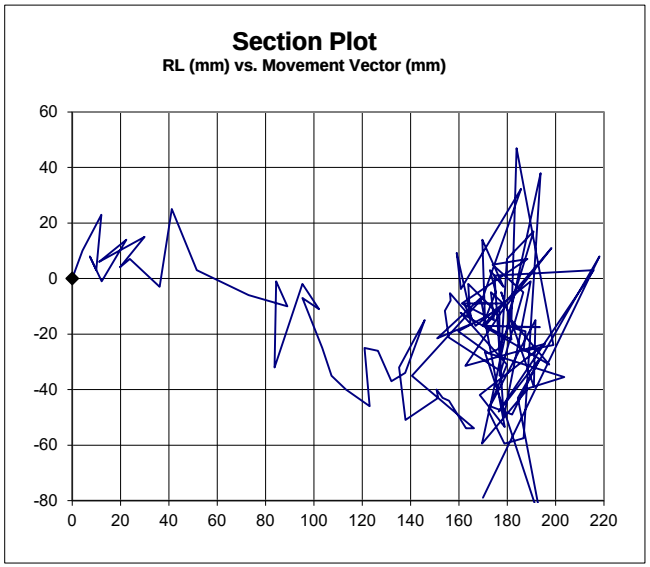

GPS Pin C2 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

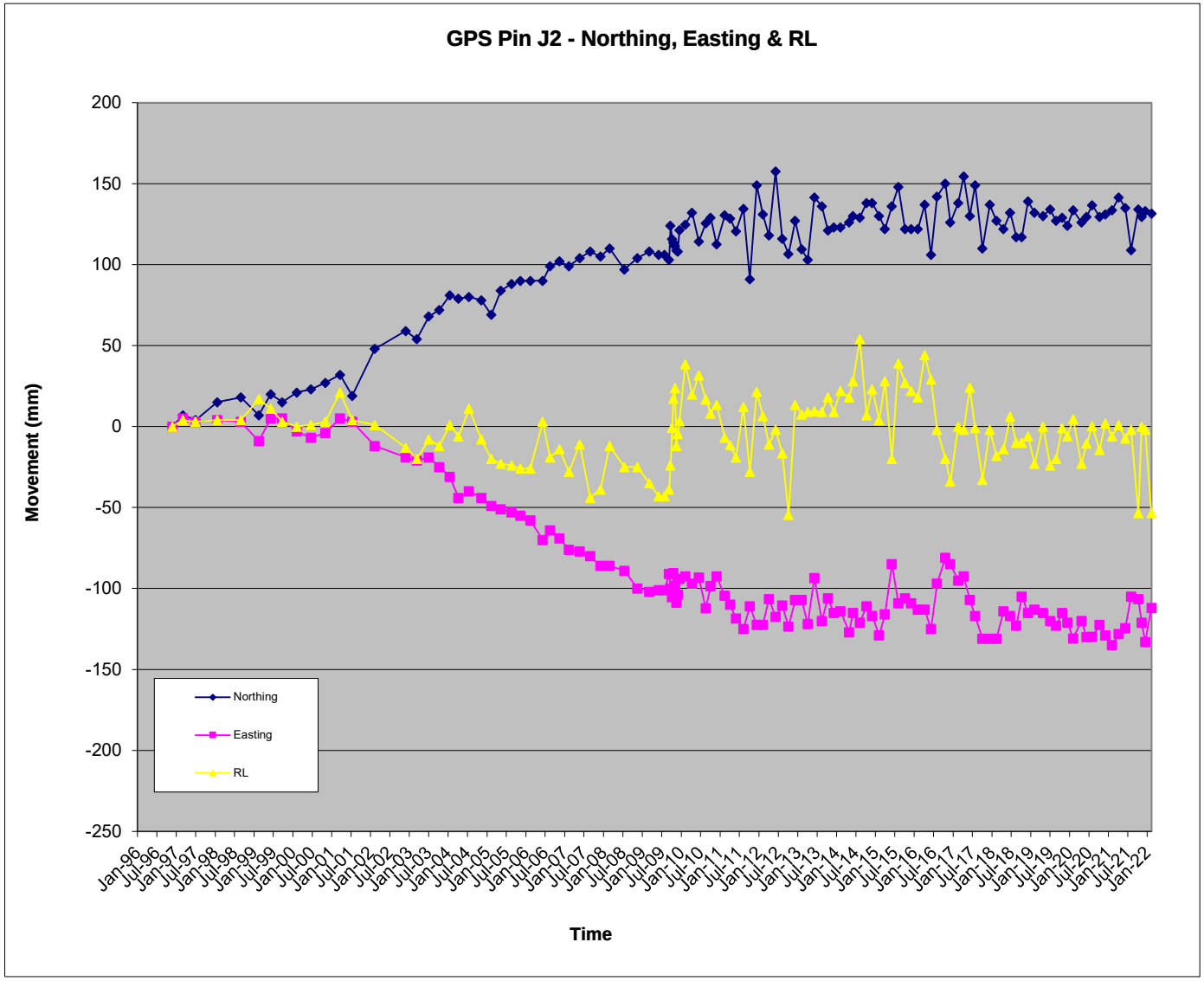

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
60
40
20
0
-20
-40
-20
0
20
40
60


Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-40
-20
0
20
40
60
80


GPS Pin J - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S


Section Plot
RL (mm) vs. Movement Vector (mm)


GPS Pin J2 - Northing, Easting & RL
Movement (mm)
200
150
100
50
0
-50
-100
-150
-200
-250
Northing
Easting
RL
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
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Jan-05
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Jul-10
Jan-11
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Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
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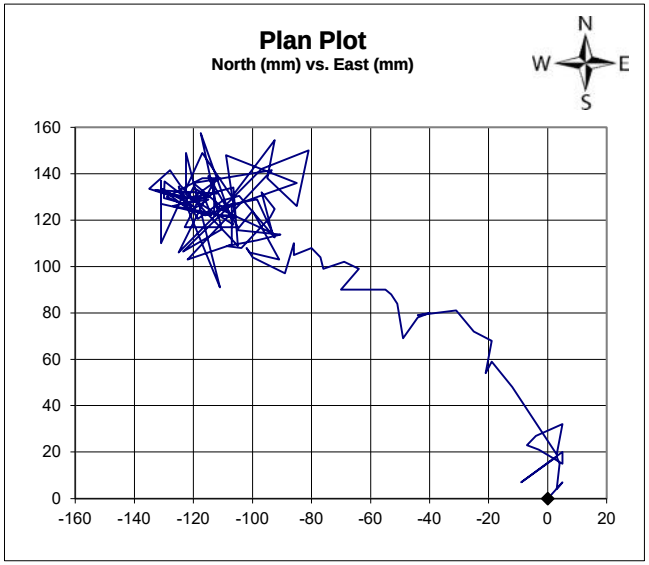
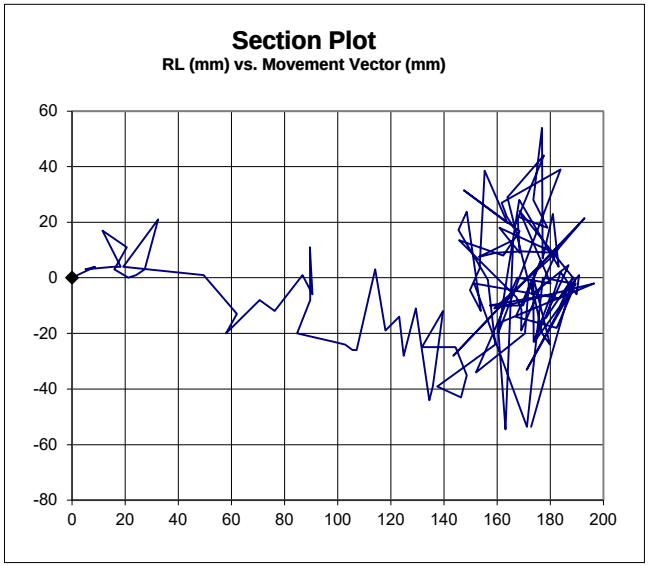
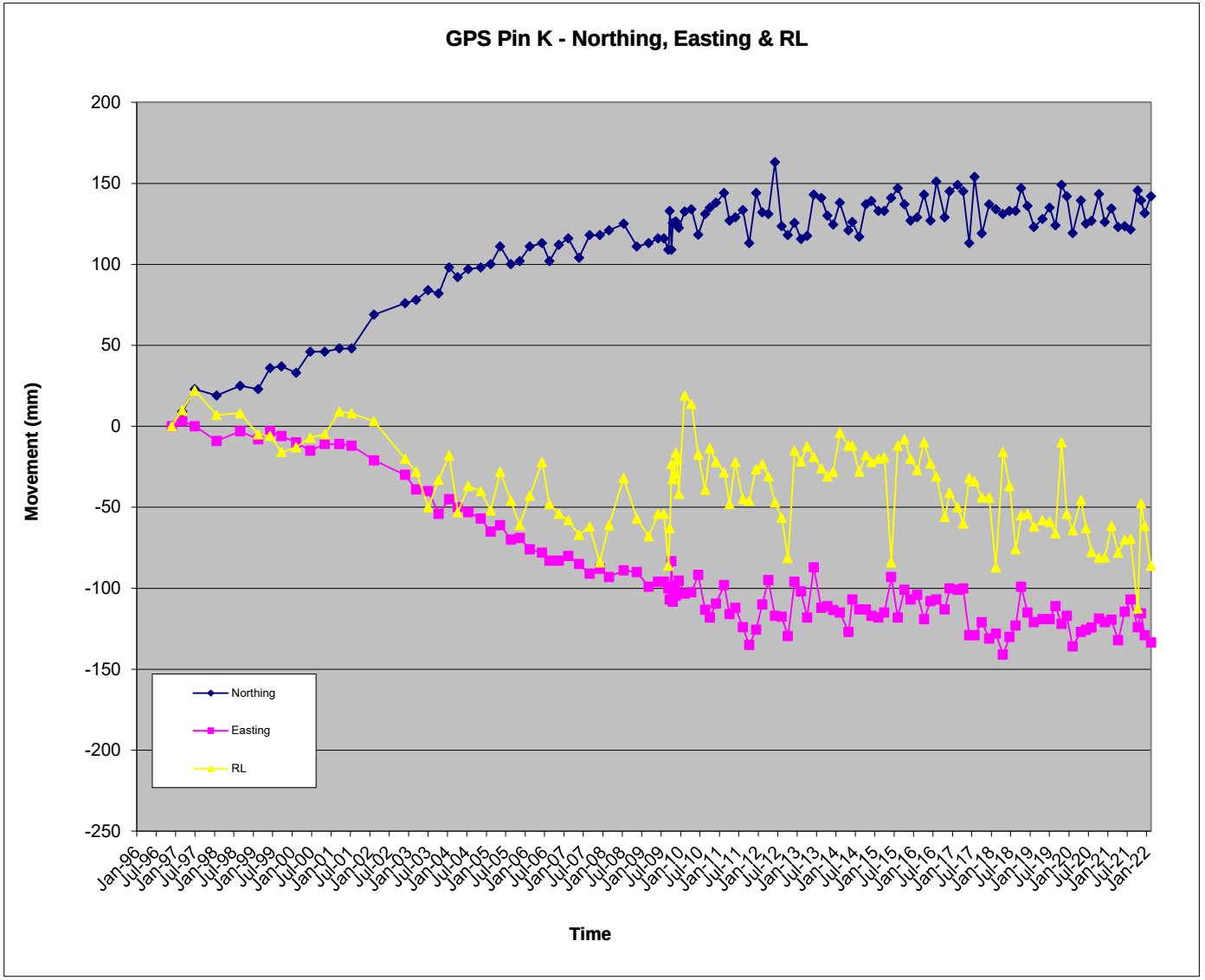
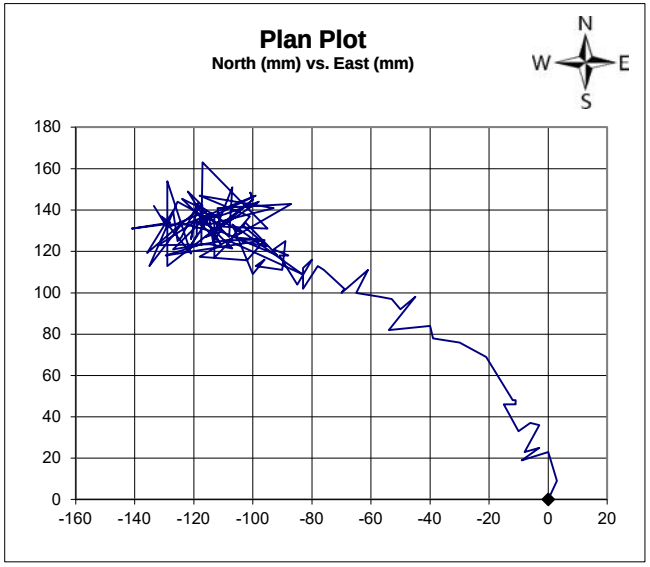
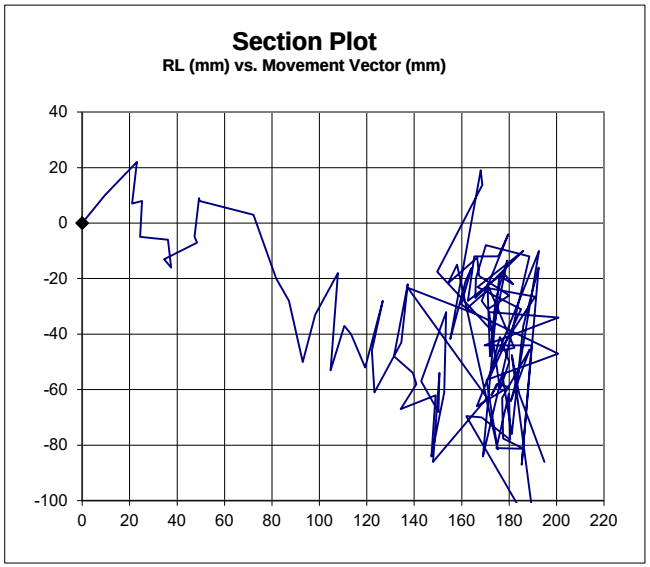
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time

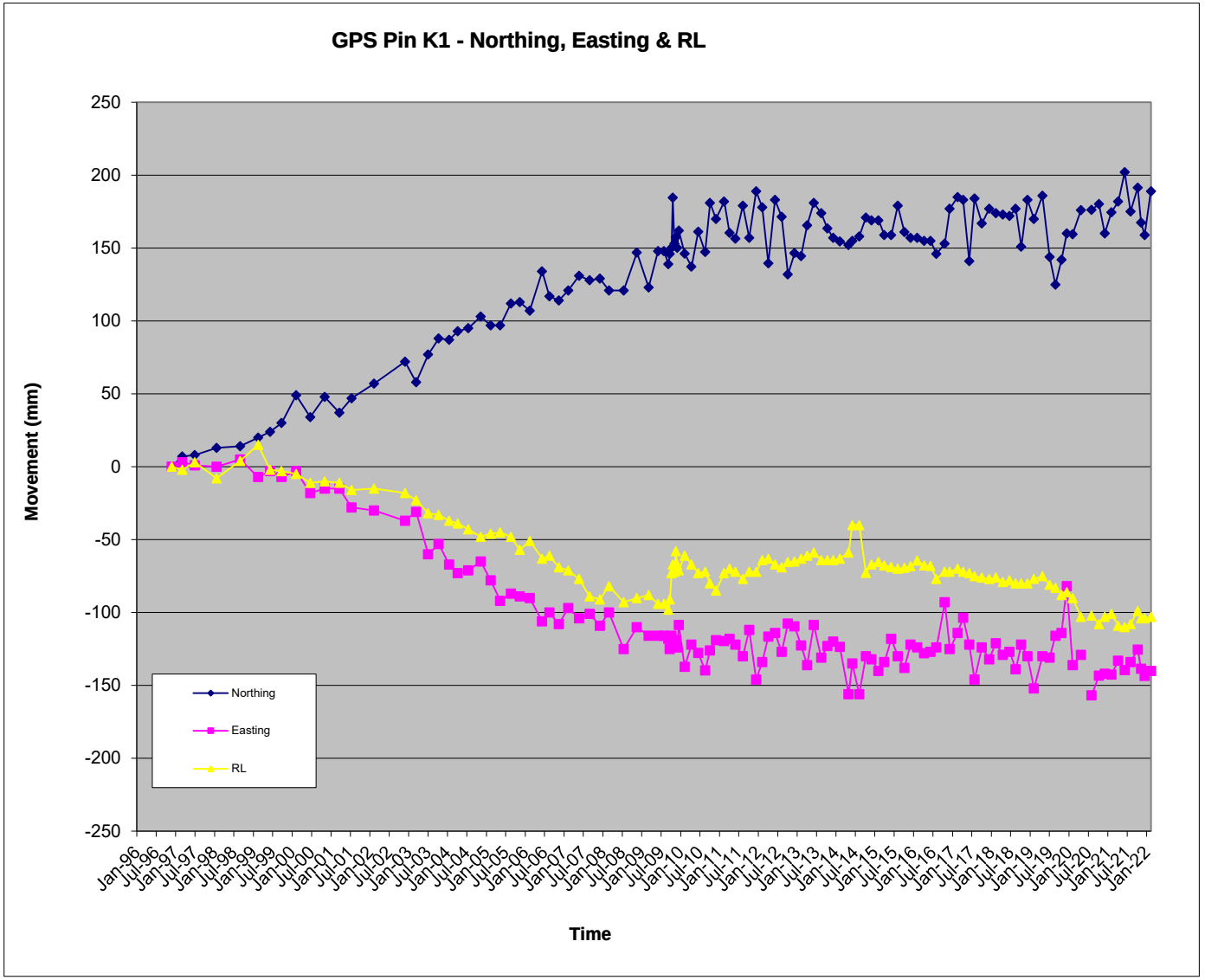

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
160
140
120
100
80
60
40
20
0
-160
-140
-120
-100
-80
-60
-40
-20
0
20

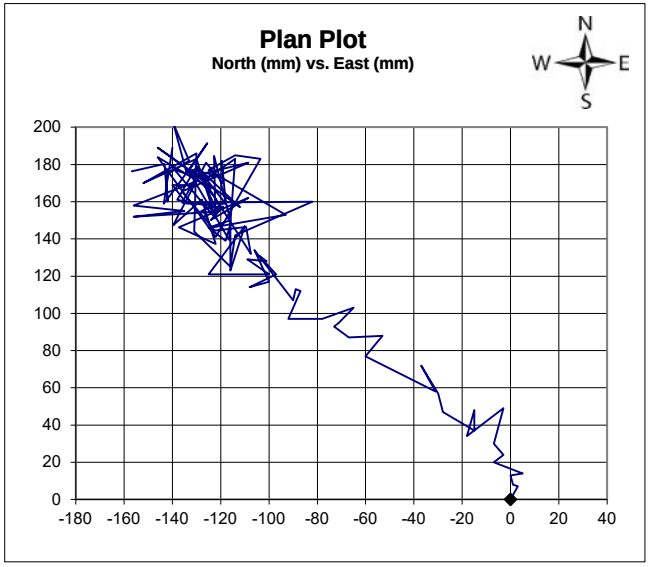

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
0
20
40
60
80
100
120
140
160
180
200

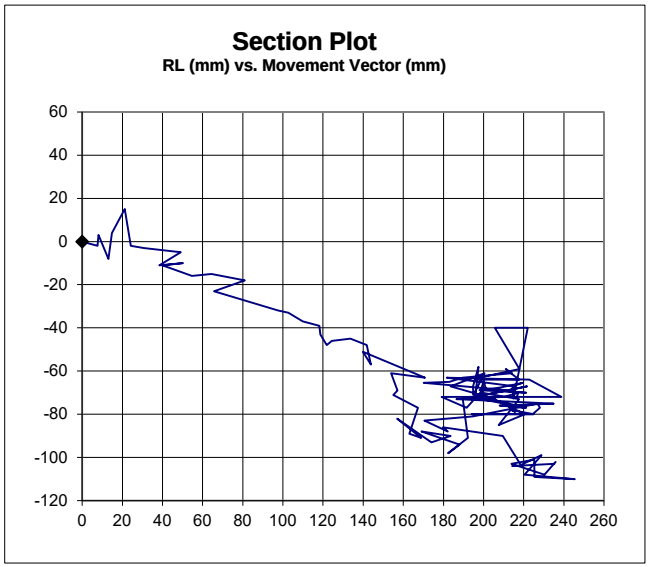

GPS Pin K - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL

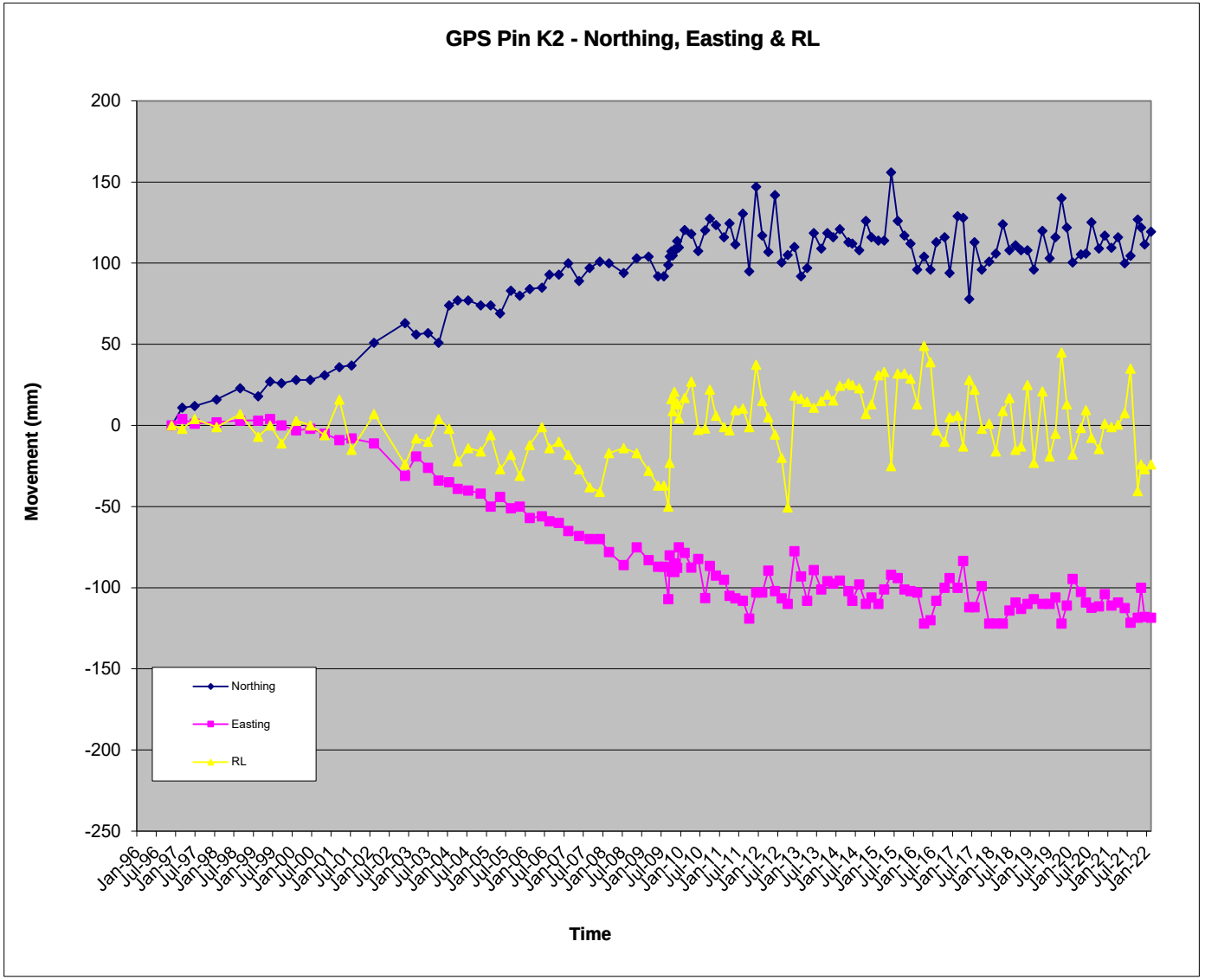

Plan Plot
North (mm) vs. East (mm)
N
W
E
S

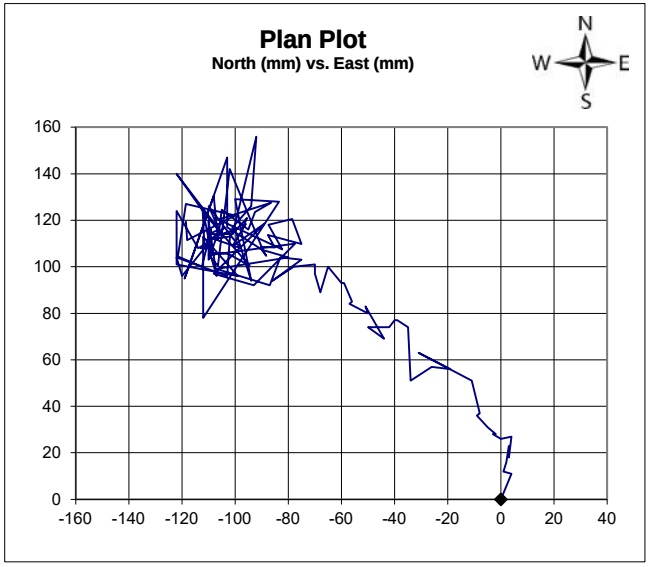

Section Plot
RL (mm) vs. Movement Vector (mm)

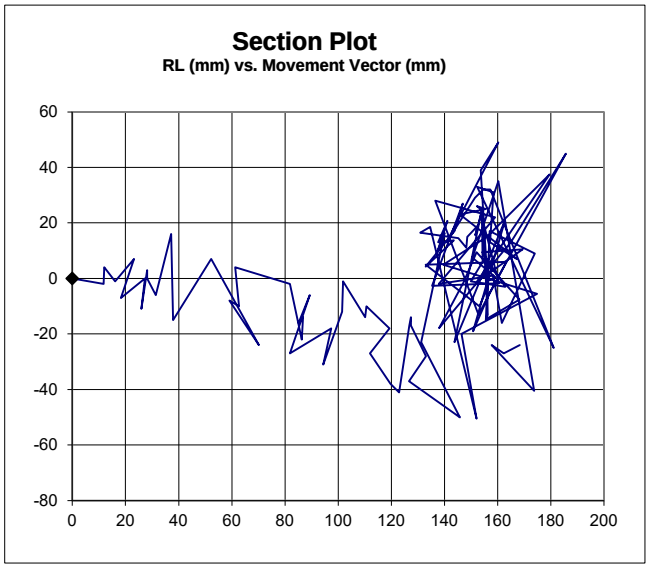

GPS Pin K1 - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL

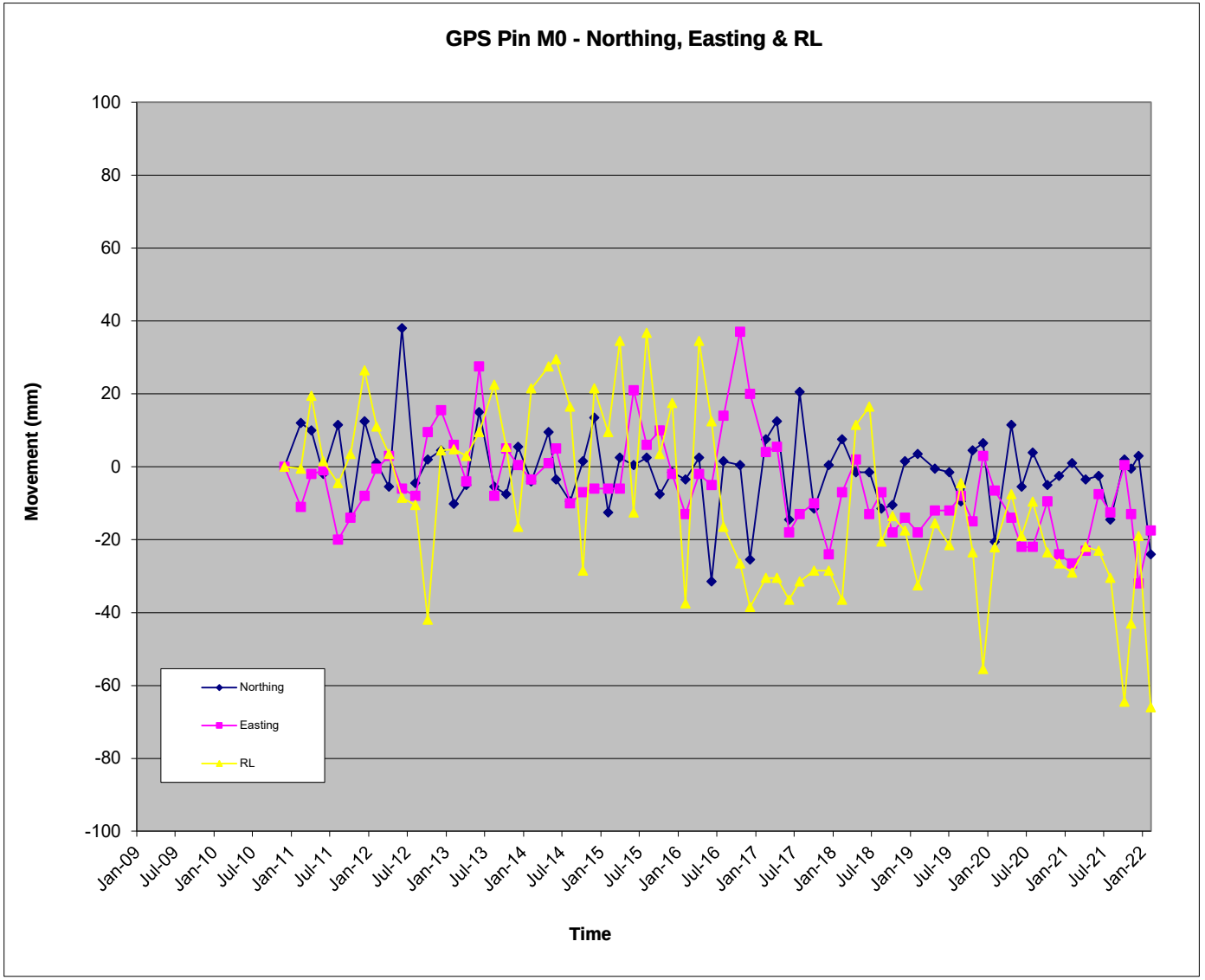

Plan Plot
North (mm) vs. East (mm)
N
W
E
S

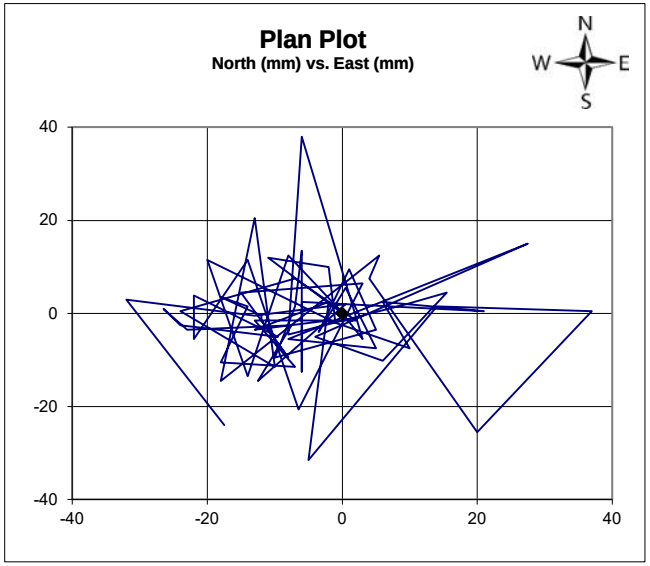

Section Plot
RL (mm) vs. Movement Vector (mm)

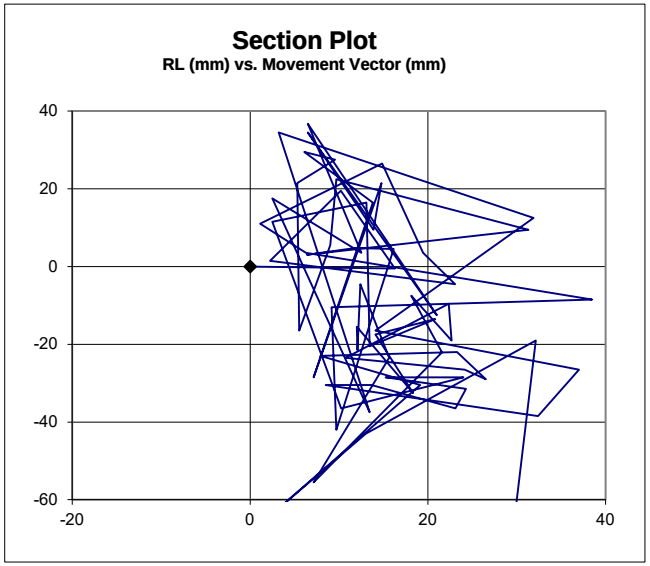

GPS Pin K2 - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL

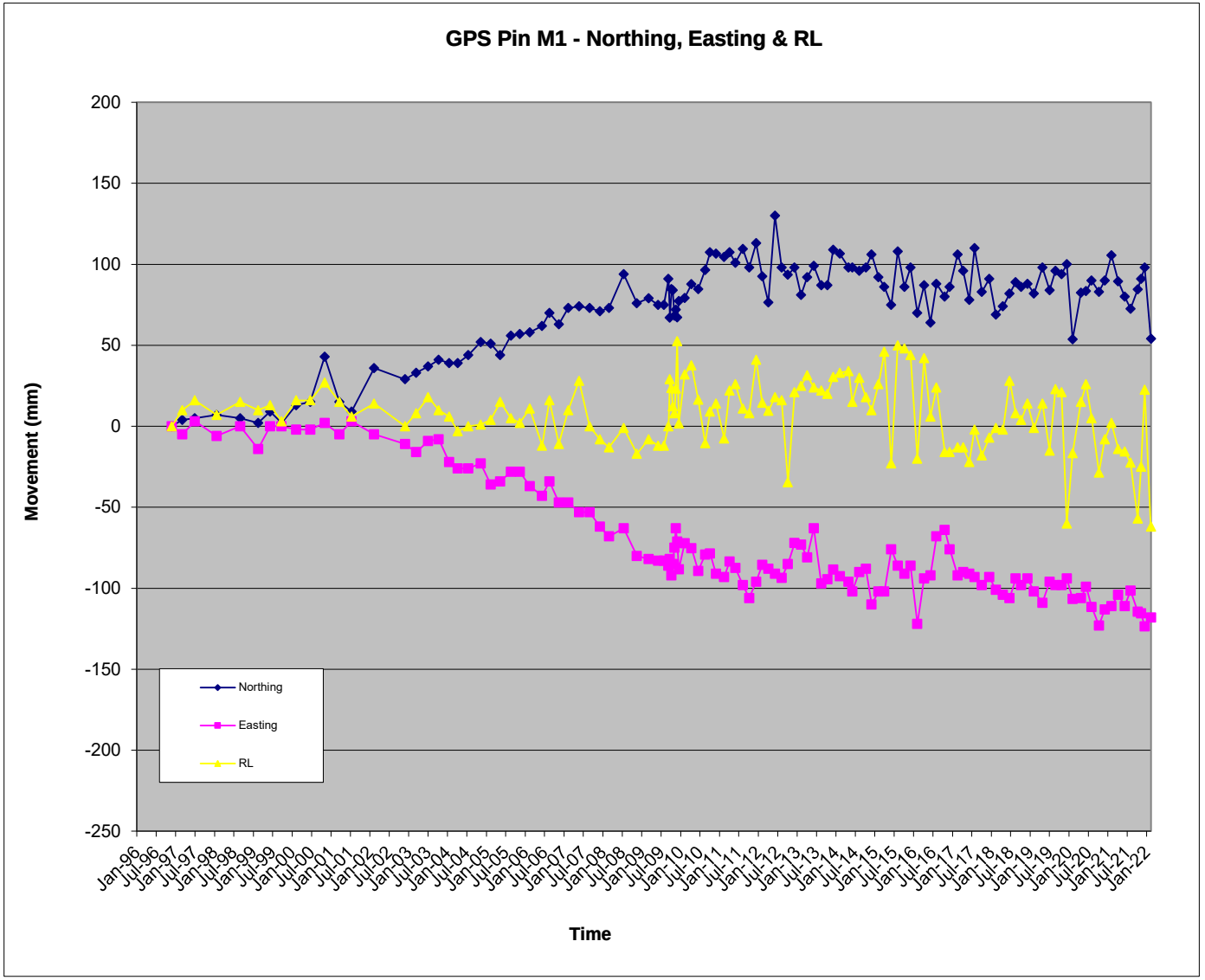

Plan Plot
North (mm) vs. East (mm)
N
W
E
S

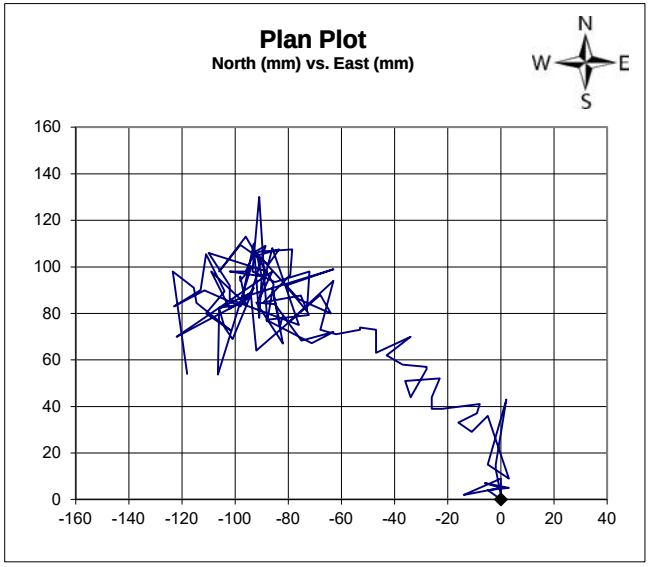

Section Plot
RL (mm) vs. Movement Vector (mm)

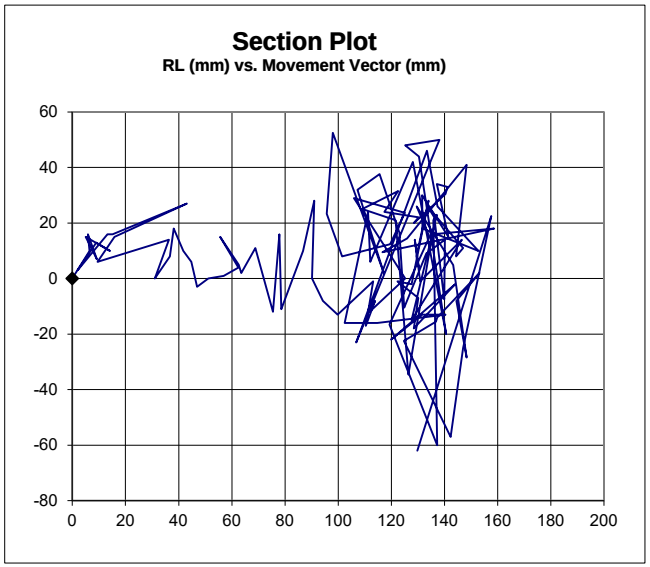

GPS Pin M0 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

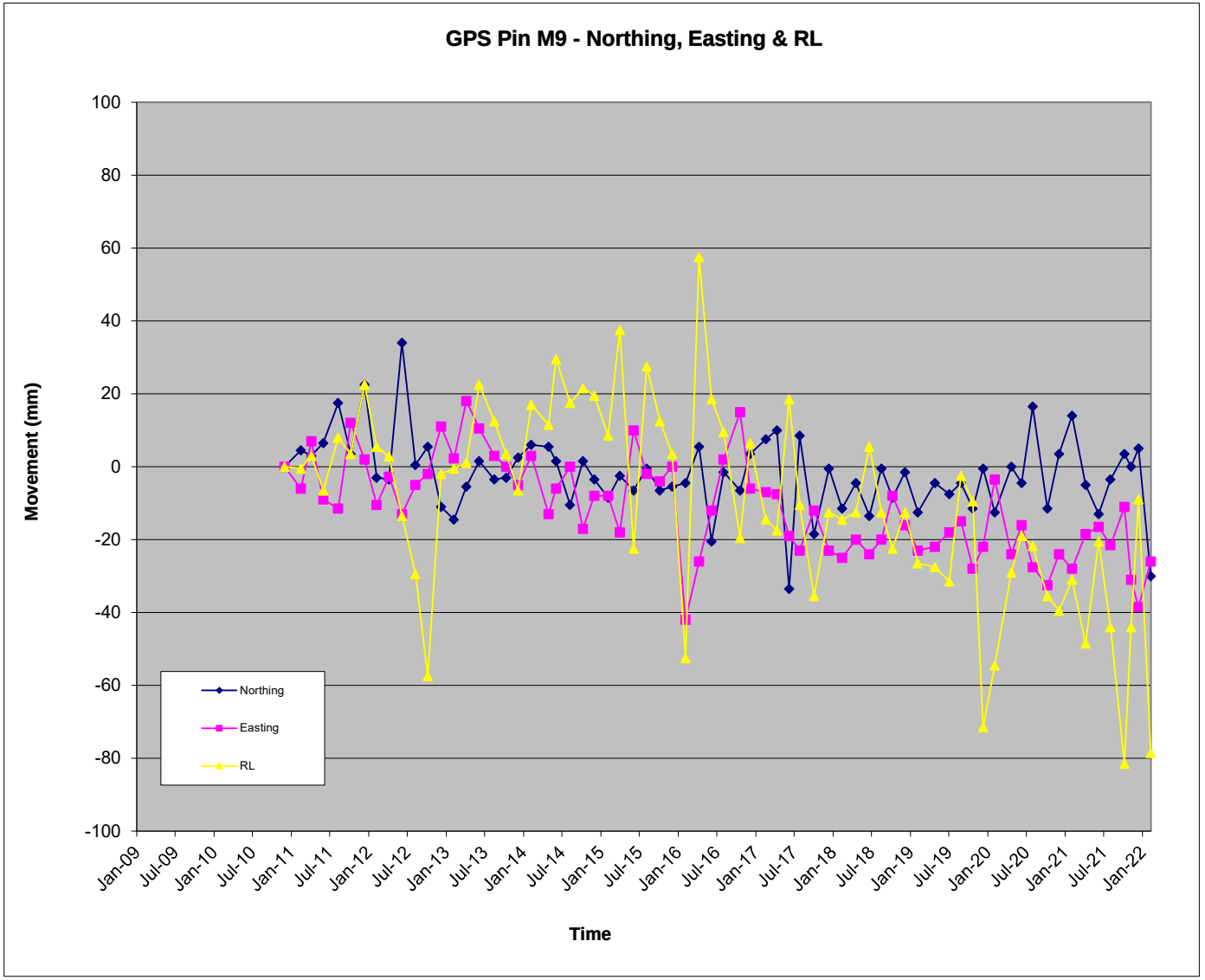

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40

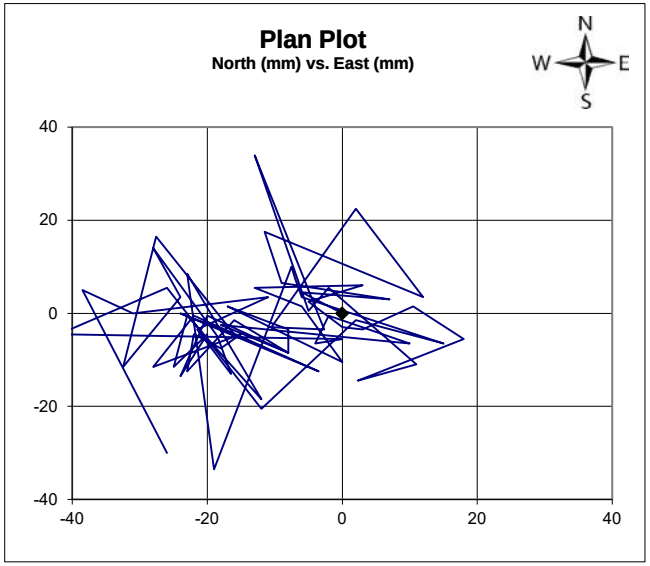

Section Plot
RL (mm) vs. Movement Vector (mm)
40
20
0
-20
-40
-60
-20
0
20
40

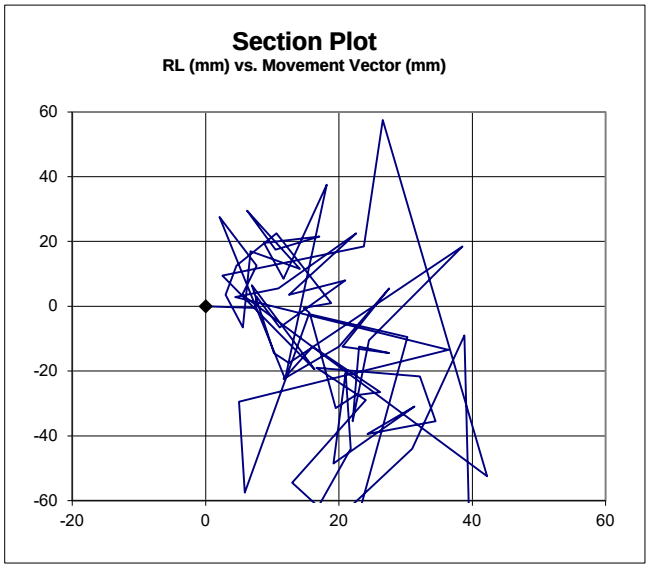

GPS Pin M1 - Northing, Easting & RL
Movement (mm)
Time
Northing
Easting
RL

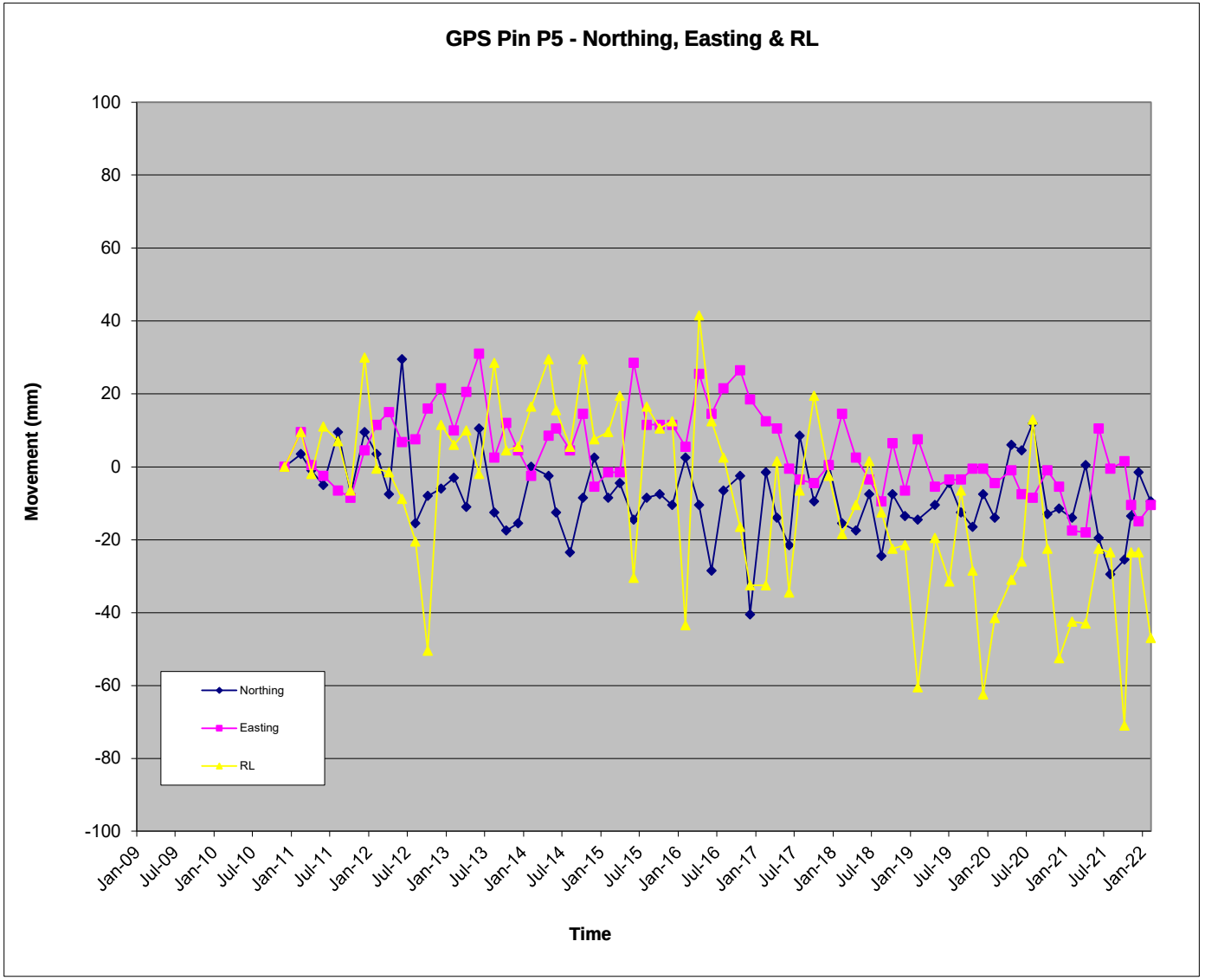

Plan Plot
North (mm) vs. East (mm)
N
W
E
S

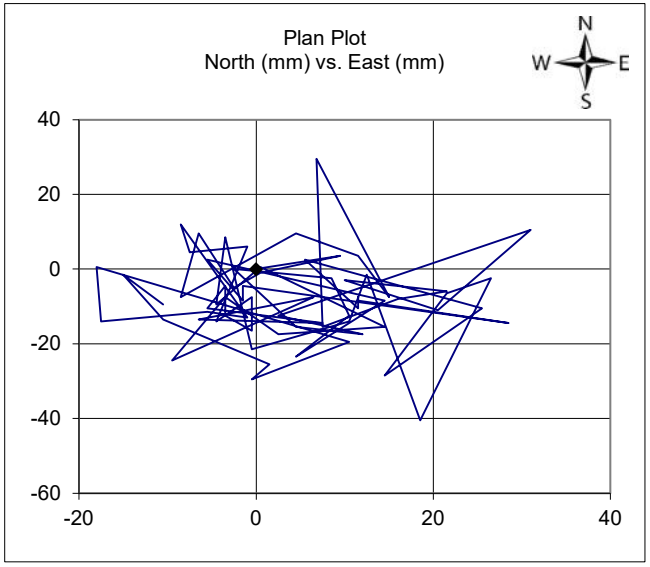

Section Plot
RL (mm) vs. Movement Vector (mm)

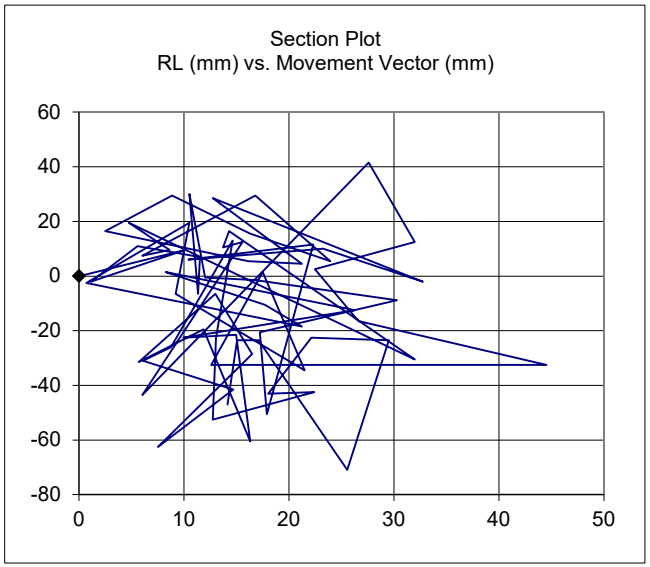

GPS Pin M9 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

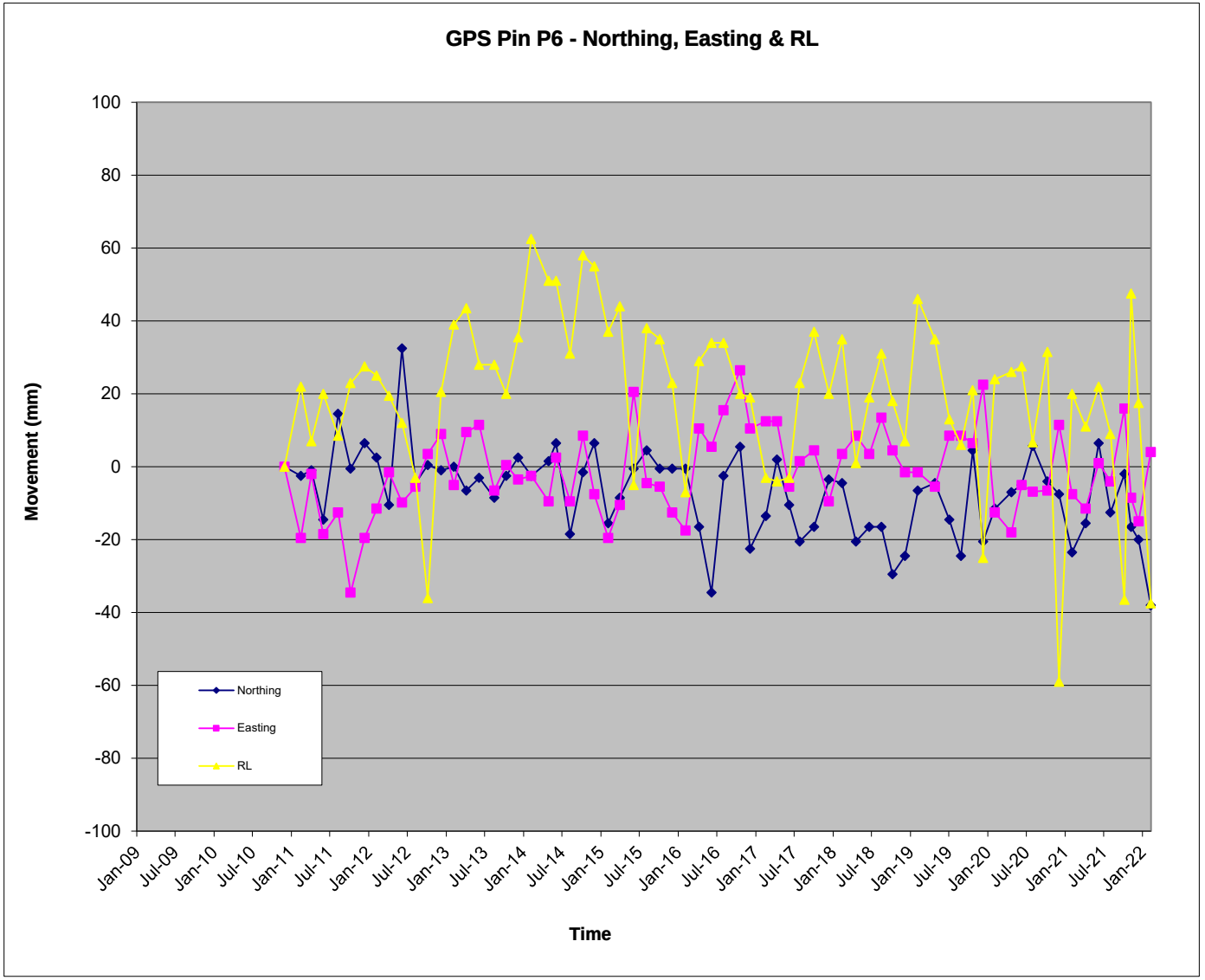

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40

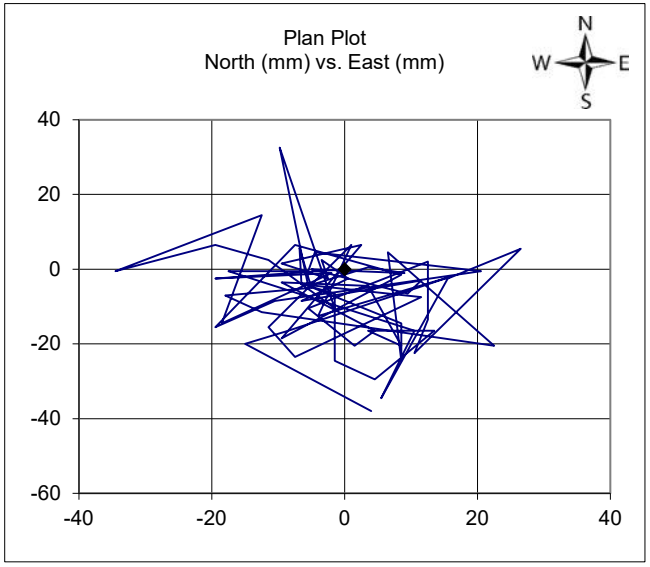

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-20
0
20
40
60

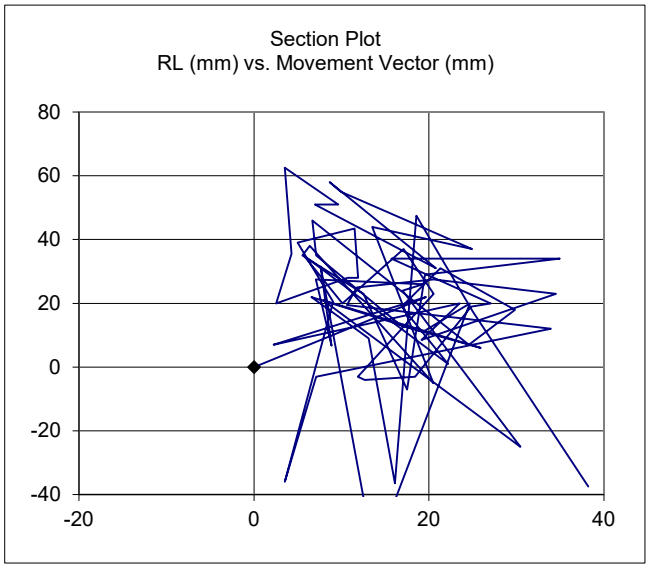

GPS Pin P5 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

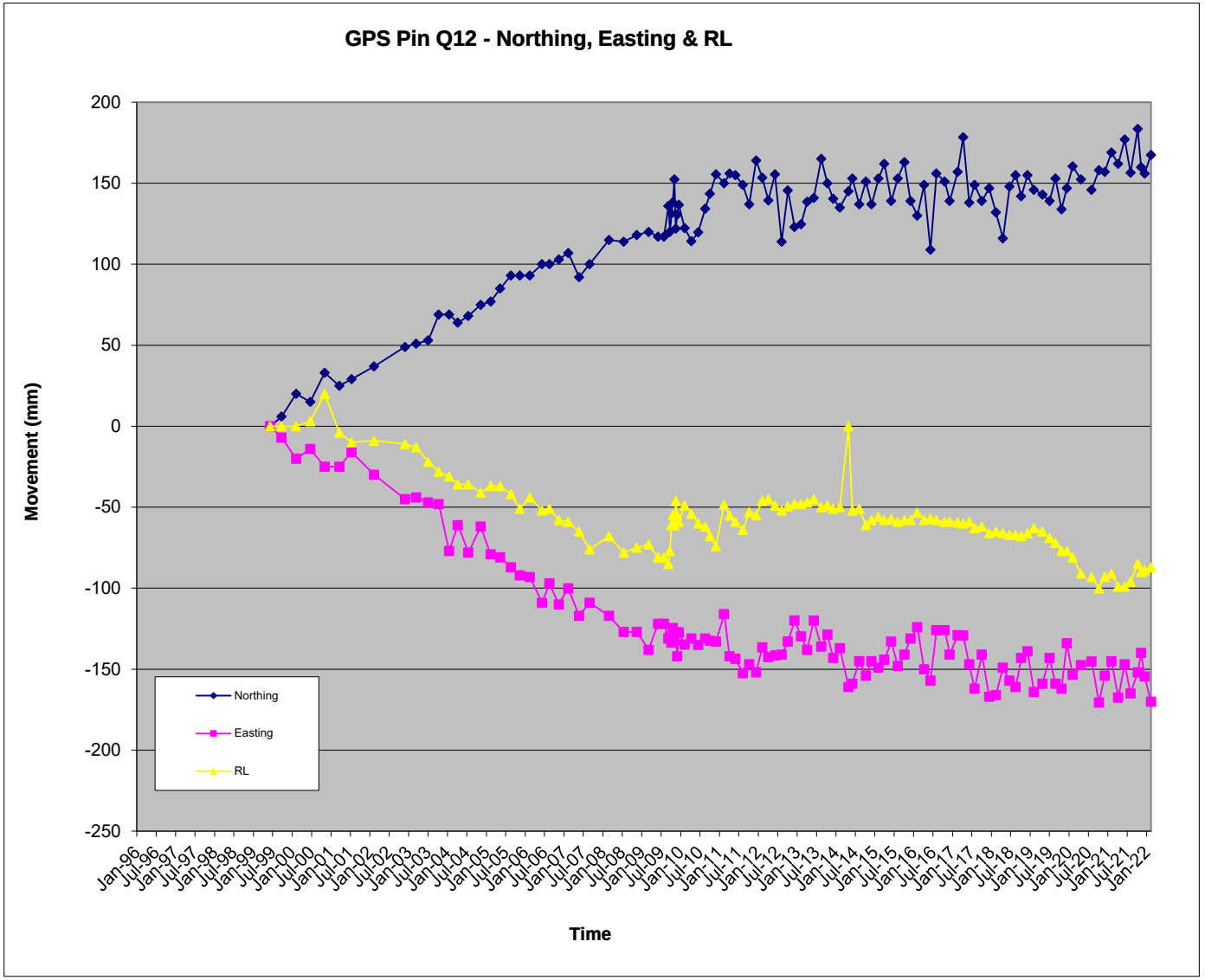

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
0
10
20
30
40
50


GPS Pin P6 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-40
-20
0
20
40


GPS Pin Q12 - Northing, Easting & RL
Movement (mm)
200
150
100
50
0
-50
-100
-150
-200
-250
Northing
Easting
RL
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
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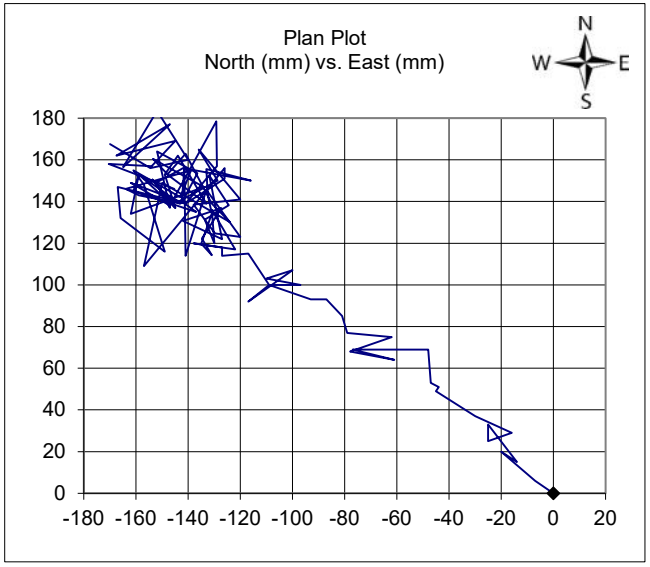
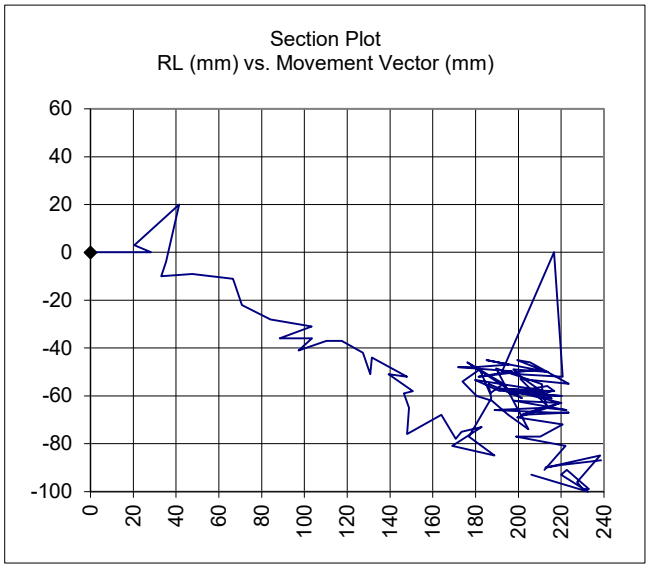
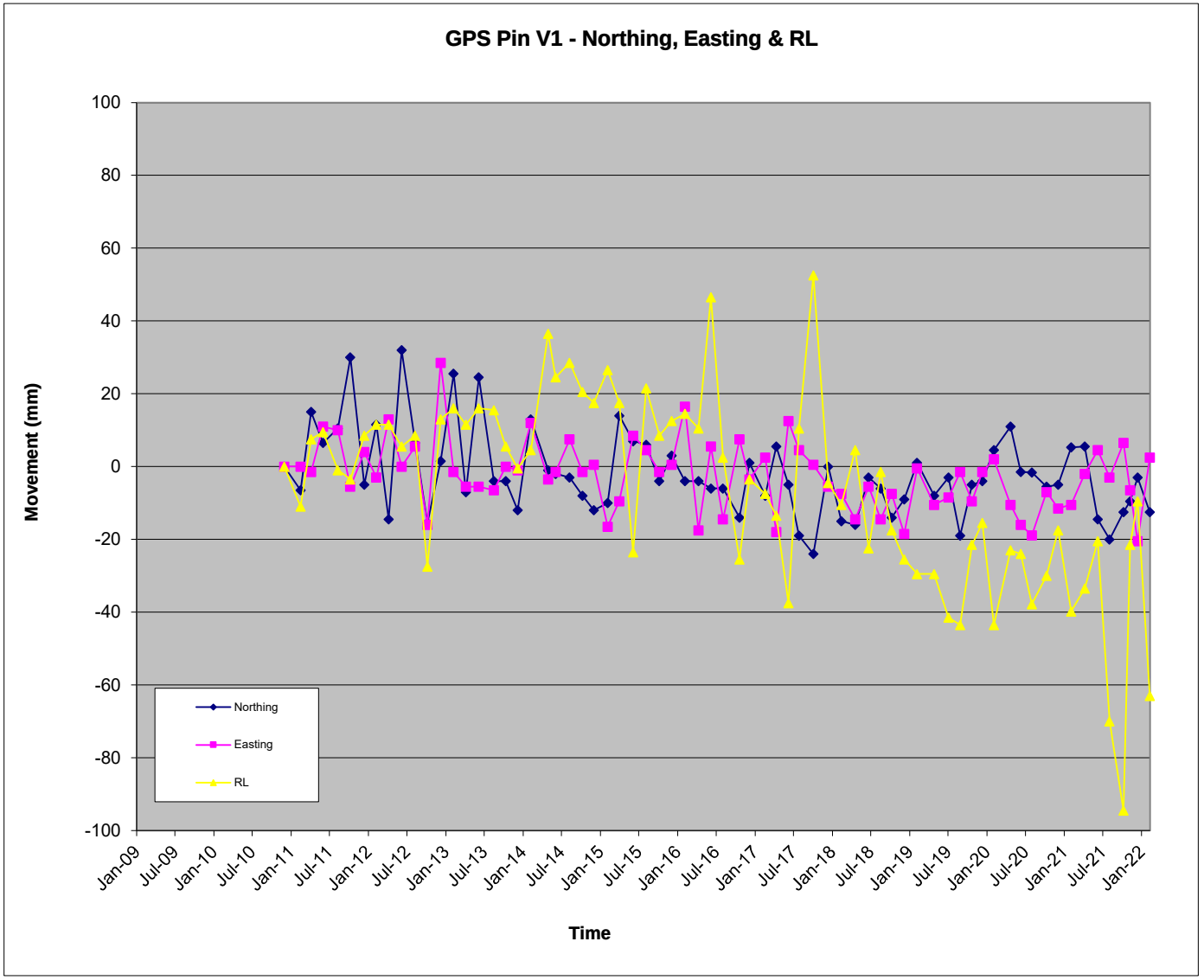
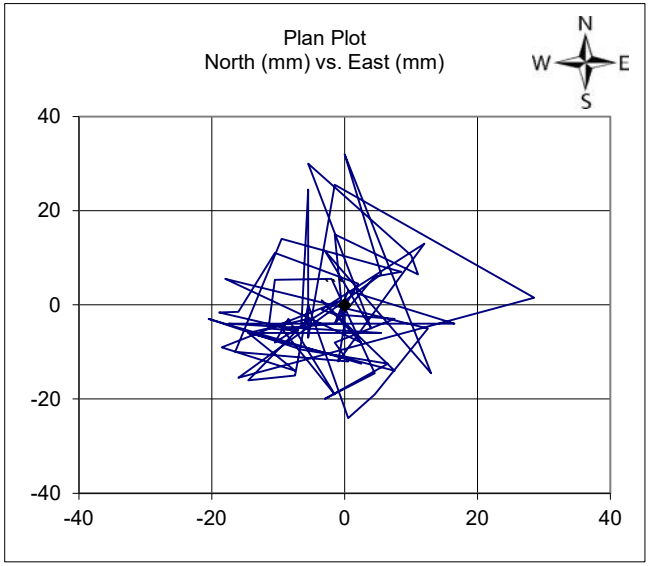
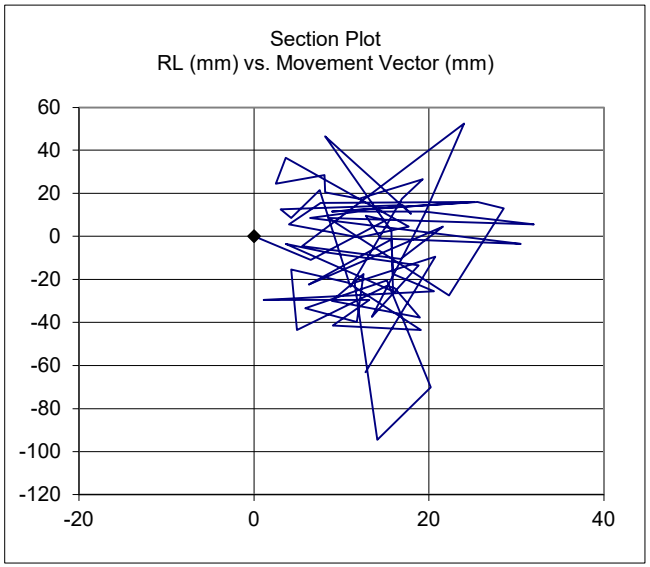
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time

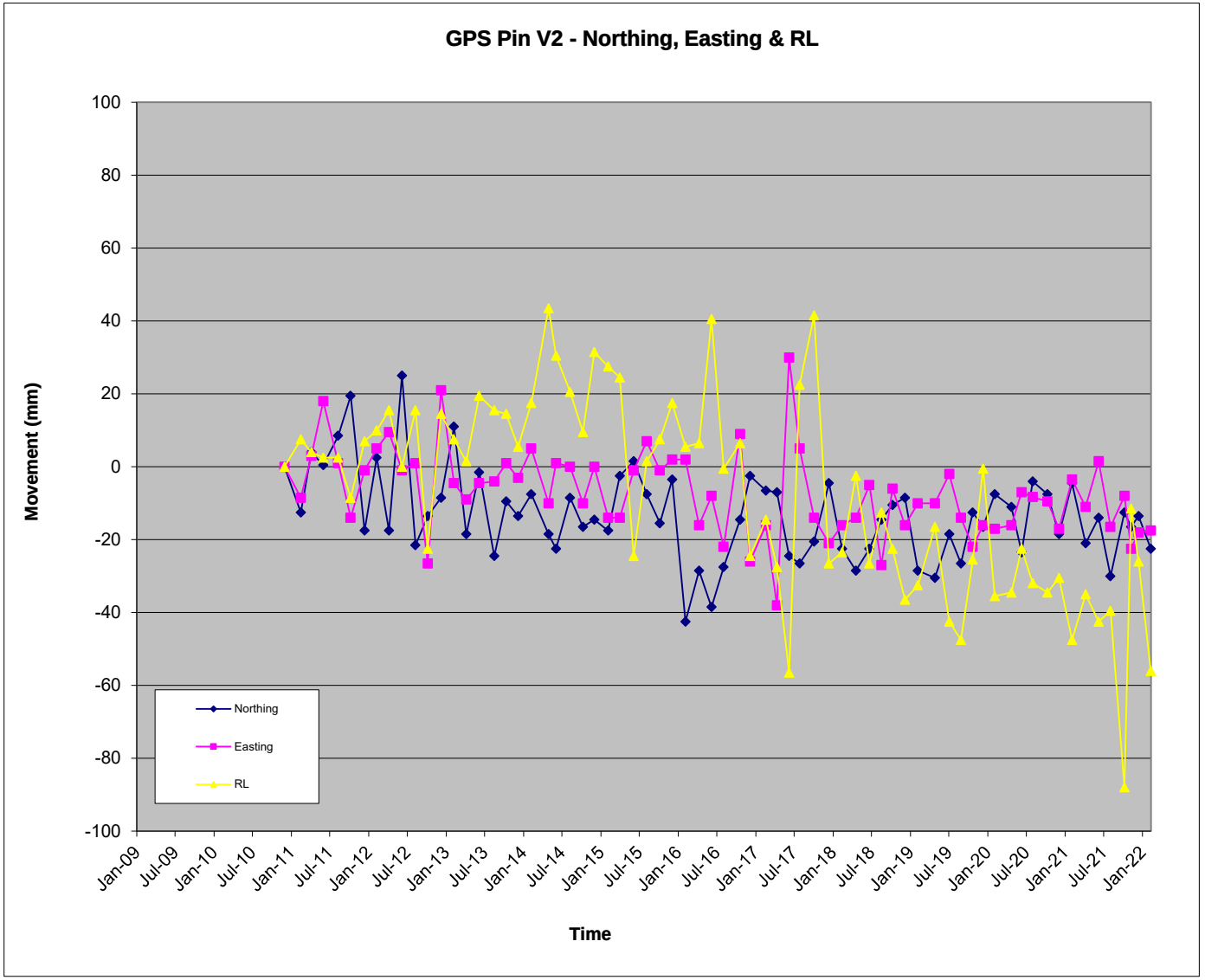

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
180
160
140
120
100
80
60
40
20
0
-180 -160 -140 -120 -100 -80 -60 -40 -20 0 20

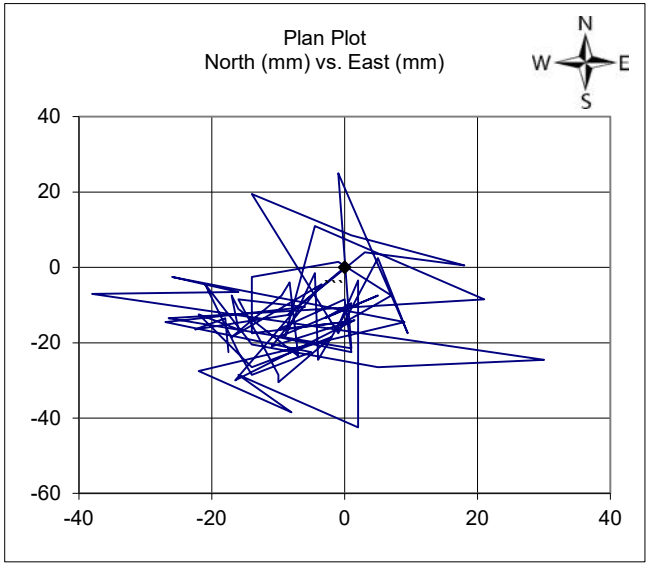

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
0 20 40 60 80 100 120 140 160 180 200 220 240

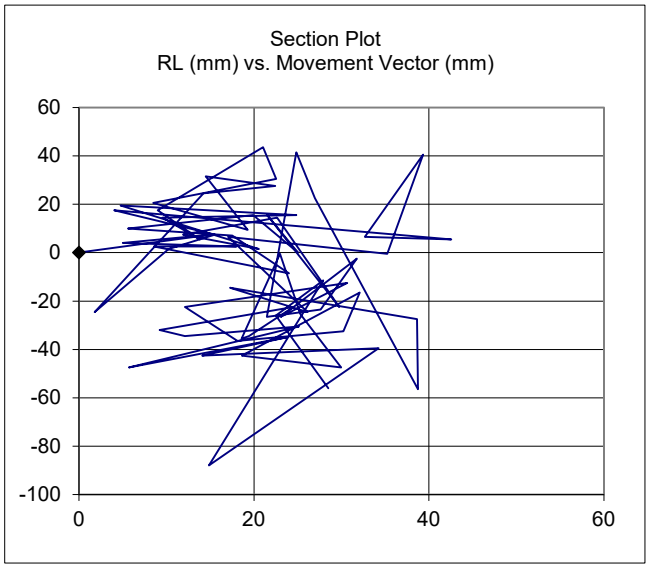

GPS Pin V1 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

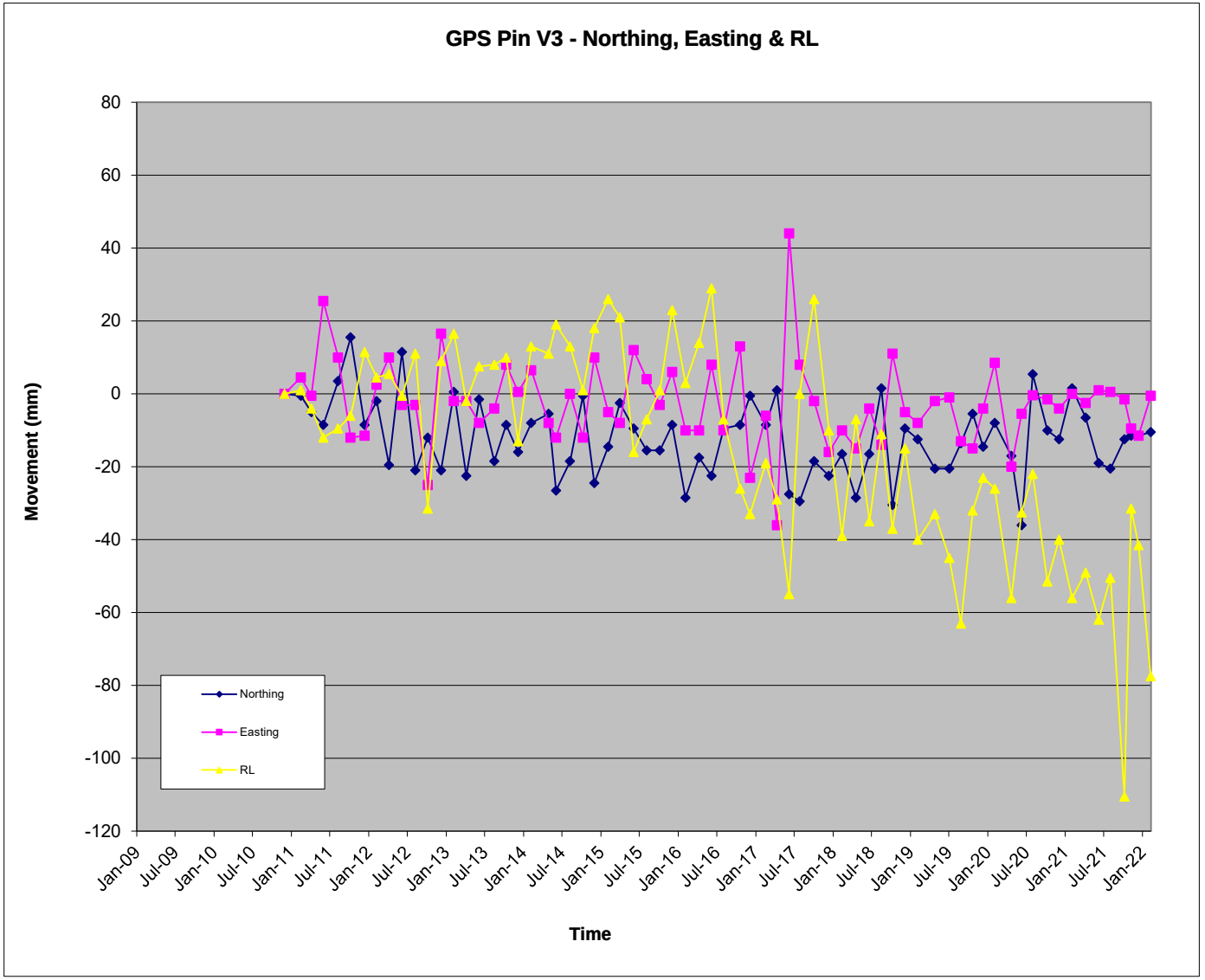

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40

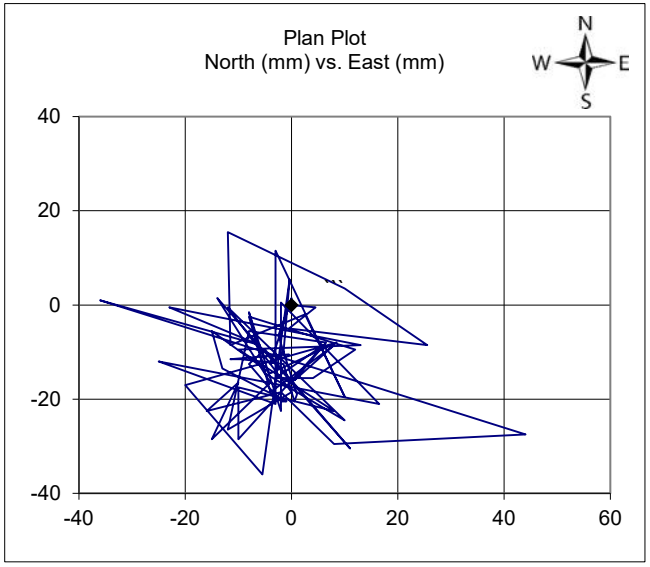

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-120
-20
0
20
40

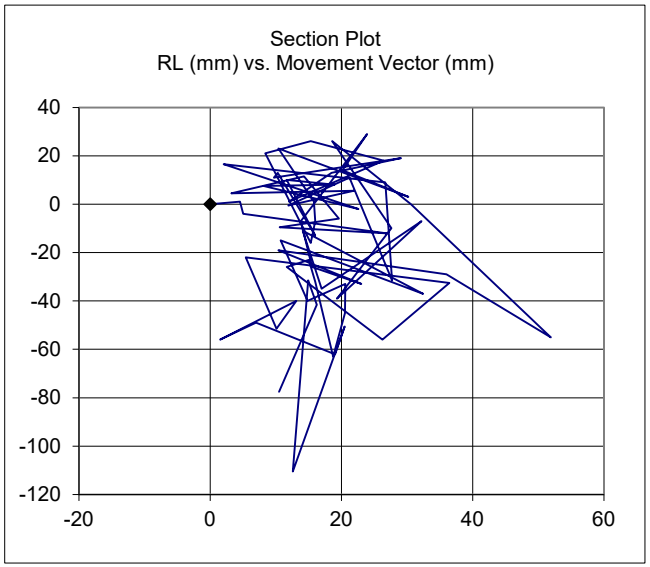

GPS Pin V2 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

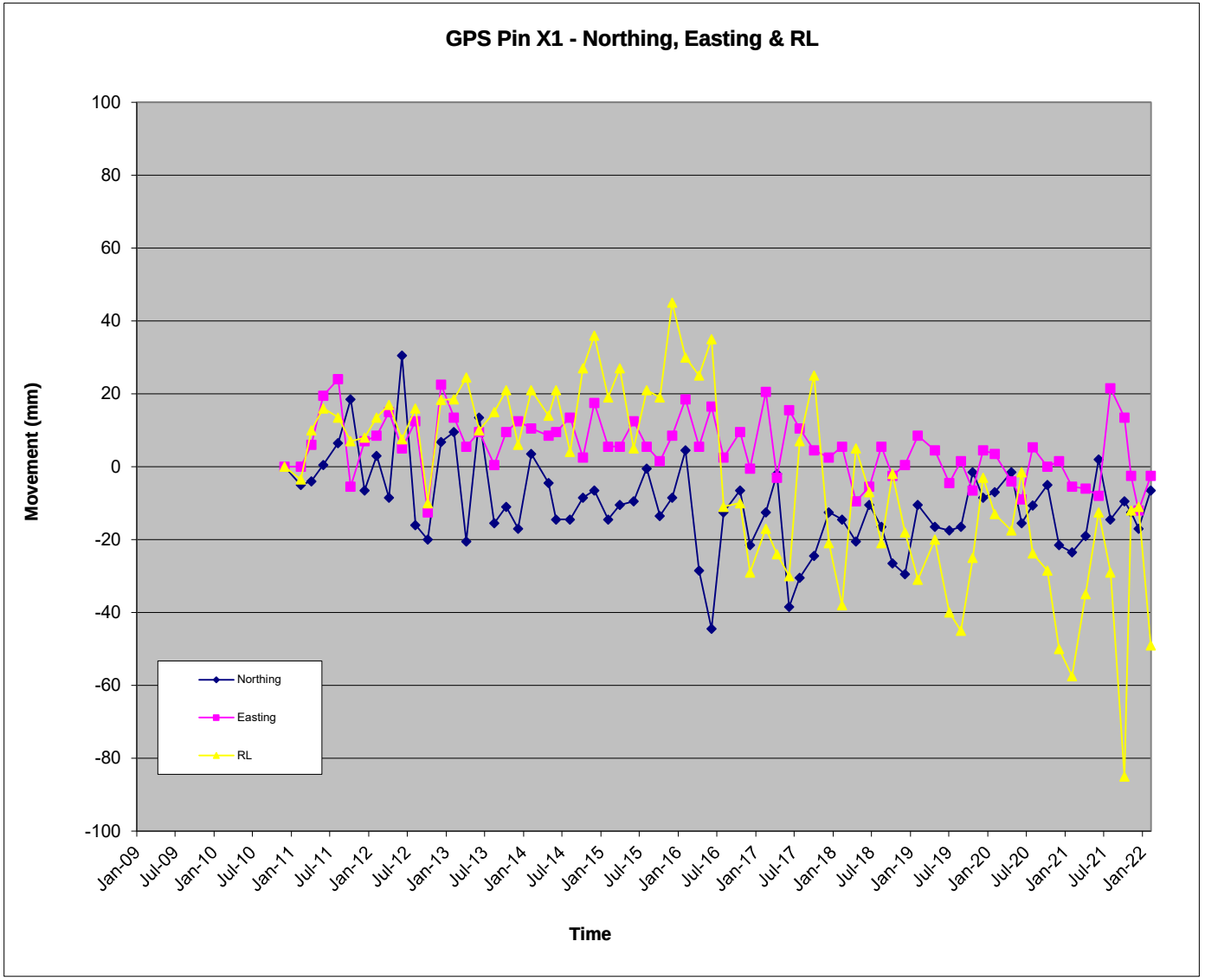

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-40
-20
0
20
40

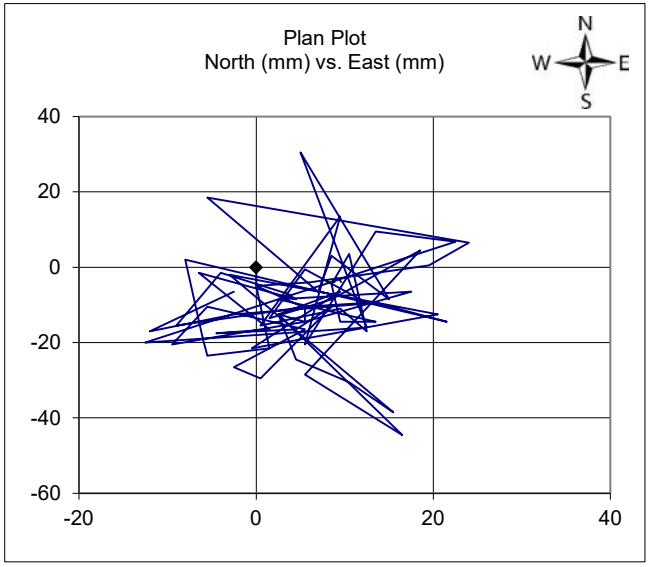

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
0
20
40
60

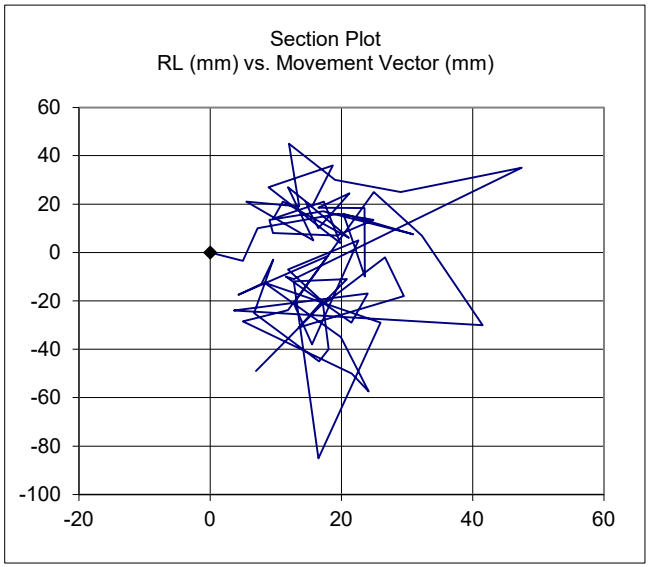

GPS Pin V3 - Northing, Easting & RL
Movement (mm)
80
60
40
20
0
-20
-40
-60
-80
-100
-120
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

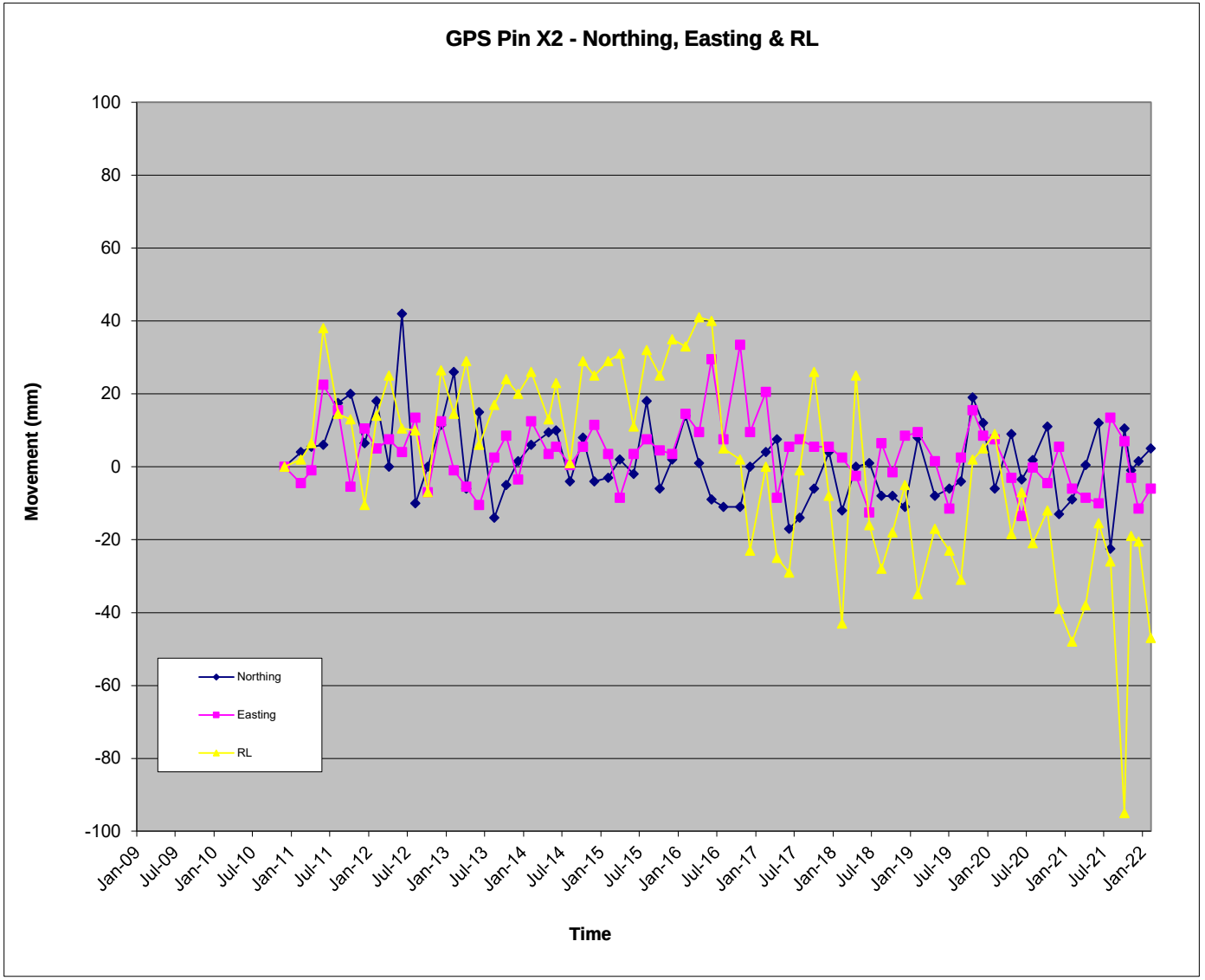

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40
60

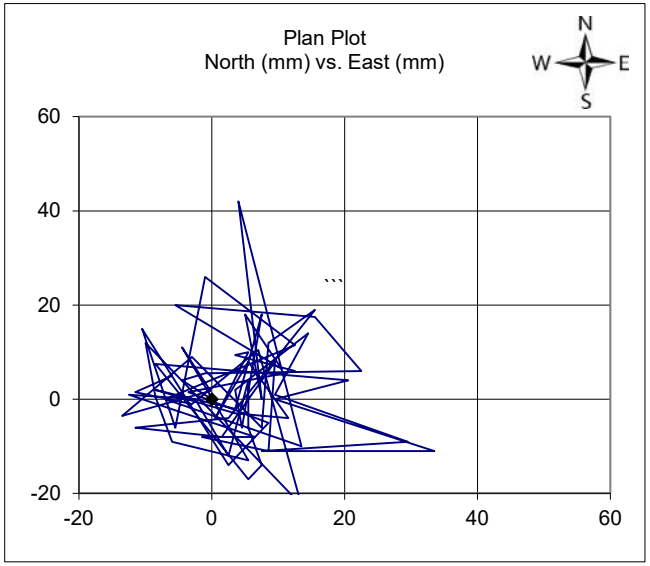

Section Plot
RL (mm) vs. Movement Vector (mm)
40
20
0
-20
-40
-60
-80
-100
-120
-20
0
20
40
60

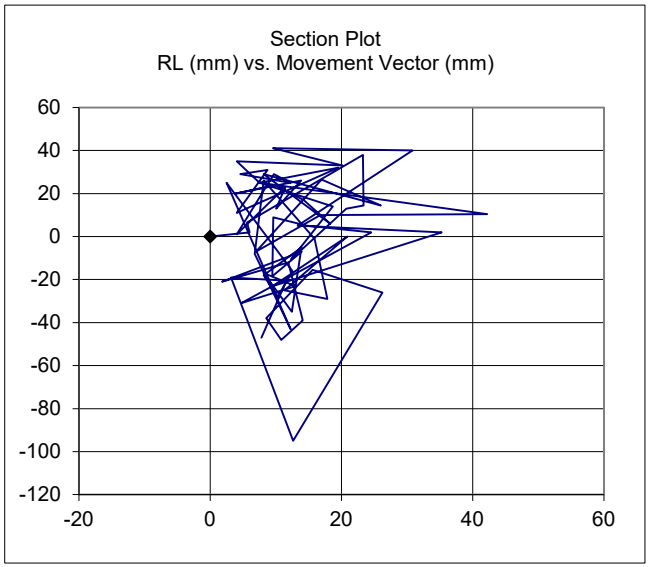

GPS Pin X1 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

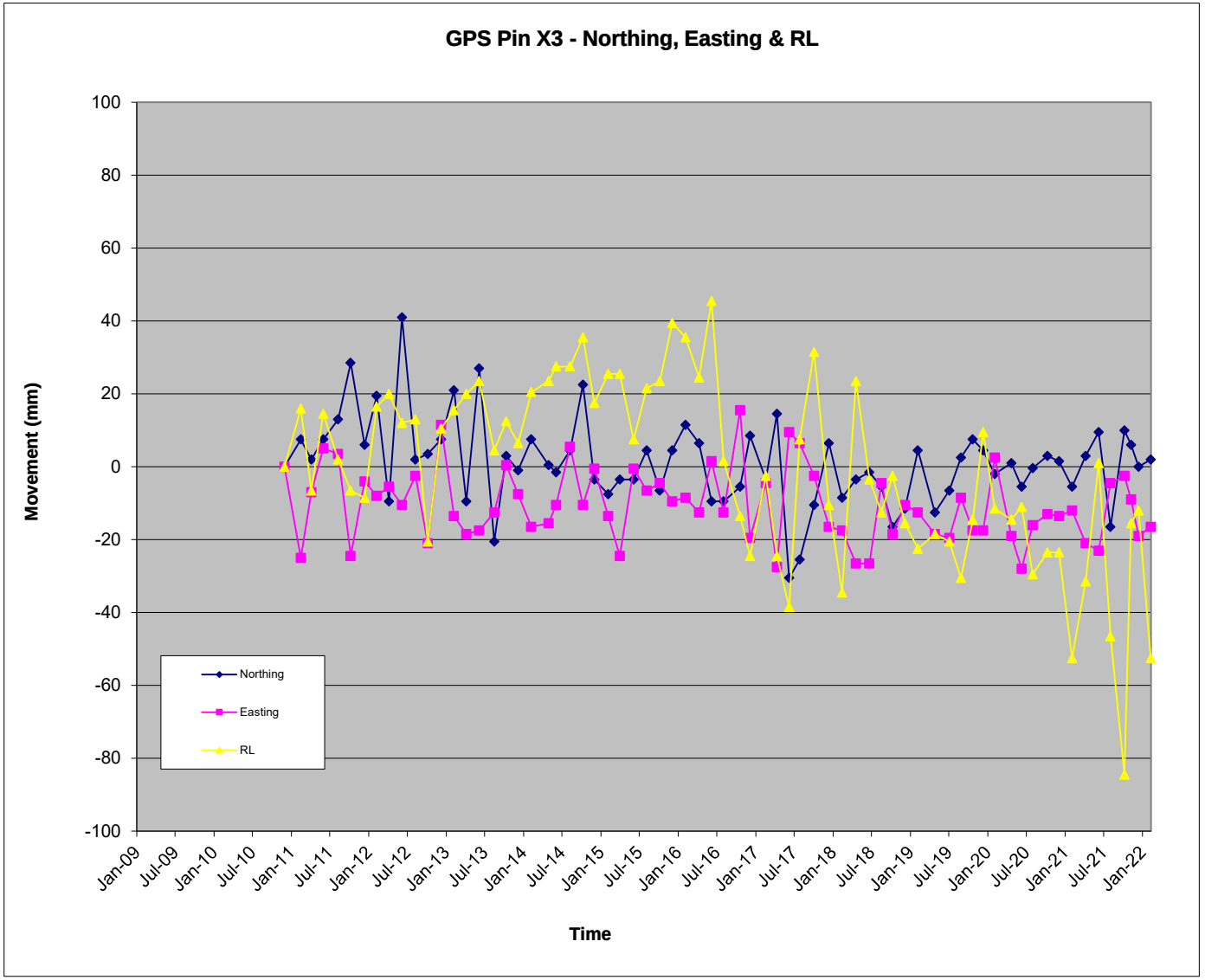

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-20
0
20
40

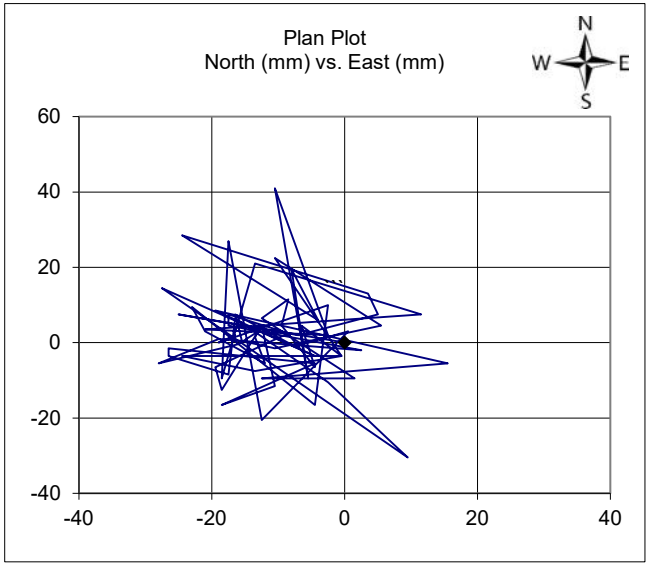

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40
60

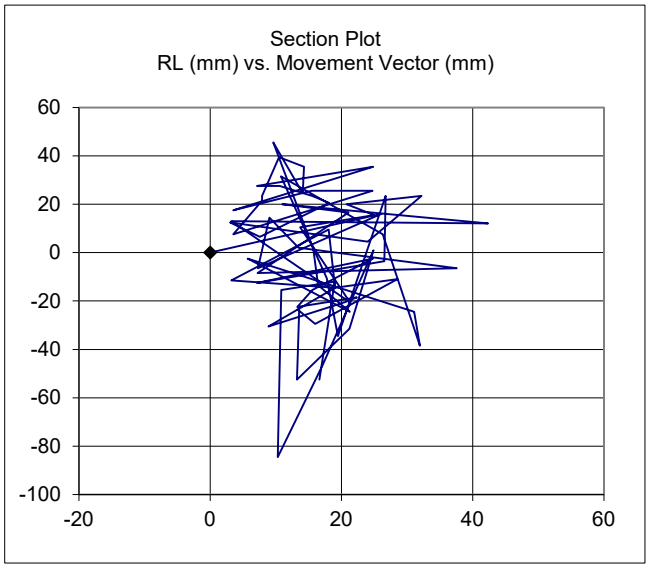

GPS Pin X2 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

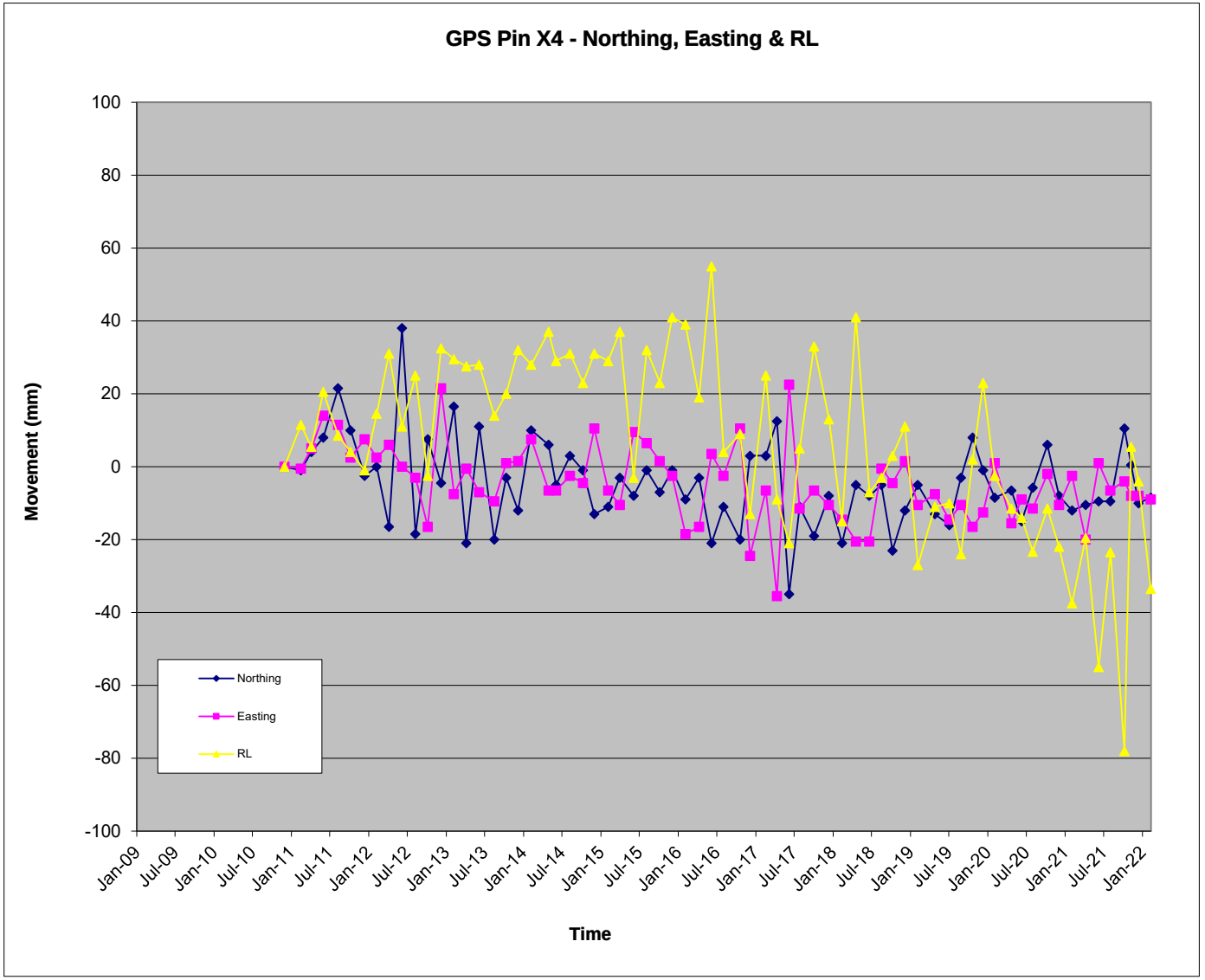

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
60
40
20
0
-20
-20
0
20
40
60

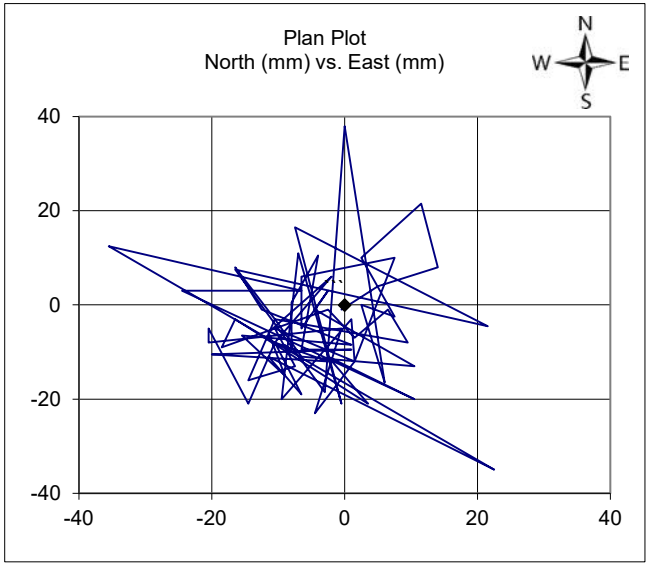

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-120
-20
0
20
40
60

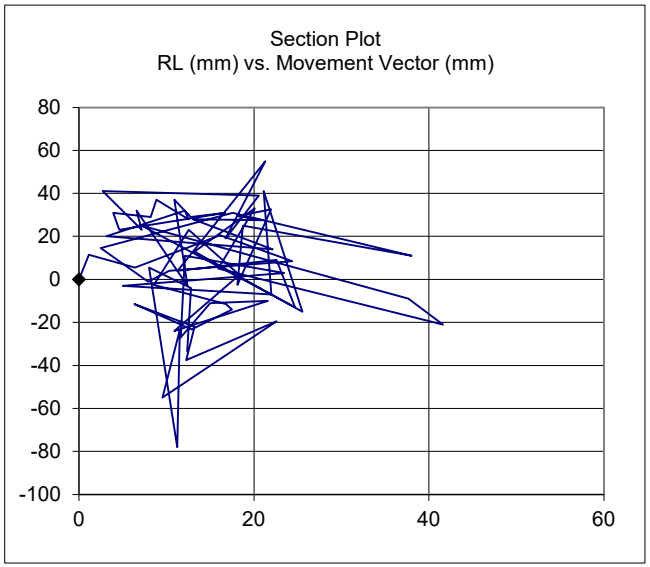

GPS Pin X3 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

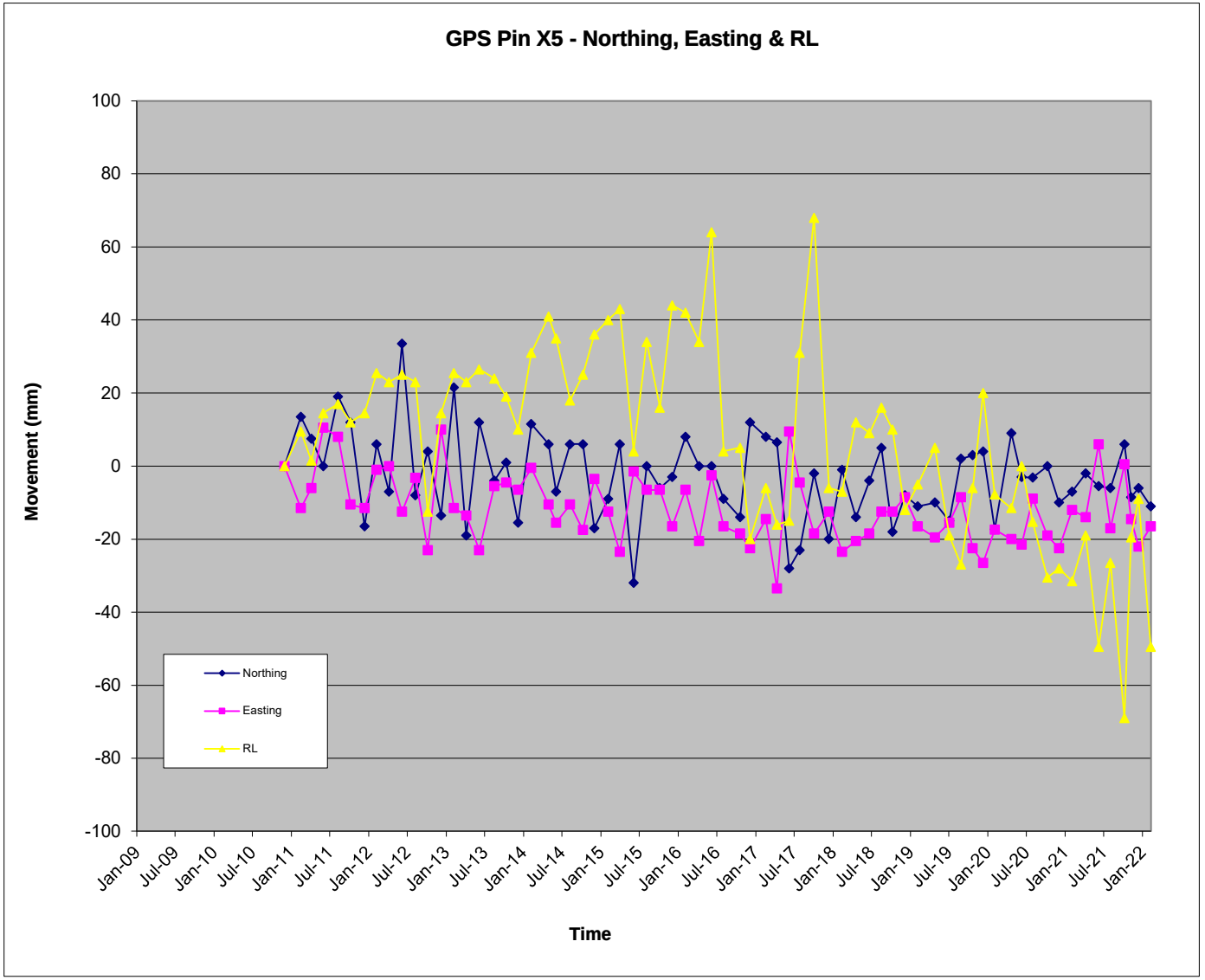

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
60
40
20
0
-20
-40
-40
-20
0
20
40

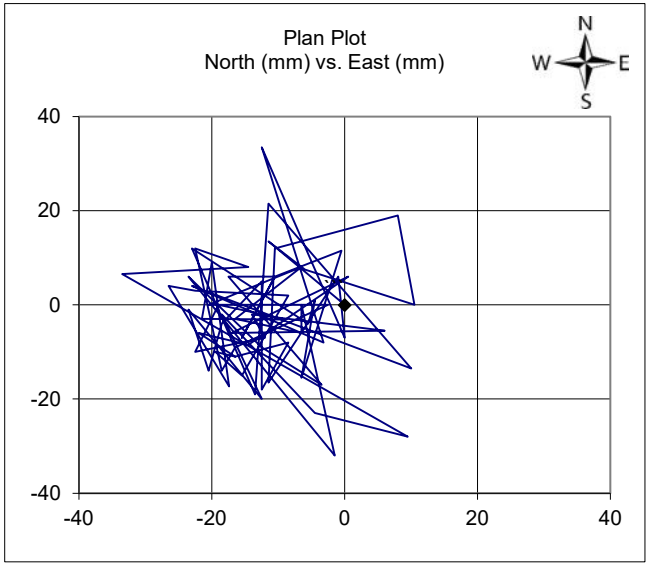

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40
60

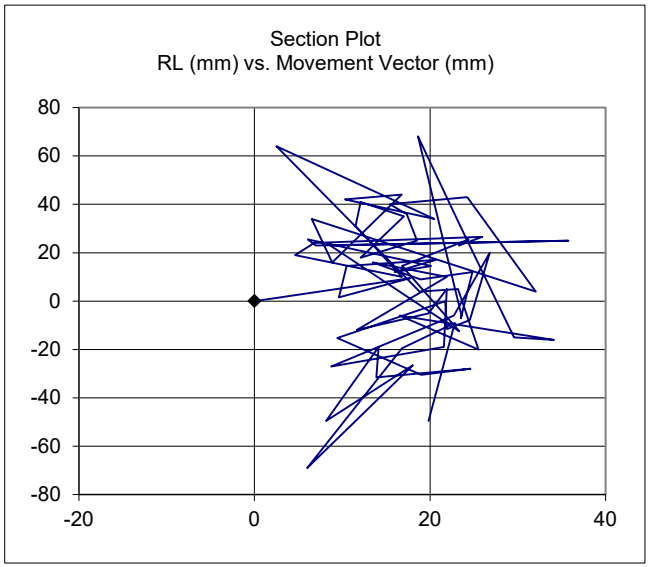

GPS Pin X4 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

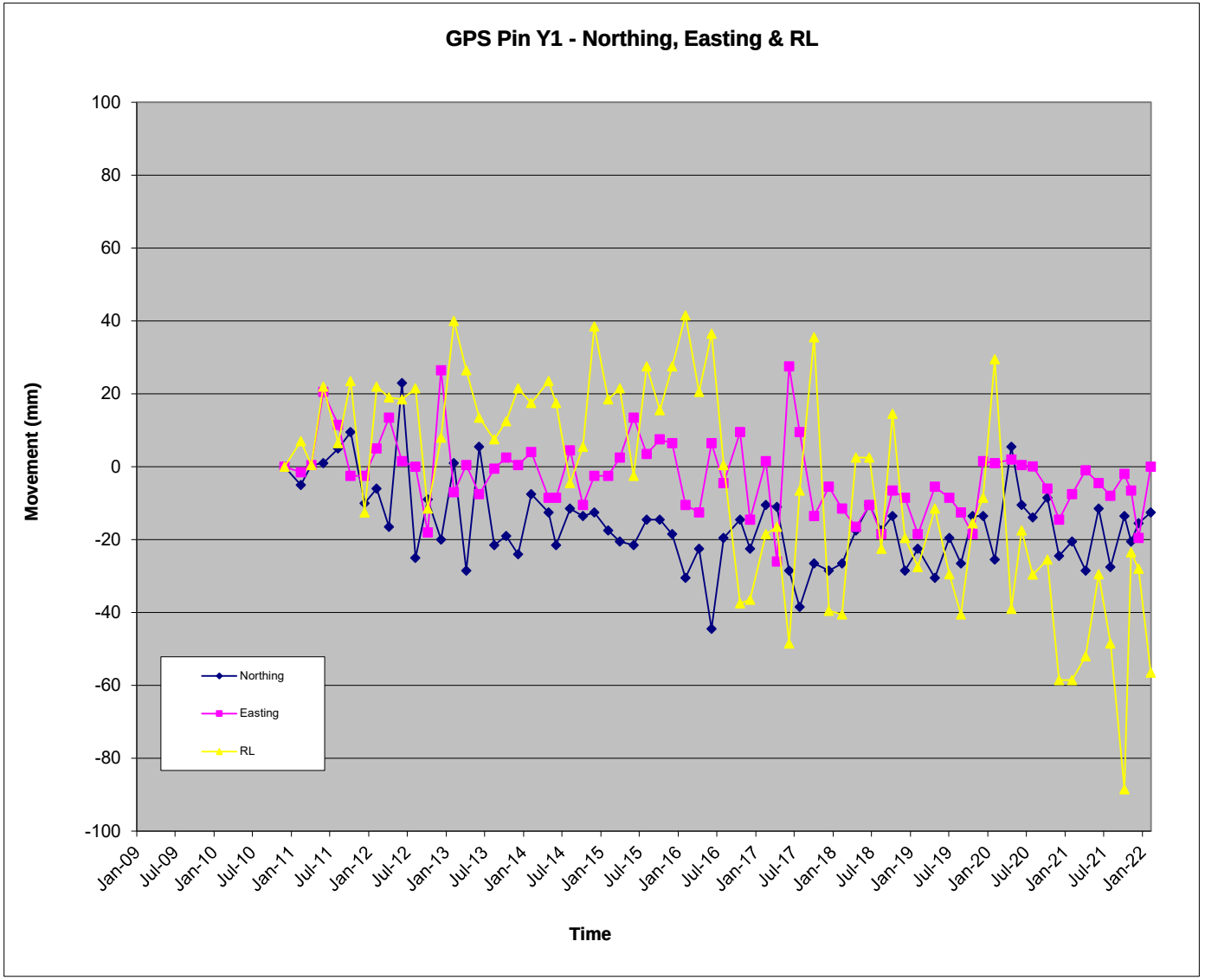

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40

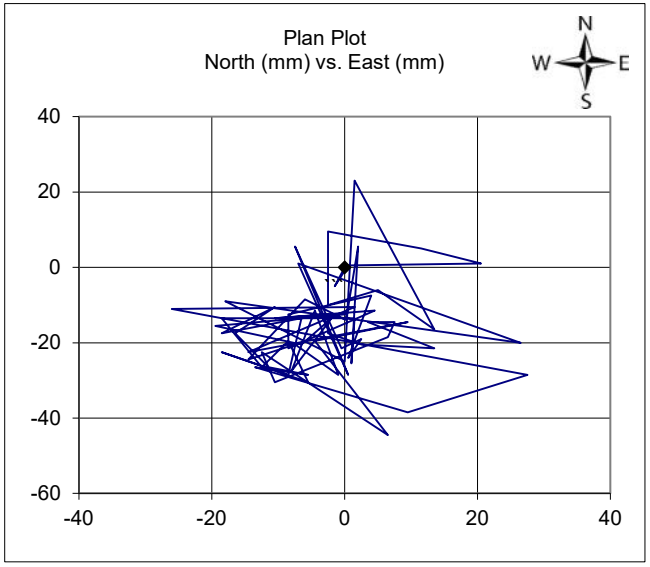

Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-40
-60
-80
-100
0
20
40
60

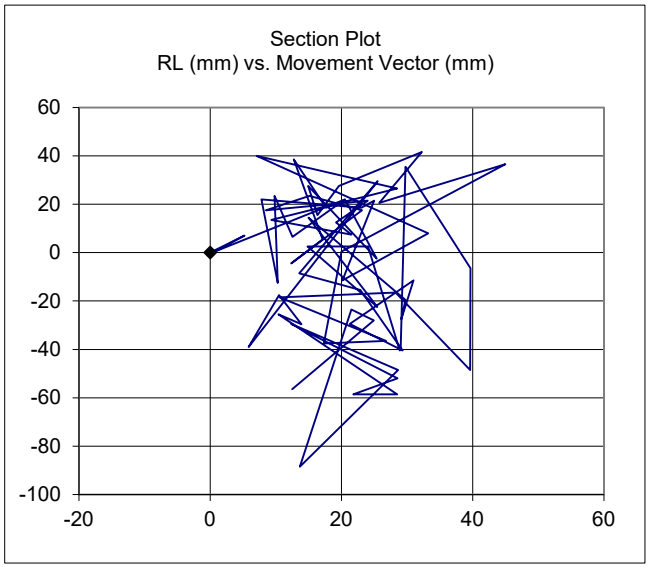

GPS Pin X5 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

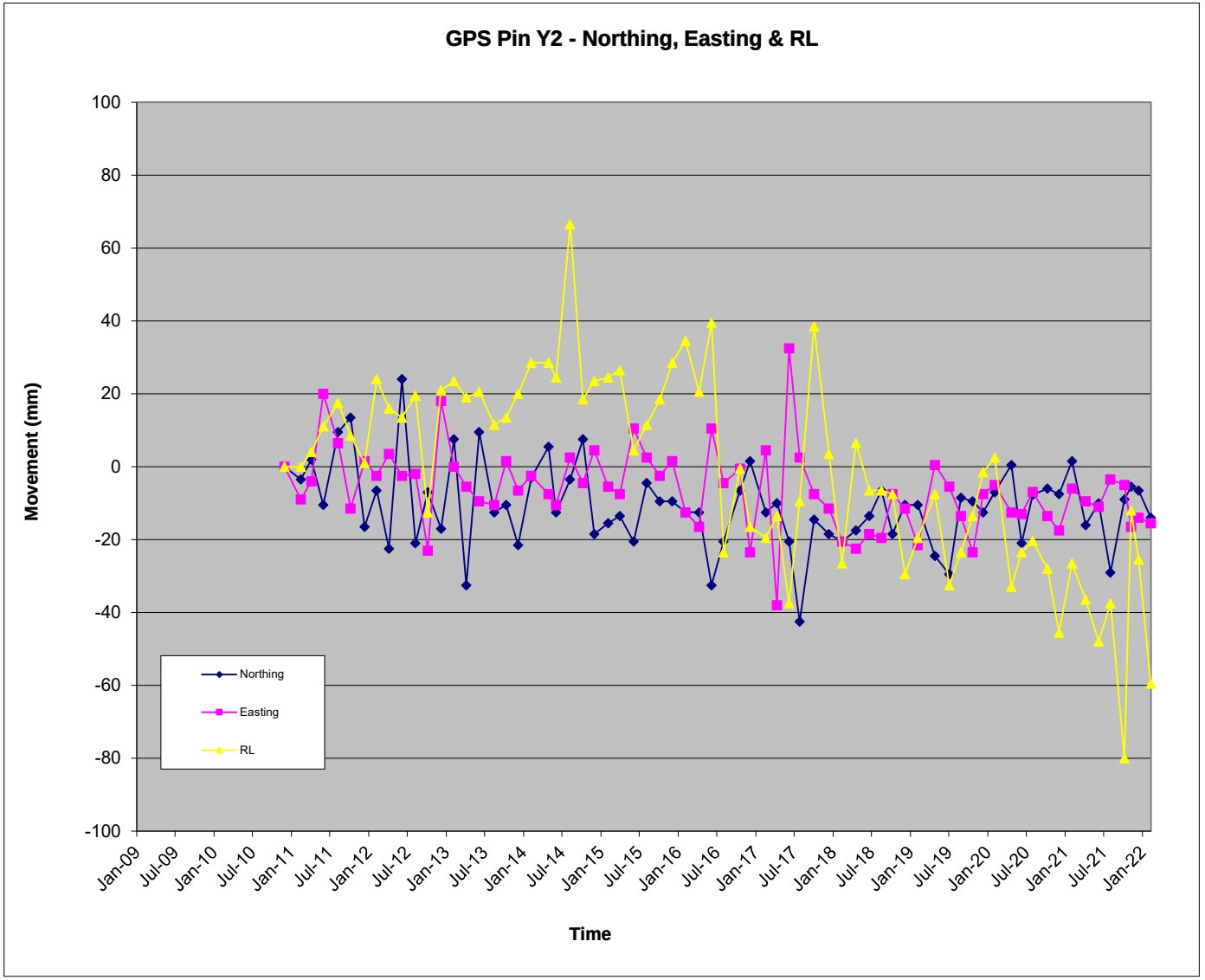

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40

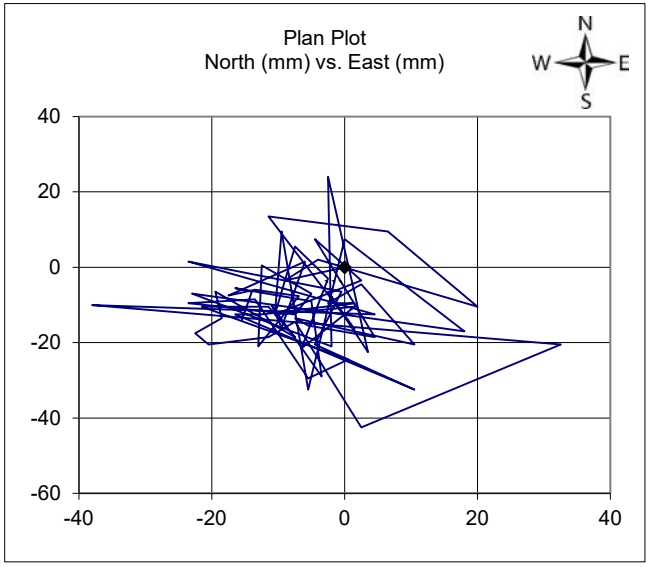

Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-40
-60
-80
-20
0
20
40

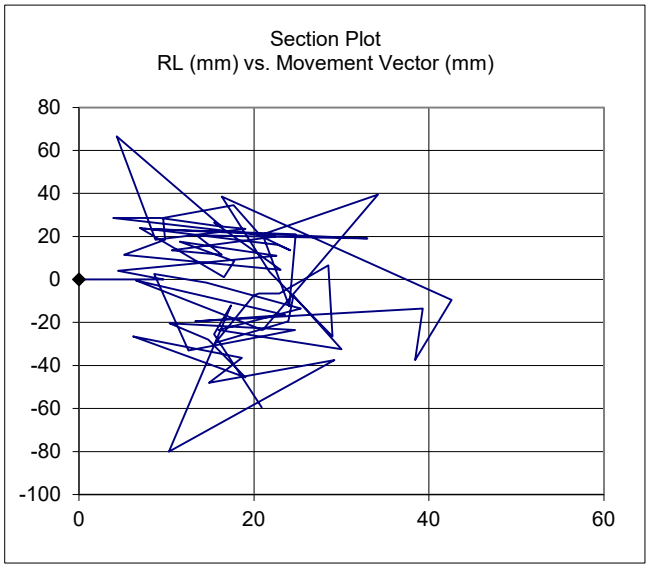

GPS Pin Y1 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

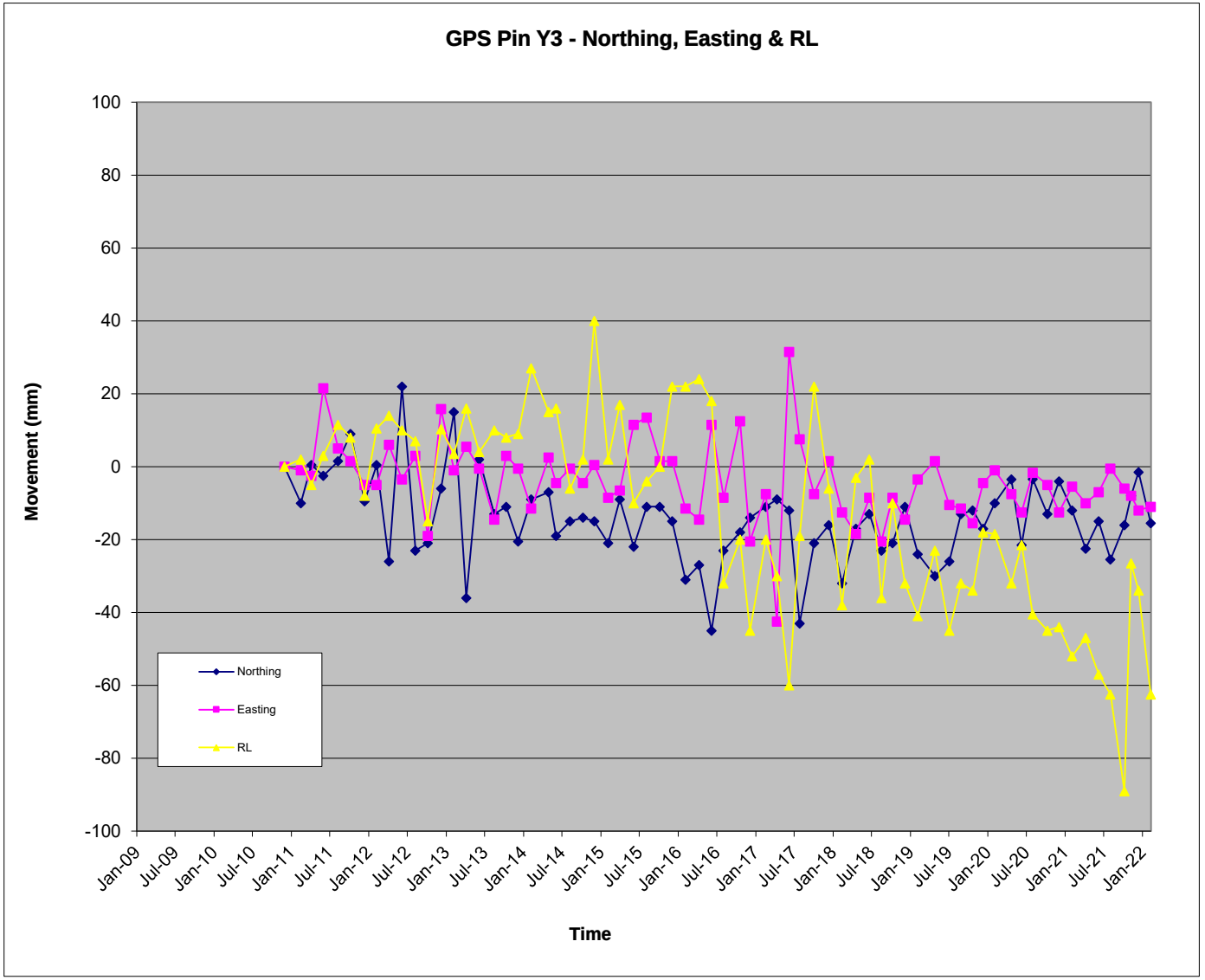

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-40
-20
0
20
40

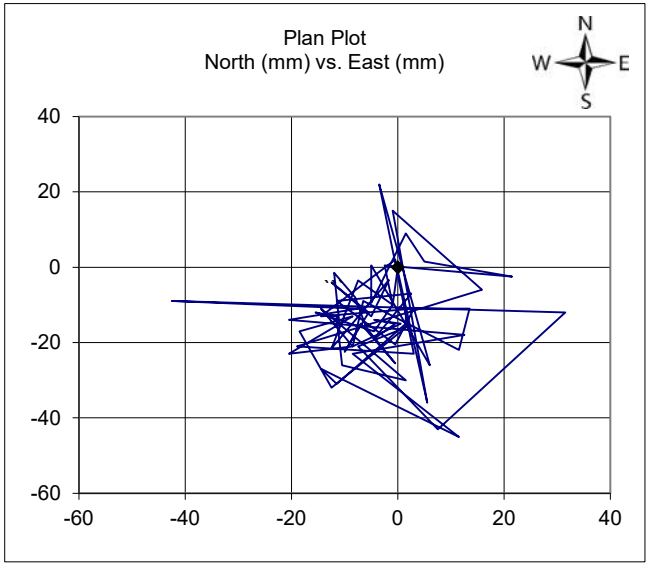

Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40
60

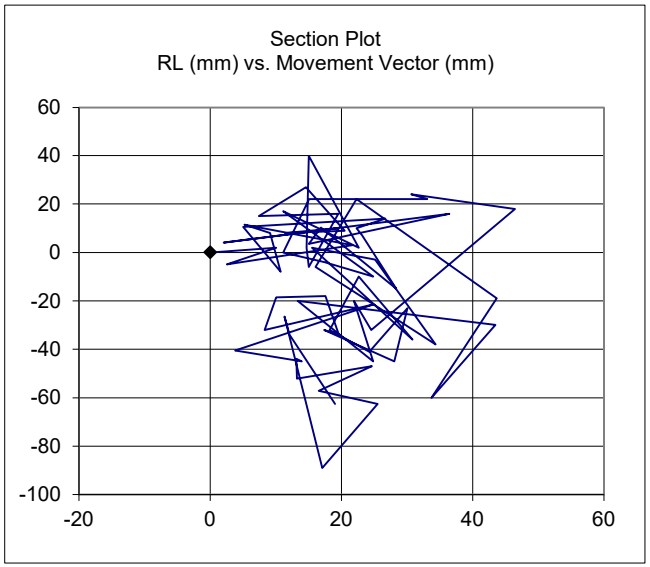

GPS Pin Y2 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

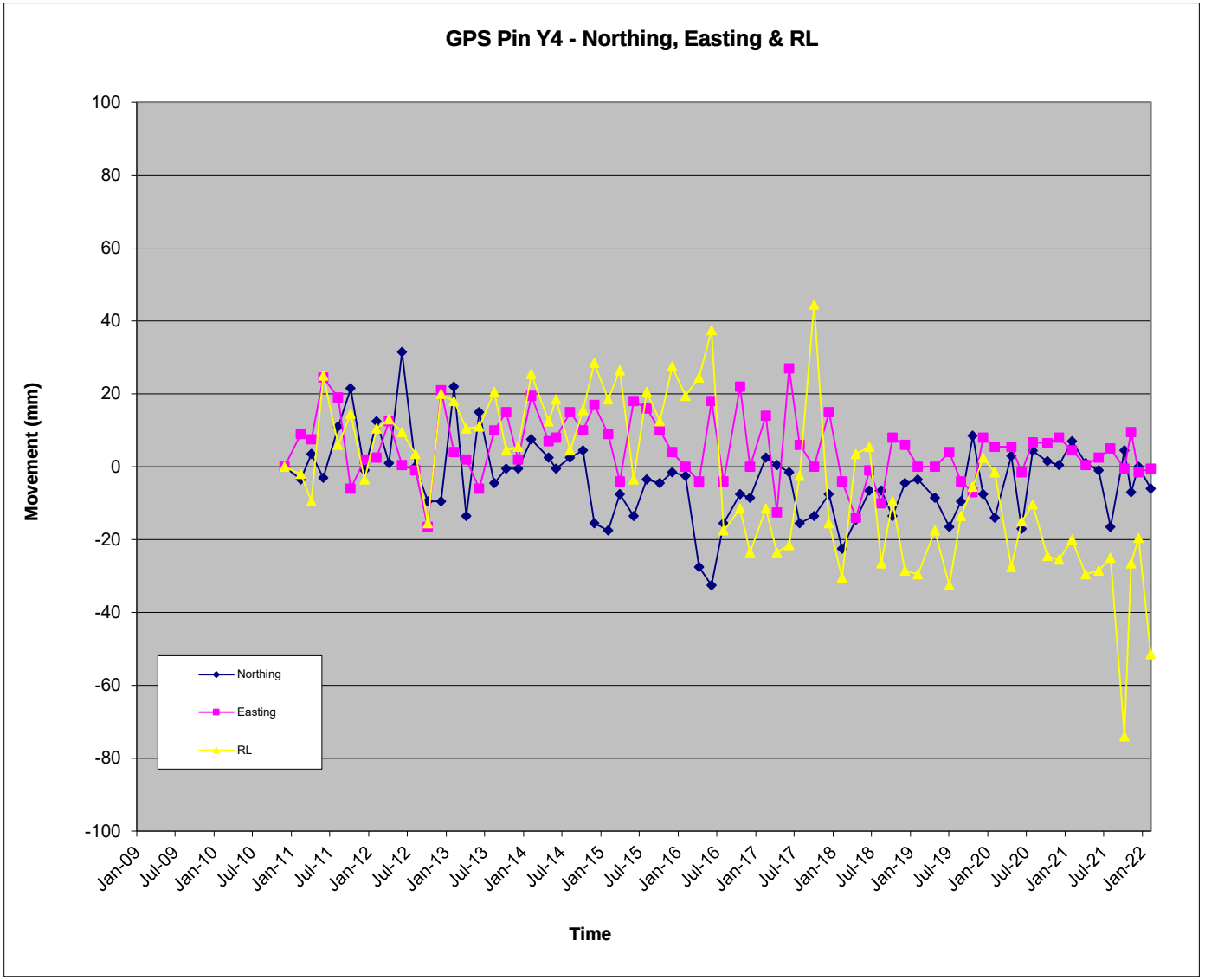

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-40
-60
-80
-100
0
20
40
60


GPS Pin Y3 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-60
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40
60


GPS Pin Y4 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
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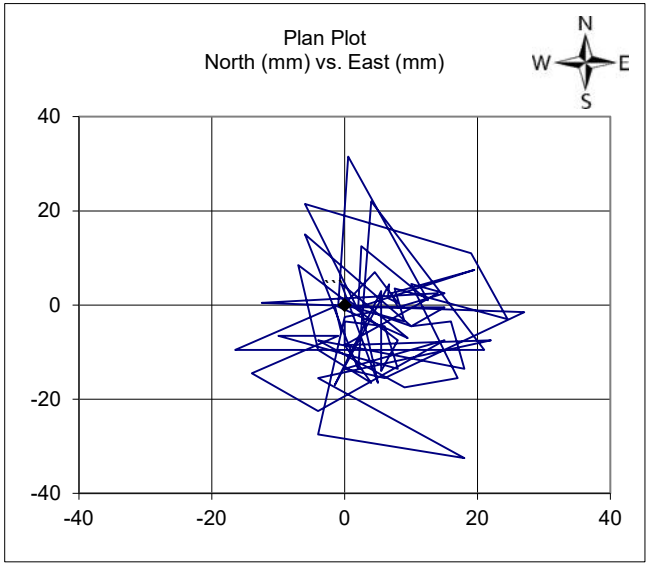
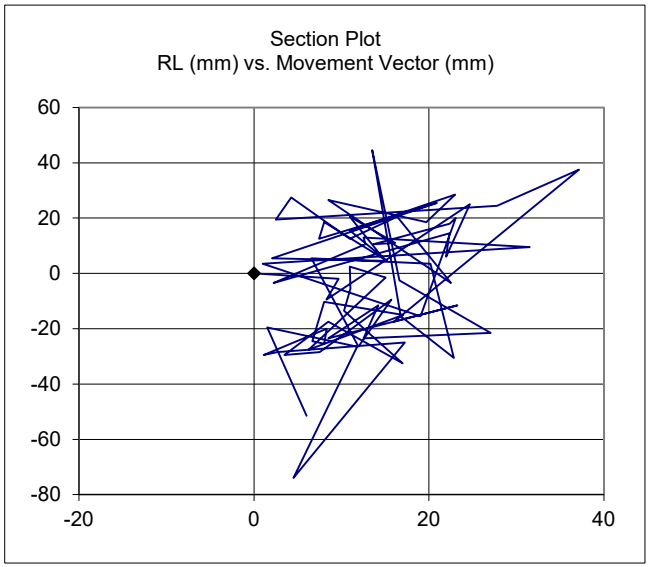
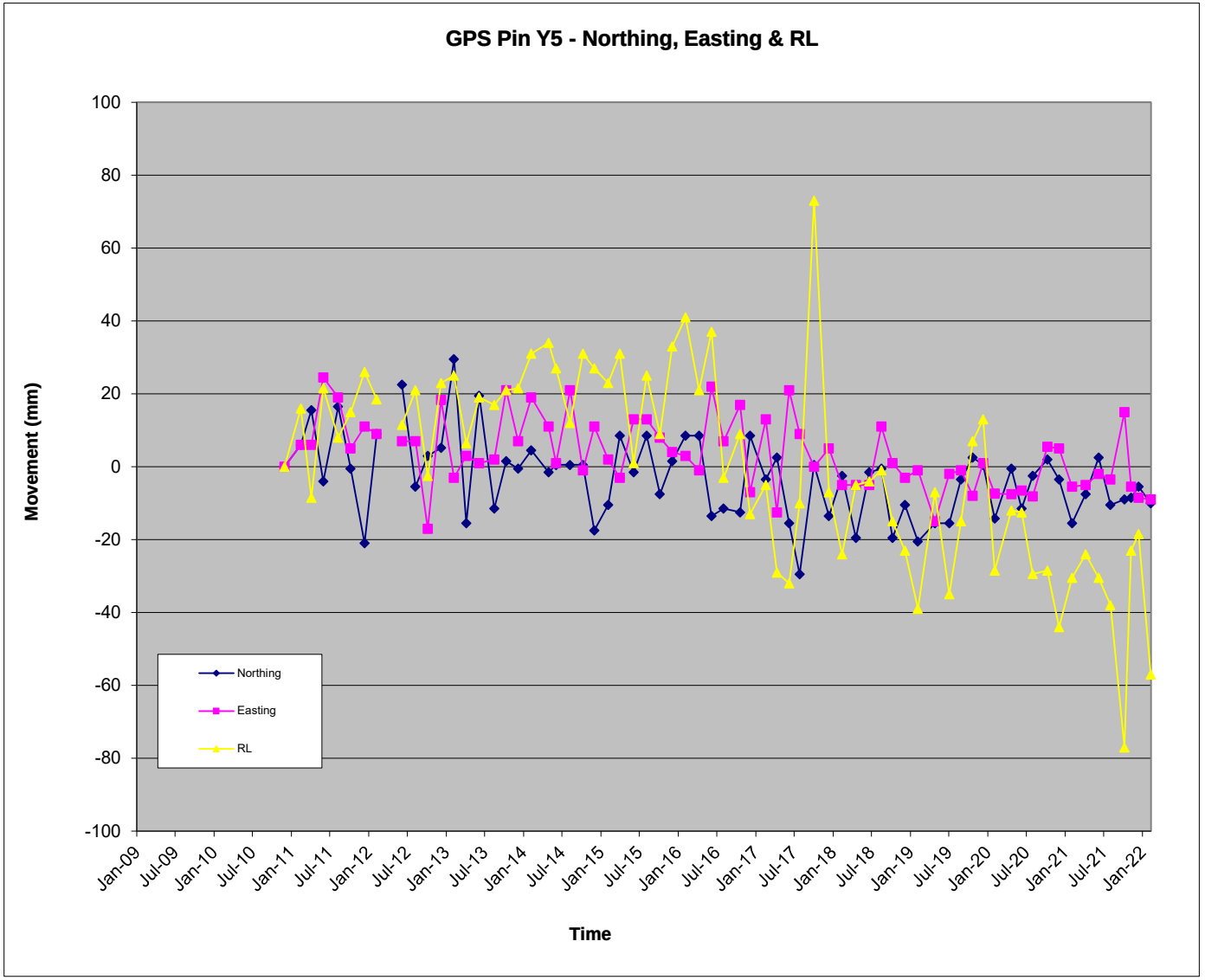
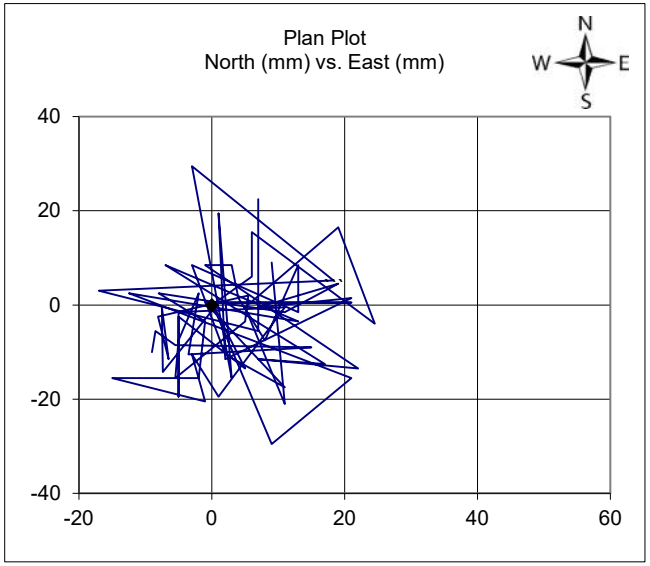
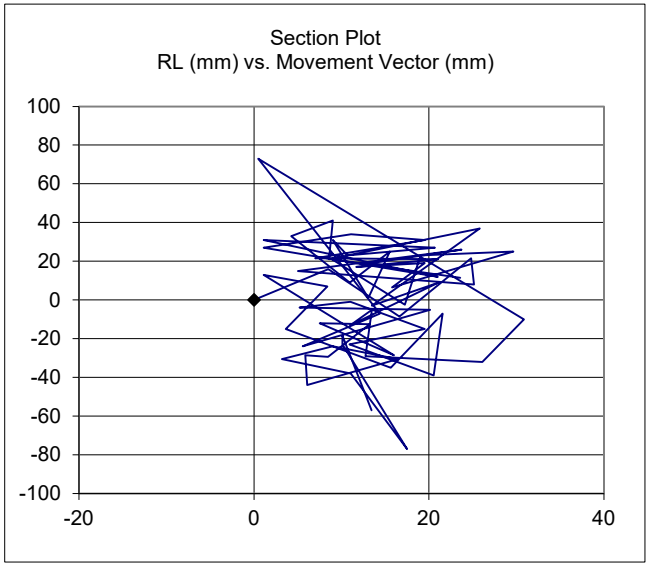
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

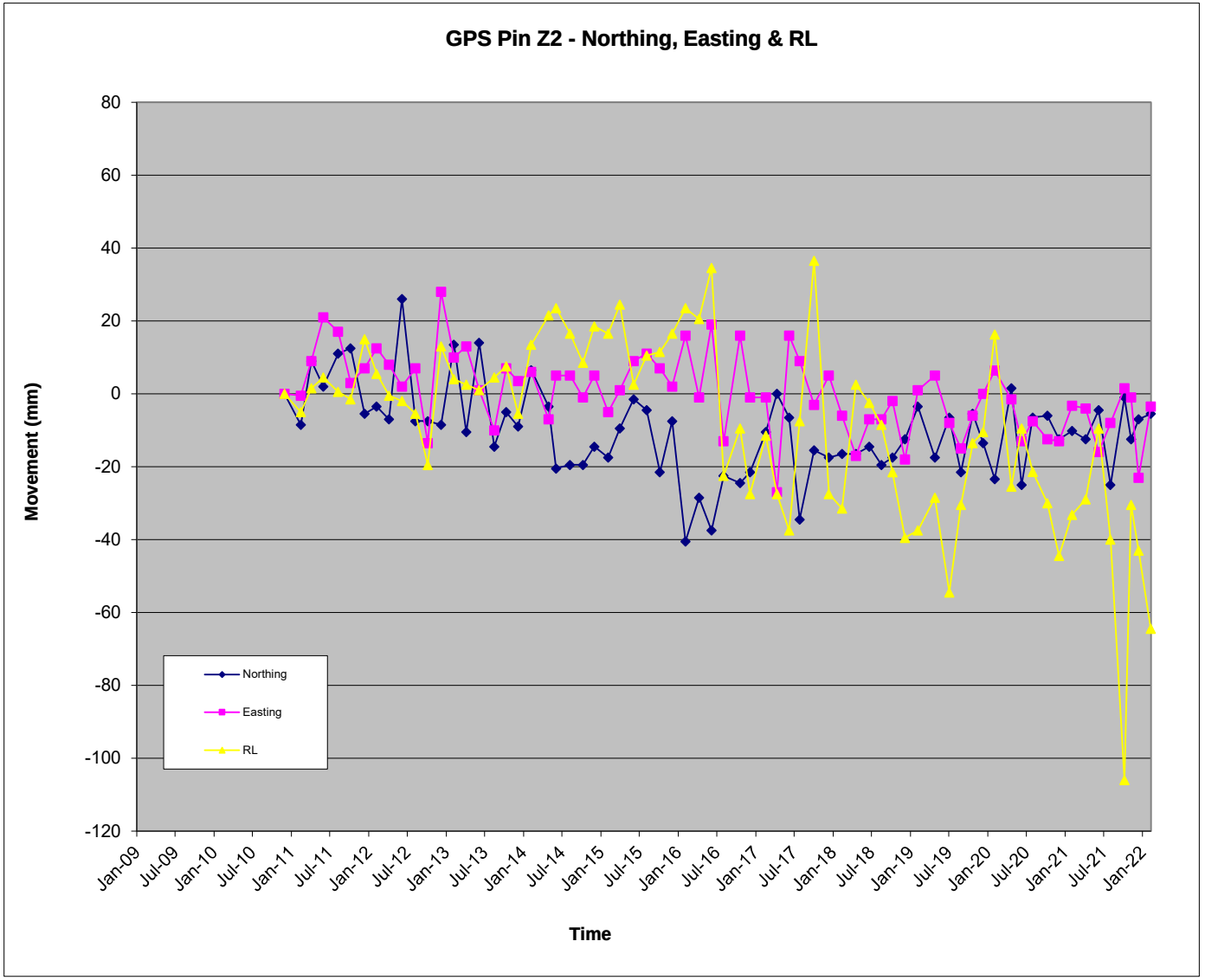

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-20
0
20
40


GPS Pin Y5 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-20
0
20
40
60


Section Plot
RL (mm) vs. Movement Vector (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40


GPS Pin Z2 - Northing, Easting & RL
Movement (mm)
80
60
40
20
0
-20
-40
-60
-80
-100
-120
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
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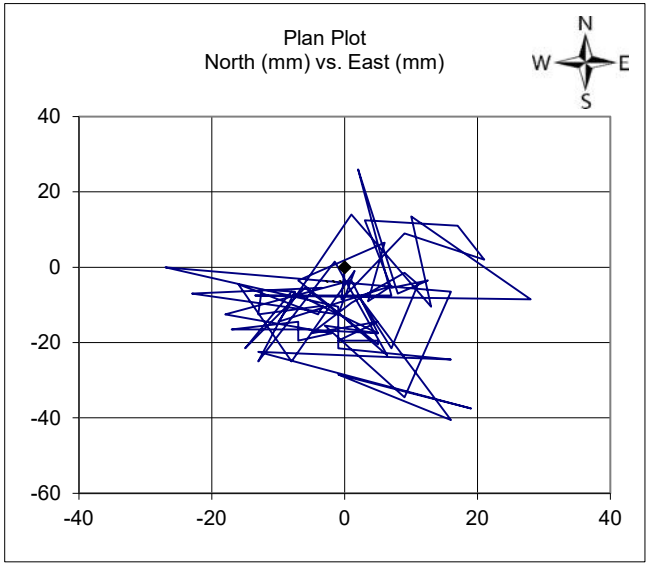
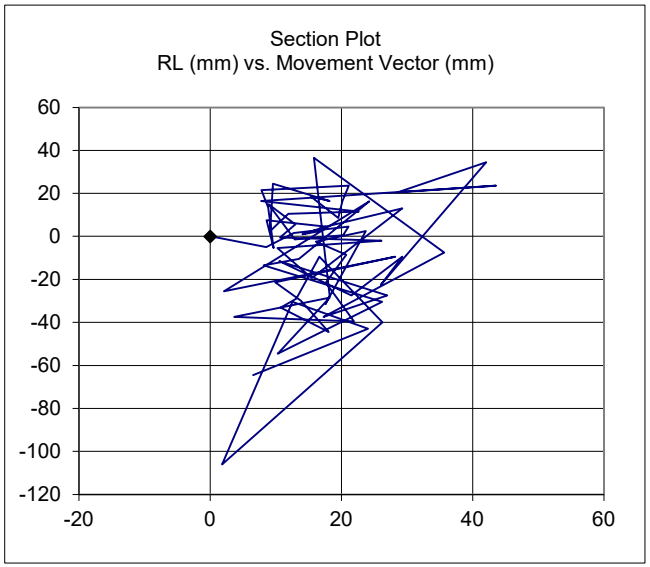
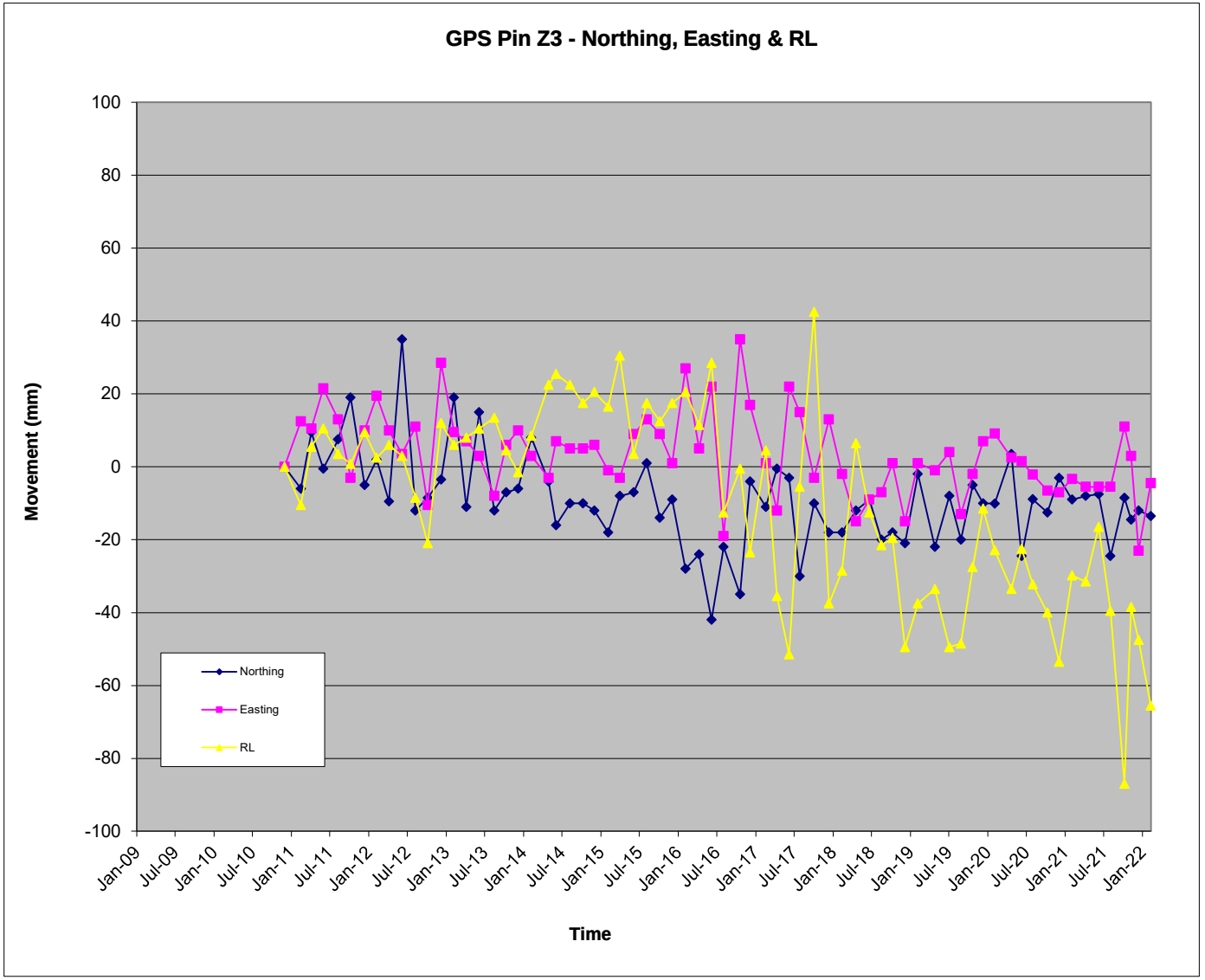
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-120
-20
0
20
40
60


GPS Pin Z3 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
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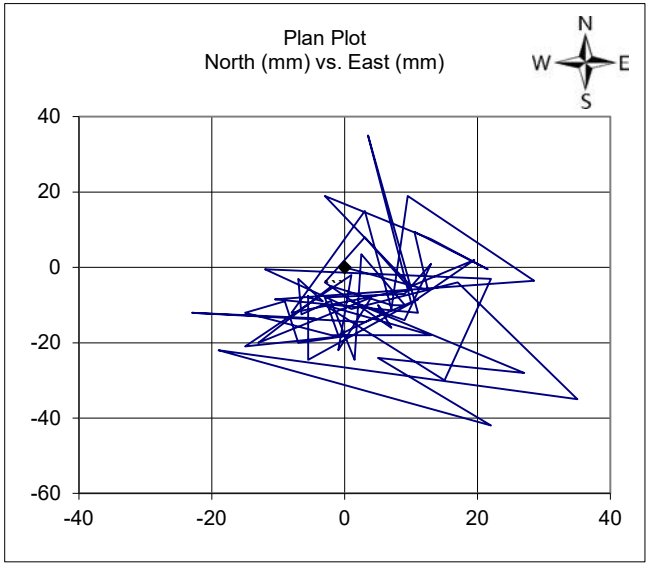
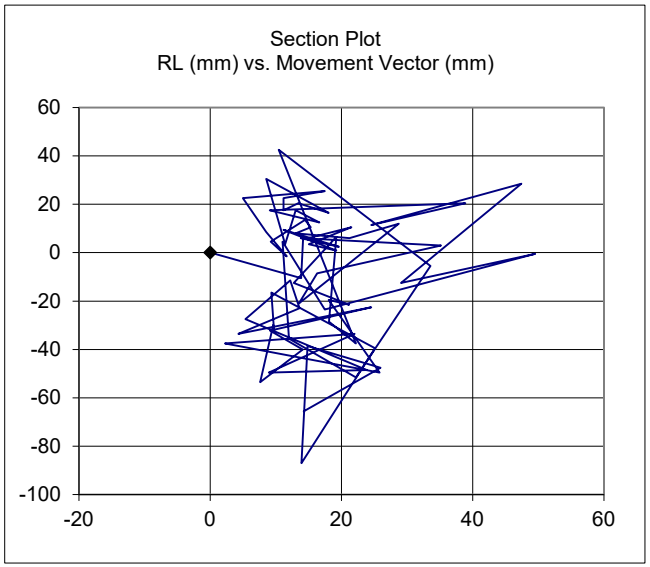
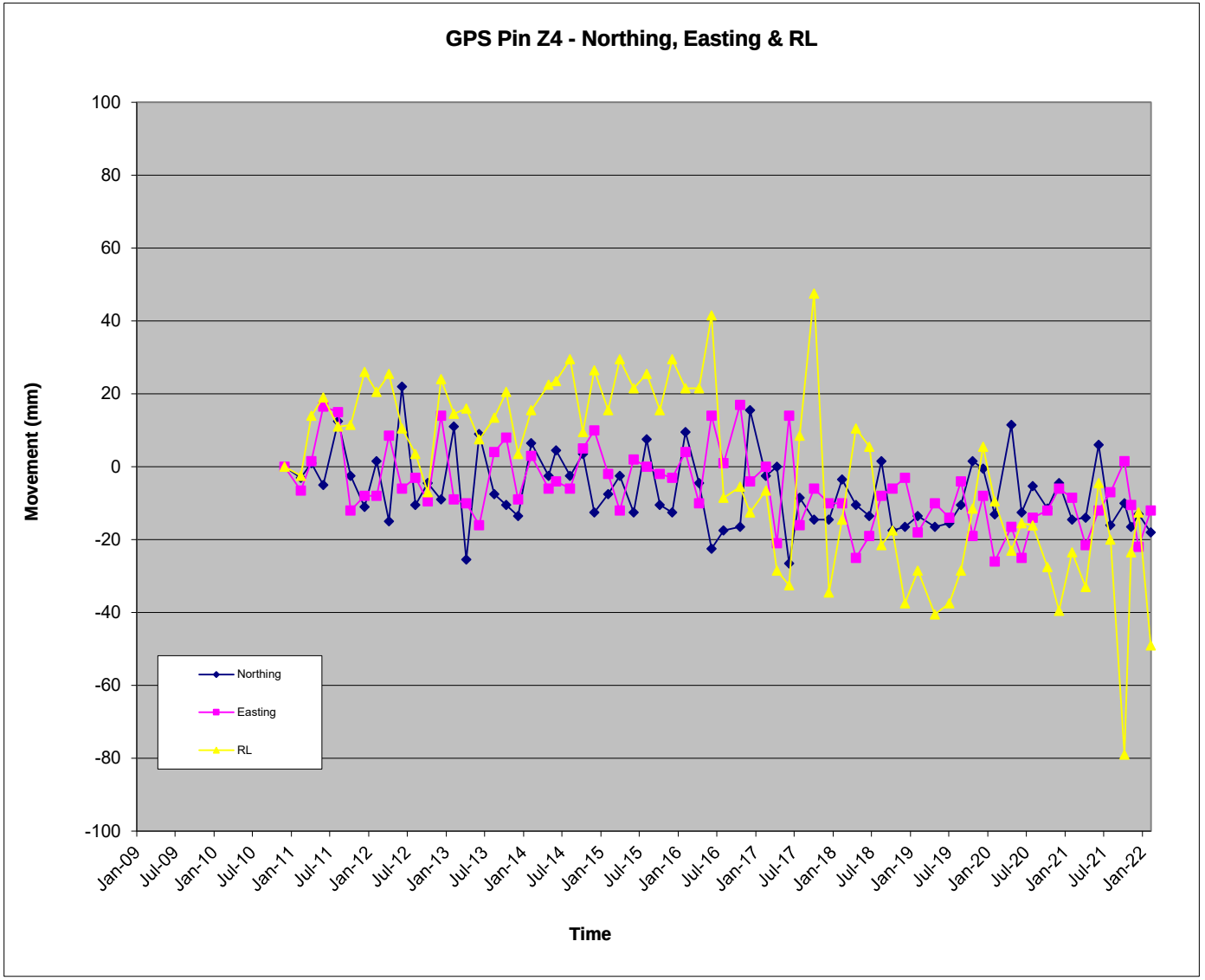
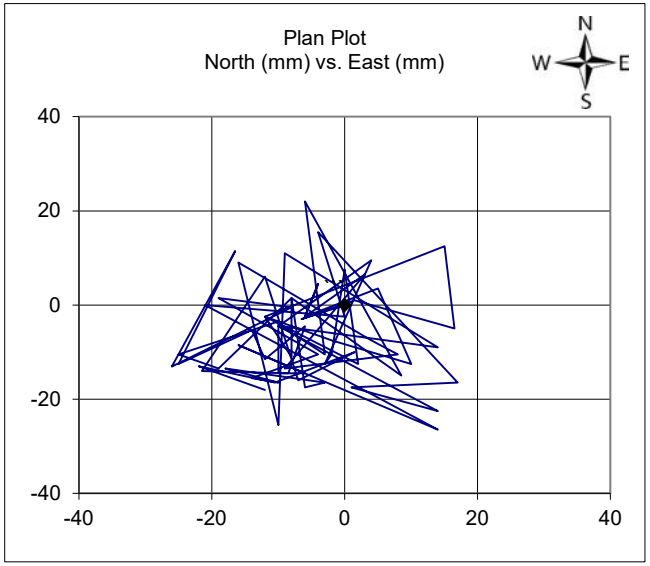
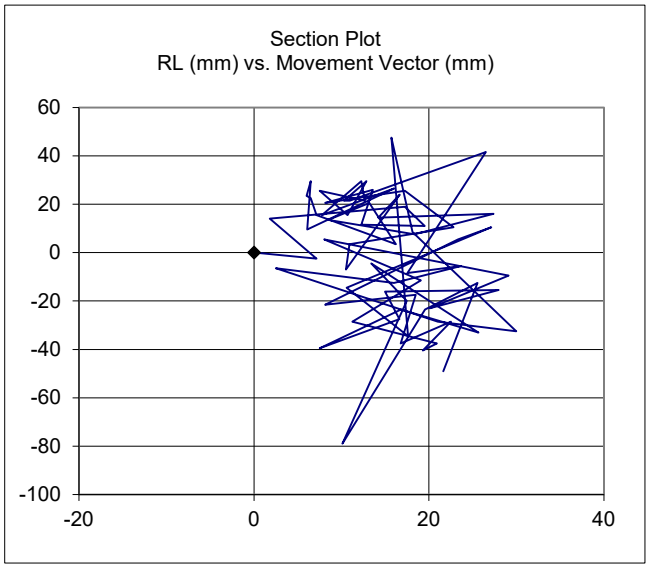
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL

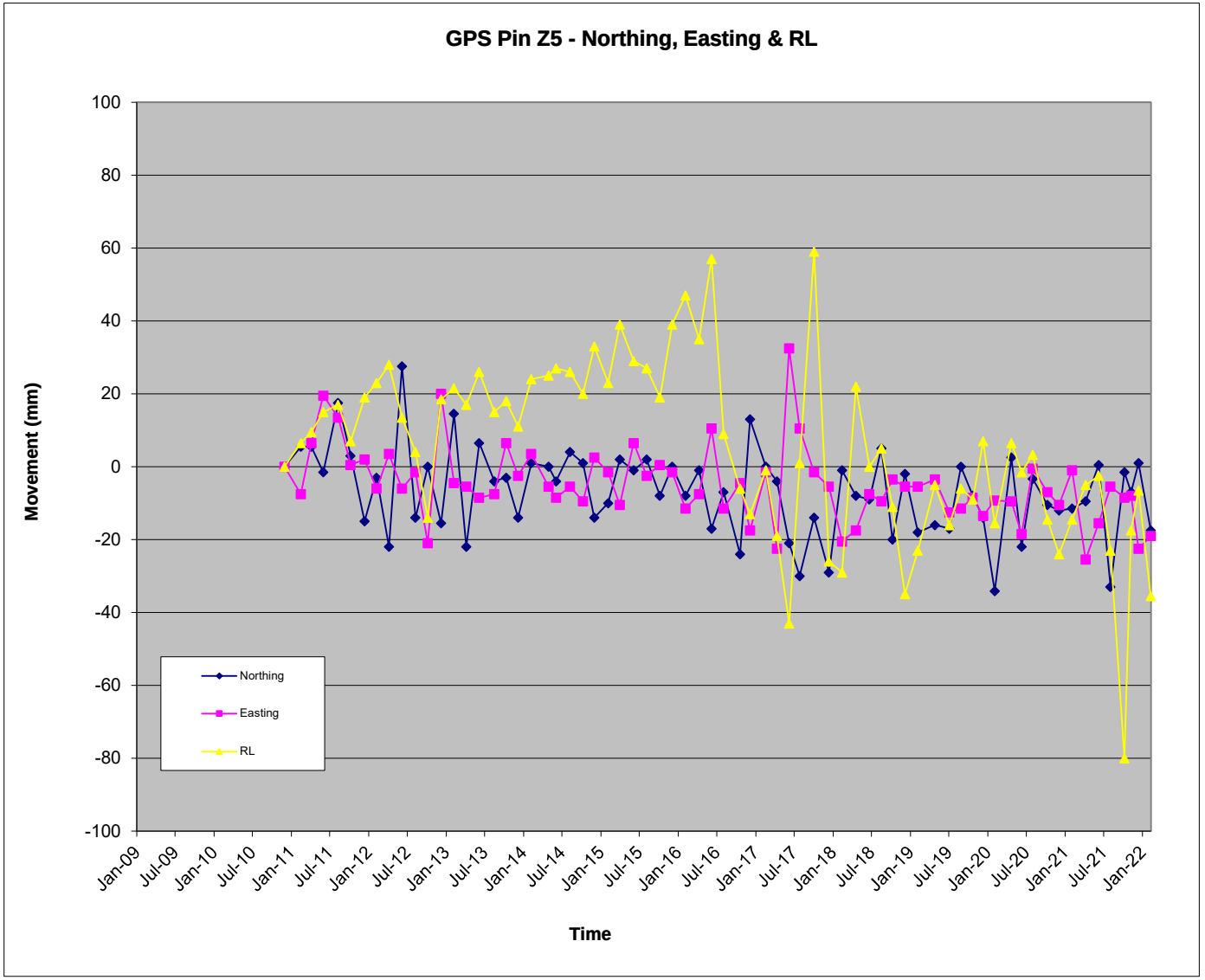

Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-60
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40
60


GPS Pin Z4 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Jul-17
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
60
40
20
0
-20
-40
-60
-80
-100
-20
0
20
40


GPS Pin Z5 - Northing, Easting & RL
Movement (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
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Jul-14
Jan-15
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Jan-16
Jul-16
Jan-17
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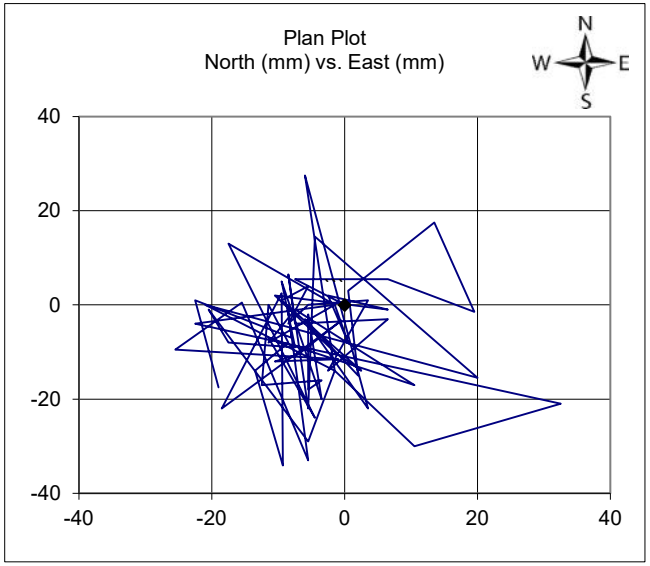
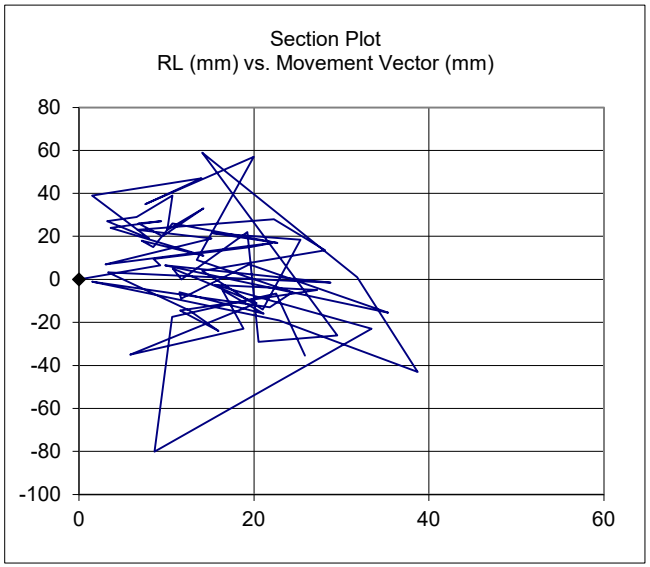
Jan-18
Jul-18
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Time
Northing
Easting
RL


Plan Plot
North (mm) vs. East (mm)
N
W
E
S
40
20
0
-20
-40
-40
-20
0
20
40


Section Plot
RL (mm) vs. Movement Vector (mm)
80
60
40
20
0
-20
-40
-60
-80
-100
0
20
40
60

Appendix B TRP Independent Peer Review Letter

Department of Energy, Environment and Climate Action

8 Nicholson St
EAST MELBOURNE, 3002
Telephone: 136 186

8 February 2024

Mr Warren Sharp
Pt Henry & Anglesea Site Asset Manager | Asset Planning & Management
Alcoa of Australia Limited
205 Coalmine Road
ANGLESEA, VIC 3230

By email: warren.sharp@alcoa.com

Dear Mr Sharp,

ANGLESEA GROUNDWATER MODEL

I am writing to inform you that the Interagency Group, representing the Water and Catchments Group DEECA, Earth Resources Regulation DEECA, and Southern Rural Water, has determined that the Anglesea Groundwater Model, as outlined in the report (12542999-REP-AngleseaNumericalModelUpdate_rev06b DRAFT – July 2023), is fit for purpose for conducting predictive modelling to inform Barwon Water's Bulk Entitlement review process and Alcoa's mine rehabilitation strategy and groundwater assessment for a groundwater licence application.

The IAG decision has been informed by an independent review process and a focus on the agreed scope of the groundwater model that does not pre-empt:

- the outcomes of future processes or work to be undertaken for groundwater related assessments; and
- any future process requirements or decisions for licence application by Alcoa or review of Barwon Water's Bulk Entitlement.

A copy of independent review report "Anglesea Groundwater Model – Review of Model Development and Calibration, January 2024" is attached.

Yours sincerely

Randal Nott
Senior Manager, Groundwater Assessment and Modelling | Water Entitlements, Licensing and Modelling | Water Resources Strategy | Water and Catchments

cc
Will McCance, Barwon Water
Matthew Hudson, SRW
Karen Sonnekus & Muthu Muthukaruppan, ERR DEECA

Any personal information about you or a third party in your correspondence will be protected under the provisions of the *Privacy and Data Protection Act 2014*. It will only be used or disclosed to appropriate Ministerial, Statutory Authority, or departmental staff in regard to the purpose for which it was provided, unless required or authorized by law. Enquiries about access to information about you held by the Department should be directed to foi.unit@delwp.vic.gov.au or FOI Unit, Department of Energy, Environment and Climate Action, PO Box 500, East Melbourne, Victoria 8002.

VICTORIA State Government

Anglesea Groundwater Model – Review of Model Development and Calibration

By

Independent Technical Review Panel

January 2024

OFFICIAL

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1. Introduction

1.1 Groundwater Technical Review Panel (TRP)

This report documents the technical review process and review outcomes in relation to the Anglesea groundwater model. The review was undertaken by the Groundwater Technical Review Panel (TRP). The TRP was convened in late 2021 to provide expert and independent review of technical groundwater investigations. The TRP was convened by an Inter-Agency Group (IAG) comprising DEECA[1], SRW[2] and DJPR-ERR[3] for the purpose to provide technical advice about the Anglesea groundwater model. The model will be used by Barwon Water and Alcoa to support groundwater bulk entitlement review and a licence application respectively.

The review is intended to critically assess the conceptual model, numerical model design, model build and model calibration. The review will provide an independent and transparent assessment of the model capability and limitations, to inform Regulatory decision makers, stakeholders and the wider community.

The two key water issues being investigated are (i) the proposed extraction of groundwater by Alcoa to fill the former Anglesea mine pit void and (ii) assessing the effects of groundwater extraction from the Barwon Water borefield[4] [i]for urban water security purposes. These issues involve interrelated technical aspects, including:

- an improved conceptual model drawing on operational, monitoring and test pumping data;
- an updated groundwater modelling tool for scenario modelling and uncertainty assessment;
- mine pit void hydrogeology;
- catchment impact assessments.

The Groundwater TRP is charged with reviewing investigation reports as to whether:

- appropriate methodologies have been applied,
- appropriate methods have been used to collect and analyse data,
- groundwater modelling is "fit for purpose",
- reasonable values and parameters have been used in calculations and computations,
- correct interpretations have been made on available and relevant data,
- uncertainty and risks have been adequately addressed, and
- recommendations and conclusions are reasonable.

1.2 Background on the TRP

The TRP is comprised of independent experts from a wide range of fields including geology, hydrogeology, modelling, geochemistry, and ecology, as outlined below.

[1] DEECA is Department of Energy, Environment and Climate Action

[2] SRW is Southern Rural Water

[3] DJPR-ERR was previously known as Department of Jobs, Precincts and Regions - Earth Resources Regulator, and it has now been incorporated into DEECA

[4] The Barwon borefield is an existing entitlement issued by a Ministerial Order in 2009 for 10,000 ML per year for the purpose of augmenting water supply to Greater Geelong customers. Barwon Water is obliged to submit a review report to the Minister about long term sustainability of resource, protect environment and improve management and will use the groundwater model to support this review.

Figure 1 - Photograph of TRP members on site (L-R: Timms, Lloyd, Middlemis, Scott)

Professor Wendy Timms (Chair of TRP)

Wendy has extensive expertise in geology, hydrogeology, and engineering, and almost 30 years' experience. She is a Chartered Engineer (Civil Engineering, Environmental Engineering) and a former Vice President of International Association of Hydrogeologists. Wendy is Professor of Environmental Engineering at Deakin University, teaching geology for geotechnical engineering, water and waste engineering and leading research in geological carbon sequestration, water tracer technology, and groundwater hydrology, especially low permeability aquitards. She has engineering project and research experience at coal, gas, uranium, metals and potash and waste sequestration sites in Australia, Asia and Canada, and has published over 200 technical reports and more than 65 peer reviewed journal papers.

Lance Lloyd (Ecology specialist)

Lance has over 30 years' experience (following a M.Sc. by research) as an ecologist in SE Australia and, in the Pacific Islands and New Zealand, in freshwater, estuarine, coastal and inland environments in fish and aquatic fauna ecology and their management requirements. His key expertise is relating the ecology of aquatic systems to the needs of management issues (especially environmental flows, ecosystem restoration and impact assessment). Lance is also the ecological expert on Southern Rural Water's Independent Technical Review Panel for the Barwon Downs Remediation and Environment Protection Plan which addresses the acid discharge issues arising from Big Swamp. He currently chairs the Great Australian Bight Resource Assessment Group, Australian Fisheries Management Authority (AFMA – 2013 to present), was previously the chair of the Translocation Evaluation Panel (Fisheries Victoria – 2004 – 2017) and a member of the Victorian Catchment Management Council (2015 -2018).

Hugh Middlemis (modelling specialist)

Hugh is a groundwater modelling specialist based in Adelaide with a degree in civil engineering, a masters in hydrology and hydrogeology, and 40 years' experience across Australia and internationally. Hugh established HydroGeoLogic in 2013 as an independent consultancy, specialising in flow and solute models, stream-aquifer interactions, groundwater dependent ecosystems and uncertainty analysis. Hugh is a co-author of best practice guidelines on groundwater modelling and uncertainty analysis, and has been appointed to expert panels, including for the Barwon Downs and Yeodene/Big Swamp remediation project, the Victorian Murray Floodplain Recovery Project and the NSW Mining and Petroleum Gateway Panel.

Peter Scott (acid specialist)

Peter is a geochemist specialising in the assessment and management of disturbance of coastal acid sulfate soils (CASS) and disturbance by mining of sulfidic rock material resulting in the generation of acid and metalliferous drainage (AMD). Peter has more than 50 years of experience in managing and minimising environmental impacts from mining and coastal land development throughout the world. Peter is a leading specialist in AMD assessment and design of mining landforms for control of AMD. Peter has established benchmark understanding of land development planning for controlling and mitigation/minimising impacts resulting from disturbance of acid sulfate soils.

1.3 Purpose of this report

This TRP report addresses the scope of work requested by the Inter-Agency Group:

- A brief explanation of the technical review panel objectives, the review process and its stages.
- A synopsis of the key elements of the review findings, in particular:
  - Are the model objectives clearly stated?
  - Is the conceptual model based on available information and fits the model objectives?
  - Does the model design and build reflect the conceptual model, fit the objectives and is it suitable for application to predictive scenario forecasting?
  - Comment on the importance of model calibration/history-matching performance and uncertainty analysis and their relevance to this model in achieving the objectives.
  - Any limitations or qualifications on the use of the model for its intended objectives.
- Any other comment from the TRP that may be relevant to modelling and model development.
- Conclusions and Recommendations about the modelling and model development. Is the model fit for its intended purpose?

2. Background on Jan Juc GMA and Anglesea

2.1 Jan Juc Groundwater Management Area (GMA)

The Jan Juc Groundwater Management Area (GMA) is part of the Torquay Basin, one of four major Tertiary depressions in the Otway Basin in southwest Victoria. The geological formations in the Jan Juc area are separated from other areas of the Otway Basin and so groundwater within the Jan Juc GMA is not connected with groundwater elsewhere in Southwest Victoria.

The Eastern View Formation (EVF) has two principal aquifers in the Jan Juc GMA. The EVF includes two distinct high permeability aquifer units that are separated by low permeability aquitards. The main aquifer units are in the Upper EVF and the Lower EVF, illustrated in the simplified conceptual model (Figure 3). In the centre of the Anglesea depression, where the sediments and coal are thickest and suitable for open pit mining (Holdgate et al 2001), there are multiple layers of low permeability sediments including:

- aquitards within the Demons Bluff Group (layers within the light grey colour in Figure 3) and,
- aquitards within the Upper EVF (layers within the orange colour in Figure 3).

The UEVF and LEVF are accessed by two major borefields operated by Alcoa and Barwon Water (BW) near the town of Anglesea:

- Alcoa borefield: 7 bores in the Upper EVF established in 1969, 4 bores decommissioned to date; historical licence to extract 4 GL/yr for industrial use relating to the former Alcoa Power Station and open pit coal mine at Anglesea; licence subject to review/amendment by Southern Rural Water (SRW) based on current investigations;
- Barwon Water borefield: 7 bores in the Lower EVF established in 2009 (5 southern bores near the Anglesea pit void; 2 northern bores about 4.5 km north of the pit); Bulk Entitlement (BE) licence to extract 10 GL/yr (average); includes trigger level conditions for the protection of the swamplands groundwater dependent ecosystems (GDEs) in the upper Anglesea River.

A timeline of historical extraction from the UEVF (Alcoa), including via the mine sump, and from the LEVF (BW) is presented in Figure 2.

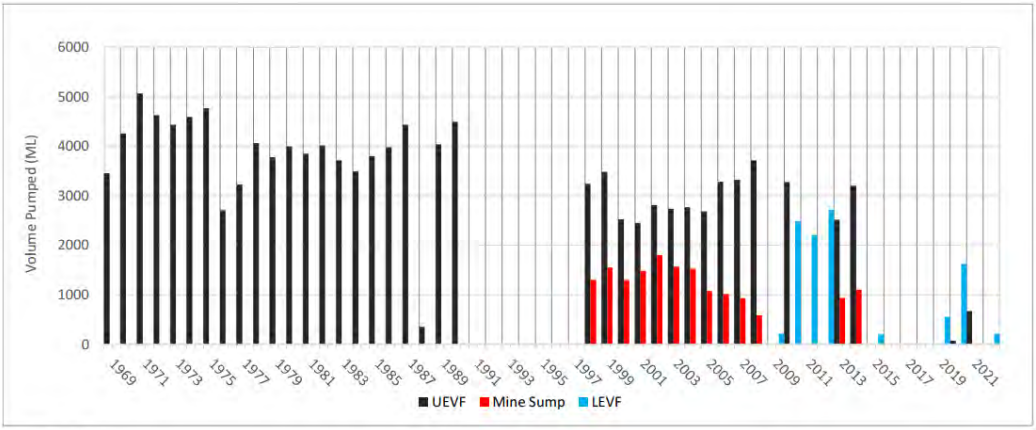

Figure Notes:

UEVF Data missing for 1991-1997, 2009 & 2011-2012
UEVF volumes prior to 1989 also include the mine sump volume
LEVF 2021 Data – Up to and including February 2022

Figure 2 - Timeline of historical groundwater extraction (after EHS Support 2022)

2.2 Background on regulatory obligations

Barwon Water's Bulk Entitlement (Anglesea Groundwater) Order 2009 authorises Barwon Water to extract groundwater from the Lower Eastern View Formation (LEVF). Under the bulk entitlement, Barwon Water must undertake a periodic review of the bulk entitlement to inform the Minister for Water about:

- the long-term sustainability of groundwater resources in the area,
- protecting the environmental values and health of groundwater dependent ecosystems, and
- improving resource management arrangements under the bulk entitlement.

Barwon Water will submit a review report to the Minister in late 2024 for the next review of the bulk entitlement. In accordance with the bulk entitlement, Barwon Water must consult with the Department of Environment, Land, Water and Planning (DELWP, now DEECA) on the review process and present the subsequent review plan to the Minister for Water for approval. Barwon Water carried out a groundwater pumping test at the Anglesea borefield from January to July 2022 to inform the review of their bulk entitlement and associated monitoring program. Data collected from the pumping test was used to identify the impacts of taking groundwater and support the process of reviewing and updating the local groundwater model.

Alcoa has a regulatory obligation to develop the Anglesea Mine Rehabilitation and Closure Plan (MRCP) for review and approval by Earth Resources Regulator (ERR). The relevant legislation is the Minerals Resources (Sustainable Development) Act 1990 (MRSD Act). Alcoa's current proposed approach is to fill the mine void with groundwater pumped from the UEVF. This proposal will require a licence application to SRW.

The relevant legislation for assessing licence applications (SRW) and Bulk Entitlements (DEECA) is the Water Act 1989, particularly matters that are listed under s40 of the Act. These matters include a range of water availability, water quality and environmental considerations.

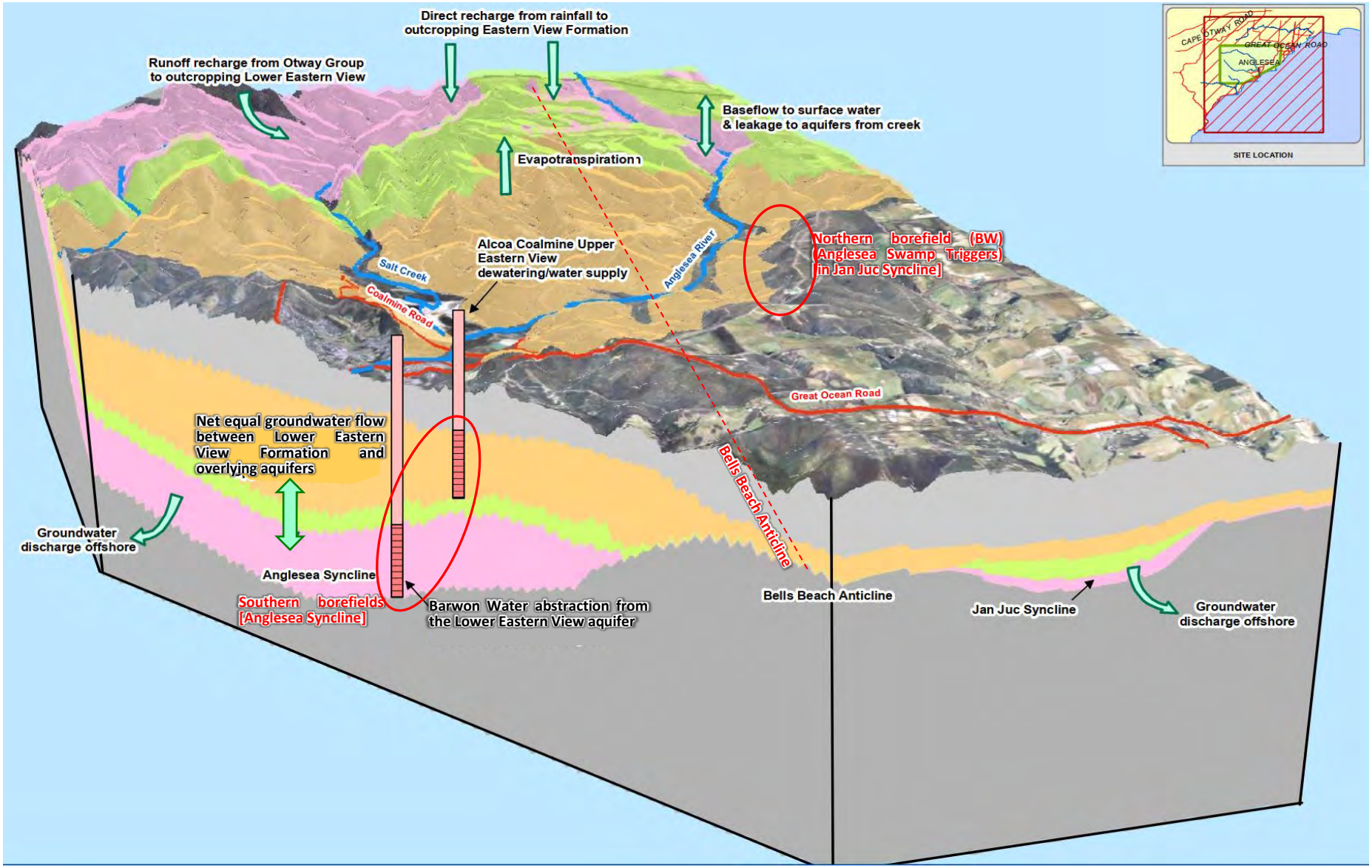

Figure 3 - Anglesea conceptual groundwater model (after GHD 2013, 2022)

2.3 Anglesea Groundwater Model

Barwon Water commissioned consultants GHD in 2009 to develop a numerical groundwater model of the Jan Juc GMA aquifer system for application to borefield sustainability and impact assessments. The model was updated in 2013 and 2019 and has undergone a major update in 2022.

The 2022 Anglesea model update involves using the latest numerical code, updated layer structure and parameterisation schemes, the latest methods of history-matching to observation data, including new information gleaned from the 6-month pumping test, and with integrated uncertainty analysis methods.

The intention is to develop a groundwater model representative of shallow and deep aquifer systems that is suitable for the ongoing water management and planning needs of both Barwon Water and Alcoa, to support:

- the Barwon Water Anglesea borefield planning, management and approvals works under the Bulk Entitlement (BE) process, including periodic model updates and re-assessment of sustainability.
- the Alcoa mine closure and rehabilitation planning and management works, including the licence application to SRW for long-term groundwater abstraction to fill the pit water body.

2.4 Anglesea Mine Rehabilitation and Closure Plan (MRCP)

A draft Anglesea Mine Rehabilitation and Closure Plan (MRCP) was submitted by Alcoa to Earth Resources Regulator (ERR) in September 2017. It was estimated that allowing the pit void to naturally fill and form a water body (lake) would take 50-100 years to reach a final level of between -4 to +4 metres AHD (EHS Support, 2017). Alternatively, filling the pit void with groundwater extracted from the Alcoa UEVF borefield could reduce the timeframe, and enable a more rapid implementation of the MRCP.

In September 2020, Alcoa submitted a Groundwater Impact Assessment (GIA), evaluating risks to the environment and third-party users associated with a proposed 12-month groundwater pumping test of the UEVF aquifer. In October 2020, Southern Rural Water (SRW) issued an amended groundwater licence for that purpose.

On 13 May 2021, Alcoa commenced the groundwater pumping test of the UEVF aquifer, with the extracted groundwater being discharged to the pit void lake, and with monitoring and modelling investigations ongoing. The pumping test was paused on December 8, 2021 after 672 ML was extracted, about 44% of the licensed volume, while the data from the first 6-months of pumping was evaluated.

3. The TRP review process

3.1 Objectives of reviewing the Anglesea groundwater model

The TRP was engaged by DEECA in November 2021 to provide independent technical expertise:

- to review the development of the Anglesea groundwater model and its application to impact and resource assessments in the Jan Juc GMA
- to provide advice to the Inter-Agency Group comprising representatives of DEECA, SRW and DJPR/ERR.

The TRP brief is outlined in section 1.1.

3.2 Processes and stages of the TRP model review

The TRP review process involved several stages:

- inception meeting, reading of background reports and a site visit on 25 February 2021 (Figure 1),
- reviews of updated conceptual and numerical model report submitted by Alcoa and Barwon Water to the IAG (see Table 1 lists and references),
- several meetings with Alcoa, Barwon Water, and their consultants, facilitated by DEECA,
- several meetings with the Inter-Agency Group, facilitated by DEECA,
- meetings for internal discussion amongst TRP members.

Apart from the site visit, all meetings were conducted by videoconference.

Outcomes of the TRP process are summarised in

Table 1:

Table 1 - Summary of TRP review process

Timeframe	Stage	Description
December 2021 to January 2022	Inception, Site Visit and Conceptualisation (initial)	Inception meeting 3 December 2021, with DEECA and Inter-Agency Group (IAG includes ERR, SRW & DEECA), and including briefings by Alcoa, Barwon Water, and their consultants. Review of technical reports provided by DEECA, notably: • previous investigations and the numerical model development (GHD 2013, 2019), and related reports on ecology and acid mobilisation • the conceptual hydrogeological model ('CHM'; EHS December 2021) • the numerical model design for the 2022 update (GHD December 2021). Outcome: TRP initial review reports to DEECA on conceptual hydrogeological model and numerical model design.
March 2022	IAG workshop	TRP and IAG workshop facilitated by DEECA, with Barwon Water, Alcoa and their consultants, to discuss the initial TRP

Timeframe	Stage	Description
		review, and the updated (March 2022) reports on the CHM and numerical model design, and the comments register.
May-June 2022	Calibration 3b	TRP review of the GHD numerical model calibration report version 3b (May 2022), including updates to address previous TRP review recommendations on the CHM and model design (TRP letter to DEECA, 24 June 2022).
July 2022	TRP/IAG Workshop	TRP and DEECA workshop on 15 July 2022 to discuss TRP response to additional questions from the Inter-Agency Group on the model suitability, historic impact (hindcasting), baseline scenario, BW pumping and risk assessment (TRP memo to DEECA, 22 July 2022).
September 2022	IAG workshop	TRP and IAG workshop facilitated by DEECA, with Barwon Water, Alcoa and their consultants, to discuss the TRP review report (June 2022) on the numerical model calibration version 3b (GHD May 2022). Key issues discussed included the Quantities of Interest (QoI; or key model forecasts), and the acid generation/mobilisation assessment methodology.
October 2022	Conceptualisation (update) Calibration 4b	Review of updated conceptual model report (EHS Sept 2021) and numerical model calibration version 4c report (GHD Oct 2022). Outcome: TRP review report on use of model for scenario forecasting and draft QoI (TRP memo to DEECA, 14 October 2022).
August 2023	Calibration 6b	Review of updated numerical model calibration version 6b report (GHD Oct 2022). Outcome: The model is "fit for purpose" and can proceed to testing "Predictions of Interest".
October-December 2023	TRP Review Summary	Preparation of updated summary report on the TRP process and outcomes.

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4. Findings of the model review

4.1 Responses to key questions

4.2 Model Objectives

The model objectives are clearly stated in the modelling report (GHD 2022) in terms of developing a single Anglesea groundwater model that is suitable to meet the needs of the ongoing water management and planning obligations of both Barwon Water and Alcoa via investigations, monitoring and periodic model updates to support:

- the Alcoa mine closure and rehabilitation planning and management works, including the licence application to SRW for long-term groundwater abstraction to fill the mine pit void;
- the Barwon Water Anglesea borefield planning, management and reviews under the Bulk Entitlement (BE) obligation, including re-assessment of the sustainability of groundwater extractions for urban water security purposes.

The latest methods of groundwater modelling and uncertainty analysis have been applied. This allows for input data and conceptualisation uncertainties to be carried through to their influence on model forecasts and their uncertainties. The model results for the history match calibration and the scenario forecasts are presented in the following terms, which is designed to aid decision-making:

- magnitude of effects of groundwater extraction
    - eg. groundwater levels and drawdowns in the EVF and swampland aquifers; river flow-duration and zero flow period changes with time; aquifer flux exchanges with rivers and swamplands; pit lake levels and water balances, etc.
- probability of occurrence of those effects
    - eg. the key metrics of 5%, 50% and 95% likelihood ('P5, P50 and P95') of predicted impacts exceeding or not exceeding established triggers at sensitive/key sites such as groundwater dependent ecosystems and at stream flow gauges (DELWP 2015a,b), and with consideration of climate change effects (DELWP 2020).

Results are presented in catchment-wide spatial terms (and also for the upper and lower catchments and specific locations), such as the area where 0.1m drawdown is predicted to be exceeded with a suitably justified probability.

4.3 Conceptual Hydrogeological Model (CHM)

The Anglesea conceptual hydrogeological model is illustrated in Figure 3. The Anglesea catchment is a very complex system and it is very challenging to quantify precise predictions of ecological hazards or impacts given this complexity and the gaps in historical data. Some of the key challenges are:

- There are complex processes that generate acidity and mobilise metals, including flushing events after drying of soils and swamps and water-rock interactions with underlying geology.
- There are complex processes influencing water quality in the estuary with dynamic conditions. For example, buffering capacity of the water to acidity and hydrodynamics of variable surface flows and interactions when the sand bar is open to the ocean.
- It is possible that small changes or short-term changes in the system could result in significant ecological effects. For example, a small watertable drawdown could significantly impact flora and fauna species in swamp and estuary if that results in a mobilisation of significant acid loads that are not buffered by the estuary water chemistry.

- Current understanding of the relative significance of natural variations and human activities on the system is limited. There is currently uncertainty in quantifying the influences of mining and/or groundwater extraction from the UEVF and/or the LEVF, particularly with time-lags for affects over many years and large variations in rainfall.
- A combination of modelling with uncertainty analysis and monitoring will be required to inform risk-based approaches that include adaptive management of groundwater extraction rates and locations.

That said, the conceptual model is based on the available information and is designed consistent with the model objectives, with the following features are adequately represented in the numerical model (with reference to Figure 3):

- catchment extent and hydrogeological setting (Anglesea and Jan Juc synclines)
- groundwater flow in the main aquifer systems (EVF and alluvial swamp aquifers)
- rainfall recharge, creek flows, evapotranspiration, and groundwater interactions, including climate variability (eg. history match variability and forecasts with/without climate change)
- groundwater pressure changes at the coast for saline intrusion risk assessment
- Alcoa and Barwon Water borefield pumping, and third party users
- Alcoa pit water body levels, water balance and groundwater interactions
- groundwater particle tracking capability to evaluate capture zones around pit water body and borefields
- simulation of dynamic watertable variability in the alluvial swamp aquifers (ASA), as a proxy indicator of acid generation/mobilisation risk across model scenarios (uncertainties apply).

The model is designed to assess the effects of climate change on key forecasts of interest, such as changes to groundwater recharge rates, changes in evaporation, particularly with the modelled pit water body, and potential future sea level rise. The TRP identified a potentially significant issue with the coastal boundary at the design stage, which was corrected.

An appropriate balance has been achieved between model design complexity and simplicity, and implementation in the numerical model, consistent with best practice guidelines, including for uncertainty assessment (Barnett al 2012; Peeters and Middlemis 2023) and climate change (DELWP 2020).

4.4 Model Design, Build and Predictive Purpose

The model is capable of simulating groundwater levels, groundwater flows, and surface water flows; however, it is not designed to directly simulate the processes of acid generation and mobilisation, or ecological impacts. The investigation into those would require different tools and assessment, for which the model results are potentially critical inputs.

The model has reasonable capability in terms of aquifer system processes. For example, the model reasonably replicates the pattern of observed groundwater response in the deeper aquifers to pumping from the deeper aquifers (UEVF, LEVF). The model also reasonably replicates the lack of groundwater response observed at key locations in the shallow Alluvial Swamp Aquifer (ASA) to groundwater pumping (see Figure 4 below, after GHD 2022 Figure 3-16 and 3-7).

The model reasonably replicates these dynamics in most monitoring bores in the main EVF aquifers for the history match period (1968-2020), although there are few nested bore sites (with screens in all units) close to the area influenced by mining activities (e.g., only two ASA bores near the Alcoa mine; WTOB1, WTOB2). Interestingly, Figure 4 shows minor decreases in measured ASA levels at times that do not appear to be related to pumping effects, suggesting climate effects may be important. Although the groundwater level drops are minor, they may be enough to expose acid sulfate soils (ASS) in the swamplands. A comparison of different model scenarios (with and

without pumping) could provide insights into the effects of groundwater extraction and climate on the shallow aquifer system, and the investigation of hydrological conditions that may be associated with acid mobilisation events.

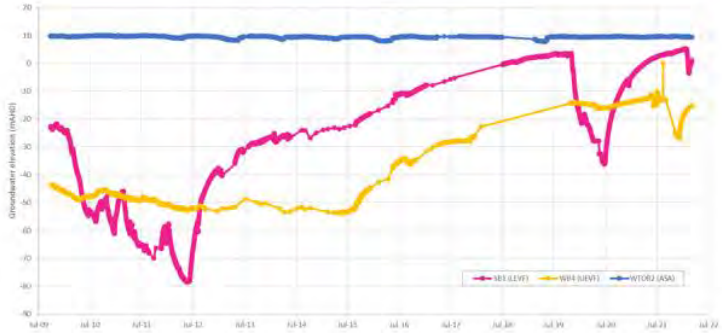


Figure 3-16 Lower Anglesea Swampland: WTOB2 (ASA_)WB4 (UEVF) & SB1 (LEVF) Nested Hydrograph

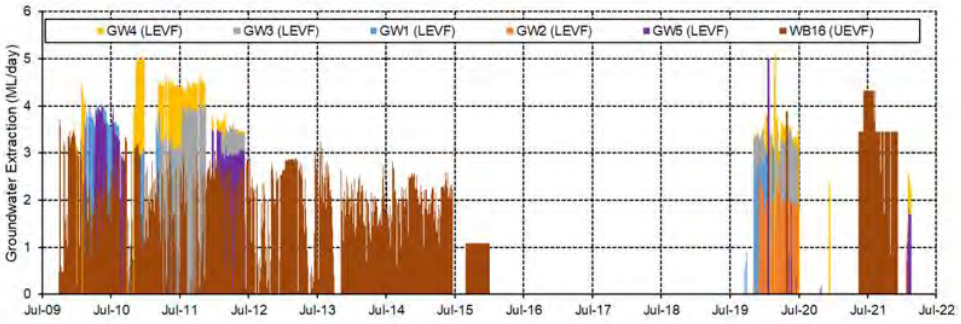
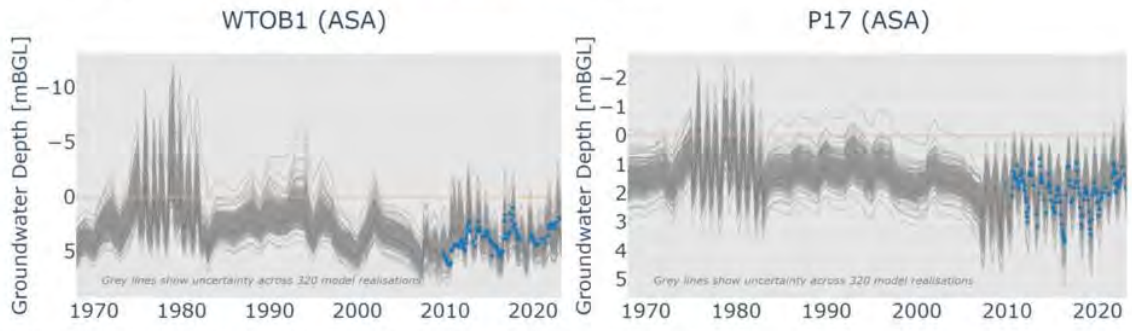


Figure 3-7 Southern Syncline: Nested Bores SB1 (LEVF) and SB2 (UEVF) (2010-2022)



Observed values shown as blue dots; modelled values shown as grey lines (for all model realisations)

Figure 4 – Observed aquifer responses to groundwater pumping (upper figure), groundwater extraction (middle figure) and modelled and observed groundwater levels (lower figure) (after GHD 2023)

4.5 Model Performance and Uncertainty Analysis

Model calibration/history-matching performance and uncertainty analysis and their relevance to this model is important in achieving the model objectives.

Available observation data have been used for model calibration/history-matching, with metrics including aquifer extractions for water supply and pit dewatering, groundwater levels and trends, stream flows, and post-mining pit lake levels and water balances/fluxes.

The model history-match period 1968-2022 includes a very wide range of stresses including climate variability (rainfall-runoff, recharge/discharge and evapotranspiration, above and below average rainfall periods), groundwater pumping, pit void rehabilitation and development of the

water-body ('pit water body'). The model commences prior to mining of the main pit and groundwater pumping that supported the first power generation at the site in March 1969.

The reasonable calibration/history-match performance provides confidence that the Anglesea model is a suitable predictive tool under a range of climate and other stresses for surface water and groundwater interactions, interactions with the pit, interaction between the main aquifers (UEVF, LEVF and ASA), groundwater trends, water balances, pit water levels, flux exchanges and parameter realisations.

The model will be a useful tool for scenario forecasting, provided that the inherent limitations of modelling are acknowledged (e.g., see sections 4.3 and 4.6).

The large uncertainties that are inherent in modelling this complex system means that the model results should be considered within a risk management framework for adaptive management. The uncertainty assessment methods applied to the model history-match and the predictive scenario forecasts are consistent with best practice methods (Peeters and Middlemis 2023) and are designed to inform a risk management framework. Confidence in future predictions can be improved with a combination of periodic updates, to the modelling and uncertainty analysis, monitoring and investigations. The model is also suitable for use in a data worth analysis to identify optimum sites for filling gaps in the monitoring network (eg. in the ASA, such as in the lower catchments to augment the existing bores WTOB1 and WTOB2).

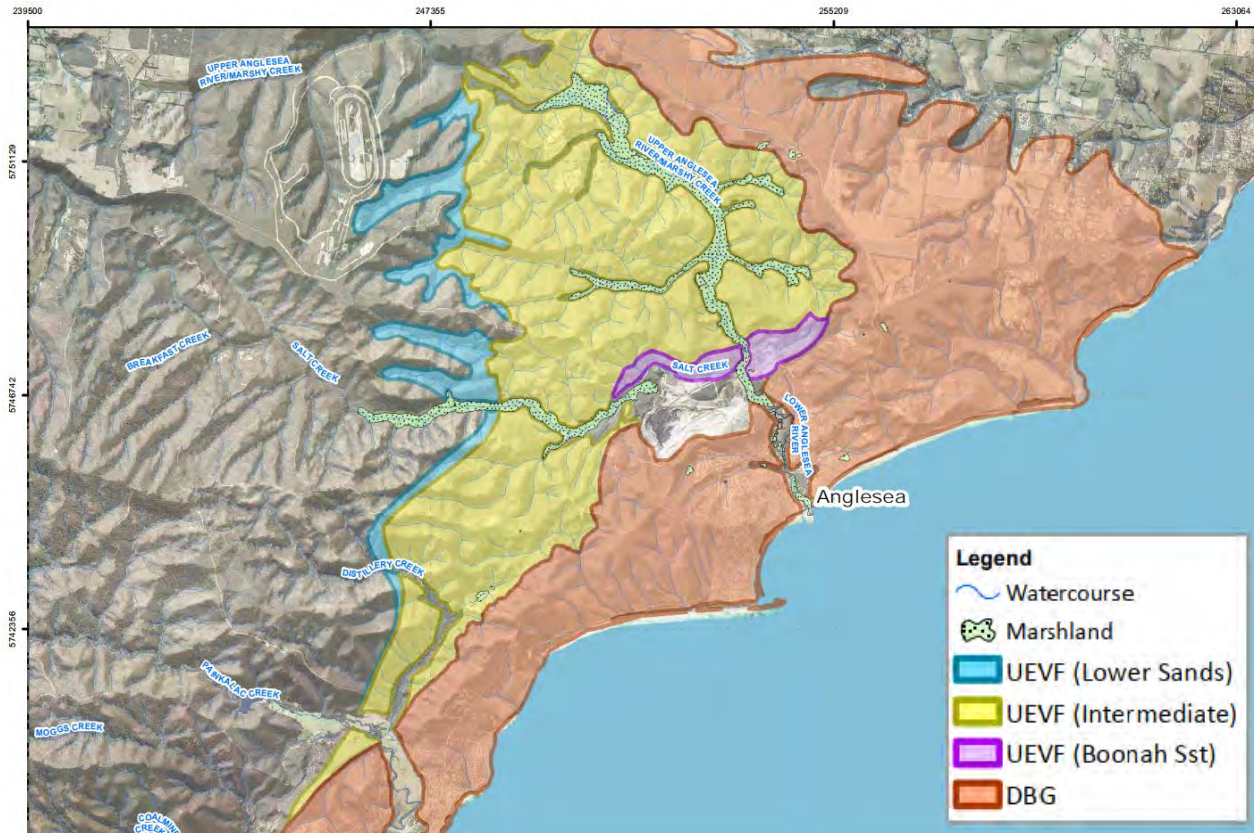
4.6 Model Capability and Key Limitations/Qualifications

The model has demonstrated capability for directly evaluating local to catchment scale resource management issues such as the effects of pumping in terms of groundwater levels and interactions with the pit water body, swampland sediments, stream flows and coastal boundaries. The modelling report (GHD 2022) outlines the main uncertainties and limitations applying, and proposes reasonable actions to address the issues.

4.6.1 Acid generation/mobilisation

The groundwater modelling is designed to investigate and unpack the influence of key processes such as climate, pumping and mine pit voids or water bodies. It provides output data for input to ecological impact and acid mobilisation assessments, and it can provide other objective insights, as follows.

The generation and mobilisation effects of acid sulfate soil (ASS) components (acid sulfates, reduced iron, low dissolved oxygen and acidity and dissolved metals) is a highly complex process. The alluvial soils present in the upper catchment of Anglesea River in the Salt Creek and Marsh Creek swamplands that support the Alluvial Swamp Aquifer (ASA) contain sulfide minerals. The sulfide presents in the alluvials that support the ASAs are derived from erosion of sulfidic carbonaceous material in EVF, Salt Creek Formation and Anglesea River Formation where exposed in the catchment (Maher 2011, Tutt 2008); see also Figure 5. Additional sulfate released into the shallow groundwaters of the ASAs is captured in the peaty soils and converted to monosulfides, which remain inert in saturated soils. When the groundwater level in the ASA is lowered (e.g. during a long dry spell), these sulfidic alluvial soils are exposed to oxidising conditions that generate the acid sulfate salts. Minor drawdowns of ~0.1m can generate acidic sulfate salts in the exposed soils, and mobilisation of these acid sulfate salts can occur when significant rainfall recharges the aquifer, flushing the acid sulfate components to the downstream receiving environment.



382 Figure 5 – Summary map of regional geology (after EHS Support 2022, Fig.5-6)

383

384 A conceptual model of the role of the swamplands on surface water flows is shown in Figure 6
385 (after GHD 2022). The most important processes in the model include:

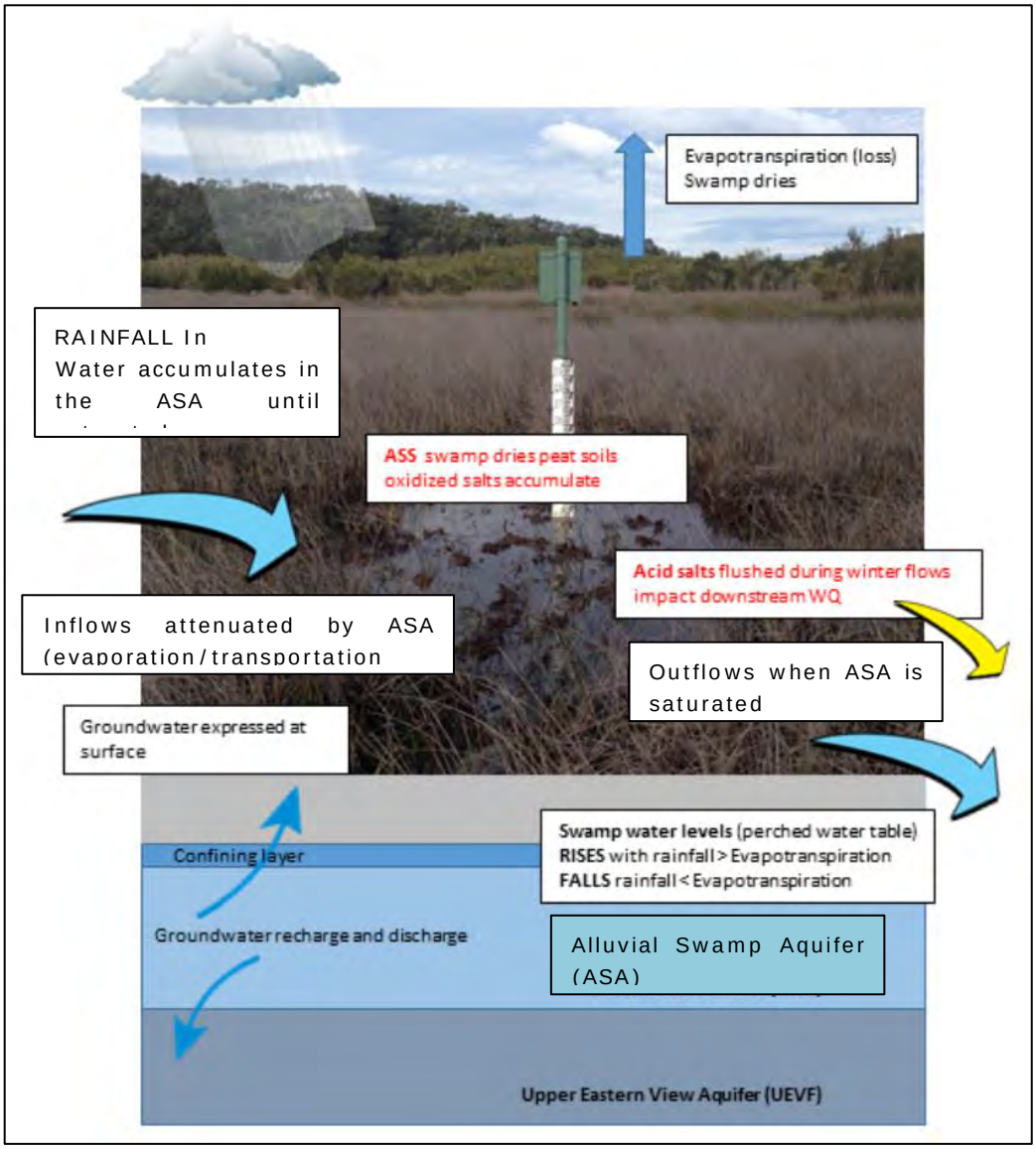
386 • During summer and other dry periods, water is lost from the ASA by evaporation and by
387 evapotranspiration from vegetation. This lowers the ASA water levels and dries and oxidises
388 the upper layers of peat in the swamplands.

389 • During wetter months, the ASA water levels increase and the soil profile is wetted up. While
390 very large flows can pass through the swamplands to the lower catchment, much of the
391 surface flow and rainfall is attenuated until the soils of the swamplands are saturated.

392 • The attenuation of surface water flow by the swampland communities increases the duration
393 of cease-to-flow periods in the downstream Anglesea River and Salt Creek, and subsequently
394 the estuary.

395

Figure 6 Conceptual model of interactions between surface water and groundwater in swamplands on the Anglesea River. In dry periods, the swamp soils dry and groundwater levels fall. Initial rainfall is attenuated by swamp until the soils are saturated and then surface water can commence to flow in downstream waterways (after GHD 2022). Note that with the lowering of the watertable in the ASAs oxidation products are mobilised into the porewater within the peaty soil of the ASA, and only are released when the swampy soils reach saturation, and the Anglesea River begins to flow, this can happen rapidly, slowly or not at all.



The groundwater model can be used to estimate the ASA drawdowns, for example from scenarios with and without borefield pumping or climate change effects, and the predicted drawdowns can be (indirectly) input to a benchmarking assessment of acid generation and mobilisation events using data on past events, or for predictive purposes.

This also means that, since the groundwater model focuses on groundwater (drawdown) in saturated materials, it does not directly evaluate the significance of other processes for oxidising ASS and metal mobilisation, such as in the unsaturated zone above the water table. However, the modelling does simulate the spatial and temporal distribution of the depth to water table, along with depth-duration-frequency curves in key areas such as the ASA, and how that changes over time in response to anthropogenic and natural stresses, for application to such assessments.

The TRP has recommended that water quality triggers be developed within the Alcoa Area of Interest (in parallel with the groundwater drawdown trigger) for ASS investigations and adaptive management. To be clear, trigger values are determined after a geochemical analysis task that uses outputs from the groundwater model for a set of key predictions of interest (or 'quantities of interest'). For example, key predictions may be designed to quantify the probability of drawdown metrics (e.g. 0.1 or 1m or 2m drawdown) at specific points or areas (e.g. Alluvial Swamp Aquifer) for specified time frames, because that may be relevant to acid mobilisation processes. The range of results from these key predictions form key inputs to the geochemical analysis of the consequences of such outcomes, which can then help determine trigger values for adaptive management purposes. In some cases, there are already agreed metrics that can be used as trigger levels or as quantities of interest, such as the drawdown metrics set out in the Ministerial guidelines for the protection of GDEs (DELWP 2015a). Scenario forecasting and differencing could provide groundwater model outputs for use in detailed analysis to gain such insights to acid mobilisation and thus to confirm whether or not the combined groundwater modelling and geochemical analysis methodology has suitable capability for the assessment acid-related effects.

4.6.2 River flow

The model simulates river flows and discharge to the top of the Anglesea estuary on a daily basis, based on rainfall-runoff variations across the Anglesea catchment, and fluxes between surface-groundwater including baseflow. These processes include groundwater discharge to surface waters and losses of surface water through river or stream beds into underlying layers. The model performance for river flows and frequency-duration will depend on good matches of surface survey elevations and water levels at key ASA monitoring bores and stream flow gauges.

During large first flows after a prolonged period of low or no flow, significant volumes of acidic water containing reduced iron can be flushed down the catchment and estuary. Flows at or above 10 ML/day occur only 10% of the time in the Anglesea River (Marshy Creek) and Salt Creek systems. Since 2009, there have been a number of high flows greater than 100 ML/day. During these high-flow events, significantly higher peak flows were generated in Salt Creek than in the Anglesea River. However, the high flow events in Salt Creek are short in comparison to the Anglesea River, where flows are lower but for a longer duration, which results in higher total flow volumes. Since 2009, higher total annual flow volumes normally occur in the Anglesea River (Marshy Creek) than in Salt Creek.

Both systems are highly ephemeral with prolonged cease-to-flow periods: 65% for Salt Creek and 50% for Marshy Creek. Turned around, these values mean that Salt Creek flows for only 35% of the time and Marshy Creek for 50% of the time. The long cease-to-flow periods are exacerbated by the natural swampland communities in both systems needing to become saturated before commencing to contribute baseflow to downstream waterways.

4.6.3 Groundwater drawdown in the swamps

The groundwater model is designed to evaluate drawdown in the swamps, although that is subject to different levels of uncertainty in different parts of the catchment given the natural complexity of the system and with limited data coverage.

Groundwater levels in layer 1 of the model (ie. the swamps) is a balance of vertical inputs from rainfall and upwards flow from groundwater, and vertical losses due to evaporation and downwards flows to deeper groundwater (as shown in Figure 6). There are also horizontal flows through the layer 1 sediments, down the catchment.

The model is capable of evaluating various scenarios of groundwater drawdown in the swamps that may potentially occur with:

- dry periods with limited rainfall and/or increased evaporative losses
- potential influence of the mine pit void and/or changes in stream bed losses
- potential influence of groundwater pumping from the Upper EVF (e.g. Alcoa) or Lower EVF (e.g. Barwon Water).

The model performance for evaluating these scenarios will also depend on the model representation of geological layers and hydraulic properties, particularly permeability. The spatial distribution and parameterisation of the multiple layers of aquifer and aquitards within the model have been based on available evidence, including many drilling investigations and hydraulic tests, and more recently, core testing and the 6-month aquifer pumping test. There is also an extensive record of data on aquifer and stream flow responses to mining and groundwater pumping, which has been used for model history-matching, demonstrating sound performance.

There are several lines of evidence that the aquitards that separate shallow and deeper groundwater near the mine site are relatively thick and are low permeability. The types of different tests and evidence of aquitards limiting vertical flow pathways presented by EHS (2022) is similar to approaches near other mine sites to test the integrity of aquitards and probability of vertical connectivity (e.g. McMillan et al 2022).

The possibility of minor groundwater flow through small scale geological features (e.g. sand lenses), that are smaller than might be mapped or modelled, cannot be discounted. However, if these features were to exist, the influence on water balance and/or drawdown in the swamps, would be minor by definition, and could be evaluated with modelling scenarios. There are also potential risks further away from the mine pit void, where the EUV aquitards are thinner and the UEV lower sands (and LEV) are closer (vertically) to the swamp. If there is a high risk that such potential flow pathways could influence water quality (e.g. acidity), surveys and monitoring may be warranted.

4.6.4 Mine Pit Water Quality

It is understood that potentially acid forming overburden has been selectively placed and encapsulated within the Anglesea mine pit. It is noted that groundwater from the borefield that is proposed to be discharged into the Anglesea mine pit has a pH of 5.5 before it is added to the current mine pit water body, which has a pH of 3.5. These processes are not represented in the groundwater model.

4.6.5 Subsidence

The risk of new land subsidence is generally a process related to:

- a new maximum drawdown of groundwater (ie. new groundwater pumping rate greater than previously) of compressible saturated strata at depth

and/or

- desaturation of peaty sediment near the land surface

and/or

- shallow geological strata that subsides due to extraction of underlying strata (ie. tunnelling or underground mining subsidence (Hebblewhite, 2022) as distinct from open pit mining at Anglesea).

There has been no detailed evaluation of the possibility that subsidence may have occurred in these areas since the late 1960s. However, the assessment of the risks of borefield use on land subsidence is a regulatory objective for Barwon Water and the TRP have considered the risk of subsidence in reviewing the groundwater modelling approach. The TRP note that the risk of

subsidence will be low if groundwater drawdown in the future is at low to moderate pumping rates compared to previous rates of pumping. The TRP therefore concur that the groundwater model objectives do not include subsidence assessment and subsidence is not examined in the groundwater model.

4.7 Recommended ongoing monitoring and investigations

As best practice guidance recommends strong linkages between monitoring, modelling and investigations to provide support for adaptive management, additional data should be collected.

Gaps in the groundwater monitoring network should be filled with additional multi-level piezometers (e.g. in the ASA lower catchment areas where there is no monitoring, to augment WTOB1 and WTOB2), and other monitoring bores with poor integrity should be replaced to ensure continuity of reliable data.

Crucial monitoring data includes groundwater levels and surface water flows/levels, along with water quality (acidity especially in the swamps/ASA, rivers/creeks and estuary, plus a range of parameters i.e., salinity, pH and EC, DO, Fe^{2+}), augmented by investigation of ecological responses to changes in acidity from upstream to the estuary will help to understand the drivers of environmental impacts.

5. Conclusions and Recommendations

The model objectives are clearly defined; to develop a single Anglesea groundwater model that can meet the ongoing water management and planning obligations of both Barwon Water and Alcoa, to support:

- the Alcoa mine closure and rehabilitation planning and management works, including the licence application to SRW for long-term groundwater abstraction to fill the pit water body;
- the Barwon Water Anglesea borefield planning, management and approvals works under the Bulk Entitlement (BE) process, including re-assessment of the sustainability of groundwater extractions for urban water security purposes.

The groundwater model is suitably designed and built for the intended objectives and predictive scenario forecasting purposes, and adequately represents the hydrogeological conceptual model. The reasonable calibration/history-match performance provides confidence that the Anglesea model is a suitable predictive tool under a range of climate and other stresses for surface water and groundwater interactions, interactions with the pit, interaction between the main aquifers, groundwater trends, water balances, pit water levels, flux exchanges and parameter realisations. The overall methodology and execution are consistent with best practice guidelines, including for uncertainty assessment (Barnett al 2012; Peeters and Middlemis 2023) and climate change (DELWP 2020), subject to review of the scenario design in progress.

The groundwater model is not designed to directly investigate acid mobilisation events, but it can provide objective insights given its capability to simulate groundwater levels, groundwater flows, and surface water flows under a range of climatic and pumping conditions. Recommendations for ongoing modelling include the following.

- The upcoming scenario forecasting and differencing task should be designed to provide groundwater model outputs for use in detailed analysis of acid mobilisation and thus to confirm whether or not the combined groundwater modelling and geochemical analysis methodology has suitable capability for the assessment acid-related effects.
- Scenario forecasts should include no pumping and low or moderate pumping rates compared to the much higher rates of groundwater extraction during mining (i.e. the model has been tested within this range), and with extraction from either or both Alcoa and Barwon Water borefields able to be included. The model is also suitable for use in a data worth analysis to identify optimum sites for filling gaps in the monitoring network (eg. in the ASA, such as in the lower catchments to augment the existing bores WTOB1 and WTOB2).

The modelling methodology is founded on the latest uncertainty analysis methods, and the results are designed to aid decision-making through presentation of combinations of:

- the magnitude of effects of groundwater extraction:
    - eg. groundwater levels and drawdowns in the aquifers; river flow-duration and zero flow period changes with time; aquifer flux exchanges with rivers and swamplands; pit lake levels and water balances; etc.
- the probability of occurrence of those effects:

key metrics of 5%, 50% and 95% likelihood ('P5, P50 and P95') of predicted impacts exceeding or not exceeding established triggers at sensitive/key sites such as groundwater dependent ecosystems and at stream flow gauges, and with consideration of climate change effects, consistent with DEECA guidelines.

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7. Appendix A – Glossary

7.1 Glossary of key terms used in this report

Table **2** - Glossary of key terms

Term	Description
Adaptive Management	An approach to natural resource management that comprises implementing management action, monitoring and evaluating outcomes and systematically adapting those actions according to what is learned.
ASA	Alluvial Swamp Aquifer (swampland sediments)
ASS	Acid Sulfate Soils
calibration / history match	The modification of model input data in a systematic fashion (eg. aquifer and aquitard parameters, recharge, boundary conditions) and repeatedly running the model over the history-match period until the model output matches measured data within an acceptable level of accuracy.
CHM	Conceptual Hydrogeological Model - a simplified and idealised representation (usually graphical) of the physical hydrogeologic setting and our hydrogeological understanding of the essential flow processes of the system; includes the identification and description of the geologic and hydrologic framework, aquifer media type, hydraulic properties, sources and sinks, and important aquifer flow and surface-groundwater interaction processes.
EVF (EVF, UEVF, LEVF)	Eastern View Formation (EVF, Upper EVF, Lower EVF)
Fit for purpose	Peeters and Middlemis (2022, in press) propose a model as fit for purpose when it is useful, reliable, and feasible for its given context. A groundwater model can be considered fit for purpose in the context of impact assessment for coal mines and coal seam gas developments when it provides: • objective evidence that the uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated, and; • information about uncertainties in the conceptualisations and model simulation outputs in a way that allows decision makers to understand the effects of uncertainty on project objectives (echoing the AS/NZS ISO 31000:2009 risk definition) and the effects of potential bias.
Groundwater Dependent Ecosystem (GDE)	Ecosystems that require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. GDEs include terrestrial vegetation, wetlands (swamps, lakes and rivers) and ecosystems in aquifers and caves.
GMA	Groundwater Management Area
Model – conceptual	See also CHM - Conceptual Hydrogeological Model. A descriptive and/or schematic hydrological, hydrogeological and ecological representation of a site,

	environment or process showing the stores, flows and uses of water, which illustrates the geological formations, water resources and water-dependent ecosystems. It provides a basis for developing water and salt balances and inferring water-related ecological responses to changes in hydrology, hydrogeology, and water quality.
Model – numerical	Computer codes that enable simulation of physical systems and processes such as groundwater and/or surface water flow and can be applied to assess the potential impacts of a project or management plan. Similar to analytical models in that they make simplifying assumptions; however, features of the governing equations and boundary conditions in numerical models (e.g., aquifer geometry, hydrogeological properties, pumping rates or sources of solute) can be specified as varying over space and time. This enables more complex representations of groundwater or surface water systems than could be achieved with an analytical model.
Quantity of Interest (QoI)	A model outcome from a specified model scenario, with a predefined spatial and temporal setting, that is relevant to assessing the likelihood and consequence of a causal pathway element representing a hazard. An alternative term is 'key prediction or scenario forecast'.
sustainable groundwater extraction	The groundwater extraction regime, measured over a specified planning timeframe, which allows acceptable levels of stress and protects the higher value uses that have a dependency on the water.
DELWP	Department of Environment, Land, Water and Planning
DEECA	Department of Energy, Environment, and Climate Action
DJPR / ERR	DJPR-ERR was previously known as Department of Jobs, Precincts and Regions - Earth Resources Regulator, and it has now been incorporated into DEECA
Inter-Agency Group (IAG)	comprises representatives from DELWP, SRW and DJPR/ERR who have shared responsibilities for, and interest in, various aspects of groundwater management in the Jan Juc GMA
SRW	Southern Rural Water One of four rural water corporations in Victoria. Responsibilities include the regulation of surface water, groundwater licensing and dams and managing the bulk entitlements for environmental water, power generation companies and the raw water for some regional and urban water corporations to treat for drinking water.
TRP	Technical Review Panel appointed by DELWP
TAP	Technical Advisory Panel appointed by SRW

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Appendix C Report Ash Risk Assessment

Consolidated Leached Ash Technical Risk Assessment

Anglesea Former Mine Pit

Anglesea, Victoria

Prepared for:

Alcoa of Australia Ltd

Prepared by:

EHS Support

May 2024

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Client	Alcoa of Australia Ltd
Client Contact	Warren Sharp
EHS Support Project Manager	Rebecca Fraser
EHS Support Project No.	PTY.03568

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Main Author	Rebecca Fraser
Approved by	Ben Petrides

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Acronyms

AGWMG	Australian Groundwater Modelling Guidelines
ANC	Acid Neutralising Capacity
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, 2000
ASA	Alluvial Swamp Aquifer
ASLP	Australian Standard Leachate Procedure
BF	Boonah Formation
BoM	Bureau of Meteorology
BPEM	Best Practice Environmental Management
CCA	Coal Combustion Ash
CCMA	Corangamite Catchment Management Authority
CCR	Coal Combustion Residuals
CLA	Consolidated Leached Ash
CLARA	consolidated leached ash technical risk assessment
CSM	Conceptual Site Model
DBF	Demons Buff Formation
DBG	Demon Bluff Group
DELWP	Department of Environment Land Water and Planning
DGV	Derived Guideline value
DJPR	Department of Job Precincts and Regions
EC	electrical conductivity
ERR	Earth Resources Regulation
ERS	Environmental Reference Standards
EPA	Environment Protection Authority
EVF	Eastern View Formation
GED	General Environmental Duty
GWB	Geochemists Workbench
IPR	independent peer review
LEVF	Lower Eastern View Formation
LOP	level of protection
LOR	limit of reporting
MEVF	Middle Eastern View Formation
MRCP	Mine Rehabilitation and Closure Plan
MPA	Maximum Potential Acidity
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
NATA	National Association of Testing Authorities
NEPC	National Environmental Protection Council
NEPM	National Environment Protection Measure

NR	Not Recorded
NSW	New South Wales
pHF	field pH - pH in deionised water
pHFOX	field oxidised pH
QA/QC	Quality Assurance / Quality Control
RCRA	Resource Conservation and Recovery Act
RL	relative levels
SECV	State Electricity Commission of Victoria
SPR	source – pathway – receptor
SRB	Sulfate Reducing Bacteria
SRW	Southern Rural Water
SS	Steady-State model run
T	transient model run
TARP	trigger action response plan
TDS	total dissolved solids
UEVF	Upper Eastern View Formation
USEPA	United States Environmental Protection Agency
WMIS	Watering Measurement Information System
WQPT	water quality performance targets

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Terminology Descriptions

Term	Description
Ash	Produced from the burning of brown coal at the former power station. A combination of bottom and precipitator/fly ash
Berm	Constructed at the toe of the consolidated leached ash area to bund drainage water from sluiced ash. Constructed of clay rich material sourced from the overburden
Clay Rich Cover	Constructed to cover the consolidated leached ash area. Comprises clay rich material sourced from the overburden
Consolidated Leached Ash	Combination of sluiced and dried leached ash consolidated into an approximate area of 4.6 ha in the south-east corner of the former mine pit
Fill Material	Backfilled overburden which surrounds the consolidated leached ash area
Leached Ash	Ash produced from the power station was sluiced into Ash Pond 1. Stored under water for years during which salts and metals were leached from the solids
Overburden	Demons Bluff Formation and Boonah Formation lithologies removed to extract underlying brown coal

Units of Measure

Area	
ha	hectare
m^2	square metres
Density	
kg/m^3	kilograms per cubic metre
Electrical Conductance	
µS/cm	microsiemen per centimetre
dS/m	decisiemen per metre
mS/cm	millisiemen per centimetre
mV	millivolt
Elevation	
mAHD	metres Australian Height Datum
mbgl	metres below ground level
RL	Relative levels
Length	
µm	micrometres
cm	centimetres
km	kilometres
m	metres
mm	millimetres
Mass	
µg	micrograms
g	grams
kg	kilograms
mg	milligrams
ppm	parts per million
t	metric tonnes

Concentration by Mass	
µg/kg	microgram per kilogram
meq/100g	Milliequivalent per 100 grammes
mg/kg	milligram per kilogram
Pressure	
kPa	kilopascals
Pa	Pascals
Temperature	
°C	degrees Celsius
°F	degrees Fahrenheit
K	kelvin
Velocity	
m/sec	metres per second
Volume	
µL	microlitres
cL	centilitres
cm^3	cubic centimetre
GL	gigalitre
L	litres
m^3	cubic metre
mL	millilitres
ML	megalitre
Concentration by Volume	
µg/L	microgram per litre
mg/L	milligram per litre
ppmv	parts per million by volume
ppbv	parts per billion by volume

1 Introduction

In September 2017, Alcoa of Australia Ltd ("Alcoa") submitted a draft Mine Rehabilitation and Closure Plan (MRCP) to Earth Resources Regulation (ERR) providing a plan that would ensure that the rehabilitation of the Anglesea coal mine (**Figure 1**, attached) would provide a safe, stable, and sustainable landform for the future that compliments the surrounding natural environment.

The draft MRCP recognised that leached ash has historically been placed into the former open cut coal mine (also referred to as the mine pit) in accordance with the Mine Work Plan endorsed by ERR in September 2011 and included an assessment of the risks associated with submerging the material within the proposed water body which concluded that risks to the environment were low.

In 2017, consistent with the draft MRCP, the leached ash material located within the south-eastern corner of the mine pit was consolidated for covering[1]. Approval was provided by ERR in December 2017, in consultation with the Environment Protection Authority Victoria (EPA), which allowed Alcoa to cover the consolidated leached ash (CLA) with at least 1 m of clay rich overburden material. The draft MRCP proposed that the CLA would be:

'…encapsulated with approximately 1 m of clay spoil and overburden material, and from below by the presence of a low permeability basal clay unit within the base of the mine pit.'

Redeposition and grading of the final CLA area was completed early 2018.

As part of this approval, ERR included several future considerations and requirements including the following, that '*… the potential impacts on water chemistry, hydrology, hydrogeology, and stability will be considered in Alcoa's revised rehabilitation and closure plan.'*

Based on re-commenced discussions between Alcoa, ERR, and EPA in 2021, and to respond to the feedback from ERR (and EPA) in 2017, Alcoa engaged EHS Support to undertake the following:

- Further field investigations and sampling in the vicinity of the CLA;
- Numerical modelling related to potential mine pit water body level increase and groundwater seepage; and
- Technical risk assessment related to submerging of the CLA.

In September 2021, samples representative of CLA material, the clay-rich layer,[2] and fill material[3] were collected in the south-eastern corner of the mine pit. Laboratory reporting included physical characterisation in addition to total and leachable fraction analysis. Permeability results indicated CLA permeabilities ranging from $1x10^{-9}$ to $7x10^{-10}$ m/sec and clay-rich layer permeabilities of $2x10^{-9}$ to $2x10^{-10}$ m/sec.

[1] As discussed with ERR/SRW/EPA on 19 December 2023, Alcoa noted that ash was historically placed elsewhere within the mine leased area which was in accordance with the regulatory regime in place at that time. The purpose of the CLA technical risk assessment is to specifically assess the risk of inundation of the CLA located in the south-east corner of the former mine void, which Alcoa can also confirm is the only ash material within the existing mine void that will be subject to inundation by the future water body. As such Alcoa considers that historical ash placement outside of the existing mine void is not relevant to this CLA technical risk assessment.

[2] Clay-rich material sourced from Demons Bluff Group used to cover consolidated leached ash by at least 1 m

[3] Consisting of reworked and back filled Demons Bluff Formation and Boonah Formation sands, silts and clays

On 20 October 2021, following discussions with Alcoa, the EPA advised Alcoa in a letter entitled 'Approval pathway under the Environment Protection Act 2017', that the following information should be provided related to the CLA area:

1 *detailed design of the landfill cap;*
2 *a description of the targeted performance (short- and long-term) and outcomes of the proposed landfill cap;*
3 *information that supports how the proposed cap can achieve the targeted performance and outcomes;*
4 *monitoring results capable of confirming that the cap is performing in line with targeted performance and outcomes (short- and long-term);*
5 *detailed and verifiable confirmation that the proposal constitutes the best available techniques;*
6 *independent technical peer-review of a qualified expert (or experts) that have expertise suitable to undertaking a technical peer-review of the proposal; and*
7 *measures taken to comply with the General Environmental Duty (GED), relevant Environment Reference Standards (ERS) and principles of the Environment Protection Act 2017.*

This document provides information in response to the above requirements, and to respond to the feedback received from ERR (and EPA) in a letter dated 29 November 2017 and entitled 'RE: Alcoa Anglesea – Ash Covering Management Commencement' in response to the sections of the draft MRCP related to CLA. An assessment of the management and characterisation of the CLA material, a review of national and international examples of the sub-aqueous storage and disposal of leached ash, water quality performance targets, numerical groundwater modelling and particle tracking, and an overall risk assessment for the activity of submerging the CLA material is provided.

1.1 Objective

The main objective is to complete a detailed technical and risk assessment for the activity of submerging the CLA material covered by at least 1 m of low permeability clay-rich overburden to understand any associated short and long-term risks to the environment. This also then provides information to support Alcoa's response to address the feedback provided by the EPA in the letter dated 21 October 2021, and the original feedback received from ERR and EPA in November 2017.

The overall intent of this assessment is to determine the risk to human health and the environment by the presence of and the submerging of the CLA material in the former mine void. A hypothesis has been defined to aid the process of assessment:

> *Hypothesis – the submergence of the encapsulated consolidated leached ash will not result in adverse risk of harm to human health or the environment within the catchment.*

This hypothesis will be examined throughout this assessment using historical data and targeted site investigations which have been used to develop a suitable numerical model. This process has been subject to an independent technical peer review by BlueSphere.

1.2 Summary

Alcoa has undertaken a detailed risk assessment of the CLA area in the south-eastern corner of the mine pit which considers the future proposed inundation of the CLA area as the water body fills. This detailed review (inclusive of independent peer review) demonstrates that the risks of harm from the presence of CLA within the former mine pit are low and has been minimised so far as is reasonably practicable. The main risk mitigation measure adopted by Alcoa is the encapsulation of the CLA in a low permeability (sandy clay) fill material, on average less than $1x10^{-9}$m/sec. In addition to this, leachable fraction analysis of the CLA demonstrates that ash pore water is unlikely to have any measurable environmental impacts in either groundwater or the water body, currently or in the future. Groundwater monitoring wells are located in the vicinity of the CLA area (Demon Bluff Group [DBG] MB4, DBG MB5, and DBG MB6) and are screened within the clay -rich fill material. These locations have been part of the groundwater monitoring network surrounding the mine area since 2021 and will continue to be monitored as the CLA area is inundated by the water body.

Numerical groundwater modelling and particle tracking analysis using the permeability characteristics of the CLA and encapsulating clay-rich fill material also supports minimal migration of conservative particles in groundwater. The modelling showed that under all simulated scenarios (natural and fast fill) the water body evolves as a groundwater sink. In the fast fill scenario (where supplementary water is used to fill the mine pit), maximum particle movement is 41 m in 200 years and groundwater flows away from the water body for less than 20 years. These distances are significantly less than the distance to the edge of the mine disturbed area of approximately 400 m.

The above outcomes are supported by a detailed risk assessment that indicates only low or rare risks in both the short and long term associated with the activity of submerging the CLA area and regardless of the water body filling strategy. In accordance with Part 3 Division 6 Section 44 of the Mineral Resources Sustainable Development (Mineral Industries) Regulations (2019), Alcoa has identified potential mining hazards and assessed risks associated with covering and submerging the CLA area located in the south-east corner of the mine. This process involved several steps, consistent with those outlined in 'Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS' **Appendix B** (December 2020 version 1.3) (Victoria, 2020) provided by the Department of Jobs Precincts and Regions.

Finally, an independent peer review (IPR) of this technical assessment was completed by BlueSphere Environmental Pty Ltd (BlueSphere). Refer to **Appendix A** for IPR letter.

This Consolidated Leached Ash Technical Assessment provides the technical information supporting the Alcoa proposal to submerge the CLA material. This was in accordance with the Mine Work Plan endorsed by ERR in September 2011. The CLA area was covered by at least 1 m of low permeability clay rich overburden meeting Alcoa's GED and demonstrating that the low risks associated with this activity to the environment have been reduced as far as reasonably practical in the short and long term.

The following Sections provide further information on the items detailed by the EPA in the letter to Alcoa dated 20 October 2021, and also addresses the feedback received from ERR in their letter to Alcoa dated 29 November 2017 **Appendix B**.

Table 1-1 Report Sections Addressing EPA Queries

EPA Query	Section	Content
1. Detailed design of the landfill cap	**Section 5.2.1**	CLA design methodology.
2. A description of the targeted performance (short- and long-term) and outcomes of the proposed landfill cap	**Section 7**	Performance based on de-ionised and saline water permeameter tests and thickness of clay-rich material surrounding the CLA, long-term performance of a low permeability material is expected in contact with saline groundwater and CLA porewater.
3. Information that supports how the proposed cap can achieve the targeted performance and outcomes	**Section 5**, **Section 7**, **Section 9**	Knowledge and documentation of the CLA placement, the clay-rich cover and surrounding fill material. Spatial distribution of field sampling and permeability results. Numerical groundwater modelling.
4. Monitoring results capable of confirming that the cap is performing in line with targeted performance and outcomes (short- and long-term)	**Section4**, **Section 6**, **Section 7**, **Section 9**	Soil sampling results from 2021 and 2022. Ongoing surface water and groundwater sampling results from the mine pit water body and monitoring bores in the vicinity which are screened within the fill material and DBF and BF surrounding the CLA area. Interim Water Quality Performance Targets.
5. Detailed and verifiable confirmation that the proposal constitutes the best available techniques	**Section 5**, **Section 8**, **Section 9**, **Section 10**	Use of low permeability clay-rich material, placement of material in lifts to minimise voids above the consolidated leached ash and surrounding with low permeability clay-rich material. Literature review of national and international examples of (leached) ash management. Use of numerical groundwater modelling to demonstrate the efficacy of the surrounding low permeability materials.
6. Independent technical peer-review (ITPR) of a qualified expert (or experts) that have expertise suitable to undertaking a technical peer-review of the proposal	**Section 2**	BlueSphere have undertaken a technical review of the assessment, refer to **Appendix A**.
7. What are the measures taken by Alcoa to ensure compliance with the GED, relevant ERS and *Environment Protection Act 2017*.	Entire document but specifically: **Section 3**, **Section 5**, **Section 9**, **Section 10**	Entire document.

2 Independent Peer Review

An independent technical peer review was completed by BlueSphere Environmental Pty Ltd (BlueSphere). BlueSphere were engaged throughout the development of the technical review and involved at each stage of the process. The peer review identified a number of improvement opportunities during the process which have been actioned and included as part of this final technical assessment, which has significantly improved the level of confidence in the conclusions reached within this report.

BlueSphere concluded that:

- The combined assessment and characterisation work on the physical properties of the CLA is considered to have been completed in accordance with appropriate and relevant legislation, guidance, and industry standards to the extent practicable. The outcomes of this work are considered to be a reasonable basis from which to assess the likely future impacts on the surrounding environment from the submergence of the CLA within the pit lake.
- Numerical modelling has been utilised to make predictions regarding the future environmental performance of the CLA cap and other encapsulating materials. The model is considered to be sufficiently rigorous given the setting, margin of safety indicated by the modelling results, and relatively modest modelling objectives.
- The numerical modelling together with other lines of evidence, including the site-specific physical characterisation of the materials, has been used to inform the risk assessment process. The risk assessment concludes that the activity of submerging the CLA beneath the pit lake represents a low risk of adverse environmental outcomes in both the short and long term.
- In the context of the specific assumptions (**Section 4.1**), the history of regulation, and the environmental setting, the ITPR team is of the view that the submergence of the CLA does present a low risk of adverse environmental outcomes for surface water and groundwater and that the approach is consistent with previous regulatory directions and broader principles of environmental protection, including the GED.
- Future monitoring and verification of the environmental performance is considered to be a key tenet of sound environmental management. The consolidated leached ash technical risk assessment (CLARA) provides the overall monitoring principles which the ITPR team considers appropriate. It is understood that specific details on the future monitoring requirements, trigger levels, and contingency actions are to be prepared prior to the submergence of the CLA. The ITPR team emphasises that an appropriately detailed water management plan as proposed should be developed and implemented so as to provide a robust framework for future environmental management of the CLA.

Refer to **Appendix A** for IPR letter.

3 General Environmental Duty

The approach used in the CLA technical assessment considers the principles of environment protection in accordance with the Environment Protection Act (2017). It provides details on the measures adopted by Alcoa which have enabled compliance with its GED by using industry best practice to achieve minimal risks of harm to human health and the environment, as far as reasonably practicable.

3.1 General Environmental Duty

The foundation of the Environment Protection Act (2017) and Environment Protection Amendment Act (2018) is the GED which requires individuals and industry to understand the risks associated with activities and minimise risk of harm to human health and the environment. The process of risk assessment assesses the chance of harm occurring, either qualitatively or quantitatively, and what the potential impacts could be to human health and the environment. A state of knowledge is developed of the risks and how they can be managed, in association with relevant regulatory guidance. The understanding of the risks enables controls that can be put in place to eliminate or minimise the risks that are reasonably practicable and are proportionate to the risk.

EPA Victoria Publication 1741.1 outlines the principles and objectives of the GED for industry and has been used by Alcoa, amongst other applicable guidance documents, to understand and demonstrate the measures that have been adopted and the framework followed to comply with the GED. This is principally associated with the activity of submerging the covered CLA material during the filling of the mine pit and development of the mine water body.

The following steps describe the approach used to demonstrate compliance with the GED:

- Undertaking appropriate technical studies related to submerging the CLA area, informed by Alcoa's extensive experience with the site – **Section 5**, **Section 6**, **Section 7**, **Section 8**, and **Section 9**;
- The application of a risk assessment process that will identify risks (based on the ERR risk assessment framework) including consideration of the consequence and likelihood associated with each risk – **Section 10**;
- Determining relevant performance objectives, controls and an appropriate level of monitoring associated with each identified risk, and commensurate of the level of each risk – **Section 4**, **Section 10**;
- The engagement of qualified and experienced technical expert consultants (EHS Support) to undertake the relevant technical studies;
- Being informed by previous technical studies completed in 2017 as part of the draft Mine Rehabilitation and Closure Plan (EHS Support, 2017);
- Being informed by ERR/EPA feedback related to the consolidated leached ash both in 2017, and in more recent 2021/2022 discussions with both ERR and the EPA – **Appendix B**;
- Completion of expert Independent Peer Review (BlueSphere) of the relevant technical studies and risk assessment – **Section 2**; and
- Implementing appropriate controls and monitoring proportionate with risks identified in the above – **Section 10**.

The approach and framework detailed above has allowed Alcoa to identify and understand all relevant risks to human health or the environment (state of knowledge), and also allowed Alcoa to minimise risks and meet its GED, so far as reasonably practicable.

4 Interim Water Quality Performance Targets

Dredged and dried leached ash has historically been placed into the former open cut coal mine in accordance with the Mine Work Plan endorsed by ERR in September 2011. Alcoa has considered the role of the Environment Protection Act (2017) in defining appropriate **interim** water quality performance targets (WQPT) for the purpose of this technical and risk assessment of the CLA area.

Since August 2015 groundwater recovery (and rainfall runoff) has slowly contributed to the development of the water body within the mine pit. A groundwater pumping test approved by Southern Rural Water (SRW) also contributed 671 ML of groundwater between May and December 2021. The mine water body itself is considered to be a constructed artificial surface water feature that enables the mine pit to meet the long term safe, stable, and sustainable landform objective of the draft MRCP. Clause 13 (2) of the ERS states that environmental values do not apply to waters in constructed artificial features, however it is acknowledged that future performance targets will be set for the protection of potential receptors in the surrounding catchment and will be aligned with the principles outlined in the GED.

A framework has been used to develop the approach to derive interim WQPTs associated with the catchment immediately surrounding the CLA area which includes the mine water body and groundwater within the Fill material and local Demons Bluff Formation (DBF) and Boonah Formation (BF). The framework derives WQPTs using water quality datasets to calculate an appropriate percentile value for each target. The main objective of this approach is to derive interim WQPTs during the activity of submerging the CLA. This is specifically to determine whether the process of submerging the CLA has any adverse impact on these potential receptors.

It is important to note that the long term (final) WQPTs for the mine water body have not been determined at this time as the mine water body filling strategy has not been finalised. Interim WQPTs have been developed and are included within this assessment. Final WQPTs are expected to be included as part of the MRCP finalisation.

The interim WQPTs presented here are complimentary to natural background water quality with the exception of boron which is discussed in greater detail below. This framework also considers technical feedback received from the EPA in relation to WQPTs for the mine pit water body and localised groundwater within the surrounding fill material, DBF and BF. Based on the direction provided by Department of Environment, Land, Water and Planning (DELWP) to Alcoa in 2016/2017 (refer to 2017 draft Mine Rehabilitation and Closure Plan [MRCP]; EHS Support, 2017) the mine pit water body is not intended to provide environmental values such as recreational uses and flora/fauna habitat support which are not complimentary to the local catchment. The water body does however have the future potential to provide non-contact recreational aesthetic enjoyment[4] such as visual appearance and bird watching from the surrounding Anglesea Heath, which will be further evaluated within the final MRCP.

[4] Reference: NHMRC – Guidelines for managing risk in recreational water, Designation of Recreational Uses

4.1 Environmental Legislation

A detailed review of the Environment Protection Act (2017) and the associated Regulations and ERS has been conducted in relation to the mine pit water body and CLA area and the surrounding catchment. The review has enabled an evaluation of how the legislation would apply to the CLA area and the mine pit water body and which environmental values are relevant for protection.

The Environment Protection Act (1970) was superseded by the Environment Protection Act (2017) ("new Act"), which came into force on 1 July 2021. The GED is at the centre of the new Act and applies to all Victorians. The GED requires that the entity engaging in an activity must reduce the risk of harm:

> *"A person engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, as far as reasonably practicable5."*
>
> *Subordinate legislation is the group of tools that support the new Act, which include Regulations and the ERS. Under the new Act, the previous State Environment Protection Policies (SEPPs) are replaced by the ERS. The purpose of the ERS is to support the protection of human health and the environment from pollution and waste by providing benchmarks to be used to assess and report on environmental conditions in the whole or any part of Victoria.*

Part 5 (Water) of the ERS lists the environmental values of water environments in Victoria and describes the environmental quality that is needed to achieve and maintain these values. The environmental values of waters (both surface water and groundwater) are defined in Table 5.1 of Part 5, Division 1 of the ERS. Applicable protected environmental values for surface water, and each groundwater segment in the Anglesea area, are relevant for the Inland segment Central Foothills and Coastal Plains, as specified in the ERS.

As discussed in the ERS guidelines (EPA Victoria Publication 1992[6],[7]), an environmental value may not apply to groundwater or surface water if the background water quality exceeds the relevant objective and as a result the environmental value is precluded (cannot be achieved or maintained):

> *"Circumstances where environmental values are not recognised in the ERS still must be managed in accordance with the general environmental duty (GED). This means that a person must still take reasonably practicable measures to minimise risks from pollution and waste to the environment or human health, even where environmental values may not apply in the ERS".*

Under these circumstances, the background water quality level is the objective for the indicator because the background water quality better protects the environmental values[8][9].

[5] Quoted from: Industry Guidance: Supporting you to comply with the general environmental duty EPA Victoria Publication 1741.1 published October 2020, page 1
[6] Division 2 – Groundwater, Section 15 2(c) page 19;
[7] Division 3 – Surface water, Section 18 (3) page 25
[8] Division 2 – Groundwater, Section 16 2(b) page 19/20
[9] Division 3 – Surface Water, Section 19 2 (b) page 28

Segments for surface water are described in Clause 17 of the ERS. The site falls within the Central Foothills and Coastal Plains Segment (1a(iv)).

The protected environmental values for the Central Foothills and Coastal Plains are listed in Table 5.5, Clause 18 of the ERS and include:

- Water dependant ecosystems and species (slightly to moderately modified);
- Agriculture and irrigation;
- Human Consumption of Aquatic Foods;
- Industrial and commercial;
- Water based recreation (includes primary, secondary, and non-contact[10] aesthetic enjoyment);
- Buildings and structures; and
- Traditional Owner cultural values.

Segments for groundwater are described in Table 5.2, Clause 14 of the ERS. The DBF and BF[11] in the vicinity of the mine pit water body and CLA area is mostly dry, however beneath the former power station this aquifer is saturated. Based on the groundwater quality beneath the power station (EHS Support 2021b) the adopted segment classification for the DBF and BF is Segment B. Segment B is based on a total dissolved solids (TDS) concentration range of 1,201 to 3,100 mg/L. The segment classification of the Upper Eastern View Formation (UEVF) is also Segment B, which agrees with previous classifications (Coffey, 2015; GHD, 2013).

The protected environmental values for Segment B groundwater are listed in Table 5.3, Clause 15 of the ERS and include:

- Water dependant ecosystems and species;
- Potable mineral water supply;
- Agriculture and irrigation (irrigation and stock watering);
- Water based recreation (includes non-contact[12] aesthetic enjoyment);
- Industrial and commercial;
- Buildings and structures;
- Traditional Owner cultural values; and
- Geothermal properties.

The area is currently zoned as a special use zone (SUZ1) Schedule 1 under the Mine (Aluminium Agreement) Act 1961[13]. Future industrial or commercial use is possible and has been presented in concept as the development of a safe, stable, and sustainable landform and water body with associated tourist facilities.

Environmental values that could potentially be realised in both groundwater and surface water are discussed further in **Table 4-1** and **Table 4-2** below together with receptors, migration, and exposure pathways.

[10] NHMRC (2008) Guidelines for managing risks to recreational water
[11] Collectively the Demons Bluff Formation and the underlying Boonah Formation (DBF and BF), were formerly referred to as the Demons Bluff Group
[12] NHMRC (2008) Guidelines for managing risks to recreational water
[13] Mines (Aluminium Agreement) Act 1961 No. 6829 of 1961 Authorised Version incorporating amendments as at 30 November 2011 - an agreement between the Victorian government and Alcoa of Australia to allow the establishment and operation of the Anglesea mine.

Table 4-1 Environmental Values of Groundwater, Potential Receptors, and Migration and Exposure Pathways

Environmental Value	Potential Existing and Future Receptors		Potential Migration and Exposure Pathways
	DBF and BF	Off-site	
Water dependent ecosystems (slightly to moderately modified)	**Yes** (in the long-term) – Currently the DBF/BF lithological unit surrounding the water body is dry; however, it is acknowledged that the DBF/BF will become saturated in the future, the hydraulic connectivity between the water body and the DBF/BF will be established, and this environmental value will be realised. Preliminary analytical modelling has predicted that outward groundwater flow from the water body will be short-lived before the water body becomes a discharge feature.	**Yes** – The surrounding surface water catchment includes Salt Creek, Upper Anglesea, and Lower Anglesea River. There is no hydraulic connectivity between the DBF and BF and surface water, however there will be future connectivity between the water body and off-site groundwater within the DBF and BF.	**On-site:** Potential migration of contaminants from the CLA area (when submerged) and the water body into the developing groundwater body within the DBF and BF aquifer via groundwater flow. **Off-site:** During the filling of the water body there will be an outward flow from the water body into the DBF and BF aquifer, however once filling ceases the groundwater flow will reverse (refer to **Section 9** for potential timeframes based on numerical groundwater modelling).

Environmental Value	Potential Existing and Future Receptors		Potential Migration and Exposure Pathways
	DBF and BF	Off-site	
Potable mineral water supply	**No** – DBF and BF is not a recognised source of potable mineral water and the area is not a recognised source of potable mineral water as defined in the ERS. As such, this environmental value is considered not to be relevant.	**No** – DBF and BF is not a recognised source of potable mineral water, and the area is not a recognised source of potable mineral water as defined in the ERS; as such, this environmental value is considered not to be relevant.	
Agriculture and irrigation (irrigation and stock watering	**No**	**No** – As agreed with ERR the water body is not intended for flora and fauna support and therefore agriculture and irrigation are also considered to be unsupported. Use of DBF and BF groundwater is unlikely due to low yield and quality. These environmental values are not considered supported or relevant.	
Water based recreation (primary, secondary, and aesthetic)	**No**	**Yes** (in part) – The upper catchment is naturally acidic with low pH and elevated soluble metals; however, Anglesea Heath does provide aesthetic enjoyment. The Lower Anglesea River does provide secondary and aesthetic contact and enjoyment for the majority of the time, however, primary contact recreation is not recommended by the Surf Coast Shire (advisory signs are in place) due to the regular naturally occurring low pH of the River. During high flows from the upper catchment the Lower Anglesea River can be closed to recreation (primary and secondary) but aesthetic enjoyment is still recognised.	
Industrial and commercial use	**Yes** – The area is currently zoned as a special use zone (SUZ1). Future industrial or commercial use is possible and has been presented in concept as the development of a safe and stable landform and water body with associated tourist facilities.	**Unlikely** – The area is currently zoned as a special use zone (SUZ1). Future industrial or commercial use is possible and has been presented in concept as the development of a safe and stable landform and water body with associated tourist facilities. Use of DBF and BF groundwater is unlikely due to low yield, quality, and the availability of reticulated water locally.	

Environmental Value	Potential Existing and Future Receptors		Potential Migration and Exposure Pathways
	DBF and BF	Off-site	
Buildings and Structures	**Yes** – Buildings that proposed to intersect the groundwater will need to be resistant to corrosion.	**Yes** – Buildings (concrete and steel footings/foundations) that proposed to intersect the groundwater will need to be resistant to corrosion.	
Traditional Owner cultural values	Refer to comments under Off-site column to the right.	**Yes** – No specific Traditional Owner cultural values have been determined in discussions with the local Traditional Owner Wadawurrung representatives to date, however Alcoa has proposed that protection of any water (surface or ground) dependent eco-systems including the Anglesea River may also ensure the protection of Traditional Owner cultural values related to ground water and surface water in the area. Refer to Water dependent ecosystems (above) which are based on the natural or background levels.	
Geothermal properties	**No** – Groundwater within the DBF and BF has been measured as less than 30 degrees Celsius, therefore, this environmental value is not considered to be relevant.	**No** – Groundwater within the DBF and BF has been measured as less than 30 degrees Celsius, therefore, this environmental value is not considered to be relevant.	

Table 4-2 Environmental Values of Surface Water, Potential Receptors, and Migration and Exposure Pathways

Environmental Value	Potential Existing and Future Receptors		Potential Migration and Exposure Pathways
	Water Body	Off-site	
Water dependent ecosystems (slightly to moderately modified)	**Yes** – It is possible that ecosystems could develop in the water body which are similar to the surrounding naturally acidic catchment.	**Yes** – The surrounding surface water catchment includes Salt Creek, Upper Anglesea, and Lower Anglesea River. There is no hydraulic connectivity between the water body and surface water.	**On-site:** Potential migration of CLA porewater through Fill Material to the water body and potentially affecting land and air-based fauna. **Off-site:** Potential migration of contaminants from the water body by land and air-based fauna.
Human Consumption after appropriate treatment and human consumption of aquatic foods	**No** – The water body is an artificial constructed feature, and this environmental value is unlikely to be realised on-site in the future.	**No** – The natural catchment is acidic with low pH and elevated metals, and this environmental value is unlikely to be realised on-site in the future.	
Agriculture and irrigation	**No.**	**No** – As agreed with ERR the water body is not intended for flora and fauna support that is not consistent with background and therefore agriculture and irrigation are also considered to be unsupported. Use of DBF and BF groundwater is unlikely due to low yield and quality. These environmental values are not considered supported or relevant.	
Industrial and commercial use	**Unlikely** – This environmental value is possible, although water quality would have to be suitable for future proposed uses. Use is unlikely due to quality and the availability of reticulated water locally.	**Unlikely** – This environmental value is possible although water quality would have to be suitable for future proposed uses. Use is unlikely due to quality and the availability of reticulated water locally.	

Environmental Value	Potential Existing and Future Receptors		Potential Migration and Exposure Pathways
	Water Body	Off-site	
Water based recreation (primary, secondary, and aesthetic)	**No** – Water body is not intended to provide environmental values such as recreational uses, however does have the potential for aesthetic enjoyment.	**Yes (in part)** – The upper catchment is naturally acidic with low pH and elevated soluble metals, however Anglesea Heath does provide aesthetic enjoyment. The Lower Anglesea River does provide primary, secondary, and aesthetic contact and enjoyment for the majority of the time, however primary contact recreation is not recommended by the Surf Coast Shire (advisory signs are in place) due to the regular naturally occurring low pH of the River. During high flows from the upper catchment the Lower Anglesea River can be closed to recreation (primary and secondary) but aesthetic enjoyment is still recognised.	
Buildings and Structures	**Yes** – Buildings that proposed to intersect the groundwater will need to be resistant to corrosion.	**Yes** – Buildings (concrete and steel footings/foundations) that proposed to intersect the groundwater will need to be resistant to corrosion.	
Traditional Owner cultural values	Refer to comments under Off-site column to the left.	**Yes** – No specific Traditional Owner cultural values have been determined in discussions with the local Traditional Owner Wadawurrung representatives to date, however Alcoa has proposed that protection of any water (surface or ground) dependent eco-systems including the Anglesea River may also ensure the protection of Traditional Owner cultural values related to ground water and surface water in the area. Refer to Water dependent ecosystems (above) which are based on the natural or background levels.	

Alcoa consider that the following environmental values are not relevant:

- Potable mineral water supply (groundwater);
- Water based recreation (primary and secondary), both surface water and groundwater;
- Agriculture and irrigation (irrigation and stock watering) from both surface water and groundwater; and
- Geothermal properties (groundwater).

The consideration of whether an environmental value is relevant or not has been based on the availability of reticulated water and the quality and yield of groundwater in shallow aquifers (DBF/BF).

The DBF and BF surrounding the water body is partially saturated, however over time it will achieve a steady-state elevation. Based on the outcomes of the numerical modelling, particles of water are not expected to migrate more than a few metres from their source (as the water body acts as a sink under steady-state conditions). The hydrogeological characteristics of the shallow aquifers align with the low yielding definition from EPA publication 1992 page 52, 'In groundwater, an environmental value may not apply when there is insufficient aquifer yield to sustain the environmental value.' Aquifer yield is represented by hydraulic conductivity, which is a measure of permeability. The average permeability (Kxy) across all aquifer tests within the DBF and BF was $7.8x10^{-4}$ m/d. This is presented in EHS Support (2022) and has been used in the calibrated numerical modelling report. The permeability of an aquifer defines the potential rate of flow through a porous media. For the purpose of Clause 15(2)(a) of the Environment Reference Standard, insufficient aquifer yield can be considered as any porous media with a hydraulic conductivity less than 0.0001 m/day. This has been demonstrated via measurement of the aquifer properties and consideration of the factors described above.

The DBF and BF is also not potable mineral water as the catchment does not have any mineral springs and is not known to be a source of mineral water. Natural groundwater quality does not support a source of safe drinking water. As per example on EPA Publication 1992, page 75; The use of groundwater for potable mineral water supply was not considered relevant given that the investigation area was not located in a mineral spring district (Department of Minerals and Energy (1981), Groundwater Resources Map, 1981, 1:1,000,000 scale).

The area does not have any documented geothermal properties.

The ERS definition of potable mineral water is "groundwater that is safe to drink and in its natural state contains carbon dioxide and other soluble matter in sufficient concentration to cause effervescence". Shallow groundwater in the vicinity of the site is not a recognised source of potable mineral water, and the site is not located in a recognised mineral water area; as such, this environmental value is considered not to be relevant.

The mine pit water body is not intended to provide environmental values such as direct contact recreational uses, based on the direction provided by Department of Environment, Land, Water and Planning (DELWP) to Alcoa in 2016/2017 (refer to 2017 draft Mine Rehabilitation and Closure Plan [MRCP]; EHS Support, 2017); therefore, this environmental value is considered not to be relevant.

As agreed with ERR the water body is not intended for flora and fauna support that is not consistent with background and therefore agriculture and irrigation are also considered to be unsupported; therefore, these environmental values are not considered supported or relevant.

The site is located within an area of known potential for geothermal energy resources at depth (greater than 300 m depth), however the temperature of groundwater in close vicinity to the site has been measured as less than 30 degrees Celsius (an indicator as stipulated in the ERS); as such, this environmental value is not considered to be relevant.

4.1.1 Registered Bore Search

A search for registered groundwater users located within a 1,000 m radius of the site, using the DELWP Watering Measurement Information System (WMIS), was conducted on 19 April 2024. The results of this search identified 50 registered groundwater bores within a 1,000 m radius of the site all of which lie within the Alcoa lease area and are (or have been) used for the purposes of groundwater monitoring and/or groundwater abstraction. The search for the bores within the vicinity of the site is included in **Appendix C** for reference.

The search radius of 1,000 m was selected based on the outcomes of the fast fill scenario run using the regional numerical model. For this scenario 98 percent of the model realisations (147 of 150) indicate that all the particles migrating from the water body circumference into the surrounding aquifers, terminate within the mine lease area (<1,000 m) over the simulation period (2023 to 2066). All particles are also simulated to ultimately discharge to the water body because it forms a groundwater sink for all aquifer discharge in the long term.

4.2 Risk Assessment and Management

As described in **Section 10** and relevant to the activity, a detailed risk assessment has been completed for the activity of submerging of the CLA during the development of the mine pit water body. This section details the approach to the risk assessment, the potential hazards identified, the risk assessment matrix, and identifies appropriate controls for each risk.

In addition to the process described in **Section 10**, the source – pathway – receptor (SPR) approach has also been used to understand the potential modes of connectivity between the artificial mine pit water body and natural water features (refer **Table 4-3**).

Table 4-3 represents the relationship between the activity of submerging the CLA and the potential for leaching into the mine pit water body, and the interactions with relevant receptors. Linkages or pathways between these features are mostly permanent, with a potential temporary discharge from the water body to the surrounding fill material and natural DBF and BF aquifer (refer to **Section 9** for further detail) during the filling of the mine water body. The upper sands of the UEVF aquifer are omitted from this assessment as there is no connectivity between the UEVF (upper sands), the local DBF and BF groundwater, and the water body.

Table 4-3 Risk Assessment: Source – Pathway – Receptor

Source	Pathway	Receptor
CLA area	**Groundwater (fill material)** Pore-water within the CLA has a potential to migrate from the CLA area, through the clay-rich cover/berm into the surrounding fill material, when saturated. This pathway is only complete if the fill material is saturated between the CLA area and the water body.	Water Body
	Groundwater (fill material) Pore-water within the CLA has a potential to migrate from the CLA area, through the clay-rich cover/berm into the surrounding fill material, when saturated. If the filling of the water body has not been completed, then groundwater flow will be away from the water body towards the in-situ DBF and BF which is identified as a potential receptor of CLA pore-water. This pathway is only complete if the fill material is saturated between the CLA area and the DBF and BF groundwater.	DBF and BF groundwater user
Water Body	**Land** Animals drinking from the water body, can migrate between the artificial catchment of the water body and the surrounding natural catchment.	Ecosystems (flora and fauna)
	Air Birds using the water body for drinking and preening, can migrate between the artificial catchment of the water body and the surrounding natural catchment.	Ecosystems (fauna)

4.2.1 Protection of Maintenance of Ecosystems Environmental Value

The SPR assessment has been used to establish the pathways between sources and receptors. This process informs which water systems (or sources) are connected and whether the environmental values of natural water dependent ecosystems and species could be adversely affected from identified sources. For toxicants in water, the Anglesea water catchment lies within the Inland Segment Central Foothills and Coastal Plains[14]. Water dependent ecosystems and species within this segment are considered to be slightly to moderately modified. The indicators and objectives for this segment are provided in Table 5.8 of the ERS and for toxicants in water the percent (%) level of species protection (LOP) that must be used to determine the objectives is 95 percent.

Upper Anglesea River (monitoring location AV2) has been used as representative of surface water quality hydraulically up-gradient of the mine pit water body. In comparison to Salt Creek (monitoring location SV2), it contributes 75 percent of flow to the Lower Anglesea River during times of flow. Based on AV2 water quality central tendency values, pH provides 0 percent species LOP, aluminium provides 0 percent species LOP, boron protects 100 percent species, and zinc provides 20 percent species LOP. The existing background pH and concentrations of toxicants (aluminium and zinc) used to characterise the water quality within the catchment fall below the LOP required for this segment.

The mine pit water body is representative of a highly modified aquatic system and the percent LOP that must be used to determine the objectives is 90 percent. As there is no applicable segment for the mine pit water body there is no pH objective, however as the water body pH is comparable to natural catchment background, the potential level of species impact is likely to be similar.

Based on the comparison between the natural background toxicant concentrations of AV2 and the mine pit water body, AV2 aluminium and zinc concentrations provide lower LOP than the water body (Warne, 2018). Boron concentrations within the water body are less protective of species than AV2, however the only species potentially affected within the water body are diatom species, Cyclotella and Navicula[15] (ANZG, 2021). Due to the low pH (high acidity) and elevated electrical conductivity in background surface waters across the catchment (natural and artificial) it is unlikely that these diatom species are present[16]. Boron concentrations within the catchment (surface water and soils) are also discussed in EHS Support (2021c). The EHS Support (2021c) report concluded that in terms of species protection aluminium presented a much higher level of risk than boron. Boron toxicity tests to derive default guideline values were also conducted at pH 6.8 to 10 (ANZG, 2021). This pH range was used as the highest level of adsorption is observed at pH 7.5 to 9 (Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand [ANZECC/ARMCANZ] 2000 and WHO 1998). At low pH boron adsorption is expected to be lower and therefore boron concentrations which are protective of aquatic ecosystems are anticipated to higher than the default toxicant guideline values; however, it is accepted that the boron concentrations considered within EHS Support (2021c) are lower than the interim WQPTs values, particularly for the DBF and BF groundwater and that this groundwater quality data is associated with the power station monitoring network and not in the vicinity of the CLA area. Further future site-specific risk assessment is therefore proposed to assess the potential

[14] Division 2 – Groundwater, Section 17 1(a, iv) page 22.

[15] Cyclotella and Navicula. Cyclotella sp. Are both known to prefer circum-neutral to alkaline waters, pH 6.5 to 8.6 and pH 7.2 to 7.8 respectively and low concentrations of electrolytes, 92-332 uS/cm. The use of Cyclotella and Navicula in limnological investigations of acidic waters, should be approached with caution. Reference - https://diatoms.org/species/

risks to ecological receptors from boron sources (in addition to the CLA area). Additional risk assessment will be conducted as part of the MCRP finalisation.

This approach is considered to be consistent with the ongoing and accepted management of the surrounding naturally occurring surface water systems by the local authorities and regulators which include: DELWP; Corangamite Catchment Management Authority (CCMA); and the Surf Coast Shire.

The following sections provide a discussion on the natural background water quality within Salt Creek (monitoring location, SV2), Marshy Creek/Upper Anglesea River (monitoring location, AV2), DBF and BF, and the UEVF (upper sands), together with the artificially constructed mine water body water quality.

4.3 Catchment Surface Water and Groundwater Quality

The local catchment surrounding the mine pit water body comprises the following natural surface water and groundwater systems:

- Surface Water:
  - Salt Creek (and tributaries);
  - Marshy Creek/Upper Anglesea River (and tributaries); and
  - Lower Anglesea River.
- Groundwater:
  - Demons Bluff Formation and Boonah Formation (DBF and BF).

The Alluvial Swamp Aquifer (ASA) and UEVF (upper sands) groundwater are not hydraulically connected to the mine pit water body and are therefore not identified as potential receptors for the purposes of this risk assessment. Further detail on the local hydrogeology is described in EHS Support (2022).

The Water Body Filling Strategy has not finalised a source of water. There is no current agreement with, or direction from, DELWP (now DEECA) for future engineered connection between the natural surface water systems (i.e., Salt Creek) and the mine pit water body; as a result, the mine pit water body will not be directly connected to the Anglesea River catchment consistent with previous discussions with DELWP and with no engineered outlet or spillway (**Table 10-6**). Water also cannot move from the water body into the UEVF (upper sands), as an upward hydraulic gradient exists between the UEVF and the water body. During the 6-month UEVF (lower sands) pumping test, the vertical hydraulic gradient was significant, with a 65 m head difference between the pumped bore (i.e., UEVF lower sands) and the overlying aquifer units and no drawdown or change in trend was observed in any overlying units (including those immediately overlying the pumped unit). This gives an indication on the competency of the clay and coal layers between the thin upper sands of the UEVF. The DBF and BF aquifers are desaturated in the vicinity of the mine pit water body, however the DBF and BF aquifer is saturated in the vicinity of the former power station (**Figure 1**, attached). Groundwater quality for the DBF and BF beneath the former power station area is discussed in detail below (**Section 4.3**) together with the mine pit water body quality (**Section 4.4**).

All water analyses in the following tables are reported for dissolved species concentrations.

Table 4-4 (**Table 1**, attached) and **Table 4-5** (**Table 2**, attached) provide the water quality summary statistics from the Upper Anglesea River (or Marshy Creek) and Salt Creek during the period 1999 to 2021. Dissolved aluminium, boron, iron, and zinc within the Upper Anglesea River (monitoring location AV2) are generally elevated and the pH is usually less than pH 3.5 (net acidic). Dissolved aluminium, boron, iron, and zinc within Salt Creek (monitoring location SV2) are also observed to be elevated and the pH is usually less than pH 3.8; however, higher pH is observed in the upper reaches.

Table 4-4 Upper Anglesea River – Surface Water Quality Summary, 2000 to 2021

Analyte	Units	Upper Anglesea River/Marshy Creek (AV2)						Number of Samples
		Mean	Median	Min	Max	10th Percentile	90th Percentile	
pH	S.U.	2.93	2.76	2.69	3.74	2.70	-	10
TDS	mg/L	1,883	2,970	302	4,150	-	3,478	9
Aluminium	mg/L	71.6	63.8	9.6	232	-	181.6	9
Boron	mg/L	0.04	0.05	0.02	0.09	-	0.08	6
Iron	mg/L	8.74	24.40	0.13	42.80	-	41.84	9
Manganese	mg/L	1.75	2.14	0.36	3.04	-	2.89	10
Zinc	mg/L	0.59	0.71	0.22	1.31	-	0.89	10

Table Notes:
mg/L = milligrams per litre

Table 4-5 Salt Creek – Surface Water Quality Summary, 2000 to 2021

Analyte	Units	Salt Creek (SV2)						Number of Samples
		Mean	Median	Min	Max	10th Percentile	90th Percentile	
pH	S.U.	3.98	3.72	2.78	6.04	3.39	-	9
TDS	mg/L	1,225	1,350	193	5,660	-	3,140	7
Aluminium	mg/L	24.72	98.40	0.16	291	-	167.10	8
Boron	mg/L	0.07	0.06	0.03	0.21	-	0.18	3
Iron	mg/L	1.09	0.80	0.10	67.9	-	21.84	8
Manganese	mg/L	0.97	2.02	0.03	4.31	-	3.25	9
Zinc	mg/L	0.50	1.38	0.01	1.93	-	1.60	9

Table Notes:
mg/L = milligrams per litre

Table 4-6 (**Table 3**, attached) presents the groundwater quality summary statistics from the bores screened within the upper sands of the UEVF during 2021 and 2022. The bore locations are all proximal to the mine pit.

Table 4-6 UEVF (upper sands) – Groundwater Water Quality Summary, 2021 to 2022

Analyte	Units	UEVF (upper sands) Groundwater (UEVF MB1 through UEVF MB7)						Number of Samples
		Mean	Median	Min	Max	10th Percentile	90th Percentile	
pH	S.U.	5.32	5.28	3.72	7.38	4.35	-	55
TDS	mg/L	871	924	155	3,860	-	3,470	55
Aluminium	mg/L	0.05	0.06	0.00	0.44	-	0.40	55
Boron	mg/L	0.17	0.13	0.06	1.29	-	1.03	55
Iron	mg/L	0.85	0.39	0.01	43.70	-	32.60	55
Manganese	mg/L	0.11	0.12	0.01	0.42	--	0.42	7
Zinc	mg/L	0.08	0.09	0.01	0.45		0.30	47

Table Notes:
mg/L = milligrams per litre
NR = Not Recorded

The UEVF (upper sands) groundwater is moderately acidic and may also contain potential acidity. The UEVF (upper sands) groundwater is anoxic and in the presence of oxygen, acidity may be generated from the oxidation of ferrous iron to ferric iron and the hydrolysis of aluminium and manganese.

In the vicinity of the mine, the DBF and BF is largely unsaturated as the mine pit acts as a discharge point, meaning there is no groundwater quality data in this area; furthermore, where the mine has progressively been rehabilitated (i.e., overburden placed back into formation), the water quality of monitoring bores in this re-worked material is not truly reflective of the natural undisturbed DBF and BF.

Representative groundwater quality has been sourced from groundwater monitoring bores in the vicinity of the power station site (**Figure 1**, attached). **Table 4-7** (**Table 4**, attached) presents the water quality summary statistics from the DBF and BF groundwater during the period 2021 to 2022.

Table 4-7 DBF and BF (overburden/fill material)[17] – Groundwater Water Quality Summary 2021 to 2022

Analyte	Units	Mean	Median	Min	Max	10th Percentile	90th Percentile	Number of Samples
pH	S.U.	6.05	6.12	3.54	7.32	5.46	-	20
TDS	mg/L	2,483	2,495	1,510	3,320	-	3,039	20
Aluminium	mg/L	0.21	0.16	0.04	5.19	-	1.41	20
Boron	mg/L	0.38	0.33	0.28	0.96	-	0.53	20
Iron	mg/L	24.60	30.10	1.24	123	-	87.12	20
Manganese	mg/L	0.56	0.69	0.25	1.03	-	0.96	3
Zinc	mg/L	0.06	0.04	0.01	0.70		0.40	3

Table Notes:
S.U. = standard units
mg/L = milligrams per litre

4.4 Current Water Body Water Quality

Surface water has collected within the low point of the mine pit and consists of rainwater, surface water runoff and groundwater pumping test discharge from the UEVF (lower sands).

The current water quality of the mine pit water body is characterised by elevated acidity (low pH), aluminium, boron, iron, and zinc (**Table 4-8** and **Table 5** [attached]), however these are generally lower in concentration within the mine pit water body (better quality) in comparison to the surrounding catchment. Boron is historically reported at higher concentrations within the mine water body; this is likely attributed to the historical dissolution of boron from coal fragments within the fill (overburden) material. Analytical results from in-situ coal samples collected in 2016 for the draft MRCP are provided as **Table 6** (attached).

Table 4-8 Mine Water Body Quality Summary 2021 to 2022

Analyte	Units	Mean	Median	Min	Max	10th Percentile	90th Percentile	Number of Samples
pH	S.U.	3.56	3.57	3.44	5.96	3.48	-	17
TDS	mg/L	1,715	1,680	1,500	2,470	-	2,004	17
Aluminium	mg/L	3.41	4.27	0.22	5.50	-	5.32	12
Boron	mg/L	1.14	1.22	0.32	2.05	-	1.46	12
Iron	mg/L	4.75	4.23	0.91	87.80	-	11.49	12
Manganese	mg/L	-		0.56	0.56	-	-	1
Zinc	mg/L	0.24	0.21	0.16	0.58	-	0.38	7

Table Notes:
S.U. = standard units
mg/L = milligrams per litre

[17] Well location: DBG MB4 and DBG MB6

4.5 Consolidated Leached Ash Porewater Quality

The 90th percentile leachable fraction values for aluminium, boron, iron, and zinc have also been provided for the CLA material (**Table 4-9**). The values include the leachable fraction analyses for samples collected from locations ADBH01 (two samples), ADBH02, ADBH03, ADBH04, ADBH05, ADBH06, and ADBH08 during the September 2021 field program (**Figure 6**, attached).

Table 4-9 Consolidated Leached Ash – Leachable Fraction (90th Percentile)

Analyte	Units	90th Percentile	
		pH 2.9	De-ionised Water
Aluminium	mg/L	17.1	3.78
Boron	mg/L	10.5	5.33
Iron	mg/L	3.0	3.45
Manganese	mg/L	3.6	0.08
Zinc	mg/L	0.1	0.02

Table Notes:
mg/L = milligrams per litre
Note: pH and TDS are not reported for leachable fraction analysis
Limit of reporting for zinc @ pH 2.9 is 0.1 mg/L

4.5.1 Quality Assurance and Quality Control

All water quality samples, and analysis collected by EHS Support has been subject to quality control and assurance (QA/QC) requirements of AS4482.1 and National Environment Protection Measure (NEPM) Schedule B2 Guideline on Site Characterisation and relevant EPA Victoria guidelines. Any analytical services are performed by a National Association of Testing Authorities (NATA) accredited laboratory. Barwon Water collect surface water samples from the wider catchment. Prior to 2016, Tetra Tech Coffey (formerly Coffey) and Alcoa shared responsibility for site sample collection and analysis. It was acknowledged in the draft MRCP that any data collected and reported prior to 2009 has no accompanying QA/QC documentation.

4.6 Water Quality Comparison

A comparison of the 90th percentile values for aluminium, boron, iron, and zinc have been provided for the leachable fraction of CLA, DBF and BF, and the mine pit water body (**Table 4-10**). The comparison indicates that only boron and aluminium would be potentially identifiable in the water body and the DBF and BF groundwater if a direct discharge of CLA porewater occurred.

Table 4-10 Comparison of CLA pore-water, Water Body and DBF and BF Groundwater (90th Percentile)

Analyte	Units	90thPercentile		
		CLA leachable Fraction pH 2.9[18]	DBG MB6 (DBF&BF)	Mine Water Body
Aluminium	mg/L	17.1	1.41	5.32
Boron	mg/L	10.5	0.53	1.46
Iron	mg/L	3.0	87.12	11.49
Manganese	mg/L	3.6	0.96	-[19]
Zinc	mg/L	0.1	0.4	0.38

Table Notes:
mg/L = milligrams per litre
Note: pH and TDS are not reported for leachable fraction analysis

After considering the influence of the groundwater hydraulic regime in the vicinity of the CLA area (change over time of hydraulic gradient from the east to the west) and the additional effects of retardation, impacts from the CLA area are unlikely to be measurable in either the water body or the DBF and BF groundwater. This is further supported by the groundwater hydraulic and particle tracking assessment in **Section 9**.

4.7 Interim Water Quality Performance Targets

The water quality datasets for the mine pit water body and DBF and BF groundwater have been used to develop interim WQPTs. The interim WQPTs will provide an indication of any impacts from the CLA area as it is submerged during the filling of the mine pit water body.

For the CLA Technical Assessment, the derivation of interim WQPTs for the mine pit water body and DBF and BF groundwater will aid in the assessment of risk, related to:

1. Short term – The activity of submerging the CLA area and potential impacts from CLA porewater on the DBF and BF groundwater; and
2. Long term – The activity of submerging the CLA area and potential impacts from CLA porewater on the mine pit water body.

The interim WQPTs developed for the mine pit water body and DBF and BF groundwater are currently considered as interim. The final mine pit water body water quality is currently unknown as the source of water to fill the water body has not been finalised, however the future water quality will be complimentary to background water quality, with the possible exception of boron. Future WQPTs will be developed during the finalisation of the MRCP using the framework described.

[18] The leachable fraction at pH 2.9 has been selected for comparison as this pH is most comparable to the water body pH. Water body water is slowly saturating the surrounding fill material
[19] Only one sample from the mine water body has been analysed for manganese therefore 90th%ile value has not been calculated

The application of interim WQPTs and the final WQPTs will aid in the identification of any deterioration of environmental values and receptors as the water body filling strategy proceeds and the CLA area is inundated. As described in the sections above, the environmental values of the surrounding natural catchment must be protected. The risk to environmental values of water dependent ecosystems and species will be low and manageable using contingency measures which will be developed as part of the water body filling strategy. It is acknowledged that boron concentrations in the water body are elevated in comparison to the natural catchment and further site-specific risk assessment is proposed to assess the potential risks to ecological receptors from boron sources (in addition to the CLA area). Additional risk assessment will be conducted as part of the MCRP finalisation.

As part of the framework for developing interim WQPTs, a statistical approach has been adopted using percentile values. The 90th percentile has been used for aluminium, boron, iron, and zinc and the 10th percentile for pH. This approach has been discussed and agreed with EPA Victoria (EPA Victoria letter dated 2 September 2022).

The interim WQPTs for the mine pit water body and DBF and BF groundwater derived from 10th and 90th percentile values for pH, aluminium, boron, iron, and zinc are provided in **Table 4-11** and **Table 4-12**. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZ Guidelines) toxicant default guideline values for the protection of aquatic ecosystems have also been provided for the 90 percent and 95 percent species LOP (where available).

Table 4-11 Interim Water Quality Performance Targets – Metals/Metalloids (90th Percentile)

Analyte	Units	DGV		90th Percentile	
		95% LOP Slightly to Moderately	90% LOP Highly Modified	DBF&BF	Mine Water Body
TDS	mg/L	-	-	3,039	2,004
Aluminium	mg/L	0.0008[20]		0.27	1.41
Boron	mg/L	0.94	1.5	0.53	1.46
Iron	mg/L	0.3[21]		30	87.12
Manganese	mg/L	1.9	2.5	0.96	-[22]
Zinc	mg/L	0.008	0.015[23]	0.4	0.38

Table Notes:
DGV = Derived Guideline value
mg/L = milligrams per litre

Table 4-12 Interim Water Quality Performance Targets – Catchment pH (10th Percentile)

Analyte	Units	DGV	10th Percentile	
		95% LOP slightly to moderately	DBF&BF	Mine Water Body
pH	S.U.	≥6.8 - ≤8	5.46	3.48

Table Notes:
S.U. = standard units

[20] For waters pH<6.5. actual pH range pH 4.5 to 6 used to derive aluminium DGV, unknown level of species protection
[21] Canadian guideline value
[22] Only one sample from the mine water body has been analysed for manganese therefore 90th%ile value has not been calculated
[23] Level of protection not pH specific

4.8 Conclusion

A framework has been used to develop interim WQPTs associated with the catchment immediately surrounding the CLA area. These receptors include the mine water body and groundwater within the Fill material and local DBF and BF. The framework for the risk-based assessment of groundwater that may be affected by water quality changes, as detailed in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC, 2013), has been considered in the development of the interim WQPTs.

The framework derives WQPTs using water quality datasets to calculate an appropriate percentile value for each target. These datasets have been used to calculate the 10th percentile values for pH and 90th percentile values for aluminium, boron, iron, and zinc. The main objective of this approach is to derive interim WQPTs during the activity of submerging the CLA. This is specifically to determine whether the submerged CLA has any adverse impact on these potential receptors. These interim WQPTs are presented in **Table 4-11** and **Table 4-12**.

It is acknowledged that groundwater monitoring should be conducted in the vicinity of the CLA area to assess whether pore water migration from the CLA area is occurring. Sentinel wells located in proximity to the CLA area (within 5-10 m) were considered, however this was not considered practicable for the following reasons:

- Any new wells could only be installed during dry conditions, providing only a seasonal opportunity to do so during summer. This becomes more difficult as the water body elevation approaches the CLA area.
- The installation and decommissioning of wells prior to inundation could present a risk of creating additional water migration pathways after inundation.
- The process of inundation is potentially within a time period of two years, during which wells will need to be decommissioned prior to submergence. This does not provide an adequate time frame to collect a representative dataset as the formation surrounding the CLA saturates and the water quality takes time to equilibrate.
- The objective of these wells would be to validate any potential seepage from the CLA, and this can't occur if the area is submerged.
- Based on the SEEP/W model outcomes the formation is expected to remain unsaturated after inundation, meaning that there will be no groundwater quality to measure prior to any new wells needing to be decommissioned.

Existing groundwater monitoring wells in the vicinity of the CLA area (DBG MB4, DBG MB5, and DBG MB6) will therefore be used to monitor the potential risks of pore water migration from the CLA area into surrounding fill material during (and after) the inundation period. These wells are screened within the clay-rich fill material and DBF and BF. These locations have been part of the groundwater monitoring network surrounding the mine area since 2021 and will continue to be monitored as the CLA area is inundated by the water body. Due to their locations, they will remain even after the water body attains steady-state elevations, and are located well within the Alcoa mine specified area, therefore provide significant early warning of any issues relative to potential receptors.

Monitoring/sampling of the mine pit water body will be undertaken during the filling period and inundation period. Evaluation of the results against WQPT will be used to assess whether seepage is occurring from the CLA.

Note that that the long term WQPTs for the mine water body cannot be determined at this time as the mine water body filling strategy has not been finalised, these are expected to be included as part of the MRCP (when finalised). Note also that the mine pit water body is not intended to provide environmental values such as direct contact recreational uses (with the exception of aesthetic enjoyment), based on the direction provided by DELWP to Alcoa in 2016/2017 (refer to 2017 draft Mine Rehabilitation and Closure Plan [MRCP]; EHS Support, 2017).

It has also been demonstrated that the interim WQPTs presented here are complimentary to natural background water quality with the exception of boron. In comparison to the natural background water quality of the catchment, the water body has lower concentrations of aluminium, iron, and zinc. Boron concentrations in the water body are higher than natural background concentrations, however, as discussed in **Section 4.2**, aluminium is considered to be the primary risk driver and not boron. The DBF and BF in the vicinity of the mine pit is currently dry, however there is a potential that this part of the DBF and BF aquifer may become saturated as the mine pit water body develops.

5 Anglesea Ash History and Management

5.1 Alcoa Former Power Station

The former power station at Anglesea used coal from the former open cut brown coal mine (adjacent to the power station) to generate electricity for the aluminium smelting facility in Point Henry, Geelong. The power station started generating electricity in 1969 and closed in 2015. Approximately 1 million tonnes of brown coal was consumed by the power station each year (GHD, 2012). The ashing system was used to collect, convey, and dispose of the ash generated within the furnace and from the precipitators at the Alcoa Anglesea former power station. The coal at Anglesea contained on average between two to four percent ash which is a by-product of the coal combustion process. Some of the ash was collected in the furnace bottom hopper, while the fly ash was entrained in the flue gases. The fly ash comprised a greater proportion of the total ash. The electrostatic precipitators collected the fly ash from the gas stream before the atmospheric dispersal of gases via the stack. The bottom ash from the furnace was sluiced away by water from the ash tank and the fly ash was removed by a pneumatic system. The combined furnace ash and fly ash was then transported by the water sluices through piping to Ash Pond 1 (**Figure 5-1** and **Figure 1** [attached]).

Leached ash from Ash Pond 1 was periodically removed and dried. Ash Pond 1 was initially designed to be dredged once every five years during a plant shutdown. Alcoa changed to a 'finger excavating' process in the late 1990s where a section of the pond (a finger) was kept operational while one other 'finger' was cleared by excavation and then brought back online avoiding the need for plant shutdown. The two fingers are observed to the north of Ash Pond 1 in **Figure 5-1**. The dried excavated leached ash was then deposited in the mine pit and incorporated into the general overburden backfill process as per the Mine Work Plan endorsed by ERR September 2011 (**Figure 2**, attached). Note that Ash Pond 2 was never required to be used for ash management.

Figure 5-1 Ash Pond Drying Areas

5.2 Alcoa Former Open Cut Mine

The CLA area within the south-eastern corner of the former coal mine consists of the final dried leached ash that was progressively tipped by truck during operations, with the final material dredged and pumped after the closure of the power station during 2016. The leached ash was sourced from the ash drying cells and Ash Pond 1 within the power station area (**Figure 1**, attached) and was permitted to be placed within the mine in accordance with the Mine Work Plan endorsed by ERR in September 2011.

The CLA area lies between relative levels (RL) - 15 metres Australian Height Datum (mAHD) and -8 mAHD, at an average thickness of 4 m, and over a final area of approximately 4.6 ha.

The leached ash that was sourced from the drying cells next to Ash Pond 1 has a considerably lower moisture content than leached ash that was dredged and pumped from Ash Pond 1; however, this dried ash would have been leached and aged (just like ash dredged from Ash Pond 1) during the residence time in Ash Pond 1. The pumped and dredged leached ash was allowed to naturally dewater and consolidate to enable earthmoving machines to then cover the leached ash with clay-rich material. Dewatering occurred via a combination of evaporation, decanting into the water body and minor lateral seepage into the surrounding fill material (refer to further discussion in **Section 6.3.2**). In late 2016 and 2017 dried leached ash was consolidated together with the dredged leached ash into the area now known as the CLA area.

The CLA was encapsulated with at least 1 m of earth-moving machine compacted clay-rich fill material, typically in approximately 300 mm lifts allowing machine compaction in each lift. This material consists of clay, silt, and minor sand which limits recharge and provides a low permeability hydraulic separation from the developing mine water body (referred to hereafter as the water body)[24] that will develop in the mine pit as part of the closure plan. Covering of the CLA with the clay-rich material was completed in the first quarter of 2018.

Additional fill material re-deposited in the pit in the vicinity of the encapsulated leached ash consists of reworked sands, clays, and silts (**Figure 3** and **Figure 4**, attached). Locally the fill material displays similar permeability characteristics (on average less than $1x10^{-9}$ m/sec) to the CLA and clay-rich cover. At depth (approximately -40 mAHD) beneath the CLA layer is the horizon referred to the Basal Clay, which underlies the mined A Group coal seam and is approximately 1-2 m thick in this locality. This unit provides a horizontal hydraulic separation between the underlying UEVF and the overlying fill material.

Refer to **Section 6** and **Section 9** for additional characterisation on the CLA area materials and local geology, respectively.

[24] Surface water feature developing in the former open cut coal pit.

5.2.1 Consolidated Leached Ash Area Design Methodology

The CLA material will be inundated and submerged by the developing water body and will be submerged by at least 12 m of water, as proposed by the draft MRCP.

Alcoa recognises that EPA Victoria's Best Practice Environmental Management (BPEM) Publication Siting, design, operation, and rehabilitation of landfills (BPEM, 2015) is the source document for best practice management measures for landfills. The BPEM states that landfills must not be located below the regional water table, however the CLA area was not intended to be designed or designated as a traditional landfill or meet the requirements of the landfill BPEM, rather it was intended that leached ash would be deposited in the mine pit and incorporated into the general overburden backfill process as per the Mine Work Plan endorsed by ERR September 2011.

The BPEM also allows *'for an alternative risk-based design*', and this is the basis that Alcoa has developed the current 'design' of the CLA area and material cover.

For this assessment the best practice objectives of the BPEM have been referenced but not necessarily adopted for all standards. A risk-based approach has been adopted to demonstrate that the low permeability clay rich material surrounding the CLA is suitable to minimise and mitigate any risks that may arise from the CLA area.

The intention has been to provide for a low permeability clay-rich cover on top of the CLA area and low permeability fill material surrounding the area to contain the CLA and mitigate future risks. The CLA area it therefore surrounded by semi-engineered materials which have achieved the same objective as an engineered liner.

Key considerations in the placement and long-term management of CLA material that mitigate both short- and long-term risks include:

1. Leaching of Coal Combustion Ash (CCA) in the power station ash ponds.
2. Historical drying of leached ash in the finger excavating process.
3. The progressive dewatering and compaction (by earth moving machines) of the dredged leached ash.
4. Consolidation of dried and dredged leached ash into a final clearly defined CLA area.
5. The defined CLA area is bounded on three sides by the haul road and berm, both of which are constructed with clay-rich material derived from the DBF and BF overburden.
6. Covering the CLA with clay-rich material:
    a. Clay-rich material was laid in three, approximately 300 mm lifts by pushing the material out with dozers and track rolled for compaction; and
    b. Completed in a short period of time to prevent drying of the surface.
7. Confirmation of the placement of CLA, clay-rich cover by intrusive field investigation and sampling to demonstrate the spatial extent of CLA, clay-rich cover and associated permeability.
8. Sampling of the clay-rich cover material and surrounding material to confirm permeability of containment area confirming that the mean values for each material group were less than $1x10^{-9}$ m/sec.
9. Numerical modelling and particle tracking to determine any potential short- and long-term interaction of CLA with surface and groundwater.
10. Assessment of identified risks related to the environment including surface and groundwater, and considerate of interim water quality performance targets for both, while being mindful of background water quality.

Table 5-1 provides a summary of the placement methodology adopted for the clay-rich cover in comparison to BPEM standards.

Table 5-1 Clay-rich Cover Placement Methods

Clay Cover Placement	Units	BPEM Standard	Site Results
Number of lifts	n/a	Minimum of 4 for 1 m thick liner	3
Lift thickness	mm	<250 mm	approximately 350 mm
Placement Method	n/a	Appropriate equipment	Appropriate equipment
Lift Scarification	n/a	Yes	Yes
Clay Total Thickness	m	≥1 m	≥ 1 m
Clay Liner Finish	n/a	Smooth	Smooth with a low gradient to the south-west (towards water body)
Photo Evidence	n/a	Yes	Yes[25]

Figure 5-2 provides a conceptualisation of the design methodology for the CLA area (also refer to **Figure 5**, attached).

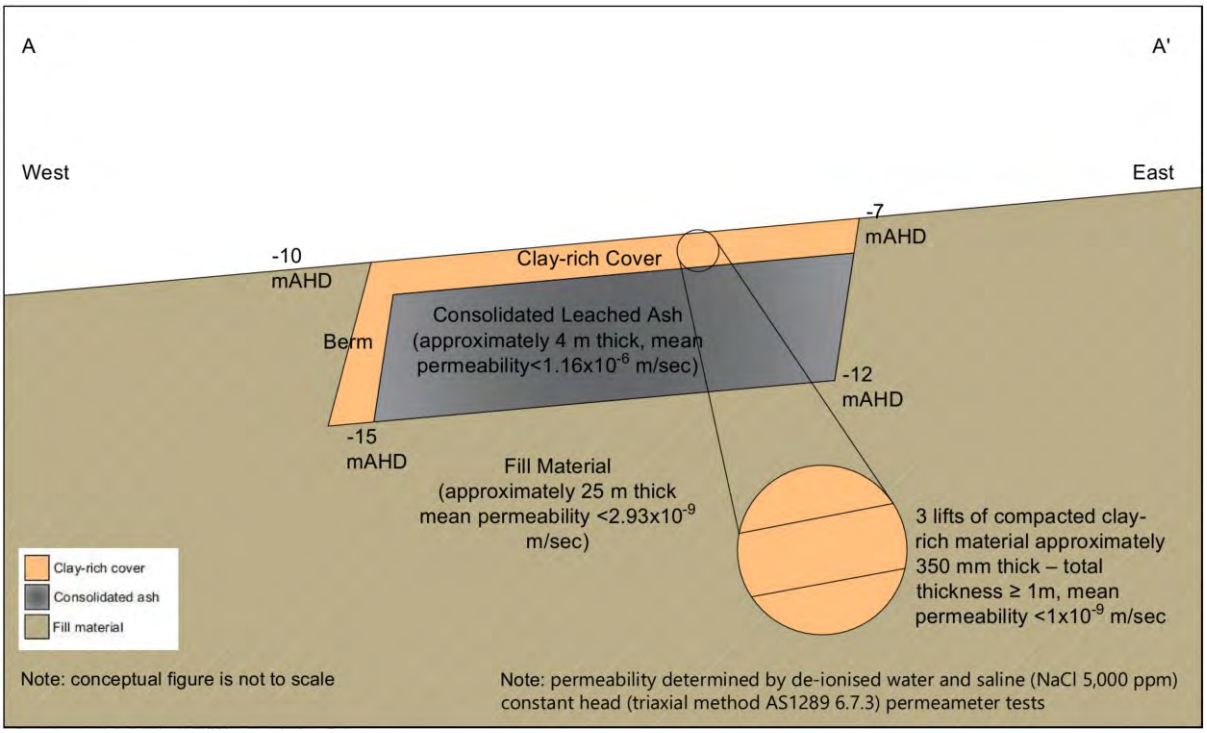

Figure 5-2 Consolidated Leached Ash Area – Conceptual Cross Section

[25] Refer to **Appendix D** CLA Site Photographs

On-going aftercare of the CLA area prior to being submerged includes weekly inspections to ensure unacceptable erosion of the clay-rich cover is not occurring, with any erosion repaired where required. In addition to the compacted clay-rich cover, the CLA area is bounded from the northwest to the east by the mine haul road. This haul road was progressively developed using the same clay-rich material as the CLA cover.

The road material has been compacted through the development and use of the haul road by heavy machinery. The road is also present through the full vertical profile of the fill material in this area of the mine pit, from approximately -40 mAHD (the base of the excavated coal horizon) to -7 mAHD (the current surface elevation). The berm (to the west of the CLA area) was also constructed using clay-rich material and the same placement methodology as the clay-rich cover. The berm was built in lifts and tracked by heavy earth-moving machinery and is wider at the base than the top.

Table 4 and **Table 9** (attached)provide a summary of permeability values measured from undisturbed samples collected in 2021 and 2022 from the following domain areas:

- Clay-rich cover;
- CLA;
- Fill material (to the south and beneath the CLA);
- Haul road (clay-rich material); and
- Berm (clay-rich material).

Field sampling in September 2021 and June/July 2022 was conducted to demonstrate that the CLA area is surrounded by at least 1m of clay-rich low permeability material. All sample holes through the clay-rich cover were re-plugged with bentonite and not remoulded clay.

Table 5-2 provides permeability characterisation of the clay-rich material used to form the cover over the CLA area.

Table 5-2 Clay-rich Layer Properties

Clay Properties	Units	BPEM Standard	Number of Tests	Site Results
Hydraulic Conductivity	m/sec	$<1x10^{-9}$	4	$2x10^{-9}$ to $2x10^{-10}$
Long-term permeation tests (5,000 ppm saline solution[26])	m/sec	$<1x10^{-9}$	5	$1x10^{-9}$ to $2x10^{-10}$

In addition to the clay-rich cover permeability characteristics, samples were also collected within the CLA and fill material (**Table 5-3**).

Table 5-3 Consolidated Leached Ash and Fill Material Properties

Domain Area	Units	Hydraulic Conductivity (de-ionised water)	Hydraulic Conductivity (5,000 ppm saline solution)
Consolidated Leached Ash	m/sec	$9x10^{-9}$ to $7x10^{-10}$ (7 samples)	Not conducted[27]
Fill material	m/sec	$6x10^{-8}$ to $9x10^{-11}$ (12 samples)	$4x10^{-8}$ to $8x10^{-11}$ (17 samples)

[26] A salinity of 5,000 ppm was agreed with BlueSphere (independent peer reviewer) prior to testing as this concentration is representative of the salinity of the CLA porewater

[27] Saline water permeameter tests were not conducted on CLA samples as this test method was only conducted on samples collected during 2022. Consolidated leached ash was not sampled during this event.

The geomean values for each material group were less than $1x10^{-9}$ m/sec. Refer to **Appendix E** for all laboratory analysis reports.

The values provided in **Table 5-2** and **Table 5-3** confirm the presence of low permeability materials (clay-rich cover and fill materials) which surround the CLA area and in addition includes the CLA. These values have also been used in the hydraulic modelling assessment (**Section 9**) which forms part of the overall CLA risk assessment. The outcome of the hydraulic modelling also demonstrates that the low permeability materials limit the migration of conservative constituents (such as boron and sulfate) from leached ash porewater to groundwater.

The placement method of the clay-rich cover together with the results of the intrusive site investigations demonstrate the effectiveness of the low permeability clay-rich material, including during any inundation and submerging of the CLA for both natural and fast fill mine water body filling strategies. These outcomes are also supported by hydraulic modelling.

The materials and placement methods have therefore met the objective and design criteria of limiting leached ash porewater migration from the CLA area in both the short and long term.

All testing and reporting is provided that support the above objective. This documentation has also been reviewed and verified by an independent peer reviewer (BlueSphere), refer to **Section 2** and **Appendix A**.

6 Anglesea Ash Characteristics

The by-product of using coal to fuel electricity generation at power stations is a combination of fly and bottom ash commonly called coal combustion residues, product, or CCA. Anglesea CCA is the product of the historical combustion of brown coal (or lignite) mined from the UEVF used to generate electricity at the former Alcoa Anglesea power station. A combination of the furnace (bottom ash) and electrostatic precipitated ash (fly ash) was produced from the combustion process. The proportions of bottom ash to fly ash can vary depending on the characteristics of the coal and the coal burning process but fly ash comprises the dominant portion (approximately 80 percent) in dry-bottom boiler furnaces and the Anglesea CCA (GHD, 2012). Fly ash comprises a very fine material usually consisting mostly of silica, calcium, aluminium, and iron. Bottom ash is coarser in texture and forms at the bottom of the furnace. Anglesea CCA can also have a small amount of sand which is an artefact from the open-cut coal mining activity. During the mining of coal, fill material would occasionally become entrained within the coal and remains after combustion in the bottom ash residue.

6.1 Ash Characterisation Studies – Historical

Historical characterisation of the Ash materials has been conducted by Alcoa and indicates that the combustion of Anglesea brown coal fly ash has produced a high calcium content ash. **Table 6-1** and **Figure 6-1** provide chemical testing of ash conducted by Alcoa (Beattie, 2003 and GHD, 2012). Concentrations of trace elements (antimony, cadmium, chromium [hexavalent], mercury, molybdenum selenium, silver, and tin) were analysed below 10 mg/kg. Arsenic, copper, lead, and vanadium concentrations were also reported less than 50 mg/kg. Trace elements that are reported as elevated (greater than 100 mg/kg) include barium, boron, manganese, nickel, and zinc.

Note that historical major ion concentrations for leached ash (ash samples recovered from ash ponds) are not available. Also, the minor ion concentrations reported by GHD (2012) are based on median concentrations reported between 2006 and 2011.

Table 6-1 Major Compound and Element Chemical Composition of Fly Ash prior to Mixture with Water – Analysed by Alcoa in 2002 (Beattie, 2003)

Major Compounds	% Dry Basis
Calcium oxide (CaO)	18.63
Sulfur trioxide (SO_3)	18.18
Magnesium oxide (MgO)	17.55
Silicon dioxide (SiO_2)	14.58
Iron (III) oxide (Fe_2O_3)	13.3
Aluminium oxide (Al_2O_3)	5.13
Sodium oxide (Na_2O)	2.65
Potassium oxide (K_2O)	0.19
Titanium dioxide (TiO_2)	0.09

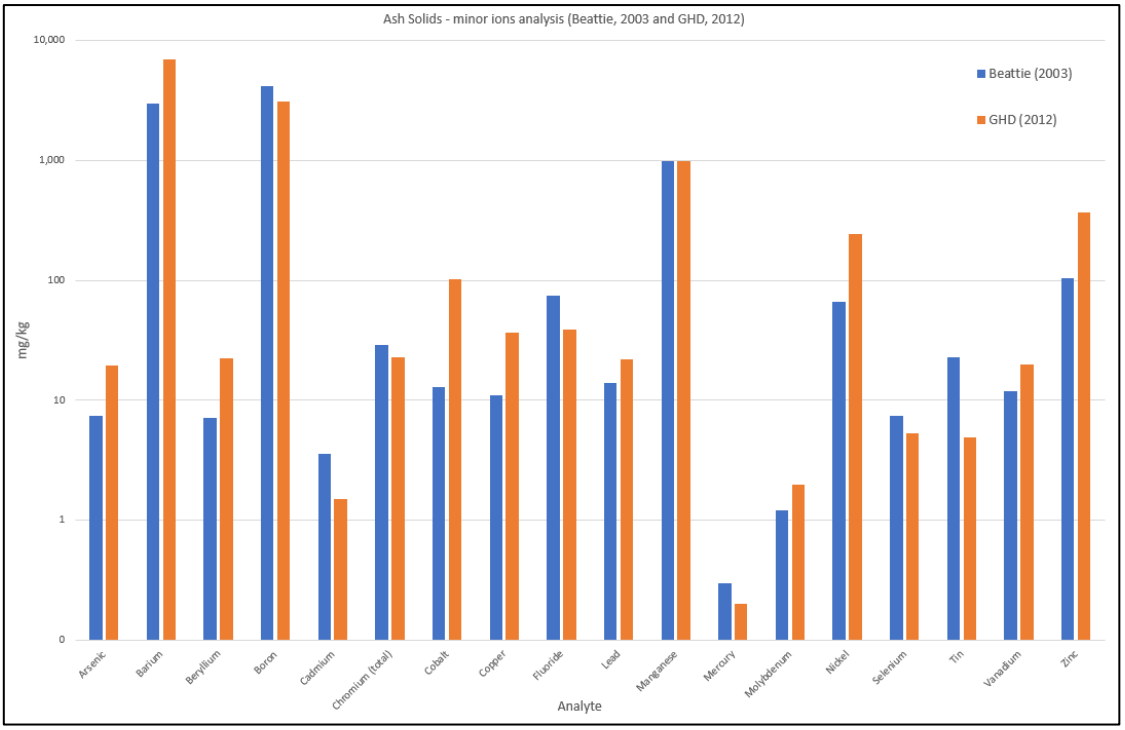

Figure 6-1 Minor Ions (Beattie, 2003 and GHD, 2012)

As shown in **Figure 6-2** and **Table 6-2**, the majority of analytes within the ash appear to have low leachability as demonstrated by the ash pond water quality. Most analytes are reported below the limit of reporting (based on the limit of reporting at the time of analysis). This is most likely due to the pH of the historical ash ponds, which is not conducive to the solubility of most metals and subsequent leaching from the ash. Total dissolved solids are elevated which is most likely due to the major ion concentrations.

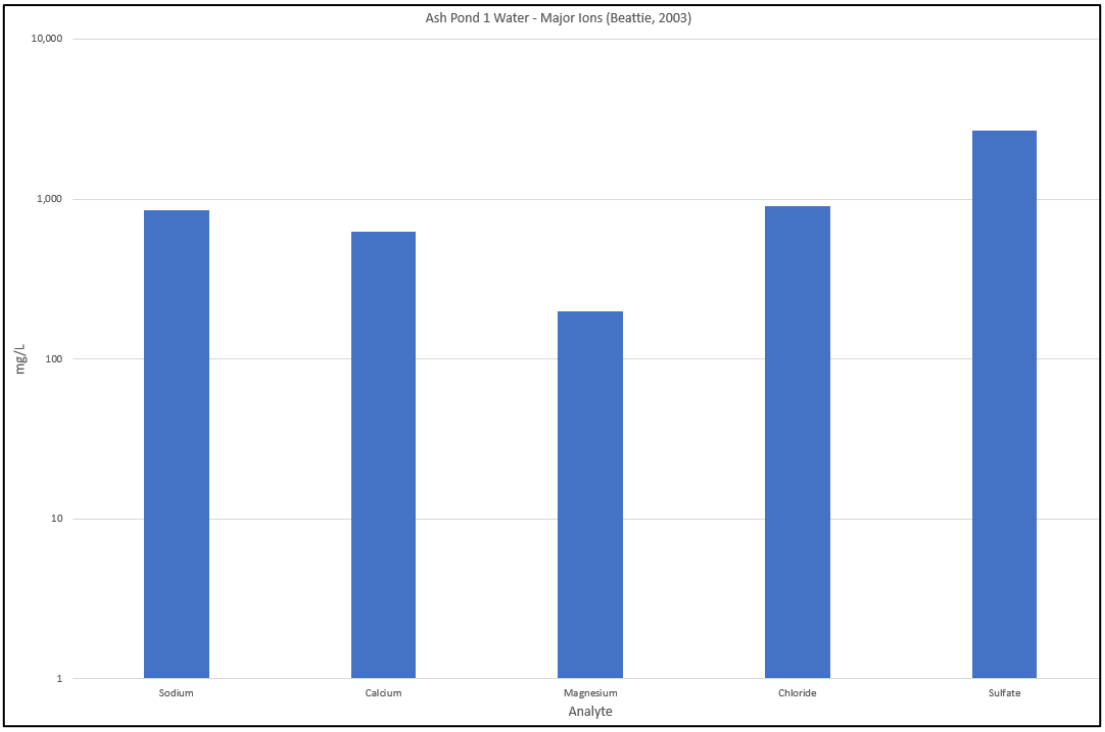

Figure 6-2 Ash Pond 1 Water – Major Ions (Beattie, 2003)

Table 6-2 Minor Ion Chemical Composition of Ash Pond 1 Effluent - Analysed by Alcoa in 1999 (Beattie, 2003)

Analyte	Ash Pond 1 Water Concentrations (mg/L)
Aluminium	<0.005
Arsenic	<0.005
Barium	0.061
Beryllium	<0.005
Boron	36
Cadmium	<0.005
Chromium	<0.005
Cobalt	<0.005
Copper	<0.005
Fluoride	<0.5
Iron	<0.1
Lead	<0.005
Manganese	0.1
Mercury	<0.001
Molybdenum	0.007
Nickel	<0.005
Selenium	0.006
Tin	<0.005
Vanadium	<0.005
Zinc	<0.005

On the basis of the historical testing (Beattie, 2003), the key constituents with potential to leach from the ash materials at high concentrations are limited to major ions (as total dissolved solids) and boron. The results are however dependent on the age of the leached ash and contact time with water in the ponds.

6.2 Ash Characterisation Study – 2016

Additional characterisation of ash solids and Ash Pond 1 water was conducted during 2016 for the development of the draft MRCP.

6.2.1 Field Sample Collection

Samples collected from Ash Pond 1 have been used to provide detailed chemical information on the characteristics of the ash material and ash pond water. Ash solid and aqueous samples were collected in June 2016 (**Table 6-3**).

Table 6-3 Solid and Aqueous Samples

Sample Location	Sample Type	Sample Analytical Test	Number of Sample Locations	Total Number of Samples
Ash Pond 1	Solid – Ash Pond 1	Solid characterisation and ash solid	3	3
	Surface water – Ash Pond 1 water	Water quality analysis and leachable fraction procedure	3	3

Figure 6-3 shows the approximate locations of where the samples were collected.

Figure 6-3 Ash Pond 1 Solid and Aqueous Locations

The solid and aqueous samples were subjected to a detailed solid and wet chemistry analytical schedule (**Table 6-4** and **Table 6-5**).

Table 6-4 Analytical Schedule for Solid Sampling

Analytical Group	Analytical Parameter
Laboratory analysis of major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate, and carbonate).
Laboratory analysis of minor ions	Fluoride.
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc, and mercury.

Analytical Group	Analytical Parameter
Laboratory analysis (soluble) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc, and mercury.
Laboratory analysis physicochemical	Particle size distribution (ash solids only), moisture content, exchangeable cations, pH, total acidity, total organic carbon.
Laboratory analysis	pH (1:2) and electrical conductivity (1:2).
Laboratory analysis	Maximum Potential Acidity (MPA).
Laboratory analysis	Acid Neutralising Capacity (ANC).
Laboratory analysis	Net Acid Producing Potential (NAPP).
Laboratory analysis	Net Acid Generation (NAG).

Table 6-5 Analytical Schedule for Aqueous Sampling

Analytical Group	Analytical Parameter
Field parameters	pH, temperature, turbidity, electrical conductivity, dissolved oxygen, redox potential.
Laboratory measured 'field' parameters (where instrumentation is not available)	pH, turbidity, electrical conductivity, redox potential.
Laboratory analysis of major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate, and carbonate), total hardness, total dissolved solids.
Laboratory analysis of minor ions	Fluoride.
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc, and mercury.
Laboratory analysis (dissolved) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc, and mercury.

A modified Australian Standard Leachate Procedure (ASLP) was also used to derive leachable fraction solutions from the batch mixing of Ash Pond 1 solids with Ash Pond 1 water.

6.2.2 Chemical Testing – Ash Solids and Leachable Fraction Analysis

As described earlier three samples of ash solids were collected from Ash Pond 1 and analysed for the constituents listed in **Table 6-4** above.

Two split samples of an ash solid sample (collected at Location 1, **Figure 6-3**) were used in a modified ASLP test which used a replicate sample of Ash Pond 1 water (collected at Location 3, **Figure 6-3**) as the reagent water. The resulting leachable fraction was then analysed using the same suite of analytical parameters used for other aqueous samples (**Table 6-5**).

The results of the ash solid sample analyses are provided in **Table 7** (attached).

The results of the ash pond water analyses are provided in **Table 8** (attached).

The results of the ash solid ASLP leachate analyses are provided in **Table 9** (attached).

6.2.2.1 Ash Solids – Physical Characteristics

The samples collected from within Ash Pond 1 are typically fine-grained with greater than 70 percent of particles reported between 2 to 60 µm (silt fraction). The ash pond samples display a variable cation exchange capacity, with Location 2 sample reporting 61.3 meq/100g and Location 3 reporting 14.1 meq/100g. Location 1 and 2 samples are dominated by exchangeable magnesium, in contrast to Location 3 which is low in exchangeable magnesium. All samples report low exchangeable sodium, potassium, and calcium (**Table 2**, attached). The fine-grained characteristics of the ash solids are likely to create a low hydraulic conductivity area when deposited in the former mine pit based on these results. The presence of silts and clays has the potential to provide attenuation in the form of sorption surfaces for metal cations and major ions (such as sodium, potassium, calcium, and magnesium).

6.2.2.2 Ash Solids – Ash Acid and Alkali Generating Characteristics

Several tests were conducted on the ash to characterise the acid-producing and acid neutralizing potential. Although the ash is an alkaline material there was a potential for the presence of coal fines within the ash. These tests included:

1. Total sulfur;
2. MPA;
3. ANC expressed as percentage calcium carbonate ($CaCO_3$) and kg of sulfuric acid (H_2SO_4) equivalents per tonne;
4. NAG at pH 4.5 and pH 7;
5. NAPP; and
6. Fizz rating.

Initial pH screening tests (field pH [pHF] – pH in deionised water and field oxidised pH [pHFOX] tests) were not undertaken on the samples to determine the degree of acidity. This was based on the historical geochemical characterisation of the ash and its anticipated alkaline nature.

The MPA can be estimated from the total sulfur content, although it is a conservative approach because it assumes all sulfur generates acidity under oxidising conditions. All the ash samples contained low amounts of sulfur (**Table 2**, attached). A conservative assessment of acidity potential using the sulfur concentrations estimates that the ash has a low potential acidity production.

ANC measures the amount of acid a sample can neutralise. The consumption of acidity by a sample is determined and expressed as kg H_2SO_4 equivalents/tonne. This reports the ability of a sample to neutralise (using its buffering capacity) any acidity generated. ANC is elevated in the ash solids, so NAPP is unlikely from the ash samples. The fizz rating for all three ash samples was reported as a ‘very strong reaction’ and Locations 1 and 2 were rated 5 where ANC is >400 kg H_2SO_4/t. The elevated pH, fizz, and ANC values are indicative of fresh or minimally leached ash. Leached ash typically has lower concentrations of alkalinity and lower pH and associated negligible fizz and ANC values.

NAG directly evaluates the generation of sulfuric acid within a sample. The NAG procedure includes a final titration to pH 4.5 and finally pH 7. The reported titration value at pH 4.5 includes acidity due to free acid (sulfuric acid, H_2SO_4) in addition to soluble iron and aluminium. The titration value at pH 7 also includes metallic ions that precipitate as hydroxides between pH 4.5 and 7. The results of the NAG tests also support the low probability of acid production potential with the ash samples.

NAPP represents the theoretical balance of a samples capacity to generate acid (MPA) and its capacity to neutralise (ANC). If the MPA is less than ANC, then the NAPP is negative and the sample may have sufficient ANC to prevent acid generation; however, if the MPA exceeds the ANC then the NAPP is positive and the same may be acid generating. All three ash samples report negative NAPP values.

The acid-producing potential is plotted as **Figure 6-4**, which shows Locations 1, 2, and 3 as non-acid forming.

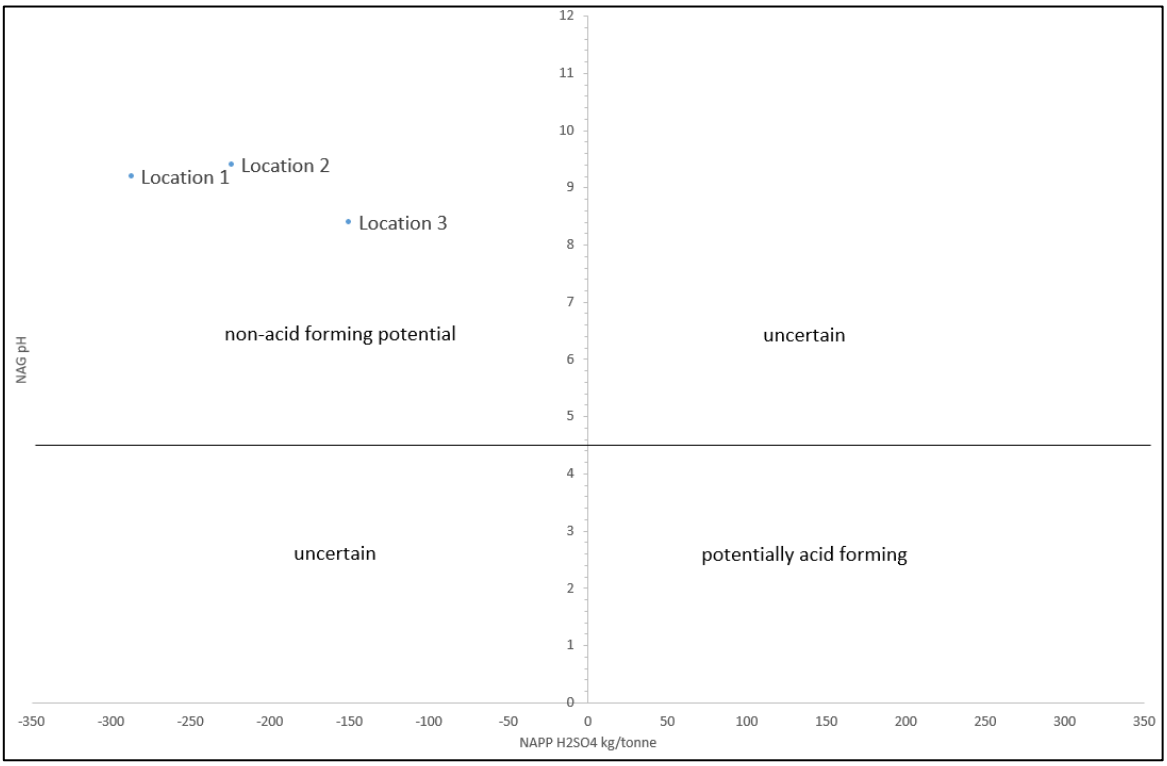

Figure 6-4 Ash Pond 1 Solid Samples – Acid Forming Potential Plot

In summary, the fresh ash material represents an elevated capacity for acid neutralisation.

6.2.2.3 Ash Solids – Major Ions

The major ion concentrations are provided in **Figure 6-5** and **Table 2** (attached).

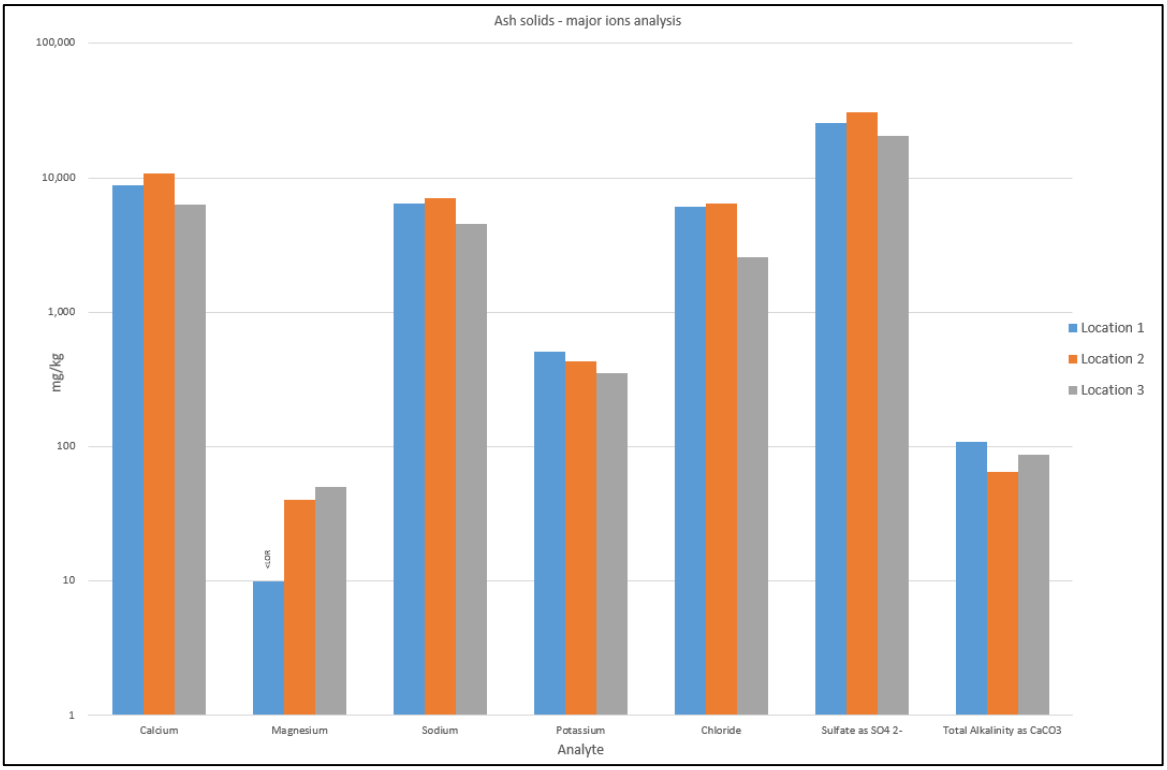

Figure 6-5 Ash Pond 1 Solids – Major Ions Analytes 2016

The analytical results for major ion concentrations in ash solids (**Figure 6-6** and **Table 2**[attached]) fall within similar ranges of concentrations presented in previously published references (Beattie, 2003).

6.2.2.4 Ash Solids – Minor Ions

Cadmium, molybdenum, tin, and selenium all reported concentrations below the laboratory limit of reporting (LOR), refer to **Figure 6-6**.

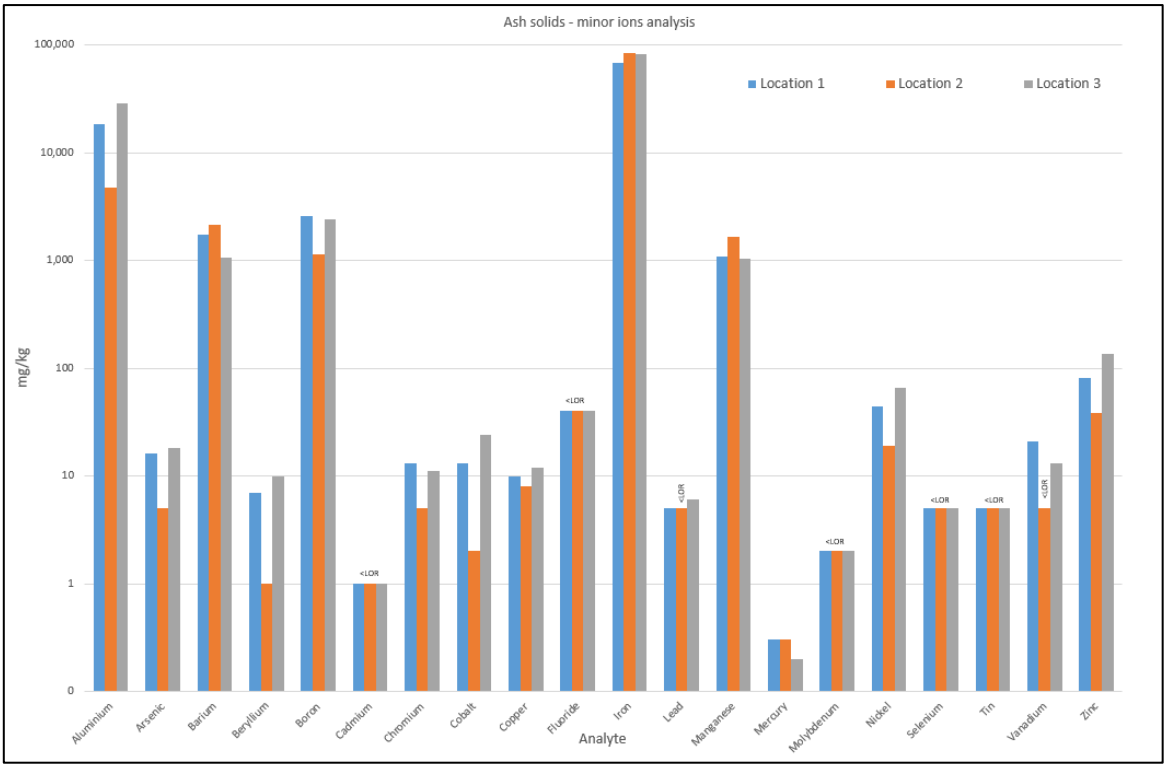

Figure 6-6 Ash Pond 1 Solids – Minor Ions 2016

The analytical results for minor ion concentrations in ash solids (**Figure 6-6**) fall within similar ranges of detectable concentrations presented in previously published references (Beattie, 2003); refer to **Figure 6-1** and GHD (2012).

6.2.2.5 Ash Pond 1 Water – Major Ions

The Ash Pond 1 water samples have been characterised for water types and major ion distribution relationships using the Geochemists Workbench (GWB) Community program. GWB can be used to check the internal consistency and carbonate equilibria of data sets and plot a variety of graphs including Piper plots.

It is noted that within some analytical reporting for total and dissolved analytes, occasionally the dissolved concentration is higher than the total concentration. These results have been reviewed by quality control procedures and the differences reported are within the experimental variation of the analytical methods.

Three samples of ash pond water were collected from Ash Pond 1. A range of analyses were carried out on the Ash Pond 1 samples (**Table 8**, attached) which included:

1. Major ions; and
2. Total and dissolved minor anions.

The Ash Pond 1 water plots as a sodium sulfate water type (**Figure 6-7**). All the ash pond samples are supersaturated with calcium carbonate which is a function of the pH (average pH 8.25).

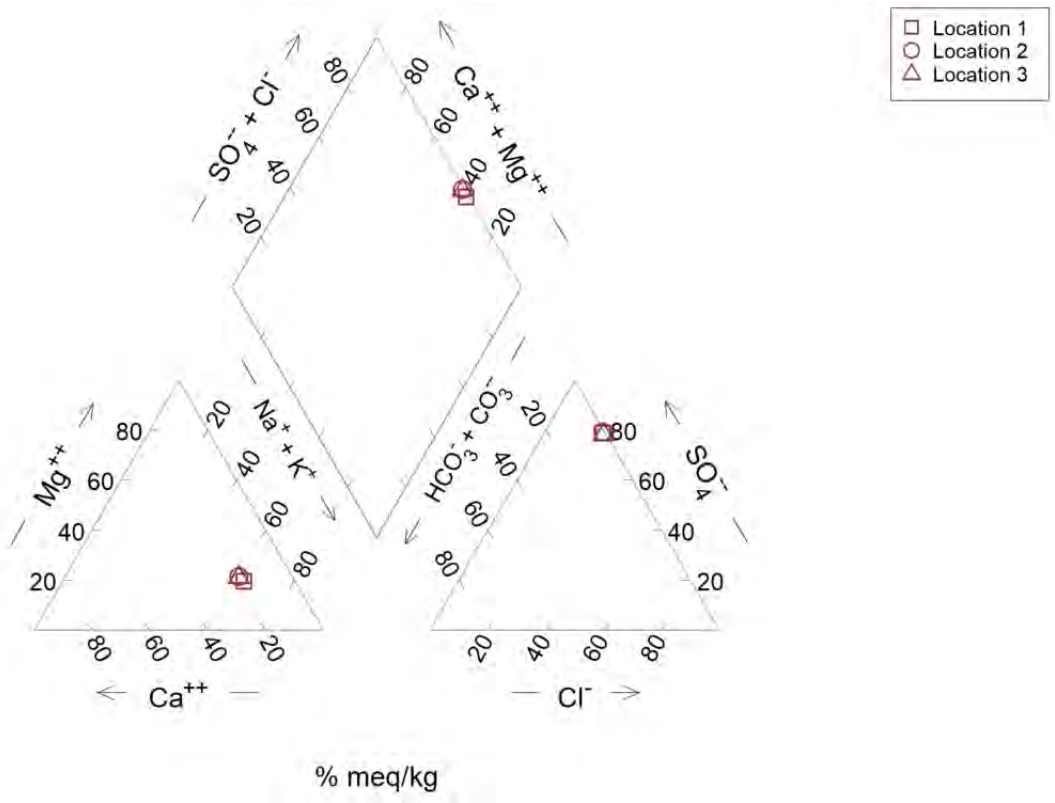

Figure 6-7 Piper Plot Ash Pond 1 Surface Water Locations

Major ion distribution is also provided in **Figure 6-8**.

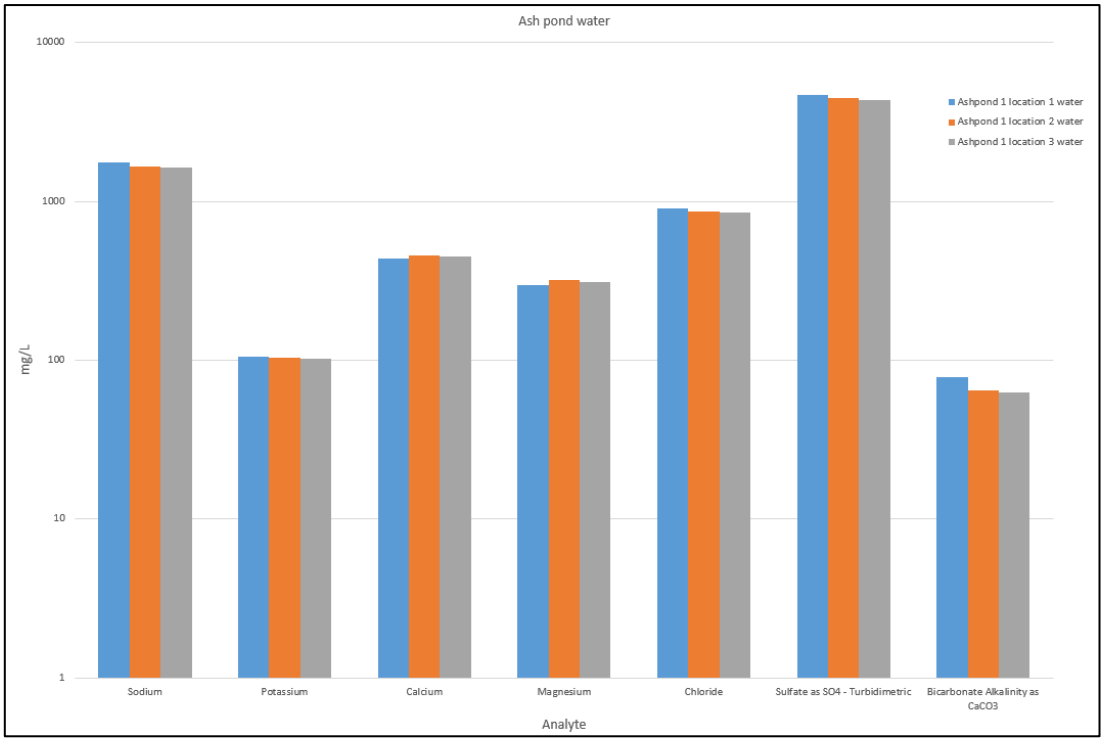

Figure 6-8 Ash Pond 1 Water – Major Ions 2016

In comparison to the historical major ion concentrations, there appears to be a good correlation between the data presented in **Figure 6-2** and **Figure 6-8**.

6.2.2.6 Ash Pond Water - Minor Ions

The Ash Pond 1 water is characterised by low to non-detectable concentrations of minor ions. Total and dissolved arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, selenium, tin, and vanadium are all reported at or below the laboratory LOR. Minor ion distribution is dominated by boron (greater than 10 mg/L), followed by aluminium, barium, and manganese (**Figure 6-9** and **Table 8** [attached]).

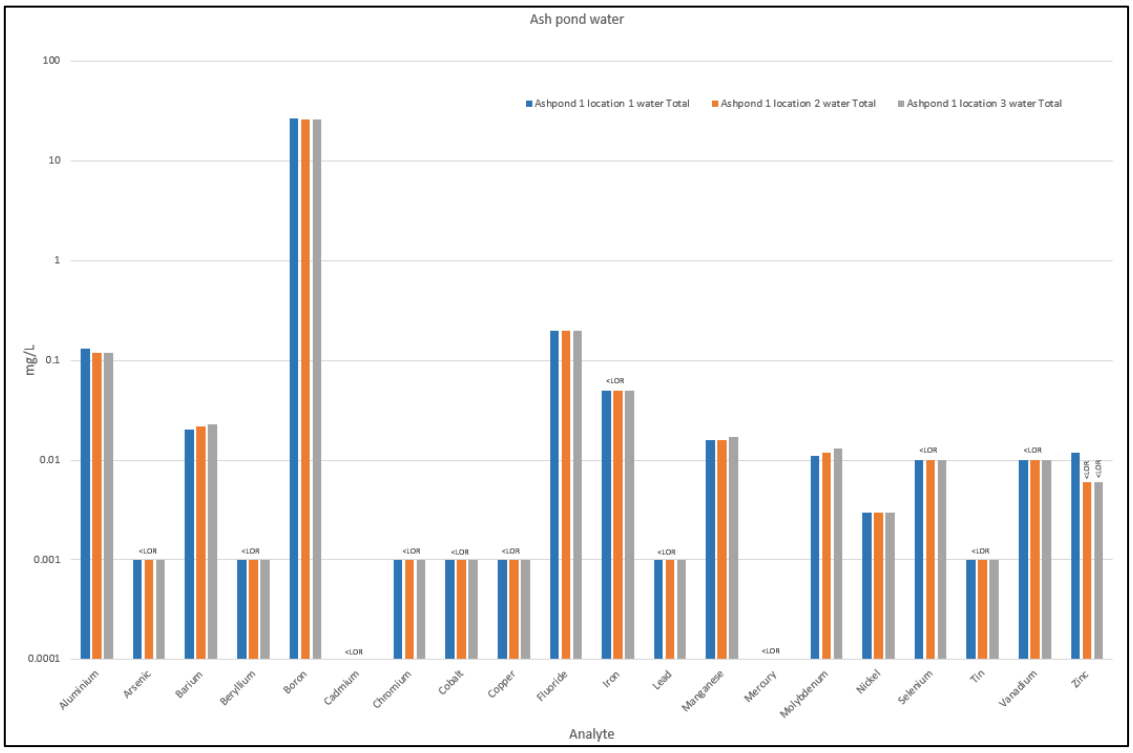

Figure 6-9 Ash Pond 1 Water – Minor Ion Concentrations 2016

6.2.3 Leachable Fraction Analysis

A sample of ash solid material was leached using Ash Pond 1 surface water as the reagent water. The ASLP method was used for the leachate procedure but instead of using a laboratory-derived reagent water (pH 5), a site representative reagent water was used, Ash Pond 1 water. The ash pond water has been in contact with the ash solid material for an extended period (years to decades). The comparison between Ash Pond 1 water and the leachable analyses provides an indication of the equilibrium between the Ash Pond 1 water and solid material and future porewater characteristics within the consolidated leached ash area.

Leachable fraction and Ash Pond 1 water analyses are provided in **Figure 6-10**.

The results of the ash solid, ash pond water and leachable fraction analyses are provided in **Table 7** to **Table 9** (attached).

The ASLP results for the Ash Pond 1 water and ash solids indicate that the main variances between the analyses are related to alkalinity and pH. The pH is observed to increase from pH 8.22 (Ash Pond 1 water) to pH 9.8 (leachate). Accompanying the increase in pH are increases in carbonate and hydroxide alkalinity and a decrease in bicarbonate alkalinity. The changes in relative abundance of alkalinity species is as expected with the change in pH. It is likely that the increase in pH initially

occurred when water came into contact with the ash material within the ponds. Over time, the hydroxide species would have been scavenged by metal cations to form insoluble precipitates, which in turn would have decreased the pH. As observed in **Figure 6-10** and **Figure 6-11**, most of the analytes report negligible changes between ash pond water and the leachable fraction of ash solids in contact with ash pond water. This supports a hypothesis that the water is anticipated to be in equilibrium with the ash solids within Ash Pond 1.

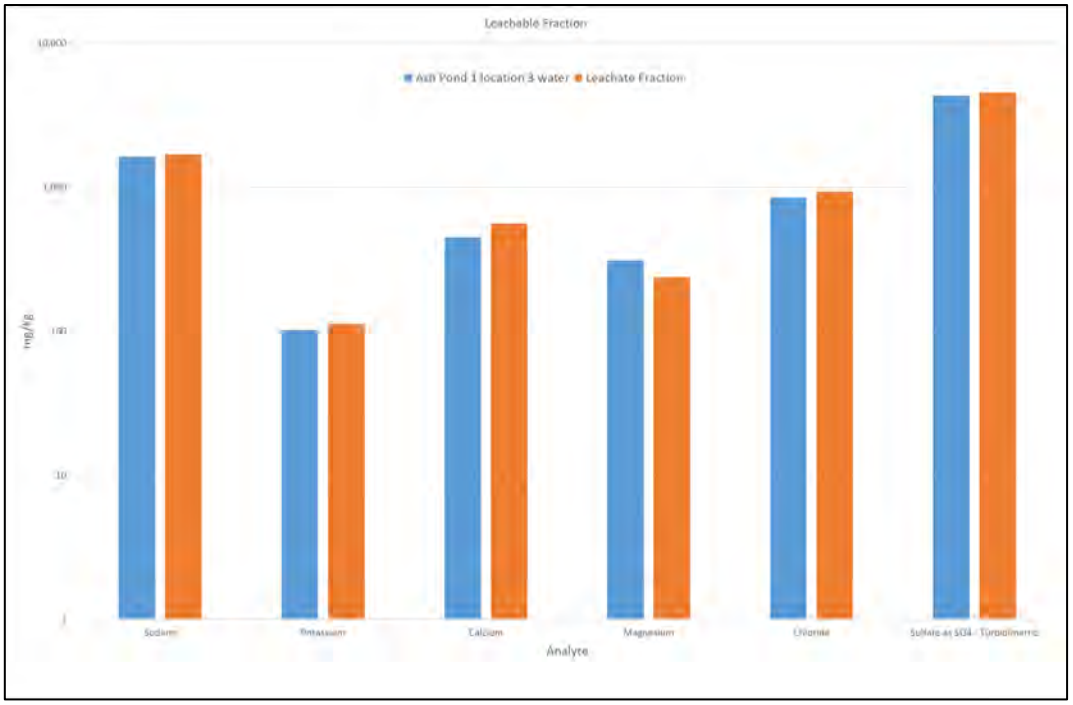

Figure 6-10 Major Ions – Ash Pond 1 Water and Leachable Fraction Analyses 2016

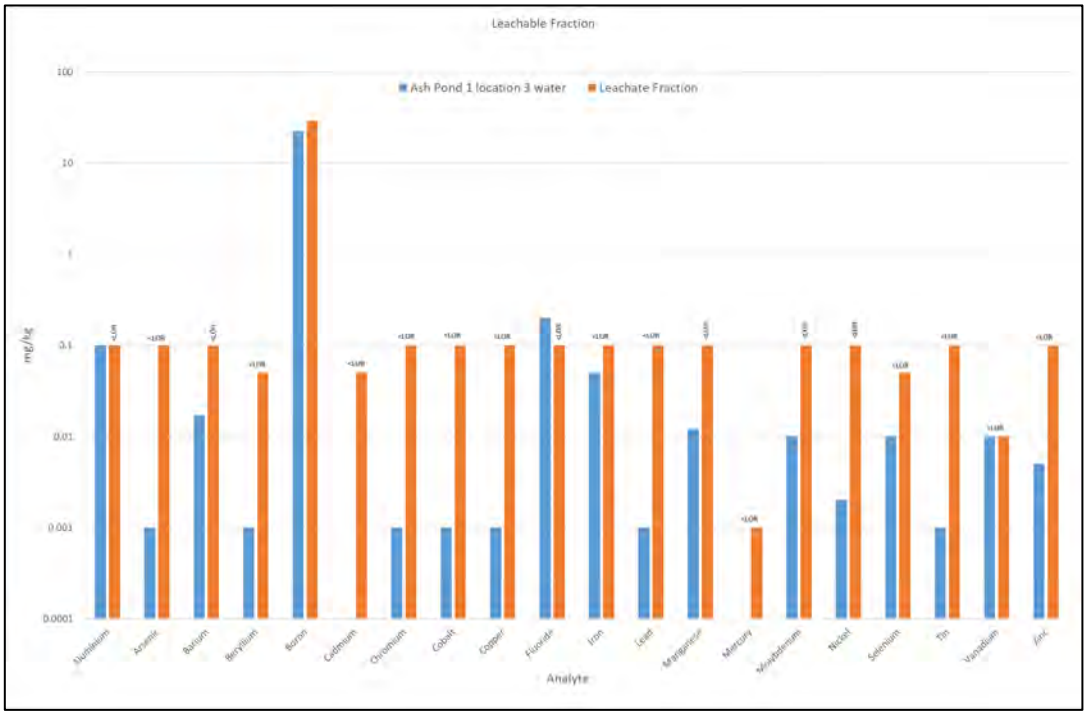

Figure 6-11 Minor Ions – Ash Pond 1 Water and Leachable Fraction Analyses 2016

Note the differing LORs between the Ash Pond 1 water and leachable fraction analysis. The LOR achieved for the leachable fraction analysis is observed to be between one and three orders of magnitude higher than that for the Ash Pond 1 water.

In summary, ASLP testing conducted using Ash Pond 1 solids and water reported limited leaching potential for metals from the ash materials. The results of these tests indicated that the majority of metals were strongly bound to the ash matrix. Boron, ammonia, and nitrate/nitrite were the only constituents detected in the leachable fraction.

6.3 Consolidated Leached Ash Characterisation – 2021

During September 2021 a two-day field sampling event collected samples for permeability, chemical, and ASLP analysis. The sampling event was focussed within the clay-rich cover (over the consolidated leached ash), the consolidated leached ash and the underlying fill material. The objective was to gather permeability data and understand the chemical profiles of the CLA, clay-rich cover, and underlying fill material. Only the CLA results are presented and discussed within this section. Refer to **Section 7** for the discussion of clay-rich cover and fill material characterisation.

The site location plan is provided as **Figure 1** (attached) and sample locations within **Figure 6** (attached).

Bore logs are provided as **Appendix G**.

6.3.1 Permeability Testing

Permeability test results are presented in **Table 6-6**. All results are less than $5x10^{-9}$ m/sec and the geomean for each material group is less than $1x10^{-9}$ m/sec. Ash permeability results are observed to be very similar to those reported for the clay-rich cover layer (refer to **Section 7.1**).

Table 6-6 Permeability Test Results (de-ionised water permeameter method)

Alcoa ID	Material	Texture	Permeability (m/sec)
ANG_21_181	Ash	Silty CLAY	$8x10^{-10}$
ANG_21_185	Ash	CLAY	$2 x10^{-10}$
ANG_21_187	Ash	Silty CLAY	$9 x10^{-9}$
ANG_21_191	Ash	CLAY	$1 x10^{-9}$
ANG_21_193	Ash	Silty CLAY	$4 x10^{-10}$
ANG_21_196	Ash	Clayey SILT	$2 x10^{-9}$
ANG_21_202	Ash	Silty CLAY	$5 x10^{-9}$

Soil testing was carried out on samples to assess the Emerson Class Number. This test indicates the degree of dispersivity, or reactivity displayed by the samples when in contact with de-ionised water and provides an indication of the ash (and surrounding material) stability under saturated conditions. The results show that most of the samples did not disperse in de-ionised water apart from two samples that showed a slight to moderate reaction.

The laboratory geotechnical results are presented in **Table 10** (attached) and **Appendix E**. Emerson results are presented in **Table 11** (attached).

A west-east cross section through the consolidated leached ash area based on selected bore logs within **Appendix G** is provided as **Figure 7** (attached).

6.3.2 Chemical Testing

Chemical testing on the leached ash samples included total and leachable fraction analysis at two pH values, pH 2.9 and pH 7. These two pH values were selected based on the pH conditions in the vicinity of the CLA area.

The CLA and leachable fraction analyses are provided in **Table 12** and **Table 13** (attached).

The laboratory analysis reports are presented in **Appendix E**.

Laboratory and field sample QA/QC is provided in **Appendix F**.

Total major and minor ion analysis results are presented in **Figure 6-12** through **Figure 6-15**.

Major ion concentrations are generally lower than those reported in 2016, particularly sodium and chloride (**Figure 6-5**).

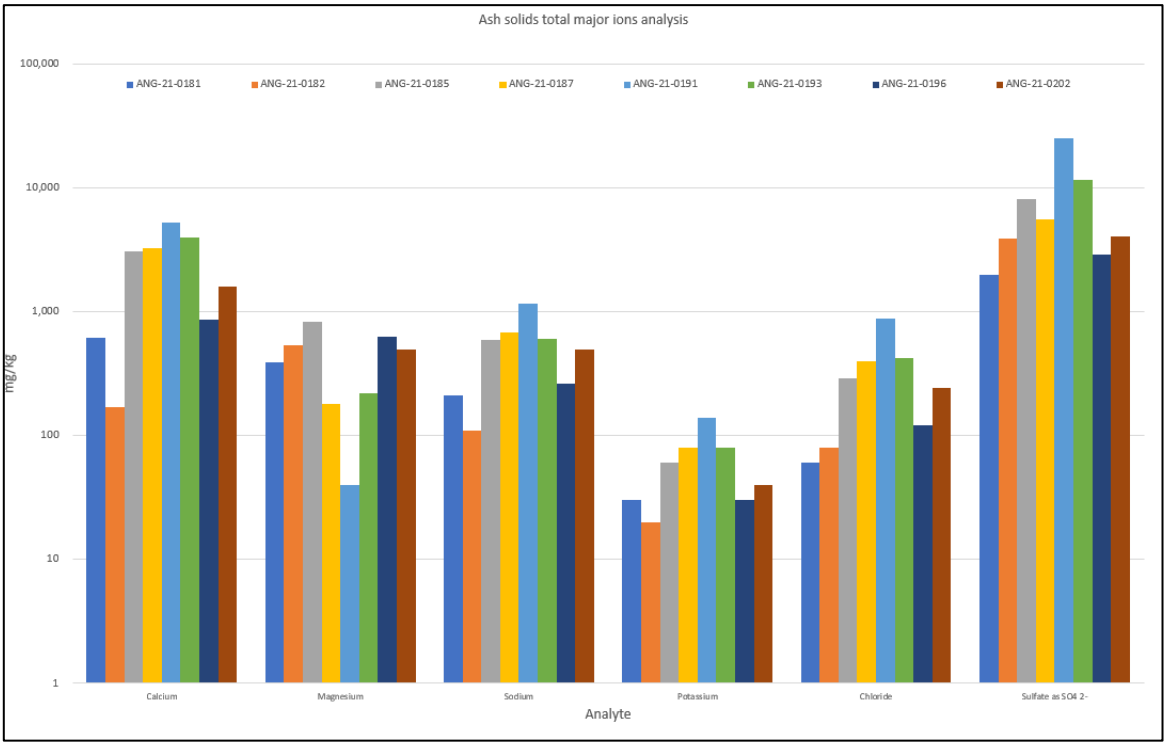

Figure 6-12 Leached Ash Solids Total Major Ions Analysis 2021

Minor ion concentrations are mostly unchanged in comparison with 2016 (**Figure 6-6**) with the exception of fluoride which is now detected above the LOR.

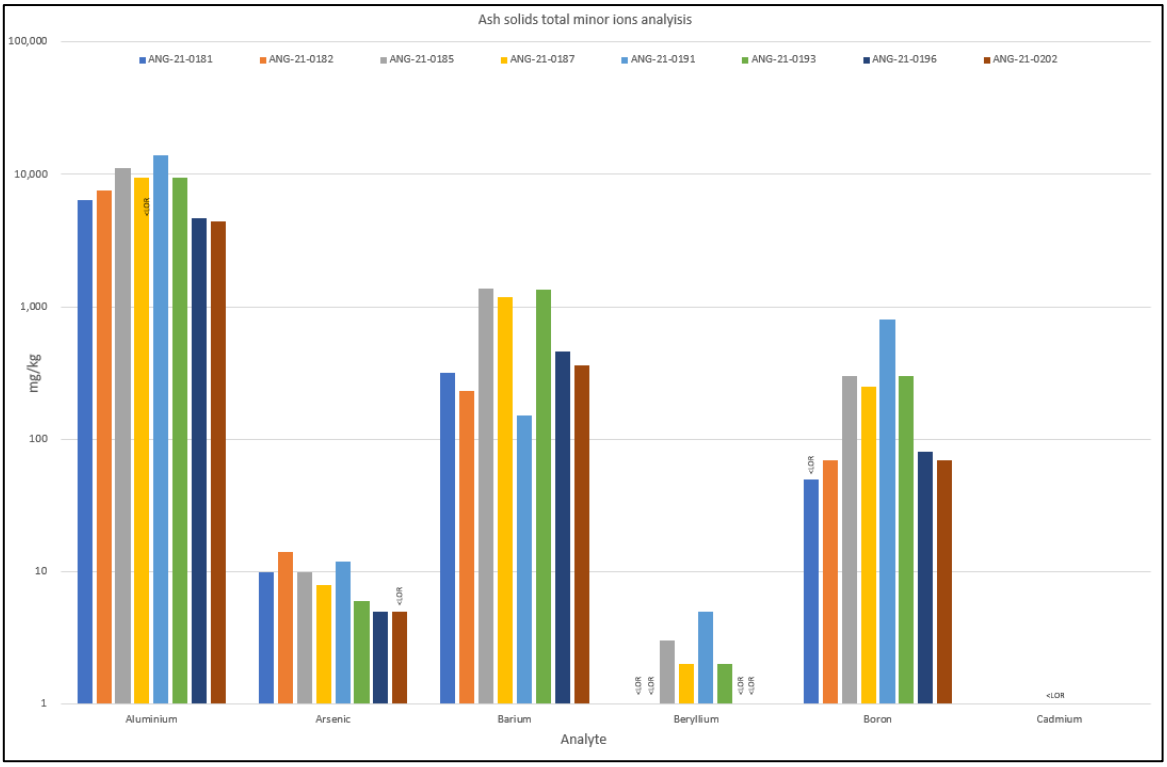

Figure 6-13 Leached Ash Solids Total Minor Ions Analysis (aluminium through cadmium) 2021

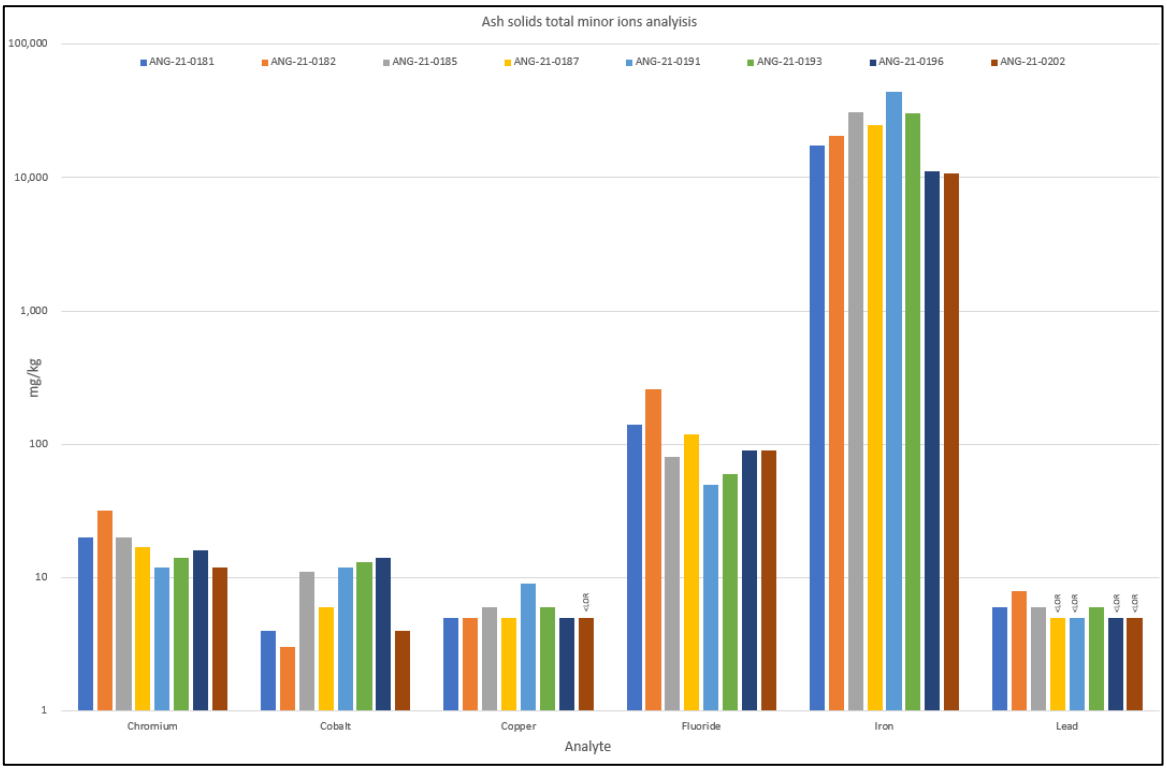

Figure 6-14 Leached Ash Solids Total Minor Ions Analysis (chromium through lead) 2021

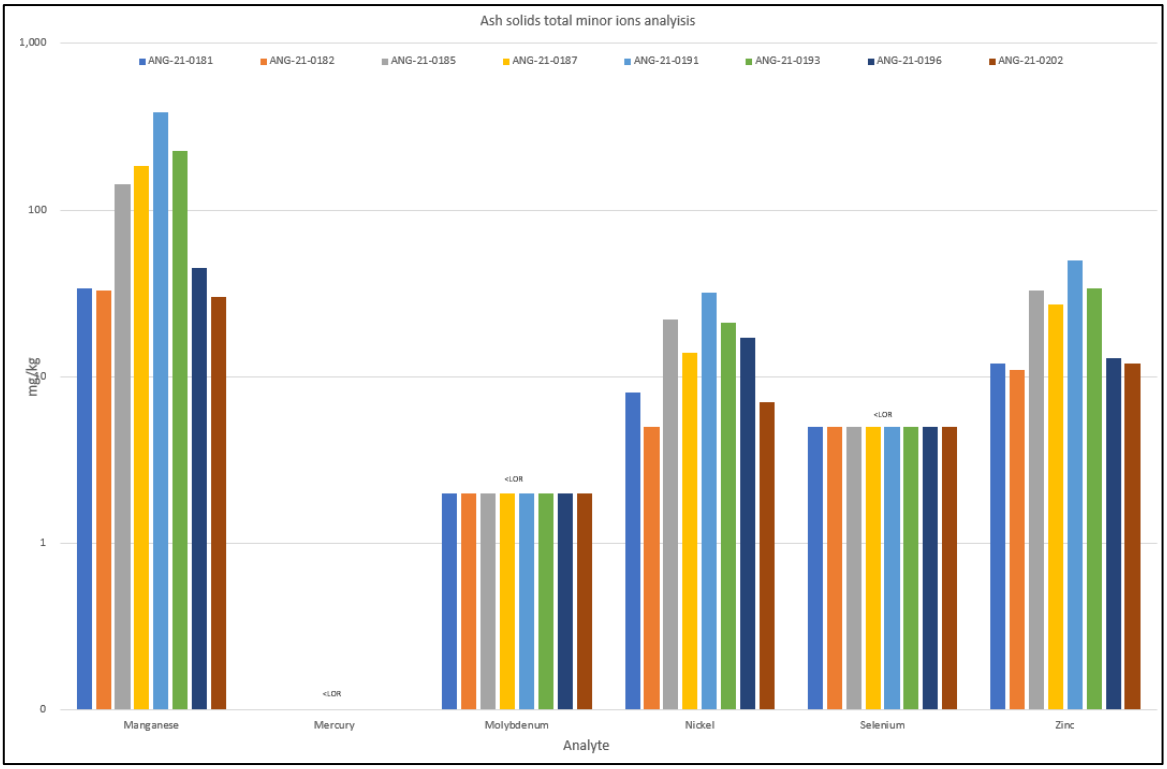

Figure 6-15 Leached Ash Solids Total Minor Ions Analysis (manganese through zinc) 2021

In comparison to the typical ranges of minor ions encountered in coal ash, Anglesea leached ash is representative of the lower end of the range presented in **Table 6-7**. The lower concentrations are most likely attributed to the extended leaching of the ash in the ash ponds.

Table 6-7 Minor Ions – Typical Ranges in fresh CCA (after Eary et al, 1990)

Analyte	Fly Ash (mg/kg)	Bottom Ash (mg/kg)	Anglesea Fly Ash (mg/kg) Beattie (2003)
Arsenic	2 – 440	0.02 – 168	7.5
Barium	1 – 13,800	11 – 9,360	2,974
Boron	10 – 5,000	2 – 513	4,148
Cadmium	0.1 – 130	0.1 – 4.7	3.6
Chromium	4 – 900	0.2 – 5,820	29
Copper	33 – 2,200	4 – 930	11
Lead	3 – 2,100	0.4 – 1,100	14
Manganese	25 – 3,000	60 – 1,900	991
Mercury	0.01 – 12	0.01 – 4	0.3
Molybdenum	1 – 140	1 – 440	1.2
Nickel	2 – 4,300	<10 – 2,900	67
Selenium	0.2 – 130	0.1 – 10	7.4
Zinc	14 – 3,500	4 – 1,800	105

ASLP testing was conducted on ash samples at two different pHs, pH 2.9 and pH 7. The leachable fraction concentrations are provided in **Figure 6-16** to **Figure 6-19**.

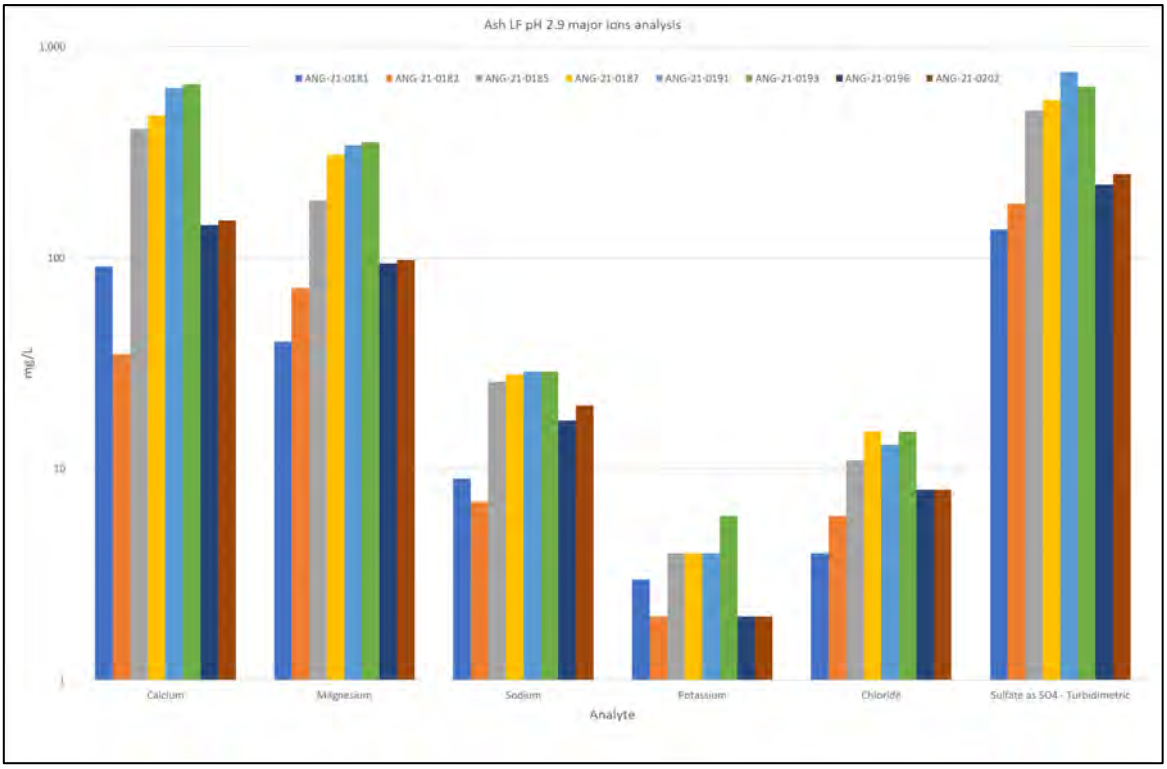

Figure 6-16 Leached Ash Leachable Fraction pH 2.9 Results – Major Ions 2021

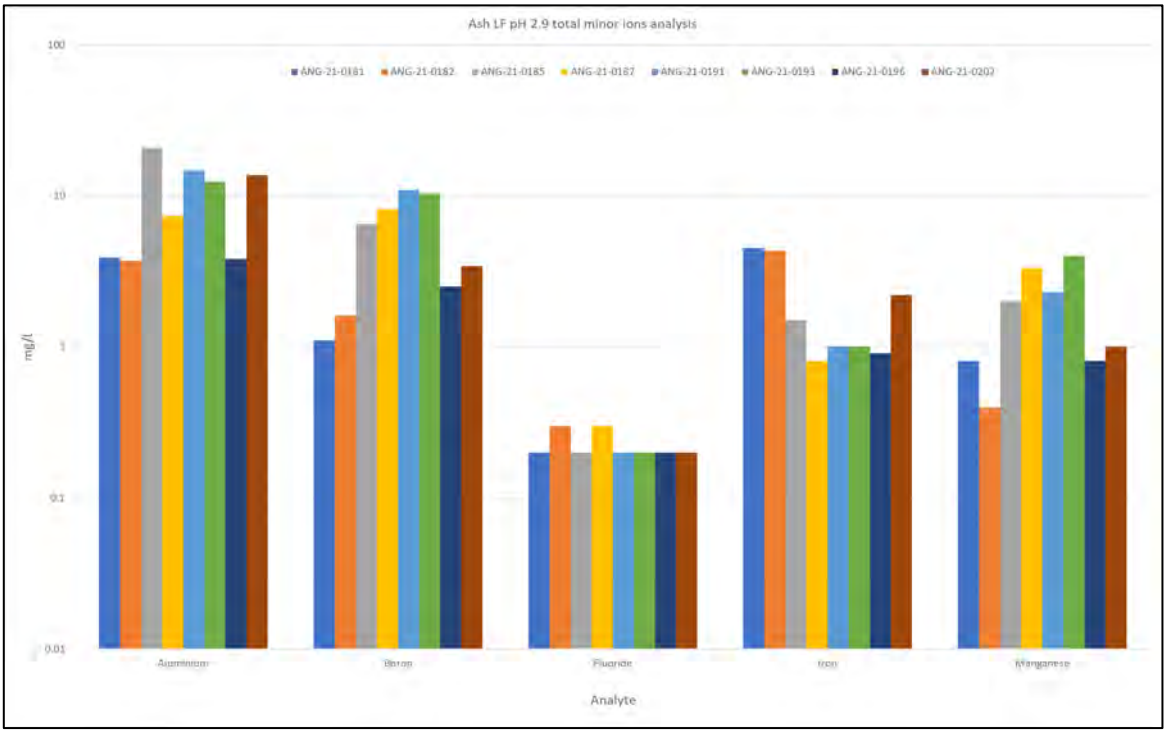

Figure 6-17 Leached Ash Leachable Fraction pH 2.9 Results – Minor Ions[28] 2021

[28] The following minor ions were reported below the LOR and not plotted – arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, selenium, zinc. Barium and nickel where also omitted from the plot as they both reported concentrations at or below the LOR of 0.1 mg/L.

The comparison of leachable fraction concentrations at pH 2.9 and pH 7 does not reveal any marked differences with the exception of manganese which appears to be less leachable at neutral pH.

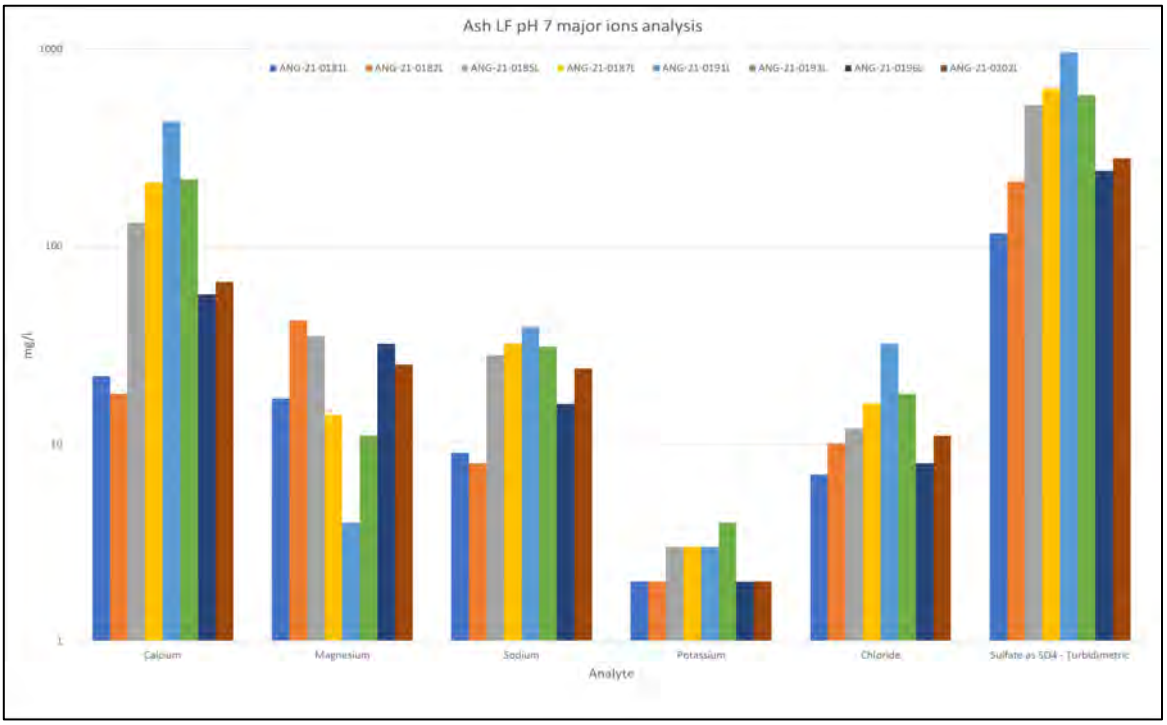

Figure 6-18 Leached Ash Leachable Fraction pH 7 Results – Major Ions 2021

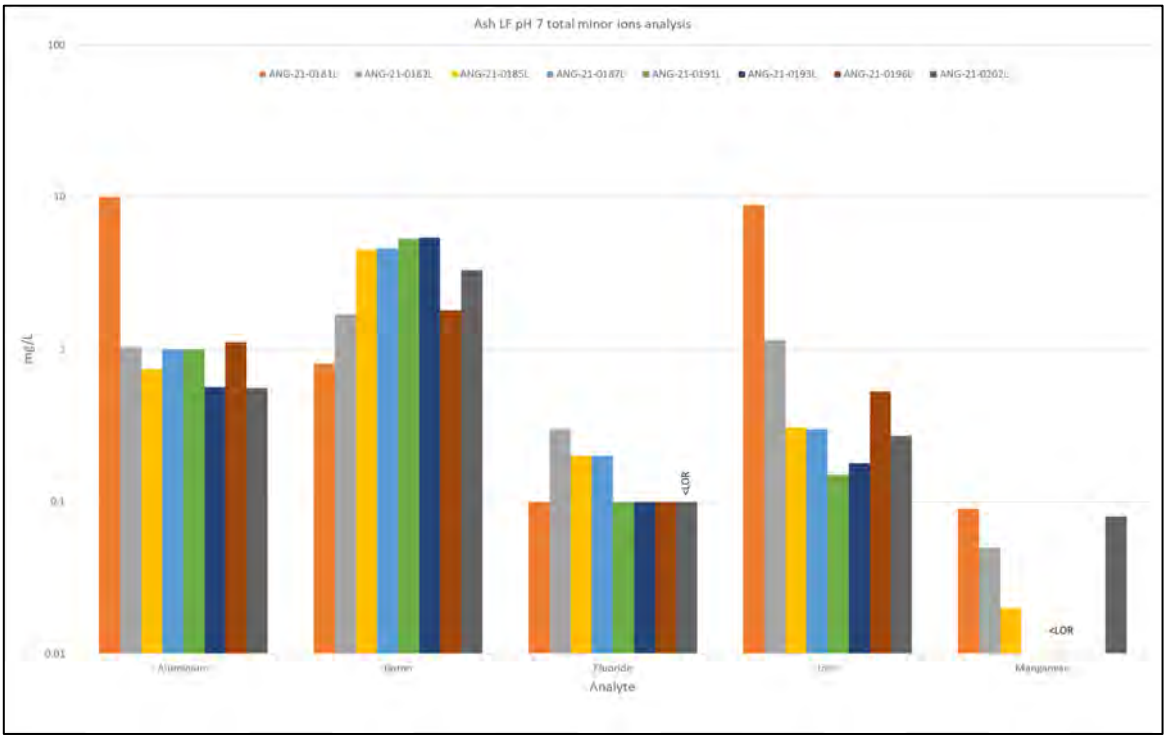

Figure 6-19 Leached Ash Leachable Fraction pH 7 Results – Minor Ions[29] 2021

[29] The following minor ions were not plotted – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iodide, lead, mercury, molybdenum, nickel, phosphorus, selenium, silver, thallium, tin, vanadium, zinc as they reported concentrations at or below the analyte LOR.

6.3.3 Comparison of Leached Ash Leachable Fraction with Water Body and Groundwater Quality

Due to the low permeability of the clay-rich fill material surrounding the CLA and the retardation properties of the clay, it is highly unlikely that constituents in leached ash pore water will impact either groundwater or surface water in the vicinity. This is also supported by the outcomes of the numerical modelling (**Section 9**).

A comparison of the acidic leachable fraction analysis of ash sample ANG-21-191 with the current groundwater (groundwater monitoring location, DBG MB6) and surface water quality (water body) in the vicinity of the consolidated leached ash indicates that if a direct discharge of ash pore water occurred into the water body it is unlikely to be detectable (**Table 6-8**).

Only iron and calcium are elevated in the leached ash leachable fraction in comparison to the water body. A direct discharge of leached ash pore water to the water body would not be subject to any retardation or dilution mechanisms that could occur along the discharge pathway. Aluminium, boron, and calcium are elevated in the leached ash leachable fraction in comparison to shallow groundwater in the vicinity of DBG MB6; again, this would assume an unattenuated discharge of leached ash pore water to the location of DBG MB6.

Table 6-8 Comparison of Leached Ash Leachable Fraction, Groundwater, and Water Body Water Quality

Sample ID	ANG-21-191	ANG-22-104	ANG-22-105
Sample Location	ADBH04	DBG MB6	Water Body
Media	Consolidated Leached Ash ASLP pH 2.9 Leachable Fraction	Groundwater	Surface Water
Sample Date	14/09/2021	27/07/2022	27/07/2022
Aluminium (mg/L)	3.9	0.12	4.69
Boron (mg/L)	1.1	0.313	1.16
Calcium (mg/L)	91	30	85
Chloride (mg/L)	4	666	471
Iron (mg/L)	4.5	66.1	0.922
Magnesium (mg/L)	40	110	91
Potassium (mg/L)	3	17	19
Sodium (mg/L)	9	564	272
Sulfate as SO^{2-} (mg/L)	136	973	654

7 Consolidated Leached Ash Area Characterisation – 2022

As recommended by BlueSphere as part of the Independent Peer Review process, a four-day field sampling event was held in June and July 2022 to collect additional samples for further permeability, chemical and ASLP analysis. The 2022 sampling event was undertaken to compliment the 2021 sampling event on the advice of BlueSphere. The spatial coverage and number of investigation locations for the 2022 event was discussed in detail as part of the Independent Peer Review process so that the combination of the 2021 and 2022 sampling events meet the requirements of the AS4482.1 Sampling Design Guidelines. Australian Standard, AS4482.1-2005, was used as a guide to ensure a sufficient sample density was achieved to characterise the clay-rich cover and fill material, in consultation with BlueSphere. A sufficient number of CLA samples had been collected in 2021 for characterisation. The clay-rich cover and fill material samples collected in 2021 are also presented and discussed in this section.

The sampling event was focussed within the clay-rich cover (over the CLA) and fill material areas surrounding the CLA. The objective was to gather more permeability data to support the assumptions made in the hydraulic modelling assessment and to assess the potential for infiltration impacts of residual ash pond water (from sluiced ash) discharged from the CLA area to the water body in 2016.

The site location plan is provided as **Figure 1** (attached) and sample locations within **Figure 6** (attached). Bore logs are provided as **Appendix G**.

7.1 Permeability Testing

Permeability test results from 2021 and 2022 are presented in **Table 7-1**.**Table** 7-2 and **Table 7-3**. All results were reported at less than 7 $x10^{-8}$ m/sec and the geomean for each material group is less than $2x10^{-9}$ m/sec with the exception of the 2021 fill material group. This result is skewed by a sample of organic clay with a permeability of $6x10^{-8}$ m/sec which is not representative of the other fill material sample permeabilities. This sample is considered to be an outlier in the dataset, however has been retained. Samples tested with both de-ionised and saline water reported minimally different permeabilities.

Table 7-1 Permeability Test Results 2021 (de-ionised water permeameter method)

Alcoa ID	Material	Texture	Permeability (m/sec)	Geomean (m/sec)
ANG-21-184	Clay rich layer	Sandy CLAY	$2x10^{-10}$	$4.7x10^{-10}$
ANG-21-189	Clay rich layer	Sandy CLAY	$4x10^{-10}$	
ANG-21-195	Clay rich layer	CLAY	$3x10^{-10}$	
ANG-21-201	Clay rich layer	Sandy CLAY	$2x10^{-9}$	
ANG-21-197	Fill material	Sandy CLAY	$4x10^{-9}$	$9.86\ x10^{-9}$
ANG-21-207	Fill material	Sandy CLAY	$4x10^{-9}$	
ANG-21-211	Fill material	Organic CLAY	$6x10^{-8}$	

Table 7-2 Permeability Test Results 2022 (de-ionised water permeameter method)

Alcoa ID	Material	Texture	Permeability (m/sec)	Geomean (m/sec)
ANG-22-0025	Fill material	Silty sandy CLAY	$4x10^{-10}$	
ANG-22-0030	Fill material	Clayey SAND	$7x10^{-8}$	
ANG-22-0034	Fill material	Clayey SAND	$7x10^{-10}$	
ANG-22-0035	Fill material	Silty SAND	$4x10^{-8}$	
ANG-22-0040	Fill material	Clayey SILT	$2x10^{-9}$	$1.97x10^{-9}$
ANG-22-0044	Fill material	Silty CLAY	$8x10^{-10}$	
ANG-22-0045	Fill material	Silty CLAY	$9x10^{-11}$	
ANG-22-0048	Fill material	Silty CLAY	$2x10^{-10}$	
ANG-22-0049	Fill material	Clayey SILT	$2x10^{-8}$	

Table 7-3 Permeability Test Results 2022 (Saline water permeameter method, 5,000 ppm)

Alcoa ID	Material	Texture	Permeability (m/sec)	Geomean (m/sec)
ANG-22-0015	Clay rich layer	Silty CLAY	$7x10^{-8}$	
ANG-22-0016	Clay rich layer	Silty CLAY	$1x10^{-9}$	
ANG-22-0019	Clay rich layer	Sandy CLAY	$1x10^{-9}$	$1.4x10^{-9}$
ANG-22-0022	Clay rich layer	Sandy CLAY	$4x10^{-10}$	
ANG-22-0023	Clay rich layer	Silty CLAY	$2x10^{-10}$	
ANG-22-0017	Fill material	Silty sandy CLAY	$2x10^{-10}$	
ANG-22-0018	Fill material	Sandy CLAY	$5x10^{-9}$	
ANG-22-0020	Fill material	Silty CLAY	$9x10^{-9}$	
ANG-22-0021	Fill material	Clayey SAND	$1x10^{-8}$	
ANG-22-0024	Fill material	Silty sandy CLAY	$7x10^{-10}$	
ANG-22-0025	Fill material	Clayey SAND	$3x10^{-10}$	
ANG-22-0027	Fill material	Silty SAND	$3x10^{-9}$	
ANG-22-0029	Fill material	Silty CLAY	$4x10^{-8}$	
ANG-22-0030	Fill material	Sandy CLAY	Test not performed[30]	$1.32x10^{-9}$
ANG-22-0032	Fill material	Silty CLAY	$5x10^{-5}$	
ANG-22-0034	Fill material	Clayey SILT	$2x10^{-10}$	
ANG-22-0035	Fill material	Silty CLAY	$9x10^{-9}$	
ANG-22-0037	Fill material	Silty CLAY	$1x10^{-9}$	
ANG-22-0039	Fill material	Silty CLAY	$1 x10^{-9}$	
ANG-22-0040	Fill material	Sandy CLAY	$2 x10^{-9}$	
ANG-22-0042	Fill material	Silty CLAY	$2 x10^{-9}$	
ANG-22-0044	Fill material	Clayey SILT	$7 x10^{-10}$	

[30] No saline test result - sample collapse between solutions

Alcoa ID	Material	Texture	Permeability (m/sec)	Geomean (m/sec)
ANG-22-0045	Fill material	Sandy CLAY	8×10^{-11}	
ANG-22-0047	Fill material	Sandy CLAY	4×10^{-10}	
ANG-22-0048	Fill material	Sandy CLAY	2×10^{-10}	
ANG-22-0049	Fill material	Silty CLAY	3×10^{-8}	
ANG-22-0051	Fill material	Clayey SAND	3×10^{-10}	

The laboratory geotechnical results are presented in **Table 10** and **Table 14** (attached) and **Appendix E**.

7.2 Chemical Testing

7.2.1 Initial Analysis

Two locations (ADBH32 and ADBH33) were advanced within the area where the discharge of leached ash pond water occurred. Three samples were collected at each location within elevations 0-2 mbgl, 2-4 mbgl, and 4-6 mbgl. Total and ASLP analysis was conducted on each sample. The leaching procedure was carried out at two pH values, pH 2.9 and a pH representative of de-ionised water (pH 5 to 6). The results have been tabulated and not plotted due to the low concentrations and non-detects reported for this group of samples.

The laboratory analysis reports are presented in **Appendix E**.

Laboratory and field sample QA/QC is provided in **Appendix F**.

The laboratory results are provided within **Table 15** and **Table 16** (attached).

Table 7-4 and **Table 7-5** provide the summary results of the total major and selected minor ion analysis from the discharge area. The total major and selected minor ion analysis from a sample of the clay-rich cover (from 2021 field sampling event) has also been added for comparison. A very similar profile of major and minor ion concentrations is observed for both the fill material in the discharge area and the clay-rich cover.

Table 7-6 and **Table 7-7**, **Table 7-8** and **Table 7-9** present the summary results of the ASLP analysis at pH 2.9 and a pH representative of de-ionised water (pH 5 to 6), respectively; again, a very similar profile of major and minor ion leachable fraction concentrations is reported for both the fill material in the discharge area and the clay-rich cover. The minor ions selected are representative of a small group of consistently detectable analytes including aluminium, which can be indicative of coal, ash, and ash pond water. Boron, which is also a coal/ash indicator analyte, was not reported above the LOR in totals or leachable fraction results. ASLP analysis of ash solids and ash pond water quality typically reports the presence of boron at concentrations greater than 10 mg/L.

Based on the results of the totals and ASLP analyses, impacts from the leached ash water discharge (and potential infiltration) appear to be limited in concentration and do not change the overall outcomes of the risk assessment; however, additional samples which were kept on hold were submitted for total and leachable fraction analysis the results of which are discussed in **Section 7.2.2**.

Table 7-4 Major Ion Total Analysis – Discharge Area and Clay-rich Cover

Analyte	Location	Discharge Area						Clay-rich Cover
	Alcoa Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	ANG-21-0189
	Location ID	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH04
	Target Depth (mbgl)	0-2	2-4	4-6	0-2	2-4	4-6	0.2
Calcium	mg/kg	<10	<10	<10	<10	<10	<10	<10
Magnesium		20	<10	<10	<10	<10	20	20
Sodium		40	310	140	90	120	170	120
Potassium		<10	<10	<10	<10	<10	<10	<10
Chloride		20	360	140	160	90	150	100
Sulfate as SO_4^{2-}		130	110	210	110	190	200	380

Table 7-5 Minor Ion Total Analysis – Discharge Area and Clay-rich Cover

Analyte	Location	Discharge Area						Clay-rich Cover
	Alcoa Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	ANG-21-0189
	Location ID	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH04
	Target Depth (mbgl)	0-2	2-4	4-6	0-2	2-4	4-6	0.2
Aluminium	mg/kg	1,810	10,500	2,280	5,300	1,140	1,480	2,480
Barium		10	20	<10	30	<10	<10	10
Chromium		4	15	10	16	4	4	11
Fluoride		<40	80	60	160	<40	<40	130
Iron		3,430	11,900	20,500	8,330	8,380	6,880	4,870
Lead		<5	8	<5	6	<5	<5	<5
Manganese		<5	12	11	9	<5	6	<5
Nickel		<2	3	<2	2	<2	<2	<2

Table 7-6 Major Ion Leachable Fraction at pH2.9 – Discharge Area and Clay-rich Cover

Analyte	Location	Discharge Area						Clay-rich Cover
	Alcoa Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	ANG-21-0189
	Location ID	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH04
	Target Depth (mbgl)	0-2	2-4	4-6	0-2	2-4	4-6	0.2
Calcium	mg/L	4	2	1	4	<1	<1	4
Magnesium		5	9	4	11	2	2	5
Sodium		4	26	5	7	5	6	6
Potassium		<1	1	<1	<1	<1	<1	<1
Chloride		1	16	5	2	4	5	5
Sulfate as SO_4^{2-}		6	6	3	5	5	6	8

Table 7-7 Minor Ion Leachable Fraction at pH2.9 – Discharge Area and Clay-rich Cover

Analyte	Location	Discharge Area						Clay-rich Cover
	Alcoa Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	ANG-21-0189
	Location ID	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH04
	Target Depth (mbgl)	0-2	2-4	4-6	0-2	2-4	4-6	0.2
Aluminium	mg/L	6.2	1	0.7	2	1	1.2	0.9
Barium		0.2	0.1	<0.1	0.2	<0.1	<0.1	<0.1
Chromium		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride		<0.1	0.1	0.2	0.2	<0.1	<0.1	<0.1
Iron		0.7	3.2	0.9	0.8	2.5	2.6	0.4
Lead		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table 7-8 Major Ion Leachable Fraction at pH7 – Discharge Area and Clay-rich Cover

Analyte	Location	Discharge Area						Clay-rich Cover
	Alcoa Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	ANG-21-0189
	Location ID	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH04
	Target Depth (mbgl)	0-2	2-4	4-6	0-2	2-4	4-6	0.2
Calcium	mg/L	1	2	<1	2	<1	<1	<1
Magnesium		2	15	<1	6	<1	1	9
Sodium		2	23	5	6	4	4	1
Potassium		<1	5	<1	2	<1	<1	<1
Chloride		2	45	5	3	4	4	8
Sulfate as SO_4^{2-}		15	123	7	30	7	9	15

Table 7-9 Minor Ion Leachable Fraction at pH7 – Discharge Area and Clay-rich Cover

Analyte	Location	Discharge Area						Clay-rich Cover
	Alcoa Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	ANG-21-0189
	Location ID	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH04
	Target Depth (mbgl)	0-2	2-4	4-6	0-2	2-4	4-6	0.2
Aluminium	mg/L	9.92	80.5	1.23	32.2	1.24	5.95	2.63
Barium		<0.1	0.5	<0.1	0.2	<0.1	<0.1	<0.1
Chromium		0.01	0.16	<0.1	0.08	<0.1	0.02	0.01
Fluoride		0.2	0.6	<0.1	0.5	<0.1	0.1	0.1
Iron		5.81	74	1.66	25.3	1.73	9.54	6.07
Lead		<0.01	0.09	<0.01	0.04	<0.01	<0.01	<0.01
Manganese		0.01	0.07	<0.01	0.04	0.01	0.01	<0.01
Nickel		<0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01

7.2.2 Additional Analysis

Additional samples (number = six) were selected for analysis from four locations (ADBH13, ADBH17, ADBH20A, and ADBH31). These locations were advanced in the Haul Road (ADBH13, ADBH17, and BH20A) and Berm (ADBH31) domain areas (**Figure 6**, attached). Samples were recovered from 0-2 m bgl (ANG-22-0026, 2-4 m bgl ANG-22-0031, and ANG-22-0050) and 4-6 m bgl (ANG-22-0028, ANG-22-0103, and ANG-22-0052). Total and ASLP analysis was conducted on each sample. The leaching procedure was carried out at two pH values, pH 2.9 and a pH representative of de-ionised water (pH 5 to 6). The results have been tabulated and not plotted due to the low concentrations and non-detects reported for this group of samples.

All samples were collected from the clay-rich fill material and characterised as clayey sand or sandy clay. The exception was sample ANG-22-0103, although it was collected within the Haul Road domain it consists of coal gravel (approximately 1.4 m in thickness). This sample was analysed to gain an understanding of the range and magnitude of constituents in the remnant coal and the chemical influence of the fill material.

The laboratory analysis reports are presented in **Appendix E**.

Laboratory and field sample QA/QC is provided in **Appendix F**.

The laboratory results are provided within **Table 17** and **Table 18** (attached).

Table 7-11 and **Table 7-12** provide the summary results of the total major and selected minor ion analysis from the discharge area. The total major and selected minor ion analysis from a sample of the clay-rich cover (from 2021 field sampling event) has also been added for comparison. A very similar profile of major and minor ion concentrations is observed for both the fill material in the discharge area and the clay-rich cover.

Table 7-13 and **Table 7-14**, **Table 7-15** and **Table 7-16** present the summary results of the ASLP analysis at pH 2.9 and a pH representative of de-ionised water (pH 5 to 6) respectively; again, a very similar profile of major and minor ion leachable fraction concentrations is reported for both the fill material in the Haul Road and Berm domain areas. The minor ions selected are representative of a small group of consistently detectable analytes including aluminium, which can be indicative of coal, ash, and ash pond water. Boron, which is also a coal/ash indicator analyte was reported above the LOR for leachable fraction results in ANG-22-0026, ANG-22-0052 and ANG-22-0103 (de-ionised water leach). The results ranged from 0.4 to 1.2 mg/L. ASLP analysis of ash solids and ash pond water quality typically reports the presence of boron at concentrations greater than 10 mg/L. Sample ANG-22-0103 (coal gravel) reported elevated sulfate (13,000 mg/kg) in comparison to all other samples. This is more elevated than historical chemical quality of coal exposed in the western face of the former coal mine (draft MRCP, 2017). The difference is likely related to the limited exposure and leaching of the coal gravel encountered beneath the Haul Road.

Table 7-10 Coal Chemical Characteristics (draft MRCP, 2017)

Analyte	Units	Min	Max	Mean	Median	90th Percentile
Calcium	mg/kg	20	160	42	40	118
Magnesium	mg/kg	20	290	44	30	120
Sodium	mg/kg	10	260	76	80	195
Potassium	mg/kg	<10	<10	<10	<10	<10
Chloride	mg/kg	30	90	46	50	69
Sulfate as SO_4^{2-}	mg/kg	160	2,880	521	465	1,911
Aluminium	mg/kg	3,320	15,800	5,085	4,150	7,383
Barium	mg/kg	20	150	55	58	118
Boron	mg/kg	20	30	23	23	27
Chromium	mg/kg	2	80	5	4	10
Fluoride	mg/kg	50	240	95	100	224
Iron	mg/kg	3,650	621,000	8,475	6,185	8,952
Lead	mg/kg	1	11	2	2	8
Manganese	mg/kg	3	17	8	9	15
Nickel	mg/kg	4	20	8	7	18

Table Notes:
mg/kg = milligrams per kilogram

Based on the results of the totals and ASLP analyses, impacts from the leached ash water discharge (and potential infiltration) appear to be limited in concentration, however do not change the overall outcomes of the risk assessment.

Table 7-11 Major Ion Total Analysis – Haul Road and Berm Domain Areas

Analyte	Location	Haul Road				Berm	
	Alcoa Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0031	ANG-22-0103	ANG-22-0050	ANG-21-0052
	Location ID	ADBH13	ADBH13	ADBH17	ADBH20A	ADBH31	ADBH31
	Target Depth (mbgl)	0-2	4-6	2-4	4-6	2-4	4-6
Calcium	mg/kg	830	<10	<10	190	<10	200
Magnesium		470	<10	<10	70	<10	100
Sodium		420	140	190	190	360	140
Potassium		30	<10	<10	40	<10	40
Chloride		160	140	530	110	270	90
Sulfate as SO_4^{2-}		2370	120	240	13,000	260	700

Table 7-12 Minor Ion Total Analysis – Haul Road and Berm Domain Areas

Analyte	Location	Haul Road				Berm	
	Alcoa Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0031	ANG-22-0103	ANG-22-0050	ANG-21-0052
	Location ID	ADBH13	ADBH13	ADBH17	ADBH20A	ADBH31	ADBH31
	Target Depth (mbgl)	0-2	4-6	2-4	4-6	2-4	4-6
Aluminium	mg/kg	6,120	2,760	10,000	4,260	5,470	1,700
Barium		280	10	90	130	50	50
Chromium		19	12	23	4	14	5
Fluoride		120	60	80	<40	160	50
Iron		15,000	3,930	23,700	5,780	6,690	2,490
Lead		7	<5	6	<5	6	<5
Manganese		21	<5	8	<5	10	<5
Nickel		7	<2	13	15	3	<2

Table 7-13 Major Ion Leachable Fraction at pH2.9 – Haul Road and Berm Domain Areas

Analyte	Location	Haul Road				Berm	
	Alcoa Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0031	ANG-22-0103	ANG-22-0050	ANG-21-0052
	Location ID	ADBH13	ADBH13	ADBH17	ADBH20A	ADBH31	ADBH31
	Target Depth (mbgl)	0-2	4-6	2-4	4-6	2-4	4-6
Calcium	mg/L	63	<1	7	13	5	24
Magnesium		48	2	10	14	9	7
Sodium		28	11	16	20	21	7
Potassium		4	<1	1	<1	2	2
Chloride		11	9	5	12	12	6
Sulfate as SO_4^{2-}		111	1	7	391	15	29

Table 7-14 Minor Ion Leachable Fraction at pH2.9 – Haul Road and Berm Domain Areas

Analyte	Location	Haul Road				Berm	
	Alcoa Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0031	ANG-22-0103	ANG-22-0050	ANG-21-0052
	Location ID	ADBH13	ADBH13	ADBH17	ADBH20A	ADBH31	ADBH31
	Target Depth (mbgl)	0-2	4-6	2-4	4-6	2-4	4-6
Aluminium	mg/L	4.4	0.2	5.2	31.9	1.4	3.3
Barium		0.2	<0.1	0.2	<0.1	0.1	0.2
Chromium		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride		0.4	<0.1	0.3	0.2	0.1	0.2
Iron		0.5	0.1	0.4	1.4	0.4	0.4
Lead		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese		0.3	<0.1	<0.1	0.2	<0.1	<0.1
Nickel		<0.1	<0.1	<0.1	0.1	<0.1	<0.1

Table 7-15 Major Ion Leachable Fraction at pH7 – Haul Road and Berm Domain Areas

Analyte	Location	Haul Road				Berm	
	Alcoa Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0031	ANG-22-0103	ANG-22-0050	ANG-21-0052
	Location ID	ADBH13	ADBH13	ADBH17	ADBH20A	ADBH31	ADBH31
	Target Depth (mbgl)	0-2	4-6	2-4	4-6	2-4	4-6
Calcium	mg/L	24	<1	3	11	4	10
Magnesium		14	3	5	14	7	6
Sodium		18	7	11	14	16	5
Potassium		2	2	3	<1	4	2
Chloride		16	15	78	9	51	11
Sulfate as SO_4^{2-}		152	12	106	302	83	45

Table 7-16 Minor Ion Leachable Fraction at pH7 – Haul Road and Berm Domain Areas

Analyte	Location	Haul Road				Berm	
	Alcoa Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0031	ANG-22-0103	ANG-22-0050	ANG-21-0052
	Location ID	ADBH13	ADBH13	ADBH17	ADBH20A	ADBH31	ADBH31
	Target Depth (mbgl)	0-2	4-6	2-4	4-6	2-4	4-6
Aluminium	mg/L	2.76	30.6	52.6	18.2	40.8	11.6
Barium		0.2	0.1	0.3	<0.1	0.4	0.3
Chromium		0.04	0.16	0.11	<0.01	0.12	0.02
Fluoride		0.4	0.3	0.3	0.2	0.4	0.2
Iron		2.09	49.9	28.8	0.82	37.1	7.42
Lead		<0.01	0.02	0.04	<0.01	0.04	<0.01
Manganese		0.02	<0.01	0.82	0.75	167	1.1
Nickel		<0.01	<0.01	0.06	0.11	0.02	0.01

7.3 Summary

The range of major and minor ions which are found in the leached ash are overall representative of the low end of concentrations generally reported in fly and bottom ash derived from brown coal. The management of ash at the Anglesea site has involved the storage and leaching in ash ponds at the power station and over time the leached ash has been dried and trucked or more recently dredged (2016) to the former mine pit. To support the risk assessment associated with the presence of the CLA area, ash characterisation studies have been completed over the last six years; this information, in addition to the characterisation of the materials surrounding the CLA, has been used to support the assessment that there are only low risks associated with the CLA being inundated and submerged by the developing water body over time.

The leached ash leachable fraction data from 2016 and 2021 indicates that major ions (calcium, magnesium, sodium, chloride, sulfate, and a lesser extent potassium) and only minor ions (aluminium, boron, fluoride, iron, and manganese) are leachable from the CLA.

Of these constituents, boron is considered to have the potential to be the most mobile in groundwater when the CLA and fill material become saturated over time. Permeability results collected in 2021 and 2022 using both de-ionised water and saline permeants indicate that clay-rich cover (over the CLA) and fill material in the vicinity of the CLA have average (geomean) permeabilities less than $1x10^{-9}$ m/sec. v permeabilities (de-ionised water permeant) are less than $2x10^{-9}$ m/sec.

In summary, although the magnitude of leachable ion concentrations from leached ash solids has diminished over time, there is still a potential for major and minor ions to be leached from the CLA into pore water. The data collected from the CLA and characterisation of the surrounding materials has provided a good understanding of the CLA domain and supported the development of a numerical model. To explore the risk of pore water migrating from the CLA area into the surrounding fill material, a hydraulic modelling assessment was conducted using the Geostudio package SEEP/W which adopted the permeability characteristics of the CLA, clay-rich cover, and surrounding fill material. The model has been used to simulate the recovery of groundwater within the fill material and CLA over time. Particle tracking was also used to look at the behaviour of a conservative constituent (such as boron) derived from CLA pore water. The results of this assessment are provided in **Section 9** and **Appendix H**.

8 Literature Review of Ash Management

The long-term management of CCA residues (fly and bottom ash) varies across the world, however storage of CCA is usually in ash ponds where the residence time can be months to years. After storage in ash ponds, the chemical characteristics of CCA change and leached ash is more appropriate terminology.

National and international examples of CCA management are discussed and summarised below with an emphasis on chemical characterisation and geochemical changes as CCA leaches and ages during the management process at Latrobe Valley, Victoria, Australia. A national focus on Latrobe Valley has been based on the use of brown coal as the source of CCA and a similar range of characteristics with the source and management of Anglesea CCA. This is because the properties of CCA and leachate are highly variable and depend on factors such as the provenance of the coal, efficiency of the combustion method, and the disposal or leaching method.

The aim of this literature review is to provide a comparison of management practices both nationally and internationally and to review the environmental impacts that may have been documented from leached ash deposits to the extent this can compare to and be used to inform the current CLA management strategy at Anglesea.

8.1 National Examples

Coal fired power production from Victoria's Latrobe Valley has occurred from 1924 when the first brick-built power station opened adjacent to the Yallourn open cut mine. Over the years three more power stations were built at Morwell, Hazelwood, and Loy Lang (plants A and B). In the 1990's approximately 550,000 tonnes of CCA was produced by power stations in the Latrobe Valley (Black et al, 1992). Historical management of CCA has been slurry disposal to on-site disposal ponds (Mudd et al, 1996). The ponds are underlain by low permeability clays and the design methodology was based on overseas research and initial research by the State Electricity Commission of Victoria (SECV). The SECV research centred mainly on the engineering aspects of ash containment.

Table 8-1 provides some major compound analysis of ash from the Latrobe Valley. Ash derived from Yallourn and Hazelwood appear to be the closest in composition to the Anglesea ash (**Table 6-1**).

Table 8-1 Major Compound and Element Chemical Composition of Ash from the Latrobe Valley (MacPhee, 1993)

Major Compounds	Loy Yang	Yallourn	Hazelwood	Anglesea
	% Dry Basis			
CaO	1	12.3	28.4	18.63
SO_3	3.4	21.7	15.6	18.18
MgO	2.2	18	18.8	17.55
SiO_2	60.4	1.4	6.6	14.58
Fe_2O_3	8.5	24.5	8.7	13.3
Al_2O_3	13.3	2.1	1.8	5.13
Na_2O	2.1	11	4.5	2.65
K_2O	1.2	0.4	0.4	0.19
TiO_2	1.7	0.1	0.2	0.09
Cl	<0.1	<0.1	3.4	0.02

The data provided in **Table 6-1** and **Table 8-1** show the large range in variability between Victorian brown coal composition.

Early research work (Bone, 1980 and Bone & Schaap, 1981) concluded that the majority of soluble components were leached during the fluidised transport to the disposal ponds. These constituents comprised calcium, sodium, magnesium, potassium, chloride, and sulfate. Analytical tests on ash from the disposal ponds indicated minor concentrations of soluble compounds. In addition, the elevated alkalinity of the Latrobe Valley ash appears to limit the solubility of most trace elements and maintained a high pH leachate. Subsequent studies (Black, 1990a & 1990b) indicate that submerged ash from the disposal ponds (leached for 12 months or more) has a lower soluble mass than dry bottom or fly ash directly from the furnaces. Kacavenda & McKinley (1994) primarily investigated the geotechnical properties of leached ash from Loy Yang overburden dump. The average hydraulic conductivity was estimated to be 3.5x10-6 m/sec and they stated the difference between vertical and horizontal hydraulic conductivity was small (values not documented).

Gavin Mudd[31] (currently Associate Professor at RMIT University, Victoria) conducted a research project (Mudd, 2001) into the environmental impacts of ash disposal techniques at the Loy Yang power station complex. The aim of the research was to investigate solute transport of constituents from ash into the surrounding environment. While this research does not directly relate to the submergence of the CLA at Anglesea, it does provide an insight into ash leaching and depletion of these constituents over time.

Leachate generation occurs through water contact with ash. The water-soluble salts on the surface of the ash are mobilised initially which contribute to the high salinity leachates. The dominant major ions include sodium, calcium, sulfate, and chloride. The majority of ash leachates are alkaline due to presence of calcium and magnesium oxides (**Table 8-1**). The generation of alkalinity can also be buffered by acidity generation from the oxidation of iron within the ash. The pH and redox of the high salinity leachate will control the leaching of minor ions from the ash. Leaching and aging of ash occurs through dissolution, advection, diffusion, adsorption, and precipitation processes which compete in the mobilisation and immobilisation of major and minor ions. In summary, the initial leachate has a high concentration of major ions with minor ions slowly increasing over time. The mass of major ions leached decreases and quasi- equilibrium conditions will be achieved overall in a closed or steady-state system (such as a sealed pond). True equilibrium is often not achieved for minor ions as the process of diffusion and sorption/precipitation processes compete with each other and the ash storage conditions are often dynamic (rainfall, ash excavation, and pond water discharge).

Mudd (2001) discusses the predominance of major ions in Latrobe Valley leached ash leachates (particularly sulfate) and the limited presence of minor ions or trace elements. This observation aligns with the reported ash pond water and leachable fraction analysis reported from Anglesea. The ash deposited in the Loy Yang ash pond is leached for 12 months or longer and has a lower soluble mass than when first produced. The Loy Yang ash pond minor ion concentrations in **Table 8-2** are within the same order of magnitude to those reported in **Figure 6-13** through **Figure 6-15** above, with the exception of mercury which is not detected in Anglesea leached ash.

[31] https://www.rmit.edu.au/contact/staff-contacts/academic-staff/m/mudd-dr-gavin accessed 14th February 2022

Table 8-2 Leached Ash Quality – Loy Yang Ash Pond (mg/kg) after McKinley, 1995

Analyte	Barium	Cadmium	Chromium	Cobalt	Molybdenum	Nickel	Tin	Mercury
Minimum	18	<0.5	7	2	<4	1	<4	0.18
Maximum	4201		71	18		20		1.5
Average	188		25	6		9		0.64
Median	200		27	7		13		0.67
Number of primary samples	1	12	12	12	12	12	12	12

Mudd (2001) also provided a review of published case studies (mainly in Wisconsin and Michigan, USA) between 1978 and 1987 of the impacts from CCA ponds on groundwater quality. The majority reported elevated concentrations of major ions in the vicinity of ponds. These included sodium, calcium, chloride, and sulfate, with considerably lower concentrations of minor ions such as aluminium, arsenic, boron, and zinc. Minor ion constituents were subject to attenuation mostly due to sorption on clays. Two studies also found that finer particles settled and accumulated at the base of ponds leading to a lower permeability.

The main constituents of interest in Mudd (2001) were restricted to sodium, sulfate, and chloride. Minor ion concentrations were not examined as part of the study; however, it is noted that solubility of minor ions was limited by the alkaline conditions and were not detected in groundwater during the period of study. While sodium and chloride were observed to be steadily increasing at selected observation points during the course of the research, sulfate was present at relatively low concentrations by comparison. This was attributed to the presence of sulfate reducing bacteria (SRB), carbon dioxide gas and the olfactory detection of hydrogen sulfide gas. The latter two gasses produced as a result of the mineralisation of labile organic matter and the reduction of sulfate by SRB mediated reactions.

At the time of writing his thesis, Mudd (2001) states that EPA Victoria had reclassified the leached ash from the Loy Yang Ash Pond as fill material (pers comm with McKinley, 1998). It is not known whether leached ash continues to be classified as fill material.

In New South Wales (NSW) coal ash repositories are located within the same sedimentary basins that contain the coal deposits[32]. It is recognised by the NSW EPA that groundwater in these sedimentary basins is naturally elevated in dissolved salts and metals and that coal ash leachate may contain the same metals and other constituents present in coal; however, discharges from coal ash repositories should be minimised and managed to reduce the risk to groundwater, surface water, and human health. Currently all CCA dams are unlined. In 2021 a report was released of a public works committee inquiry on the costs for the remediation of coal ash repositories in NSW (New South Wales Parliament, 2021). The concerns of the community relating to the cap and cover method of storing coal ash in unlined dams (some in direct contact with groundwater or surface water) is resulting in heavy metals and other pollutants escaping from coal ash dams. But the community was also aware of the cost implications of excavating coal ash from unlined dams and replacing them with lined dams. One of the recommendations was that NSW EPA commission '…a comprehensive and independent assessment of the environmental impacts of coal ash dams to provide a better understanding of the issues and to inform best practice remediation'.

[32] https://www.epa.nsw.gov.au/working-together/community-engagement/community-news/regulation-of-power-stations/coal-ash-dams

8.2 International Examples

CCA management varies from country to country. Fly and bottom ash produced from coal fired power stations internationally has traditionally been either dry managed in the sub-surface or wet managed in impoundments.

Long term management of CCA in the USA is most commonly by the dry management method (EPRI, 2009). CCA management disposal sites are mainly landfill or surface impoundments. Some power plants are also permitted to dispose via discharge to local waterways (United Sates Environmental Protection Agency [USEPA] website[33]). According to the American Coal Ash Association, in 2014 approximately 48 percent of ash is recycled, however since then changes in the regulations has resulted in a decrease in recycling. The USEPA Resource Conservation and Recovery Act (RCRA) regulates coal ash as a non-hazardous solid waste and historically surface impoundments which stored ash did not have geomembranes, leachate, or stormwater management systems. Since 2016 more stringent rules on the handling and disposal of CCA were developed which allow a risk-based approach to be adopted, the Coal Combustion Residuals (CCR) Regulations 2015. Groundwater and stormwater management practices were identified to have contributed to slope failures and leachate leakages at sites in West Virginia and Pennsylvania (e.g., Quarrier ash impoundment, West Virginia). In 2008 a failure occurred in a coal ash pond in Tennessee at the Kingston fossil Plant[34]. Over 3 million m^3 of coal ash slurry was released over 120 ha. The cause of the failure was investigated and reported to be due to slippage and failure of ash and an embankment during heavy rainfall. As a result of the failure the USEPA began developing more stringent regulations which would apply to all ash ponds and dams in the USA. The CCR Regulations were published in 2015. In 2020 the USEPA published a RCRA Regulation which required all unlined impoundments to be retrofitted with liners or close by 2021.

In the coal mining districts of Germany there are several examples of sub-aqueous deposition of wastes including lignite coal ash (Schultze, 2009, 2011; & 2012). The objective of sub-aqueous ash deposition in Germany is mainly to achieve a decrease in water acidity and increase pH to near neutral conditions. Circum-neutral conditions exist naturally in soils and surface waters surrounding these acidic lakes.

There are examples of diverting river water through acidic lakes to flush and achieve neutralisation (Lessmann et al, 2003; Schultze et al, 2010), although this remedy is only short-term in some cases where acidic groundwaters reverse the neutralisation. The former coal mine at Burghammer in the Lausitz region was flooded with rising acidic groundwater to form Lake Bernstein (Merkel et al, 2005 & Koch et al, 2008). About $26x10^6$ m^3 of CCA was deposited into the flooded mine for lake neutralisation from 1970 to 1990. During 2000 to 2002 a resuspension of the settled ash was tested and was demonstrated to increase the pH. The pH of the lake water increased from pH 2.9 to a range pH 5.3 to 9.2 while sulfate and metals (e.g., aluminium, manganese, iron, and zinc) decreased in concentration due to complexation and mineralisation reactions; however, there was no change in minor ion concentrations such as copper, cobalt, and chromium over the study period.

In some European countries such as Denmark and the Netherlands, all the ash is recycled for use in construction and road projects where it can replace raw materials such as sand and sub-base (gravel). Trace metals and salt (NaCl) can also be recovered from bottom ash. China also provides subsidies to promote coal ash recycling, achieving recycling rates of 60 percent, according to the Asian Coal Ash Association[35]; as a result, CCA management and waste disposal information is limited in these countries.

[33] https://www.epa.gov/coalash/coal-ash-basics accessed 14th February 2022
[34] http://appvoices.org/coalash/disasters/
[35] https://www.asiancoalash.org/ accessed 14th February 2022

There are examples of the subaqueous capping or covering of dredged sediments where the capping is used to manage the advective flux of heavy metals within the dredged sediments (Palermo, 1998). This approach has been used in the USA (e.g., Long Island Sound), Netherlands (e.g., Rotterdam Harbour), and Japan (e.g., Hiroshima Bay). While the capped material was not fly or bottom ash, it did consist of dredged sediments containing elevated heavy metals. Capping (the construction of a cover layer consisting of solid material on top of the waste) results in longer diffusion paths, eventually decreasing the diffusive transport rate of constituents to practically zero. Capping also prevents the resuspension of waste in the water column. The USEPA has adopted the technique of capping to remediate or isolate contaminated sediments in a subaqueous environment. The objective of using a cover is to fulfill the following:

A. Physical isolation of the sediment;
B. Sediment stabilisation, in terms of preventing erosion and resuspension; and
C. Reduction of dissolved contaminant flux.

Several models have been developed to calculate contaminant advective mass flux (Alshawabkeh et al, 2005; Eek et al, 2007; and Labianca et al, 2022). In addition to non-linear advection and diffusion, the models consider the effects of consolidation and pore pressure dissipation influences on contaminant migration. For the scenarios discussed in these papers, the dredged sediments are still saturated when covered. The authors found that sediment consolidation (from the cap weight) contributed to significant contaminant flux and accelerated the contaminant breakthrough by orders of magnitude. Not surprisingly, the moisture content (and sediment compression) was found to be the most sensitive parameter in decreasing the contaminant flux. It would appear that the capping of a material intended for sub-aqueous disposal should be conducted when the material has been drained and excess moisture removed by compaction prior to capping.

8.3 Summary

In summary, the management of CCA and leachable ash in sub-aqueous settings differs both nationally and internationally. In countries where the surrounding catchment (soil and surface water) is naturally less acidic than the acidic water bodies within them, these water bodies have been amended with alkaline CCA to achieve neutral conditions and lower concentrations of major ions and acid producing metals. This approach can however be short-lived and may not affect trace metal concentrations. Depending on the leachable characteristics of CCA, surrounding CCA in low permeability materials is beneficial in lowering the risk of mobilisation of major and minor ions which can affect surrounding surface quality and groundwater quality. Prior to encapsulating with low permeability materials, the ash should also be dewatered to achieve a low moisture content.

Prior to consolidation within the mine pit, the Anglesea CCA was leached in ash ponds over many years, the result of this process is a leachable ash with a low leachable fraction of major and minor ions that are normally associated with leachable ash and ash leachate (**Section 6**). The leached ash has been dried and the minimal amount of dredged leachable ash was dewatered and consolidated before being covered by clay-rich material. The surrounding materials are low permeability (on average less than $1x10^{-9}$ m/sec) and have been placed by semi-engineered methodologies in most areas surrounding the CLA area (berm, haul road and cover), refer to **Section 7**.

9 Numerical Modelling and Particle Tracking

9.1 Introduction

This section presents the conceptualisation used to support hydraulic modelling of recovering groundwater and the results of hydraulic modelling and particle tracking using GeoStudio SEEP/W software. The results have been used to inform on the potential conservative migration of constituents within CLA porewater as groundwater and the mine water body inundates the CLA and surrounding fill material.

9.2 Aim and Objectives

The CLA is covered with low permeability clay (referred to as the clay-rich layer) and will be inundated with water as the water body elevation increases over time. Separate long term groundwater modelling is currently underway to determine the final steady-state water level; however, this is dependent upon the final water fill strategy and is expected to be approximately +5.5 mAHD. The modelling to support the leached ash assessment has been used to simulate a “fast fill” strategy whereby the rising water body level increases faster than the surrounding groundwater elevation and in turn, groundwater flow into the model domain and CLA is estimated. The migration of water particles is simulated to be conservative (not subject to attenuation or retardation) constituent for the purposes of the subsequent risk assessment. The aim of the modelling is to provide information on the predicted hydraulic performance of the clay-rich layer.

The following information has been collated to develop the conceptual site model (CSM) related to the CLA and clay-rich layer:

1. Geometry of CLA area;
2. Characteristics of the CLA, clay-rich layer and fill material, including:
    a. Geotechnical properties of CLA and clay samples;
    b. Leaching procedure tests on CLA and clay samples; and
    c. Dispersivity characteristics of the CLA and clay.

The development of a CSM using the physical and hydrogeological characteristics of the materials within the model domain have been used to construct a numerical model using the finite element software package SEEP/W, which is able to simulate flow in unsaturated and saturated profiles.

The overall objective is to use SEEP/W to simulate:

- Hydraulic behaviour of rising water body and groundwater levels and potential groundwater seepage into the fill material under steady-state and transient conditions; and
- Particle tracking to observe movement of particles representative of a conservative (not subject to attenuation or retardation) constituent within the model domain.

9.3 Field Investigations

Consolidation of the leached ash material from the ash storage ponds was completed in 2017 within the south-eastern corner of the pit between RL -15 mAHD and -8 mAHD over an area of approximately 4.6 ha (**Figure 5**, attached). The CLA was covered with at least 1 m of clay-rich material to provide a hydraulic separation layer between the CLA and the surrounding fill material. Additional fill material was re-deposited in the pit in the vicinity of the CLA which consists of re-worked clay, silt, and sands from DBF and BF. Refer to **Section 6** and **Section 7** for further detail on the leached ash, clay-rich cover layer, and fill material characteristics.

Drilling and sampling were carried out in the vicinity of the CLA area in September 2021 and also in June/July 2022. Samples recovered from this investigation were submitted to Golder Geotechnical Laboratory and GroundScience for geotechnical testing. Geotechnical testing comprised of saline and de-ionised water permeameter tests, moisture content, and dry density. The geotechnical parameters from the laboratory tests are summarised in **Table 10** and **Table 14** (attached). Bore logs have been provided in **Appendix G**. The bore logs provide visual and textural characteristics of the CLA, clay-rich material and the fill material.

These data provide the basis for development of the model input parameters discussed in the following sections.

9.3.1 Dispersivity /Reactivity

Soil testing was carried out on samples to assess the Emerson Class Number. This test indicates the degree of dispersivity or reactivity displayed by the samples when in contact with de-ionised water and provides an indication of the leached ash (and surrounding material) stability under saturated conditions. The results are presented in **Table 11** (attached). The results show that most of the samples did not disperse in de-ionised water apart from two samples that showed a slight to moderate reaction.

9.3.2 Lithological Characteristics

Lithological characteristics have enabled a detailed understanding of the in-situ geology and the spatial distribution of the reinstated fill material. For this technical assessment only the geological units relevant to this CSM are discussed in detail within this section and **Section 9.4**. These units are summarised in **Table 9-1** and **Figure 9-1** below.

Table 9-1 Geological Units – Conceptual Site Model

Period	Geological Unit	Description	Approximate Thickness
Tertiary	DBF	Marine deposit of fine-grained micaceous and carbonaceous silts and silty clays comprising Anglesea Formation and Salt Creek Formation in the vicinity of the former Anglesea mine.	Along the coastal stretch between Aireys Inlet and Anglesea and stretches inland towards the Bells Beach anticline. The Demons Bluff Formation is up to 20 m thick. Within the Anglesea coal mine area, the DBF consists mainly of sandy clay with localised silty clays and clayey sands.
	BF	The BF has historically been reported to be a member of both the UEVF (upper most unit) and the DBF (lower most unit). The formation consists of 1-3 m thick-coarse-grained sand-channel units with interbedded minor clay, shale, and carbonaceous siltstone.	In the Anglesea coal mine, the Boonah Formation is up to 32 m thick with the basal permeable sections (1-3 m thick) extending laterally up to 50 m (e.g., representative of disconnected “shoe-string sands”). Mainly consists of sandy and silty clays.
	EVF	Deposited in a non-marine lacustrine or deltaic environment and subdivided into three distinct units.	

Period	Geological Unit	Description	Approximate Thickness
	UEVF	The UEVF comprises the upper part of the EVF. Clay, silty clay, silt and fine to medium grained sand sequences with minor fine gravel lenses. Brown coal seams are common in the top of the sequence, with the A Group coal seam mined within the former coal pit.	Unit up to 250 m thick in Anglesea Syncline. Coals from this unit were formerly mined by Alcoa (generally <50 m thick).

Table Notes:
EVF = Eastern View Formation
UEVF = Upper Eastern View Formation

In contrast to the local DBF&BF geology in the Anglesea area, the Anglesea mine facies comprises clays which are sandier and siltier with localised coarse sand as observed in **Appendix G**. The Middle Eastern View Formation (MEVF) and Lower Eastern View Formation (LEVF) underlie the Upper Eastern View Formation (UEVF). Due to their depth (located >250m below the site), these are not relevant to this CSM and are discussed no further.

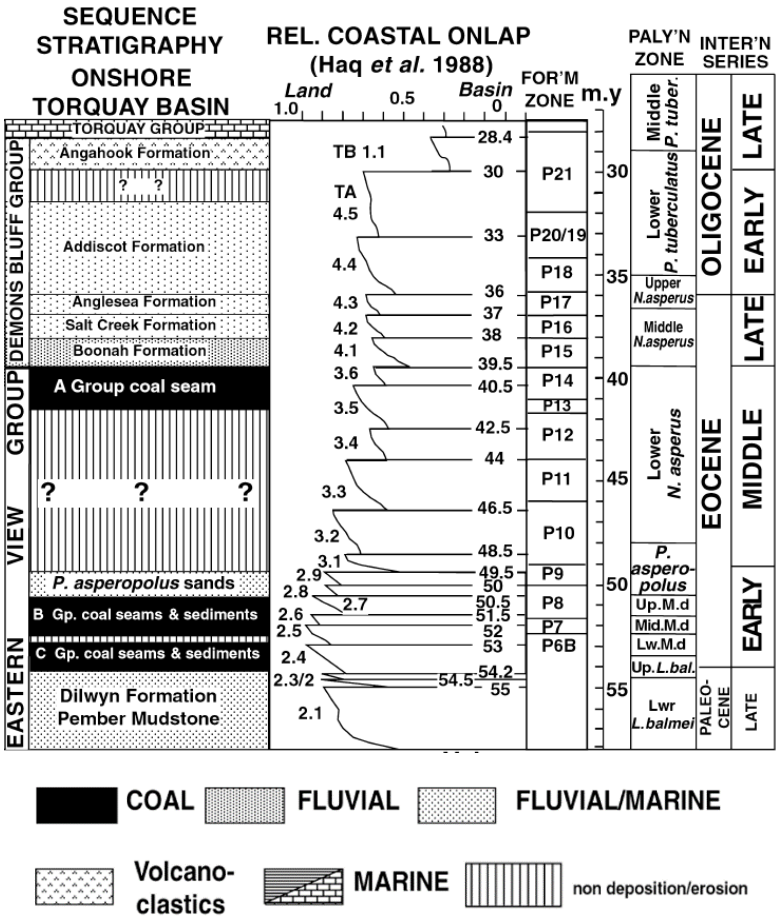

Figure 9-1 Stratigraphic Sequence of the Onshore Torquay Basin (Holdgate et al., 2001)

The DBF and BF are discussed in more detail below as these lithologies have been reworked to form the fill material which is the main material within both the CSM and the SEEP/W model domain. The A Group coal seam and basal clay of the UEVF form the base of the CSM, with additional detail provided below.

9.3.2.1 Demons Bluff Formation

The Anglesea Formation is interpreted to represent a complex of low-energy fluvial channel and braided sheet-like sands deposited on a lower coastal plain, which periodically became higher energy channel-like features with increased downcutting into earlier deposits. The upper highwall succession in the Anglesea coal mine comprises up to a 20 m thick red to purple carbonaceous and pyritic siltstone to fine sandstone. At least one short-duration marine flooding event (preserved as pyritic shale containing marine dinoflagellates) followed the infilling of the basal down-cut surface. The remaining facies preserve low-energy fluvial channel and braided sheet-like sandstone and shale-filled meander loops.

The Salt Creek Formation is on an erosional contact that can be linked across the mine face as a series of stratigraphically connected sandstone channels. The disconformity contact is a 0.1 m shale layer between cross-bedded micaceous fine quartz sandstone of the top Salt Creek Formation below, and the homogenous micaceous fine quartz sandstone of the overlying Anglesea Formation. Other more localised low-angle channels occur at the base of overlying units. Samples shown in **Figure 9-2** indicate where pervasive limonite cements form ferricrete layers in the coarser grained channel bases. Red limonite staining appears to increase rapidly over the top 5 m of the Formation and is associated with weathering from the present ground level. Interbedded carbonaceous shale and laminated siltstone units immediately overlie the basal channel layers and form a 5 to 7 m thick unit along the mine face. The basal silty shale of this unit is pyritic and contains evidence indicative of a short-duration marine transgression.

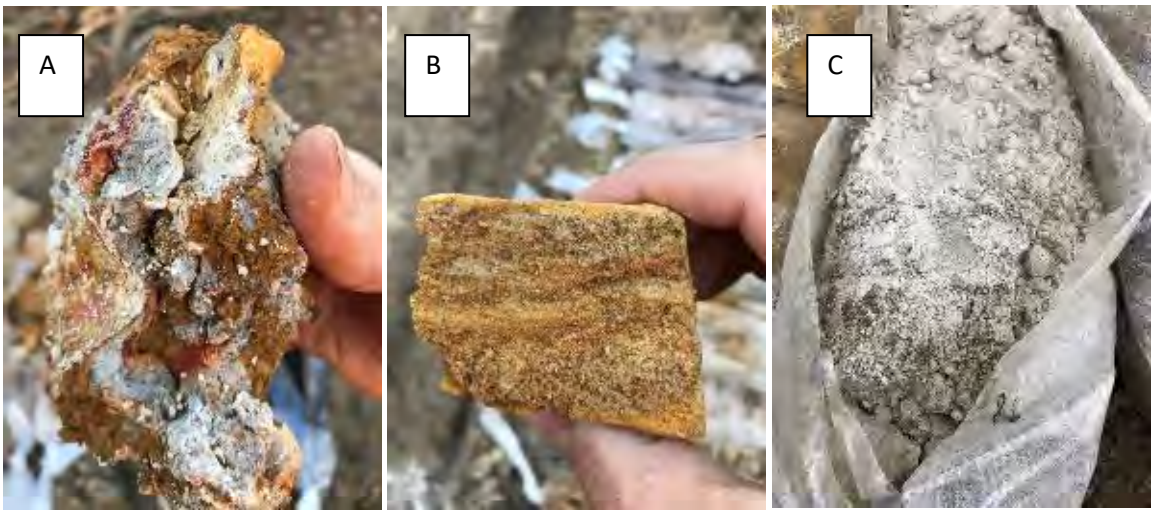

Figure 9-2 Demons Bluff and Boonah Formations (a) Salt Creek Formation, (b & c) Boonah Formation

9.3.2.2 Boonah Formation

Unconformably overlying the A Group coal seam (main Coal Seam) in the Anglesea coal mine, and in nearby bores, are clean sandstones with minor carbonaceous shale, clay, and coal. Down dip the sandstones increase from 10 m to 70 m in thickness. These sediments belong to the Boonah Formation (Holdgate et al 2002; Smith 1998). The basal coarse channel gravels and sandstones overlie the A Group coal seam at an erosional angular unconformity. The unit is thickest in the Anglesea Syncline, which thins to the north-east and south-west outside the synclinal area. The unconformity surface defines the upper boundary of the EVF; due to this unconformity, the Boonah Formation is placed in the DBF rather than the EVF.

In the Anglesea coal mine the Boonah Formation is up to 32 m thick, comprising fine to coarse-grained sand-channel units in the upper and lower 10 m, with interbedded shale and carbonaceous (leafy) siltstone occurring in the middle 10 m to 12 m (**Figure 9-2**). The basal coarse facies are exposed mainly in the central part of the Anglesea Syncline and onlap the top of the A Group coal seam to the west.

Cross-cutting, fining-upward channel units range between 1 m and 3 m thick and extend laterally from 30 m to 50 m. Finer grained overbank deposits are poorly represented, but where preserved, consist of planar-laminated carbonaceous siltstone.

9.3.2.3 Upper Eastern View Formation

A Group Coal Seam

Most of the significant coal seams of the EVF occur in the upper parts of the Formation. This is interpreted to be the UEVF (EHS Support, 2022). The uppermost and thickest A Group coal seam is up to 36 m thick and locally splits near the base into the A1 and A2 seams.

Basal Clay

The Basal Clay underlies the mined A Group coal seam and is approximately 1-4 m thick, refer **Figure 9-3**. Mining One conducted a field investigation in early 2016 of the Basal Clay, comprising three test pits and two drill holes. A factual report (Mining One, 2016) has been prepared which incorporates the findings. In the vicinity of the consolidated leached ash area the Basal Clay is approximately -40 mAHD and 1-2m thick.

Figure 9-3 Site Photos Showing the Main Coal Seam Exposure (A) and Basal Clay (B)

9.4 Hydrogeological Characteristics

9.4.1 Fill Material

Groundwater monitoring bore, DBG MB6, is located approximately 500 m north-west of the consolidated leached ash area. This bore is screened within the fill material which consists of re-worked clay, silt. and sands from DBF and BF. Groundwater recovery in the vicinity of this bore has been measured since December 2020 and the water table was reported as -16.62 mAHD in February 2022 (**Table 21**, attached).

9.4.2 Demon Bluff Group

The DBG comprises the DBF and the underlying BF.

The DBF includes the Angahook Formation, Addiscot Formation, Anglesea Formation, and Salt Creek Formation (Holdgate, et al., 2001). In the greater Anglesea region only the Salt Creek Formation and Anglesea Formation are present (**Figure 9-1**).

The BF is also present in the area and forms the base of the DBG and overlies the UEVF at an erosional angular unconformity (Holdgate, et al., 2001). The formation is distinctly different from other members of the DBF and comprises cross-cutting coarse-grained sand-channels in the lower and upper units, with shale and carbonaceous siltstone interbedded with lenses of fine-grained sandstone (Holdgate, et al., 2001). BF is well exposed at the Alcoa Coal Mine and is expected to have highly variable aquifer properties consistent with the heterogenous horizons.

Groundwater conditions at the Alcoa Coal Mine indicate that the DBF and BF near to the coal mine are largely unsaturated and discreet perched aquifers are common (in the vicinity of the former power station). For the saturated DBF bores located nearer the former power station, groundwater levels generally fall within the -4 to +4 mAHD range, which was the same range previously reported for the unconfined aquifer prior to Alcoa development (Hancock, 1967). If present, groundwater flow is expected to follow topography as well as being influenced by the mine pit.

Estimates of hydraulic conductivity in the DBF (likely the BF) were calculated from slug tests at four monitoring bores, MW4, MW10, MW11, and MW22 (Beattie, 2003). A summary of the results are presented in **Table 9-2**.

Table 9-2 Slug Test Summary (DBF)

Bore	Lithology	Bore Depth (m)	2015 Standing Water Level (mAHD)	2015 EC (µS/cm)	Hydraulic Conductivity (m/sec)
MW4	Silty Clay	3.5	5.7	7,170	$1.04x10^{-6}$
MW10	Silty Sand	5.6	8.4	2,630	$1.18x10^{-7}$
MW11	Clayey Gravel	5.5	8.3	3,260	$3.1x10^{-6}$
MW22	Silty Clay	11.8	1.6	3,410	$6.9x10^{-7}$

Table Notes:
m = metres
AHD = Australian Height Datum
µS/cm = microseimens per centimetre
EC = electrical conductivity

To support the values provided in **Table 9-2**, Domenico and Schwartz (1990) have published values for clay ($5x10^{-9}$ to $1x10^{-11}$ m/sec), silt ($2x10^{-5}$ to $1x10^{-9}$ m/sec), and sand ($6x10^{-4}$ to $9x10^{-7}$ m/sec). Hydraulic conductivities listed in Hazleton and Murphy (2016) have published values for clay ($1x10^{-9}$ m/sec), silt ($3x10^{-6}$ to $1x10^{-9}$ m/sec), and sand ($2x10^{-4}$ to $3x10^{-8}$ m/sec). Beattie (2003) values fall within the range of the Domenico and Schwartz (1990) and Hazleton and Murphy (2016) values. A slug (falling head) test was conducted on groundwater monitoring bore DBG MB6 in May 2022. Analysis of the test indicates a hydraulic conductivity of $1.16x10^{-7}$ m/sec (**Appendix I**).

Hydraulic conductivity values have also been sourced from the Anglesea numerical model (GHD, 2022) that is currently in development and under separate independent peer review by DELWP Technical Review Panel.

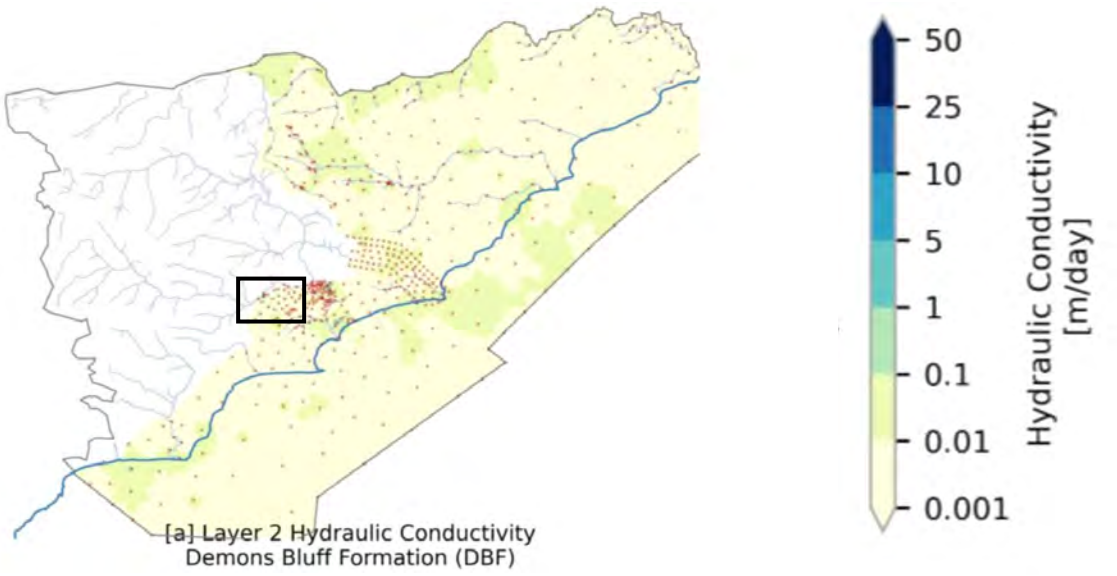

Figure 9-4 Demons Bluff Formation Horizontal Hydraulic Conductivity (GHD, 2022)

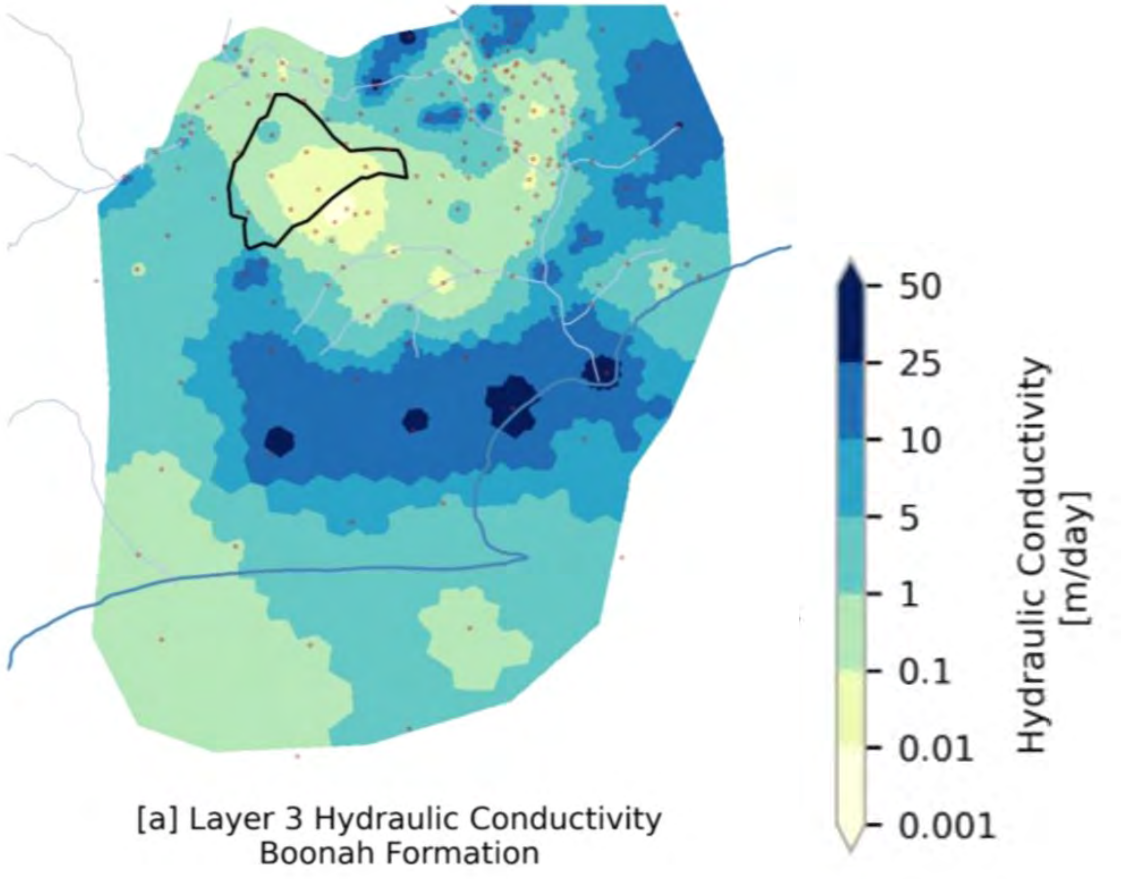

Figure 9-5 Boonah Formation Horizontal Hydraulic Conductivity (GHD, 2022)

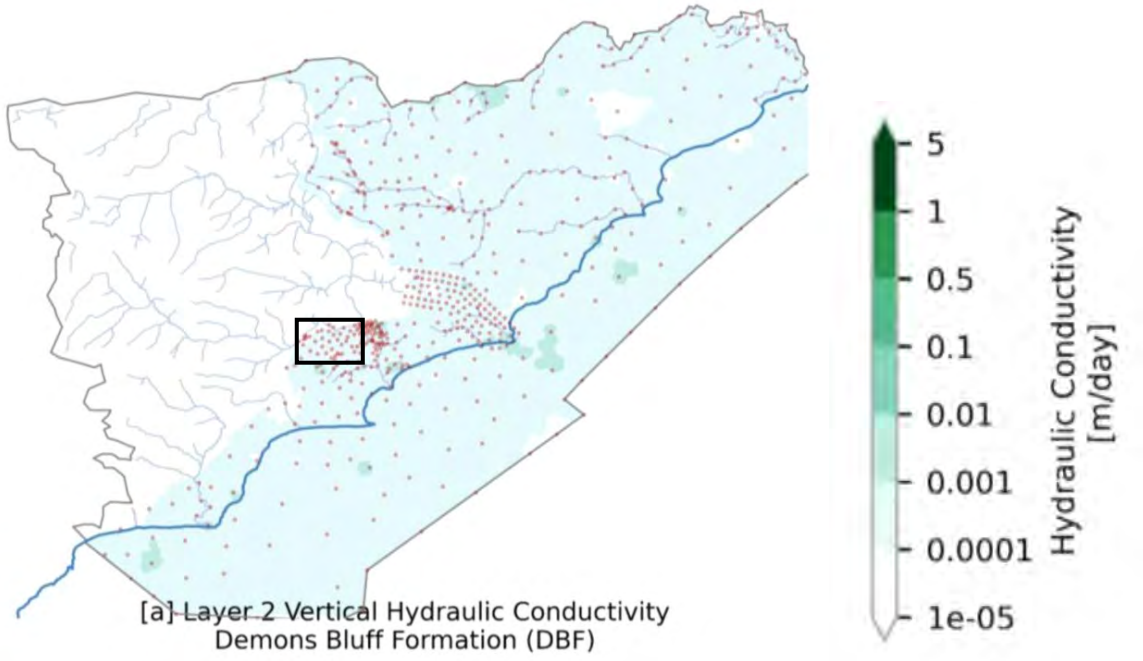

Figure 9-6 Demons Bluff Formation Vertical Hydraulic Conductivity (GHD, 2022)

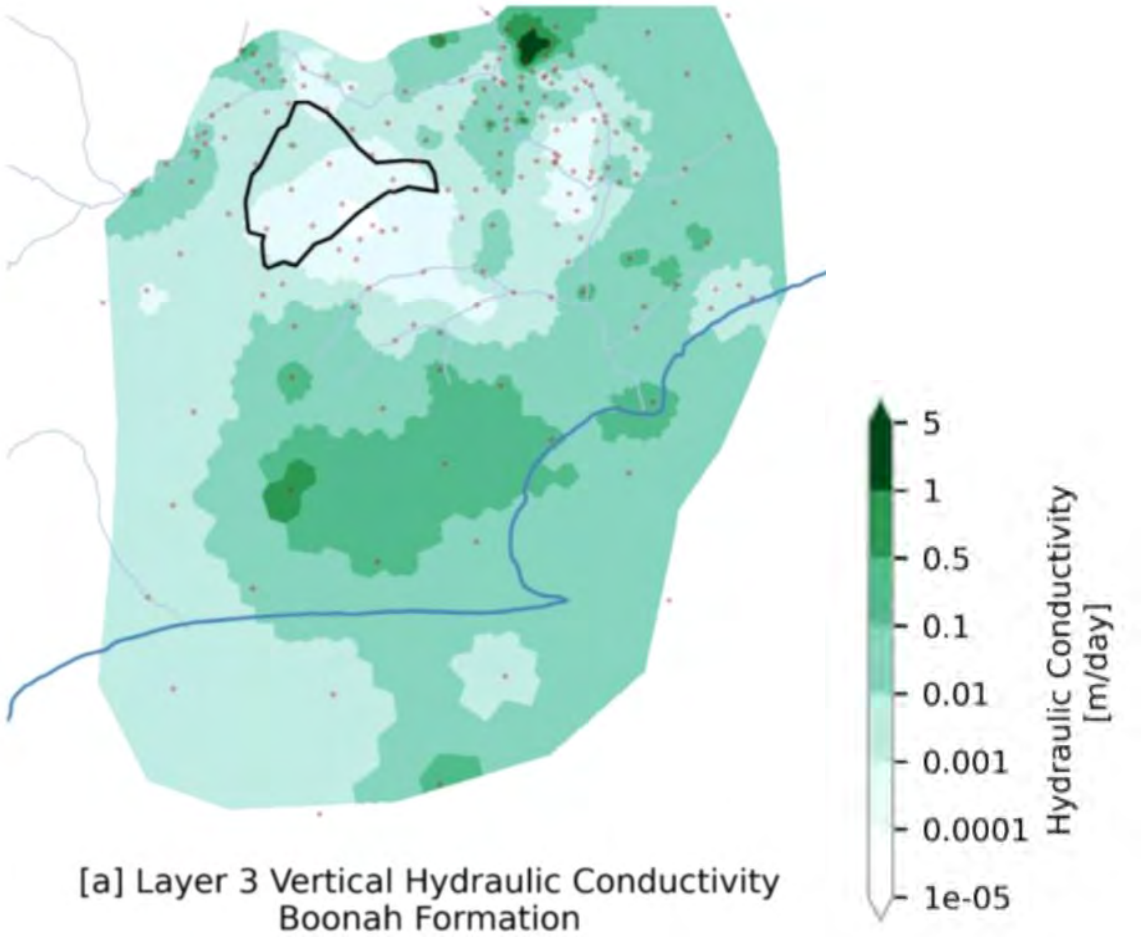

Figure 9-7 Boonah Formation Vertical Hydraulic Conductivity (GHD, 2022)

The horizontal hydraulic conductivity values in the DBF range between $1.16x10^{-6}$ to $1.16x10^{-7}$ m/sec. The BF horizontal hydraulic conductivity values range from $1.16x10^{-5}$ to $1.16x10^{-7}$ m/sec. The vertical hydraulic conductivity values in the DBF range between $1.16x10^{-7}$ to $1.16x10^{-9}$ m/sec. The BF vertical hydraulic conductivity values range from $1.16x10^{-8}$ to $1.16x10^{-10}$ m/sec (GHD, 2022). The anisotropy between the minimum and maximum horizontal and vertical hydraulic conductivity ranges between 0.01 and 0.00001.

9.4.3 Eastern View Formation

Hydrogeologically, the EVF can be sub-divided into three main units;

- UEVF;
- MEVF; and
- LEVF.

In the vicinity of the mine pit, the UEVF is considered to be a confined aquifer and is approximately 250 m thick. It consists of clay, silty clay, silt, and fine to medium-grained sand sequences with minor fine gravel lenses. Brown coal is also common in the top of the UEVF sequence. Evidence of different potentiometric heads exists (through site observations by Hancock (ibid), as well as in recent installation of observation bores) throughout the profile. A bore drilled near the former power station, M274, was believed to be completed in the middle section of the UEVF. Small artesian flows (hydraulic head of ~+4mAHD) were recorded from a sand lens at a depth of 138 metres below ground level (mbgl) or approximately - 120 mAHD. This elevation provides a good indication of the pre-mining UEVF (upper sands) potentiometric surface (EHS Support, 2022).

Alcoa ceased abstracting groundwater from the UEVF in 2016. Since this date groundwater levels have been recovering within the UEVF and the water table within the upper sands of this unit are approximately -20 mAHD to -16 mAHD (as of November 2021) and rising at a rate of approximately 0.2 m per month. Refer to EHS Support (2022) for more detail on the hydrogeology of the UEVF.

Figure 8 (attached) illustrates a conceptualisation of the in-situ geology and hydrogeology in the vicinity of the mine pit.

9.5 Consolidated Leached Ash Risk Assessment

In accordance with Part 3 Division 6 Section 44 of the Mineral Resources Sustainable Development (Mineral Industries) Regulations (2019), Alcoa has identified potential mining hazards and assessed risks associated with covering and submerging the CLA area located in the south-east corner of the mine. This process involved several steps, consistent with those outlined in 'Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS' **Appendix B** (December 2020 version 1.3) (Victoria, 2020) provided by the Department of Jobs Precincts and Regions.

A summary of the findings of the Leached Ash Risk Assessment is provided in **Section 10**. Evaluation of the significance of the consolidated leached ash deposit in terms of environmental risks and commensurate management necessary to minimise risks to the environment which has been conducted in accordance with an appropriate risk management framework.

9.6 Conceptual Site Model

The CSM relates to the CLA, the clay-rich layer and the surrounding fill material and has been developed to be representative of existing and future conditions as groundwater levels recover in the fill material and as the water body is expected to inundate the area above the CLA.

The CSM was developed sequentially as three scenarios:

1. Scenario 1 – water body surface elevation of -17.4 mAHD, representative of current conditions;
2. Scenario 2 – increase in water body surface elevation from -17.4 mAHD to 5.5 mAHD under natural fill conditions, and
3. Scenario 3 – increase in water body surface elevation from -17.4 mAHD to 5.5 mAHD under fast fill[36] conditions.

The water body level of 5.5 mAHD has been conservatively adopted for the conceptual model, however the final water level will depend on the hydrogeological response in the catchment and the long-term water strategy. Fast fill refers to additional water to supplement natural groundwater and rainfall recharge. Surface water in-flows to the water body such as discharge water from the 2021 groundwater pumping test could be used to achieve the fast fill option.

The CSM geology assumes that the model domain is represented by fill material (reworked DBF and BF overburden), which was known to be used as back-fill during the long-term operation of the mine. Backfilling within the mine footprint has occurred since commencement of mining in the 1960's to the present day (**Figure 3** and **Figure 4**, attached).

A bench of fill material in the south-eastern corner of the mine pit has been placed where the A Group coal seam was worked out and subsequently covered by the fill material. As part of the operation of the mine, the coal was continuously worked out to the top of the basal clay leaving only minor coal spoil, and fill material was progressively backfilled to cover the basal clay. The top of the basal clay is approximately -40 mAHD in the vicinity of the consolidated leached ash. Leached ash was discharged at an elevation of -15 mAHD and consolidated within the fill material bench to -8 mAHD at an approximate thickness of 4 m, based on the topography of the leached ash consolidation area at the time. The clay-rich cover material was then laid over the top of the CLA (laterally covers the same area as the CLA) and machine rolled/compacted to a depth of 1 m or greater (**Figure 1**, attached).

9.6.1 Scenario 1 – Current Condition

Scenario 1 represents the current conditions in the vicinity of the CLA. The water body level lies at -17.40 mAHD (surveyed March 2022). The water body has developed through the rebound of groundwater in the vicinity of the mine pit, in addition to rainfall and surface water run-off, including water from the recent groundwater pumping test, after groundwater abstraction from the UEVF ceased in March 2016. The maximum depth at the north centre point of the water body is approximately -45 mAHD. **Figure 9-8** is a conceptualisation of Scenario 1 in the eastern portion of the water body and fill material. The west-east (A-A') transect illustrates the relationship between the water body, the CLA and the clay-rich layer covering the top of the CLA. Fill material (consisting of reworked overburden material) extends up to 900 m from the water body towards the east. Groundwater within the fill material is reported at an elevation of -16.62 mAHD (groundwater

[36]Fast fill equates to 1.5 GL/yr of abstracted groundwater to achieve a water body surface elevation of 5.5 mAHD.

monitoring bore DBG MB6, 1 February 2022). Groundwater monitoring bore DBG MB6 is located approximately 540 m north-west of the CLA. This bore is screened within the fill material and has been adopted to represent the fill material groundwater elevation at the eastern boundary of the model.

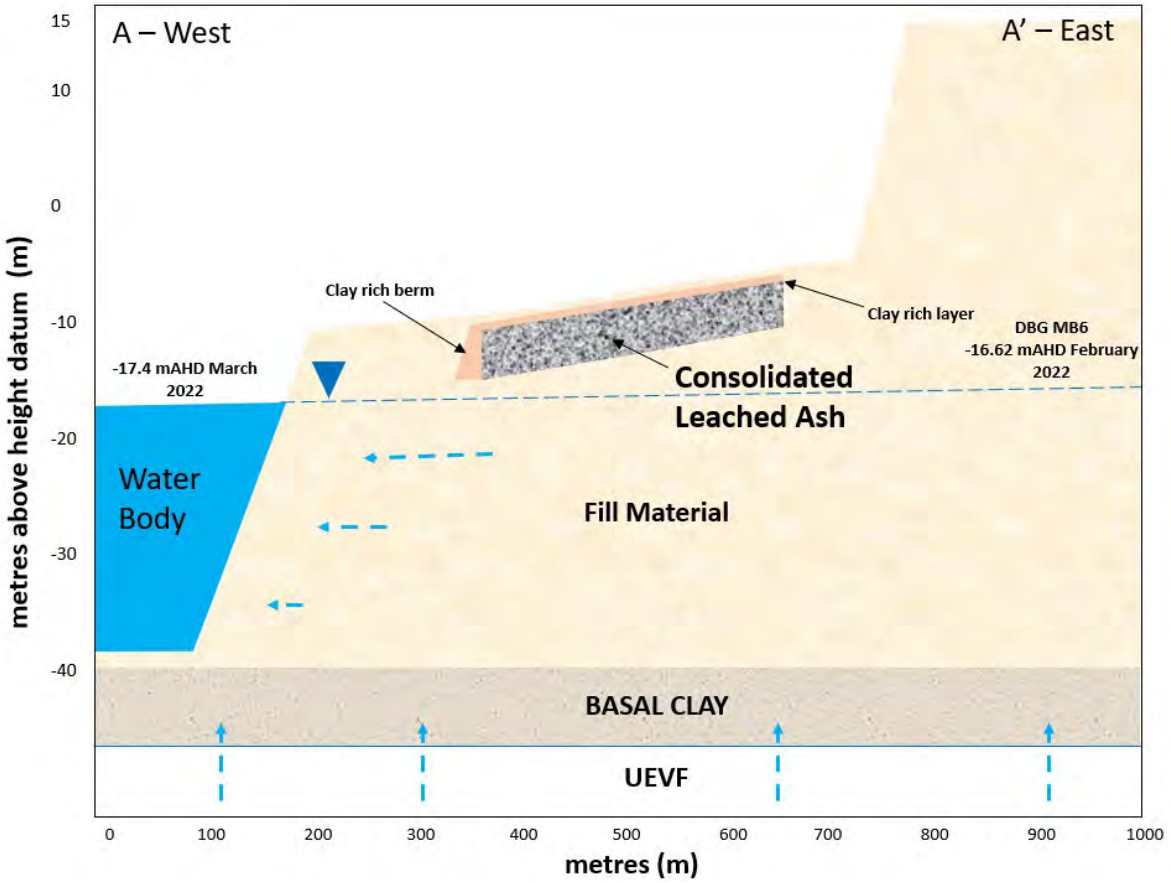

Figure 9-8 Scenario 1 Representative of Current Conditions

9.6.2 Scenario 2 – Natural Fill

Scenario 2 is representative of an increase in water body elevation from -17.4 mAHD to 5.5 mAHD. This water level has been adopted for the conceptual model; however, the final water level will depend on the hydrogeological response in the catchment and the long-term water strategy (**Figure 9-9**). Groundwater flow in this scenario is towards the water body, with the water body predicted to behave as a long-term groundwater sink (GHD, 2022). The water body development in the hydrogeological conceptualisation is based on the rising groundwater levels within the UEVF as the groundwater pressures recover. A combination of natural groundwater recovery, direct rainfall and local catchment runoff will result in the formation of the water body between 50 to 100 years (EHS Support, 2018). When the water body reaches 5.5 mAHD, evaporative losses from the surface of the water body will maintain a groundwater flow in a westerly direction into the water body. The water body is anticipated to behave as a long-term groundwater sink.

Due to the permeability contrast between the CLA /clay-rich layer and the surrounding fill material, groundwater is more likely to flow preferentially through the fill material rather than the mass of CLA and clay-rich layer. The CLA and clay-rich layer will saturate over time; however, since its hydraulic conductivity is orders of magnitude lower than the fill material, throughflow will be proportionally lower in the CLA and clay-rich layer.

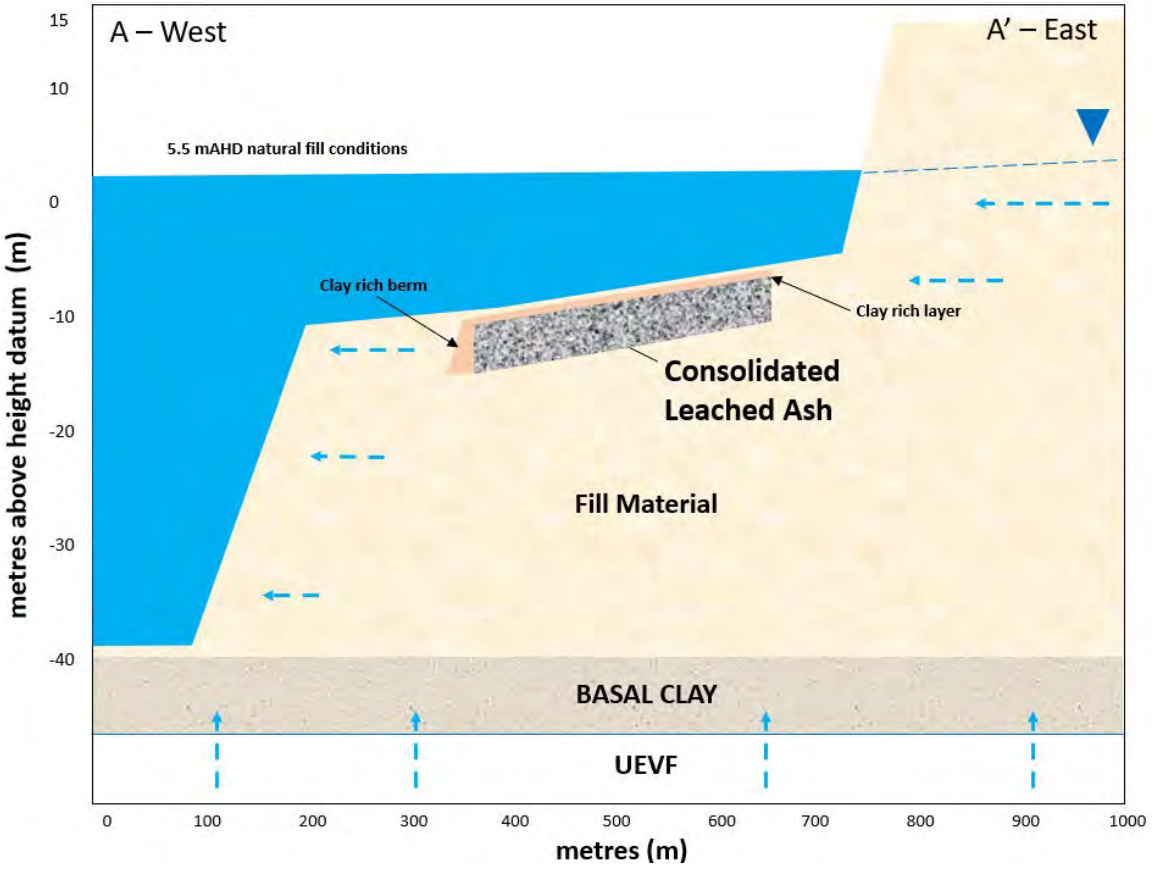

Figure 9-9 Scenario 2 Future Water Body Level (5.5 mAHD) Under Natural Fill Conditions

9.6.3 Scenario 3 – Fast Fill

Scenario 3 is representative of the development of the water body under fast fill conditions. During filling the water body is anticipated to lose water locally over a limited distance for a period of time into the surrounding geology; however, once at steady state, the water body is predicted to behave as a long-term groundwater sink (GHD, 2022). This includes groundwater movement from the UEVF to the water body; it is also supported by numerical modelling undertaken in 2017 and 2019 (GHD) and preliminary modelling using the revised Anglesea Groundwater model which has been deemed fit for purpose by an independent technical review panel (appointed by DELWP). DELWP appointed an independent technical review panel consisting of expert modellers, ecologists, acid mine drainage and groundwater engineers. Their review concluded that the conceptualisation and revised Anglesea Groundwater model is deemed fit for purpose, with one of the objectives of the model being to understand pit water/groundwater interactions. Analytical modelling (using the laboratory derived parameters of the basal clay) also suggested that during the filling of the water body the level remained 2 m higher than the groundwater level and it would take about 7 years for any pressure impacts to migrate through 2 m of Basal Clay. At steady state evaporation will be the primary water loss mechanism from the water body. The artesian heads of the UEVF were also found in the basal sand lenses. Drilling in the 1950/60 found evidence of lithostatic pressure (i.e., as drilling progressed through each coal and clay seam, the pressure would spike). The basal sand lenses are under greater pressure than the shallower sand seams.

The final water body elevation is 5.5 mAHD (as in Scenario 2); however, the time predicted to fill to this level is over a much shorter time frame due to additional water input (**Figure 9-10**).

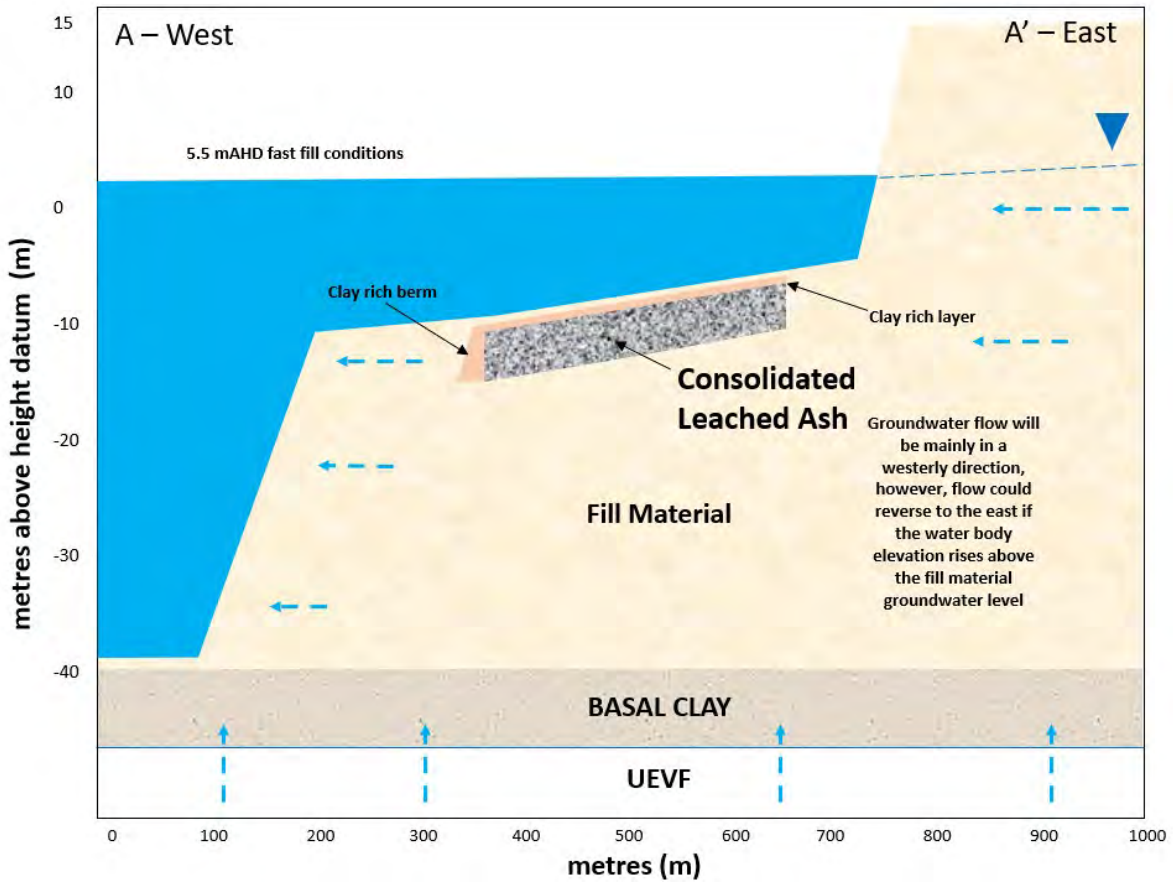

Figure 9-10 Scenario 3 Future Water Body Level at 5.5 mAHD using Fast Fill Conditions[37]

9.7 Simple Analytical Calculation

A simple analytical calculation is presented in this section as a high-level assessment of potential travel distances based on simple advective principles. All leached ash vertical permeabilities (n = 7) are all lower (less) than $1x10^{-9}$ m/sec (laboratory measurements). Assuming a highly conservative 1:1,000 horizontal anisotropy (i.e., groundwater flows 3 orders of magnitude faster in the horizontal direction than vertical) and using the very conservative analytical Darcy law assessment with a porosity of 20% and assuming the water body fills in 1 year (i.e., the water level is approximately 15m above the highest RL of the CLA area). In 12 months a particle of water has the potential to travel only 11 m. If the horizontal permeability of the formation was an order of magnitude higher (to $1x10^{-5}$ m/s; or approximately 1 m/day, which is representative of a sand), water will migrate only up to 111 m. In any case this is less that the distance from the CLA area to the licensed mine boundary[38] as the undisturbed DBF is approximately 400 m (east) and 200 m (south) of CLA material.

A numerical model (SEEP/W) has been used to explore the hydraulics of the model domain in greater detail.

[37] Note: The groundwater flow arrows are depicted in a westerly direction (end of simulation) however there will be an easterly flow for a period of time (refer to **Section 9.9**)

[38] The licenced mine area will remain in place for as long as it needs to mitigate any risks and Alcoa is in a position to surrender the licenced area to the State. This can only be done once the State accepts that Alcoa has met all of its obligations and reduced long term risk to an acceptable level.

9.8 Model Selection

SEEP/W has enabled a transient assessment of the development of the water body and the change in pore water pressure using variable hydraulic boundary conditions within the fill material and CLA/clay-rich layer. SEEP/W uses a finite element mesh and boundary conditions and has the functionality to consider the change in pore water pressures in response to changing head conditions and incorporate multiple boundary conditions within a 2-dimensional model environment. Multiple-particle-tracking in SEEP/W can also be used to assess the heterogeneity of the groundwater flow through the saturated materials surrounding and through the CLA.

For this assessment report, SEEP/W particle tracking has been used to observe conservative (not subject to attenuation or retardation) particle migration under advective flow.

This modelling assessment has not been developed in accordance with the 2012 Australian Groundwater Modelling Guidelines (AGWMG). As stated in the Guidelines, they are not intended to prescribe a particular approach to modelling. A detailed Class 3 regional numerical model is currently in development in accordance with the AGWMG for separate purposes. This is a catchment wide (Jan Juc GMA) groundwater model which is being peer reviewed by an Inter-Agency Group (DELWP, SRW, ERR) independent Technical Review Panel. Input parameters used in the catchment wide model have been reviewed and used in this modelling review, e.g., DBF and BF permeability value of $1x10^{-6}$ m/sec. This model also has a typical overall Class 1 model confidence level classification (Merz, 2012), however is considered to be still fit for purpose as it predicts long-term impacts to groundwater and a water body with existing low-quality water (refer to Table 2-1, AGWMG [2012]).

The outcomes from this modelling assessment inform the risk assessment (**Section 10**) and decision-making process by simulating any potential impacts on identified receptors. The modelling may also guide further data acquisition and additional modelling if required.

9.9 Model Construction and Input Parameters

The SEEP/W model was developed sequentially on the basis of the three scenarios described above:

1. Scenario 1 – Initial current condition steady-state model and transient model change in water body elevation from -39.79 mAHD to -17.4 mAHD;
2. Scenario 2 – Transient model, change in water body elevation from -17.4 mAHD to 5.5 mAHD under natural fill conditions; and
3. Scenario 3 – Transient model, change in water body elevation from -17.4 mAHD to 5.5 mAHD under fast fill conditions.

The geometry of the model domain consists of a west to east orientated transect from the water body (in the west) through the fill material and CLA to the edge of the fill material in the east. This orientation is approximate and based on the future steady state radial groundwater flow surrounding the water body, the orientation of the model domain is not considered to have a qualitative or quantitative influence on the model outcomes and assessment of risk to identified environmental values.

The model elevations have been derived from survey data provided by Alcoa. The primary y-axis is defined by the maximum depth of the water body in this section of the model domain, -40 mAHD, and the secondary y-axis by the maximum height of fill material on the eastern wall of the mine pit. The x-axis is the extent of fill material from the base of the water body to the eastern extent of backfilling of overburden. The fill material domain was created as a polygonal region and the CLA plotted as an additional polygon within the fill material region.

The geometry of the overall model domain is shown in **Figure 9-11**.

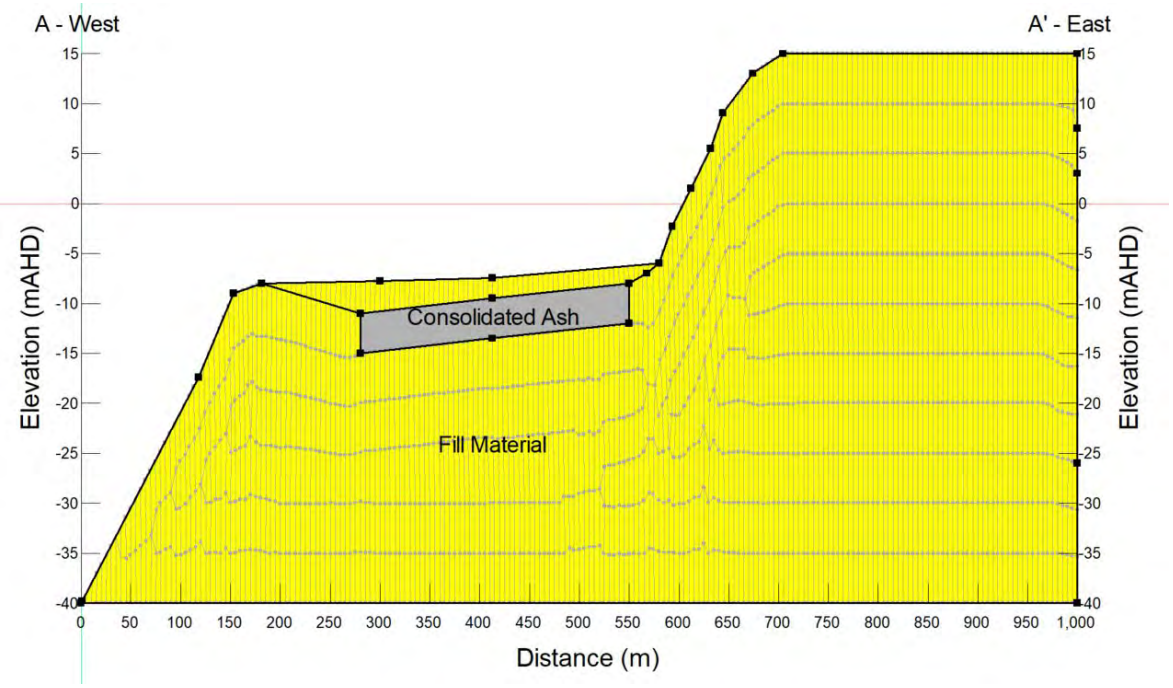

Figure 9-11 Model Domain Geometry

The CLA and clay-rich layer has been conceptualised within SEEP/W as one region. Differentiation of these two materials was not considered necessary when the hydraulic properties of the CLA and clay-rich layer are so similar. The hydraulic conductivity geomean (based on de-ionised water permeameter tests) for the CLA is $1.93x10^{-9}$ m/sec, in comparison to $4.68x10^{-10}$ m/sec for the clay-rich layer (**Table 10** and **Table 14**, attached). Saline permeameter tests conducted on the clay-rich layer indicate a hydraulic conductivity geomean of $1.41x10^{-9}$ m/sec. The CLA hydraulic conductivity has been selected to represent the CLA and clay-rich layer region.

Table 9-3 provides hydraulic conductivities used to represent the CLA and fill material regions. The clay-rich layer is most likely representative of the DBF and upper BF, which are expected to be at the lower range of hydraulic conductivities encountered. The geomean hydraulic conductivity of the clay-rich layer is between $1.41x10^{-9}$ and $4.68x10^{-10}$ m/sec (**Table 10** and **Table 14**, attached) based on the de-ionised and saline permeameter tests; however, due to the limited extent of the clay-rich layer covering the CLA (approximately 1 m thick) and the resolution of the model domain, the clay-rich layer and CLA are represented by one region with a hydraulic conductivity of $2.93x10^{-9}$ m/sec (representative of CLA permeability). The CLA permeability is also very similar to the fill material permeability which surrounds the majority of the ash.

Fill material hydraulic conductivities range between $7x10^{-8}$ and $9x10^{-11}$ m/sec (de-ionised water permeameter tests) and $4x10^{-8}$ and $8x10^{-11}$ m/sec (saline water permeameter tests). These values are representative of vertical hydraulic conductivities, whereas the outcome of the falling head slug test in May 2022 (**Appendix I**) indicates horizontal conductivities are higher, $1.16x10^{-7}$ m/sec. The horizontal hydraulic conductivities used by GHD (2022) in the Anglesea numerical model range between $1.16x10^{-5}$ to $1.16x10^{-7}$ m/sec for the DBF and BF. Based on the reworked nature of the DBF and BF (the fill material) the hydraulic conductivity selected to represent the fill material is $1.16x10^{-6}$ m/sec. The anisotropy between this horizontal conductivity value and the vertical hydraulic conductivity values ranges between 0.1 and 0.0001. A value of 0.005 was used for the Ky/Kz ratio. The application of anisotropy was based on the interpretation of hydraulic field tests.

Four slug tests in the DBF and BF lithology (**Table 9-2** and **Appendix I**) were undertaken (Kx = ranging from $3.1x10^{-6}$ m/sec to $1.1x10^{-7}$ m/sec) and two laboratory permeability tests (representing vertical permeability) with Ky ranging from $2x10^{-9}$ m/sec to $4x10^{-10}$ m/sec). This represents an anisotropy of 1:100 and is quite common in this type of field setting. Furthermore, the calibrated regional numerical model uses a ratio 1:100 with a relatively uniform distribution based on test data, geomean Kv to geomean Kh. A more 'isotropic' distribution may occur within the ash emplacement, but the intent is to examine migration away from CLA area.

Material parameters have been assigned on the basis of the field observations/investigations and laboratory results (**Table 9-3** and **Table 9-4**). The thickness of the CLA and surrounding materials has been sourced from communications from Alcoa. All other CLA parameters provided in **Table 9-3** were sourced from the analysis of site sampling as provided in **Table 10** and **Table 14** (attached). The saturated water content for the CLA region is based on the geomean value of the leached ash assumed porosity results (**Table 10**, attached). The fill material saturated water content is based on the minimum assumed porosity result, as there were not a sufficient number of values to derive a geomean with confidence.

Table 9-3 Material Hydraulic Parameters

Lithological Layer	Volumetric Water Content Function		Hydraulic Conductivity Function		
	Saturated Water Content (fraction)	Sample Material	Estimation Method	Residual Water Content (fraction)	Hydraulic Conductivity (m/sec)
Leached Ash	0.41	Silty Clay	Van Genuchten	0.043	$2.93x10^{-9}$
Fill material	0.41	Sand	Van Genuchten	0.02	$1.16x10^{-6}$

Table Notes:
m/sec = metres per second

Table 9-4 Material Dimension Parameters

Lithological Layer	Dimensions		
	Thickness (m)	Width (m)	Area (m^2)
Leached Ash	4	270	46,000
Fill material	0 to 55	1,000	36,316

Table Notes:
m = metres
m^2 = square metres

The western BC is formed by the mine pit and water body, while the eastern BC represents the transition between the fill material and the natural undisturbed and unconsolidated DBF. The fill material which comprises the majority of the model domain has been compacted and has a higher component of clay. The western and eastern BCs have been developed using existing water body and DBG MB6 elevation datasets. Predicted mine water levels for use in transient Scenarios 2 and 3 were derived from a groundwater model presented in (EHS Support, 2018) along with updated (rehabilitated) mine bathymetry. Forecast groundwater levels in DBG MB6 were conservatively extrapolated based on historical data. These forecasts are shown in **Figure 9-12** and **Figure 9-13**. Refer to the attached **Table 19**, **Table 20**, and **Table 21** (attached) for the measured and extrapolated water levels for the water body (natural and fast fill) and the eastern BC.

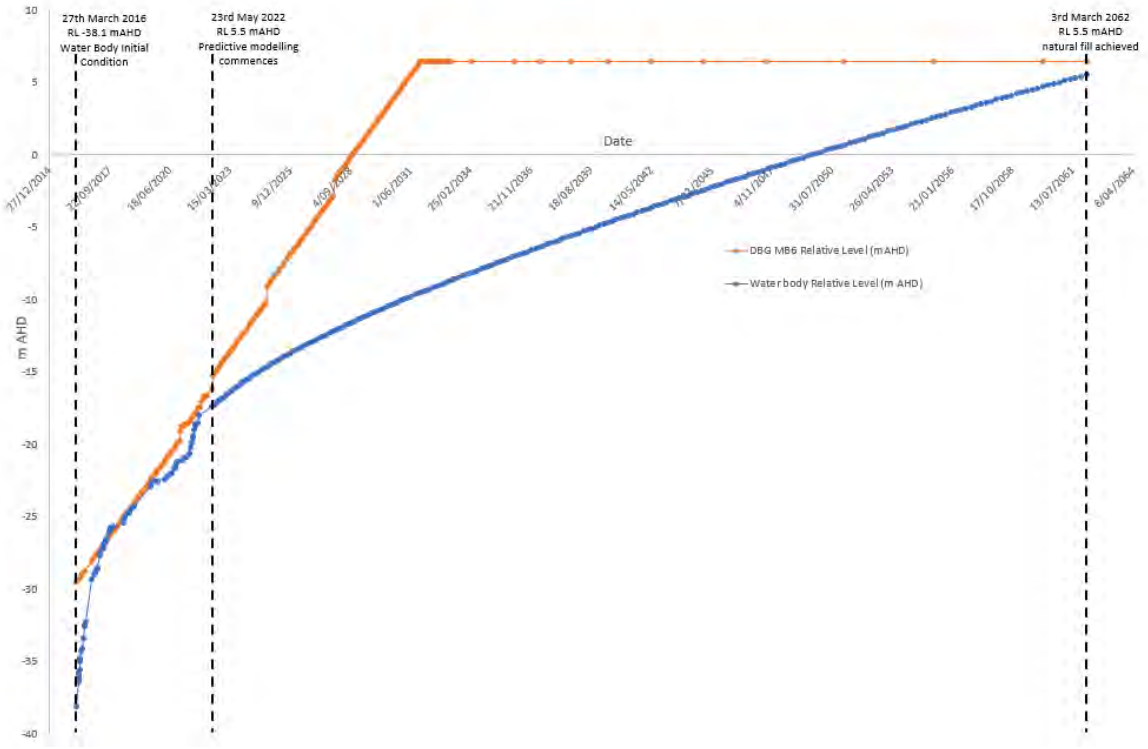

Figure 9-12 Scenario 2 (Natural Fill) Extrapolated Water Body and DBG MB6 Groundwater Recovery

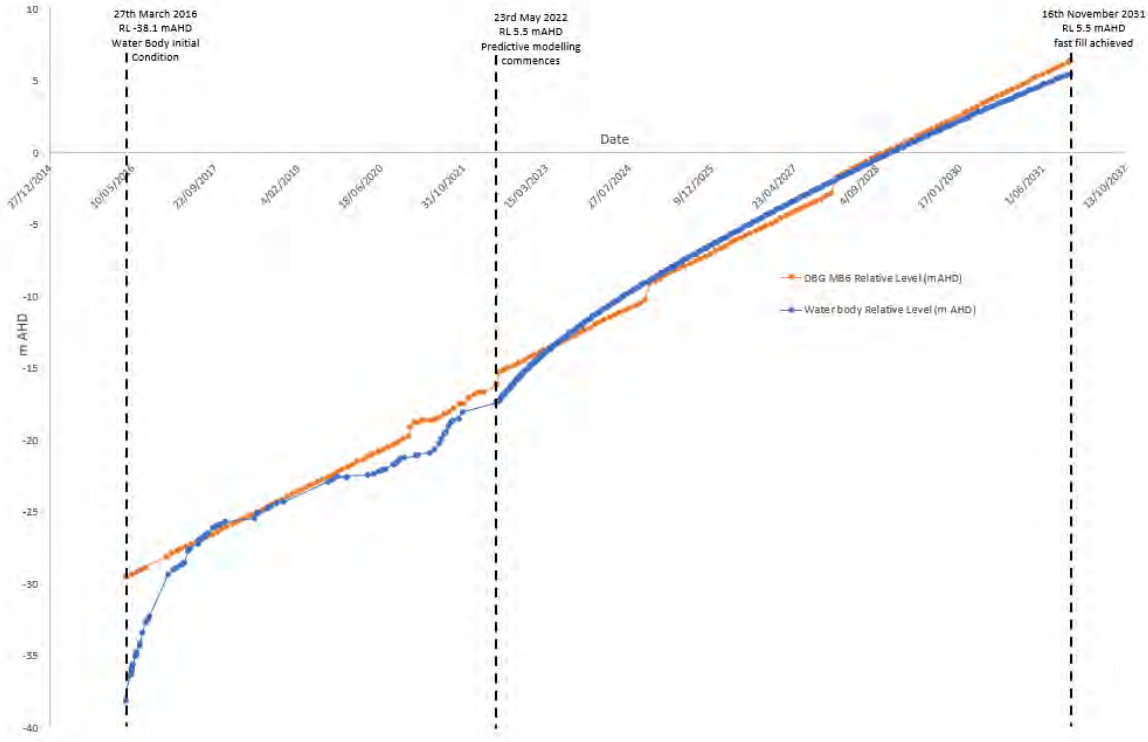

Figure 9-13 Scenario 3 (Fast Fill) Extrapolated Water Body and DBG MB6 Groundwater Recovery

The conceptualisation above and the extrapolated datasets have been used to develop two temporally variable total head BCs, one on the boundary between the water body and the fill material to the west and a second BC between the fill material and the natural DBF to the east of the water body. BC input parameters are provided in **Table 9-5**.

Table 9-5 Boundary Condition Parameters

Boundary Condition	Scenario	Description	Type		Date	Groundwater Flow Direction	Height (mAHD)
Eastern Boundary (SS)	1a	Initial conditions	Total Head	Constant	2016	East to West	-29.51 Assumption
Water Body (SS)	1a	Initial conditions	Total Head	Constant	2016	East to West	-38.10 Site specific data
Eastern Boundary Recovery (T)	1b	Simulation of current conditions	Total Head	Function	2016 to 2022	West to East	-29.51 to -16.55 Site specific data and assumption
Water Body Recovery (T)	1b	Simulation of current conditions	Total Head	Function	2016 to 2022	West to East	-38.10 to -17.4 Site specific data
Eastern Boundary Recovery (T)	2	Simulation of natural fill	Total Head	Function	2016 to 2062	West to East	-29.51 to 6.41 Site specific data and assumption
Water Body Recovery (T)	2	Simulation of natural fill	Total Head	Function	2016 to 2062	West to East	-38.10 to 5.5 Site specific data and assumption
Eastern Boundary Recovery (T)	3	Simulation of fast fill	Total Head	Function	2016 to 2031	Variable	-29.51 to 6.41 Assumption
Water Body Recovery (T)	3	Simulation of fast fill	Total Head	Function	2016 to 2031	Variable	-38.10 to 5.5 Site specific data and assumption

Table Notes:
SS = Steady-State model run
T = Transient model run

The eastern BC marks the separation between the fill material and the undisturbed DBF at the edge of the mine workings. The minimum head for the eastern boundary (SS) condition (Scenario 1a) is set at -29.51 mAHD, which assumes a higher groundwater elevation compared to the water body elevation in March 2016. The difference in elevation creates a hydraulic gradient with westerly groundwater flow towards the water body. The water body BC for Scenario 1a is based on the surveyed elevation in March 2016. This steady-state model sets the initial conditions or parent model which all transient models use as a base model.

The eastern boundary recovery (T) condition (Scenario 1b) is a groundwater level of -29.51 mAHD. This is an extrapolated water level (representative of March 2022) from groundwater elevations reported from DBG MB6 between April 2016 and February 2022 (refer **Table 21**, attached). The water body BC for Scenario 1b is based on the surveyed elevation in March 2022.

The total head BCs for Scenario 2 vary over time and are intended to simulate the future development of the water body under natural fill conditions to an elevation of 5.5 mAHD. The fill rate has been derived from extrapolating the measured water body levels based on estimated inputs from groundwater, rainfall, and surface runoff (**Table 21**, attached). Groundwater flow within the fill material is towards the water body throughout the simulation.

The total head BCs for Scenario 3 also vary over time, however, they simulate the future development of the water body under fast fill conditions to an elevation of 5.5 mAHD. An assumed artificial fill rate of 1.5 gigalitres per year has been used to achieve the 5.5 mAHD water body elevation by 2031 (**Table 20**, attached). During this period the groundwater flow direction fluctuates between a westerly and an easterly direction. This is dependent on the water body and fill material groundwater elevations. **Figure 9-13** illustrates the relationship between water body and fill material groundwater elevations. Between 2023 and 2028 the water body elevation is above the fill material elevation and groundwater flow is easterly away from the water body. From 2028 to 2031 the fill material groundwater elevation is above the water body elevation and groundwater flow changes from an easterly to a westerly direction. The 5.5 mAHD water body elevation is achieved by 2031.

To further support the DBF and BF groundwater elevations under steady state conditions, **Figure 9-14** provides simulated depths to water table within the DBF and BF over time as groundwater levels recover to steady-state conditions. These simulated depths have been derived from the regional numerical model and includes a proposed (not yet approved) UEVF pumping scenario of 1.5 GL/yr for 10 years as well as Barwon Waters Bulk Entitlement Operation for the LEVF; for context, groundwater monitoring well DBG MB6 has a surface elevation of 11.29 mAHD, under steady-state conditions the water table in DBG MB6 has been estimated to be 4.88 m below ground level. This is within the range of water table levels in **Figure 9-14**.

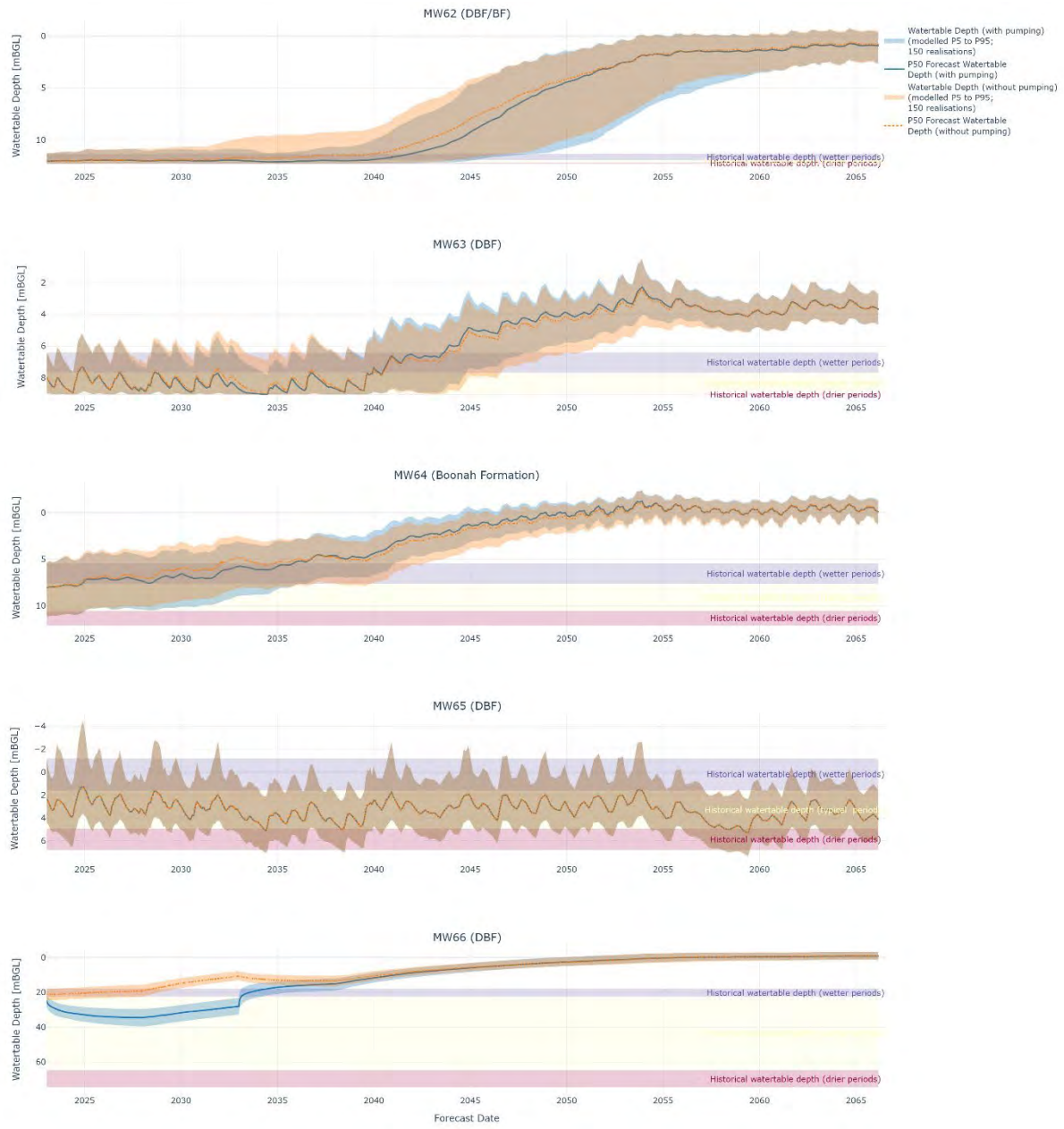

Figure 9-14 DBF and BF Regional Numerical Anglesea Groundwater Model Simulated Depths to Watertable

All of the above input parameters which have been used to characterise the SEEP/W model are within the uncertainty estimate ranges as adopted by the regional numerical model.

A BC has not been specified for rainfall. Whilst rainfall is likely to provide a minor contribution to the water body directly and via surface runoff, evaporation, and evapotranspiration results in a net loss of water. As discussed by EHS Support (2022), the cumulative 5-year period 2005 to 2009 and 2014 to 2018 represent the two driest five-year cumulative rainfall totals on record. Corresponding reductions in catchment flows and infiltration are also expected. The greenmap equation (GHD, 2022) has demonstrated that rainwater infiltration is negated by evaporation and by capillary rise in the vadose zone. Hydrographs of bores screened within the DBF and BF (in the vicinity of the former power station) also show no instantaneous responses to episodic rainfall events (EHS Support, 2022).

Particle tracking has been used to simulate the migration of a conservative solute in groundwater. Particle tracking is provided for Scenario 2 and Scenario 3 and for the sensitivity analysis section.

The model mesh element size has been set as 5 m for both the fill material and the CLA. Quads and triangles were selected for the finite element mesh pattern as this configuration complements the model geometry. A refinement of the CLA element grid was trialled to enable particle tracking on a 1 m scale which relates to the thickness of the clay-rich layer surrounding the CLA; however, the numerical solution did not converge due to the complexity of the finite element mesh in this region and the hydraulic conductivity contrast between the fill material and the CLA.

Model calibration has not been undertaken according to the classical calibration approach where a set of parameters, boundary conditions, and stresses produce simulated heads and fluxes that match field measured values within a pre-defined range of error (Andersen and Woessner, 2002). The classic approach is referred to as the ‘inverse problem’, whereas the ‘forward problem’ has been adopted for this risk assessment, where hydraulic conductivity, specific storage, recharge rate, and initial and final heads are specified, and the model calculates heads and head distribution during the simulation period. The initial conditions are defined from field measured values while the final heads have been verified using the regional numerical model. This approach was adopted because the objective of the modelling was to establish the predicted groundwater flow field in the vicinity of the CLA and assess the level of risk to identified environmental values using the conservative method of particle tracking.

9.10 Results and Discussion

9.10.1 Scenario 1 Current Conditions

The model project definitions for Scenario 1 are provided in **Table 9-6** below.

Table 9-6 Scenario 1 Project Definitions

Scenario 1	Time Frame	Physical Processes	Water	Time	
				Duration (days)	Steps
a. Steady-state	2016	Water	Default parameters	0	-
b. Transient	2016 to 2022	Water	Default parameters	2,248	6

The steady-state model was established for Scenario 1a to derive the initial conditions for the transient model 1b which represent the development of current conditions (March 2022). The initial condition represents the total water heads after the cessation of UEVF dewatering in 2016.

BCs used for the steady-state and transient model runs are as defined in **Table 9-5**.

The result for Scenario 1a (steady-state) is provided as **Figure 9-15**. There is a hydraulic gradient from the east to the west (at the base of the model) as a result of the differing head elevations at the water body and eastern BCs. Groundwater flow is from the east to the water body (west) as controlled by the BCs. Velocity vectors are depicted as arrows (orientated in the direction of flow), with the size of the arrow representing the flow rate. (i.e., larger the arrow, the higher the flow rate).

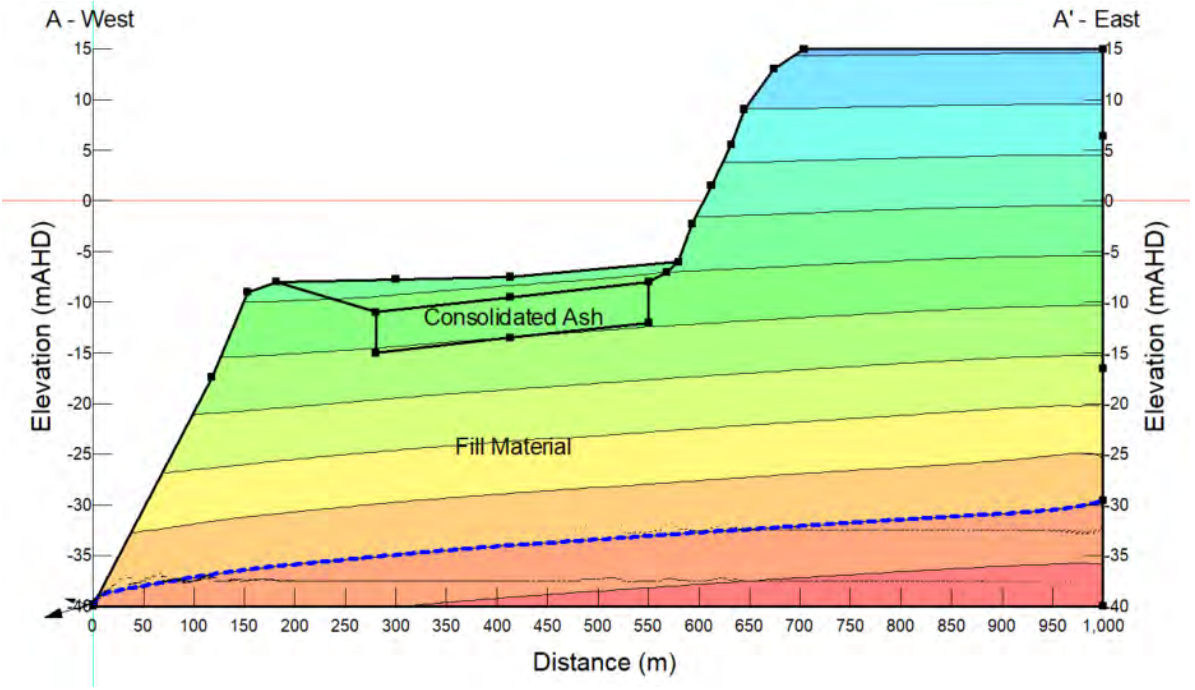

Figure 9-15 Scenario 1a Steady-State Result (2016)

Pore water pressure zones are depicted in the following colour ranges:

- Red - >400 kPa;
- Orange - 200 to 400 kPa;
- Yellow - 0 to 200 kPa;
- Green - 0 to -200 kPa; and
- Blue - >-200 kPa.

The steady-state initial conditions were used as the parent for the transient condition analysis. Transient results for two time-steps are provided in **Figure 9-16** and **Figure 9-17**.

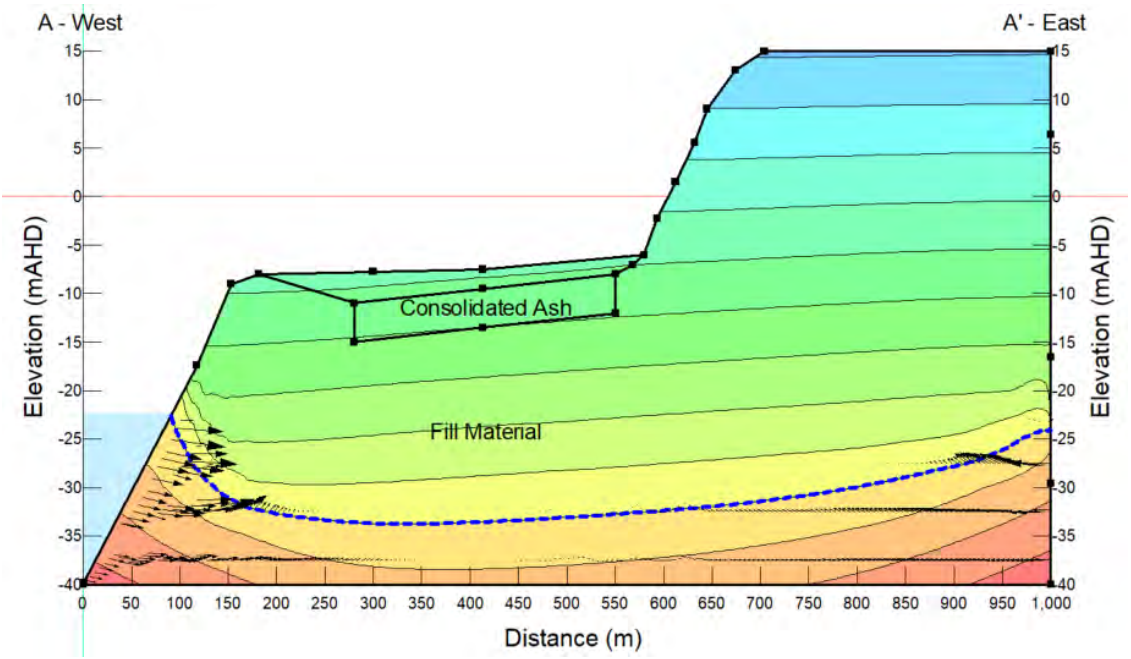

Figure 9-16 Scenario 1b Transient Time-Step 4.1 Years (2020)

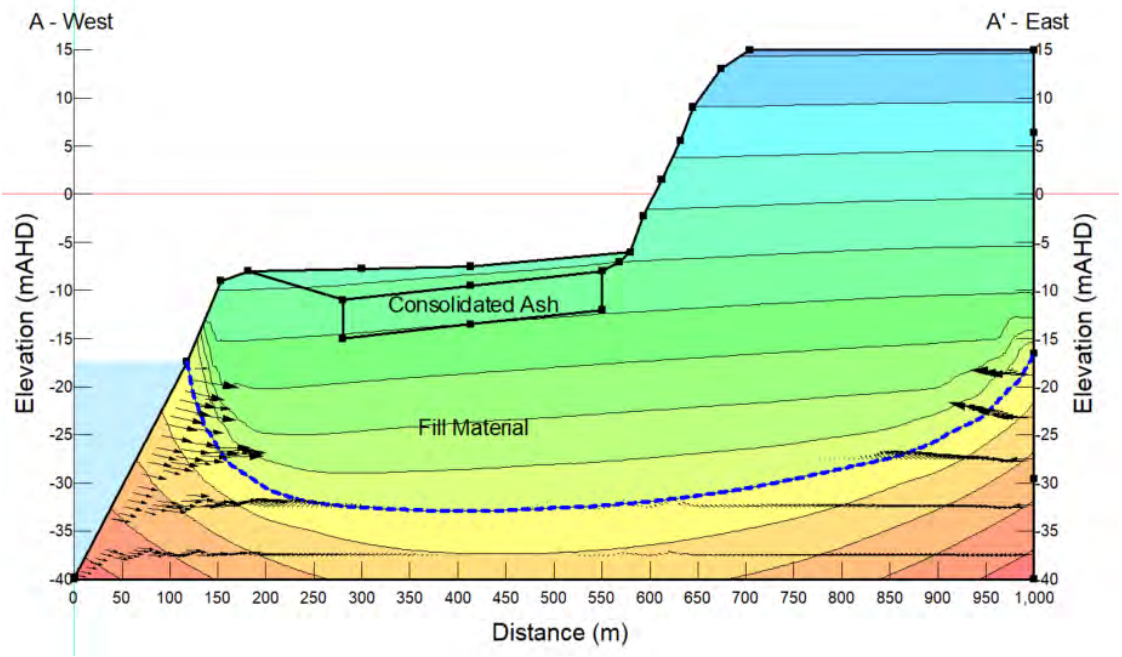

Figure 9-17 Scenario 1b Transient Time-Step 6.15 Years (2022)

The western and eastern hydraulic boundary conditions are providing water into the model domain which has created seepage faces in the fill material. Due to the low hydraulic conductivity of the fill material, the potentiometric surface within the fill is highly variable.

9.10.2 Scenario 2 Natural Fill

The model project definitions for Scenario 2 are provided in **Table 9-7**.

Table 9-7 Scenario 2 Project Definitions

Scenario 2	Time Frame[39]	Physical Processes	Water	Time	
				Duration (days)	Steps
Transient	2016 to 2062	Water	Default parameters	14,529	26

The steady-state model which was established for Scenario 1a was also used to derive the initial conditions for the transient model in Scenario 2. The initial condition represents the total water heads after the cessation of UEVF dewatering in 2016. The Scenario 2 transient model simulates the continuation of increasing water body levels to an elevation of 5.5 mAHD under natural fill conditions. The water body is estimated to reach an elevation of 5.5 mAHD in 2062 (refer to **Figure 9-12**).

BCs used for the transient model runs are as defined in **Table 9-5**.

Transient results for various time steps are provided in **Figure 9-18** through **Figure 9-20.**

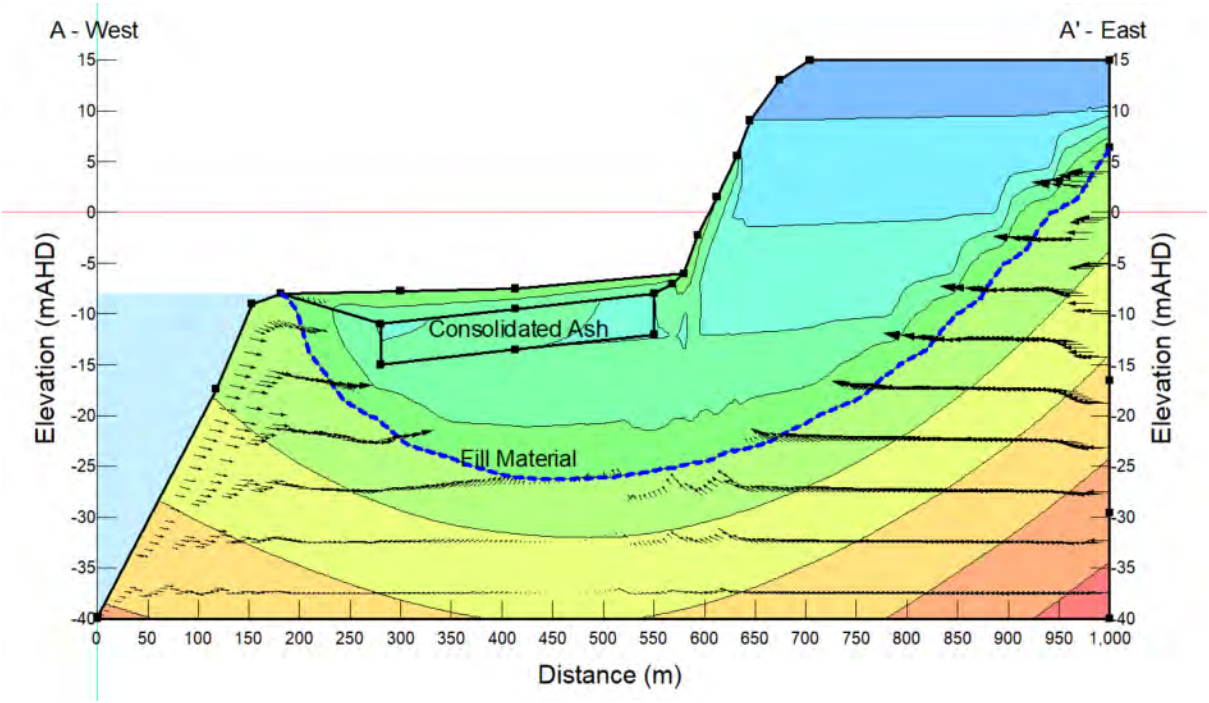

Figure 9-18 Scenario 2 Transient Time-Step 18.4 yrs (2034)

[39] Time Frame is the total time frame as this scenario uses the initial steady-state model (2016) as the parent model.

The simulation time-steps show the contrast in permeability between the CLA and the fill material. **Figure 9-18** and **Figure 9-19** show the lower water pressures (smaller degree of saturation) within the CLA in comparison to the fill material. The CLA is still not saturated by 2039 (**Figure 9-18**) as indicated by the water table and more negative pore water pressures (blue zone surrounded by green zone).

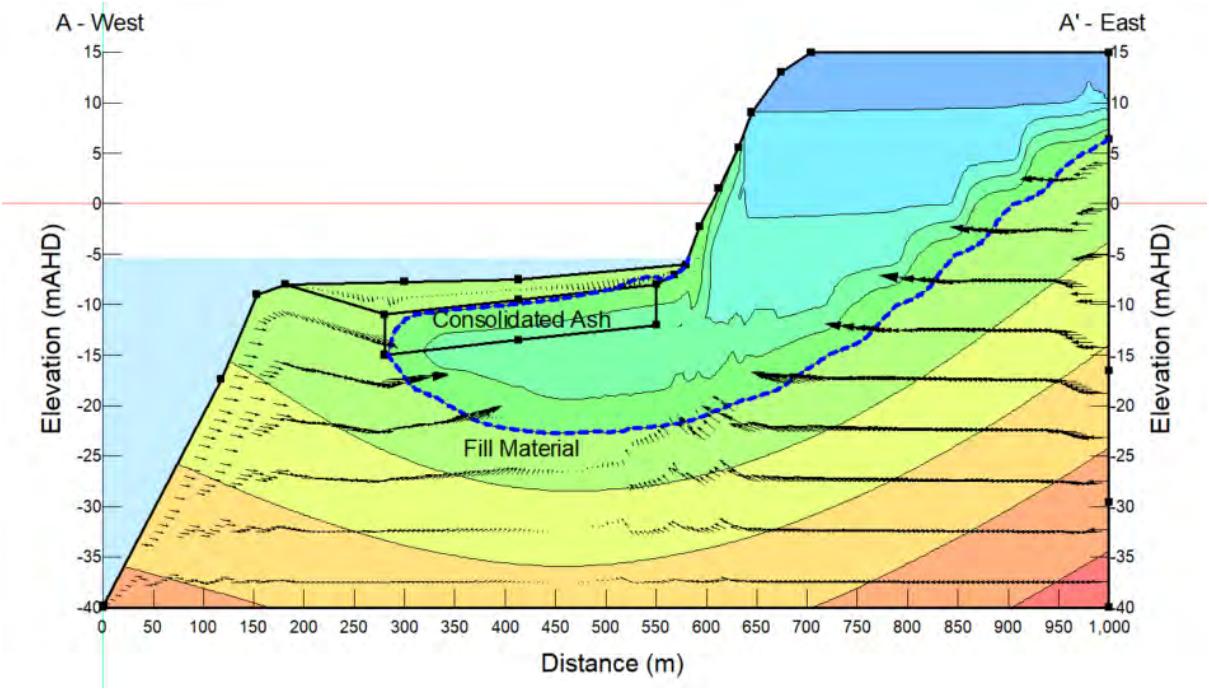

Figure 9-19 Scenario 2 Transient Time-Step 22.9 yrs (2039)

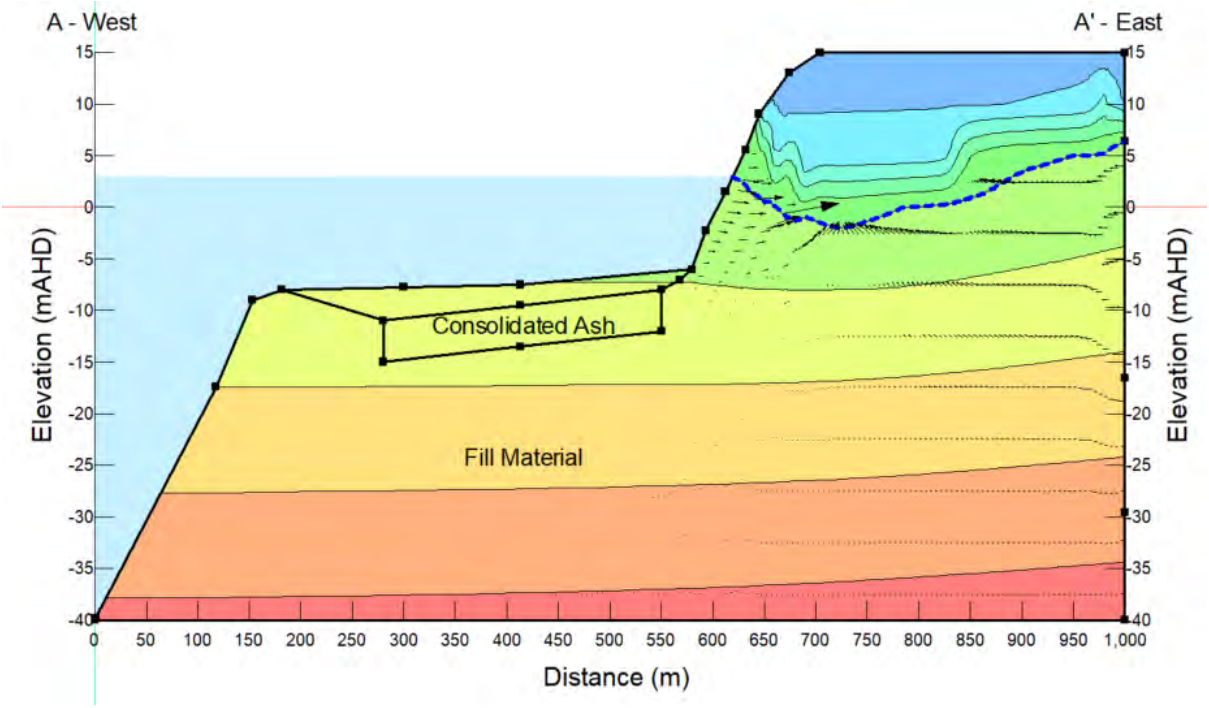

Figure 9-20 Scenario 2 Transient Time-Step 39.8 yrs (2062)

The 'depression' in the water table surface at final time-step 39.8 years (**Figure 9-20**), indicates that steady-state conditions were not achieved for this transient simulation. The low permeability of the fill material controls the slow seepage and saturation of the fill material over time.

The time-step representative of the water body at an elevation of 5.5 mAHD was simulated as a steady-state model (**Figure 9-21**). Contours and mesh (elements and nodes) have been switched off in this figure to show the flow Paths (green lines) more clearly.

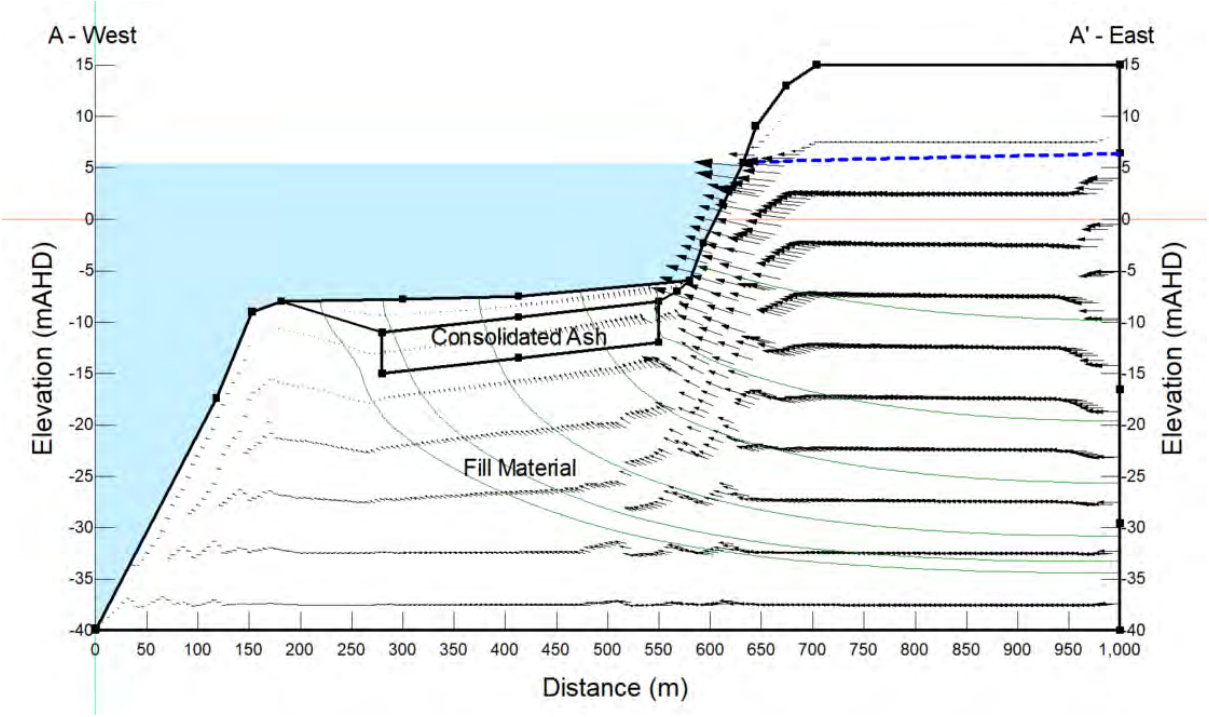

Figure 9-21 Scenario 2 Steady-State Westerly Groundwater Flow – Flow Paths

Flow paths are shown in the vicinity of the CLA (drawing flow paths is not possible in a transient analysis). Flow paths in SEEP/W are not flow lines as in a traditional flow net. Flow paths are a line based on velocity vectors within an element and draw the paths that a drop of water would follow under steady-state conditions from the point of entrance into the flow regime to the point of exit. Flow paths can be used to provide a conservative estimate of the transport direction of a particle in groundwater. There is a slight deflection of the flow paths in the vicinity of the CLA which is due to the hydraulic conductivity contrast between the CLA and the fill material. Although the particles are not predicted to migrate to the water body during the specified time frames, it is noted that the flow paths in **Figure 9-21** do indicate that ultimately there is potential for particle discharge into the water body.

9.10.2.1 Particle Tracking

Particle tracking has been used to view single particle flow paths within the transient simulations. The particle flow paths are not the same as the flow paths computed in steady-state simulations, as these paths are known through the entire model domain as the flow is established. With transient particle flow paths, a particle has infinite vectors to flow over time and particle pathways are unknown until the simulations have completed.

Particles have been placed within the CLA region at a time-step where the CLA is saturated. Simulations did not converge when particles were placed in unsaturated parts of this region. This is likely to have been a function of the low hydraulic conductivity and negative pore water pressures.

Six particles were placed within the CLA region within 1 m of the boundary. This distance is representative of the clay-rich layer surrounding the CLA (**Figure 9-22**).

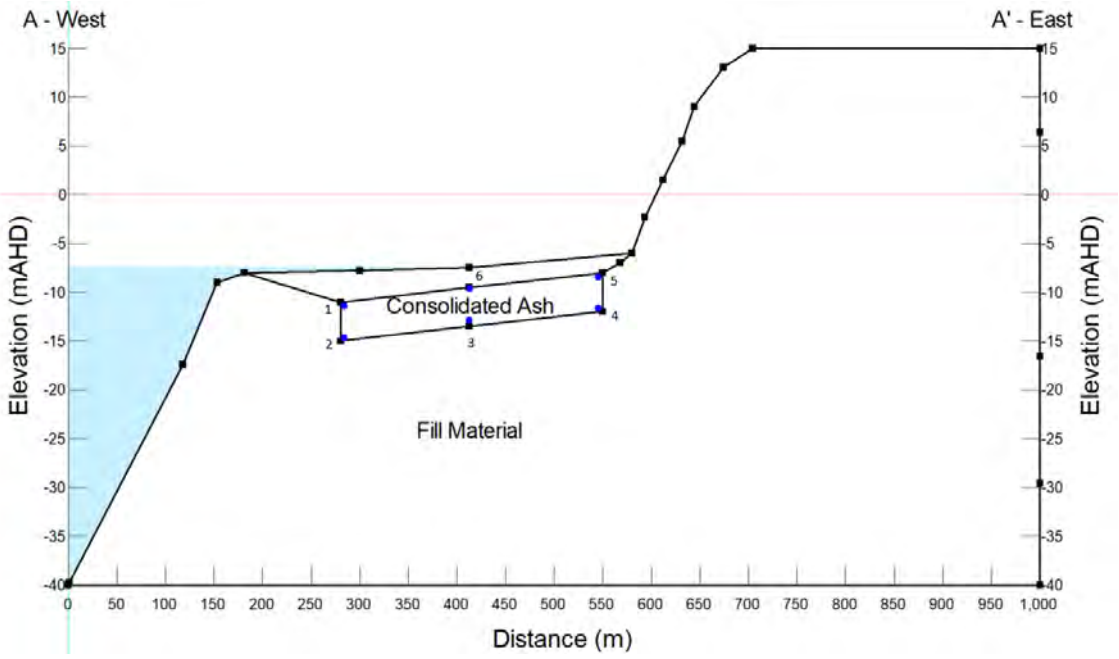

Figure 9-22 Scenario 2 Particle Tracking Initial Conditions – Particle Locations

The time-step selected for particle placement is 30.6 years and approximately represents 2047, at which point the leached ash is simulated to be saturated.

The particle tracking simulation was run for a total of 100 years within a 131-year total simulation period. This represents a total time frame 2016 through to 2147. The groundwater flow direction is westerly throughout the simulation (**Figure 9-23**).

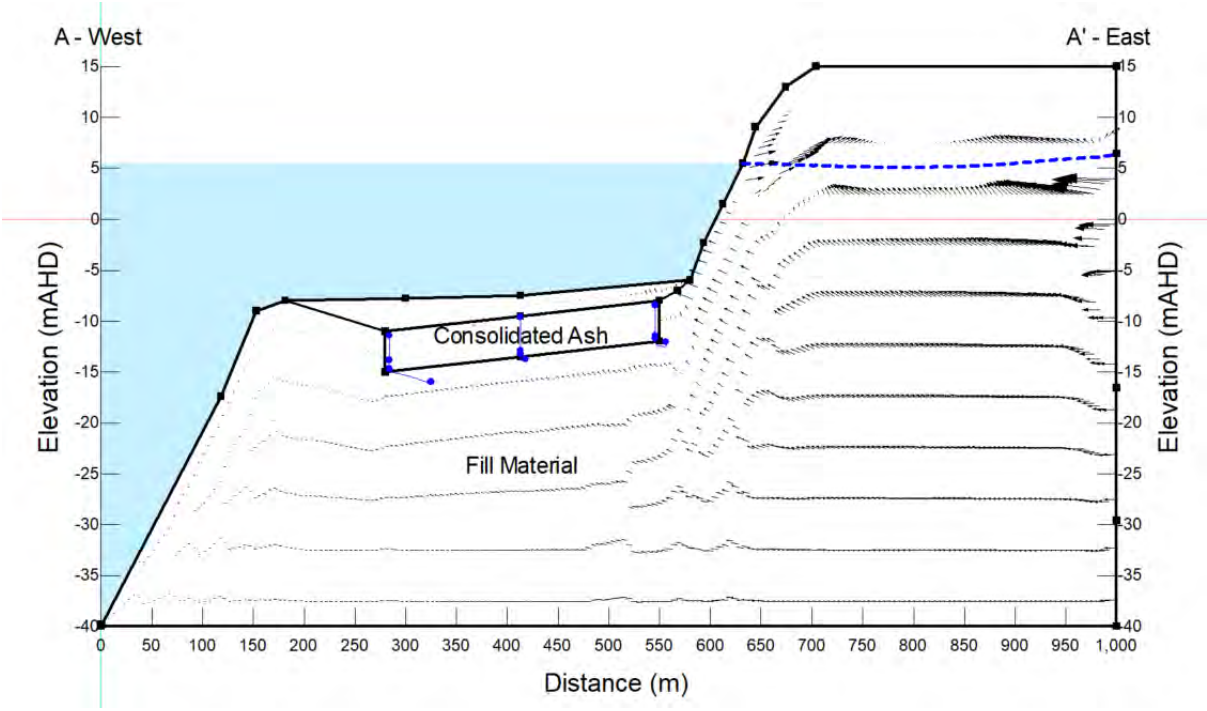

Figure 9-23 Scenario 2 Particle Tracking 2047 to 2147 Simulation – 100 Year Time Frame

Table 9-8 provides tracking information on each particle within the CLA and fill material domains.

Table 9-8 Particle Tracking 100-Year Time Frame

Particle		1	2	3	4	5	6
Travel Time (days)		36,500	36,500	36,500	36,500	36,500	36,500
Initial Location	**X-Coordinate (m)**	284	284	413	546	546	413
	Y-Coordinate (m)	-11	-15	-13	-12	-8	-10
Final Location	**X-Coordinate (m)**	284	325	418	556	546	413
	Y-Coordinate (m)	-14	-16	-14	-12	-11	-13
Total Distance Travelled (m)		3	46	10	13	4	4
Average Speed (m/d)		$7.x10^{-5}$	$1x10^{-3}$	$3x10^{-4}$	$4x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$

Particle 2 is observed to have travelled approximately 46 m; however, the particle pathway is not linear along the x axis, and overall it has travelled 41 m in an easterly direction but at a tangent before reversing direction as flow with the model domain evolves (**Figure 9-24**).

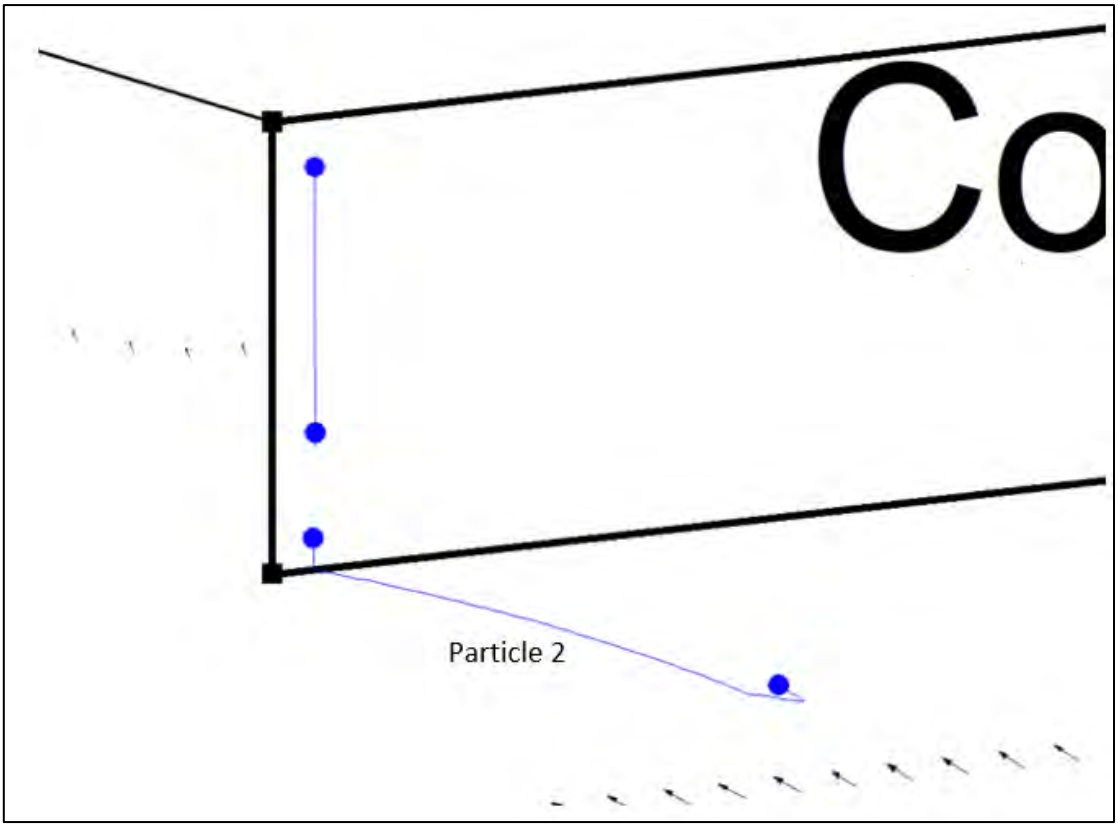

Figure 9-24 Scenario 2 Particles 1 and 2 Travel Pathways at 2147 yr Time-step

Particle tracking was extended for another 100 years to 2247 (**Figure 9-25**). The particles are observed to have migrated a minimal distance with no discharge to the water body after 200 years.

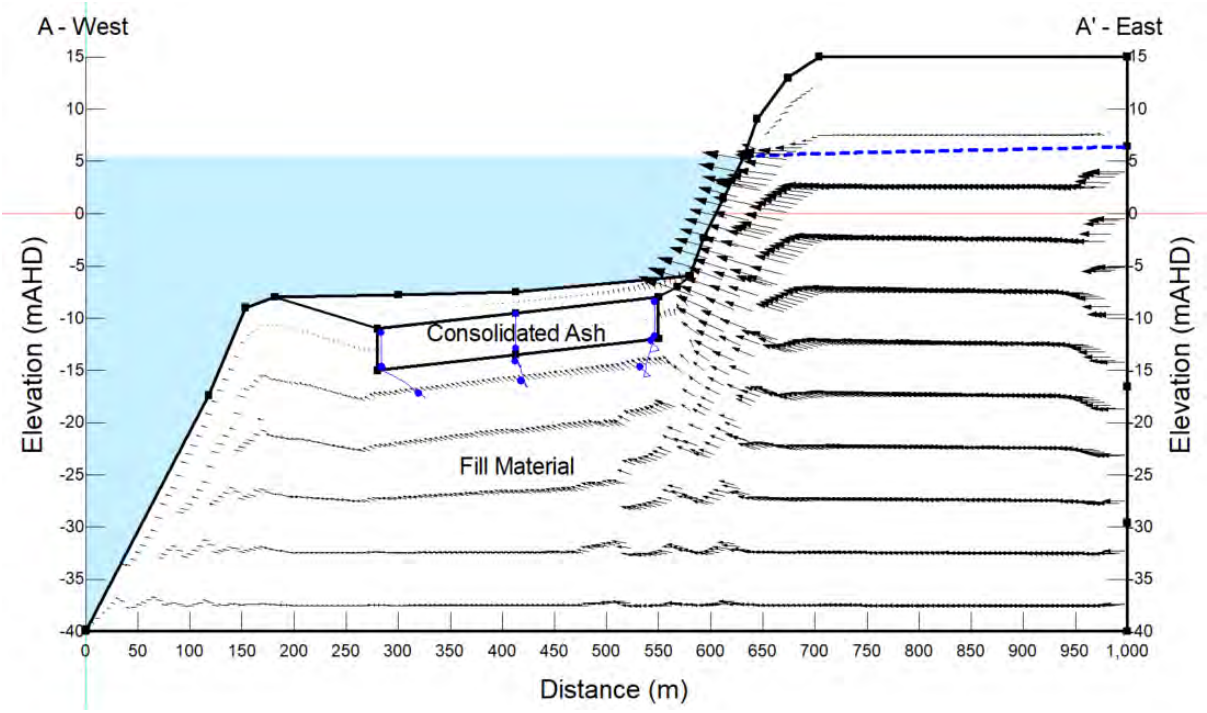

Figure 9-25 Scenario 2 Particle Tracking 2047 to 2247 Simulation – 200 Year Time Frame

9.10.3 Scenario 3 Fast Fill

The model project definitions for Scenario 3 are provided in **Table 9-9**.

Table 9-9 Scenario 3 Project Definitions

Scenario 3	Time Frame	Physical Processes	Water	Time	
				Duration (days)	Steps
Transient	2016 to 2031	Water	Default parameters	5,713	10

The steady-state model which was established for Scenario 1a was also used to derive the initial conditions for the transient model in Scenario 3. The initial condition represents the total water heads after the cessation of UEVF dewatering in 2016. The Scenario 3 transient model simulates the continuation of increasing water body levels to an elevation of 5.5 mAHD under fast fill conditions (addition of 1.5GL/yr). The water body is estimated to reach an elevation of 5.5 mAHD in 2031 (**Figure 9-13**). The simulation has been extended by two years until 2033 so the fill material groundwater elevation recovers to a height above the water body elevation (6.42 mAHD) which establishes the predicted westerly groundwater flow direction.

BCs used for the transient model runs are as defined in **Table 9-5**.

Transient results for various time steps are provided in **Figure 9-26** through **Figure 9-28**.

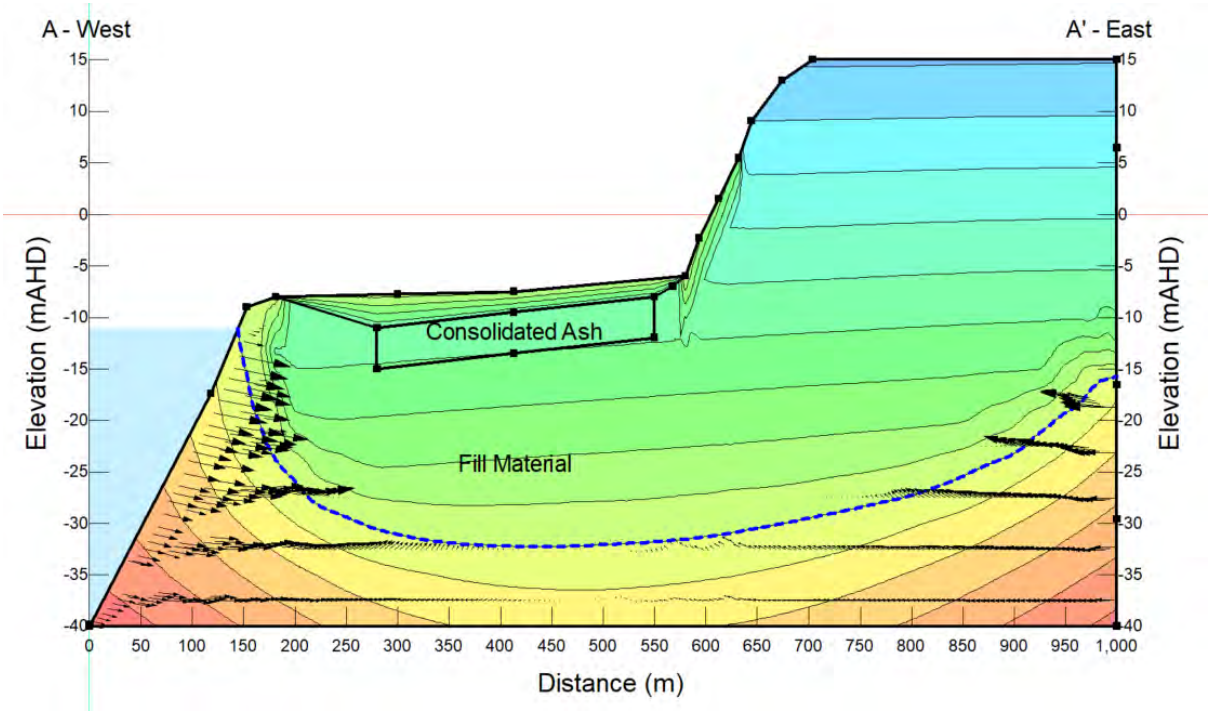

Figure 9-26 Scenario 3 Transient Time-Step 7.85 Years (2024)

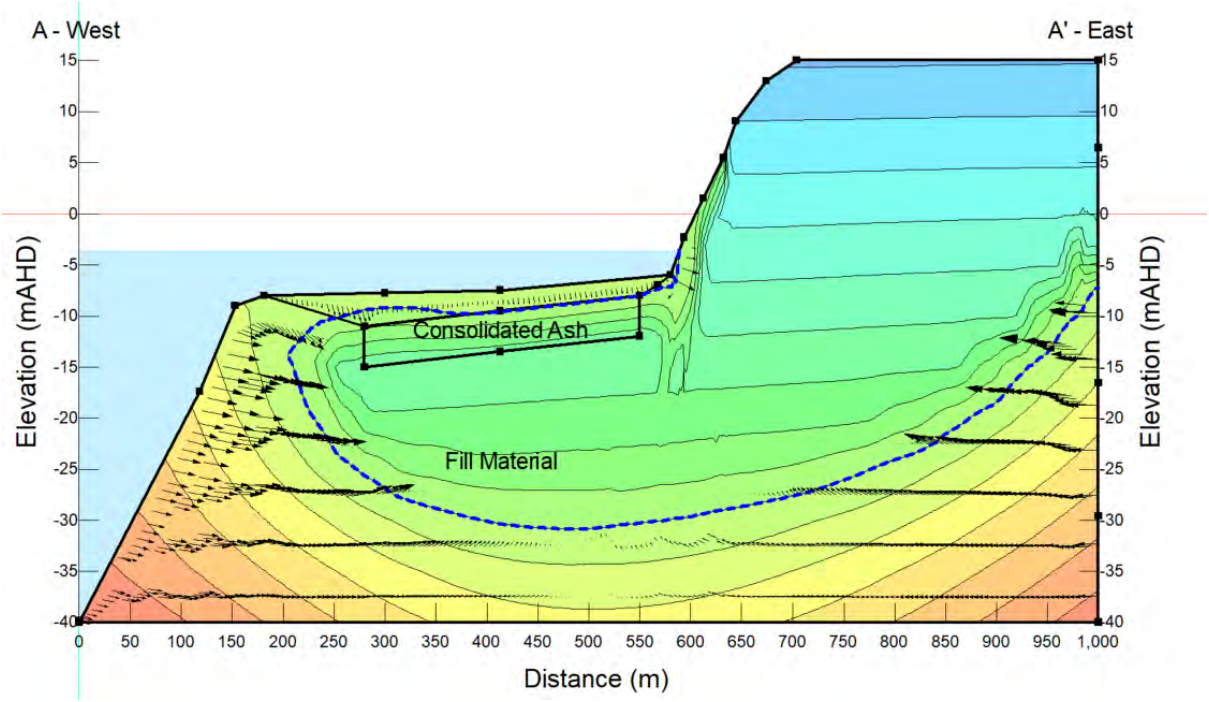

Figure 9-27 Scenario 3 Transient Time-Step 11 Years (2027)

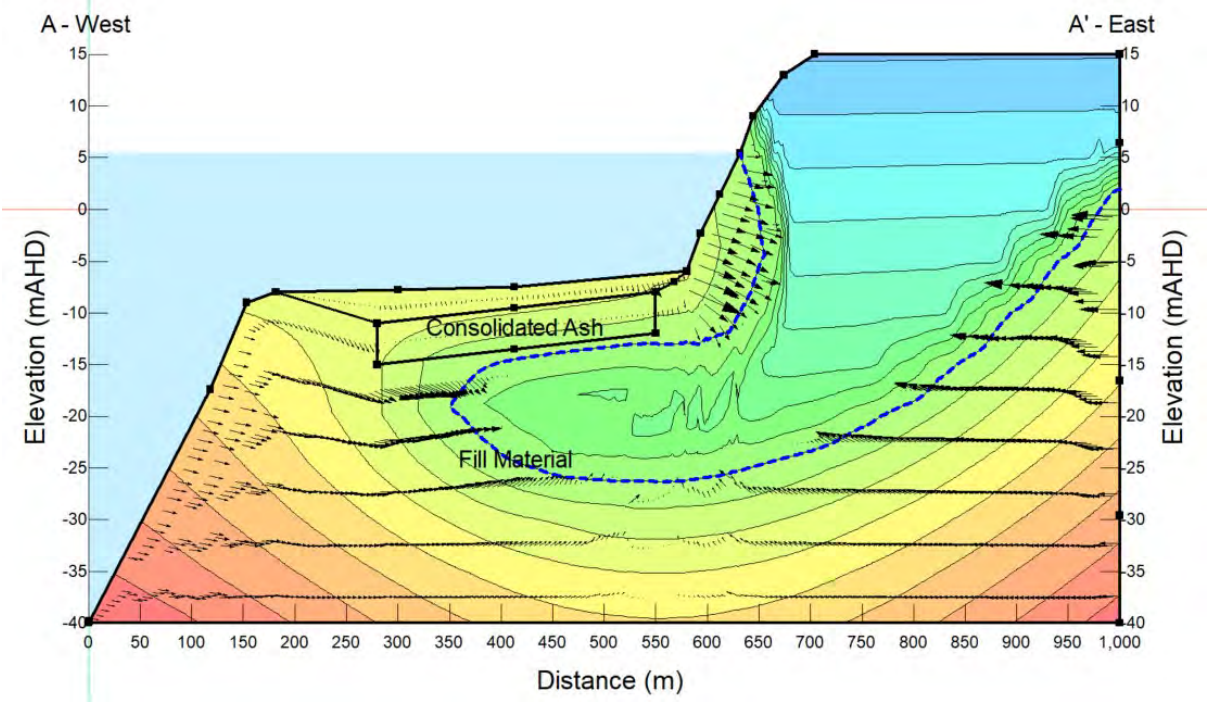

Figure 9-28 Scenario 3 Transient Time-Step 15.7 Years (2031)

The depression in the water table surface in **Figure 9-28** indicates steady-state conditions have not been achieved. Similar to Scenario 2, the low permeability of the fill material is controlling the slow saturation; however, for the fast fill scenario this is more evident in the recovering water table surface.

9.10.3.1 Particle Tracking

Particle tracking has been used to view single particle flow paths within the transient simulations. The particle flow paths are not the same as the flow paths computed in steady-state simulations, as these paths are known through the entire model domain as the flow is established. With transient particle flow paths, a particle has infinite vectors to flow over time and it is not known what the particle path will be until the simulations have completed.

Six particles were placed within the CLA region within 1 m of the boundary. This distance is representative of the clay-rich layer surrounding the CLA (**Figure 9-29**).

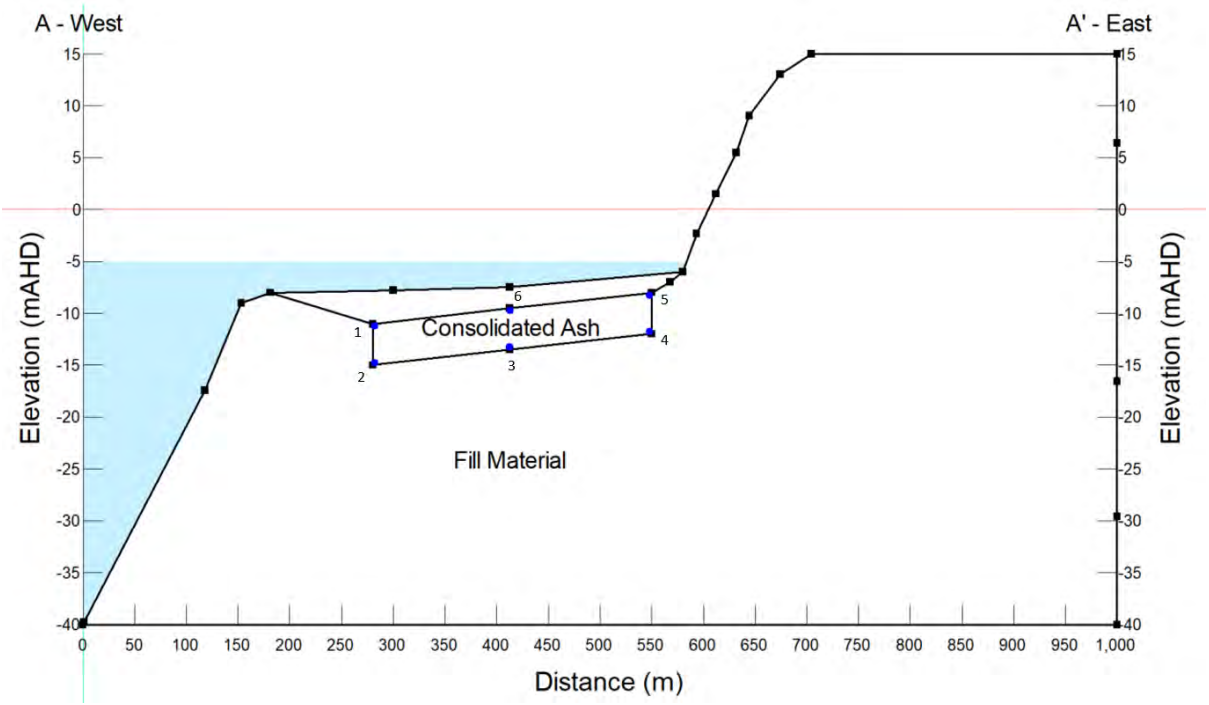

Figure 9-29 Scenario 3 Particle Tracking Initial Conditions – Particle Locations

The time-step selected for particle placement is 14.1 years and represents 2030, at which point the CLA is predicted to be saturated.

The particle tracking simulation was run for a total of 100 years within a 114-year total simulation period. This represents a total time frame 2016 through to 2127. The groundwater flow direction is westerly and discharges to the water body (**Figure 9-30**).

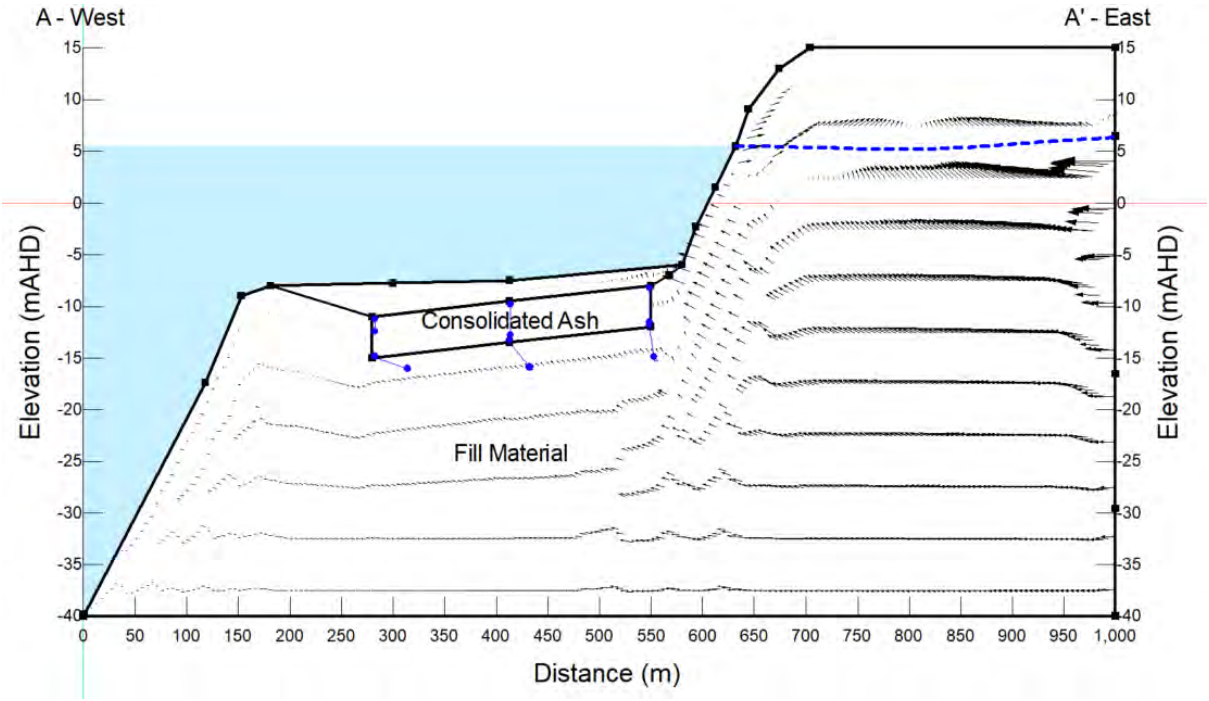

Figure 9-30 Scenario 3 Particle Tracking 2030 to 2130 Simulation – 100 Year Time Frame

Table 9-10 below provides tracking information on each particle within the CLA and fill material domains.

Table 9-10 Particle Tracking 100-Year Time Frame

Particle		1	2	3	4	5	6
Travel Time (days)		36,500	36,500	36,500	36,500	36,500	36,500
Initial Location	X-Coordinate (m)	282	282	413	548	548	413
	Y-Coordinate (m)	-11	-15	-13	-12	-8	-10
Final Location	X-Coordinate (m)	282	314	432	553	548	413
	Y-Coordinate (m)	-13	-16	-16	-15	-12	-13
Total Distance Travelled (m)		1	38	26	13	4	4
Average Speed (m/d)		$4x10^{-5}$	$1x10^{-3}$	$7x10^{-4}$	$4x10^{-4}$	$1x10^{-4}$	$1x10^{-4}$

Particle 2 is observed to have travelled approximately 38 m, however the particle pathway is not linear along the x-axis; overall, it has travelled 31 m in an easterly direction but at a tangent before reversing direction to the west as groundwater flow with the model domain evolves (**Figure 9-31**).

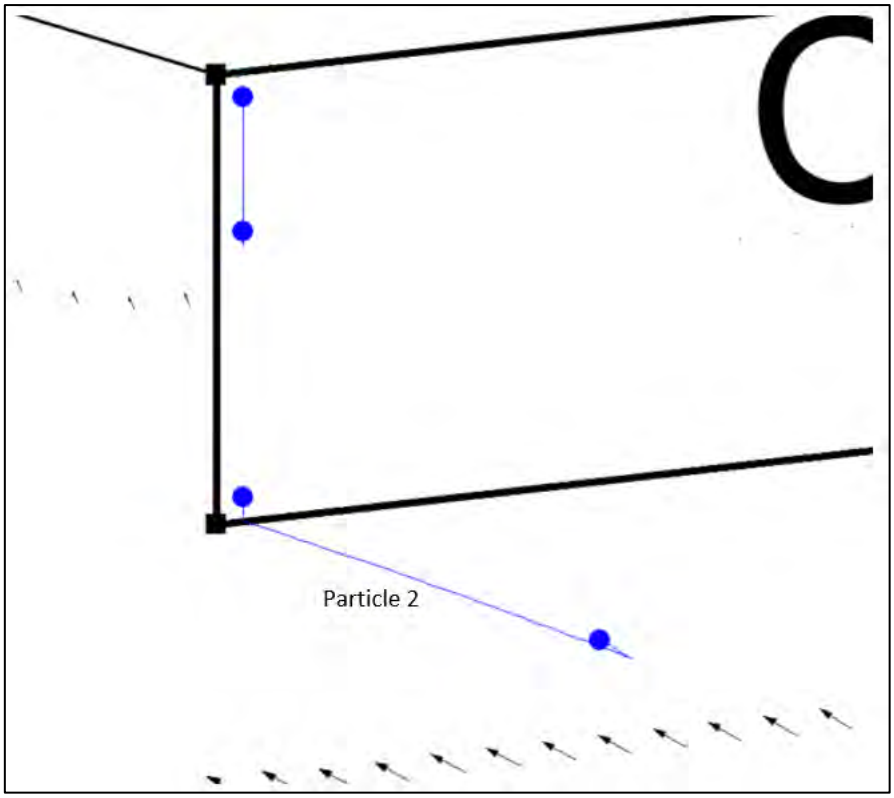

Figure 9-31 Scenario 3 Particles 1 and 2 Travel Pathways at 2130 yr Time-step

Particle tracking was extended for another 100 years to 2230 (**Figure 9-32**). The particles are observed to have migrated a minimal distance (3 m) with no discharge to the water body after 200 years.

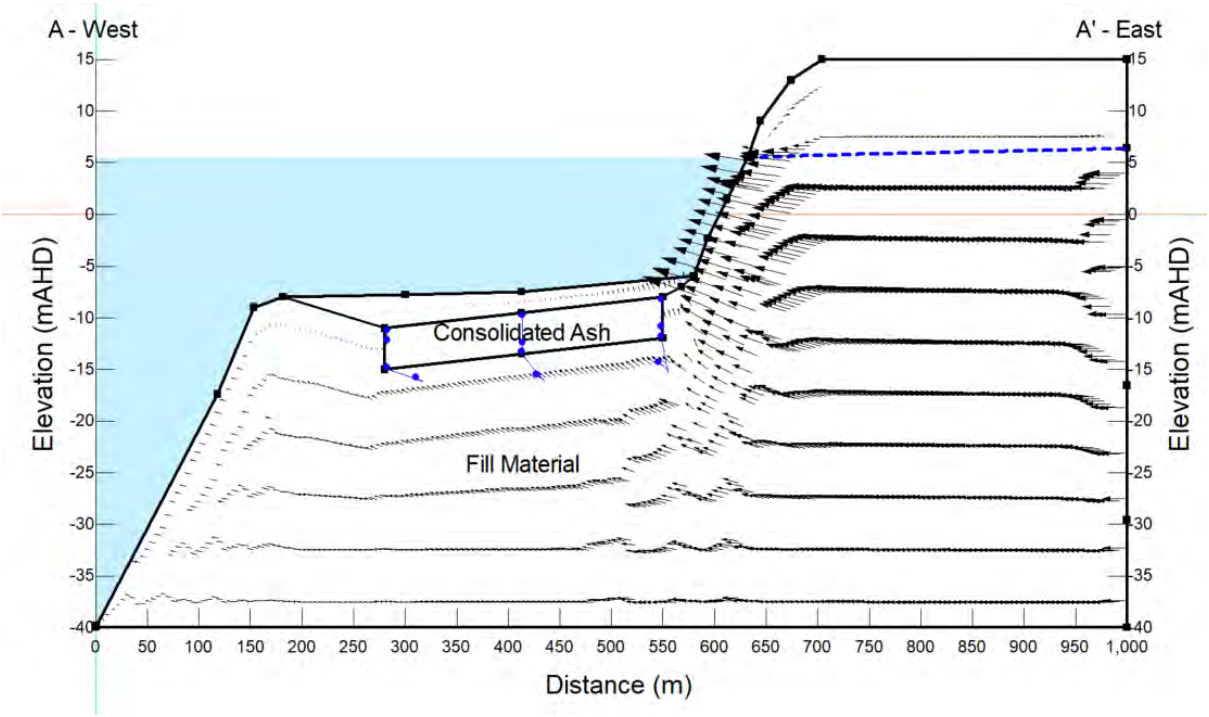

Figure 9-32 Scenario 3 Particle Tracking 2030 to 2230 Simulation – 200 Year Time Frame

Although the particles are not predicted to migrate to the water body during the specified time frames, it is noted that flow paths (**Figure 9-21**) do indicate that ultimately there is potential for particle discharge into the water body.

9.10.4Sensitivity Analysis

The hydraulic conductivity of the materials and the fill rate were selected as parameters for sensitivity analysis.

The hydraulic conductivity of the CLA was increased by three orders of magnitude, from $2.9x10^{-9}$ m/sec to $2.9x10^{-6}$ m/sec. Sensitivity analysis was conducted for both Scenarios 2 and 3. Particle tracking was also enabled for both scenarios. Scenario 2 particle tracking was conducted for 100 years in a total transient simulation of 131 years. Scenario 3 particle tracking was conducted for 100 years in a total transient simulation of 114 years (**Section 9.10.4.1** and **Section 9.10.4.2**).

A fill rate was used to depict an event where the water body fills after a storm event and prolonged heavy rainfall. This has been simulated as a 15 GL volume of water added in 12 months (2023) at a single time step. The simulation was extended for an additional 50 years until 2073 to observe changes in the model domain flow regime (**Section 9.10.4.3**).

9.10.4.1 Scenario 2 Hydraulic Conductivity

Scenario 2 was re-simulated using an increased hydraulic conductivity for the CLA of $2.9x10^{-6}$ m/sec.

The time-step representative of the water body at an elevation of 5.5 mAHD was simulated as a steady-state model (**Figure 9-33**). Contours and mesh (elements and nodes) have been switched off in this figure to show the flow Paths (green lines) more clearly. The comparison of **Figure 9-21** with **Figure 9-33** indicates the higher permeability of the CLA is not having a significant effect on the flow pathways which is expected as the fill material and CLA hydraulic permeabilities are very similar.

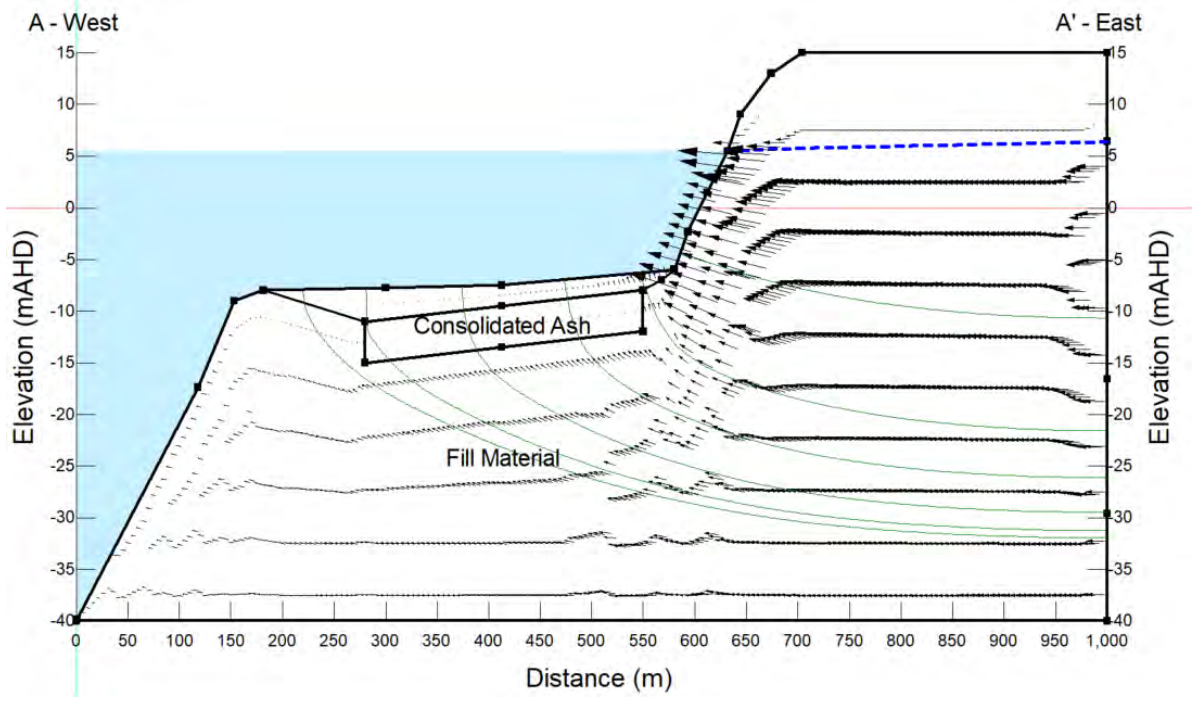

Figure 9-33 Scenario 2 Steady-State Westerly Groundwater Flow, Ash Hydraulic Conductivity $2.9x10^{-6}$ m/sec – Flow Paths

Particle tracking was conducted for 100 years in a total transient simulation of 131 years (**Figure 9-34**). Particle locations are the same as those provided in **Figure 9-22**.

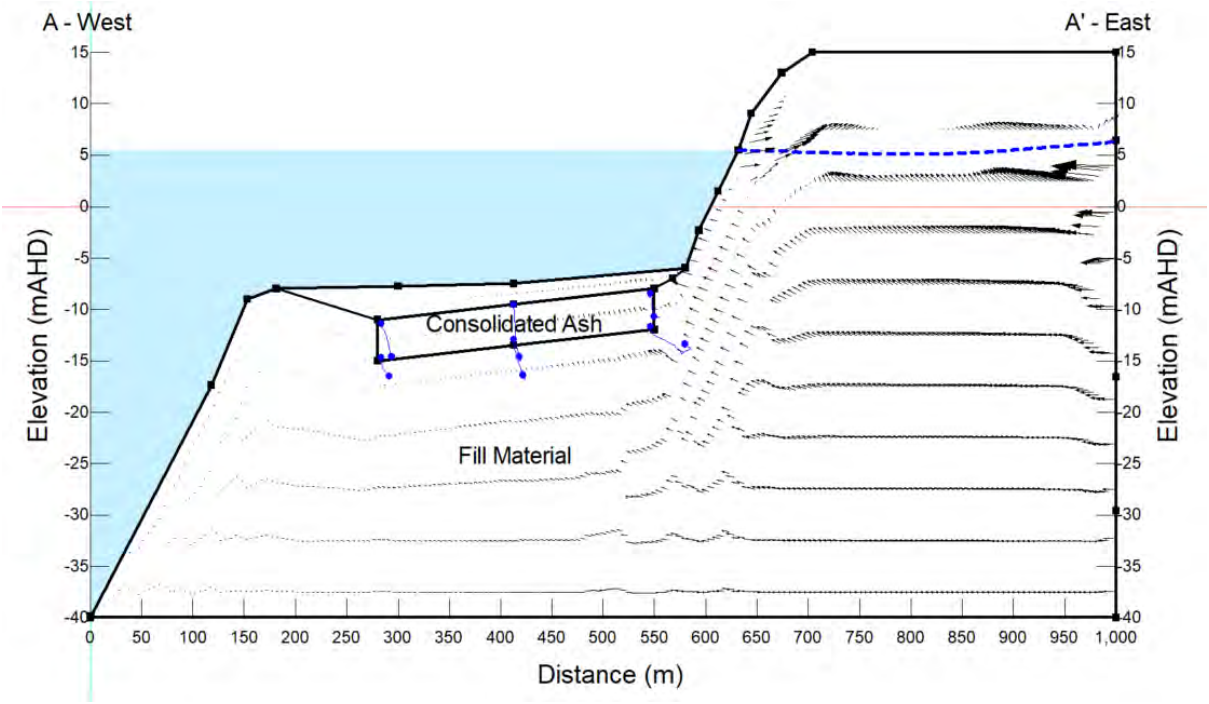

Figure 9-34 Particle Tracking 2047 to 2147 Simulation – Scenario 2 Sensitivity Analysis

Table 9-11 provides tracking information on each particle within the CLA and fill material domains. Scenario 2 particle tracking was conducted for 100 years in a total transient simulation of 131 years.

Table 9-11 Particle Tracking – Scenario 2 Sensitivity Analysis

Particle		1	2	3	4	5	6
Travel Time (days)		36,500	36,500	36,500	36,500	36,500	36,500
Initial Location	X-Coordinate (m)	284	284	413	546	546	413
	Y-Coordinate (m)	-11	-15	-8	-12	-8	-10
Final Location	X-Coordinate (m)	293	291	422	580	550	418
	Y-Coordinate (m)	--15	--17	-16	-13	-11	-15
Total Distance Travelled (m)		12	11	14	46	24	11
Average Speed (m/d)		$3x10^{-4}$	$3x10^{-4}$	$4x10^{-4}$	$1x10^{-3}$	$7x10^{-4}$	$3x10^{-4}$

Particle 4 is observed to have travelled approximately 46 m, however the particle pathway is not linear along the x axis; overall, it has travelled 34 m in an easterly direction but at a tangent before reversing direction as groundwater flow with the model domain evolves (**Figure 9-35**).

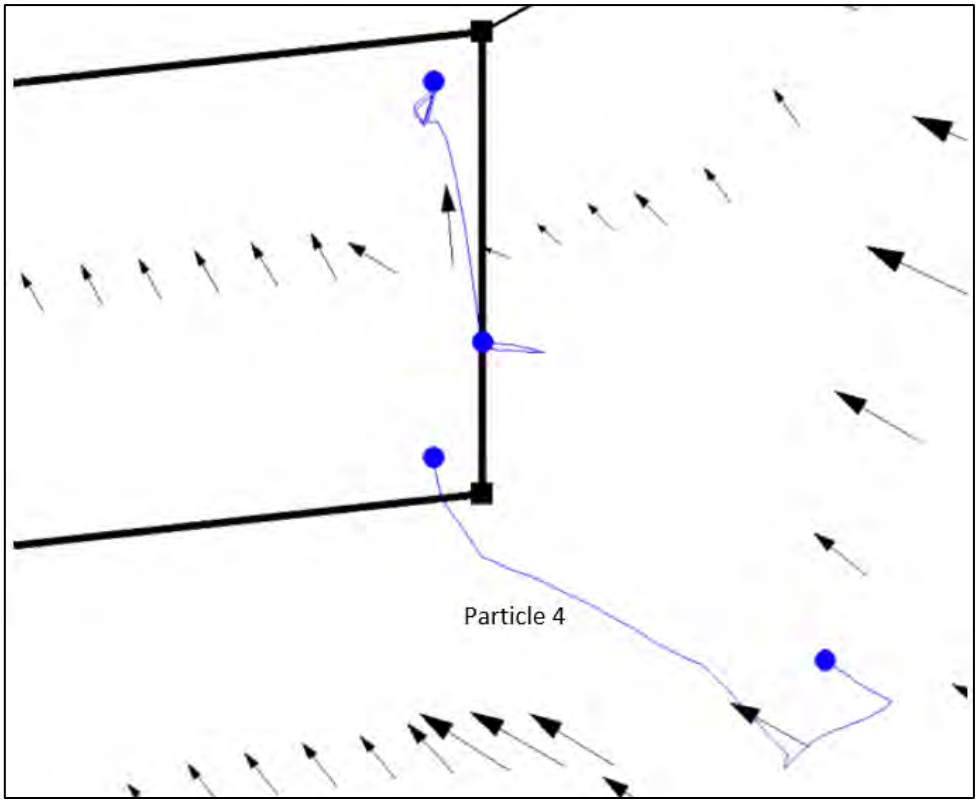

Figure 9-35 Particles 4 and 5 Travel Pathways at 2147 yr Time-step

9.10.4.2 Scenario 3 Hydraulic Conductivity

Scenario 3 was re-simulated using an increased hydraulic conductivity for the CLA of 2.9×10^{-6} m/sec.

Particle tracking was conducted for 100 years in a total transient simulation of 114 years (**Figure 9-36**). Particle locations are the same as those provided in **Figure 9-22**.

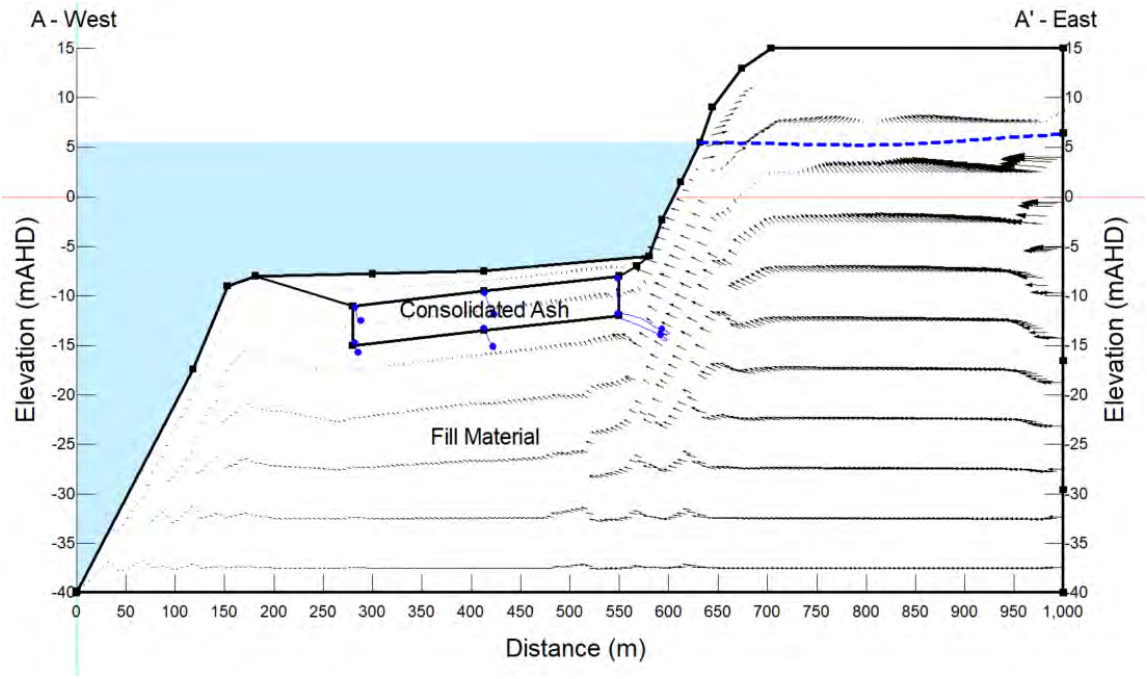

Figure 9-36 Particle Tracking 2030 to 2130 Simulation – Scenario 3 Sensitivity Analysis

Table 9-12 provides tracking information on each particle within the consolidated leached ash domain.

Table 9-12 Particle Tracking – Scenario 3 Sensitivity Analysis

Particle		1	2	3	4	5	6
Travel Time (days)		36,500	36,500	36,500	36,500	36,500	36,500
Initial Location	X-Coordinate (m)	282	282	413	548	548	413
	Y-Coordinate (m)	-11	-15	-13	-12	-8	-10
Final Location	X-Coordinate (m)	288	285	422	591	593	423
	Y-Coordinate (m)	-12	-16	-15	-14	-13	-12
Total Distance Travelled (m)		8	5	14	58	63	14
Average Speed (m/d)		$2x10^{-4}$	$1x10^{-4}$	$4x10^{-4}$	$2x10^{-3}$	$2x10^{-3}$	$4x10^{-4}$

Particle 5 is observed to have travelled approximately 63 m, however the particle pathway is not linear along the x axis; overall, it has travelled 45 m in an easterly direction but at a tangent before reversing direction as groundwater flow with the model domain evolves (**Figure 9-37**).

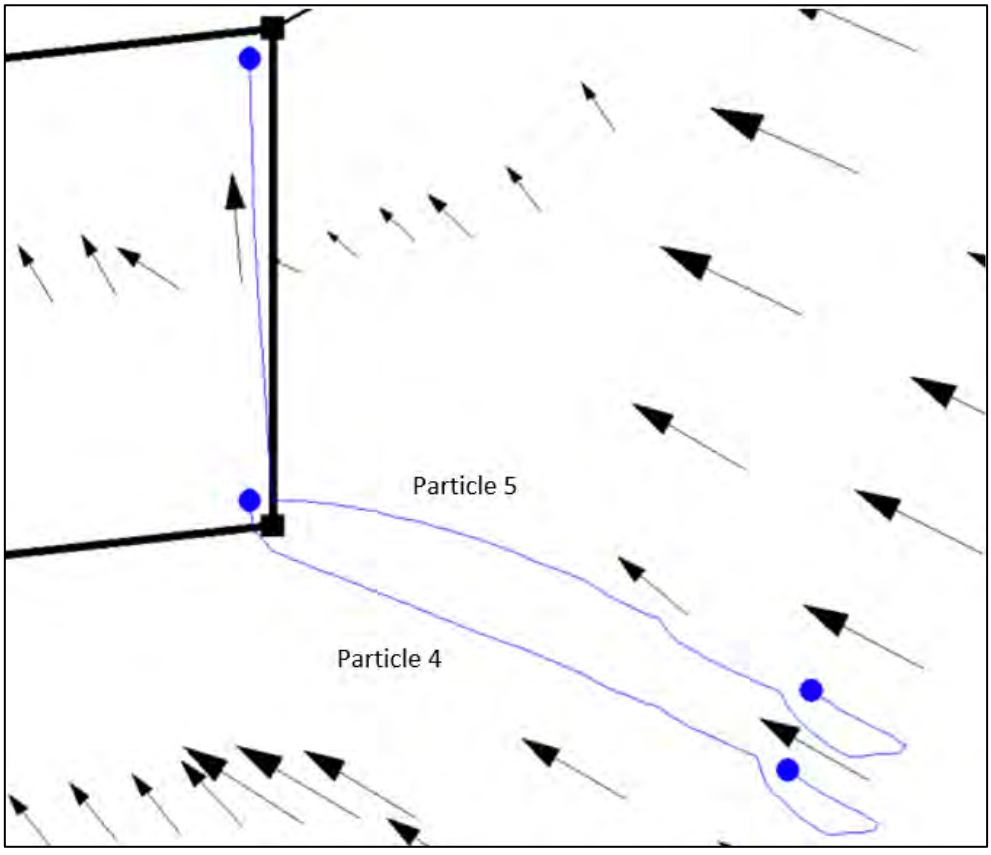

Figure 9-37 Scenario 3 Sensitivity Particles 4 and 5 Travel Pathways at 2130 yr Time-step

9.10.4.3 Sensitivity Analysis Rapid Fill

A fill rate was used to depict an event where the water body fills after a storm event and prolonged heavy rainfall. This has been simulated as a 15 GL volume of water added in 12 months (2023) at a single time step.

The model project definitions for the sensitivity analysis of a rapid fill are provided in **Table 9-13**.

Table 9-13 Sensitivity Analysis – Scenario 3 Rapid Fill Project Definitions

Scenario 3	Time Frame	Physical Processes	Water	Time	
				Duration (days)	Steps
Transient	2016 to 2023	Water	Default parameters	2,564	50

The steady-state model which was established for Scenario 1a was also used to derive the initial conditions for the transient model in Scenario 3 rapid fill sensitivity analysis.

This sensitivity analysis simulates the addition of 15 GL volume of water in 12 months (2023) at a single time step (**Figure 9-38**).

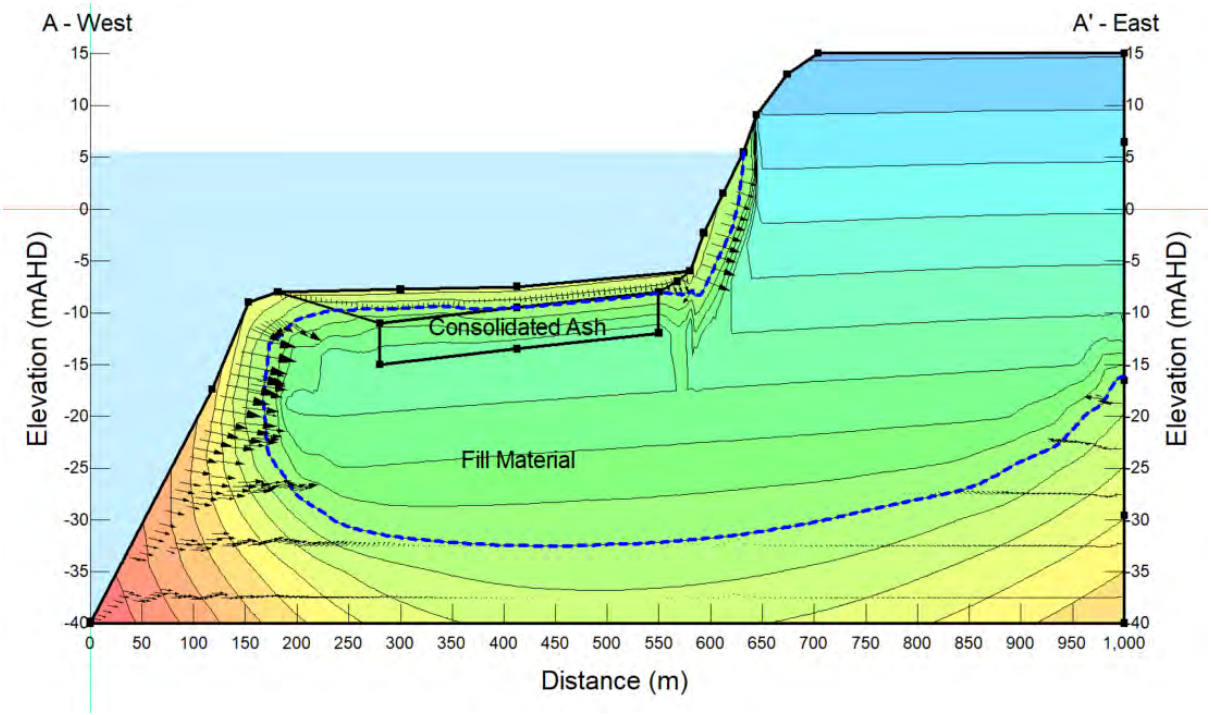

Figure 9-38 Sensitivity Analysis Rapid Fill Transient Time-Step 7.02 Years (2023)

Due to the rapid increase in the total head of the water body BC, there is a steep hydraulic gradient in the fill material towards the eastern BC (year 2023). To observe the change in the water table hydraulic gradient and elevation as the eastern BC total head increases, the simulation was extended by 75 years to 2098 (**Figure 9-39**).

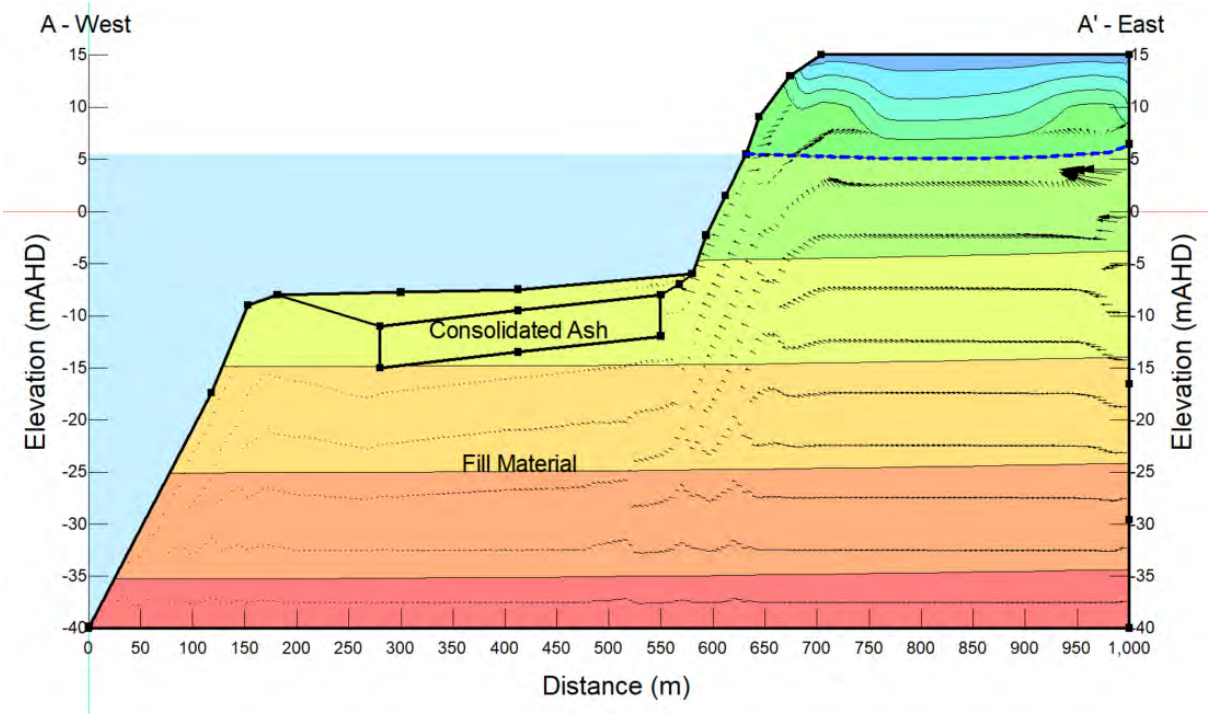

Figure 9-39 Sensitivity Analysis Rapid Fill Transient Time-Step 82 Years (2098)

In **Figure 9-39** the groundwater flow direction has reversed to a westerly direction towards the water body.

Particle Tracking – Rapid Fill

Particle tracking has been used to view single particle flow paths within the transient simulations. The particle flow paths are not the same as the flow paths computed in steady-state simulations, as these paths are known through the entire model domain as the flow is established. With transient particle flow paths, a particle has infinite vectors to flow over time and it is not known what the particle path will be until the simulations have completed.

The time-step selected for particle placement is 10.4 years and represents 2026, at which point the CLA is simulated to be saturated. The particle tracking simulation was run for a total of 100 years within a 110 year total simulation period. This represents a total time frame 2016 through to 2126. Particle locations are the same as those provided in **Figure 9-22**.

The groundwater flow direction is westerly and discharges to the water body (**Figure 9-40**).

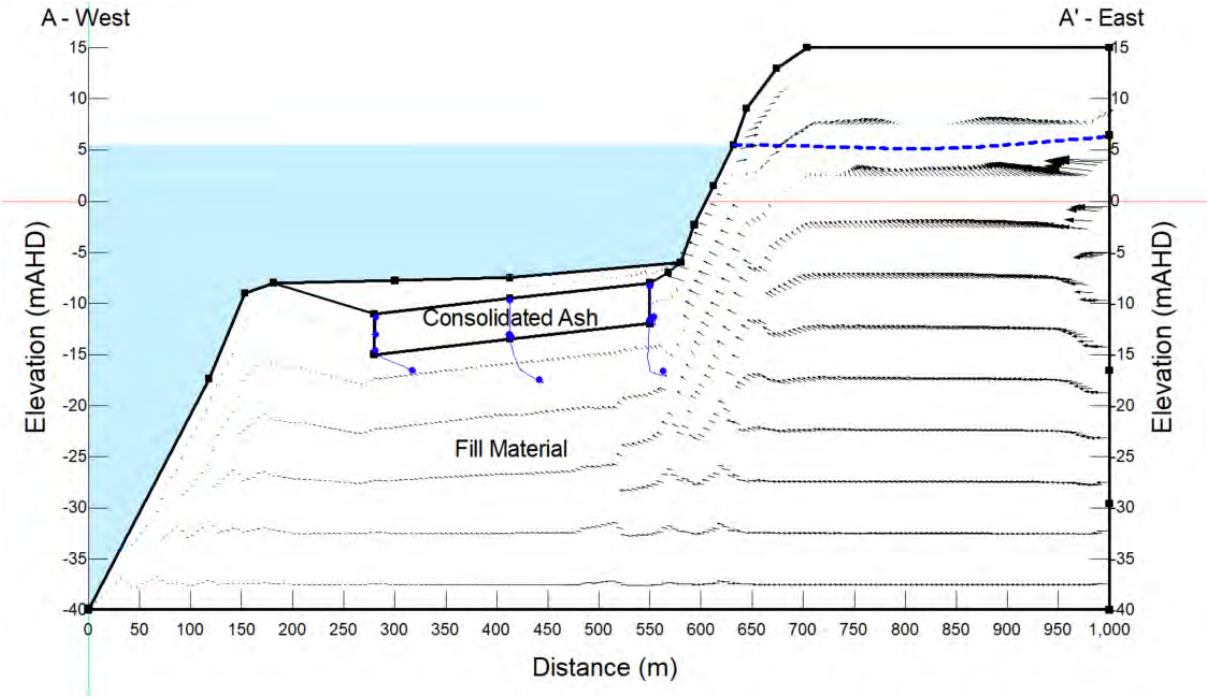

Figure 9-40 Particle Tracking 2026 to 2126 Simulation – 100 Year Time Frame

Table 9-14 below provides tracking information on each particle within the CLA domain**.**

Table 9-14 Particle Tracking 100-Year Time Frame

Particle		1	2	3	4	5	6
Travel Time (days)		15,048	17,929	17,610	18,250	18,250	18,250
Initial Location	X-Coordinate (m)	282	281	413	549	549	413
	Y-Coordinate (m)	-11	-15	-13	-12	-8	-10
Final Location	X-Coordinate (m)	282	318	442	563	554	414
	Y-Coordinate (m)	-13	-17	-18	-17	-11	-13
Total Distance Travelled (m)		2	43	38	26	11	6
Average Speed (m/d)		$5x10^{-5}$	$1x10^{-3}$	$1x10^{-3}$	$7x10^{-4}$	$3x10^{-4}$	$2x10^{-4}$

Particle 2 is observed to have travelled approximately 43 m, however the particle pathway is not linear along the x axis; overall, it has travelled 37m in an easterly direction but at a tangent before reversing direction as groundwater flow with the model domain evolves.

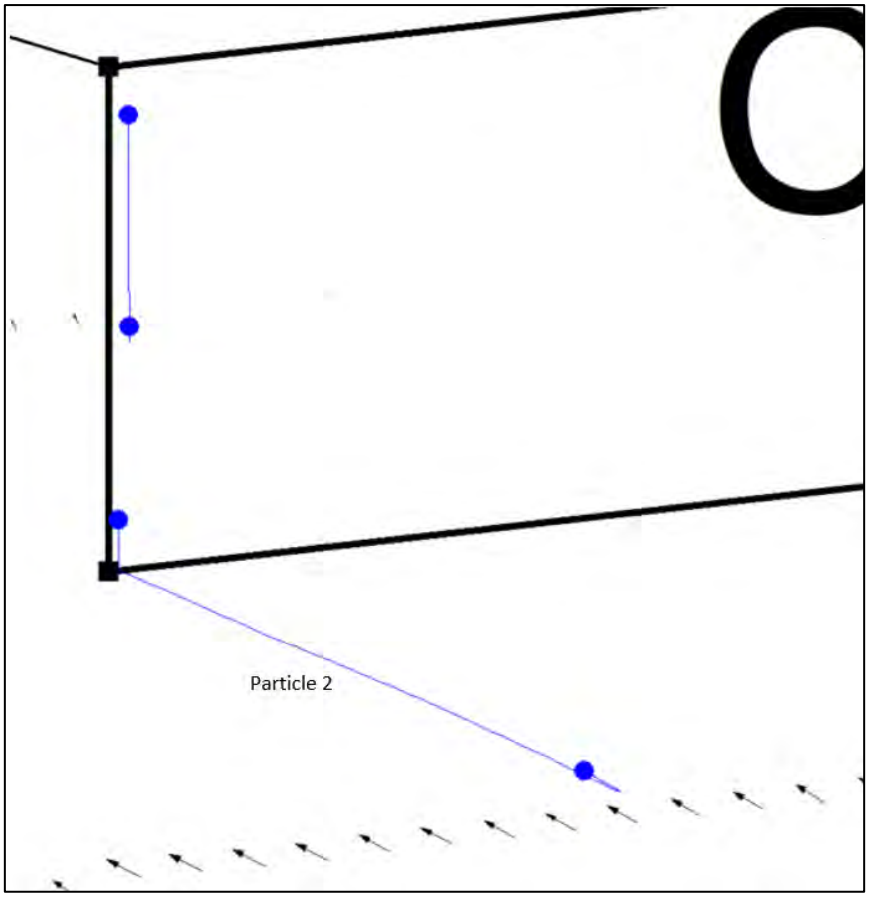

Figure 9-41 Particles 2 Travel Pathways at 2126 yr Time-step

9.11 Summary and Conclusions

Three scenarios have been developed using SEEP/W that simulate the current and future anticipated flow path regime in the vicinity of the CLA/clay-rich liner, fill material, and the water body.

The outcomes of the simulated scenarios indicate that particles representing a conservative constituent (not subject to attenuation or retardation) within the CLA do not have the potential to migrate in groundwater to either the natural in-situ DBF and BF or to the water body within the simulated time frames for groundwater recovery. These time frames consisted of a natural fill option from 2016 to 2062 (Scenario 2) and a fast fill option from 2016 to 2031 (Scenario 3).

Breakthrough and migration of a conservative constituent from the CLA to the natural in-situ DBF and BF is unlikely to occur under either a natural fill (Scenario 2) or a fast fill (Scenario 3). During Scenario 2, an easterly (i.e., movement from pit water into formation) groundwater flow exists until year 2090 of the simulation. After approximately 43 years, the groundwater flow direction changes towards the west. In the first 100 years, under this scenario a conservative particle within the CLA is estimated to move no more than 46 m and no more than 49 m in 200 years. During Scenario 3, an easterly groundwater flow exists for less than 20 years (between 2030 and 2050) before reversing to a westerly flow. In the first 100 years, under this scenario a conservative particle within the CLA is estimated to move no more than 38 m and no more than 41 m in 200 years.

Sensitivity analysis used a higher hydraulic conductivity for the CLA which is similar to the surrounding fill material. Under this sensitivity a conservative particle within the CLA is estimated to move no more than 63 m (under the fast fill scenario). This sensitivity analysis is valid for estimating the travel distance of a particle just outside the CLA (within fill material), as the hydraulic conductivities adopted for the fill material and CLA are $1x10^{-6}$ and $2.93x10^{-6}$ m/sec, respectively.

Additional sensitivity analysis simulated a rapid fill, where the water body reached a surface water elevation of 5.5 mAHD within 1 year. This assumes the addition of 15 GL of water to the water body after a storm event and prolonged heavy rainfall between 2022 and 2023. In the first 100 years, under this scenario a conservative particle within the CLA is estimated to move no more than 43 m.

It should be noted that the background groundwater quality has not been taken into consideration for this modelling review. There is currently no groundwater within the vicinity of the CLA deposit (groundwater seepage is occurring in the vicinity of DBG MB6, approximately 500 m distant from CLA area). The aim of this modelling task was to conduct a high-level assessment of the hydraulics of particle flow within the model domain. By using particle tracking (without attenuation or retardation) the conservative assessment of constituent migration could be assessed. As the outcome of this task was that particle tracking did not suggest significant migration of particles (after 200 years) from the CLA, through the clay-rich layer and into the fill material, it is concluded that a fate and transport modelling assessment was not necessary.

The low permeability of the CLA and surrounding clay-rich layer are providing an effective advective control and limit the potential for the migration of constituents within the surrounding fill material under saturated conditions.

9.12 Supplementary Hydrogeological and Geochemical Modelling

Following the development of the SEEP/W numerical model, the calibrated regional numerical model was used to explore further the short-term groundwater flow surrounding the water body during and after a fast fill scenario lasting twelve months. The geochemical modelling program PHREEQC was also used to conduct a simple mixing model to estimate the evolving water body quality during a fast fill scenario using a water quality representative of UEVF groundwater. A fast fill of the water body (i.e., over 12 months) is considered to be representative of the 'worst-case' scenario for the potential magnitude of groundwater flow radially outwards form the water body over the short-term.

9.12.1 12-Month Fast Fill Scenario

The long-term water body filling strategy is exploring the use of UEVF groundwater as a source of water to augment the filling process as part of the mine rehabilitation and closure planning.

The regional Anglesea numerical groundwater model was originally developed to support a bulk entitlement application for groundwater abstraction by Barwon Water. A new regional numerical model has been developed and is being used to inform Alcoa's potential licence application process for the proposed abstraction of groundwater from the UEVF to accelerate the filling of the water body in the former coal mine. This specific task has used quantitative outputs from the updated numerical model which have been used for the qualitative assessment of the water body under 12 months UEVF fill (augmentation) scenario.

The quality of water used to fill the void will potentially influence the chemistry of the developing water body. PHREEQC is a geochemical modelling program which can be used to assess the effects of mixing varying volumes of different quality water sources in conjunction with evaporation to estimate how the future water body quality will evolve.

The following sections provide an account of the geochemical modelling approach used to develop a PHREEQC model using the regional numerical model (MODFLOW). Volumetric outputs and surface water and groundwater quality inputs were used to assess water body quality recovery under a 12-month UEVF fill scenario using groundwater abstracted from the UEVF. This scenario was selected for the initial model scenario as it represents using UEVF water as the largest proportion of water used to fill the water body over the shortest (but still reasonable) amount of time. Longer scenarios (such as 10 years) still use the UEVF as the major contributor of water in the overall water balance but the contributions of rainfall, sidewall run-off and leakage from the DBF/consolidated fill will be greater but currently less easily defined that the UEVF volumes. The level of confidence associated with longer model runs will therefore increase over time as more data is collected.

9.12.1.1 Regional Numerical Model MODFLOW outputs

EHS Support requested from GroundwaterLogic Pty Ltd (who run the regional groundwater model scenarios for Alcoa and Barwon Water) the following MODFLOW quantitative outputs (**Table 9-15**):

Table 9-15 Water Volume Inputs and Outputs over 12 months

Water Balance Data		Volumes (ML)
Natural Inputs		
1	Leakage from ASA	<1
2	Natural groundwater inflow into the waterbody (from DBF)	455
3	Groundwater inflow into the waterbody (from UEVF)	626
4	Rainfall input to water body	303.5
5	Side wall run-off into water body	
Augmentation		
6	Augmented (modelling purposes only) UEVF Groundwater	17,464
Natural Outputs		
7	Evaporation output from water body	422

The data covered a time frame of 12 months and a final water body elevation of at least 5.5 mAHD. The final elevation of the water body for the 12 months fill scenario is 5.81 mAHD. The data was provided as 2 weekly timesteps for a total of 24 timesteps during the augmentation period.

During the augmentation period, groundwater contribution from the ASA was negligible (less than $2x10^{-4}$ ML per timestep) and was discounted from the water balance calculations. Outflow from the water body into the UEVF or the DBF and BF was also not accounted for in the water balance as it did not have a qualitative influence on the water body development and the augment volumes accounted for the loss of this water from the system. Localised catchment and sidewall runoff into the water body was small (less than 2 ML per timestep) and although not accounted for qualitatively, the volumes have been combined with the rainfall inputs. Evaporation from the water body is considerable and the volumes are compensated by additional water volumes from the UEVF, i.e., total groundwater (natural and augmented) from the UEVF into the water body is 18,090 ML for a 12 month fill scenario.

Despite the 12-month fast fill, 98 percent of the model realisations (147 of 150) indicate that all the particles migrating from the water body circumference into the surrounding aquifers, terminate within the mine lease area over the simulation period (2023 to 2066). All particles are also simulated to ultimately discharge to the water body because it forms a groundwater sink for all aquifers in the long term. In Australian post closure mine cases, steady state groundwater flow conditions are represented by radial groundwater in-flow because evaporation from the water body exceeds the rate of water discharge (from surface water and groundwater) into the water body.

9.12.1.2 Water Quality inputs

Water quality data was used from a single groundwater and surface water monitoring event in early November 2022. The event was selected as it is the most recent data capture using the broad analytical suite and samples from both the UEVF and DBF and BF aquifers. The largest contributors to the developing water body (the waterbody itself and the UEVF) under an augmentation scenario also have stable geochemistry profiles over time.

Major and selected minor ions were used to characterise the water inputs. The major ions were used to ensure an acceptable ionic balance and the minor ions for the acid producing and buffering characteristics (**Table 9-16** and **Table 9-17**).

Table 9-16 Water Composition – Major Ions

Sample Location	Date	pH	Sodium mg/L	Potassium mg/L	Calcium mg/L	Magnesium mg/L	Chloride mg/L	Sulfate (as SO4) mg/L	Alkalinity (as CaCO3) mg/L
Water Body	9/11/2022	3.6	250	19	87	82	427	626	<1
DBF&BF (DBG MB4)	9/11/2022	6.51	383	11	94	119	430	922	68
UEVF (WB12)	8/11/2022	6.82	150	17	29	49	384	64	72
Rainfall	*Note 1*	5.47	2.46	0.37	1.2	0.5	4.43	ND	*Note 2*

Table Notes:
ND – non-detectable
Note 1 – Rainfall composition based on 28 stations over 36 stations in south-east Australia (Carroll, 1962)
Note 2 – alkalinity calculated based on equilibrium with atmospheric $CO_{2(g)}$

Table 9-17 Water Composition – Minor Ions

Sample Location	Date	Aluminium mg/L	Barium mg/L	Boron mg/L	Iron mg/L	Manganese mg/L	Zinc mg/L
Water Body	9/11/2022	5.33	0.0509	1.23	2.59	0.555	0.582
DBF&BF (DBG MB4)	9/11/2022	0.154	0.0798	0.336	11.4	1.03	0.695
UEVF (WB12)	8/11/2022	0.0002	0.11	0.227	13.9	0.56	0.0116
Rainfall	*Note 1*	ND	ND	ND	ND	ND	ND

Table Notes:
ND – non-detectable
Note 1 – Rainfall composition based on 28 stations over 36 stations in south-east Australia (Carroll, 1962)

9.12.1.3 PHREEQC Model Development

The geochemical conceptual model for the water body development was based on an assumed input of water at each timestep of water quality derived from the DBF and BF, UEVF, and rainfall and the ratios (or volumes) from the regional MODFLOW model. Water (as H_2O) was removed at each timestep (as evaporation). Solution composition was equilibrated with mineral species and atmospheric gasses at each timestep. Oversaturated (SI>0) mineral phases were removed (precipitated) from the solution. At the end of each timestep a proportion (as a ratio for the next timestep simulation) of the final solution composition was used to form the water body component of the next timestep. In total 24 timesteps (representative of 1 year) were simulated. The Minteq version 4 database was used for all simulations.

9.12.1.4 PHREEQC Outputs

The water body quality development over the 24 timesteps (1 January 2023 to 1 January 2024) has been plotted in **Figure 9-42** (major ions) and **Figure 9-43** (minor ions) below. As the volume of the water body increases with the addition of groundwater and surface water, fluctuations in major and minor ion chemistry are observed.

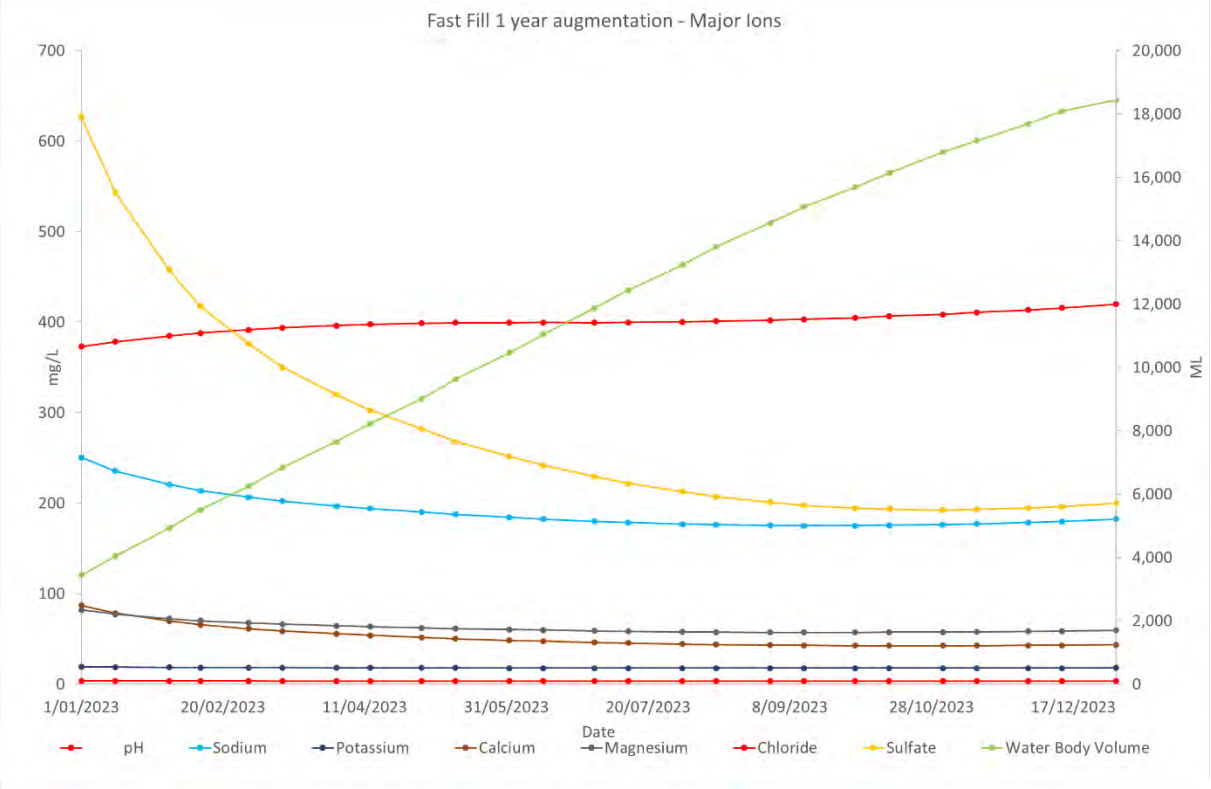

Figure 9-42 Fast Fill 1 Year – Major Ions

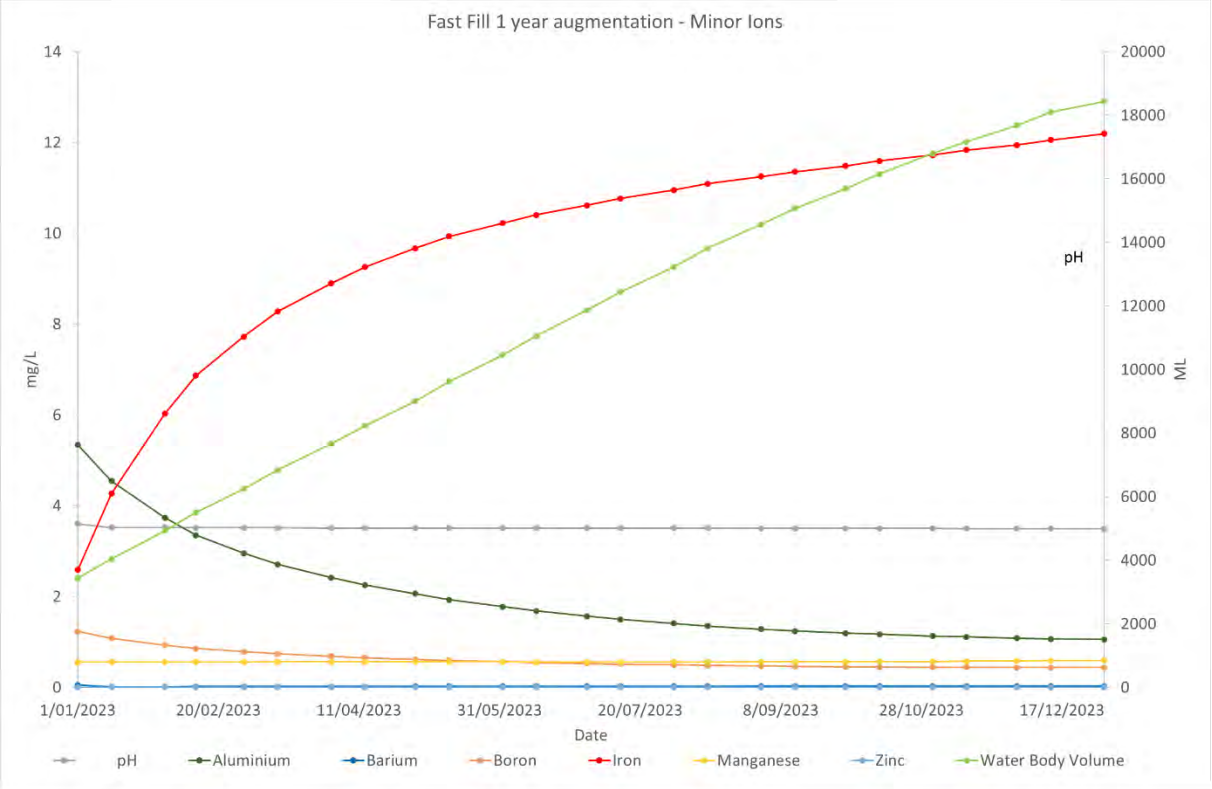

Figure 9-43 Fast Fill 1 Year – Minor Ions

Although the pH of the UEVF water is only slightly acidic (pH 6.82) the potential acidity loading is high based on the concentration of iron (and to a lesser extent aluminium, manganese, and zinc). The overall increase in iron concentration at the end of the augmentation period is sufficient to maintain the acidic nature of the water body with a slight decrease in the pH from 3.6 to pH 3.5. The final water body quality is improved with lower concentrations of aluminium (5.34 mg/L to 1.06 mg/L), barium (0.05 mg/L to 0.03 mg/L), boron (1.23 mg/L to 0.44 mg/L), zinc (0.58 mg/L to 0.14 mg/L), and major ions (sodium, potassium, calcium, magnesium, and sulfate). The decrease in metal and major ion species is due to dilution (lower concentrations in UEVF groundwater) although precipitation of mineral phases (iron minerals including ferrihydrite) could potentially affect metal concentrations (via co-precipitation) in the long term. There are increases in the concentrations of chloride (373 mg/L to 420 mg/L), iron (2.59 to 12.19 mg/L), and manganese (0.56 mg/L to 0.60 mg/L).

The PHREEQC model ran successively with no convergence issues or errors.

9.12.1.5 Additional Scenarios

In addition to the 12 months scenario, four and ten year fill scenarios were also simulated using an extrapolation of the original numerical model data (**Table 9-18**). This assumption will underestimate the natural inflow contributions especially from the UEVF but the augmentation volume has compensated for this shortfall. Rainfall contribution will increase over time and sidewall runoff will decrease however these are proportionally minor volumes compared to augmentation. Evaporation will also increase over time, so evapoconcentration is underestimated.

Table 9-18 Comparison of One, Four, and Ten Year Fill Scenarios

Fill Scenario	pH	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate	Aluminium	Barium	Boron	Iron	Manganese	Zinc
	S.U.	*mg/L*											
Initial	3.60	250	19	87	82	373	627	5.34	0.05	1.23	2.59	0.56	0.58
Final 1yr	3.49	182	18	43	59	420	200	1.06	0.03	0.44	0[40]	0.60	0.14
Final 4yr	3.50	196	17	48	63	410	267	1.09	0.02	0.44	0	0.61	0.20
Final 10yr	3.54	241	16	61	77	413	441	1.23	0.01	0.48	0	0.70	0.34

[40] PHREEQC model precipitates iron (as iron mineral species) if oversaturated, in reality the mine water is supersaturated with iron

9.12.1.6 Summary and Conclusions

The regional numerical model and a PHREEQC geochemical model has been used to estimate the evolution of water body quality using measured groundwater and surface water chemistry over a 1 year timeframe. The final water body chemistry is estimated to have lower concentrations of metals and major ions (with the exception of chloride and manganese) and slightly more acidic (**Table 9-19**). The existing water body and UEVF chemistry exert a strong acidity buffering over the final water body pH.

Predicted variation in water body quality between a 1, 4, and 10 year fill is dependent upon the water quality of the UEVF groundwater used as the primary source of amendment water. The geochemical modelling has used a 'fixed' water chemistry based on one sampling event in November 2022. As more data is collected for the UEVF water quality the predicted water body chemistry will be revised, reassessed, and verified against the interim water quality performance targets (WQPTs) proposed in **Section 4.7**.

Table 9-19 Initial and final Water Body Quality

Location	Unit	Water Body – Initial	Water body – Final
		Sampled 09 Nov 2022 (simulation date 01 Jan 2023)	01 Jan 2024
pH	S.U.	3.6	3.49
Sodium	mg/L	250	182
Potassium	mg/L	19	18
Calcium	mg/L	87	43
Magnesium	mg/L	82	59
Chloride	mg/L	373	420
Sulfate (as SO4)	mg/L	627	200
Total alkalinity (as CaCO3)	mg/L	<1	<1
Aluminium	mg/L	5.34	1.06
Barium	mg/L	0.05	0.03
Boron	mg/L	1.23	0.44
Iron	mg/L	2.59	ND[41]
Manganese	mg/L	0.56	0.60
Zinc	mg/L	0.58	0.14

9.12.2 Consolidated Leached Ash and Water Body – Simple Mixing Calculation

To evaluate the scenario where the entire CLA area is eroded and mixed into the water body, a simple mass balance approach was used to calculate the concentrations of selected analytes in the water body after mixing. The leachability analysis of CLA at pH 2.9 and the water body quality (90th percentile) have been used (**Table 9-20**) to derive the resulting water quality after mixing (**Table 9-23**). The current estimated water body volume and estimated steady-state water body volume (**Table 9-21**) have been used together with the volume of the CLA area (**Table 9-22**).

[41] ND – non detect

Table 9-20 Water Body and CLA Quality Characteristics – 90th Percentile Values

Analyte	Unit	CLA leachable Fraction pH 2.9	Water Body
Aluminium	mg/L	17.1	5.32
Boron	mg/L	10.5	1.46
Iron	mg/L	3	11.49
Manganese	mg/L	3.6	0.56[42]
Zinc	mg/L	0.1	0.38

Table 9-21 Water Body Volume

Parameter	Unit	Estimated Volume – 2024	Estimated Volume – Steady State
Volume	ML	3,442	17,689

Table 9-22 CLA Physical Characteristics

Parameter	Unit	Value
Area	m^2	45,602
Thickness	m	4
Volume	m^3	182,408

Table 9-23 Water Body Quality – Before and After CLA Mixing

Analyte	Unit	Water Body – Current	Water Body After Mixing – Current Volume	Water Body After Mixing – Steady State Volume
Aluminium	mg/L	5.32	6.23	5.50
Boron	mg/L	1.46	2.02	1.57
Iron	mg/L	11.49	11.65	11.52
Manganese	mg/L	0.56[43]	0.75	0.60
Zinc	mg/L	0.38	0.39	0.38

Even if all the CLA was dispersed through the current or future steady -state water body, the resulting concentrations of aluminium, boron, iron, manganese, and zinc would be most likely be within the range of expected concentrations and with limited increase in risk to environmental values.

[42] Manganese has only recently been added to the analytical suite for the water body sampling events, therefore, currently there is only one result available
[43] Manganese has only recently been added to the analytical suite for the water body sampling events, therefore, currently there is only one result available

10 Consolidated Leached Ash Risk Assessment Matrix

In accordance with Part 3 Division 6 Section 44 of the Mineral Resources Sustainable Development (Mineral Industries) Regulations 2019 Alcoa has identified potential mining hazards and assessed risks associated with covering and submerging the CLA area located in the south-east corner of the mine.

This process involved several steps, consistent with those outlined in 'Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS' **Appendix B** (December 2020 version 1.3) (Victoria, 2020) provided by the Department of Jobs Precincts and Regions, as outlined below:

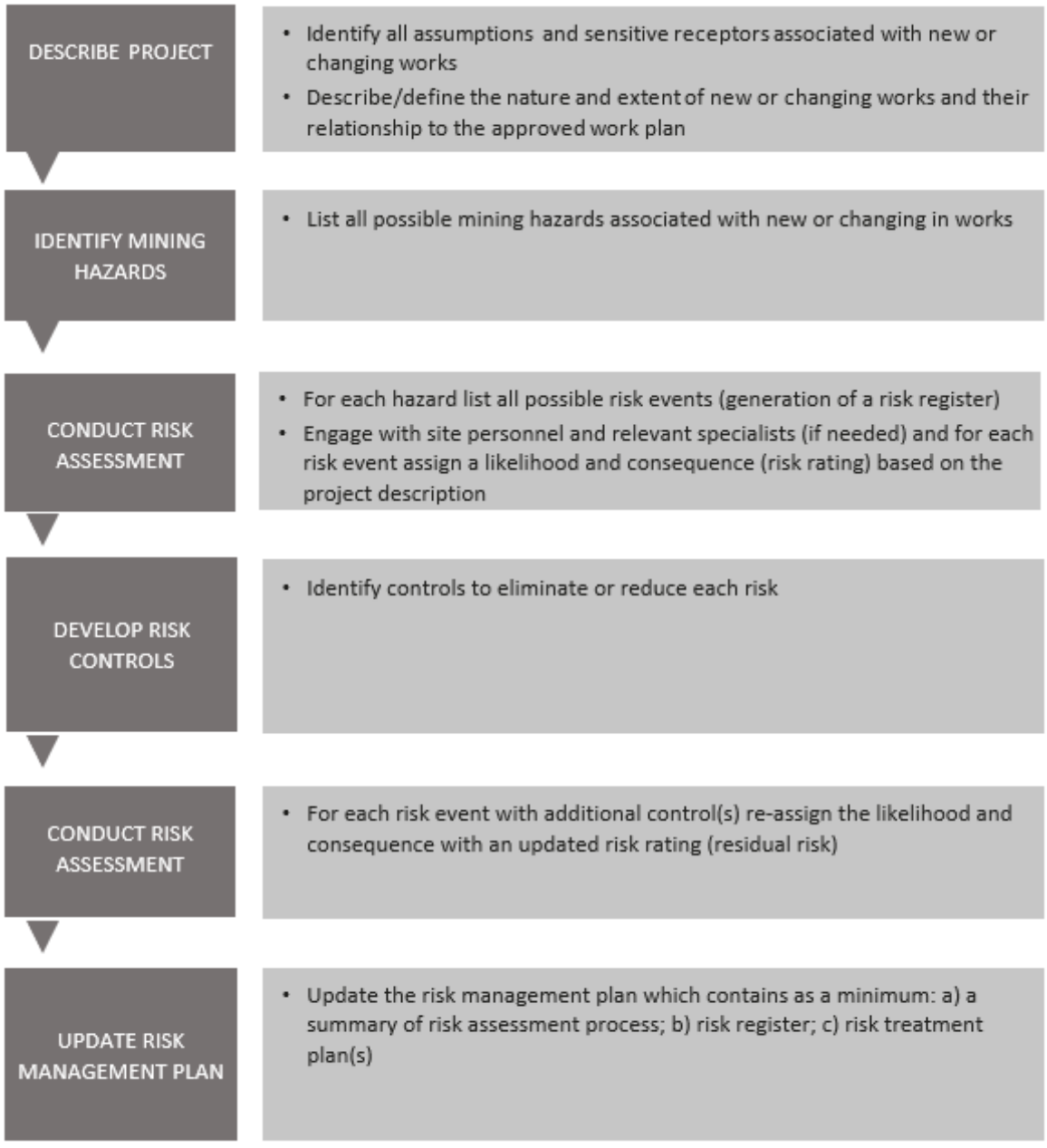

Figure 10-1 Assessment Process of Identifying Potential Hazards and Risks

The risk assessment process is intended to identify and assess all risks that the new or changing works may pose to the environment, to the public, or to nearby land, property, or infrastructure – these are known as mining hazards. The identified risks are then eliminated or minimised as far as reasonably practicable with appropriate controls (risk treatment plan).

These aspects are outlined in the sections below.

10.1 Project Description and Key Assumptions

As a key input into understanding any potential risks associated with submerging the CLA area, the results of the chemical and physical sampling have been used to inform hydraulic modelling using GeoStudio SEEP/W software (**Section 9**) with the objective of simulating:

- Hydraulic behaviour of rising water body and groundwater levels and potential groundwater seepage into the fill material under steady-state and transient conditions as the mine water body develops; and
- Particle tracking to observe movement of particles representative of a conservative (not subject to attenuation or retardation) constituent within the model domain.

Informed by the above, the intent of the Risk Assessment is to 'identify and assess all risks that the new or changing works may pose to the environment, to the public, or to nearby land, property, or infrastructure – these are known as mining hazards. The identified risks are then eliminated or minimised as far as reasonably practicable with appropriate controls (risk treatment plan).'

The new or changing works for the purpose of the risk assessment is the **submerging of the CLA during the development of the mine water body**. This remans consistent with the draft Mine Rehabilitation and Closure Plan submitted to ERR in 2017 (EHS Support, 2017), the Work Plan Variation – Progressive Rehabilitation Works approved by ERR March 2018, and the Work Plan Notification – Groundwater Pumping Test acknowledged by ERR February 2021.

Considerate of the above, the key assumptions associated with this risk assessment are outlined below.

Key Assumptions

- The CLA has been covered with at least 1 m of clay rich overburden material, with the depth of covering confirmed by 19 test pits in 2018 (**Appendix E** & **Appendix G**).
- Permeability results indicated CLA, clay-rich layer, and fill material permeabilities of less than $1x10^{-9}$ m/sec as confirmed by field sampling September 2021 and June 2022.
- The mine water body water level will develop based on a fast fill strategy using UEVF groundwater (subject to potential future licence submission to Southern Rural Water and final MCRP approval) in addition to shallow groundwater recovery and rainfall and is expected to rise from a water level of -17.4mAHD in April 2022 to approx. +5.5 mAHD over a period of about 10 years. Once the water body is full the CLA area will be submerged between approximately 12 m and 19 m below surface level.
- The mine water body will not be directly connected to the Anglesea River catchment consistent with the previous discussions with DELWP, with no engineered outlet or spillway.

- The mine water body interim WQPTs have been established based on the baseline water quality dataset for the mine water body and associated with potential changes to the mine pit water quality. A statistical approach has been adopted which uses the 10th (pH only) and 90th percentiles (**Section 4**):
  - This approach is considered to be consistent with the ongoing and accepted management of the surrounding naturally occurring background surface water systems by the local authorities and regulators which include DELWP, CCMA, and the Surf Coast Shire.
- The adopted segment classification for the UEVF is segment B.
- Based on the water quality data collected across the Power Station site, the segment classification of the DBF and BF is also Segment B as described in Table 5.2, Clause 14 of the ERS. Segment B is based on a TDS concentration range of 1,201 to 3,100 mg/L.
- The long term mine pit water body will act as a groundwater sink otherwise known as a groundwater discharge feature, for the shallow aquifer system. The DBF and BF in the vicinity of the mine pit is currently dry, however there is a potential that this part of the DBF and BF may become saturated, as the mine pit fills.
- The future mine water body will not be available for recreational purposes consistent with the draft MRCP (2017) and consistent with historical discussions with DELWP.
- The landforms surrounding the CLA area and the CLA area itself, are geotechnically safe and stable as per the Geotechnical Designs submitted as part of the Work Plan Variation – Progressive Rehabilitation Works approved by ERR March 2018, and since constructed in accordance with the approved designs.
- The cap material in particular is unimpacted by the effects of bioturbation and a range of other potential physical, biological, and chemical processes.
- The licensed mine boundary and Alcoa's land management will remain in effect until future surrender to the state, which will be done once the state accepts that Alcoa has met all of its obligations and reduced long term risk to an acceptable level, including as relating to the CLA.

10.2 Identification of Potential Mining Hazards, Risk Sources and Receptors at Risk

After operating the Anglesea mine for 46 years, inclusive of developing forward looking potential future rehabilitation and closure plans, Alcoa is appropriately informed to identify the various potential issues associated with the covering and submerging the CLA area located in the south-eastern corner of the mine.

In addition to the extensive experience that Alcoa has with the site and associated understanding of potential issues, Alcoa has undertaken various processes during the development of the draft MRCP, the mine water body filling strategy, and in particular the proposed covering and submerging the CLA area located in the south-eastern corner of the mine to ensure that it has identified all issues associated with activity so far as reasonably practical.

These processes have been implemented to ensure that all relevant risks are identified, understood and that appropriate management controls are in place. These processes also represent the measures taken to comply with the GED, relevant ERS and principles of the *Environment Protection Act 2017,* and include:

- Review of the Department of Primary Industries endorsed Work Plan for the Anglesea Mine, dated 22 September 2011 inclusive of the then incorporated mine closure plan.
- Ongoing, frequent consultation with the regulator(s) throughout development of the key concepts in support of the proposal for covering and submerging the CLA area located in the southeast corner of the mine. This includes Department of Job Precincts and Regions (DJPR) ERR, DELWP, EPA, and SRW.
- Development of the Draft Anglesea Mine Rehabilitation and Closure Plan submitted to ERR September 2017 including a detailed technical assessment (Appendix K Anglesea Mine Ash Assessment, refer to **Appendix J**), and consideration of the feedback subsequently provided by the regulators regarding the proposal for covering and submerging the CLA area located in the southeast corner of the mine.
- Review of the relevant Acts, Regulations, Reference Standards, and Guidance documents to understand the appropriately relevant legislative requirements.
- Engagement of appropriately experienced and qualified technical consultants (EHS Support) to complete the appropriate technical studies related to the CLA area, inclusive of research on similar leached ash related situations to identify successes, issues, risks, and lessons that could be applied to Anglesea former mine pit.
- Internal review by technical expertise that forms part of Alcoa's Global Asset Planning and Management Group experienced in the rehabilitation and closure of Alcoa's operating sites globally.
- Engagement of an appropriately experienced and qualified technical consultant (BlueSphere) to conduct an independent peer review of the covering and submerging the CLA area (**Section 2**).
- Completion of numerical modelling (**Section 9**) specifically related to hydraulic behaviour of rising water body and groundwater levels and potential groundwater seepage, and particle tracking to observe movement of particles representative of a conservative (not subject to attenuation or retardation) constituent within the model domain, related to the submerging of the CLA area.
- Completion of appropriate risk assessment (*this risk assessment*) to identify and assess all risks that the new or changing works may pose to the environment, to the public, or to nearby land, property or infrastructure using '*Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS'* **Appendix B** (December 2020 version 1.3) provided by the Department of Jobs Precincts and Regions.

As an outcome of the processes undertaken, a list of potential mining hazards, risk sources and sensitive receptors has been identified associated with covering and submerging the CLA area located in the southeast corner of the mine (**Table 10-1**).

As part of determining the potential sensitive receptors the following has been considered consistent with 'Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS' **Appendix B** (December 2020 version 1.3) provided by the Department of Jobs Precincts and Regions:

- Members of the public – public health, safety, amenity, and Aboriginal heritage;
- Land, property and infrastructure: neighbouring property as well as nearby infrastructure such as highways, schools, and hospitals; and
- Environment: air, water, soil, vegetation, flora, and fauna outside the work area.

Table 10-1 Potential Mining Hazards, Risk Sources, and Sensitive Receptors

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk
1	Surface Water quality	• CLA interaction with mine water body adversely impacts mine water body water quality during filling. • Adversely impacted (by CLA) mine water body water has an adverse impact on local surface water systems environmental values during filling.	• Mine water body • Anglesea River
2	Groundwater quality	• CLA interaction with groundwater adversely impacts DBF/ASA groundwater quality in the undisturbed DBF/ASA aquifers during filling. • CLA interaction with groundwater adversely impacts UEVF groundwater quality in the undisturbed UEVF aquifer during filling. • CLA ash interaction with groundwater (DBF/UEVF/ASA) adversely impacts third party users during filling. • CLA ash interaction with groundwater (DBF/UEVF) adversely impacts GDE's? during filling.	• DBF / ASA • UEVF • UEVF aquifer domestic users • LEVF Barwon Water • NOTE there are no third-party users for DBF/ASA. • GDE's Flora and Fauna
3	Erosion & Sedimentation	• Surface water run off (rain fall) reducing cover material to below 0.7m depth before being submerged. • Water body level increase eroding cover material to below 0.7m depth at shoreline interface. • Differential settlement of area during submersion resulting in cover material to below 0.7m depth. • Erosion of submerged cover material to below 0.7m depth. • Risk of bioturbation.	• Mine Water Body

10.3 Control Measures and Performance Objectives

Alcoa recognises that Anglesea mine rehabilitation and closure issues are specific to the site and dependent on a variety of factors, and that any plan and management of associated risk needs to be founded on detailed technical understanding and management strategies.

To ensure appropriate understanding of each identified issue or hazard, inclusive of potential associated risks, Alcoa initiated detailed technical studies early in the development of the plan as described in various sections above. These studies have helped inform not only the level of any identified risk, but also on the potential controls that are appropriate to manage the identified risks.

With the development of the control measures Alcoa was also then able to specify appropriate performance objectives for each combination of control measures.

Both the proposed control measures and associated performance objectives for each combination of control measures, against each potential mining hazard, are shown in **Table 10-6** further below.

10.4 Risk Assessment

The current requirements of Part 3 Division 6 Section 44 of the Mineral Resources Sustainable Development (Mineral Industries) Regulations 2019 requires Alcoa to identify potential mining hazards and assess risk associated with the new or changing works which is the submerging of the CLA area during the development of the mine water body.

Risk assessment is the process of finding, recognising, and describing the potential risks associated with the activity, identifying potential impact areas, and the potential impact(s) on these areas if the risk occurs.

With an understanding of the potential mining hazards, risk sources and receptors at risk, coupled with proposed control measures and associated performance objectives, a structured and consistent risk assessment process has been applied by Alcoa.

The risk assessment has also been **Independently Peer Reviewed** by BlueSphere (**Section 2**).

To ensure a high level of consistency with ''*Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS'* **Appendix B** (December 2020 version 1.3) published by the Department of Jobs Precincts and Regions, Alcoa has directly adopted the Risk Matrix, Consequence rating, and Likelihood ratings provided within.

The Risk Matrix Table, shown in **Table 10-2** below, provides an overall risk rating for each identified mining hazard considerate of the proposed controls with regard to the assessed consequence and likelihood of each hazard occurring.

Table 10-2 ERR Risk Matrix

Figure A1: ERR Risk Matrix

Likelihood	Insignificant	Minor	Moderate	Major	Critical
Almost Certain	Medium	High	Very High	Very High	Very High
Likely	Medium	Medium	High	Very High	Very High
Possible	Low	Medium	Medium	High	Very High
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Medium	Medium	High
	Consequence				

Table Notes:
(Source: *Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS'* **Appendix B** (December 2020 version 1.3) published by the Department of Jobs Precincts and Regions)

The potential consequence associated with each assessed risk was assessed using a series of descriptors described in the **Table 10-3** below, which were assessed separately for each of the following potential impact areas:

- "Any member of the public" - public health, safety, amenity, and Aboriginal heritage;
- "Land, property and infrastructure" – *beyond the boundary of the licence area*; and
- "The environment" – air, water, soil, vegetation, flora, and fauna species *other than for planned and approved disturbances within the licence area.*

Table 10-3 ERR Consequence Descriptions

Severity	Consequence For "any member of the public" – Public Health, Safety, Amenity, and Aboriginal Heritage	Consequences For "land, property and infrastructure" Beyond the Boundary of the Licence Area	Consequences For "the environment" – Air, Water, Soil, Vegetation, Flora, and Fauna Species Other Than For Planned and Approved Disturbances Within the Licence Area
Critical			
Hazard has critical impact, in terms of severity and/ or duration. Treatment or remediation effort is required, although some effects may be irreversible. Remediation of environmental contamination would require significant private and public resources. Hazard event would be the subject of widespread community outrage.	**Public Health and Safety** One or more fatalities or life-threatening injuries or illness. Public exposed to a severely debilitating chronic health impact or life-threatening hazard. One or more injuries resulting in permanent disablement. **Public Amenity** Community or multiple individuals continuously experience major losses of amenity from dust, odour, fumes, noise, or other similar hazards over periods of weeks or longer. **Aboriginal Heritage** Harm to features and/or places of Indigenous cultural value. **Heritage** Irreversible damage, or destruction of a place, object or historical archaeological site listed on the Commonwealth National Heritage List, Victorian Heritage Register, Victorian Heritage Inventory, or local Heritage Overlay.	**Land and Land Uses** Permanent loss of production from primary production land >1h0 ha. Loss of annual- seasonal primary production from >100 ha of land. Irreversible or long-term environmental damage (with rehabilitation taking years or longer) to >1 ha of National Park or other conservation reserve. **Public and Private Property** Total damage to private or public property or infrastructure or loss of income resulting from this damage >$10 million. Total loss of value of private property equivalent to >$10 million. **Services Provided by Infrastructure** Important community services (e.g., transport, energy, health, telecommunications, education, water) suspended or significantly disrupted for extended period (weeks or longer).	**Environmental Contamination Event** Environmental contamination event (of air, soil-land and/or water) of a magnitude that a State-level incident response is required. Incident response, clean-up and rehabilitation expected to run for years and/or cost ≥$10 million. **Native Vegetation, Flora Species or Fauna Species** Environmental contamination event or other form of environmental damage leading to bioregional, State, or national extinction of listed threatened species of native flora or fauna or vegetation community. Irreversible or long-term (years) damage or environment harm to ≥10 ha of native vegetation (not listed threatened vegetation community) or to ≥1 ha listed threatened native vegetation community. Deaths of hundreds (or more) of listed native flora or fauna species or native mammals. Contamination or other environmental damage leading to deaths of native fauna well beyond (>1 km) the boundaries of the operation. **Surface Water or Groundwater** Contamination of surface water/ groundwater aquifer leading to disruption of environmental values as defined by Environment Reference Standard (VGG2021S245) for more than year.

Severity	Consequence For "any member of the public" – Public Health, Safety, Amenity, and Aboriginal Heritage	Consequences For "land, property and infrastructure" Beyond the Boundary of the Licence Area	Consequences For "the environment" – Air, Water, Soil, Vegetation, Flora, and Fauna Species Other Than For Planned and Approved Disturbances Within the Licence Area
Major			
Hazard has major impact, in terms of severity, duration and/ or frequency of occurrence. Treatment or remediation effort is required. Some effects may be irreversible. Remediation of environmental contamination would require significant private and public resources. Hazard event would be the subject of widespread community concern.	**Public health and safety** One or more injuries or illness requiring surgery or resulting in long-term disablement. Public exposed to a hazard that results in hospitalisation for treatment from injury or illness. **Public amenity** Community or multiple individuals regularly experience (weekly-monthly basis) major losses of amenity due to dust, odour, fumes, noise, or other similar hazards for multiple days on end. **Heritage** Damage to a place, object or historical archaeological site listed on the Commonwealth National Heritage List, Victorian Heritage Register, Victorian Heritage Inventory, or local Heritage Overlay. Removal or relocation of elements associated with places, objects, or historical archaeological sites.	**Land and land uses** Permanent loss of production from primary production land <10 ha. Loss of annual- seasonal primary production from 10–100 ha of land. Irreversible or long-term environmental damage to <1 ha of National Park or other conservation reserve or to ≥10 ha of other public land. Reversible damage to ≥1 ha of National Park or other conservation reserve or to ≥10 ha of other public land. **Public and private property** Total damage to private or public property or infrastructure or loss of income resulting from this damage $1–10 million. Total loss of value of private property equivalent to $1–10 million. **Services provided by infrastructure** Important community services (e.g., transport, energy, health, telecommunications, education) suspended or significantly disrupted for days or experiencing minor disruptions for long periods (weeks or longer).	**Environmental contamination event** Environmental contamination event (of air, soil-land and/ or water) of a magnitude that would necessitate a regional emergency management incident response. Clean-up and rehabilitation expected to run for months and/or cost $1–10 million. **Native vegetation, flora species or fauna species** Environmental contamination event or other form of environmental damage leading to local extinction of listed threatened species of native flora or fauna or vegetation community. Deaths of up to ~100 listed threatened flora or fauna species or native mammals. Major damage or environment harm to 1–10 ha of native vegetation (not listed threatened vegetation community) or to <1 ha listed threatened native vegetation community that will be irreversible or take years to recover from. **Surface water or groundwater** Contamination of surface water/ groundwater aquifer leading to disruption of environmental values as defined by Environment Reference Standard (VGG2021S245) for up to one year.

Severity	Consequence For "any member of the public" – Public Health, Safety, Amenity, and Aboriginal Heritage	Consequences For "land, property and infrastructure" Beyond the Boundary of the Licence Area	Consequences For "the environment" – Air, Water, Soil, Vegetation, Flora, and Fauna Species Other Than For Planned and Approved Disturbances Within the Licence Area
Moderate			
Hazard has moderate, noticeable impact, in terms of severity, duration and/ or frequency of occurrence. Moderate treatment or remediation effort may be required. Hazard event would be the subject of limited community concern.	**Public health and safety** One or more injuries or illness requiring treatment by a physician or hospitalisation. Public exposed to a hazard that results in injuries or health effects requiring treatment by a physician. **Public amenity** Community or multiple individuals regularly (weekly- monthly basis) experience significant loss of amenity from dust, odour, fumes, light, noise, vibration, or other similar hazards. **Heritage** Works to a place, object or historical archaeological site that will not alter the cultural significance as stated on the Commonwealth National Heritage List, Victorian Heritage Register, Victorian Heritage Inventory, or local Heritage Overlay.	**Land and land uses** Loss of annual-seasonal primary production from <10 ha of land. Short-term (days- weeks) disruption to 10–100 ha of primary production land. Reversible damage to <1 ha of National Park or other conservation reserve or to <10 ha of other public land. **Public and private property** Individual hazard event causes total damage to private or public property or infrastructure or loss of income resulting from this damage $50k–$1 million. Individual hazard event causes total loss of value of private property equivalent to $50k–$1 million. **Services provided by infrastructure** Important community services (e.g., transport, energy, health, telecommunications, education) suspended or significantly disrupted for up to 1 day or experiencing minor disruptions for weeks.	**Environmental contamination event** Environmental contamination event (of air, soil-land and/ or water) with clean-up and rehabilitation expected to run for weeks and cost $10k–$1 million. **Native vegetation, flora species or fauna species** Environmental contamination event or other form of environmental damage leading to deaths of a small number of listed threatened flora or fauna species or native mammals. Reversible damage or environmental harm to <10 ha of non-listed native vegetation community or <1 ha of listed native vegetation community. **Surface water or groundwater** Localised contamination of surface water/groundwater aquifer leading to disruption of environmental values as defined by Environment Reference Standard (VGG2021S245) for weeks to months.

Severity	Consequence For "any member of the public" – Public Health, Safety, Amenity, and Aboriginal Heritage	Consequences For "land, property and infrastructure" Beyond the Boundary of the Licence Area	Consequences For "the environment" – Air, Water, Soil, Vegetation, Flora, and Fauna Species Other Than For Planned and Approved Disturbances Within the Licence Area
Minor			
Hazard is perceived but has minor and typically temporary effects. Some remediation may be required	**Public health and safety** One or more injuries or illness requiring first aid treatment. Public exposed to a hazard that could cause injuries or adverse health effects requiring first aid treatment. **Public amenity** Dust, odour, light, fumes, vibration, or other similar hazards infrequently (no more than monthly) have a minor effect on the amenity of the community or individuals. **Heritage** Isolated damage to regionally or locally significant natural or historic heritage features that is readily rectified.	**Land and land uses** Minor damage to agricultural land or public land not requiring active rehabilitation. Temporary and small-scale disruption to agricultural production (days, 1–10 ha). **Public and private property** Total damage to private or public property or infrastructure $1–50k. Total loss of value of private property equivalent to $1–50k. **Services provided by infrastructure** Important community services (e.g., transport, energy, health, telecommunications, education) suspended or significantly disrupted for short period (hours).	**Environmental contamination event** Minor environmental contamination event (of air, soil-land and/or water). Clean- up and rehabilitation may be required, but can be completed within days. **Native vegetation, flora species or fauna species** Minor damage or environment harm to <1 ha of native vegetation (not listed threatened vegetation community) that can be recovered in weeks to months. Minor contamination or other environmental damage that affects native fauna populations but does not kill individuals or disrupt breeding or other important ecological processes. **Surface water or groundwater** Minor contamination of natural waterway or wetland occurs, but water quality remains within applicable EPA or ANZECC guidelines for existing beneficial uses. Water extraction or diversion reduces surface water flows or groundwater available for environmental uses, but with no detectable effect on dependent species or ecosystems and carried out within terms of water licence.

Severity	Consequence For "any member of the public" – Public Health, Safety, Amenity, and Aboriginal Heritage	Consequences For "land, property and infrastructure" Beyond the Boundary of the Licence Area	Consequences For "the environment" – Air, Water, Soil, Vegetation, Flora, and Fauna Species Other Than For Planned and Approved Disturbances Within the Licence Area
Insignificant			
Impacts are barely recognised and/or quickly recovered from. No specific remediation required.	**Public health and safety** An injury or ailment that does not require medical or first aid treatment. **Public amenity** Dust, odour, light, fumes, vibration, or other similar hazards infrequently (no more than monthly) contribute to a small reduction in the amenity of the community or individuals.	**Land and land uses** Minor, temporary disruption to primary production (<days) from <1 ha of land. **Public and private property** Total damage to private or public property or infrastructure <$1k. Total loss of value of private property equivalent to <$1k. **Services provided by infrastructure** Important community services (e.g., transport, energy, health, tele-communications, education) maintained, but experiencing minor disruptions or delays.	Hazard event with minimal environmental impact and no noticeable effect beyond the immediate occurrence or expression of the hazard.

(Source: *Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS'* **Appendix B** (December 2020 version 1.3) published by the Department of Jobs Precincts and Regions)

The likelihood of each risk occurring was assessed using a series of descriptors described in **Table 10-4** below, ranging from almost certain to rare. The standard descriptors for probability include both a qualitative description, and a quantitative descriptor, with the quantitative descriptor available to be used when a statistical probability has been calculated. The probability for most of the risks was assessed in a qualitative way.

Table 10-4 ERR Likelihood Assessment Ratings

Severity	Description	Probability of Event Occurring
Almost certain	The risk event is expected to occur in most circumstances.	90–100%
Likely	The risk event will probably occur in most circumstances.	70–90%
Possible	The risk event might occur at some time.	30–70%
Unlikely	The risk event could occur at some time.	5–30%
Rare	Highly unlikely, but the risk event may occur in exceptional circumstances.	0–5%

Table Notes:
(Source: *Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS'* **Appendix B** (December 2020 version 1.3) published by the Department of Jobs Precincts and Regions)

The risk assessment team included:

Table 10-5 Risk Assessment Team

Name	Company	Title
Warren Sharp	Alcoa	Pt Henry & Anglesea Site Asset Manager
Nicci Marris	Alcoa	Environment, Health & Safety Manager
John Osborne	Alcoa	Director Asset Planning & Manager
Rebecca Fraser	EHS Support	Principal Hydrogeochemist
Chris Smitt	EHS Support	Director and Principal Hydrogeologist
Ben Petrides	EHS Support	Principal Hydrogeologist

Risk Assessment Summary

There were no very high, or high risks identified. Two medium risks were conservatively identified, with the remainder of risks assessed as low.

The medium risks related to:

- *Covered leached ash interaction with groundwater (DBF/UEVF/ASA) adversely impacts third party users during filling* – while the likelihood of this risk occurring was considered 'Rare' given the very low particle movements modelled (maximum of 49 m over 200 years), the distance to third party users, and the upward gradient from UEVF, in the event that it did occur it may result in localised contamination that may result in disruption of environmental values for that third party as defined by Environment Reference Standard (VGG2021S245) for weeks to months (and likely to exceed 1 year). In this respect the risk assessment framework and matrix are considered conservative in nature. With the nearest third party more than 400 m away (due to the extent of Alcoa mine and land management area) it is not considered conceivable from a likelihood perspective that any adverse impacts (particles) would ever reach a third-party user.
- *Surface water run off (rain fall) reducing cover material to below 0.7 m depth before being submerged / Water body level increase eroding cover material to below 0.7 m depth at shoreline interface* – While the consequence of this was assessed as minor, the likelihood was assessed as possible given that erosion could occur and it could take a number of months to address dependent on identification and timing to safely access and repair with suitable machines. It should be noted that direct discharge of ash pore water into the water body is very unlikely as maximum particle movement occurs away from the water body during filling and negligible movement towards the water body after filling. Also note that with a maximum modelled particle movement of 49 m over 200 years, then it would take approximately 2.8 years for a particle to move through 0.7m of cover material. Monthly inspections and a trigger action response plan (TARP) in place to trigger repairs to cover material in the event of observed erosion in excess of 0.3 m then would adequately address this risk.

The outcomes of the risk assessment are shown in **Table 10-6** below for the CLA area.

Table 10-6 Consolidated Leached Ash Risk Assessment

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
1.1	Surface Water Quality	• Covered leached ash interaction with mine water body adversely impacts mine water body water quality during filling	• Mine Water Body	• CLA located in the southeast corner of the mine known to be located between RL-15 and -8 m • >1 m clay rich cover material with lab sampled permeabilities less than 1x10-9 m/sec. • Lab sampled ash permeabilities less than 1x10-9 m/sec. • 'Ash Risk Assessment Hydrogeological Modelling Report' (EHS Support April 2022) using SEEP/W numerical modelling for groundwater and leached ash particle migration not expected to extend beyond the licenced mine boundary. During filling particles expected to move away from the water body. Refer to Consolidated Leached Ash Technical Assessment, EHS Support (2023) Section 9 showing maximum particle movement of 49 m away from the water body over 200 years during fast fill scenario. Direct discharge of ash pore water into the water body is unlikely as maximum particle movement occurs away from the water body during filling and negligible movement towards the water body after filling. • Independent Peer Review of Ash Modelling and Risk Assessment by BlueSphere.	• No adverse impact on mine water body water quality measured by no exceedance of 10th or 90th percentile of interim WQPTs. NOTE: - Historical water body quality is complimentary with background surface waters including Anglesea River and Salt Creek and therefore environmental value of water dependent ecosystems and species with regard to the local catchment is protected. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters. NOTE: the mine water body lies entirely within the disturbed and controlled area and will not interact with any area outside the boundary of the licensed mining area during water body filling.	Insignificant	Insignificant	Minor	Unlikely	Low	• Six monthly mine water body water quality sampling. • Six monthly groundwater water quality sampling and MB UEVF and DBG bores. • Reporting via monthly ERR report and via Community Consultative Network meetings or regular updates. • Health and Safety and Environmental Incident reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
1.2	Surface Water Quality	• Adversely impacted (by CLA) mine water body water has an adverse impact on local surface water systems environmental values during filling.	• Anglesea River	• All control measures listed in Element 1.1 above. • Mine water body is a physically closed system with no direct connection of the mine water body with Salt Creek (inlet) or Anglesea River (outlet). • Salt Creek Diversion Channel diverts high rainfall event water around the mine water body. • Natural topography of the rehabilitated landform ensures no surface water can 'spill' into the Anglesea River system below approx. RL +10 m. • The water quality of the mine water body is characterised by elevated acidity (low pH), aluminium, boron, iron and zinc, however these are generally lower in concentration within the water body (better quality) in comparison to the surrounding catchment, with the exception of Boron, which is less than that of seawater, and hence the mine water body is unlikely to have an adverse impact on the Anglesea River. • Water volumes in the event of a 1:100 type rainfall event that resulted in any possible mine water body overflow into the Anglesea River would preclude any measurable impact on environmental values.	• No adverse impact on Anglesea River environmental values. NOTE: - Historical Anglesea River water quality precludes most environmental values which is complimentary with background surface waters including Anglesea River and Salt Creek. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 - Waters. NOTE: - the mine water body lies entirely within the disturbed and controlled area and will not interact with any area outside the boundary of the licensed mining area during water body filling.	Insignificant	Insignificant	Insignificant	Rare	Low	• Six-Monthly mine water body water quality sampling • Six-Monthly groundwater water quality sampling at MB UEVF and DBG bores. • Mine water body water level and Bureau of Meteorology (BOM) rainfall monitoring. • Reporting via monthly ERR report and via Community Consultative Network meetings or regular updates. • Health and Safety and Environmental Incident reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
2.1	Groundwater quality	• CLA interaction with groundwater adversely impacts DBF/ASA groundwater quality in the undisturbed DBF/ASA aquifers during filling.	• DBF • ASA	• Refer to control measures in Element 1.1 above. • Leached ash particle migration not expected to extend beyond the licensed mine boundary. (Refer to Consolidated Leached Ash Technical Assessment, EHS Support (2023) Section 9 showing maximum particle movement of 49 m away from the water body over 200 years during fast fill scenario). • Direct discharge of ash pore water into the water body is unlikely as maximum particle movement occurs away from the water body during filling and negligible movement towards the water body after filling. • Undisturbed DBF approx. 400 m (east) of consolidated leached ash material. • DBG water quality monitoring and potential modification of WB16 extraction rates during filling (if required) to adjust the phreatic surface gradient into formation dependent on water quality monitoring results and pressures. • ASA overlies the DBF deposits and associated with the Lower Anglesea River system and is located at least 400 m away.	• No adverse impact on undisturbed DBF/ASA water quality measured by no exceedance of the adopted screening criteria for Water Quality Performance Targets as discussed in Section 4 Consolidated Leached Ash Technical Assessment, EHS Support (2023), applicable in accordance with the environment values to be protected under Segment B groundwater. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters. • Potential for elevated calcium however there are no ANZECC criteria for this constituent (refer to Table 6-8).	Insignificant	Insignificant	Minor	Unlikely	Low	• Six monthly mine water body water quality sampling. • Six monthly groundwater water quality sampling at MB UEVF and DBG and ASA bores. • Reporting via monthly ERR report and via Community Consultative Network meetings or regular updates. • Health and Safety and Environmental Incident reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
2.2	Groundwater quality	• CLA interaction with groundwater adversely impacts UEVF groundwater quality in the underlying UEVF (upper sands) aquifer during filling.	• UEVF	• Refer to control measures in Element 1.1 above. • Leached ash particle migration not expected to extend beyond the licensed mine boundary. (Refer to Consolidated Leached Ash Technical Assessment, EHS Support (2023) Section 9 showing maximum particle movement of 49 m over 200 years during fast fill scenario). • UEVF separation via basal clay and multiple low permeability layers therefore there is no perceived pathway between the CLA area and the UEVF below the basal clay. • UEVF water quality monitoring and modification of WB16 extraction rates during filling (if required) to reduce potential UEVF leakage into formation dependent on water quality monitoring results and pressures. • Upward hydraulic gradient currently exists between underlying UEVF (upper sands) and mine pit.	• No adverse impact on UEVF water quality measured by no exceedance of the adopted screening criteria for Water Quality Performance Targets as discussed in Section 4 Consolidated Leached Ash Technical Assessment, EHS Support (2023)in accordance with the environmental values to be protected under Segment B groundwater. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters.	Insignificant	Insignificant	Minor	Rare	Low	• Six monthly mine water body water quality sampling. • Six monthly groundwater water quality sampling at MB UEVF and DBG bores. • Reporting via monthly ERR report and via Community Consultative Network meetings or regular updates. • Health and Safety and Environmental Incident reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
2.3	Groundwater quality	• CLA with groundwater (DBF/UEVF/ASA) adversely impacts third party users during filling.	• UEVF aquifer domestic users. • LEVF Barwon Water. NOTE there are no third-party users for DBF/ASA.	• Refer to control measures in Element 1.1 above. • Two nearest domestic users are located 3 km southeast and8.5 km northeast of the mine. • No authorised or unauthorised domestic users could be located within 400 m of the CLA due to the extent of the Alcoa mine and land management area. • UEVF sits above the LEVF separated via the MEVF (aquitard). General upward gradient from the LEVF. • Leached ash particle migration not expected to extend beyond the licenced mine boundary. (Refer to Consolidated Leached Ash Technical Assessment, EHS Support (2023) Section 9 showing maximum particle movement of 49 m over 200 years during fast fill scenario). • Direct discharge of ash pore water into the water body is unlikely as maximum particle movement occurs away from the water body during filling and negligible movement towards the water body after filling • Decommissioning of historical redundant power station bores where required. • No UEVF/LEVF interactions observed by Alcoa or Barwon Water during 2021 and 2022 pumping tests.	• No adverse impact on LEVF/UEVF third party water users. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters.	Insignificant	Insignificant	Major	Rare	Medium	• Six monthly mine water body water quality sampling. • Six monthly groundwater water quality sampling at MB UEVF and DBG and ASA bores. • Reporting via monthly ERR report and via Community Consultative Network meetings or regular updates. • Health and Safety and Environmental Incident reporting.
2.4	Groundwater quality	• CLA with groundwater (DBF/UEVF) adversely impacts GDE's during filling.	• GDE's Flora and Fauna	• Refer to Control Measures in Element 3 and Element 4. • Interim WQPTs for the mine water body water quality complimentary to existing background surface water quality which the native flora and fauna are adapted to. • No known GDE's in the pathway of the modelled groundwater flow direction.	• No adverse impact on GDE's native flora and fauna. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters.	Insignificant	Insignificant	Minor	Rare	Low	• Six monthly mine water body water quality sampling. • Six monthly groundwater water quality sampling at MB UEVF and DBG bores. • Reporting via monthly ERR report and via Community Consultative Network meetings or regular updates. • Health and Safety and Environmental Incident reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
3.1	Erosion & Sedimentation	• Surface water run off (rain fall) reducing cover material to below 0.7m depth before being submerged. • Water body level increase eroding cover material to below 0.7m depth at shoreline interface.	• Mine Water body	• >1 m clay rich cover material with lab sampled permeabilities of less than 1x10-9m/sec. • Leached ash particle migration not expected to extend beyond the licensed mine boundary. (Refer to Consolidated Leached Ash Technical Assessment, EHS Support (2023) Section 9 showing maximum particle movement of 49 m over 200 years during fast fill scenario). then it would take approximately 2.8 years for a particle to move through 0.7 m of cover material. • Erosion trigger of 0.7 m set considerate of this. • Direct discharge of ash pore water into the water body is unlikely as maximum particle movement occurs away from the water body during filling and negligible movement towards the water body after filling. • Cover material surface area grade approx. 1:50 minimising surface water and 'shoreline' erosion, with site observations of similar grade shorelines showing minimal shoreline erosion. • Steeper 'shoreline' sections (west end and north side) material cover approximately 6m thick due to haul road and embankment construction, with site observations of steeper grade shorelines showing localised erosion of approximately 0.3 m. • Dispersivity testing of CLA material and surrounding fill material suggests risk of soil dispersion is low. • Implement monthly inspection program and repair strategy (TARP) for any surface water or shoreline erosion features to maintain cover.	• No adverse impact on mine water body water quality measured by no exceedance of 10th or 90th percentile of interim WQPT's. • No active erosion rill lines in surface cover material resulting in consolidated leached ash cover <0.7 m. • No shoreline erosion of cover material resulting in consolidated leached ash cover <0.7 m. • No aesthetic issue created by erosion of ash into the water body and creating a cloud of silty water. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters. NOTE: the mine water body lies entirely within the disturbed and controlled area.	Insignificant	Insignificant	Minor	Possible	Medium	• Monthly inspection of covered ash surface area for rill presence/activity using accepted visual criteria for activity recording or rill location and dimensions. • TARP for Inspect and repair program for any erosion features with trigger for erosion >0.3m cover depth until consolidated leached ash material fully submerged. • Monthly consolidated leached ash shoreline interface area erosion/slumping inspection for unacceptable erosion (>0.3mm). • Six monthly mine water body water quality sampling. • Establish a baseline LiDAR survey for CLA area, and investigate ongoing topographic survey methods including both LiDAR and/or using a single or multibeam echo sounding methodology to measure CLA surface during filling. • Reporting via monthly ERR report and bimonthly Community Consultative Network meetings. • Health and Safety and Environmental Incident reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
3.2	Erosion & Sedimentation	• Differential settlement of area during submersion resulting in cover material to below 0.7m depth. • Erosion of submerged cover material to below 0.7m depth.	• Mine Water body	• Refer to control measures in Element 3.1 above. • No Salt Creek inlet or Anglesea River discharge so no flows or currents through the water body. • No planned active recreational use so no powerboats and no associated water disturbance or mixing. • Ongoing silting expected during the filling period due to water and material run off from unsubmerged 1:3 slopes. Expected (as observed experientially since 2016) additional silt material settlement on top of the existing area further protecting the cover material. • Long term covered ash area estimated to be more than 12 m below the future surface level of the mine water body limiting any surface flows/current impacts on the covering. • Geotechnical Designs submitted as part of the Work Plan Variation – Progressive Rehabilitation Works approved by ERR March 2018 demonstrating safe and stable nature of the area. • No differential settlement observed in this area since consolidation and covering in 2017/2018.	• No adverse impact on mine water body water quality measured by no exceedance of 10th or 90th percentile of interim WQPT's. • No active erosion rill lines in surface cover material resulting in ash cover <0.7 m. • No shoreline erosion of cover material resulting in ash cover <0.7m. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters. NOTE: the mine water body lies entirely within the disturbed and controlled mine area.	Insignificant	Insignificant	Minor	Rare	Low	• Monthly inspection of covered ash unsubmerged surface area for potential settlement/surface cracking/etc during filling. • Annual LIDAR survey of covered ash unsubmerged surface area to measure for potential differential settlement. • Six monthly mine water body water quality sampling. • Reporting via Monthly ERR report and bimonthly Community Consultative Network meetings. • Health and Safety and Environmental Incident Reporting.

Element	Mining Hazard	Potential Risk Source (incl activity or circumstance)	Potential Receptors at Risk	Control Measures (Physical and Administrative)	Performance Objective, Standard, OR Criteria for Each Control OR Combination of Control Measures	Consequence			Likelihood	Risk Rating	Monitoring and Reporting
						Public Safety	Community Facilities, Including Property, and Infrastructure	Land and Environment			
3.3	Erosion & Sedimentation	• Disturbance of clay-rich cover material after submergence to below 0.7m depth • Bioturbation of clay-rich cover surface by benthic fauna	• Mine Water body	• Refer to control measures in Element 3.1 above. • Reference to limnological research of acidic pit lakes, indicate that when the CLA area is completely submerged (to approximately 12 m depth) the presence of benthic fauna within the sub-surface of the clay-rich cover will be controlled by the availability of carbon sources, i.e., organic material. Literature suggests that benthic fauna are restricted to areas where aquatic plants are present and more diverse ecosystems can develop due to shelter and direct or indirect food sources. Benthic macrofauna development is also limited by the acidic environment (e.g., prevents shell development in molluscs) and soft bodied fauna are susceptible to epidermis coagulation due to the sulfuric acid. Negligible dissolved oxygen concentrations at depth also limit the presence of benthic fauna. • Post submergence, bathymetric surveillance will be conducted to monitor the elevation and stability of the CLA area. • With no connection to surrounding surface water systems the input of nutrients (carbon, nitrogen, and phosphorus) will be extremely low and biological development within the mine water body is unlikely. • Based on the literature research it is concluded that the potential for the presence of benthic fauna is very low and the risk of bioturbation is also very low. • (Harp and Hubbard, 1972; Rodriques, 2001; Lagauzere et al, 2010; and Lund et al, 2020).	• No adverse impact on mine water body water quality measured by no exceedance of 10th or 90th percentile of interim WQPT's. • No active erosion rill lines in surface cover material resulting in ash cover <0.7 m. • No shoreline erosion of cover material resulting in ash cover <0.7 m. • Compliance with EPA Act 2017 Environmental Reference Standard Part 5 – Waters. NOTE: the mine water body lies entirely within the disturbed and controlled mine area.	Insignificant	Insignificant	Minor	Rare	Low	• Monthly consolidated leached ash shoreline interface area erosion/slumping inspection for unacceptable erosion (>0.3mm). • Six monthly mine water body water quality sampling. • Establish a baseline LiDAR survey for CLA area and investigate ongoing topographic survey methods including both LiDAR and/or using a single or multibeam echo sounding methodology to measure CLA surface during filling. • Reporting via monthly ERR report and bimonthly Community Consultative Network meetings. • Health and Safety and Environmental Incident reporting.

10.5 Monitoring and Reporting

In addition to an awareness of the potential mining hazards and risks, the proposed control measures, and the associated performance objectives for each combination of control measures, Alcoa has also identified appropriate monitoring tools and programs to measure performance against the specified objectives and methods for reporting on performance against the specified objective.

The monitoring and reporting tools are consistent with those used for similar works at Anglesea under the currently endorsed Work Plan (September 2011) and Work Plan Variation – Progressive Rehabilitation Works (March 2018). The proposed monitoring and reporting tools, processes, and methods for each combination of control measures are shown in **Table 10-6** and include:

- Six monthly mine water body water quality sampling;
- Six monthly groundwater water quality sampling at MB UEVF and DBG and ASA bores;
- Monthly inspection of covered consolidated leached ash surface area for rill presence/activity using accepted visual criteria for activity recording or rill location and dimensions;
- Monthly covered consolidated leached ash shoreline interface area erosion/slumping inspection for unacceptable erosion (>300mm);
- Monthly inspection of covered ash unsubmerged surface area for potential settlement/surface cracking/etc. during filling;
- TARP for inspection and repair program for any erosion features with trigger for erosion >0.3m cover depth until consolidated leached ash area is fully submerged;
- Annual LIDAR survey of covered ash unsubmerged surface area to measure for potential differential settlement;
- Development of a post submergence plan which will include bathymetric surveillance to monitor the elevation and stability of the CLA area;
- Health and Safety and Environmental Incident reporting; and
- Reporting via monthly ERR report.

A key reporting tool is expected to continue to be the monthly ERR report, a process that currently exists and is expected to continue to be refined in consultation with the ERR to ensure that it is efficient, effective, and meets the needs of both ERR and Alcoa.

It is expected that the specific consolidated leached ash area data, report format and WQPT collected as part of the above monitoring events and inspections will be included appropriately in the monthly report.

11 Summary and Conclusions

The objective of this review was to complete a detailed technical review and risk assessment for the activity of submerging the CLA material covered by at least 1 m of low permeability clay-rich overburden in order to understand any associated short and long-term risks to the environment.

The aim of the assessment, including the numerical modelling, was to test the hypothesis:

> *'The submergence of the encapsulated consolidated leached ash will not result in adverse risk of harm to human health or the environment within the catchment.'*

Based on the summary and conclusions below, this hypothesis has been confirmed.

This review also provides a detailed technical response to the feedback received from ERR (and EPA) in the letter to Alcoa dated 29 November 2017, and also on the items detailed by the EPA in the letter to Alcoa dated 20 October 2021.

The technical review has included:

- A review of CCA and leached ash characterisation and management at the former power station and open cut brown coal lignite mine at Anglesea.
- Extensive field investigations, sampling, and laboratory analysis of the materials in and around the CLA area located within the south-east corner of the mine.
- Development of a bespoke numerical hydraulic model to simulate water fluxes in and around the CLA related to both surface water and groundwater changes over time, inclusive of particle movement and tracking.
- A literature review of ash management and characterisation at national and international facilities and the evaluation of best available techniques and technologies.
- Completion of a detailed risk assessment related to both surface water and groundwater risks to the environment.
- Completion of an independent peer review of the key elements above and this final report, by BlueSphere.

Historically CCA has been produced and managed at the former Anglesea power station and was temporarily stored and leached in Ash Pond 1 before being dried and deposited in the former open cut pit as leached ash. The leached ash was then historically placed into the former open cut coal mine in accordance with the Mine Work Plan endorsed by ERR in September 2011.

Interim WQPTs have been developed and are included within this assessment (**Section 4**). Final WQPTs, are expected to be included as part of the MRCP (when finalised).

More recently following mine closure, in early 2018 the existing leached ash in the south-east corner of the former mine was consolidated into a small footprint between RL -15 m and RL -8 m and clay-rich material was then used to cover the CLA to a minimum 1 m thickness. The CLA is also bounded by clay-rich material from the west (clockwise) around to the north-east, by the berm and haul road respectively. Unconsolidated fill material (silts, clays, and minor sands) underlies and surrounds the CLA from the north-east (clockwise) to the west (**Section 5**).

There have been two phases of field investigations within the CLA area in 2021 and 2022. The objectives of the field investigation were to collect multiple samples for the measurement of permeability and chemical characterisation of materials encountered within and surrounding the consolidated leached ash. The outcome of both phases of investigation have confirmed that low permeability materials (less that $1x10^{-9}$ m/sec) were consistently encountered both within and surrounding the CLA area and to a minimum thickness of 1 m of clay-rich cover overlying the CLA. Chemical characterisation and comparison between CLA and surrounding fill material show that constituents indicative of and at a magnitude representative of leached ash, are only encountered within the CLA area (**Section 6** and **Section 7**).

The following chemical and physical controls were noted from the literature review (Section 8) to influence and limit the mobility of major and minor ion constituents from CCA porewater to groundwater:

1. Leaching and aging of CCA in ash ponds for at least one year, enables the dissolution of more soluble constituents from the CCA into the pond water to produce leached ash.
2. Drying of leached ash occurred prior to deposition or consolidation and draining to lower the moisture content so leached ash could be tracked with earth moving machines to produce CLA.
3. Surrounding the CLA with low permeability clay-rich material.
4. Settling of fines within the CLA creating low permeability horizons.
5. Alkaline porewater within the leached ash limits the solubility and mobility of minor ions.
6. Sulfate can be attenuated by SRB providing electron donors are present, e.g., labile organic carbon.

These management controls have been demonstrated to have been used by Alcoa and chemical characterisation has demonstrated that leaching of CCA has produced a leached ash with a significantly lower leachable fraction of major and minor ion constituents.

A numerical model was developed using GeoStudio SEEP/W software simulating the hydraulic behaviour of rising water body and groundwater levels and potential groundwater seepage into the fill material under steady-state and transient conditions; and included particle tracking to observe movement of particles representative of a conservative (not subject to attenuation or retardation) constituent within the model domain. The model was run under various scenarios including natural water body filling (46 years), fast filling (10 years), and under a rapid fill type- event (less than 1 year).

The modelling showed that under all simulated scenarios (natural and fast fill) the water body evolves as a groundwater sink. In the fast fill scenario (where supplementary water is used to fill the mine pit), maximum particle movement is 41 m in 200 years and groundwater flows away from the water body for less than 20 years. Under sensitivity analysis particles did migrate further that 46 m however, not to distances that indicate receptor impacts. These distances are significantly less than the distance to the edge of the mine disturbed area of approximately 400 m; overall, the modelling results clearly indicate that the low permeability characteristics of the CLA, the 1 m clay rich cover material, and the surrounding materials are highly effective in reducing the advective flux of particles placed within the CLA during any future inundation scenario in both the short and long term.

Finally, a simple mass balance calculation using the leachable mass of selected constituents in CLA and the water body quality was used to assess current and future water body quality if the CLA was mixed into the water body. The resulting concentrations of aluminium, boron, iron, manganese, and zinc would be most likely be within the range of expected concentrations and with limited increase in risk to environmental values. (**Section 9**).

A detailed risk assessment (**Section 10**) was completed in accordance with Part 3 Division 6 Section 44 of the Mineral Resources Sustainable Development (Mineral Industries) Regulations 2019 assessing risks associated with submerging the CLA material located in the south-east corner of the mine. The process and framework is consistent with those outlined in 'Preparation of Work Plans and Work Plan Variations GUIDELINE FOR MINING PROJECTS' **Appendix B** (December 2020 version 1.3) provided by the Department of Jobs Precincts and Regions. The risk assessment considered all elements outlined in the various sections of this technical assessment, including the water quality performance targets for both surface water and groundwater (**Section 4**).

The risk assessment did not identify any high risks, with only two medium risks identified and all remaining risks identified as low. The main risk mitigation measure adopted by Alcoa is the encapsulation of the CLA in a low permeability material, on average less than 1x10-9 m/sec. The medium risks are considered to be conservatively assessed and are related to third party users (albeit with the lowest likelihood rating of 'Rare') and potential for erosion of the covering material. Appropriate performance criteria, counter measures and monitoring criteria have been identified for ongoing monitoring and management of the risks into the future.

It should be noted that leachable fraction analysis of the CLA demonstrates that ash pore water is unlikely to have any measurable environmental impacts in either groundwater or the water body.

In addition to the technical assessment work completed by Alcoa described above, BlueSphere were engaged to conduct an independent peer review of the entire technical assessment and all of its key elements. The independent peer review identified a number of improvement opportunities during the process which have been actioned and included as part of this final technical assessment, significantly improving the level of confidence in the conclusions reached. The independent peer review concluded that:

- The combined assessment and characterisation work on the physical properties of the CLA is considered to have been completed in accordance with appropriate and relevant legislation, guidance, and industry standards to the extent practicable. The outcomes of this work are considered to be a reasonable basis from which to assess the likely future impacts on the surrounding environment from the submergence of the CLA within the pit lake.
- Numerical modelling has been utilised to make predictions regarding the future environmental performance of the CLA cap and other encapsulating materials. The model is considered to be sufficiently rigorous given the setting, margin of safety indicated by the modelling results, and relatively modest modelling objectives.
- The numerical modelling, together with other lines of evidence including the site-specific physical characterisation of the materials, has been used to inform the risk assessment process. The risk assessment concludes that the activity of submerging the CLA beneath the pit lake represents a low risk of adverse environmental outcomes in both the short and long term.
- In the context of the specific assumptions (**Section 4.1**), the history of regulation and the environmental setting, the ITPR team is of the view that the submergence of the CLA does present a low risk of adverse environmental outcomes for surface water and groundwater and that the approach is consistent with previous regulatory directions and broader principles of environmental protection, including the GED.

- Future monitoring and verification of the environmental performance is considered to be a key tenet of sound environmental management. The CLARA provides the overall monitoring principles which the ITPR team considers appropriate. It is understood that specific detail on the future monitoring requirements, trigger levels and contingency actions are to be prepared prior to the submergence of the CLA. The ITPR team emphasises that an appropriately detailed water management plan as proposed should be developed and implemented so as to provide a robust framework for future environmental management of the CLA.

Refer to **Appendix A** for IPR letter.

In conclusion, this Consolidated Leached Ash Technical Assessment provides the technical information supporting the Alcoa proposal to submerge the CLA material covered by at least 1 m of low permeability clay-rich fill material, meeting Alcoa's GED. This demonstrates that risks to the environment (including surface water and/or groundwater) remain low as far as reasonably practical in both the short and long term regardless of the water body fill strategy.

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Tables

Table 1 Upper Anglesea River AV2 Surf

			Location	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2
			Alcoa ID	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2
			Lab Sample ID																							
			Matrix Code	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	01/09/2000	16/01/2008	23/07/2008	26/08/2008	24/09/2008	14/10/2008	23/01/2009	12/05/2009	18/06/2009	08/07/2009	13/08/2009	21/09/2009	19/10/2009	17/11/2009	09/12/2009	05/01/2010	15/06/2010	16/07/2010	11/08/2010	16/09/2010	13/10/2010	02/11/2010	06/12/2010
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																										
pH Value	pH_Lab	N	SU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
METALS																										
Aluminium	7429-90-5	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Boron	7440-42-8	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	7439-89-6	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	7440-66-6	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 1 Upper Anglesea River AV2 Surf

			Location	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2
			Alcoa ID	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	AV2	PTH-16-0059	V2_2507201	V2_2507201	NG-19-0000	NG-19-0000	NG-19-0001	NG-19-0001	NG-20-0022	NG-20-0022	NG-20-0032	NG-20-0032
			Lab Sample ID													EM160947 9-001		EM191194 8-001		EM191425 9-003	EM191477 0-003	EM191525 1-003		EM201919 5-002		EM202255 7-001
			Matrix Code	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	20/01/2011	17/02/2011	17/03/2011	13/04/2011	17/05/2011	16/06/2011	13/07/2011	09/08/2011	15/09/2011	25/10/2011	22/11/2011	14/12/2011	11/08/2016	26/07/2019	26/07/2019	30/08/2019	30/08/2019	06/09/2019	13/09/2019	30/10/2020	30/10/2020	16/12/2020	16/12/2020
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																										
pH Value	pH_Lab	N	SU	--	--	--	--	--	--	--	--	--	--	--	--	2.69	--	2.7	--	2.72	2.77	2.71	--	2.75	--	2.87
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4150	--	3310	3040	2970	--	2280	--	3050
METALS																										
Aluminium	7429-90-5	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	232	--	169	--	148	141	--	--	63.8	--	63.7
Boron	7440-42-8	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	< 0.05	--	< 0.05	--	< 0.05	< 0.05	0.05	--	0.09	--	0.06
Iron	7439-89-6	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	42.8	--	41.6	--	24.4	29.1	--	--	15.2	--	39.9
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	2.87	--	3.04	--	2.62	2.38	2.51	--	1.8	--	1.89
Zinc	7440-66-6	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	1.31	--	0.847	--	0.768	0.788	0.718	--	0.469	--	0.476

Table 1 Upper Anglesea River AV2 Surf

			Location	AV2	AV2	AV2	AV2
			Alcoa ID	ANG-21-0233	ANG-21-0233	ANG-22-0111	ANG-22-1044
			Lab Sample ID		EM2118953-017	EM2216610-002	EM2221258-002
			Matrix Code	WS	WS	WS	WS
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	23/09/2021	23/09/2021	29/08/2022	26/10/2022
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result
GENERAL CHEMISTRY							
pH Value	pH_Lab	N	SU	--	2.85	3.74	3.74
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	2060	555	302
METALS							
Aluminium	7429-90-5	D	mg/L	--	45.1	34.6	9.55
Boron	7440-42-8	D	mg/L	--	0.05	0.018	0.022
Iron	7439-89-6	D	mg/L	--	8.39	0.366	0.127
Manganese	7439-96-5	D	mg/L	--	1.66	0.956	0.362
Zinc	7440-66-6	D	mg/L	--	0.322	0.709	0.22

mean	median	min	max	10th %ile	90th %ile	Count
2.93	2.76	2.69	3.74	2.70	3.74	10
1,883	2,970	302	4,150	504	3,478	9
71.62	63.80	9.55	232.00	29.6	181.60	9
0.04	0.05	0.02	0.09	0.02	0.08	6
8.74	24.40	0.13	42.80	0.32	41.84	9
1.75	2.14	0.36	3.04	0.90	2.89	10
0.59	0.71	0.22	1.31	0.31	0.89	10

			Location	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2	SV2
			Alcoa ID	SV2	SV2	SV2	SV2	SV2	SV2	SV2	PTH-16-0056	PTH-16-0060	PTH-16-0085	PTH-16-0058	ANG-19-0000	ANG-19-0000	ANG-19-0001	ANG-19-0001	ANG-20-0028	ANG-20-0029	ANG-21-0232	ANG-21-0232
			Lab Sample ID								EM160829 2-001	EM160967 6-001	EM161003 3-002	EM161159 8-001		EM191425 9-002	EM191477 0-002	EM191525 1-002		EM201986 0-002		EM211895 3-014
			Matrix Code	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	01/09/2000	16/09/2010	13/10/2010	02/11/2010	20/01/2011	17/02/2011	15/09/2011	13/07/2016	16/08/2016	25/08/2016	03/10/2016	30/08/2019	30/08/2019	06/09/2019	13/09/2019	10/11/2020	10/11/2020	23/09/2021	23/09/2021
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																						
pH Value	pH_Lab	N	SU	--	--	--	--	--	--	--	6.04	2.78	5.51	3.54	--	3.71	3.72	3.67	--	3.95	--	3.83
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	--	--	--	--	--	--	193	5660	--	--	--	1390	1280	1350	--	1460	--	1080
METALS																						
Aluminium	7429-90-5	D	mg/L	--	--	--	--	--	--	--	0.16	291	0.33	86.8	--	110	112	--	--	114	--	74.5
Boron	7440-42-8	D	mg/L	--	--	--	--	--	--	--	0.21	0.06	< 0.05	< 0.05	--	< 0.05	< 0.05	< 0.05	--	< 0.05	--	0.026
Iron	7439-89-6	D	mg/L	--	--	--	--	--	--	--	0.1	67.9	0.43	0.76	--	0.84	0.83	--	--	2.1	--	0.608
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	0.054	4.31	0.03	1.98	--	2.12	1.95	2.24	--	2.99	--	2.02
Zinc	7440-66-6	D	mg/L	--	--	--	--	--	--	--	0.019	1.38	0.006	1.32	--	1.51	1.52	1.52	--	1.93	--	1.38

mean	median	min	max	10th %ile	90th %ile	Count
3.98	3.72	2.78	6.04	3.39	5.6	9
1,225	1,350	193	5,660	725	3,140	7
24.72	98.40	0.16	291.00	0.28	167.10	8
0.07	0.06	0.03	0.21	0.03	0.18	3
1.09	0.80	0.10	67.90	0.33	21.84	8
0.97	2.02	0.03	4.31	0.05	3.25	9
0.50	1.38	0.01	1.93	0.02	1.60	9

Table 3 Upper Eastern View Groundwater Quality

Location				UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB1	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB2	UEVF MB3	UEVF MB3	UEVF MB3
Alcoa ID				ANG-21-0049	ANG-21-0049	ANG-21-0081	ANG-21-0081	ANG-21-0131	ANG-21-0131	ANG-21-0161	ANG-21-0221	ANG-21-0221	ANG-21-0243	ANG-21-0243	ANG-21-0265	ANG-21-0261	ANG-22-0121	ANG-21-0082	ANG-21-0082	ANG-21-0131	ANG-21-0131	ANG-21-0171	ANG-21-0221	ANG-21-0221	ANG-21-0241	ANG-21-0241	ANG-21-0261	ANG-21-0261	ANG-22-0121	ANG-21-0083	ANG-21-0083	ANG-21-0133
Lab Sample ID				EM2106304-001		EM2109820-003		EM2114330-0		M2117045-007		EM2118953-003		EM2120894-004		EM2123180-0	M2222257-001		EM2109923-004		EM2114330-0	M2117045-008		EM2118953-002		EM2120894-005		EM2123180-0	M2222257-002		EM2109923-005	E
Matrix Code				WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG
Sample Type				PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
Sample Date				08/04/2021	08/04/2021	25/05/2021	25/05/2021	22/07/2021	22/07/2021	26/08/2021	23/09/2021	23/09/2021	19/10/2021	19/10/2021	18/11/2021	18/11/2021	10/11/2022	26/05/2021	26/05/2021	22/07/2021	22/07/2021	26/08/2021	23/09/2021	23/09/2021	19/10/2021	19/10/2021	18/11/2021	18/11/2021	10/11/2022	26/05/2021	26/05/2021	22/07/2021
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																																
pH Value	pH_Lab	N	SU	--	5.76	--	5.68	--	6.01	5.47	--	5.61	--	5.67	--	5.7	5.75	--	6.22	--	6.9	6.28	--	7.34	--	7.26	--	7.21	7.38	--	4.15	--
Total Dissolved Solids (Resid	TDS	T	mg/L	--	722	--	1020	--	753	854	--	789	--	780	--	977	817	--	1040	--	916	949	--	925	--	889	--	968	955	--	884	--
METALS																																
Aluminium	7429-90-5	D	mg/L	--	0.0217	--	0.0214	--	0.0396	0.0172	--	0.0169	--	0.0178	--	0.0173	0.0153	--	0.0034	--	0.02	0.0017	--	0.0025	--	0.0018	--	0.0072	0.0091	--	0.0358	--
Boron	7440-42-8	D	mg/L	--	0.079	--	0.174	--	0.096	0.143	--	0.096	--	0.096	--	0.097	0.088	--	0.116	--	0.09	0.129	--	0.095	--	0.087	--	0.095	0.09	--	0.093	--
Iron	7439-89-6	D	mg/L	--	9.58	--	9.4	--	9.19	9.77	--	7.64	--	9.46	--	8.34	9.02	--	0.071	--	0.03	0.021	--	0.006	--	0.01	--	0.027	0.353	--	5.42	--
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0701	--	--	--	--	--	--	--	--	--	--	--	0.0403	--	--	--
Zinc	7440-66-6	D	mg/L	--	--	--	0.005	--	0.0223	0.0834	--	0.0659	--	0.0736	--	0.0417	0.0346	--	0.107	--	0.122	0.0976	--	0.0927	--	0.0903	--	0.0811	0.0273	--	0.0904	--

Table 3 Upper Eastern View Groundwater Quality

			Location	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB3	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB4	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5
			Alcoa ID	ANG-21-0133	ANG-21-017	ANG-21-022	ANG-21-022	ANG-21-024	ANG-21-024	ANG-21-026	ANG-21-026	ANG-22-012	ANG-21-005	ANG-21-005	ANG-21-005	ANG-21-008	ANG-21-008	21-0134_202	ANG-21-013	ANG-21-017	ANG-21-022	ANG-21-022	ANG-21-024	ANG-21-024	ANG-21-026	ANG-21-026	ANG-22-012	ANG-21-005	ANG-21-005	ANG-21-008	ANG-21-013	ANG-21-013
			Lab Sample ID	M2114330-01	M2117045-009		EM2118953-001		EM2120894-006		EM2123180-00	M2222257-003		EM2106304-00	M2106304-008		EM2109923-006		EM2114330-00	M2117045-010		EM2118953-005		EM2120894-010		EM2123180-01	M2222206-006		EM2106304-00	M2109923-008		EM2114330-0
			Matrix Code	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	22/07/2021	26/08/2021	23/09/2021	23/09/2021	19/10/2021	19/10/2021	18/11/2021	18/11/2021	10/11/2022	09/04/2021	09/04/2021	09/04/2021	27/05/2021	27/05/2021	21/07/2021	21/07/2021	25/08/2021	23/09/2021	23/09/2021	20/10/2021	20/10/2021	19/11/2021	19/11/2021	09/11/2022	09/04/2021	09/04/2021	27/05/2021	21/07/2021	21/07/2021
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																															
pH Value	pH_Lab	N	SU	4.28	4.37	--	4.65	--	4.62	--	4.72	5	--	5.09	5.28	--	4.59	--	4.34	4.38	--	5.01	--	3.72	--	3.87	4.3	--	5.84	5.28	--	5.55
Total Dissolved Solids (Resid	TDS	T	mg/L	899	987	--	949	--	924	--	1010	978	--	3840	3860	--	3470	--	3360	3690	--	3690	--	3470	--	3840	3310	--	923	1000	--	949
METALS																															
Aluminium	7429-90-5	D	mg/L	0.0852	0.0654	--	0.0672	--	0.0615	--	0.0684	0.0435	--	0.424	0.438	--	0.368	--	0.424	0.419	--	0.408	--	0.4	--	0.406	0.39	--	0.15	0.149	--	0.198
Boron	7440-42-8	D	mg/L	0.08	0.109	--	0.086	--	0.089	--	0.092	0.087	--	0.269	0.254	--	0.275	--	0.217	0.264	--	0.232	--	0.206	--	0.242	0.233	--	1.03	1.29	--	1.06
Iron	7439-89-6	D	mg/L	0.058	0.029	--	0.021	--	0.039	--	0.035	0.403	--	43.7	42.3	--	34.8	--	35	37.7	--	35	--	29.3	--	28.4	22.6	--	23.6	19.8	--	21.1
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	--	0.421	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.415	--	--	--	--	--
Zinc	7440-66-6	D	mg/L	0.128	0.089	--	0.234	--	0.136	--	0.141	0.0814	--	--	--	--	0.292	--	0.451	0.307	--	0.4	--	0.286	--	0.328	0.376	--	--	0.0852	--	0.137

Table 3 Upper Eastern View Groundwater Quality

			Location	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB5	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB6	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7
			Alcoa ID	ANG-21-017	ANG-21-022	ANG-21-022	ANG-21-024	ANG-21-024	ANG-21-026	ANG-21-026	ANG-22-013	ANG-21-005	ANG-21-005	ANG-21-008	ANG-21-008	ANG-21-010	ANG-21-013	ANG-21-013	ANG-21-017	ANG-21-022	ANG-21-022	ANG-21-024	ANG-21-024	ANG-21-027	ANG-21-027	ANG-22-013	ANG-21-005	ANG-21-005	ANG-21-008	ANG-21-008	ANG-21-013	ANG-21-013
			Lab Sample ID	M2117045-011		EM2118953-007		EM2120894-011		EM2123180-0	M2222206-007		EM2106304-003		EM2109715-002			EM2114330-0	M2117045-012		EM2118953-009		EM2120894-012		EM2123180-0	M2222206-009		EM2106304-005		EM2109923-009		EM2114330-0
			Matrix Code	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	25/08/2021	23/09/2021	23/09/2021	20/10/2021	20/10/2021	18/11/2021	18/11/2021	09/11/2022	08/04/2021	08/04/2021	24/05/2021	24/05/2021	22/06/2021	21/07/2021	21/07/2021	25/08/2021	23/09/2021	23/09/2021	20/10/2021	20/10/2021	18/11/2021	18/11/2021	09/11/2022	09/04/2021	09/04/2021	27/05/2021	27/05/2021	21/07/2021	21/07/2021
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																																
pH Value	pH_Lab	N	SU	5.27	--	5.36	--	5.19	--	5.12	5.14	--	5.8	--	5.24	--	--	5.38	4.89	--	5.42	--	4.76	--	5.22	5.18	--	6.01	--	5.18	--	5.51
Total Dissolved Solids (Resid	TDS	T	mg/L	1080	--	957	--	956	--	1070	968	--	638	--	776	--	--	618	683	--	634	--	683	--	709	672	--	190	--	176	--	155
METALS																																
Aluminium	7429-90-5	D	mg/L	0.188	--	0.179	--	0.184	--	0.178	0.214	--	0.0504	--	0.0536	--	--	0.0807	0.0611	--	0.0584	--	0.0594	--	0.0654	0.0663	--	0.0296	--	0.0264	--	0.0405
Boron	7440-42-8	D	mg/L	1.14	--	1.02	--	1.06	--	1.03	1.03	--	0.072	--	0.063	--	--	0.069	0.08	--	0.063	--	0.072	--	0.072	0.079	--	0.203	--	0.237	--	0.205
Iron	7439-89-6	D	mg/L	22	--	20.7	--	20.4	--	20.2	18.8	--	0.005	--	0.019	--	--	0.026	0.011	--	0.018	--	0.018	--	0.021	0.029	--	0.316	--	0.309	--	0.33
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	0.239	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.122	--	--	--	--	--	--
Zinc	7440-66-6	D	mg/L	0.12	--	0.106	--	0.0914	--	0.0903	0.126	--	--	--	0.0141	--	--	0.06	0.0553	--	0.0671	--	0.032	--	0.0437	0.0413	--	--	--	--	--	0.12

Table 3 Upper Eastern View Groundwater Quality

			Location	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7	UEVF MB7
			Alcoa ID	ANG-21-0175	ANG-21-0227	ANG-21-0227	ANG-21-0254	ANG-21-0254	ANG-21-0273	ANG-21-0277	ANG-22-0132
			Lab Sample ID	M2117045-013		EM2118953-008		EM2120894-013		EM2123180-0	M2222206-005
			Matrix Code	WG	WG	WG	WG	WG	WG	WG	WG
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	25/08/2021	23/09/2021	23/09/2021	20/10/2021	20/10/2021	18/11/2021	18/11/2021	09/11/2022
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY											
pH Value	pH_Lab	N	SU	5.4	--	5.53	--	5.79	--	5.14	6.09
Total Dissolved Solids (Resid	TDS	T	mg/L	172	--	174	--	168	--	218	204
METALS											
Aluminium	7429-90-5	D	mg/L	0.0229	--	0.0223	--	0.0213	--	0.0224	0.0178
Boron	7440-42-8	D	mg/L	0.223	--	0.212	--	0.199	--	0.202	0.184
Iron	7439-89-6	D	mg/L	0.309	--	0.291	--	0.372	--	0.388	0.301
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	0.0108
Zinc	7440-66-6	D	mg/L	0.0637	--	0.0578	--	0.0091	--	--	0.0389

mean	median	min	max	10th %ile	90th %ile	Count
5.32	5.28	3.72	7.38	4.35	6.26	55
871	924	155	3,860	196	3,470	55
0.05	0.06	0.00	0.44	0.01	0.40	55
0.17	0.13	0.06	1.29	0.07	1.03	55
0.85	0.39	0.01	43.70	0.02	32.60	55
0.11	0.12	0.01	0.42	0.03	0.42	7
0.08	0.09	0.01	0.45	0.03	0.30	47

Table 4 Demons Bluff Formation and Boonah Formation Groundwater Quality

			Location	DBG MB4	DBG MB4	DBG MB4	DBG MB4	DBG MB4	DBG MB4	DBG MB4	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6	DBG MB6
			Alcoa ID	-MB04/0/07	ANG-22-011	ANG-22-011	ANG-23-001	ANG-23-001	ANG-23-002	ANG-23-002	ANG-21-004	ANG-21-004	ANG-21-007	ANG-21-007	ANG-21-012	ANG-21-012	ANG-21-016	ANG-21-016	ANG-21-021	ANG-21-021	ANG-21-024	ANG-21-024	ANG-21-026	ANG-21-026	ANG-22-000	ANG-22-000	ANG-23-001	ANG-23-001	ANG-23-002	ANG-23-003	ANG-23-003	ANG-23-003
			Lab	EM222220	EM222220	EM222225	EM230288	EM230871	EM231501	EM232075		EM210630		EM210971		EM211433		EM211704		EM211895		EM212089		EM212318		EM220307	EM230288	EM230871	EM231501	EM232075	EM232075	
			Sample ID	6-012	6-013	7-007	5-005	8-001	8-001	1-001		4-002		5-001		0-001		5-001		3-010		4-014		0-007		9-001	5-006	8-002	8-002	1-004	1-003	
			Matrix Code	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	WG	
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	
			Sample Date	07/11/2022	09/11/2022	09/11/2022	20/02/2023	15/05/2023	21/08/2023	20/11/2023	08/04/2021	08/04/2021	24/05/2021	24/05/2021	21/07/2021	21/07/2021	25/08/2021	25/08/2021	23/09/2021	23/09/2021	20/10/2021	20/10/2021	18/11/2021	18/11/2021	23/02/2022	23/02/2022	20/02/2023	15/05/2023	21/08/2023	20/11/2023	20/11/2023	
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	
GENERAL CHEMISTRY																																
pH Value	pH_Lab	N	SU	6.52	6.51	6.05	5.75	5.51	5.04	6.04	--	7.32	--	7.19	--	7.01	--	6.6	--	6.64	--	6.18	--	6.31	--	6.43	6.02	5.88	5.86	3.54	5.9	
Total Dissolv	TDS	T	mg/L	1760	2150	2430	2140	2530	2790	3020	--	3320	--	3210	--	2680	--	2580	--	2480	--	2370	--	2490	--	2850	2500	2480	2720	1510	2420	
METALS																																
Aluminium	7429-90-5	D	mg/L	0.116	0.154	0.0518	0.832	1.18	3.52	0.762	--	0.305	--	0.266	--	0.182	--	0.155	--	0.0931	--	0.0356	--	0.0432	--	0.0358	0.0698	0.114	0.155	5.19	0.219	
Boron	7440-42-8	D	mg/L	0.39	0.336	0.312	0.458	0.517	0.638	0.523	--	0.277	--	0.363	--	0.285	--	0.32	--	0.28	--	0.324	--	0.293	--	0.309	0.326	0.348	0.412	0.958	0.32	
Iron	7439-89-6	D	mg/L	1.24	11.4	67.2	11.4	30	53.9	123	--	7.76	--	9.28	--	17.4	--	23.8	--	26.8	--	30.2	--	36.3	--	48.1	69.5	77.9	99.9	1.56	85.7	
Manganese	7439-96-5	D	mg/L	0.693	1.03	0.246	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Zinc	7440-66-6	D	mg/L	0.326	0.695	0.0311	--	--	--	--	--	--	--	0.0055	--	0.0576	--	0.0478	--	0.0415	--	0.031	--	0.0355	--	--	--	--	--	--	--	

mean	median	min	max	10th %ile	90th %ile	Count
6.05	6.12	3.54	7.32	5.46	7.03	20
2,483	2,495	1,510	3,320	2,102	3,039	20
0.21	0.16	0.04	5.19	0.04	1.41	20
0.38	0.33	0.28	0.96	0.28	0.53	20
24.60	30.10	1.24	123.00	7.14	87.12	20
0.56	0.69	0.25	1.03	0.34	0.96	3
0.06	0.04	0.01	0.70	0.03	0.40	9

Table 5 Mine Water Body surface Water Quality

			Location	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MINEWATER BODY	MWB 1	MWB 1	MWB 2	MWB 2	MWB 4	MWB 4	MWB 6	MWB 6	MWB 7	MWB 7	MWB 8	MWB 8
			Alcoa ID	ANG-21-009	ANG-21-009	ANG-21-017	ANG-21-017	ANG-21-023	ANG-21-023	ANG-21-025	ANG-21-025	ANG-21-027	ANG-21-027	ANG-22-000	ANG-22-000	ANG-22-014	ANG-23-001	ANG-23-001	ANG-23-002	ANG-23-003	ANG-21-014	ANG-21-014	ANG-21-014	ANG-21-014	ANG-21-014	ANG-21-014	ANG-21-014	ANG-21-014	ANG-21-015	ANG-21-015	ANG-21-015	ANG-21-015
			Lab		EM210971		EM211704		EM211895		EM212089		EM212318		EM220307	EM222220	EM230288	EM230871	EM231501	EM232075		EM211433		EM211433		EM211433		EM211433		EM211433		EM211433
			Sample ID		5-004		5-016		3-012		4-015		0-014		9-003	6-011	5-008	8-004	8-004	1-002		0-014		0-015		0-016		0-017		0-018		0-019
			Matrix Code	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WG	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS
			Sample Type	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY	PRIMARY
			Sample Date	24/05/2021	24/05/2021	25/08/2021	25/08/2021	23/09/2021	23/09/2021	20/10/2021	20/10/2021	19/11/2021	19/11/2021	23/02/2022	23/02/2022	09/11/2022	20/02/2023	15/05/2023	21/08/2023	20/11/2023	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021	22/07/2021
Analyte	CAS Number	Fraction	Unit	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
GENERAL CHEMISTRY																																
pH Value	pH_Lab	N	SU	--	3.59	--	3.72	--	3.55	--	3.46	--	3.63	--	3.44	3.6	3.56	3.62	3.61	5.96	--	3.53	--	3.51	--	3.52	--	3.58	--	3.51	--	3.5
Total Dissol	TDS	T	mg/L	--	1980	--	1610	--	1570	--	1520	--	1680	--	1840	1500	1550	1520	1570	2470	--	1710	--	1740	--	1720	--	1600	--	2040	--	1790
METALS																																
Aluminium	7429-90-5	D	mg/L	--	5.2	--	3.9	--	3.75	--	3.33	--	3.66	--	3.54	5.33	4.64	5.01	5.5	0.216	--	--	--	--	--	--	--	--	--	5.16	--	--
Boron	7440-42-8	D	mg/L	--	2.05	--	1.31	--	1.15	--	1.09	--	1.22	--	1.13	1.23	1.21	1.12	1.3	0.32	--	--	--	--	--	--	--	--	--	1.48	--	--
Iron	7439-89-6	D	mg/L	--	4.8	--	10.5	--	7.36	--	11.6	--	8.7	--	0.906	2.59	1.61	1.13	2.58	87.8	--	--	--	--	--	--	--	--	--	3.65	--	--
Manganese	7439-96-5	D	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	0.555	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	7440-66-6	D	mg/L	--	0.249	--	0.184	--	0.21	--	0.161	--	0.194	--	--	0.582	--	--	--	--	--	--	--	--	--	--	--	--	--	0.227	--	--

mean	median	min	max	10th %ile	90th %ile	Count
3.67	3.56	3.44	5.96	3.48	3.67	17
1,715	1,680	1,500	2,470	1,520	2,004	17
3.41	4.27	0.22	5.50	3.35	5.32	12
1.14	1.22	0.32	2.05	1.09	1.46	12
4.75	4.23	0.91	87.80	1.18	11.49	12
0.56	0.56	0.56	0.56	0.56	0.56	1
0.24	0.21	0.16	0.58	0.17	0.38	7

Table 6 2016 Coal Analysis

Parameter	Unit	EM1704609001	EM1704609002	EM1704609003	EM1704609004	EM1704609005	EM1704609006
		ANG-17-0091	ANG-17-0092	ANG-17-0093	ANG-17-0094	ANG-17-0095	ANG-17-0096
		UEVF coal Location 1 top of seam	UEVF coal Location 1 mid of seam	UEVF coal Location 1 base of seam	UEVF coal Location 2 top of seam	UEVF coal Location 2 mid of seam	UEVF coal Location 2 base of seam
Aluminium	mg/kg	4020	3780	3810	7440	6530	6870
Arsenic	mg/kg	6.2	3	2.2	3.2	1.5	1.5
Barium	mg/kg	60.4	88.9	57.6	28.3	22.2	95.2
Beryllium	mg/kg	0.8	0.4	0.4	1.4	1.3	1.3
Boron	mg/kg	30	20	24	22	20	24
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	mg/kg	6.4	6.8	4.3	5.1	2.3	1.8
Cobalt	mg/kg	5.7	1.7	1.5	9.8	8.3	6.9
Copper	mg/kg	1.8	1.7	1.3	1.6	1	1
Fluoride	mg/kg	50	110	60	150	<40	240
Iron	mg/kg	8050	8160	6350	6020	4510	3770
Lead	mg/kg	1.9	2.3	2.4	1.9	1.5	1.1
Manganese	mg/kg	12.7	5.8	14.4	4.2	2.7	2.6
Mercury	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	mg/kg	0.1	0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	7.5	4.6	7.2	19.5	17.8	16.1
Selenium	mg/kg	3	2	1	2	1	1
Tin	mg/kg	4.7	2.9	3	10.5	2	4.6
Vanadium	mg/kg	9	11	7	8	5	3
Zinc	mg/kg	8.2	3.8	4.8	50.7	49.9	31.8

mean	median	min	max	10th %ile	90th %ile	Count
5,180	5,275	3,780	7,440	3,795	7,155	6
2.6	2.6	1.5	6.2	1.5	4.7	6
51.4	59.0	22.2	95.2	25.3	92.1	6
0.8	1.1	0.4	1.4	0.4	1.4	6
23	23	20	30	20	27	6
			<0.1			
4.0	4.7	1.8	6.8	2.1	6.6	6
4.5	6.3	1.5	9.8	1.6	9.1	6
1.4	1.5	1.0	1.8	1.0	1.8	6
104	110	50	240	54	204	5
5,912	6,185	3,770	8,160	4,140	8,105	6
1.8	1.9	1.1	2.4	1.3	2.4	6
5.6	5.0	2.6	14.4	2.7	13.6	6
		0.1	0.1			1
		0.1	0.1			2
10.6	11.8	4.6	19.5	5.9	18.7	6
2	2	1	3	1	3	6
4.0	3.8	2.0	10.5	2.5	7.6	6
7	8	3	11	4	10	6
15.1	20.0	3.8	50.7	4.3	50.3	6

Table 7
2016 Ash Analyses

Location ID Alcoa ID Lab Sample ID Matrix Code Sample Date Sample Depth Material	cas	Fraction	Units	Location 1 ash PTH-16-0042 EM1607144002 SO 20/06/2016 0-1 m Ash	Location 2 ash PTH-16-0043 EM1607144003 SO 21/06/2016 0-1 m Ash	Location 3 ash PTH-16-0044 EM1607144004 SO 22/06/2016 0-1 m Ash
(None)						
Net Acid Production Potential	ACID_ProdPot	N	kg H2SO4 eq/t	0.5 U	0.5 U	0.5 U
GENERAL CHEMISTRY						
Acidity as CaCO3	ACID	N	mg/kg	1 U	1 U	1 U
Alkalinity, Bicarbonate (As CaCO3)	ALKB	N	mg/kg	22	1 U	1 U
Alkalinity, Carbonate (As CaCO3)	ALKC	N	mg/kg	87	44	54
Alkalinity, Total (As CaCO3)	ALK	N	mg/kg	109	65	87
ANC as CaCO3	ANCasCaCO3	N	% CaCO3	44	45.5	29.6
ANC as H2SO4	ANCasH2SO4	N	kg H2SO4 eq/t	432	446	290
Chloride (As Cl)	16887-00-6	N	mg/kg	6100	6490	2560
Electrical Conductivity @ 25°C	EC_Lab	N	us/cm	4060	3770	3420
Fizz Rating	FizzRating	N	Fizz Unit	5	5	4
Fluoride	16984-48-8	T	mg/kg	40 UJ	40 U	40 UJ
Moisture, Percent	MOIST	N	%	67.4	73.2	57.6
Net Acid Generation - pH 4.5	NAG_pH4.5	N	kg H2SO4 eq/t	0.1 U	0.1 U	0.1 U
Net Acid Generation - pH 7.0	NAG_pH7.0	N	kg H2SO4 eq/t	0.1 U	0.1 U	0.1 U
pH OX (23B)	pH_Ox	N	SU	9.2	9.4	8.4
pH Value	pH_Lab	N	SU	11.2	10.8	10.3
pH (CaCl2)	pH_Lab	N	SU	--	--	--
Sulfate (As SO4)	14808-79-8	D	mg/kg	25500	31000	20400
Sulfur	7704-34-9	T	%	4.74	7.27	4.58
Total Organic Carbon	TOC	N	%	2.27	1.47	9.57
GEOPHYSICAL						
+1180µm	+1180µm	N	%	1 U	1 U	5
+150µm	+150µm	N	%	2	3	19
+19.0mm	+19.0mm	N	%	1 U	1 U	1 U
+2.36mm	+2.36mm	N	%	1 U	1 U	2
+300µm	+300µm	N	%	1 U	2	13
+37.5mm	+37.5mm	N	%	1 U	1 U	1 U
+4.75mm	+4.75mm	N	%	1 U	1 U	1 U
+425µm	+425µm	N	%	1 U	2	11
+600µm	+600µm	N	%	1 U	1	8
+75.0mm	+75.0mm	N	%	1 U	1 U	1 U
+75µm	+75µm	N	%	3	5	25
+9.5mm	+9.5mm	N	%	1 U	1 U	1 U
Clay (<2 µm)	Clay (<2 µm)	N	%	1 U	2	3
Cobbles (>6cm)	Cobbles (>6cm)	N	%	1 U	1 U	1 U
Gravel (>2mm)	Gravel (>2mm)	N	%	1 U	1 U	3
Sand (0.06-2.00 mm)	edms_0047	N	%	4	13	22
Silt (2-60 um)	Silt (2-60 um)	N	%	96	85	72
METALS						
Aluminum	7429-90-5	T	mg/kg	18500	4730	28600
Antimony	7440-36-0	T	mg/kg	7	7	5 UJ
Arsenic	7440-38-2	T	mg/kg	16	5	18
Barium	7440-39-3	T	mg/kg	1740	2140	1070
Beryllium	7440-41-7	T	mg/kg	7	1 U	10
Boron	7440-42-8	T	mg/kg	2570	1150	2400
Cadmium	7440-43-9	T	mg/kg	1 U	1 U	1 U
Calcium	7440-70-2	D	mg/kg	8830	10800	6330
Cation Exchange Capacity	CEC	N	meq/100g	29.6	61.3	14.1
Chromium, total	7440-47-3	T	mg/kg	13	5	11
Chromium, hexavalent	18540-29-9	T	mg/kg	--	--	--
Cobalt	7440-48-4	T	mg/kg	13	2	24
Copper	7440-50-8	T	mg/kg	10	8	12
Cyanide, total	57-12-5	T	mg/kg	--	--	--
Exchangeable Calcium	7440-70-2_exch	N	meq/100g	5.2	2.2	7.7
Exchangeable Magnesium	7439-95-4_exch	N	meq/100g	22.5	57	3.2
Exchangeable Potassium	7440-09-7_exch	N	meq/100g	0.2 U	0.2 U	0.3
Exchangeable Sodium	7440-23-5_exch	N	meq/100g	1.8	2.1	2.9
Iron	7439-89-6	T	mg/kg	68100	83800	82900
Lead	7439-92-1	T	mg/kg	5	5 UJ	6
Magnesium	7439-95-4	D	mg/kg	10 UJ	40	50
Manganese	7439-96-5	T	mg/kg	1080	1670	1030
Mercury	7439-97-6	T	mg/kg	0.3	0.3	0.2
Molybdenum	7439-98-7	T	mg/kg	2 U	2 U	2 U
Nickel	7440-02-0	T	mg/kg	44	19	66
Potassium	7440-09-7	D	mg/kg	510	430	350
Selenium	7782-49-2	T	mg/kg	5 UJ	5 UJ	5 UJ
Sodium	7440-23-5	D	mg/kg	6490	7060	4580
Tin	7440-31-5	T	mg/kg	5 UJ	5 UJ	5 UJ
Vanadium	7440-62-2	T	mg/kg	21	5 UJ	13
Zinc	7440-66-6	T	mg/kg	81	38	136
MONOCYCLIC AROMATIC HYDROCARBONS						
Benzene	71-43-2	T	mg/kg	--	--	--
Sum of monocyclic aromatic hydrocarbons	--	T	mg/kg		--	--

Table 7
2016 Ash Analyses

Location ID Alcoa ID Lab Sample ID Matrix Code Sample Date Sample Depth Material	cas	Fraction	Units	Location 1 ash PTH-16-0042 EM1607144002 SO 20/06/2016 0-1 m Ash	Location 2 ash PTH-16-0043 EM1607144003 SO 21/06/2016 0-1 m Ash	Location 3 ash PTH-16-0044 EM1607144004 SO 22/06/2016 0-1 m Ash
VOLATILE HALOGENATED HYDROCARBONS						
Vinyl chloride	75-01-4	T	mg/kg	--	--	--
Hexachlorobutadiene	87-68-3	T	mg/kg	--	--	--
Sum of other chlorinated hydrocarbons	--	T	mg/kg	--	--	--
PHENOLIC COMPOUNDS						
Sum of Phenols (halogenated)	--	T	mg/kg	--	--	--
Sum of Phenols (non-halogenated)	--	T	mg/kg	--	--	--
POLYNUCLEAR AROMATIC HYDROCARBONS						
Benzo(a)pyrene	50-32-8	T	mg/kg	--	--	--
Sum of polycyclic aromatic hydrocarbons	--	T	mg/kg	--	--	--
ORGANOCHLORINE PESTICIDES						
Heptachlor	76-44-8	T	mg/kg	--	--	--
Sum of Aldrin + Dieldrin	--	T	mg/kg	--	--	--
Sum of DDD + DDE + DDT	--	T	mg/kg	--	--	--
Chlordane	57-74-9	T	mg/kg	--	--	--
Sum of other organochlorine pesticides		T	mg/kg	--	--	--
TOTAL PETROLEUM HYDROCARBONS						
C6 - C9 Fraction	--	T	mg/kg	--	--	--
C10 - C36 Fraction (sum)	--	T	mg/kg	--	--	--

Table 8
2016 Ash Pond Water analyses

Location ID Alcoa ID Lab Sample ID Matrix Code Sample Date Depth Material	cas	Fraction	Unit	Location 1 water PTH-16-0037 EM1607137001 WS 20/06/2016 Surface Ash pond water		Location 2 water PTH-16-0038 EM1607137002 WS 21/06/2016 Surface Ash pond water		Location 3 water PTH-16-0039 EM1607137003 WS 22/06/2016 Surface Ash pond water	
GENERAL CHEMISTRY									
Alkalinity, Bicarbonate (As CaCO3)	ALKB	N	mg/L	78		65		63	
Alkalinity, Carbonate (As CaCO3)	ALKC	N	mg/L	1	U	1	U	1	U
Alkalinity, Hydroxide (As CaCO3)	ALKH	N	mg/L	1	U	1	U	1	U
Alkalinity, Total (As CaCO3)	ALK	N	mg/L	78		65		63	
Ammonia	7664-41-7	N	mg/L	0.02		0.03		0.02	
Anions Total	TOT_ANION	N	meq/L	124		120		116	
Cations Total	TOT_CATION	N	meq/L	125		124		122	
Chloride (As Cl)	16887-00-6	N	mg/L	897		866		849	
Dissolved Organic Carbon	DOC	N	mg/L	4		5		4	
Electrical Conductivity @ 25°C	EC_Lab	N	us/cm	9870		9560		9360	
Fluoride	16984-48-8	N	mg/L	0.2		0.2		0.2	
Ionic Balance	ION_BAL	N	%	0.36		1.75		2.51	
Nitrate	14797-55-8	N	mg/L	0.01	U	0.05		0.1	
Nitrate and Nitrite	NO3NO2	N	mg/L	0.01	U	0.05		0.1	
Nitrite	14797-65-0	N	mg/L	0.01	U	0.01	U	0.01	U
Oxidation-Reduction Potential	ORP	N	mV	255		254		254	
pH Redox	pH_redox	N	SU	8.55		8.28		8.22	
pH Value	pH_Lab	N	SU	8.25		8.28		8.22	
Phosphorus	7723-14-0	T	mg/L	0.01	U	0.01	U	0.01	U
Sulfate (As SO4)	14808-79-8	D	mg/L	4670		4510		4340	
Total Dissolved Solids (Calc.)	TDS_Calc	N	mg/L	6420		6210		6080	
Total Kjeldahl Nitrogen	TKN	N	mg/L	0.1	U	0.1	U	0.1	U
Total Nitrogen, All Forms, Calculated	7727-37-9CAL	N	mg/L	0.1	U	0.1	U	100	
Total Organic Carbon	TOC	N	mg/L	2		4		3	
Turbidity	TURB	N	NTU	0.7		0.8		0.7	
METALS									
Aluminum	7429-90-5	D	mg/L	0.11		0.12		0.1	
Aluminum	7429-90-5	T	mg/L	0.13		0.12		0.12	
Antimony	7440-36-0	D	mg/L	0.001		0.001	U	0.001	
Antimony	7440-36-0	T	mg/L	0.001	U	0.001		0.001	U
Arsenic	7440-38-2	D	mg/L	0.001	U	0.001	U	0.001	U
Arsenic	7440-38-2	T	mg/L	0.001	U	0.001	U	0.001	U
Barium	7440-39-3	D	mg/L	0.019		0.02		0.017	
Barium	7440-39-3	T	mg/L	0.02		0.022		0.023	
Beryllium	7440-41-7	D	mg/L	0.001	U	0.001	U	0.001	U
Beryllium	7440-41-7	T	mg/L	0.001	U	0.001	U	0.001	U
Boron	7440-42-8	D	mg/L	24		22.8		22.4	
Boron	7440-42-8	T	mg/L	26.8		25.9		26.3	
Cadmium	7440-43-9	D	mg/L	0.0001	U	0.0001	U	0.0001	U
Cadmium	7440-43-9	T	mg/L	0.0001		0.0001	U	0.0001	U
Calcium	7440-70-2	D	mg/L	438		457		450	
Chromium, total	7440-47-3	D	mg/L	0.001	U	0.001	U	0.001	U
Chromium, total	7440-47-3	T	mg/L	0.001	U	0.001		0.001	U
Cobalt	7440-48-4	D	mg/L	0.001		0.001	U	0.001	U
Cobalt	7440-48-4	T	mg/L	0.001		0.001	U	0.001	U
Copper	7440-50-8	D	mg/L	0.001	U	0.001	U	0.001	U
Copper	7440-50-8	T	mg/L	0.001	U	0.001	U	0.001	U
Ferrous Iron	15438-31-0	T	mg/L	0.05	U	0.05	U	0.05	U
Iron	7439-89-6	D	mg/L	0.05	U	0.05	U	0.05	U
Iron	7439-89-6	T	mg/L	0.05		0.05	UJ	0.05	UJ
Lead	7439-92-1	D	mg/L	0.001	U	0.001	U	0.001	U
Lead	7439-92-1	T	mg/L	0.001	U	0.001	U	0.001	U
Magnesium	7439-95-4	D	mg/L	296		319		311	
Manganese	7439-96-5	D	mg/L	0.012		0.011		0.012	
Manganese	7439-96-5	T	mg/L	0.016		0.016		0.017	
Mercury	7439-97-6	D	mg/L	0.0001	U	0.0001	U	0.0001	U
Mercury	7439-97-6	T	mg/L	0.0001	U	0.0001	U	0.0001	U
Molybdenum	7439-98-7	D	mg/L	0.01		0.01		0.01	
Molybdenum	7439-98-7	T	mg/L	0.011		0.012		0.013	
Nickel	7440-02-0	D	mg/L	0.003		0.002		0.002	
Nickel	7440-02-0	T	mg/L	0.003		0.003		0.003	
Potassium	7440-09-7	D	mg/L	106		104		102	
Selenium	7782-49-2	D	mg/L	0.01	U	0.01	U	0.01	U
Selenium	7782-49-2	T	mg/L	0.01	U	0.01	U	0.01	U
Sodium	7440-23-5	D	mg/L	1750		1660		1630	
Tin	7440-31-5	D	mg/L	0.001	U	0.001	U	0.001	U
Tin	7440-31-5	T	mg/L	0.001	U	0.001	U	0.001	U
Total Hardness	TOTHARD	D	mg/L	2310		2450		2400	
Vanadium	7440-62-2	D	mg/L	0.01	U	0.01	U	0.01	U
Vanadium	7440-62-2	T	mg/L	0.01	U	0.01	U	0.01	U
Zinc	7440-66-6	D	mg/L	0.008		0.005	U	0.005	U
Zinc	7440-66-6	T	mg/L	0.012		0.006		0.006	

Table 9
2016 Ash Leachable Fraction Analyses

Location ID			Location 1 ash
Alcoa ID			PTH-16-0045
Lab Sample ID			EM1607137009
Matrix Code			SO
Sample Date			20/06/2016
Sample Depth			0-1 m
Material			Ash solids
Leachate	cas	Unit	PTH-16-0039
GENERAL CHEMISTRY			
Alkalinity, Bicarbonate (As CaCO3)	ALKB	mg/L	1 U
Alkalinity, Carbonate (As CaCO3)	ALKC	mg/L	87
Alkalinity, Hydroxide (As CaCO3)	ALKH	mg/L	29
Alkalinity, Total (As CaCO3)	ALK	mg/L	116
Ammonia	7664-41-7	mg/L	0.08
Anions Total	TOT_ANION	meq/L	123
Cations Total	TOT_CATION	meq/L	124
Chloride (As Cl)	16887-00-6	mg/L	931
Dissolved Organic Carbon	DOC	mg/L	2
Electrical Conductivity @ 25°C	EC_Lab	us/cm	9440
Fluoride	16984-48-8	mg/L	0.1 U
Ionic Balance	ION_BAL	%	0.28
Nitrate	14797-55-8	mg/L	0.04
Nitrate and Nitrite	NO3NO2	mg/L	0.16
Nitrite	14797-65-0	mg/L	0.12
pH Value	pH_Lab	SU	9.21
Phosphorus	7723-14-0	mg/L	0.01 U
Sulfate (As SO4)	14808-79-8	mg/L	4540
Total Dissolved Solids (Calc.)	TDS_Calc	mg/L	6140
Total Kjeldahl Nitrogen	TKN	mg/L	0.1 U
Total Nitrogen, All Forms, Calculated	7727-37-9CAL	mg/L	0.2
METALS			
Aluminum	7429-90-5	mg/L	0.1 UJ
Arsenic	7440-38-2	mg/L	0.1 U
Barium	7440-39-3	mg/L	0.1 U
Beryllium	7440-41-7	mg/L	0.05 U
Boron	7440-42-8	mg/L	29
Cadmium	7440-43-9	mg/L	0.05 U
Calcium	7440-70-2	mg/L	560
Chromium, total	7440-47-3	mg/L	0.1 U
Cobalt	7440-48-4	mg/L	0.1 U
Copper	7440-50-8	mg/L	0.1 U
Ferrous Iron	15438-31-0	mg/L	0.05 U
Iron	7439-89-6	mg/L	0.1 UJ
Lead	7439-92-1	mg/L	0.1 U
Magnesium	7439-95-4	mg/L	237
Manganese	7439-96-5	mg/L	0.1 U
Mercury	7439-97-6	mg/L	0.001 U
Molybdenum	7439-98-7	mg/L	0.1 U
Nickel	7440-02-0	mg/L	0.1 U
Potassium	7440-09-7	mg/L	112
Selenium	7782-49-2	mg/L	0.05 UJ
Sodium	7440-23-5	mg/L	1690
Tin	7440-31-5	mg/L	0.1 U
Total Hardness	TOTHARD	mg/L	2370
Vanadium	7440-62-2	mg/L	0.1 U
Zinc	7440-66-6	mg/L	0.1 U

Notes
Modified ASLP test was undertaken on a split replicate sample (PTH-16-0045) of PTH-16-0042 (EM1607137-006), Ash Pond 1 location 1 S bank.
One reagent water was a replicate ashpond water sample (PTH-16-0040) of PTH-16-0039 (), Ash Pond 1 location 3 NE bank.
For original analysis of replicate samples refer to PTH-16-0039 (ash pond water) and PTH-16-0042 (ash solid)

Table 10
Geotechnical Results - De-Ionised Water

Sample ID	Depth (m bgl)	Lithology- Field	Lithology - Laboratory	Classification	Plasticity	Material Type	Moisture content (%)	Dry density (t/m3)	Assumed porosity (%)	Hydraulic Conductivity (m/sec)
ANG-21-0181	1.5	Dark brown - dark grey, soft, some ash, trace coal fragments	Sandy CLAY, dark brown mottled orange, fine to coarse grained sand, trace fine gravel	Sandy CLAY	M	Ash	27.3	1.55	41.6	8.00E-10
ANG-21-0185	4	dark brown - black, soft, moist, with very fine silt content (possible ash). Increasing silt content with depth	Sandy CLAY, dark brown, fine to coarse grained sand, trace fine gravel	Sandy CLAY	M	Ash	22.3	1.59	40.1	9.00E-09
ANG-21-0187	3	brown-dark brown, soft to firm, moist, with trace ash and coal fragments at 3 m	Sandy CLAY, dark brown, fine to coarse grained sand	Sandy CLAY	H	Ash	32.9	1.42	48.3	1.00E-09
ANG-21-0191	5	brown-dark brown, soft, moist	Sandy CLAY, dark brown, fine to coarse sand, trace fine gravel	Sandy CLAY	L	Ash	20.1	1.61	39.3	2.00E-09
ANG-21-0193	4	dark grey to black, soft	Sandy CLAY, dark brown, fine to coarse grained sand	Sandy CLAY	H	Ash	34.6	1.35	49.2	5.00E-09
ANG-21-0196	3	dark grey to black, fine silts, loose with brittle coal fragments	Clayey SAND, fine to coarse grained, brown mottled orange, medium plasticity clay	Clayey SAND	M	Ash	12	1.88	29	2.00E-09
ANG-21-0202	4 - 4.4	dark brown to dark grey to black, moist, soft, trace silts and possible ash with brittle coal fragments	Sandy CLAY, brown, fine to coarse grained sand	Sandy CLAY	H	Ash	28.1	1.56	41.3	7.00E-10
Min							12	1.35	29	7.00E-10
Max							34.6	1.88	49.2	9.00E-09
90th%ile							33.58	1.72	48.66	6.60E-09
Average (geomean)							24.1	1.56	40.7	1.93E-09
Standard Deviation							7.8	0.17	6.7	3.06E-09
ANG-21-0184	0	pale brown - orange, coarse grained sands, loose, subangular to subrounded, well graded	Sandy CLAY, mottled orange grey, fine to coarse sand, trace fine gravel	Sandy CLAY	L	Clay rich layer	10.3	2.02	23.7	2.00E-10
ANG-21-0189	0.2	brown to pale brown, fine to coarse grained subangular sands, poorly graded	Sandy CLAY, orange brown, trace fine gravel, fine to coarse sand	Sandy CLAY	M	Clay rich layer	9.9	2.04	23.1	4.00E-10
ANG-21-0195	0	grey to pale brown with orange mottles, soft	CLAY, mottled grey and brown	CLAY	H	Clay rich layer	16	1.83	30.8	3.00E-10
ANG-21-0201	0.3	light brown to orange, fine to medium grained sands, loose	Sandy CLAY, orange brown, fine to coarse grained sand, trace fine gravel	Sandy CLAY	M	Clay rich layer	13	1.97	25.8	2.00E-09
Min							9.9	1.83	23.1	2.00E-10
Max							16	2.04	30.8	2.00E-09
Average (geomean)							12.1	2.0	25.7	4.68E-10
Standard Deviation							2.8	0.1	3.5	8.54E-10
ANG-21-0197	9	dark brown to dark grey, firm and dry	Sandy CLAY, dark brown mottled orange, fine to coarse grained sand	Sandy CLAY	M	Fill material	19.8	1.56	41.2	4.00E-09
ANG-21-0207	9 - 9.4	dark brown to grey, soft, with trace subangular to subrounded sands. Increasing plasticity with depth	Sandy CLAY, dark brown, fine to coarse grained sand, trace fine gravel	Sandy CLAY	H	Fill material	28.8	1.47	44.4	4.00E-09
ANG-21-0211	8 - 8.4	grey, soft, moist	Organic CLAY, dark brown, with fine to coarse sand	Organic CLAY	L	Fill material	91.7	0.82	68.9	6.00E-08
ANG-22-0025	0-2	Fine to coarse grained, dark brown to black, loose, slightly moist, with some quartz gravels, subrounded to 8 mm and low plasticity clay	silty sandy CLAY, medium plasticity, brown, trace gravel	Clayey SAND	M	Fill material	14.8	1.83	-	4.00E-10
ANG-22-0030	2-4	Medium plasticity, dark grey/black to brown, slightly firm, moist, with coal.	clayey SAND, fine to coarse grained, grey	Sandy CLAY	M	Fill material	13.5	1.61	-	7.00E-08
ANG-22-0034	4-6	Medium plasticity, dark grey/black to brown with traces of red, slightly firm, moist, with coal.	clayey SAND, fine to coarse, brown, fines of low to medium plasticity	Sandy CLAY	M	Fill material	13.1	1.79	-	7.00E-10
ANG-22-0035	0-2	High plasticity, black to orange, soft, moist, with trace angular gravels to 10 mm	silty SAND, fine to coarse, black	Silty CLAY	H	Fill material	30.1	1.13	-	4.00E-08
ANG-22-0040	2-4	Medium plasticity, dark brown to brown, soft, moist, with trace coal	clayey SILT, medium plasticity, brown	Sandy CLAY	M	Fill material	52.4	0.96	-	2.00E-09
ANG-22-0044	4-6	Fine to coarse grained, pale brown, loose, wet, with some rounded quartz gravels to 6 mm.	silty CLAY, medium plasticity, grey, with sand	Silty SAND	M	Fill material	24.1	1.6	-	8.00E-10
ANG-22-0045	0-2	Medium plasticity, dark brown to brown and grey, soft to slightly firm, moist, with fine grained sand. Traces of coal and silty clay: high plasticity, grey, soft.	silty CLAY, medium to high plasticity, brown	Sandy CLAY	M	Fill material	18.5	1.71	-	9.00E-11
ANG-22-0048	4-6	Medium to high plasticity, grey to brown, very soft, moist to slightly wet	silty CLAY, medium plasticity, brown, trace gravel	Sandy CLAY	M	Fill material	31.2	1.53	-	2.00E-10
ANG-22-0049	2-4	High plasticity,light brown to grey, soft to slightly firm, moist to slightly wet, very fine silt, with trace coal	clayey SILT, low to medium plasticity, brown, with sand	Silty CLAY	L/M	Fill material	64.2	0.82	-	2.00E-08
Min							13.1	0.82	41.2	9.00E-11
Max							91.7	1.83	68.9	7.00E-08
Average (geomean)							27.6	1.4	50.1	2.95E-09
Standard Deviation							26.6	1.3	50.1	2.15E-09

Table Notes:

m bgl: metres below ground level

t/m3: metric tonnes per cubic metre

(m/sec): metres per second

Table 11
Emerson Results

Sample	Emerson Class Number	Observations
ANG-21-0189	4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
ANG-21-0193	4	
ANG-21-0195	4	
ANG-21-0196	4	
ANG-21-0197	4	
ANG-21-0200	4	
ANG-21-0207	4	
ANG-21-0211	4	
ANG-21-0191	2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
ANG-21-0201	2	
ANG-21-0202	2	

Table 12
2021 Ash Analyses

Location ID			ADBH01	ADBH01	ADBH02	ADBH03	ADBH04	ADBH05	ADBH06	ADBH08	ADBH08	ADBH03	ADBH08
Alcoa ID			ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0202	ANG-21-0205_DUP	ANG-21-0207	ANG-21-0210_TRIP
Lab Sample ID			EM2118436002	EM2118436003	EM2118436006	EM2118436008	EM2118436012	EM2118436014	EM2118436016	EM2118436022	EM2118436024	EM2118436026	M21-Se40682
Matrix Code			SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO
Sample Date			14 Sep 2021	14 Sep 2021	13 Sep 2021	14 Sep 2021	14 Sep 2021	13 Sep 2021	14 Sep 2021	14 Sep 2021	14 Sep 2021	14 Sep 2021	14 Sep 2021
Sample Depth			1-2 m	4-6 m	4-6 m	2-4 m	4-6 m	4-6 m	2-4 m	4-6 m	4-6 m	8-10 m	4-6 m
Material	cas	Unit	Ash	Ash	Ash	Ash	Ash	Ash	Ash	Ash	Ash	Ash	Ash
GENERAL CHEMISTRY													
Acid Neutralising Capacity (19A2)	ANCBT	% CaCO3	--	--	--	--	--	--	--	--		--	1.3
Ammonia as N	7664-41-7N	mg/kg	20 UJ	20 U	20 U	20 UJ	20 U	20 U	20 U	20 U	20 U	20 U	5.5
ANC as CaCO3	ANCasCaCO3	% CaCO3	0.5	0.7	3.4	6.2	13.6	9.2	2.3	1.3	0.9	5.1	
ANC as H2SO4	ANCasH2SO4	kg H2SO4 eq/t	5.3	6.6	33.3	61.3	133	89.8	22.8	13.2	8.5	50.3	
Chloride (As Cl)	16887-00-6	mg/kg	60	80	290	400	870	420	120	240	200	260	200
Cyanide	57-12-5	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5 U
Cyanides (Amenable to chlorination)	57-12-5_AMEN	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5 U
Electrical Conductivity (1:5 aqueous extract at 25°C as rec.)	COND_EXTRACT	us/cm	1170	2530	2740	2670	1570	2860	2120	1940	1610	2570	1200
Fizz Rating	FizzRating	Fizz Unit	0 U	0 U	1	2	2	2	1	1	1	2	
Fluoride	16984-48-8	mg/kg	140	260	80	120	50	60	90	90	80	90	100 U
Iodide (As I)	20461-54-5	mg/kg	0.5 U	1 U	1 U	0.5 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	1 U	5 U
Moisture Content (dried @ 103°C)	MOISTCONTENT	%	--	--	--	--	--	--	--	--		--	20
Moisture Content (dried @ 105-110°C)	MOIST	%	14.4	23.1	26.9	21.8	40.8	21.6	14	21.1	17.8	23.8	--
Nitrate and Nitrite	NO3NO2	mg/kg	0.1 UJ	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U	0.1	0.1 U	0.1 U	0.1 U	--
Nitrate as N	14797-55-8N	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1	0.1 U	0.1 U	0.1 U	5 U
Nitrite as N	14797-65-0N	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	5 U
pH (CaCl2)	pH(CaCl2)	SU	5.8	7.2	8	8.5	9.8	9.1	7.2	4.4	5.4	8.2	6.4
Phosphorus	7723-14-0	mg/kg	103	90	185	179	415	169	113	154	140	133	110
Sulfate (As SO4)	14808-79-8	mg/kg	1980	3900	8090	5570	24800	11500	2900	4060	3450	11700	1000
Total Kjeldahl Nitrogen	TKN	mg/kg	510	590	620	730	590	850	600	1560	830	460	690
Total Nitrogen, All Forms, Calculated	7727-37-9CAL	mg/kg	510	590	620	730	590	850	600	1560	830	460	690
Total Organic Carbon	TOC	%	1.5	1.2	2.1	2.4	2.2	1.7	2.6	3	3	1.7	5.2
Total Organic Matter	ORGANICMATTER	%w/w	--	--	--	--	--	--	--	--		--	11
Total Soluble Salts	TotalSolSalts	mg/kg	3960	8600	9330	9070	5340	9720	7200	6600	5470	8740	980
METALS													
Aluminum	7429-90-5	mg/kg	6460	7560	11100	9500	14000	9440	4650	4460	6460	2030	6900
Antimony	7440-36-0	mg/kg	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U
Arsenic	7440-38-2	mg/kg	10	14	10	8	12	6	5	5 UJ	7	5 UJ	6.1
Barium	7440-39-3	mg/kg	320	230	1380	1190	150	1350	460	360	400	100	370
Beryllium	7440-41-7	mg/kg	1 UJ	1 UJ	3	2	5	2	1 UJ	1 U	1	1 U	2 U
Boron	7440-42-8	mg/kg	50 UJ	70	300	250	810	300	80	70	140	50 UJ	73
Cadmium	7440-43-9	mg/kg	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.4 U
Calcium	7440-70-2	mg/kg	610	170	3090	3250	5270	3940	860	1600	1110	4050	2800
Cation Exchange Capacity	CEC	meq/100g	10.6	3	16	16.6	17.9	15	14.7	13.1	11.4	13.4	8.9
Chromium, hexavalent	18540-29-9	mg/kg	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1 U
Chromium, total	7440-47-3	mg/kg	20	32	20	17	12	14	16	12	13	6	14
Cobalt	7440-48-4	mg/kg	4	3	11	6	12	13	14	4	7	2 UJ	8.1
Copper	7440-50-8	mg/kg	5	5	6	5	9	6	5	5 UJ	5 UJ	5 UJ	5 U
Exchangeable Calcium	7440-70-2_exch	meq/100g	5.8	0.9	7.4	11.4	13.6	9.4	5	9.4	5.6	11	--
Exchangeable Calcium, percent	7440-70-2_exch%	%	--	--	46.5	68.6	76.1	62.8	33.9	--	48.8	82.3	--
Exchangeable Magnesium	7439-95-4_exch	meq/100g	4.6	2	6.4	2.6	1.2	3.3	8.4	3.5	4	1.2	--
Exchangeable Magnesium, percent	7439-95-4_exch%	%	--	--	39.8	15.8	7	21.8	57.1	--	35.3	9.2	--
Exchangeable Potassium	7440-09-7_exch	meq/100g	0.1 U	0.1 U	0.3	0.4	0.4	0.4	0.2	0.1 U	0.2	0.2	--
Exchangeable Potassium, percent	7440-09-7_exch%	%	--	--	1.8	2.4	2	2.6	1.5	--	2	1.6	--
Exchangeable Sodium	7440-23-5_exch	meq/100g	0.1 U	0.1 U	1.9	2.2	2.7	1.9	1.1	0.1	1.6	0.9	--
Exchangeable Sodium, percent	7440-23-5_exch%	%	0.8	0.9	11.8	13.2	14.9	12.7	7.5	0.9	13.9	6.9	--
Iron	7439-89-6	mg/kg	17400	20500	31100	24900	43700	30400	11200	10700	13600	2360	12000
Lead	7439-92-1	mg/kg	6	8	6	5 UJ	5 UJ	6	5 UJ	5 UJ	5 UJ	5 UJ	5 U
Magnesium	7439-95-4	mg/kg	390	540	820	180	40	220	630	490	410	140	2100
Manganese	7439-96-5	mg/kg	34	33	143	183	385	227	45	30	60	11	39
Mercury	7439-97-6	mg/kg	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 UJ	0.1 U	0.1 UJ	0.1 U	0.1 U
Molybdenum	7439-98-7	mg/kg	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	5 U
Nickel	7440-02-0	mg/kg	8	5	22	14	32	21	17	7	14	3	12
Potassium	7440-09-7	mg/kg	30	20	60	80	140	80	30	40	30	60	200
Selenium	7782-49-2	mg/kg	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 U	5 UJ	5 U	2 U
Sodium	7440-23-5	mg/kg	210	110	590	680	1160	600	260	490	460	360	520
Zinc	7440-66-6	mg/kg	12	11	33	27	50	34	13	12	26	5	23

Table 13
2021 Ash Leachable Fraction Analyses

Location ID				ADBH01	ADBH01	ADBH01	ADBH01
Alcoa ID				ANG-21-0181	ANG-21-0181	ANG-21-0182	ANG-21-0182
Lab Sample ID				EM2118436002	EM2118436030	EM2118436003	EM2118436031
Matrix Code				SO	SO	SO	SO
Sample Date				14 SEP 2021	14 SEP 2021	14 SEP 2021	14 SEP 2021
Sample Depth				1-2 m	1-2 m	4-6 m	4-6 m
Material				Ash	Ash	Ash	Ash
Leachate	cas	Fraction	Unit	ALSP PH2.9	DI water	ALSP PH2.9	DI water
(None)							
pH (Leachate fluid)	pH_EXF		SU	2.9	--	2.9	--
Final pH	pH_FINAL		SU	3.6	--	3.4	--
pH (Leachate fluid)	pH_EXF		SU	--	5	--	5
Final pH (inorganics and PFAS)	pH_FINAL		SU	--	5.1	--	7.1
Final pH (zero headspace extraction)	pH_FINAL		SU	--	7.2	--	8.6
GENERAL CHEMISTRY							
Alkalinity, Bicarbonate (As CaCO3)	ALKB	N	mg/L	--	6	--	16
Alkalinity, Carbonate (As CaCO3)	ALKC	N	mg/L	--	1 U	--	1 U
Alkalinity, Hydroxide (As CaCO3)	ALKH	N	mg/L	--	1 U	--	1 U
Alkalinity, Total (As CaCO3)	ALK	N	mg/L	--	6	--	16
Ammonia	7664-41-7	N	mg/L	0.22	0.12	0.16	0.01 U
Chloride (As Cl)	16887-00-6	N	mg/L	4	7	6	10
Cyanide	57-12-5	T	mg/L	0.004 U	0.004 U	0.004 U	0.004 U
Cyanides amenable to chlorination	CNA	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U
Dissolved Organic Carbon	DOC	N	mg/L	--	3	--	3
Electrical Conductivity @ 25°C	EC_Lab	N	us/cm	--	148	--	475
Fluoride	16984-48-8	N	mg/L	0.2	0.1	0.3	0.3
Iodide (As I)	20461-54-5	N	mg/L	0.5 U	0.5 U	0.5 U	0.5 U
Nitrate	14797-55-8	N	mg/L	0.01 U	0.01	0.01 U	0.01 U
Nitrate and Nitrite	NO3NO2	N	mg/L	0.01 U	0.01	0.01 U	0.01 U
Nitrite	14797-65-0	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U
Phosphorus	7723-14-0	T	mg/L	0.12	0.05 U	0.06	0.02
Sulfate (As SO4)	14808-79-8	D	mg/L	136	116	180	213
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	382	--	432
Total Kjeldahl Nitrogen	TKN	N	mg/L	0.8	0.5 U	0.6	0.2
Total Nitrogen, All Forms, Calculated	7727-37-9CAL	N	mg/L	0.8	0.5 U	0.6	0.2
METALS							
Aluminum	7429-90-5	D	mg/L	3.9	10	3.7	1.03
Antimony	7440-36-0	D	mg/L	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Arsenic	7440-38-2	D	mg/L	0.1 U	0.02	0.1 U	0.01 U
Barium	7440-39-3	D	mg/L	0.1	0.3	0.1	0.1 U
Beryllium	7440-41-7	D	mg/L	0.05 U	0.01 U	0.05 U	0.01 U
Boron	7440-42-8	D	mg/L	1.1	0.8	1.6	1.7
Cadmium	7440-43-9	D	mg/L	0.05 U	0.005 U	0.05 U	0.005 U
Calcium	7440-70-2	N	mg/L	91	22	35	18
Chromium, hexavalent	18540-29-9	N	mg/L	0.01 U	0.01 U	0.01 U	--
Chromium, total	7440-47-3	D	mg/L	0.1 U	0.04	0.1 U	0.01 U
Cobalt	7440-48-4	D	mg/L	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Copper	7440-50-8	D	mg/L	0.1 U	0.02	0.1 U	0.01 U
Iron	7439-89-6	D	mg/L	4.5	8.82	4.3	1.15
Lead	7439-92-1	D	mg/L	0.1 U	0.01	0.1 U	0.01 U
Magnesium	7439-95-4	N	mg/L	40	17	72	42
Manganese	7439-96-5	D	mg/L	0.8	0.09	0.4	0.05
Mercury	7439-97-6	D	mg/L	0.001 U	0.001 UJ	0.001 U	0.001 U
Molybdenum	7439-98-7	D	mg/L	0.1 U	0.01	0.1 U	0.01 U
Nickel	7440-02-0	D	mg/L	0.1 UJ	0.01	0.1 UJ	0.01 U
Phosphorus	7723-14-0	N	mg/L	--	1 U	--	1 U
Potassium	7440-09-7	N	mg/L	3	2	2	2
Selenium	7782-49-2	D	mg/L	0.05 U	0.01 U	0.05 U	0.01 U
Silver	7440-22-4	N	mg/L	--	0.01 U	--	0.01 U
Sodium	7440-23-5	N	mg/L	9	9	7	8
Strontium	7440-24-6	N	mg/L	--	0.3	--	0.2
Thallium	7440-28-0	N	mg/L	--	0.01 U	--	0.01 U
Tin	7440-31-5	N	mg/L	--	0.01	--	0.01 U
Titanium	7440-32-6	N	mg/L	--	0.11	--	0.05
Vanadium	7440-62-2	N	mg/L	--	0.04	--	0.01 U
Zinc	7440-66-6	D	mg/L	0.1 U	0.02	0.1 U	0.01 U

Table 13
2021 Ash Leachable Fraction Analyses

Location ID				ADBH02	ADBH02	ADBH03	ADBH03	ADBH04	ADBH04
Alcoa ID				ANG-21-0185	ANG-21-0185	ANG-21-0187	ANG-21-0187	ANG-21-0191	ANG-21-0191
Lab Sample ID				EM2118436006	EM2118436032	EM2118436008	EM2118436033	EM2118436012	EM2118436035
Matrix Code				SO	SO	SO	SO	SO	SO
Sample Date				13 SEP 2021	13 SEP 2021	14 SEP 2021	14 SEP 2021	14 SEP 2021	14 SEP 2021
Sample Depth				4-6 m	4-6 m	2-4 m	2-4 m	4-6 m	4-6 m
Material				Ash	Ash	Ash	Ash	Ash	Ash
Leachate	cas	Fraction	Unit	ALSP PH2.9	DI water	ALSP PH2.9	DI water	ALSP PH2.9	DI water
(None)									
pH (Leachate fluid)	pH_EXF		SU	2.9	--	2.9	--	2.9	--
Final pH	pH_FINAL		SU	4.2	--	4.5	--	4.6	--
pH (Leachate fluid)	pH_EXF		SU	--	5	--	5	--	5
Final pH (inorganics and PFAS)	pH_FINAL		SU	--	8.4	--	8.7	--	9.7
Final pH (zero headspace extraction)	pH_FINAL		SU	--	8.9	--	9.3	--	10
GENERAL CHEMISTRY									
Alkalinity, Bicarbonate (As CaCO3)	ALKB	N	mg/L	--	24	--	16	--	5
Alkalinity, Carbonate (As CaCO3)	ALKC	N	mg/L	--	1 U	--	1 U	--	18
Alkalinity, Hydroxide (As CaCO3)	ALKH	N	mg/L	--	1 U	--	1 U	--	1 U
Alkalinity, Total (As CaCO3)	ALK	N	mg/L	--	24	--	16	--	23
Ammonia	7664-41-7	N	mg/L	0.13	0.1	0.38	0.35	0.17	0.11
Chloride (As Cl)	16887-00-6	N	mg/L	11	12	15	16	13	32
Cyanide	57-12-5	T	mg/L	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Cyanides amenable to chlorination	CNA	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dissolved Organic Carbon	DOC	N	mg/L	--	2	--	2	--	2
Electrical Conductivity @ 25°C	EC_Lab	N	us/cm	--	986	--	1	--	1860
Fluoride	16984-48-8	N	mg/L	0.2	0.2	0.3	0.2	0.2	0.1
Iodide (As I)	20461-54-5	N	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Nitrate	14797-55-8	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nitrate and Nitrite	NO3NO2	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nitrite	14797-65-0	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Phosphorus	7723-14-0	T	mg/L	0.07	0.02	0.02	0.06	0.12	0.07
Sulfate (As SO4)	14808-79-8	D	mg/L	498	519	561	631	760	960
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	693	--	860	--	956
Total Kjeldahl Nitrogen	TKN	N	mg/L	0.5 U	0.1 U	0.4	0.5 U	0.5 U	0.5 U
Total Nitrogen, All Forms, Calculated	7727-37-9CAL	N	mg/L	0.5 U	0.1 U	0.4	0.5 U	0.5 U	0.5 U
METALS									
Aluminum	7429-90-5	D	mg/L	20.8	0.74	7.3	0.99	14.7	0.99
Antimony	7440-36-0	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Arsenic	7440-38-2	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Barium	7440-39-3	D	mg/L	0.1	0.1 U	0.1	0.1 U	0.1 U	0.1 U
Beryllium	7440-41-7	D	mg/L	0.05 UJ	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Boron	7440-42-8	D	mg/L	6.5	4.5	8.1	4.6	10.9	5.3
Cadmium	7440-43-9	D	mg/L	0.05 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U
Calcium	7440-70-2	N	mg/L	406	132	471	210	635	430
Chromium, hexavalent	18540-29-9	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Chromium, total	7440-47-3	D	mg/L	0.1 UJ	0.01 U	0.1 U	0.01 U	0.1 UJ	0.01 U
Cobalt	7440-48-4	D	mg/L	0.1 UJ	0.01 U	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Copper	7440-50-8	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Iron	7439-89-6	D	mg/L	1.5	0.31	0.8	0.3	1	0.15
Lead	7439-92-1	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Magnesium	7439-95-4	N	mg/L	186	35	308	14	342	4
Manganese	7439-96-5	D	mg/L	2	0.02	3.3	0.01 U	2.3	0.01 U
Mercury	7439-97-6	D	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Molybdenum	7439-98-7	D	mg/L	0.1 U	0.01	0.1 U	0.01 U	0.1 U	0.01 U
Nickel	7440-02-0	D	mg/L	0.1	0.01 U	0.1 UJ	0.01 U	0.1	0.01 U
Phosphorus	7723-14-0	N	mg/L	--	1 U	--	1 U	--	1 U
Potassium	7440-09-7	N	mg/L	4	3	4	3	4	3
Selenium	7782-49-2	D	mg/L	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Silver	7440-22-4	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Sodium	7440-23-5	N	mg/L	26	28	28	32	29	39
Strontium	7440-24-6	N	mg/L	--	1	--	1.2	--	2.4
Thallium	7440-28-0	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Tin	7440-31-5	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Titanium	7440-32-6	N	mg/L	--	0.03	--	0.02	--	0.01 U
Vanadium	7440-62-2	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Zinc	7440-66-6	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.02

Table 13
2021 Ash Leachable Fraction Analyses

Location ID				ADBH05	ADBH05	ADBH06	ADBH06	ADBH08	ADBH08
Alcoa ID				ANG-21-0193	ANG-21-0193	ANG-21-0196	ANG-21-0196	ANG-21-0202	ANG-21-0202
Lab Sample ID				EM2118436014	EM2118436036	EM2118436016	EM2118436037	EM2118436022	EM2118436039
Matrix Code				SO	SO	SO	SO	SO	SO
Sample Date				13 SEP 2021	13 SEP 2021	14 SEP 2021	14 SEP 2021	14 SEP 2021	14 SEP 2021
Sample Depth				4-6 m	4-6 m	2-4 m	2-4 m	4-6 m	4-6 m
Material				Ash	Ash	Ash	Ash	Ash	Ash
Leachate	cas	Fraction	Unit	ALSP PH2.9	DI water	ALSP PH2.9	DI water	ALSP PH2.9	DI water
(None)									
pH (Leachate fluid)	pH_EXF		SU	2.9	--	2.9	--	2.9	--
Final pH	pH_FINAL		SU	4.8	--	3.9	--	3.9	--
pH (Leachate fluid)	pH_EXF		SU	--	5	--	5	--	5
Final pH (inorganics and PFAS)	pH_FINAL		SU	--	9.4	--	7.5	--	7.2
Final pH (zero headspace extraction)	pH_FINAL		SU	--	9.4	--	7.5	--	7.2
GENERAL CHEMISTRY									
Alkalinity, Bicarbonate (As CaCO3)	ALKB	N	mg/L	--	6	--	47	--	27
Alkalinity, Carbonate (As CaCO3)	ALKC	N	mg/L	--	20	--	1 U	--	1 U
Alkalinity, Hydroxide (As CaCO3)	ALKH	N	mg/L	--	1 U	--	1 U	--	1 U
Alkalinity, Total (As CaCO3)	ALK	N	mg/L	--	26	--	47	--	27
Ammonia	7664-41-7	N	mg/L	0.29	0.18	0.24	0.16	0.27	0.31
Chloride (As Cl)	16887-00-6	N	mg/L	15	18	8	8	8	11
Cyanide	57-12-5	T	mg/L	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Cyanides amenable to chlorination	CNA	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Dissolved Organic Carbon	DOC	N	mg/L	--	2	--	9	--	8
Electrical Conductivity @ 25°C	EC_Lab	N	us/cm	--	1230	--	577	--	619
Fluoride	16984-48-8	N	mg/L	0.2	0.1	0.2	0.1	0.2	0.1 U
Iodide (As I)	20461-54-5	N	mg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Nitrate	14797-55-8	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nitrate and Nitrite	NO3NO2	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nitrite	14797-65-0	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Phosphorus	7723-14-0	T	mg/L	0.1	0.09	0.05 U	0.06	0.05 U	0.1
Sulfate (As SO4)	14808-79-8	D	mg/L	647	585	222	242	250	279
Total Dissolved Solids (Residue, Filterable)	TDS	T	mg/L	--	848	--	408	--	474
Total Kjeldahl Nitrogen	TKN	N	mg/L	0.5	0.5 U	0.5 U	0.5 U	0.5	0.7
Total Nitrogen, All Forms, Calculated	7727-37-9CAL	N	mg/L	0.5	0.5 U	0.5 U	0.5 U	0.5	0.7
METALS									
Aluminum	7429-90-5	D	mg/L	12.4	0.57	3.8	1.11	13.7	0.56
Antimony	7440-36-0	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.04
Arsenic	7440-38-2	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Barium	7440-39-3	D	mg/L	0.1	0.1 U	0.1	0.1 U	0.1	0.1 U
Beryllium	7440-41-7	D	mg/L	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Boron	7440-42-8	D	mg/L	10.3	5.4	2.5	1.8	3.4	3.3
Cadmium	7440-43-9	D	mg/L	0.05 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U
Calcium	7440-70-2	N	mg/L	666	218	143	57	150	66
Chromium, hexavalent	18540-29-9	N	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Chromium, total	7440-47-3	D	mg/L	0.1 UJ	0.01 U	0.1 U	0.01 U	0.1 UJ	0.01 U
Cobalt	7440-48-4	D	mg/L	0.1 UJ	0.01 U	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Copper	7440-50-8	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Iron	7439-89-6	D	mg/L	1	0.18	0.9	0.53	2.2	0.27
Lead	7439-92-1	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Magnesium	7439-95-4	N	mg/L	352	11	94	32	98	25
Manganese	7439-96-5	D	mg/L	4	0.01 U	0.8	0.01 U	1	0.08
Mercury	7439-97-6	D	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Molybdenum	7439-98-7	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Nickel	7440-02-0	D	mg/L	0.1	0.01 U	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Phosphorus	7723-14-0	N	mg/L	--	1 U	--	1 U	--	1 U
Potassium	7440-09-7	N	mg/L	6	4	2	2	2	2
Selenium	7782-49-2	D	mg/L	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Silver	7440-22-4	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Sodium	7440-23-5	N	mg/L	29	31	17	16	20	24
Strontium	7440-24-6	N	mg/L	--	1.3	--	0.4	--	0.5
Thallium	7440-28-0	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Tin	7440-31-5	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Titanium	7440-32-6	N	mg/L	--	0.01 U	--	0.04	--	0.02
Vanadium	7440-62-2	N	mg/L	--	0.01 U	--	0.01 U	--	0.01 U
Zinc	7440-66-6	D	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.2	0.01 U

Table 14
Geotechnical Results - Saline Water (5,000 ppm NaCl)

Sample ID	Depth (m bgl)	Lithology- Field	Lithology - Laboratory	Classification	Plasticity	Material Type	Moisture Content (%)	Dry Density (t/m3)	Hydraulic Conductivity (m/sec)
ANG-22-0015	0-0.5	Fine to coarse grained, pale brown, firm, moist, with clay - low plasticity, firm, moist	clayey SAND,fine to coarse, brown, trace gravel	Clayey SAND	L	Clay rich layer	8.3	1.9	7.00E-08
ANG-22-0016	0.5-1	Fine to coarse grained, pale brown, firm, moist, with clay - low plasticity, firm, moist	silty CLAY, medium plasticity, mottled brown, grey, black	Clayey SAND	M	Clay rich layer	18.9	1.69	1.00E-09
ANG-22-0019	0.5-1	Fine to coarse grained, dark brown, firm, moist, with interstitial clay - medium plasticity, pale grey to dark brown.	sandy silty CLAY, low to medium plasticity, mottled brown, grey, black, white	Silty SAND	M	Clay rich layer	20.5	1.69	1.00E-09
ANG-22-0022	0-0.5	Fine to coarse grained, brown to dark brown, loose, slightly moist, medium plasticity clay, grey to brown.	sandy CLAY, low to medium plasticity, brown, trace gravel	Clayey SAND	M	Clay rich layer	9.9	1.89	4.00E-10
ANG-22-0023	0.5-1	Fine to coarse grained, brown to dark brown, loose, slightly moist, medium plasticity clay, grey to brown.	CLAY, low to medium plasticity, dark brown	Clayey SAND	M	Clay rich layer	20.1	1.71	2.00E-10
Min							8.3	1.69	2.00E-10
Max							20.5	1.90	7.00E-08
Average (geomean)							14.5	1.77	1.41E-09
Standard Deviation							5.9	0.11	3.10E-08
ANG-22-0017	5-5.5	Medium plasticity, soft, moist, becomes mottled orange, red and dark brown, with interstitial coal	silty CLAY, low to medium plasticity, mottled brown, grey, black, yellow, with sand	Silty CLAY	M	Fill material	38.3	1.48	2.00E-10
ANG-22-0018	5.5-6	Medium plasticity, soft, moist, becomes mottled orange, red and dark brown, with interstitial coal	silty CLAY, medium plasticity, brown, trace sand	Silty CLAY	M	Fill material	62.8	0.93	5.00E-09
ANG-22-0020	5-5.5	Fine to coarse grained, orange, well sorted, medium plasticity clay, soft, moist	sandy CLAY, low to medium plasticity, brown	Clayey SAND	M	Fill material	14.9	1.8	9.00E-09
ANG-22-0021	5.5-6	Fine to coarse grained, orange, well sorted, medium plasticity clay, soft, moist	sandy CLAY, low to medium plasticity, brown	Clayey SAND	M	Fill material	13.1	1.85	1.00E-08
ANG-22-0024	5-5.5	Medium plasticity, grey, moist to wet, very soft, with no gravel and interstitial coal	silty CLAY, medium to high plasticity, brown, trace gravel, trace sand	Sandy CLAY	M	Fill material	35.7	1.34	7.00E-10
ANG-22-0025	0-2	Fine to coarse grained, dark brown to black, loose, slightly moist, with some quartz gravels, subrounded to 8 mm and low plasticity clay	silty sandy CLAY, medium plasticity, brown, trace gravel	Clayey SAND	M	Fill material	14.8	1.83	3.00E-10
ANG-22-0027	4-6	Fine grained, yellow to orange, loose, moist, with some medium plasticity clay and rounded gravels to 25 mm	sandy CLAY, medium to high plasticity, brown	Silty SAND	M	Fill material	8.7	1.92	3.00E-09
ANG-22-0029	0-2	Fine to coarse grained, orange to red, loose, moist, with low plasticity clay and some quartz gravels, rounded to 5 mm	silty CLAY, medium plasticity, mottled brown, yellow, with sand, trace gravel	Clayey SAND	L	Fill material	12.1	1.76	4.00E-08
ANG-22-0030	2-4	Medium plasticity, dark grey/black to brown, slightly firm, moist, with coal	No saline test result - sample collapse between solutions	Sandy CLAY	M	Fill material	-	-	-
ANG-22-0032	2-4	High plasticity, brown to grey with black, fine to coarse grained sand	silty sandy CLAY, medium to high plasticity, brown, with gravel	Sandy CLAY	H	Fill material	13.9	1.85	5.00E-10
ANG-22-0034	4-6	Medium plasticity, dark grey/black to brown with traces of red, slightly firm, moist, with coal	clayey SAND, fine to coarse, brown, fines of low to medium plasticity	Sandy CLAY	M	Fill material	13.1	1.79	2.00E-10
ANG-22-0035	0-2	High plasticity, black to orange, soft, moist, with trace angular gravels to 10 mm	silty SAND, fine to coarse, black	Silty CLAY	H	Fill material	30.1	1.13	9.00E-09
ANG-22-0037	4-6	High plasticity, grey, black and red, soft, moist, with trace wood fragments and angular gravels to 10 mm	silty CLAY, high plasticity, mottled brown, dark grey, trace sand	Silty CLAY	H	Fill material	21.5	1.72	1.00E-09
ANG-22-0039	0-2	Fine to coarse grained, pale brown, soft/loose, moist, with some rounded quartz gravels to 8 mm.	silty CLAY, medium to high plasticity, brown, trace gravel, trace sand	Silty SAND	M/H	Fill material	56	1.04	1.00E-09
ANG-22-0040	2-4	Medium plasticity, dark brown/grey, soft, wet, with trace orange/red mottling	clayey SILT, medium plasticity, brown	Sandy CLAY	M	Fill material	52.4	0.96	2.00E-09
ANG-22-0042	2-4	Fine to coarse grained, pale brown to brown, moist, with trace quartz gravels	silty CLAY,medium-high plasticity, dark brown, trace gravel	Clayey SAND	M/L	Fill material	71.9	0.91	2.00E-09
ANG-22-0044	4-6	Fine to coarse grained, pale brown, loose, wet, with some rounded quartz gravels to 6 mm.	silty CLAY, medium plasticity, grey, with sand	Silty SAND	M	Fill material	24.1	1.6	7.00E-10
ANG-22-0045	0-2	Medium plasticity, dark brown to brown and grey, soft to slightly firm, moist, with fine grained sand. Coal and silty clay: high plasticity, grey, soft	silty CLAY, medium to high plasticity, brown	Sandy CLAY	M/H	Fill material	18.5	1.71	8.00E-11
ANG-22-0047	2-4	Medium plasticity, dark brown to orange, with increasing fine sand content, moist. Coal and silty clay: high plasticity, grey, soft.	sandy CLAY,medium to high plasticity, brown, trace gravel	Sandy CLAY	M/H	Fill material	15.5	1.81	4.00E-10
ANG-22-0048	4-6	Medium to high plasticity, grey to brown, very soft, moist to slightly wet	silty CLAY, medium plasticity, brown, trace gravel	Sandy CLAY	M	Fill material	31.2	1.51	2.00E-10
ANG-22-0049	2-4	High plasticity,light brown to grey, soft to slightly firm, moist to slightly wet, very fine silt, with trace coal	clayey SILT, low to medium plasticity, brown, with sand	Silty CLAY	M	Fill material	64.2	0.82	3.00E-08
ANG-22-0051	4-6	Fine to coarse grained, dark brown to orange and grey, loose and soft, clay: medium plasticity, with some coal and gravel.	sandy CLAY, low to medium plasticity, dark brown, trace gravel	Clayey SAND	M	Fill material	18.1	1.74	3.00E-10
Min							8.7	0.82	8.00E-11
Max							71.9	1.92	4.00E-08
Average (geomean)							24.6	1.45	1.32E-09
Standard Deviation							23.5	1.41	1.16E-09

Table Notes:

m bgl: metres below ground level

t/m3: metric tonnes per cubic metre

(m/sec): metres per second

Table 15
2022 Soil Analyses

Location ID			ADBH32	ADBH32	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33
Alcoa ID			ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0055_TRIP	ANG-22-0056	ANG-22-0057	ANG-22-0058
Lab Sample ID			EM2212813007	EM2212813008	EM2212813009	EM2212813010	M22-JI0012613	EM2212813010	EM2212813011	EM2212813012
Matrix Code			SO	SO	SO	SO	SO	SO	SO	SO
Sample Date			1-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022
Actual depth (mbgl)			1	3	5	5	5	1	3	5
Material	CAS RN	Units	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill
GENERAL CHEMISTRY										
Alkalinity, Bicarbonate (As CaCO3)	ALKB	mg/kg	5 U	228	5 U	5 U	20 U	5 U	5 U	5 U
Alkalinity, Carbonate (As CaCO3)	ALKC	mg/kg	5 U	5 U	5 U	5 U	20 U	5 U	5 U	5 U
Alkalinity, Hydroxide (As CaCO3)	ALKH	mg/kg	5 U	5 U	5 U	5 U	20 U	5 U	5 U	5 U
Alkalinity, Total (As CaCO3)	ALK	mg/kg	5 U	228	5 U	5 U	50 U	5 U	5 U	5 U
Chloride (As Cl)	16887-00-6	mg/kg	20	360	130	140	96	160	90	150
Electrical Conductivity @ 25°C (1:5 aqueous extract)	EC_Lab	µS/cm	149	230	289	155	630	160	82	110
Electrical Conductivity @ 25°C air dried at 40°C	EC_Lab	µS/cm	75	328	144	150	--	102	136	228
Fluoride	16984-48-8	mg/kg	40 U	80	40 UJ	60	100 U	160	40 UJ	40 UJ
Moisture, content (dried @ 103°C)	MOIST	%	9.1	18.1	17.3	17.7	17	18.3	17.6	16.8
pH (CaCl2)	pH(CaCl2)	SU	4.1	4.9	5	5	--	4	4.2	4.5
Sulfate (As SO4)	14808-79-8	mg/kg	130	110	210	210	97	110	190	200
Total Soluble Salts	TotalSolSalts	mg/kg	256	1120	490	509	--	346	462	774
METALS										
Aluminum	7429-90-5	mg/kg	1810	10500	3520	2280	2800	5300	1140	1480
Antimony	7440-36-0	mg/kg	5 U	5 U	5 U	5 U	0.05 U	5 U	5 U	5 U
Arsenic	7440-38-2	mg/kg	5 UJ	5 UJ	5 UJ	5 UJ	4.4	5 UJ	5 UJ	5 UJ
Barium	7440-39-3	mg/kg	10	20	10 UJ	10 UJ	0.5 U	30	10 U	10 UJ
Beryllium	7440-41-7	mg/kg	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U
Boron	7440-42-8	mg/kg	50 U	50 U	50 U	50 U	0.05 U	50 U	50 U	50 U
Cadmium	7440-43-9	mg/kg	1 U	1 U	1 U	1 U	0.005 U	1 U	1 U	1 U
Calcium	7440-70-2	mg/kg	10 U	10 U	10 UJ	10 UJ	47	10 U	10 UJ	10 UJ
Cation Exchange Capacity	CEC	meq/100g	2.3	8.7	2.2	1.9	3	5.9	0.8	1
Chromium, total	7440-47-3	mg/kg	4	15	10	10	10	16	4	4
Cobalt	7440-48-4	mg/kg	2 U	2 UJ	2 U	2 U	5 U	2 UJ	2 U	2 U
Copper	7440-50-8	mg/kg	5 UJ	5 UJ	5 UJ	5 UJ	0.01 U	5 U	5 U	5 U
Exchangeable Calcium	7440-70-2_exch	meq/100g	0.8	0.8	0.4	0.3	--	0.8	0.1	0.2
Exchangeable Magnesium	7439-95-4_exch	meq/100g	1.2	4.6	1	0.9	--	4	0.3	0.4
Exchangeable Potassium	7440-09-7_exch	meq/100g	0.1 U	0.2	0.2	0.1 U	--	0.1	0.1 U	0.1 U
Exchangeable Sodium	7440-23-5_exch	meq/100g	0.3	3	0.7	0.6	--	0.9	0.3	0.4
Exchangeable Sodium, percent	7440-23-5_exch%	%	12	34.5	30.9	32.5	--	16	36.9	39
Iron	7439-89-6	mg/kg	3430	11900	17800	20500	14000	8330	8380	6880
Lead	7439-92-1	mg/kg	5 UJ	8	5 UJ	5 UJ	5 U	6	5 UJ	5 UJ
Magnesium	7439-95-4	mg/kg	20	10 U	10 UJ	10 UJ	130	10 UJ	10 UJ	20
Manganese	7439-96-5	mg/kg	5 UJ	12	11	11	5 U	9	5 UJ	6
Mercury	7439-97-6	mg/kg	0.1 U	0.1 U	0.1 U	0.1 U	0.001 U	0.1 U	0.1 U	0.1 U
Molybdenum	7439-98-7	mg/kg	2 U	2 U	2 U	2 U	5 U	2 U	2 U	2 U
Nickel	7440-02-0	mg/kg	2 UJ	3	2 UJ	2 UJ	0.01 U	2	2 U	2 UJ
Potassium	7440-09-7	mg/kg	10 U	10 U	10 UJ	10 UJ	130	10 UJ	10 UJ	10 UJ
Selenium	7782-49-2	mg/kg	5 UJ	5 U	5 U	5 U	0.05 U	5 U	5 U	5 U
Sodium	7440-23-5	mg/kg	40	310	130	140	140	90	120	170
Zinc	7440-66-6	mg/kg	5 UJ	5 UJ	5 UJ	5 UJ	0.01 U	5 UJ	5 UJ	5 UJ

Notes:
% = percent
µS/cm = microsiemens per centimetre
meq/100g = milliequivalents per 100 grams of soil
mg/kg = milligrams per kilogram
SU = standard units

EHS Support

Table 16
2022 Soil Leachable Fraction Analyses

Location ID			ADBH32	ADBH32	ADBH32	ADBH32	ADBH32	ADBH32	ADBH32	ADBH32
Alcoa ID			ANG-22-0053	ANG-22-0053	ANG-22-0054	ANG-22-0054	ANG-22-0055	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0055_DUP
Lab Sample ID			EM2212813007	EM2212813016	EM2212813008	EM2212813017	EM2212813009	EM2212813018	EM2212813010	EM2212813019
Matrix Code			SO	SO	SO	SO	SO	SO	SO	SO
Lab Matrix Code			WL	WL	WL	WL	WL	WL	WL	WL
Sample Date			1-Jul-2022	1-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022
Actual depth (mbgl)			1	1	3	3	5	5	5	5
Material			Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill
Leachate	CAS RN	Units	ALSP PH2.9	DI water	ALSP PH2.9	DI water	ALSP PH2.9	DI water	ALSP PH2.9	DI water
GENERAL CHEMISTRY										
Alkalinity, Bicarbonate (As CaCO3)	ALKB	mg/L	1 U	6	1 U	13	1 U	2	1 U	2
Alkalinity, Carbonate (As CaCO3)	ALKC	mg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alkalinity, Hydroxide (As CaCO3)	ALKH	mg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alkalinity, Total (As CaCO3)	ALK	mg/L	1 U	6	1 U	13	1 U	2	1 U	2
Chloride (As Cl)	16887-00-6	mg/L	1	2	16	45	5	5	5	5
Electrical Conductivity @ 25°C	EC_Lab	µS/cm	433	57	489	152	472	38	477	39
Fluoride	16984-48-8	mg/L	0.1 U	0.2	0.1	0.6	0.1 U	0.1	0.2	0.1 U
Final pH	pH_FINAL	SU	3.1	5.4	3	6.3	3.1	6.1	3	6
pH (Leachate fluid)	pH_EXF	SU	2.9	5.6	2.9	6.9	2.9	6.11	2.9	6.06
Sulfate (As SO4)	14808-79-8	mg/L	6	15	6	123	3	7	3	7
METALS										
Aluminum	7429-90-5	mg/L	6.2	9.92	1	80.5	0.8	1.19	0.7	1.23
Antimony	7440-36-0	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Arsenic	7440-38-2	mg/L	0.1 U	0.01 U	0.1 UJ	0.02	0.1 U	0.01 U	0.1 U	0.01 U
Barium	7440-39-3	mg/L	0.2	0.1 U	0.1	0.5	0.1 U	0.1 U	0.1 U	0.1 U
Beryllium	7440-41-7	mg/L	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Boron	7440-42-8	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	7440-43-9	mg/L	0.05 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U
Calcium	7440-70-2	mg/L	4	1	2	2	2	1 U	1	1 U
Chromium, total	7440-47-3	mg/L	0.1 U	0.01	0.1 U	0.16	0.1 U	0.01 U	0.1 U	0.01 U
Cobalt	7440-48-4	mg/L	0.1 U	0.01 U	0.1 U	0.01	0.1 U	0.01 U	0.1 U	0.01 U
Copper	7440-50-8	mg/L	0.1 U	0.01 U	0.1 U	0.01	0.1 U	0.01 U	0.1 U	0.01 U
Iron	7439-89-6	mg/L	0.7	5.81	3.2	74	1.5	1.69	0.9	1.66
Lead	7439-92-1	mg/L	0.1 U	0.01 U	0.1 U	0.09	0.1 U	0.01 U	0.1 U	0.01 U
Magnesium	7439-95-4	mg/L	5	2	9	15	4	1 U	4	1 U
Manganese	7439-96-5	mg/L	0.1 UJ	0.01	0.1 UJ	0.07	0.1 UJ	0.01 U	0.1 UJ	0.01 U
Mercury	7439-97-6	mg/L	0.001 U	0.0001 U	0.001 U	0.0001 U	0.001 U	0.0001 U	0.001 U	0.0001 U
Molybdenum	7439-98-7	mg/L	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Nickel	7440-02-0	mg/L	0.1 U	0.01 U	0.1 U	0.02	0.1 U	0.01 U	0.1 U	0.01 U
Potassium	7440-09-7	mg/L	1 U	1 U	1	5	1 U	1 U	1 U	1 U
Selenium	7782-49-2	mg/L	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Sodium	7440-23-5	mg/L	4	2	26	23	6	5	5	5
Zinc	7440-66-6	mg/L	0.1 U	0.01	0.1 U	0.03	0.1 U	0.01 U	0.1 U	0.01 U

Notes:
µS/cm = microsiemens per centimetre
mg/L = milligrams per litre
SU = standard units

Table 16
2022 Soil Leachable Fraction Analyses

Location ID			ADBH32	ADBH32	ADBH33	ADBH33	ADBH33	ADBH33	ADBH33	ADBH33
Alcoa ID			ANG-22-0055_TRIP	ANG-22-0055_TRIP	ANG-22-0056	ANG-22-0056	ANG-22-0057	ANG-22-0057	ANG-22-0058	ANG-22-0058
Lab Sample ID			M22-JI0012614	M22-JI0012615	EM2212813011	EM2212813020	EM2212813012	EM2212813021	EM2212813013	EM2212813022
Matrix Code			SO	SO	SO	SO	SO	SO	SO	SO
Lab Matrix Code			WL	WL	WL	WL	WL	WL	WL	WL
Sample Date			4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022	4-Jul-2022
Actual depth (mbgl)			5	5	1	1	3	3	5	5
Material			Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill
Leachate	CAS RN	Units	ALSP PH2.9	DI water	ALSP PH2.9	DI water	ALSP PH2.9	DI water	ALSP PH2.9	DI water
GENERAL CHEMISTRY										
Alkalinity, Bicarbonate (As CaCO3)	ALKB	mg/L	20 U	20 U	1 U	6	1 U	1 U	1 U	2
Alkalinity, Carbonate (As CaCO3)	ALKC	mg/L	20 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Alkalinity, Hydroxide (As CaCO3)	ALKH	mg/L	20 U	20 U	1 U	1 U	1 U	1 U	1 U	1 U
Alkalinity, Total (As CaCO3)	ALK	mg/L	50 U	50 U	1 U	6	1 U	1 U	1 U	2
Chloride (As Cl)	16887-00-6	mg/L	5.2	6.3	2	3	4	4	5	4
Electrical Conductivity @ 25°C	EC_Lab	µS/cm	--	--	445	64	476	42	501	40
Fluoride	16984-48-8	mg/L	100 U	100 U	0.2	0.5	0.1 U	0.1 U	0.1 U	0.1
Final pH	pH_FINAL	SU	3.6	6.6	3.1	5.7	3	5.3	3	5.5
pH (Leachate fluid)	pH_EXF	SU	2.9	--	2.9	6.75	2.9	5.07	2.9	6.18
Sulfate (As SO4)	14808-79-8	mg/L	1.4	4.8	5	30	5	7	6	9
METALS										
Aluminum	7429-90-5	mg/L	0.18	1.8	2	32.2	1	1.24	1.2	5.95
Antimony	7440-36-0	mg/L	0.05 U	0.05 U	0.1 U	0.06	0.1 U	0.01	0.1 U	0.01 U
Arsenic	7440-38-2	mg/L	0.01 U	0.03	0.1 U	0.01	0.1 U	0.01 U	0.1 U	0.01 U
Barium	7440-39-3	mg/L	0.5 U	0.5 U	0.2	0.2	0.1 U	0.1 U	0.1 U	0.1 U
Beryllium	7440-41-7	mg/L	2 U	2 U	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Boron	7440-42-8	mg/L	0.38	0.33	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	7440-43-9	mg/L	0.005 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U
Calcium	7440-70-2	mg/L	5 U	5 U	4	2	1 U	1 U	1 U	1 U
Chromium, total	7440-47-3	mg/L	0.01 U	0.01 U	0.1 U	0.08	0.1 U	0.01 U	0.1 U	0.02
Cobalt	7440-48-4	mg/L	5 U	5 U	0.1 UJ	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Copper	7440-50-8	mg/L	0.02	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Iron	7439-89-6	mg/L	20 U	1.8	0.8	25.3	2.5	1.73	2.6	9.54
Lead	7439-92-1	mg/L	0.01 U	0.06	0.1 U	0.04	0.1 U	0.01 U	0.1 U	0.01 U
Magnesium	7439-95-4	mg/L	0.5 U	0.5 U	11	6	2	1 U	2	1
Manganese	7439-96-5	mg/L	5 U	5 U	0.1 UJ	0.04	0.1 UJ	0.01	0.1 UJ	0.01
Mercury	7439-97-6	mg/L	0.001 U	0.001 U	0.001 U	0.0001 U	0.001 U	0.0001 U	0.001 U	0.0001 U
Molybdenum	7439-98-7	mg/L	5 U	5 U	0.1 U	0.01 U	0.1 U	0.01 U	0.1 U	0.01 U
Nickel	7440-02-0	mg/L	0.01 U	0.01 U	0.1 UJ	0.02	0.1 U	0.01 U	0.1 U	0.01 U
Potassium	7440-09-7	mg/L	5 U	0.9	1 U	2	1 U	1 U	1 U	1 U
Selenium	7782-49-2	mg/L	0.05 U	0.05 U	0.05 U	0.01 U	0.05 U	0.01 U	0.05 U	0.01 U
Sodium	7440-23-5	mg/L	5 U	8	7	6	5	4	6	4
Zinc	7440-66-6	mg/L	0.02	0.14	0.1 U	0.03	0.1 U	0.01	0.1 U	0.01

Notes:
µS/cm = microsiemens per centimetre
mg/L = milligrams per litre
SU = standard units

Table 17
2022 Soil Analyses - Additional Samples

Location ID			ADBH13		ADBH13		ADBH17		ADBH20A		ADBH31		ADBH31	
Alcoa ID			ANG-22-0026		ANG-22-0028		ANG-22-0031		ANG-22-0103		ANG-22-0050		ANG-22-0052	
Lab Sample ID			EM2221404-001		EM2221404-002		EM2221404-005		EM2221404-006		EM2221404-003		EM2221404-004	
Matrix Code			SO		SO		SO		SO		SO		SO	
Sample Date			01 Jul 2022		01 Jul 2022		04 Jul 2022		04 Jul 2022		01 Jul 2022		01 Jul 2022	
Target depth (mbgl)			0-2m		4-6m		2-4m		4-6m		2-4m		4-6m	
Material	CAS RN	Units	Fill		Fill		Fill		Fill		Fill		Fill	
GENERAL CHEMISTRY														
Alkalinity, Bicarbonate (As CaCO3)	ALKB	mg/kg	155		10		38		5	U	17		5	U
Alkalinity, Carbonate (As CaCO3)	ALKC	mg/kg	5	U	5	U	5	U	5	U	5	U	5	U
Alkalinity, Hydroxide (As CaCO3)	ALKH	mg/kg	5	U	5	U	5	U	5	U	5	U	5	U
Alkalinity, Total (As CaCO3)	ALK	mg/kg	155		10		38		5	U	17		5	U
Chloride (As Cl)	16887-00-6	mg/kg	160		140		530		110		270		90	
Electrical Conductivity @ 25°C (1:5)	EC_Lab	us/cm	1630		142		163		369		363		502	
Fluoride	16984-48-8	mg/kg	120		60		80		40	UJ	160		50	
Moisture, Percent	MOIST	%	12.4		10.8		36.4		42.6		16.7		15.4	
pH (CaCl2)	pH(CaCl2)	SU	7.7		5.8		3.8		4		4		4	
pH Value	pH_Lab	SU	7.6		7.5		5.1		2.4		5.2		5	
Sulfate (As SO4)	14808-79-8	mg/kg	2370		120		240		13000		260		700	
Total Soluble Salts	TotalSolSalts	mg/kg	5540		482		554		1250		1230		1710	
METALS														
Aluminum	7429-90-5	mg/kg	6120		2760		10000		4260		5470		1700	
Antimony	7440-36-0	mg/kg	5	U	5	U	5	U	5	U	5	U	5	U
Arsenic	7440-38-2	mg/kg	8		5	UJ	16		5	UJ	5		5	UJ
Barium	7440-39-3	mg/kg	280		10	UJ	90		130		50		50	
Beryllium	7440-41-7	mg/kg	1	UJ	1	U	5		1	U	1	U	1	U
Boron	7440-42-8	mg/kg	50		50	U	50	U	50	UJ	50	U	50	UJ
Cadmium	7440-43-9	mg/kg	1	U	1	U	1	U	1	U	1	U	1	U
Calcium	7440-70-2	mg/kg	830		10	UJ	10	UJ	190		10	UJ	200	
Calcium/Magnesium Ratio	Ca/Mg_Ratio	mg/kg	--		--	U	--		--		--		--	
Cation Exchange Capacity	CEC	meq/100g	11.6		0.3		12.6		15.7		4.7		4	
Chromium, total	7440-47-3	mg/kg	19		12		23		4		14		5	
Cobalt	7440-48-4	mg/kg	4		2	U	2		7		2	UJ	2	U
Copper	7440-50-8	mg/kg	5	UJ	5	U	6		5	U	5	UJ	5	UJ
Exchangeable Calcium	7440-70-2_exch	meq/100g	4.6		0.2	U	1.6		2.1		0.8		2.8	
Exchangeable Calcium, percent	7440-70-2_exch%	%	40.1		0.2	U	--		--		--		--	
Exchangeable Magnesium	7439-95-4_exch	meq/100g	5.5		0.2	U	3.4		0.6		2.6		1	
Exchangeable Magnesium, percent	7439-95-4_exch%	%	47.5		0.2	U	--		--		--		--	
Exchangeable Potassium	7440-09-7_exch	meq/100g	0.2	UJ	0.2	U	0.1		0.1	U	0.2		0.1	U
Exchangeable Potassium, percent	7440-09-7_exch%	%	1.2		0.2	U	--		--		--		--	
Exchangeable Sodium	7440-23-5_exch	meq/100g	1.3		0.3		2.3		0.2		0.8		0.1	U
Exchangeable Sodium, percent	7440-23-5_exch%	%	11.2		100		31.2		1.2		16.6		1.6	
Iron	7439-89-6	mg/kg	15000		3930		23700		5780		6690		2490	
Lead	7439-92-1	mg/kg	7		5	UJ	6		5	U	6		5	UJ
Magnesium	7439-95-4	mg/kg	470		10	UJ	10	UJ	70		10	UJ	100	
Magnesium/Potassium Ratio	edms_0024	mg/kg	--	U	--	U	--		--		--		--	
Manganese	7439-96-5	mg/kg	21		5	UJ	8		5	UJ	10		5	UJ
Mercury	7439-97-6	mg/kg	0.1		0.1	U	0.1		0.1	UJ	0.1	UJ	0.1	U
Molybdenum	7439-98-7	mg/kg	2	U	2	U	2	U	2	U	2	U	2	U
Nickel	7440-02-0	mg/kg	7		2	UJ	13		15		3		2	UJ
Potassium	7440-09-7	mg/kg	30		10	UJ	10	UJ	40		10	UJ	40	
Selenium	7782-49-2	mg/kg	5	U	5	U	5	UJ	5	U	5	U	5	U
Sodium	7440-23-5	mg/kg	420		140		190		190		360		140	
Zinc	7440-66-6	mg/kg	8		5	UJ	12		20		5		5	UJ

Notes:
meq/100g = milliequivalents per 100 grams of soil
% = percent
mg/kg = milligrams per kilogram
µS/cm = microsiemens per centimetre
SU = standard units

EHS Support

Table 18

2022 Soil Leachable Fraction Analyses - Additional Samples

Location ID Alcoa ID Lab Sample ID Matrix Code Lab Matrix Code Sample Date Actual depth (mbgl) Material Leachate	CAS RN	Units						
GENERAL CHEMISTRY								
Alkalinity, Bicarbonate (As CaCO3)	ALKB	mg/L						
Alkalinity, Carbonate (As CaCO3)	ALKC	mg/L						
Alkalinity, Hydroxide (As CaCO3)	ALKH	mg/L						
Alkalinity, Total (As CaCO3)	ALK	mg/L						
Chloride (As Cl)	16887-00-6	mg/L						
Electrical Conductivity @ 25°C	EC_Lab	µS/cm						
Fluoride	16984-48-8	mg/L						
Final pH	pH_FINAL	SU						
pH (Leachate fluid)	pH_EXF	SU						
Sulfate (As SO4)	14808-79-8	mg/L						
METALS								
Aluminum	7429-90-5	mg/L						
Antimony	7440-36-0	mg/L						
Arsenic	7440-38-2	mg/L						
Barium	7440-39-3	mg/L						
Beryllium	7440-41-7	mg/L						
Boron	7440-42-8	mg/L						
Cadmium	7440-43-9	mg/L						
Calcium	7440-70-2	mg/L						
Chromium, total	7440-47-3	mg/L						
Cobalt	7440-48-4	mg/L						
Copper	7440-50-8	mg/L						
Iron	7439-89-6	mg/L						
Lead	7439-92-1	mg/L						
Magnesium	7439-95-4	mg/L						
Manganese	7439-96-5	mg/L						
Mercury	7439-97-6	mg/L						
Molybdenum	7439-98-7	mg/L						
Nickel	7440-02-0	mg/L						
Potassium	7440-09-7	mg/L						
Selenium	7782-49-2	mg/L						
Sodium	7440-23-5	mg/L						
Zinc	7440-66-6	mg/L						

Notes:
µS/cm = microsiemens per centimetre
mg/L = milligrams per litre
SU = standard units

Table 19
Water Body Transient Hydraulic Function - Natural Fill

Date	Time (years)	Time (days)	Water Body Relative Level (mAHD)	
27/03/2016	0	0	-38.1	Water body initial conditions
24/04/2016	0.08	28	-36.4	
26/04/2016	0.08	30	-36.3	
1/05/2016	0.10	35	-36.1	
5/05/2016	0.11	39	-35.9	
7/05/2016	0.11	41	-35.8	
12/05/2016	0.13	46	-35.6	
26/05/2016	0.16	60	-35	
29/05/2016	0.17	63	-34.9	
30/05/2016	0.18	64	-34.8	
18/06/2016	0.23	83	-34.3	
25/06/2016	0.25	90	-34.1	
10/07/2016	0.29	105	-33.4	
1/08/2016	0.35	127	-32.6	
8/08/2016	0.37	134	-32.5	
20/08/2016	0.40	146	-32.3	
10/12/2016	0.71	258	-29.3	
14/01/2017	0.80	293	-29	
21/01/2017	0.82	300	-28.9	
6/02/2017	0.87	316	-28.8	
22/02/2017	0.91	332	-28.7	
14/03/2017	0.96	352	-28.6	
19/03/2017	0.98	357	-28.5	
10/04/2017	1.04	379	-27.7	
25/04/2017	1.08	394	-27.5	
13/06/2017	1.21	443	-27.2	
17/06/2017	1.22	447	-27	
22/06/2017	1.24	452	-26.9	
8/07/2017	1.28	468	-26.8	
18/07/2017	1.31	478	-26.7	
27/07/2017	1.33	487	-26.6	
5/08/2017	1.36	496	-26.5	
14/09/2017	1.47	536	-26.1	
21/09/2017	1.49	543	-26	
7/10/2017	1.53	559	-25.9	
21/10/2017	1.57	573	-25.8	
20/11/2017	1.65	603	-25.7	
15/05/2018	2.13	779	-25.4	
1/06/2018	2.18	796	-25.1	
13/06/2018	2.21	808	-25	
4/08/2018	2.36	860	-24.8	
12/08/2018	2.38	868	-24.7	
22/08/2018	2.41	878	-24.6	
1/10/2018	2.52	918	-24.4	
10/11/2018	2.62	958	-24.3	
31/07/2019	3.35	1221	-22.9	
31/08/2019	3.43	1252	-22.7	
30/11/2019	3.68	1343	-22.6	
30/09/2019	3.51	1282	-22.5	
1/04/2020	4.02	1466	-22.4	
11/05/2020	4.13	1506	-22.3	
1/06/2020	4.18	1527	-22.2	
22/06/2020	4.24	1548	-22.1	
20/07/2020	4.32	1576	-22	
31/08/2020	4.43	1618	-21.7	
14/09/2020	4.47	1632	-21.6	
28/09/2020	4.51	1646	-21.5	
13/10/2020	4.55	1661	-21.3	
9/11/2020	4.62	1688	-21.2	
19/01/2021	4.82	1759	-21.1	
2/02/2021	4.86	1773	-21	
12/04/2021	5.05	1842	-20.9	
10/05/2021	5.12	1870	-20.6	
7/06/2021	5.20	1898	-20.2	
21/06/2021	5.24	1912	-19.9	
5/07/2021	5.28	1926	-19.6	
19/07/2021	5.32	1940	-19.4	
3/08/2021	5.36	1955	-19	

Table 19
Water Body Transient Hydraulic Function - Natural Fill

Date	Time (years)	Time (days)	Water Body Relative Level (mAHD)	
16/08/2021	5.39	1968	-18.8	
30/08/2021	5.43	1982	-18.6	
1/10/2021	5.52	2014	-18.5	
25/10/2021	5.58	2038	-18	
23/05/2022	6.16	2248	-17.4	Predictive modelling commences
20/06/2022	6.24	2277	-17.3	
20/07/2022	6.32	2306	-17.2	
18/08/2022	6.40	2335	-17.1	
16/09/2022	6.48	2365	-17	
16/10/2022	6.56	2395	-16.9	
15/11/2022	6.64	2425	-16.8	
15/12/2022	6.73	2455	-16.7	
15/01/2023	6.81	2485	-16.6	
14/02/2023	6.89	2516	-16.5	
17/03/2023	6.98	2547	-16.4	
18/04/2023	7.06	2578	-16.3	
19/05/2023	7.15	2610	-16.2	
20/06/2023	7.24	2642	-16.1	
22/07/2023	7.33	2674	-16	
24/08/2023	7.42	2707	-15.9	
27/09/2023	7.51	2740	-15.8	
30/10/2023	7.60	2774	-15.7	
3/12/2023	7.69	2808	-15.6	
7/01/2024	7.79	2842	-15.5	
11/02/2024	7.88	2877	-15.4	
17/03/2024	7.98	2913	-15.3	
22/04/2024	8.08	2949	-15.2	
29/05/2024	8.18	2986	-15.1	
5/07/2024	8.28	3023	-15	
12/08/2024	8.39	3061	-14.9	
20/09/2024	8.49	3099	-14.8	
29/10/2024	8.60	3138	-14.7	
8/12/2024	8.71	3178	-14.6	
17/01/2025	8.82	3218	-14.5	
26/02/2025	8.93	3259	-14.4	
9/04/2025	9.04	3300	-14.3	
20/05/2025	9.16	3342	-14.2	
2/07/2025	9.27	3384	-14.1	
14/08/2025	9.39	3427	-14	
27/09/2025	9.51	3471	-13.9	
10/11/2025	9.63	3515	-13.8	
24/12/2025	9.75	3560	-13.7	
7/02/2026	9.88	3605	-13.6	
24/03/2026	10.00	3650	-13.5	
9/05/2026	10.12	3695	-13.4	
23/06/2026	10.25	3741	-13.3	
8/08/2026	10.37	3787	-13.2	
23/09/2026	10.50	3833	-13.1	
9/11/2026	10.63	3879	-13	
26/12/2026	10.76	3926	-12.9	
11/02/2027	10.89	3974	-12.8	
31/03/2027	11.02	4022	-12.7	
18/05/2027	11.15	4070	-12.6	
6/07/2027	11.28	4118	-12.5	
23/08/2027	11.42	4167	-12.4	
11/10/2027	11.55	4216	-12.3	
30/11/2027	11.69	4265	-12.2	
19/01/2028	11.82	4315	-12.1	
9/03/2028	11.96	4365	-12	
28/04/2028	12.10	4416	-11.9	
18/06/2028	12.24	4466	-11.8	
8/08/2028	12.38	4518	-11.7	
29/09/2028	12.52	4569	-11.6	
19/11/2028	12.66	4621	-11.5	
10/01/2029	12.80	4673	-11.4	
4/03/2029	12.95	4725	-11.3	
25/04/2029	13.09	4778	-11.2	
17/06/2029	13.24	4831	-11.1	

Table 19
Water Body Transient Hydraulic Function - Natural Fill

Date	Time (years)	Time (days)	Water Body Relative Level (mAHD)
10/08/2029	13.38	4884	-11
3/10/2029	13.53	4938	-10.9
26/11/2029	13.68	4993	-10.8
20/01/2030	13.83	5047	-10.7
16/03/2030	13.98	5102	-10.6
10/05/2030	14.13	5158	-10.5
6/07/2030	14.29	5214	-10.4
31/08/2030	14.44	5271	-10.3
27/10/2030	14.60	5328	-10.2
23/12/2030	14.75	5385	-10.1
19/02/2031	14.91	5442	-10
17/04/2031	15.07	5500	-9.9
14/06/2031	15.23	5558	-9.8
11/08/2031	15.39	5616	-9.7
10/10/2031	15.55	5676	-9.6
9/12/2031	15.71	5736	-9.5
7/02/2032	15.88	5796	-9.4
8/04/2032	16.04	5856	-9.3
7/06/2032	16.21	5917	-9.2
7/08/2032	16.38	5978	-9.1
7/10/2032	16.54	6038	-9
7/12/2032	16.71	6099	-8.9
6/02/2033	16.88	6161	-8.8
9/04/2033	17.05	6222	-8.7
9/06/2033	17.22	6284	-8.6
10/08/2033	17.38	6346	-8.5
11/10/2033	17.55	6407	-8.4
12/12/2033	17.73	6470	-8.3
13/02/2034	17.90	6532	-8.2
16/04/2034	18.07	6595	-8.1
18/06/2034	18.24	6657	-8
20/08/2034	18.41	6721	-7.9
22/10/2034	18.59	6784	-7.8
25/12/2034	18.76	6847	-7.7
26/02/2035	18.93	6911	-7.6
1/05/2035	19.11	6975	-7.5
4/07/2035	19.28	7039	-7.4
6/09/2035	19.46	7103	-7.3
10/11/2035	19.64	7167	-7.2
13/01/2036	19.81	7231	-7.1
18/03/2036	19.99	7296	-7
21/05/2036	20.17	7361	-6.9
25/07/2036	20.34	7426	-6.8
29/09/2036	20.52	7491	-6.7
3/12/2036	20.70	7557	-6.6
7/02/2037	20.88	7622	-6.5
13/04/2037	21.06	7688	-6.4
18/06/2037	21.24	7754	-6.3
23/08/2037	21.42	7820	-6.2
28/10/2037	21.61	7886	-6.1
3/01/2038	21.79	7952	-6
10/03/2038	21.97	8019	-5.9
16/05/2038	22.15	8085	-5.8
22/07/2038	22.33	8152	-5.7
27/09/2038	22.52	8219	-5.6
3/12/2038	22.70	8286	-5.5
8/02/2039	22.89	8354	-5.4
17/04/2039	23.07	8421	-5.3
23/06/2039	23.26	8489	-5.2
30/08/2039	23.44	8557	-5.1
6/11/2039	23.63	8625	-5
13/01/2040	23.82	8693	-4.9
22/03/2040	24.00	8761	-4.8
29/05/2040	24.19	8829	-4.7
6/08/2040	24.38	8898	-4.6
13/10/2040	24.57	8967	-4.5
21/12/2040	24.76	9036	-4.4
28/02/2041	24.94	9105	-4.3

Table 19
Water Body Transient Hydraulic Function - Natural Fill

Date	Time (years)	Time (days)	Water Body Relative Level (mAHD)
9/05/2041	25.13	9174	-4.2
17/07/2041	25.32	9243	-4.1
25/09/2041	25.52	9313	-4
3/12/2041	25.71	9383	-3.9
11/02/2042	25.90	9453	-3.8
22/04/2042	26.09	9523	-3.7
1/07/2042	26.28	9593	-3.6
10/09/2042	26.47	9663	-3.5
20/11/2042	26.67	9734	-3.4
29/01/2043	26.86	9805	-3.3
10/04/2043	27.06	9876	-3.2
21/06/2043	27.25	9947	-3.1
31/08/2043	27.45	10018	-3
10/11/2043	27.64	10090	-2.9
21/01/2044	27.84	10162	-2.8
2/04/2044	28.04	10234	-2.7
13/06/2044	28.23	10306	-2.6
24/08/2044	28.43	10378	-2.5
5/11/2044	28.63	10450	-2.4
16/01/2045	28.83	10523	-2.3
30/03/2045	29.03	10595	-2.2
11/06/2045	29.23	10668	-2.1
23/08/2045	29.43	10741	-2
3/11/2045	29.63	10814	-1.9
15/01/2046	29.83	10886	-1.8
29/03/2046	30.03	10959	-1.7
10/06/2046	30.23	11032	-1.6
22/08/2046	30.43	11105	-1.5
3/11/2046	30.63	11179	-1.4
16/01/2047	30.83	11252	-1.3
31/03/2047	31.03	11326	-1.2
13/06/2047	31.23	11400	-1.1
26/08/2047	31.44	11474	-1
8/11/2047	31.64	11548	-0.9
21/01/2048	31.84	11623	-0.8
5/04/2048	32.05	11697	-0.7
19/06/2048	32.25	11772	-0.6
2/09/2048	32.46	11847	-0.5
16/11/2048	32.66	11922	-0.4
30/01/2049	32.87	11998	-0.3
16/04/2049	33.08	12073	-0.2
30/06/2049	33.28	12149	-0.1
14/09/2049	33.49	12225	0
30/11/2049	33.70	12301	0.1
15/02/2050	33.91	12378	0.2
2/05/2050	34.12	12455	0.3
19/07/2050	34.33	12532	0.4
4/10/2050	34.55	12609	0.5
20/12/2050	34.76	12687	0.6
8/03/2051	34.97	12765	0.7
25/05/2051	35.19	12843	0.8
11/08/2051	35.40	12921	0.9
29/10/2051	35.61	12999	1
15/01/2052	35.83	13078	1.1
3/04/2052	36.05	13157	1.2
21/06/2052	36.26	13236	1.3
8/09/2052	36.48	13315	1.4
27/11/2052	36.70	13394	1.5
14/02/2053	36.91	13474	1.6
5/05/2053	37.13	13554	1.7
24/07/2053	37.35	13634	1.8
12/10/2053	37.57	13714	1.9
1/01/2054	37.79	13794	2
22/03/2054	38.01	13875	2.1
11/06/2054	38.23	13956	2.2
31/08/2054	38.46	14036	2.3
20/11/2054	38.68	14118	2.4
9/02/2055	38.90	14199	2.5

Table 19
Water Body Transient Hydraulic Function - Natural Fill

Date	Time (years)	Time (days)	Water Body Relative Level (mAHD)	
2/05/2055	39.12	14281	2.6	
23/07/2055	39.35	14362	2.7	
13/10/2055	39.57	14444	2.8	
3/01/2056	39.80	14526	2.9	
25/03/2056	40.02	14609	3	
16/06/2056	40.25	14691	3.1	
6/09/2056	40.48	14774	3.2	
30/11/2056	40.71	14858	3.3	
23/02/2057	40.94	14943	3.4	
18/05/2057	41.17	15028	3.5	
11/08/2057	41.40	15112	3.6	
4/11/2057	41.64	15197	3.7	
28/01/2058	41.87	15282	3.8	
23/04/2058	42.10	15367	3.9	
17/07/2058	42.33	15452	4	
10/10/2058	42.57	15538	4.1	
4/01/2059	42.80	15624	4.2	
31/03/2059	43.04	15710	4.3	
26/06/2059	43.28	15797	4.4	
21/09/2059	43.52	15884	4.5	
18/12/2059	43.76	15971	4.6	
15/03/2060	44.00	16059	4.7	
11/06/2060	44.24	16148	4.8	
8/09/2060	44.48	16236	4.9	
6/12/2060	44.73	16325	5	
6/03/2061	44.97	16415	5.1	
3/06/2061	45.22	16505	5.2	
2/09/2061	45.47	16595	5.3	
2/12/2061	45.72	16686	5.4	
3/03/2062	45.96	16777	5.5	Natural fill achieved

Table 20
Water Body Transient Hydraulic Function - Fast Fill

Date	Time (Years)	Time (days)	Water Body Relative Level (mAHD)	
27/03/2016	0.00	0	-38.10	Water body initial conditions
24/04/2016	0.08	28	-36.40	
26/04/2016	0.08	30	-36.30	
1/05/2016	0.10	35	-36.10	
5/05/2016	0.11	39	-35.90	
7/05/2016	0.11	41	-35.80	
12/05/2016	0.13	46	-35.60	
26/05/2016	0.16	60	-35.00	
29/05/2016	0.17	63	-34.90	
30/05/2016	0.18	64	-34.80	
18/06/2016	0.23	83	-34.30	
25/06/2016	0.25	90	-34.10	
10/07/2016	0.29	105	-33.40	
1/08/2016	0.35	127	-32.60	
8/08/2016	0.37	134	-32.50	
20/08/2016	0.40	146	-32.30	
10/12/2016	0.71	258	-29.30	
14/01/2017	0.80	293	-29.00	
21/01/2017	0.82	300	-28.90	
6/02/2017	0.87	316	-28.80	
22/02/2017	0.91	332	-28.70	
14/03/2017	0.96	352	-28.60	
19/03/2017	0.98	357	-28.50	
10/04/2017	1.04	379	-27.70	
25/04/2017	1.08	394	-27.50	
13/06/2017	1.21	443	-27.20	
17/06/2017	1.22	447	-27.00	
22/06/2017	1.24	452	-26.90	
8/07/2017	1.28	468	-26.80	
18/07/2017	1.31	478	-26.70	
27/07/2017	1.33	487	-26.60	
5/08/2017	1.36	496	-26.50	
14/09/2017	1.47	536	-26.10	
21/09/2017	1.49	543	-26.00	
7/10/2017	1.53	559	-25.90	
21/10/2017	1.57	573	-25.80	
20/11/2017	1.65	603	-25.70	
15/05/2018	2.13	779	-25.40	
1/06/2018	2.18	796	-25.10	
13/06/2018	2.21	808	-25.00	
4/08/2018	2.36	860	-24.80	
12/08/2018	2.38	868	-24.70	
22/08/2018	2.41	878	-24.60	
1/10/2018	2.52	918	-24.40	
10/11/2018	2.62	958	-24.30	
31/07/2019	3.35	1221	-22.90	
31/08/2019	3.43	1252	-22.70	
30/11/2019	3.68	1343	-22.60	
30/09/2019	3.51	1282	-22.50	
1/04/2020	4.02	1466	-22.40	
11/05/2020	4.13	1506	-22.30	
1/06/2020	4.18	1527	-22.20	
22/06/2020	4.24	1548	-22.10	
20/07/2020	4.32	1576	-22.00	
31/08/2020	4.43	1618	-21.70	
14/09/2020	4.47	1632	-21.60	
28/09/2020	4.51	1646	-21.50	
13/10/2020	4.55	1661	-21.30	
9/11/2020	4.62	1688	-21.20	
19/01/2021	4.82	1759	-21.10	
2/02/2021	4.86	1773	-21.00	
12/04/2021	5.05	1842	-20.90	
10/05/2021	5.12	1870	-20.60	
7/06/2021	5.20	1898	-20.20	
21/06/2021	5.24	1912	-19.90	
5/07/2021	5.28	1926	-19.60	
19/07/2021	5.32	1940	-19.40	
3/08/2021	5.36	1955	-19.00	
16/08/2021	5.39	1968	-18.80	

Table 20
Water Body Transient Hydraulic Function - Fast Fill

Date	Time (Years)	Time (days)	Water Body Relative Level (mAHD)	
30/08/2021	5.43	1982	-18.60	
1/10/2021	5.52	2014	-18.50	
25/10/2021	5.58	2038	-18.00	
23/05/2022	12.32	2248	-17.40	Predictive modelling commences
20/06/2022	18.50	2255	-17.30	
20/07/2022	18.51	2262	-17.20	
18/08/2022	18.53	2269	-17.10	
16/09/2022	18.55	2276	-17.00	
16/10/2022	18.57	2283	-16.90	
15/11/2022	18.59	2290	-16.80	
15/12/2022	18.61	2297	-16.70	
15/01/2023	18.63	2305	-16.60	
14/02/2023	18.65	2312	-16.50	
17/03/2023	18.67	2319	-16.40	
18/04/2023	18.69	2327	-16.30	
19/05/2023	18.71	2334	-16.20	
20/06/2023	18.73	2342	-16.10	
22/07/2023	18.76	2350	-16.00	
24/08/2023	18.78	2357	-15.90	
27/09/2023	18.80	2365	-15.80	
30/10/2023	18.82	2373	-15.70	
3/12/2023	18.84	2381	-15.60	
7/01/2024	18.87	2390	-15.50	
11/02/2024	18.89	2398	-15.40	
17/03/2024	18.91	2407	-15.30	
22/04/2024	18.93	2415	-15.20	
29/05/2024	18.96	2424	-15.10	
5/07/2024	18.98	2433	-15.00	
12/08/2024	19.01	2442	-14.90	
20/09/2024	19.03	2451	-14.80	
29/10/2024	19.06	2460	-14.70	
8/12/2024	19.08	2470	-14.60	
17/01/2025	19.11	2479	-14.50	
26/02/2025	19.14	2489	-14.40	
9/04/2025	19.16	2499	-14.30	
20/05/2025	19.19	2509	-14.20	
2/07/2025	19.22	2519	-14.10	
14/08/2025	19.25	2529	-14.00	
27/09/2025	19.28	2540	-13.90	
10/11/2025	19.30	2550	-13.80	
24/12/2025	19.33	2561	-13.70	
7/02/2026	19.36	2572	-13.60	
24/03/2026	19.39	2582	-13.50	
9/05/2026	19.42	2593	-13.40	
23/06/2026	19.45	2604	-13.30	
8/08/2026	19.48	2615	-13.20	
23/09/2026	19.51	2626	-13.10	
9/11/2026	19.54	2637	-13.00	
26/12/2026	19.57	2648	-12.90	
11/02/2027	19.60	2660	-12.80	
31/03/2027	19.64	2671	-12.70	
18/05/2027	19.67	2682	-12.60	
6/07/2027	19.70	2694	-12.50	
23/08/2027	19.73	2706	-12.40	
11/10/2027	19.76	2717	-12.30	
30/11/2027	19.79	2729	-12.20	
19/01/2028	19.83	2741	-12.10	
9/03/2028	19.86	2753	-12.00	
28/04/2028	19.89	2765	-11.90	
18/06/2028	19.93	2777	-11.80	
8/08/2028	19.96	2789	-11.70	
29/09/2028	19.99	2801	-11.60	
19/11/2028	20.03	2814	-11.50	
10/01/2029	20.06	2826	-11.40	
4/03/2029	20.10	2839	-11.30	
25/04/2029	20.13	2851	-11.20	
17/06/2029	20.16	2864	-11.10	
10/08/2029	20.20	2877	-11.00	
3/10/2029	20.23	2890	-10.90	

Table 20
Water Body Transient Hydraulic Function - Fast Fill

Date	Time (Years)	Time (days)	Water Body Relative Level (mAHD)
26/11/2029	20.27	2902	-10.80
20/01/2030	20.31	2915	-10.70
16/03/2030	20.34	2929	-10.60
10/05/2030	20.38	2942	-10.50
6/07/2030	20.41	2955	-10.40
31/08/2030	20.45	2969	-10.30
27/10/2030	20.49	2982	-10.20
23/12/2030	20.53	2996	-10.10
19/02/2031	20.56	3010	-10.00
17/04/2031	20.60	3023	-9.90
14/06/2031	20.64	3037	-9.80
11/08/2031	20.68	3051	-9.70
10/10/2031	20.72	3065	-9.60
9/12/2031	20.76	3080	-9.50
7/02/2032	20.79	3094	-9.40
8/04/2032	20.83	3108	-9.30
7/06/2032	20.87	3123	-9.20
7/08/2032	20.91	3137	-9.10
7/10/2032	20.95	3152	-9.00
7/12/2032	20.99	3166	-8.90
6/02/2033	21.03	3181	-8.80
9/04/2033	21.07	3196	-8.70
9/06/2033	21.11	3210	-8.60
10/08/2033	21.15	3225	-8.50
11/10/2033	21.19	3240	-8.40
12/12/2033	21.23	3255	-8.30
13/02/2034	21.28	3270	-8.20
16/04/2034	21.32	3284	-8.10
18/06/2034	21.36	3299	-8.00
20/08/2034	21.40	3315	-7.90
22/10/2034	21.44	3330	-7.80
25/12/2034	21.48	3345	-7.70
26/02/2035	21.52	3360	-7.60
1/05/2035	21.56	3375	-7.50
4/07/2035	21.61	3390	-7.40
6/09/2035	21.65	3406	-7.30
10/11/2035	21.69	3421	-7.20
13/01/2036	21.73	3436	-7.10
18/03/2036	21.77	3452	-7.00
21/05/2036	21.82	3467	-6.90
25/07/2036	21.86	3483	-6.80
29/09/2036	21.90	3498	-6.70
3/12/2036	21.94	3514	-6.60
7/02/2037	21.99	3529	-6.50
13/04/2037	22.03	3545	-6.40
18/06/2037	22.07	3561	-6.30
23/08/2037	22.12	3577	-6.20
28/10/2037	22.16	3592	-6.10
3/01/2038	22.20	3608	-6.00
10/03/2038	22.25	3624	-5.90
16/05/2038	22.29	3640	-5.80
22/07/2038	22.33	3656	-5.70
27/09/2038	22.38	3672	-5.60
3/12/2038	22.42	3688	-5.50
8/02/2039	22.47	3704	-5.40
17/04/2039	22.51	3720	-5.30
23/06/2039	22.55	3736	-5.20
30/08/2039	22.60	3752	-5.10
6/11/2039	22.64	3769	-5.00
13/01/2040	22.69	3785	-4.90
22/03/2040	22.73	3801	-4.80
29/05/2040	22.78	3817	-4.70
6/08/2040	22.82	3834	-4.60
13/10/2040	22.87	3850	-4.50
21/12/2040	22.91	3867	-4.40
28/02/2041	22.96	3883	-4.30
9/05/2041	23.00	3900	-4.20
17/07/2041	23.05	3916	-4.10
25/09/2041	23.09	3933	-4.00

Table 20
Water Body Transient Hydraulic Function - Fast Fill

Date	Time (Years)	Time (days)	Water Body Relative Level (mAHD)
3/12/2041	23.14	3949	-3.90
11/02/2042	23.18	3966	-3.80
22/04/2042	23.23	3983	-3.70
1/07/2042	23.28	3999	-3.60
10/09/2042	23.32	4016	-3.50
20/11/2042	23.37	4033	-3.40
29/01/2043	23.41	4050	-3.30
10/04/2043	23.46	4067	-3.20
21/06/2043	23.51	4084	-3.10
31/08/2043	23.55	4101	-3.00
10/11/2043	23.60	4118	-2.90
21/01/2044	23.65	4135	-2.80
2/04/2044	23.69	4152	-2.70
13/06/2044	23.74	4169	-2.60
24/08/2044	23.79	4187	-2.50
5/11/2044	23.84	4204	-2.40
16/01/2045	23.88	4221	-2.30
30/03/2045	23.93	4238	-2.20
11/06/2045	23.98	4256	-2.10
23/08/2045	24.03	4273	-2.00
3/11/2045	24.07	4291	-1.90
15/01/2046	24.12	4308	-1.80
29/03/2046	24.17	4325	-1.70
10/06/2046	24.22	4343	-1.60
22/08/2046	24.26	4360	-1.50
3/11/2046	24.31	4378	-1.40
16/01/2047	24.36	4395	-1.30
31/03/2047	24.41	4413	-1.20
13/06/2047	24.46	4430	-1.10
26/08/2047	24.50	4448	-1.00
8/11/2047	24.55	4466	-0.90
21/01/2048	24.60	4484	-0.80
5/04/2048	24.65	4501	-0.70
19/06/2048	24.70	4519	-0.60
2/09/2048	24.75	4537	-0.50
16/11/2048	24.80	4555	-0.40
30/01/2049	24.85	4573	-0.30
16/04/2049	24.90	4591	-0.20
30/06/2049	24.94	4609	-0.10
14/09/2049	24.99	4627	0.00
30/11/2049	25.04	4645	0.10
15/02/2050	25.09	4664	0.20
2/05/2050	25.15	4682	0.30
19/07/2050	25.20	4700	0.40
4/10/2050	25.25	4719	0.50
20/12/2050	25.30	4737	0.60
8/03/2051	25.35	4756	0.70
25/05/2051	25.40	4774	0.80
11/08/2051	25.45	4793	0.90
29/10/2051	25.50	4812	1.00
15/01/2052	25.55	4830	1.10
3/04/2052	25.60	4849	1.20
21/06/2052	25.66	4868	1.30
8/09/2052	25.71	4887	1.40
27/11/2052	25.76	4906	1.50
14/02/2053	25.81	4925	1.60
5/05/2053	25.86	4944	1.70
24/07/2053	25.92	4963	1.80
12/10/2053	25.97	4982	1.90
1/01/2054	26.02	5001	2.00
22/03/2054	26.07	5021	2.10
11/06/2054	26.13	5040	2.20
31/08/2054	26.18	5059	2.30
20/11/2054	26.23	5078	2.40
9/02/2055	26.28	5098	2.50
2/05/2055	26.34	5117	2.60
23/07/2055	26.39	5137	2.70
13/10/2055	26.44	5156	2.80
3/01/2056	26.50	5176	2.90

Table 20
Water Body Transient Hydraulic Function - Fast Fill

Date	Time (Years)	Time (days)	Water Body Relative Level (mAHD)	
25/03/2056	26.55	5196	3.00	
16/06/2056	26.61	5215	3.10	
6/09/2056	26.66	5235	3.20	
30/11/2056	26.72	5255	3.30	
23/02/2057	26.77	5275	3.40	
18/05/2057	26.83	5295	3.50	
11/08/2057	26.88	5316	3.60	
4/11/2057	26.94	5336	3.70	
28/01/2058	26.99	5356	3.80	
23/04/2058	27.05	5376	3.90	
17/07/2058	27.10	5397	4.00	
10/10/2058	27.16	5417	4.10	
4/01/2059	27.22	5438	4.20	
31/03/2059	27.27	5458	4.30	
26/06/2059	27.33	5479	4.40	
21/09/2059	27.39	5500	4.50	
18/12/2059	27.44	5520	4.60	
15/03/2060	27.50	5541	4.70	
11/06/2060	27.56	5562	4.80	
8/09/2060	27.62	5584	4.90	
6/12/2060	27.67	5605	5.00	
6/03/2061	27.73	5626	5.10	
3/06/2061	27.79	5648	5.20	
2/09/2061	27.85	5669	5.30	
2/12/2061	27.91	5691	5.40	
3/03/2062	27.97	5713	5.50	Fast fill achieved

Table 21
Fill Material Transient Hydraulic Function

Date	Time (years)	Time (days)	DBG MB6 Relative Level (mAHD)
13/03/2016	0.00	0	-29.59
1/04/2016	0.05	19	-29.48
1/05/2016	0.13	49	-29.31
1/06/2016	0.22	80	-29.13
1/07/2016	0.30	110	-28.96
1/08/2016	0.39	141	-28.79
1/12/2016	0.72	263	-28.09
1/01/2017	0.81	294	-27.91
1/02/2017	0.89	325	-27.74
1/03/2017	0.97	353	-27.58
1/04/2017	1.05	384	-27.40
1/05/2017	1.13	414	-27.23
1/06/2017	1.22	445	-27.05
1/07/2017	1.30	475	-26.88
1/08/2017	1.39	506	-26.71
1/09/2017	1.47	537	-26.53
1/10/2017	1.55	567	-26.36
1/11/2017	1.64	598	-26.18
1/12/2017	1.72	628	-26.01
1/01/2018	1.81	659	-25.83
1/02/2018	1.89	690	-25.66
1/03/2018	1.97	718	-25.50
1/04/2018	2.05	749	-25.32
1/05/2018	2.13	779	-25.15
1/06/2018	2.22	810	-24.97
1/07/2018	2.30	840	-24.80
1/08/2018	2.39	871	-24.63
1/09/2018	2.47	902	-24.45
1/10/2018	2.55	932	-24.28
1/11/2018	2.64	963	-24.10
1/12/2018	2.72	993	-23.93
1/01/2019	2.81	1024	-23.75
1/02/2019	2.89	1055	-23.58
1/03/2019	2.97	1083	-23.42
1/04/2019	3.05	1114	-23.24
1/05/2019	3.13	1144	-23.07
1/06/2019	3.22	1175	-22.89
1/07/2019	3.30	1205	-22.72
1/08/2019	3.39	1236	-22.55
1/09/2019	3.47	1267	-22.37
1/10/2019	3.55	1297	-22.20
1/11/2019	3.64	1328	-22.02
1/12/2019	3.72	1358	-21.85
1/01/2020	3.81	1389	-21.67
1/02/2020	3.89	1420	-21.50
1/03/2020	3.97	1449	-21.33
1/04/2020	4.05	1480	-21.15
1/05/2020	4.14	1510	-20.98
1/06/2020	4.22	1541	-20.81
1/07/2020	4.30	1571	-20.64
1/08/2020	4.39	1602	-20.46
1/09/2020	4.47	1633	-20.28
1/10/2020	4.56	1663	-20.11
1/11/2020	4.64	1694	-19.93
1/12/2020	4.72	1724	-19.76
10/12/2020	4.75	1733	-19.06
5/01/2021	4.82	1759	-18.80
1/02/2021	4.89	1786	-18.74

Table 21
Fill Material Transient Hydraulic Function

Date	Time (years)	Time (days)	DBG MB6 Relative Level (mAHD)
1/03/2021	4.97	1814	-18.61
1/04/2021	5.05	1845	-18.64
1/05/2021	5.14	1875	-18.56
1/06/2021	5.22	1906	-18.40
1/07/2021	5.30	1936	-18.22
1/08/2021	5.39	1967	-17.97
1/09/2021	5.47	1998	-17.77
1/10/2021	5.56	2028	-17.46
1/11/2021	5.64	2059	-17.45
1/12/2021	5.72	2089	-17.06
1/01/2022	5.81	2120	-16.81
1/02/2022	5.89	2151	-16.62
1/03/2022	5.97	2179	-16.66
21/03/2022	6.02	2199	-16.55
1/04/2022	6.05	2210	-16.48
1/05/2022	6.14	2240	-16.31
1/06/2022	6.22	2271	-16.14
1/07/2022	6.30	2301	-15.96
1/08/2022	6.39	2332	-15.79
1/09/2022	6.47	2363	-15.61
1/10/2022	6.56	2393	-15.44
1/11/2022	6.64	2424	-15.26
1/12/2022	6.72	2454	-15.09
1/01/2023	6.81	2485	-14.92
1/02/2023	6.89	2516	-14.74
1/03/2023	6.97	2544	-14.58
1/04/2023	7.05	2575	-14.40
1/05/2023	7.14	2605	-14.23
1/06/2023	7.22	2636	-14.06
1/07/2023	7.30	2666	-13.88
1/08/2023	7.39	2697	-13.71
1/09/2023	7.47	2728	-13.53
1/10/2023	7.56	2758	-13.36
1/11/2023	7.64	2789	-13.18
1/12/2023	7.72	2819	-13.01
1/01/2024	7.81	2850	-12.84
1/02/2024	7.89	2881	-12.66
1/03/2024	7.97	2910	-12.49
1/04/2024	8.06	2941	-12.32
1/05/2024	8.14	2971	-12.15
1/06/2024	8.22	3002	-11.97
1/07/2024	8.31	3032	-11.80
1/08/2024	8.39	3063	-11.62
1/09/2024	8.48	3094	-11.44
1/10/2024	8.56	3124	-11.27
1/11/2024	8.64	3155	-11.10
1/12/2024	8.73	3185	-10.93
1/01/2025	8.81	3216	-10.75
1/02/2025	8.90	3247	-10.57
1/03/2025	8.97	3275	-10.41
1/04/2025	9.06	3306	-10.24
1/05/2025	9.14	3336	-10.07
1/06/2025	9.22	3367	-9.89
1/07/2025	9.31	3397	-9.72
1/08/2025	9.39	3428	-9.54
1/09/2025	9.48	3459	-9.36
1/10/2025	9.56	3489	-9.19
1/11/2025	9.64	3520	-9.02
1/12/2025	9.73	3550	-8.85

Table 21
Fill Material Transient Hydraulic Function

Date	Time (years)	Time (days)	DBG MB6 Relative Level (mAHD)
1/01/2026	9.81	3581	-8.67
1/02/2026	9.90	3612	-8.49
1/03/2026	9.97	3640	-8.33
1/04/2026	10.06	3671	-8.16
1/05/2026	10.14	3701	-7.98
1/06/2026	10.22	3732	-7.81
1/07/2026	10.31	3762	-7.64
1/08/2026	10.39	3793	-7.46
1/09/2026	10.48	3824	-7.28
1/10/2026	10.56	3854	-7.11
1/11/2026	10.64	3885	-6.94
1/12/2026	10.73	3915	-6.77
1/01/2027	10.81	3946	-6.59
1/02/2027	10.90	3977	-6.41
1/03/2027	10.97	4005	-6.25
1/04/2027	11.06	4036	-6.08
1/05/2027	11.14	4066	-5.90
1/06/2027	11.22	4097	-5.73
1/07/2027	11.31	4127	-5.56
1/08/2027	11.39	4158	-5.38
1/09/2027	11.48	4189	-5.20
1/10/2027	11.56	4219	-5.03
1/11/2027	11.64	4250	-4.86
1/12/2027	11.73	4280	-4.68
1/01/2028	11.81	4311	-4.51
1/02/2028	11.90	4342	-4.33
1/03/2028	11.98	4371	-4.17
1/04/2028	12.06	4402	-3.99
1/05/2028	12.14	4432	-3.82
1/06/2028	12.23	4463	-3.64
1/07/2028	12.31	4493	-3.47
1/08/2028	12.39	4524	-3.29
1/09/2028	12.48	4555	-3.12
1/10/2028	12.56	4585	-2.95
1/11/2028	12.65	4616	-2.77
1/12/2028	12.73	4646	-2.60
1/01/2029	12.81	4677	-2.42
1/02/2029	12.90	4708	-2.25
1/03/2029	12.98	4736	-2.09
1/04/2029	13.06	4767	-1.91
1/05/2029	13.14	4797	-1.74
1/06/2029	13.23	4828	-1.56
1/07/2029	13.31	4858	-1.39
1/08/2029	13.39	4889	-1.21
1/09/2029	13.48	4920	-1.04
1/10/2029	13.56	4950	-0.87
1/11/2029	13.65	4981	-0.69
1/12/2029	13.73	5011	-0.52
1/01/2030	13.81	5042	-0.34
1/02/2030	13.90	5073	-0.16
1/03/2030	13.98	5101	0.00
1/04/2030	14.06	5132	0.17
1/05/2030	14.14	5162	0.34
1/06/2030	14.23	5193	0.52
1/07/2030	14.31	5223	0.69
1/08/2030	14.39	5254	0.87
1/09/2030	14.48	5285	1.04
1/10/2030	14.56	5315	1.21
1/11/2030	14.65	5346	1.39

Table 21
Fill Material Transient Hydraulic Function

Date	Time (years)	Time (days)	DBG MB6 Relative Level (mAHD)
1/12/2030	14.73	5376	1.56
1/01/2031	14.81	5407	1.74
1/02/2031	14.90	5438	1.92
1/03/2031	14.98	5466	2.08
1/04/2031	15.06	5497	2.25
1/05/2031	15.14	5527	2.42
1/06/2031	15.23	5558	2.60
1/07/2031	15.31	5588	2.77
1/08/2031	15.39	5619	2.95
1/09/2031	15.48	5650	3.12
1/10/2031	15.56	5680	3.30
1/11/2031	15.65	5711	3.47
1/12/2031	15.73	5741	3.64
1/01/2032	15.81	5772	3.82
1/02/2032	15.90	5803	4.00
1/03/2032	15.98	5832	4.16
1/04/2032	16.06	5863	4.34
1/05/2032	16.15	5893	4.51
1/06/2032	16.23	5924	4.69
1/07/2032	16.31	5954	4.86
1/08/2032	16.40	5985	5.03
1/09/2032	16.48	6016	5.21
1/10/2032	16.56	6046	5.38
1/11/2032	16.65	6077	5.56
1/12/2032	16.73	6107	5.73
1/01/2033	16.82	6138	5.91
1/02/2033	16.90	6169	6.08
1/03/2033	16.98	6197	6.24
1/04/2033	17.06	6228	6.42
9/03/2034	18.00	6570	6.42
4/03/2036	19.99	7296	6.42
29/04/2037	21.14	7717	6.42
18/09/2038	22.53	8224	6.42
17/05/2040	24.19	8831	6.42
16/05/2042	26.19	9560	6.42
7/10/2044	28.59	10435	6.42
22/08/2047	31.46	11484	6.42
2/02/2051	34.92	12744	6.42
24/03/2055	39.05	14255	6.42
11/03/2060	44.02	16069	6.42
25/02/2066	49.99	18246	6.42
29/01/2068	51.92	18949	6.42
21/05/2070	54.22	19792	6.42
27/02/2073	57.00	20805	6.42
25/06/2076	60.33	22019	6.42
22/06/2080	64.32	23477	6.42
7/04/2085	69.12	25227	6.42
5/01/2091	74.87	27326	6.42
28/11/2097	81.77	29845	6.42
10/03/2106	90.05	32868	6.42
14/02/2116	99.99	36496	6.42
14/02/2119	102.99	37592	6.42

Figures

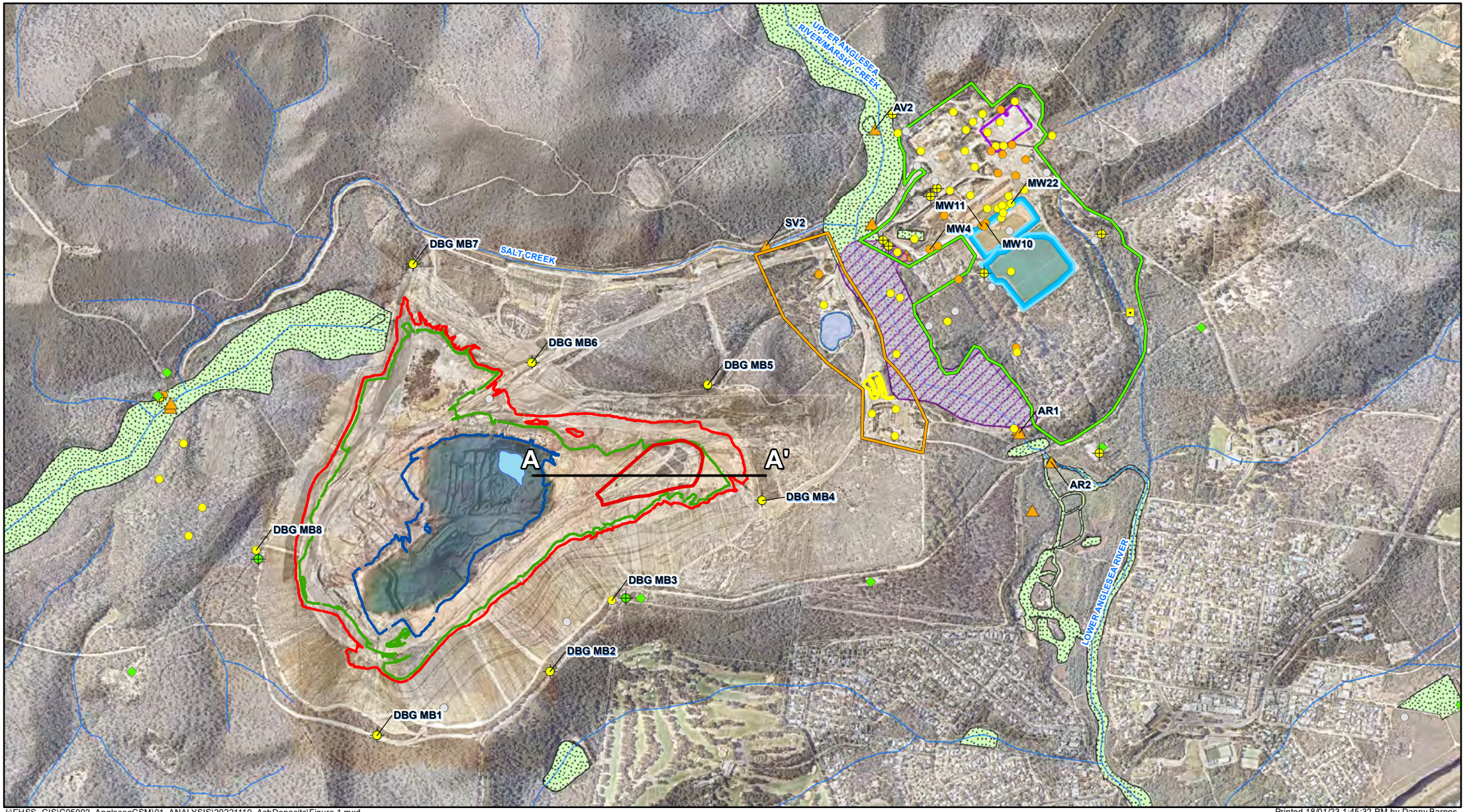

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Figure 1 Site Location

Monitoring Bore - Aquifer Monitored

- Demons Bluff Group - Perched Aquifer (Alluvial)
- Demons Bluff Group - Boonah Sands Aquifer
- UEVF
- UEVF (Basal Sands)
- UEVF (Upper Sands)
- UEVF/MEVF
- UEVF/LEVF
- LEVF
- Decommissioned
- Surface Water Sample Location
- June 2021 Water Level (-20mAHD)
- -4mAHD
- 4mAHD
- Mine Sump
- APS Investigation Area
- Mine Infrastructure Area
- Extent of Consolidated leached ash (CLA)
- Ash/Water Reclamation Ponds
- Mine Water Reclamation Pond
- Wetland Dam
- Formerly Licensed Mixing Zone
- Former Power Station
- Watercourse
- Parcel Boundary
- Marshland
- Cross-section line marks the approximate extent of the SEEP/W model domain

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Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	18/01/2023
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
PROJECT NO:	AUS_C03568
MAP PROJECTION:	GDA94
SCALE:	1:17,484

N

Kilometers

0 0.25 0.5 1

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Figure 2 Extent of leached and dried leached ash deposits

- Soil/Ash Sampling Locations - 2021
- Sampling Locations 2022
- Area of tipped and dried leached ash
- Extent of consolidated leached ash (CLA)

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REVIEWED BY:	C. Smitt [EHS Support]
PROJECT NO:	AUS_C03568
MAP PROJECTION:	GDA94
SCALE:	1:2,281

N

Meters

0 30 60 120

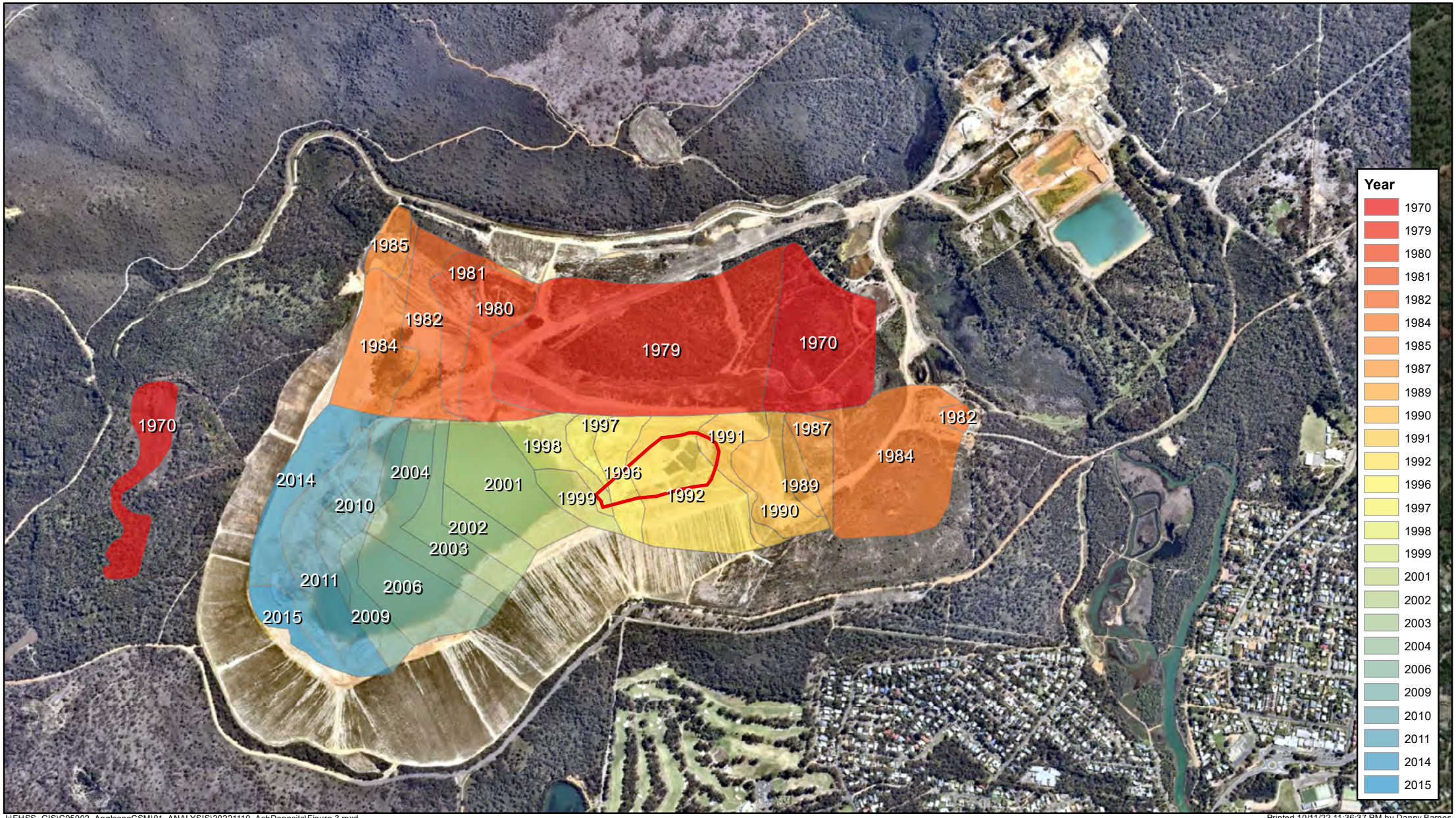

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Figure 3 Historic Mine Extent

Extent of consolidated leached ash (CLA)

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Alcoa Anglesea Consolidated Leached Ash Investigation

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REVIEWED BY:	C. Smitt [EHS Support]
PROJECT NO:	AUS_C03568
MAP PROJECTION:	GDA94
SCALE:	1:15,000

N

Meters

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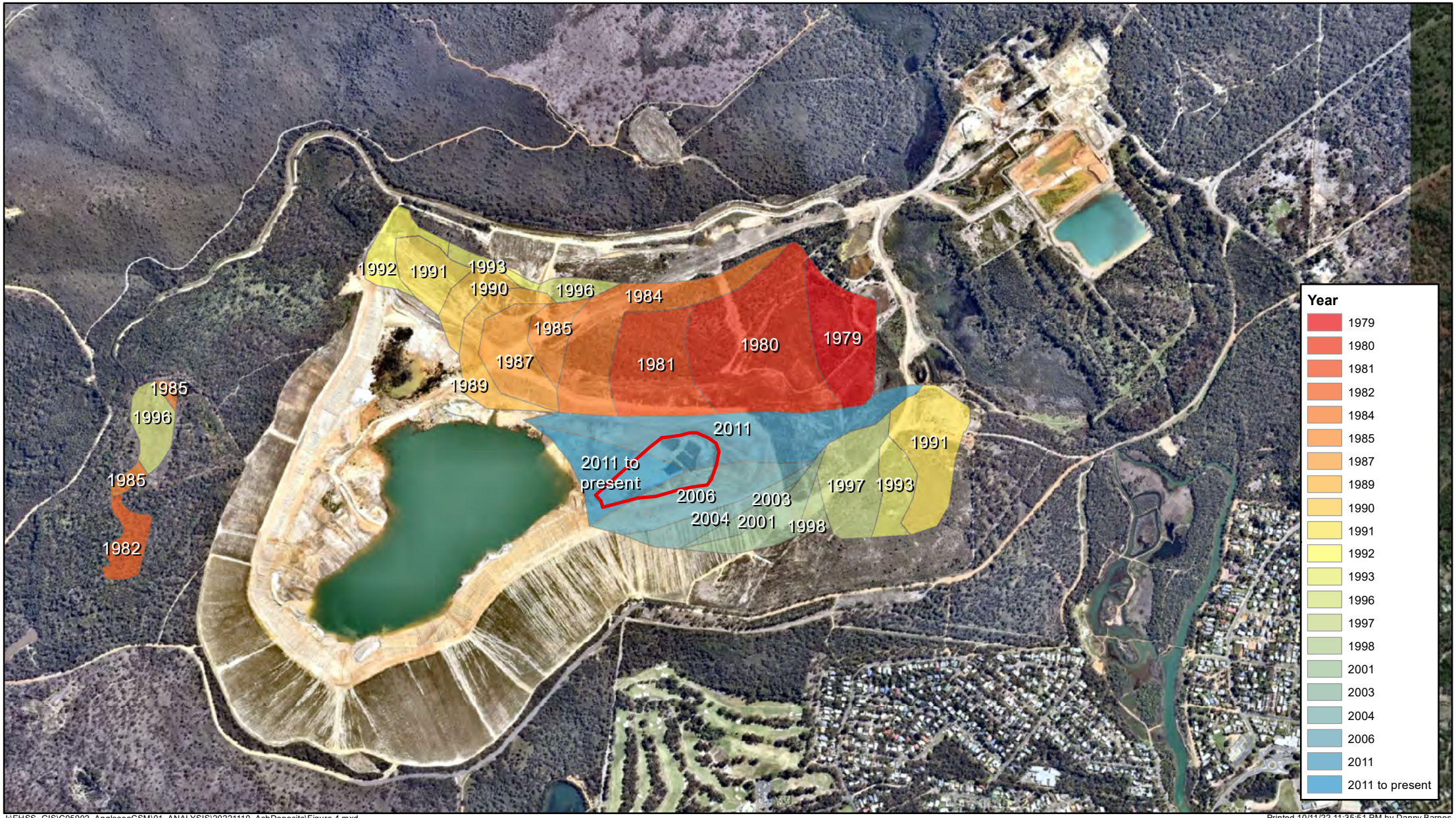

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Figure 4 Historic Mine Backfill

Extent of consolidated leached ash (CLA)

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Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	10/11/2022
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REVIEWED BY:	C. Smitt [EHS Support]
PROJECT NO:	AUS_C03568
MAP PROJECTION:	GDA94
SCALE:	1:15,000

N

Meters

0 210 420 840

A

A'

West

East

-10
mAHD

Clay-rich Cover

-7
mAHD

Berm

Consolidated Leached Ash
(approximately 4 m thick, mean permeability<1x10^{-9} m/sec)

-12
mAHD

-15
mAHD

Fill Material
(approximately 25 m thick mean permeability <1x10^{-9} m/sec)

3 lifts of compacted clay-rich material approximately 350 mm thick – total thickness ≥ 1m, mean permeability <1x10^{-9} m/sec

Note: conceptual figure is not to scale

Note: permeability determined by de-ionised water and saline (NaCl 5,000 ppm) constant head (triaxial method AS1289 6.7.3) permeameter tests

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Figure 5 Consolidated Leached Ash Design - Conceptual cross-section

- Clay-rich cover
- Consolidated ash
- Fill material

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Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	23/03/2023
CREATED BY:	D. Barnes
APPROVED BY:	R. Fraser
PROJECT REF. NO:	AUS_C03568
MAP PROJECTION:	N/A
SCALE:	Not to scale

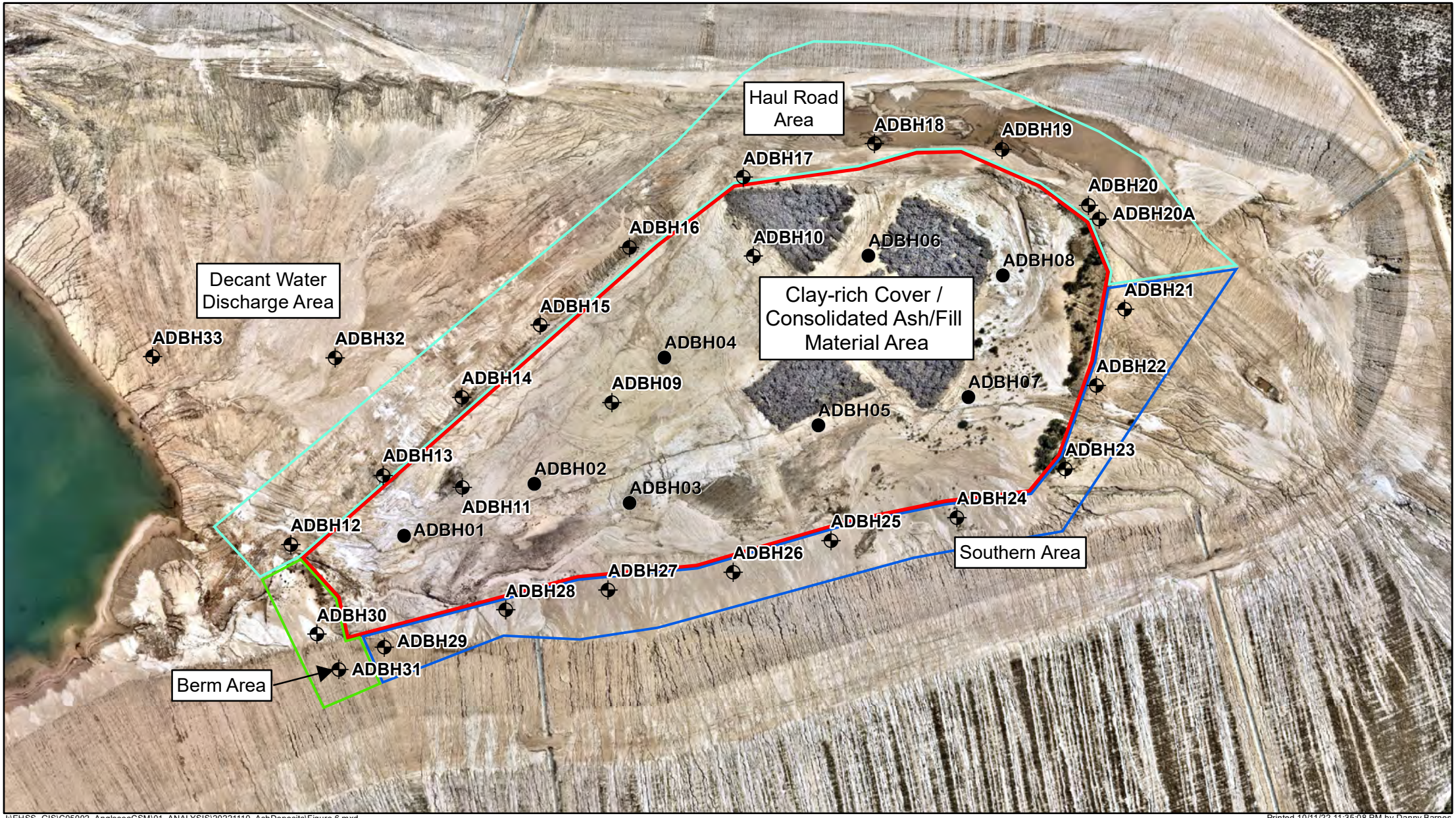

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Figure 6 Ash risk Assessment Sampling Locations and Domain Areas 2021 & 2022

- Sampling Locations 2021
- Sampling Locations 2022
- Approximate extent of consolidated ash and clay-rich cover

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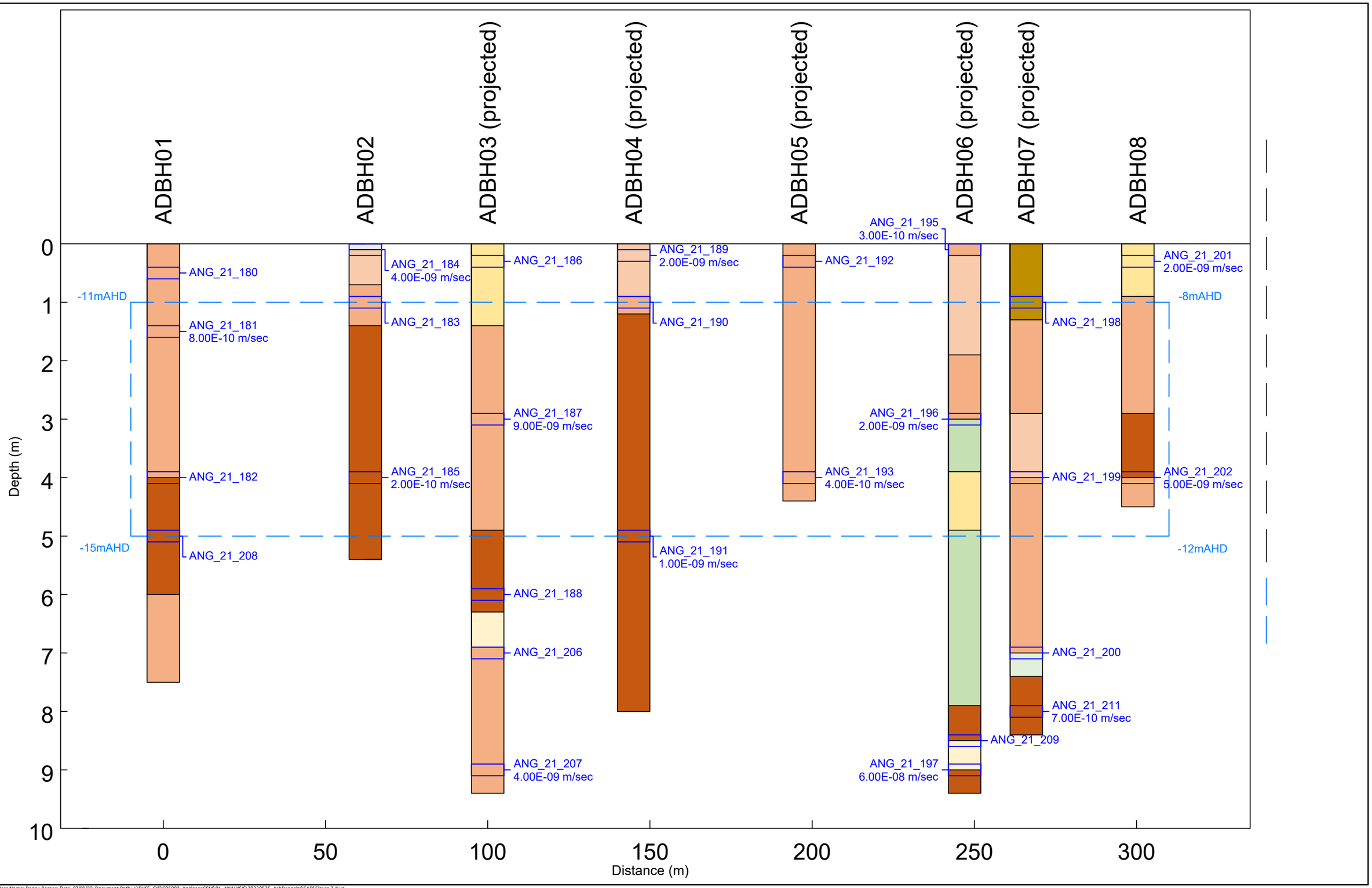
Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	10/11/2022
CREATED BY:	D. Barnes [EHS Support]
REVIEWED BY:	C. Smitt [EHS Support]
PROJECT NO:	AUS_C03568
MAP PROJECTION:	GDA94
SCALE:	1:2,293

N

Meters

0 30 60 120



Internal Document Control Information: User Name: Danny Barnes; Date: 07/09/22; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20220525_AshDeposits\CAD\Figure 7.dwg

Figure 7 Consolidated Leached Ash (CLA) - Bore Log Cross-section

Material Description

- gravelly SAND
- SAND
- silty SAND
- clayey SAND
- sandy SILT
- clayey SILT
- sandy CLAY
- silty CLAY
- CLAY

Consolidated Ash Deposit

ANG_21_181
8.00E-10 m/sec
Sample ID and permeability (flexible wall permeameter)

ALCOA

EHS Support

Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	10/11/2022
CREATED BY:	D. Barnes
APPROVED BY:	R. Fraser
PROJECT REF. NO:	AUS_C03568
MAP PROJECTION:	N/A
SCALE:	Not to scale

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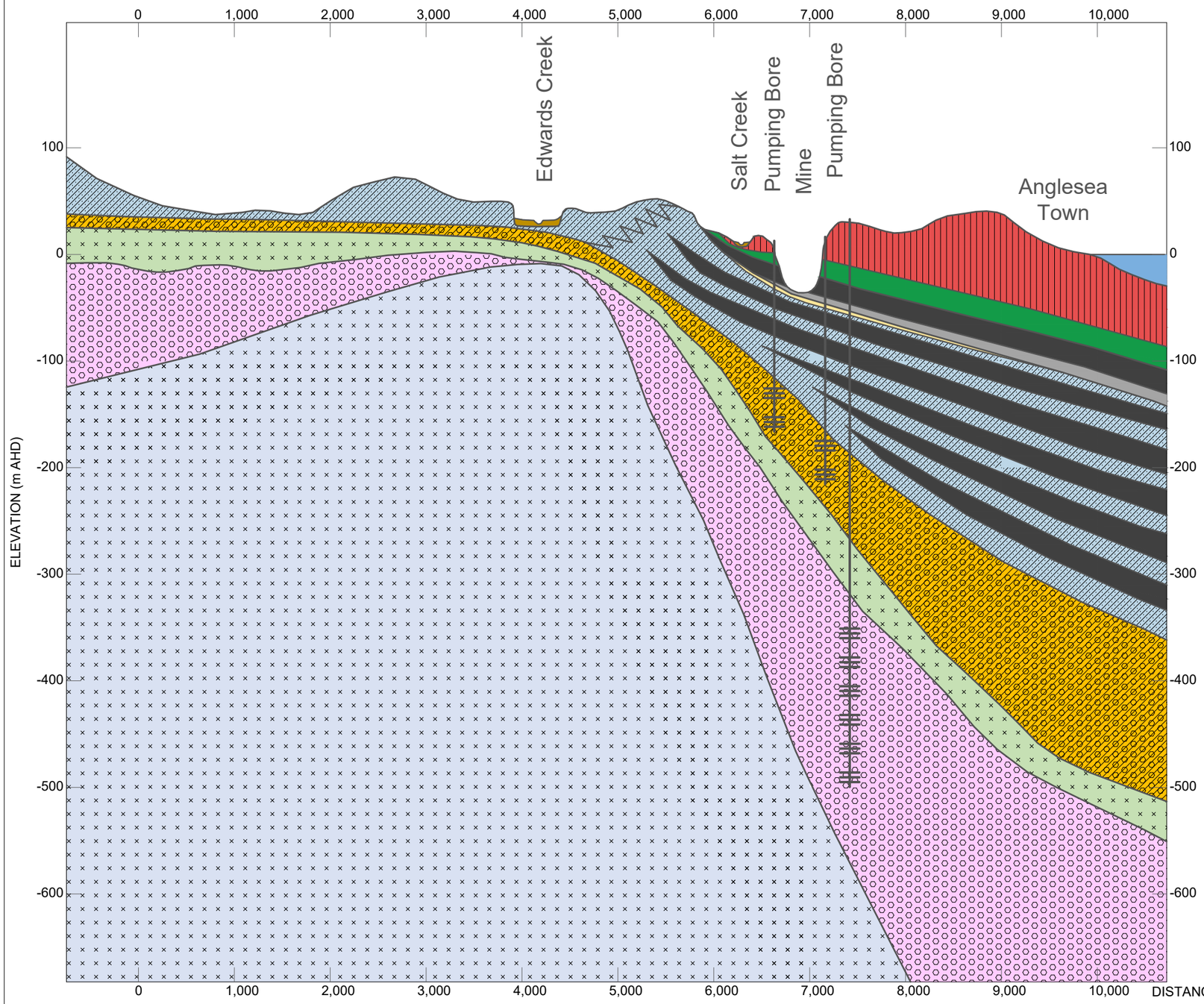

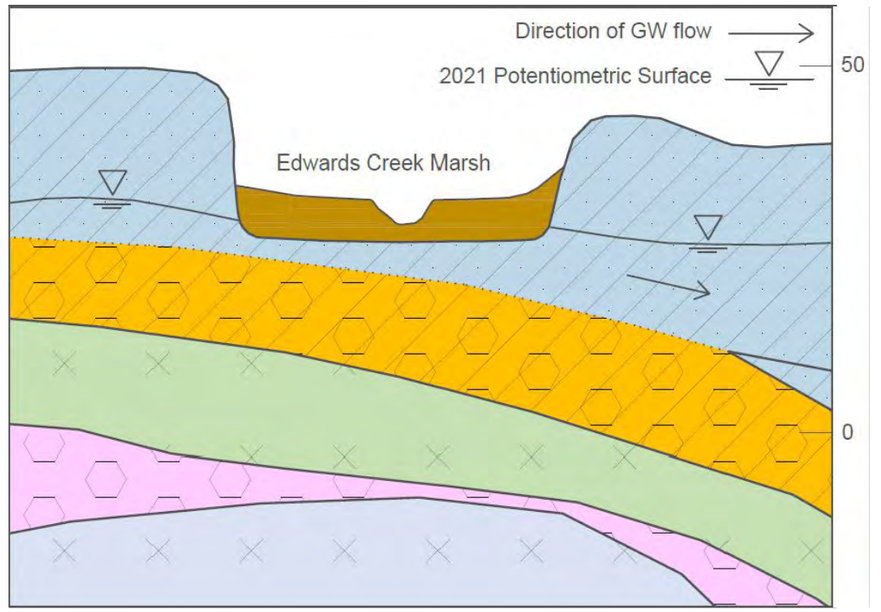

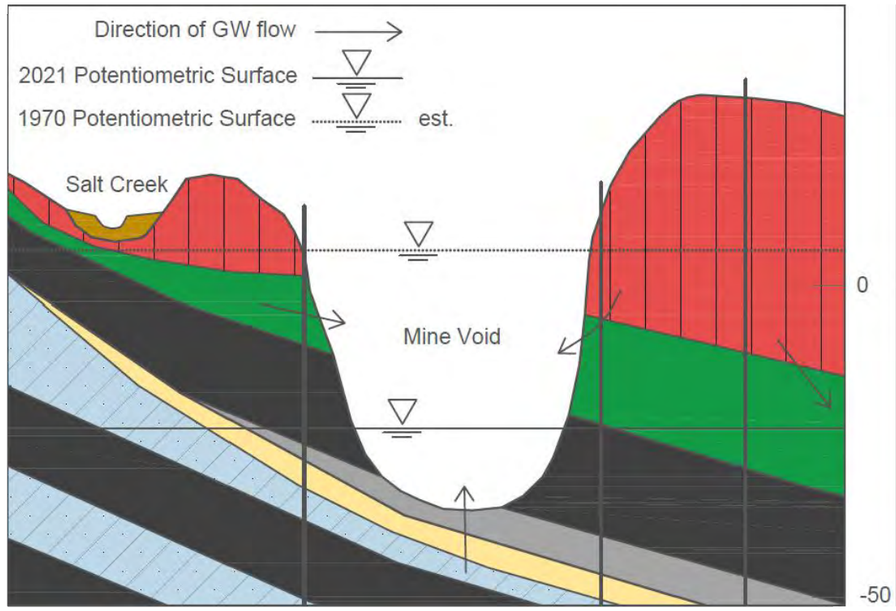

Internal Document Control Information: User Name: Danny Barnes; Date: 07/09/22; Document Path: J:\EHSS_GIS\C05002_AngleseaCSM\01_ANALYSIS\20220525_AshDeposits\CAD\Figure 7.dwg

Figure 7 Consolidated Leached Ash (CLA) - Bore Log Cross-section

MATERIAL GRAPHIC

- Clayey Gravel
- Clayey Sand
- Well-graded Sand
- Siltstone
- Silt

GEOLOGY UNIT 1

- Channel Alluvial
- Demons Bluff Group
- Boonah Formation
- Upper Eastern View Formation (Coal Seam)
- Upper Eastern View Formation (Basal Clay)
- Upper Eastern View Formation (Upper Sands)
- Upper Eastern View Formation (Intermediate)
- Upper Eastern View Formation (Lower Sands)
- Middle Eastern View Formation
- Lower Eastern View Formation
- Torquay Group

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Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	10/11/2022
CREATED BY:	D. Barnes
APPROVED BY:	R. Fraser
PROJECT REF. NO:	AUS_C03568
MAP PROJECTION:	N/A
SCALE:	Not to scale

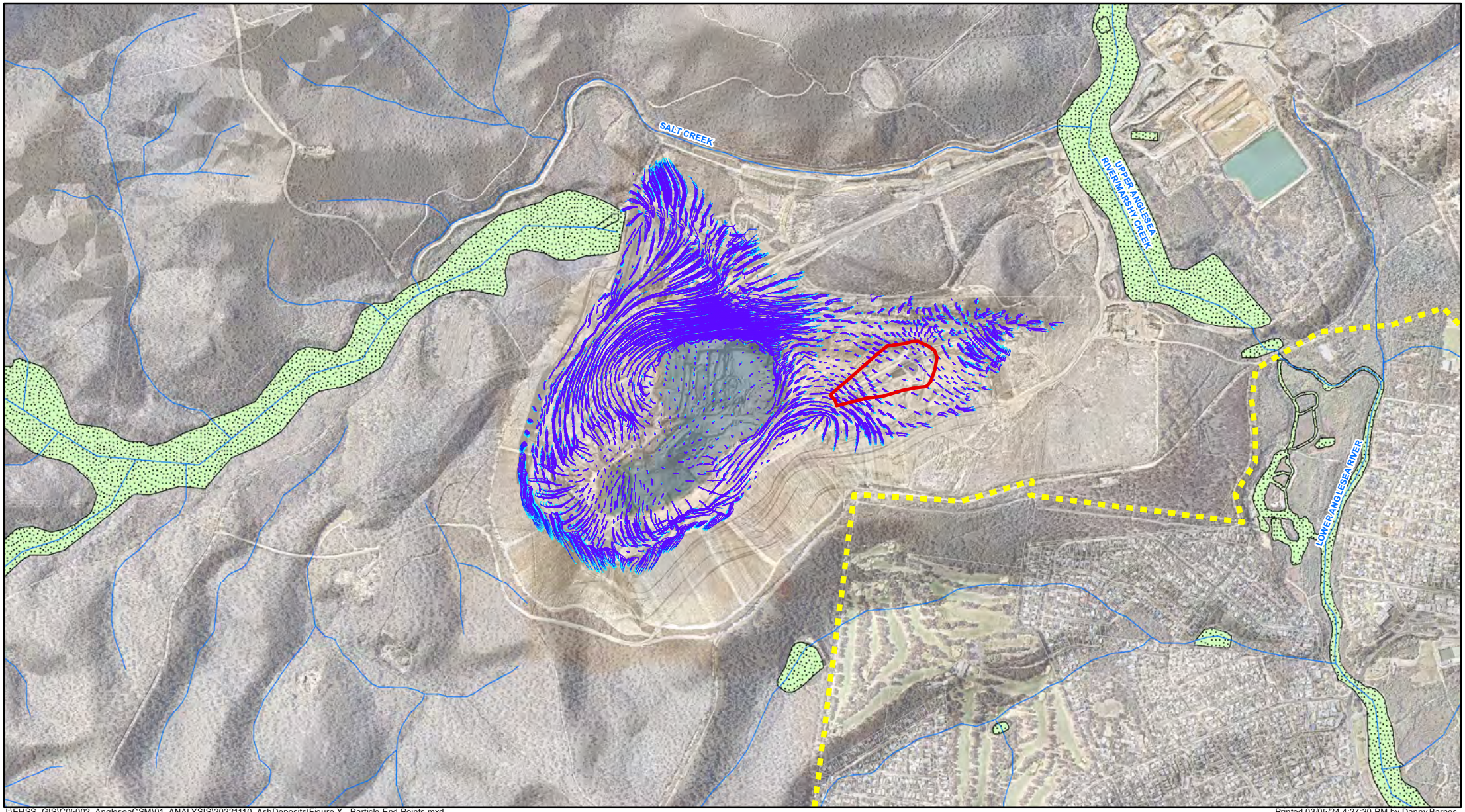

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Figure 9a - Pit water body particle tracking summary (Time: 0-5.51 years)

- Extent of Consolidated leached ash (CLA)
- Alcoa Lease Boundary
- Watercourse
- Parcel Boundary
- Marshland

Particle Tracks - base realisation migration distance from pit

Travel time (years)

- 0.00 - 2.78
- 2.79 - 4.27
- 4.28 - 5.08
- 5.09 - 5.51

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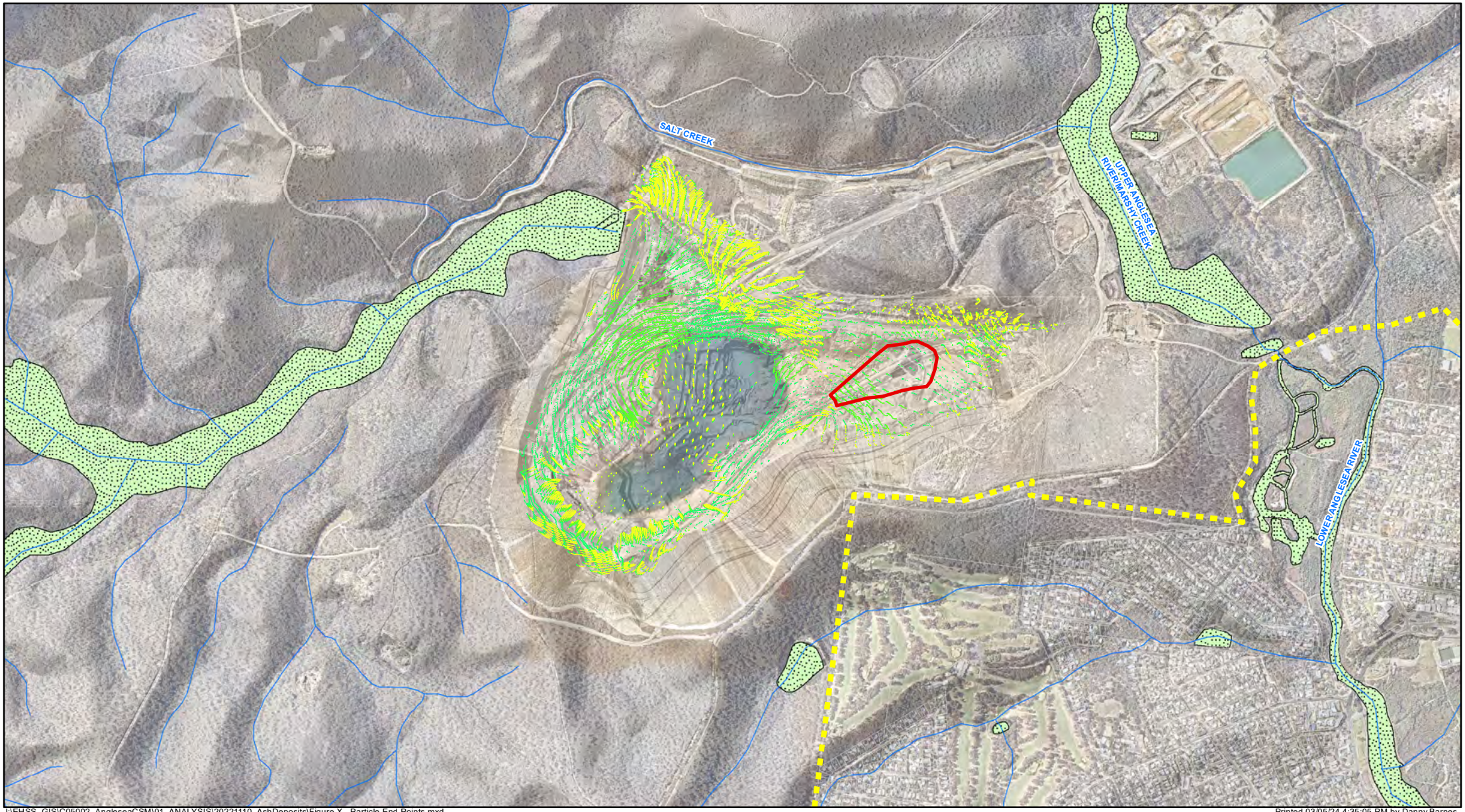
Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	03/05/2024
CREATED BY:	D. Barnes
REVIEWED BY:	R. Fraser
PROJECT NO:	PTY.03568
MAP PROJECTION:	GDA94
SCALE:	1:17,484

N

Kilometers

0 0.25 0.5 1



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Printed 03/05/24 4:35:05 PM by Danny.Barnes

Figure 9b - Pit water body particle tracking summary (Time: 5.52-10.58 years)

Extent of Consolidated leached ash (CLA)
Alcoa Lease Boundary
Watercourse
Parcel Boundary
Marshland

Particle Tracks - base realisation migration distance from pit

Travel time (years)

5.52 - 6.31
6.32 - 7.81
7.82 - 10.58

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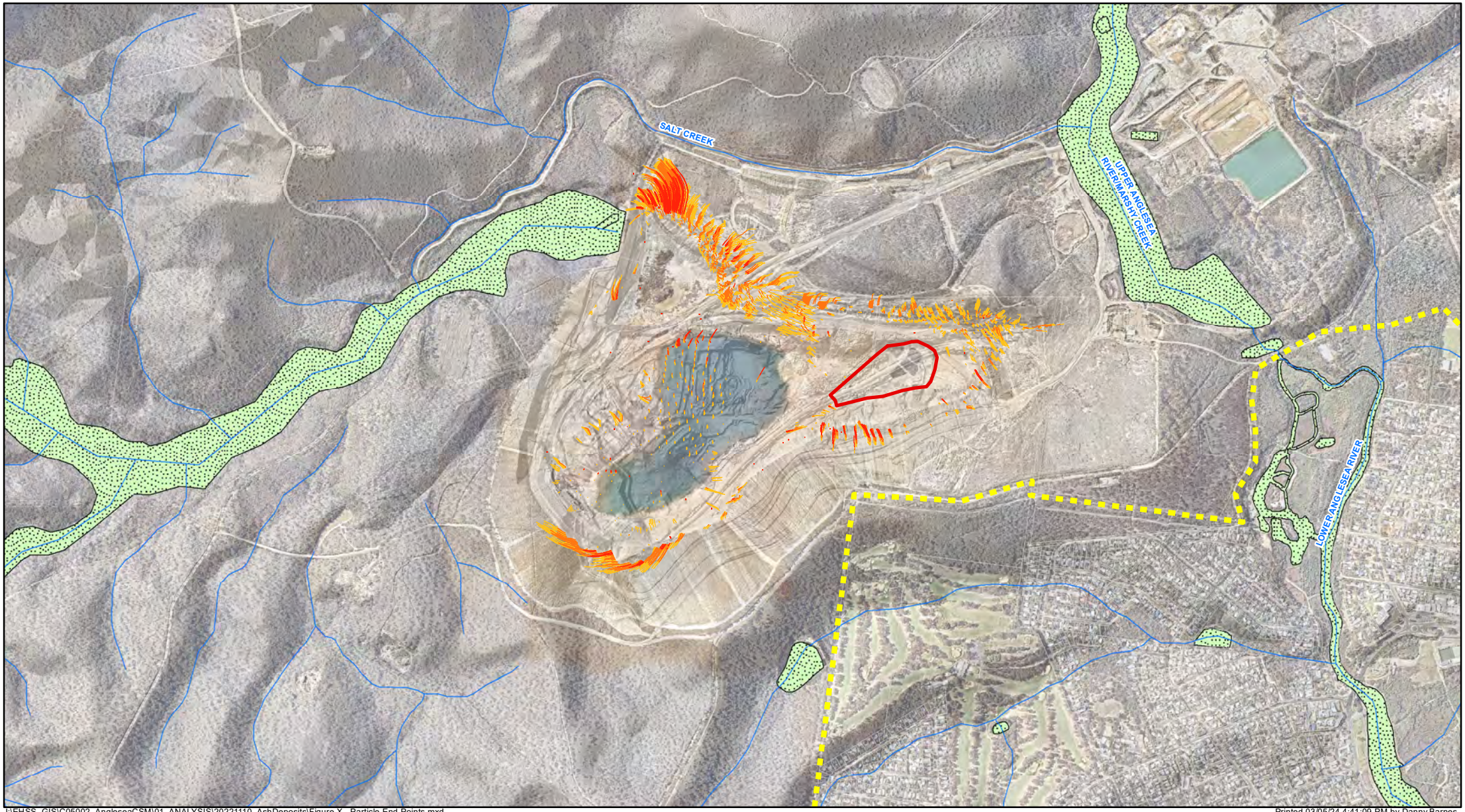
Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	03/05/2024
CREATED BY:	D. Barnes
REVIEWED BY:	R. Fraser
PROJECT NO:	PTY.03568
MAP PROJECTION:	GDA94
SCALE:	1:17,484

N

Kilometers

0 0.25 0.5 1



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Printed 03/05/24 4:41:09 PM by Danny.Barnes

Figure 9c - Pit water body particle tracking summary (Time: 10.59-43.19 years)

Extent of Consolidated leached ash (CLA)
Alcoa Lease Boundary
Watercourse
Parcel Boundary
Marshland

Particle Tracks - base realisation migration distance from pit

Travel time (years)

10.59 - 15.74
15.75 - 25.33
25.34 - 43.19

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Alcoa Anglesea Consolidated Leached Ash Investigation

DATE:	03/05/2024
CREATED BY:	D. Barnes
REVIEWED BY:	R. Fraser
PROJECT NO:	PTY.03568
MAP PROJECTION:	GDA94
SCALE:	1:17,484

N

Kilometers

0 0.25 0.5 1

Appendix A Independent Peer Review Letter

BlueSphere Environmental Pty Ltd
113 Ferrars Street
Southbank VIC 3006

19 June 2023

Warren Sharp
Alcoa of Australia Limited
Alcoa Anglesea
Camp Road,
Anglesea, VIC 3230

Dear Warren,

Re: Independent Technical Peer Review of the Consolidated Leached Ash Technical Risk Assessment, Alcoa Anglesea Mine

1 Introduction

BlueSphere Environmental Pty Ltd (BlueSphere) was engaged by Alcoa of Australia Limited (Alcoa) to provide independent technical peer review (ITPR) services in relation to the characterisation and risk assessment of a consolidated leached ash deposit within the mine void of the former Anglesea coal mine. The characterisation and risk assessment work has been conducted by environmental consultants EHS Support Pty Ltd (EHS Support), who is also engaged by Alcoa.

Specifically, the review was to consider the potential environmental impacts associated with the activity of submerging the consolidated leached ash (CLA), its cap and other encapsulating materials, beneath the future pit lake from a technical perspective.

2 Background

Alcoa operated a coal mine and power station at Anglesea from 1969 to 2015, with decommissioning, rehabilitation and closure activities having been ongoing since that time. In 2017, Alcoa developed a draft Mine Closure and Rehabilitation Plan (MCRP), to ensure that the rehabilitation would provide a safe, stable and sustainable landform that compliments the surrounding natural environment. Key elements of the MCRP included development of a pit lake, extensive rehabilitated and revegetated areas and some areas of future alternative land uses. The MCRP was submitted to Earth Resources Regulation (ERR) in late 2017.

In accordance with the MCRP, and as part of the ERR approval of the cover and overburden backfilling strategy, leached ash from two former ash ponds was deposited and consolidated in the south eastern corner of the mine void and covered with a semi-engineered clay cap. The CLA occupies an area of approximately seven (7) hectares, with an average depth of 4 metres, within a mine void covering approximately 100 hectares.

The ERR approval included a requirement for the further consideration of the potential environmental impacts of the CLA in Alcoa's final MCRP. Furthermore, in 2021, EPA Victoria (EPA), advised Alcoa that approval for the landfill cap was required through a licence surrender process, the application for which would require the provision of detailed technical information in relation to the landfill cap, including an ITPR.

These further technical studies were conducted between 2017 and September 2022 by EHS Support and the findings consolidated in the Consolidated Leached Ash Technical Risk Assessment (CLARA) report (EHS Support 2023). The CLARA is the primary document subject to review by the ITPR team.

3 Objectives

The objectives of the ITPR are as follows:

- Provide an independent opinion on the technical veracity of the works completed by Alcoa (and its consultants) in ensuring an environmentally sound outcome in relation to the submergence of the consolidated leached ash deposit; and

- Provide advice regarding the technical aspects of the assessment process to help ensure a robust outcome that is consistent with relevant environmental legislation and guidance.

4 Scope and Methodology

4.1 Basis and Scope of Review

The review conducted by the ITPR team was limited to the potential environmental impacts associated with the CLA under a specific scenario whereby it was submerged within the developing pit lake.

The review relies on a number of specific assumptions to constrain the predictions regarding likely future environmental outcomes. These assumptions include:

- That the consolidated leached ash remains a geotechnically stable landform, with the integrity of the encapsulating materials remaining fundamentally unchanged from present day conditions;
- That the consolidated leached ash is submerged within the pit lake at a depth of approximately 12 m;
- That the pit lake acts as a terminal discharge feature once established, with a surplus of evaporation over inputs of rainfall, runoff and groundwater ingress, and that there is no surface water connectivity between the pit lake and surrounding catchment.

The review scope comprised four key components:

1) Review of the conceptualisation of the consolidated leached ash deposit and the further physical characterisation of the ash and encapsulating materials;
2) Review of the hydrogeological modelling, including model selection, parameterisation, predictions and sensitivity analysis;
3) Review of the consolidated leached technical ash risk assessment; and
4) Review of proposed water quality performance standards and monitoring for the pit lake in so far as they relate to any future impacts on water quality deriving from the CLA.

The review work considers only information relevant to, and the potential outcomes of, the activity of submerging the CLA within the pit lake water body; it does not consider potential broader water quality issues within the pit lake water body. It is understood that these matters have been, or will be, addressed through separate limnological, geochemical and water balance studies as necessary as part of the MCRP.

The work completed by BlueSphere does not constitute a statutory Environmental Audit as defined under the *Environment Protection Act 2017* and BlueSphere did not act in the role of an EPA-appointed Auditor.

4.2 Regulatory Framework and Approach

The review was conducted in accordance with, or with reference to, the following Acts, regulations, guidelines and codes, to the extent that each was considered relevant to the review scope:

- ANZG 2018. Australian and New Zealand Guidelines for fresh and marine water quality. Australian and New Zealand Governments and Australian State and Territory Governments, Canberra, ACT, Australia.
- Barnett, B; Townley, L; Post, V; Evans, R; Hunt, R; Peeters, L; Richardson, S; Werner, A; Knapton, A; Boronkay, A. Australian groundwater modelling guidelines. National Water Commission, Canberra, June 2012.
- EPA Victoria 2022, *Hydrogeological Assessment (Groundwater Quality) Guidelines*, EPA Victoria Publication 668.1.
- EPA Victoria, 2015, Siting, design, operation and rehabilitation of landfills, Best Practice Environmental Management, Publication 788.3, August 2015.
- Government of Victoria, 2017, *Environment Protection Act 2017*, No. 51 of 2017, as amended January 2020;
- Government of Victoria, 2021, Environment Protection Regulations 2021, S.R No 47/2021;

- Government of Victoria, 2021, Environment Reference Standard, No. S 245, 26 May 2021;
- National Environment Protection Council (1999, 2013 revision), National Environment Protection (Assessment of Site Contamination) Measure (NEPM 2013).

4.3 Documents Reviewed

The following documents were reviewed by the ITPR team, with detailed commentary provided in a register, a copy of which is enclosed as **Attachment 1**:

- Primary Document (including draft iterations):
  - EHS Support, 2023. Consolidated Leached Ash Technical Risk Assessment. Anglesea Former Mine Pit, Anglesea, Victoria. Final, 24 May 2023
- Supporting Documents (including draft iterations), some of which were later consolidated into the primary document:
  - EHS Support, 2022. Ash Risk Assessment, Hydrogeological Modelling, Former Coal Mine, Anglesea, Victoria, 6 June 2022.
  - EHS Support, 2022. Memo, SAQP Data Gap Analysis – Consolidated Ash Risk Assessment
  - EHS Support, 2022. Memo, Ash Risk Assessment – Supplementary Field Sampling Results
  - EHS Support, 2022. Memo, Alcoa Anglesea Mine Water Body and Groundwater Water Quality Performance Standards
  - EHS Support 2022, *Ash Risk Assessment – Overview and Supporting Documents*, Memorandum, 2 February 2022, including the following attachments:
    - Attachment 1 Conceptual hydrogeological model report
    - Attachment 2 Waste discharge licence EM32162
    - Attachment 3 Operating Licence 11429
    - Attachment 4 Consolidated Ash TWG Update Jul 2021
    - Attachment 5 Ash Assessment Technical Appendix M Mine Closure and Rehabilitation Plan Sep 2017
    - Attachment 6 EPA letter October 2021 Approval pathway under new EP Act 2017.
  - EHS Support, 2021. Supplemental Surface Water and Soil investigation Report, Anglesea Alcoa Power Station, April 2021.

It should be noted that the ITPR team has not undertaken a comprehensive data validation (QA/QC) exercise to independently verify the accuracy, completeness and fitness for purpose of analytical results and other raw data sources. These data have been reviewed and utilised on an “as is” basis.

4.4 Site Inspection and Workshops

Members of the ITPR team (Dr Darren Bennetts and Dr Matt Edwards) conducted a Site inspection with representatives of Alcoa (Mr Warren Sharp, Ms Nicci Marris and Mr John Osborne) and EHS Support (Dr Rebecca Fraser and Mr Chris Smitt) on 28 March 2022.

The Site visit included a general Site overview, including history of mining operations, historical ash management practices and ongoing rehabilitation activities, followed by a walkover of the CLA area and inspection of the surficial encapsulating materials, including the cap, former haul road and berm area.

In addition to the Site visit, six formal meetings were conducted via teleconference or in person between the ITPR team, EHS Support and Alcoa on to discuss technical issues raised as part of the review. These meeting took place on the following dates:

- 31 May 2022;
- 15 September 2022;
- 7 October 2022;

- 12 January 2023;
- 8 May 2023; and
- 18 May 2023.

4.5 Independent Technical Peer Review Team

The members of the ITPR Team, role throughout the project, relevant qualifications, and fields of expertise, are summarised in **Table 1**.

Table 1 ITPR Team Roles and Capabilities

Reviewer	Role	Qualifications/Accreditations	Relevant field of expertise
Dr Darren Bennetts	Lead Reviewer	B.Sc (hons), Ph.D EPA Appointed Environmental Auditor (Contaminated Land)	Hydrogeology Contaminant Fate and Transport Environmental Chemistry Environmental Regulation
Dr Matt Edwards	Specialist Support – Geology and Hydrogeology	B.Sc (hons), Ph.D	Geology Hydrogeology
Dr Stuart Brown	Specialist Support – Groundwater Modelling	B.Sc (hons), M.Sc, Ph.D, MBA	Hydrogeology Groundwater Modelling
Darren Ellis	Internal Peer Review	B.Sc; M.Sc	Hydrogeology

5 Findings

The findings of the ITPR process have been structured with reference to the advice provided by EPA regarding the approval pathway for the ash landfill cap in its correspondence to Alcoa dated 21 September 2021. In this correspondence, EPA outlined the information that should be provided in order to facilitate the surrender of the ash landfill from EPA Operating Licence OL000011429. The ITPR team's opinions on how the CLARA responds to those items are addressed in turn in the following sections.

5.1 Detailed Design of the Landfill Cap

The design elements relevant to the clay-rich cover material placed over the CLA are detailed in Section 5.2.1 of the CLARA. As described by EHS Support the CLA was not intended to be designed as a traditional landfill and subsequently many of the requirements of the landfill BPEM are not considered to be applicable to the CLA. The CLA was deposited in the former mine pit and incorporated into the overburden backfill process, in accordance with the Mine Work Plan endorsed by ERR in 2011. The CLA will ultimately be submerged by the developing pit lake water body, as proposed by the draft Mine Closure and Rehabilitation Plan (MRCP). Rather for this application the landfill BPEM provides best practice guidance regarding specific design elements of the CLA such as cap and lining materials properties, performance objectives and construction quality assurance.

The CLA was placed between a portion of the sidewall of mine void to the east and south, a constructed haul road to the north and a constructed berm to the west, and underlain by pre-existing clay-rich overburden. Following emplacement a ≥ 1 m clay rich cover was placed over the CLA in a series of three lifts of approximately 0.35 m using clay-rich material derived from Demons Bluff Formation and Boonah Formation overburden, which were track rolled by bulldozer for compaction. The final cap was graded with a shallow gradient to the southwest to facilitate drainage.

As shown in Table 5-1 of the CLARA, this is considered to meet the relevant requirements for traditional landfill caps as per the BPEM, apart from lift thickness which was 350 mm as opposed to the BPEM which includes the suggested measure of placing clay in at least four to six lifts equating to a minimum lift thickness of 250 mm. It was also noted that the cap, sidewalls and base were not emplaced under CQA as per the BPEM, noting the CLA was not intended to be constructed or managed as a tradition landfill.

In view of the above, the emphasis has been on retrospectively confirming the physical properties of encapsulating materials such as the cap, adjacent berm and haul road and underlying and adjacent fill material. The outcome of these assessments is described in subsequent sections, but in summary the data collected generally describes a high degree of uniformity in physical properties, including low permeabilities equivalent to the partially engineered clay-rich cover, which in turn has permeability characteristics broadly consistent with the requirements from clay liners under the landfill BPEM. That is, whilst the construction elements of the BPEM were not always met, the performance outcomes in terms of material properties are indicated to have been met.

It is also noted that the permeability of the ash within the CLA was also assessed post-placement, with permeability values ranging from 2 x 10^{-10} to 9 x 10^{-9} m/s comparable to clay liner specifications (less than 1 x 10^{-9} m/s). This highlights that the rate of water movement through the CLA itself would be very low, which is in contrast to a traditional landfill which is often relatively porous.

5.2 Targeted Performance (short and long-term) and Outcomes of the Proposed Landfill Cap

The targeted performance and outcomes of the landfill cap includes providing an enduring physical separation of the leached ash and overlying water body when in contact with saline groundwater and CLA porewater, and to act as a long-term low permeability barrier reducing any dissolved contaminant flux from the CLA to the surrounding environment to acceptable levels.

Targeted performance includes maintenance of overlying water body and surrounding groundwater quality that is consistent with the current interim water quality performance targets, as defined in the CLARA, and in the fullness of time the final water quality performance targets developed as part of the final Mine Closure and Rehabilitation Plan (MCRP).

The ITPR team provided considerable feedback on the proposed interim WQPTs, which are based on the current water quality in the developing water body. In light of the following considerations the ITPR team concluded that the Interim WQPTs are an appropriate short-term benchmark:

- The proposed WQPTs are interim and that final WQPTs would be determined once a filling strategy has been confirmed;
- The Interim WQPTs are intended to relate only to localised impacts from the CLA on the water body and groundwater and not to broader pit lake water quality issues, with impacts from the CLA having been demonstrated through physical testing and modelling to present a low risk;
- Using the existing water body quality as the basis for the Interim WQPT will ensure there is no water quality deterioration beyond the existing conditions until such a time that the final filling strategy is resolved; and
- The proposed Interim WQPTs are consistent with natural background catchment water quality in most respects, with the exception of boron. If the final WQPTs proposed a boron target above catchment background, it would need to be subject to a quantitative site-specific ecological risk assessment to determine the appropriateness of the target. Maintaining consistency with natural background water quality is consistent with the requirements of the ERS.

Overall, the stated targeted performance and outcomes of the cap, as described in the CLARA are considered appropriate and consistent with prevailing environmental principles, including the General Environmental Duty (GED) to minimise risks to human health and the environment so far as reasonably practicable.

5.3 Information that Supports how the Proposed Cap is able to Achieve the Targeted Performance and Outcomes

The assessment program has provided information that supports how the proposed cap will achieve the targeted performance and outcomes in the following ways:

- Provision of information in relation the design, engineering (as relevant) and construction of the cap and the extent to which this complies with relevant best practice guidance (e.g. the landfill BPEM);
- Physical testing and laboratory analysis of parameters relevant to the performance of the cap, other encapsulating materials and the leached ash itself, such as permeability, dispersity and leachability testing;
- Numerical groundwater modelling, utilising the model inputs based on the above testing to predict future performance under a number of scenarios in which the CLA becomes submerged, including sensitivity analysis.

Overall, the information provided in the CLARA through these three lines of enquiry is considered to adequately demonstrate the likely performance of the cap and other encapsulating materials. The ITPR team raised a number of issues throughout the review process in relation to this item, including:

- The density of sampling and the appropriateness of the laboratory methods to replicate actual and predicted site conditions;
- Modelling assumptions, including that the CLA had no advective potential prior to being submerged, despite some of the ash deposit being placed as a slurry; and
- Long term cap integrity, including, but not limited to, the effects of wave action and bioturbation on the cap materials during and post lake establishment.

Throughout the review and consultation process, these issues were resolved through additional sampling and characterisation (**Section 5.4.1**), sensitivity analysis (**Section 5.4.2**) and commitments to the development of an appropriate monitoring and maintenance program (**Section 5.4.3**), respectively.

5.4 Monitoring Results Capable of Confirming that the Cap is Performing in line with Targeted Performance and Outcomes, short and long term

The CLA is currently sitting above the water level in the waterbody, such that the CLA, encapsulating materials and surrounding fill material are expected to be unsaturated. As the CLA has not yet been inundated, monitoring results confirming the caps performance have not yet been collected.

However, testing and analysis of construction materials followed by modelling has been utilised to predict performance during and post inundation, with a monitoring program proposed to verify performance once inundation occurs.

5.4.1 Testing and Analysis

The testing and analysis has focussed on the physical characteristics of the encapsulating materials and the chemical characteristics and behaviour of the leached ash under a range of conditions. These analyses are intended to inform future cap performance and have included the following in consultation with the ITPR team:

- Total major and minor ion analysis of the leached ash;
- Major and minor ion leachable fraction (Australian Standard Leaching Procedure) analysis of leached ash at two pH values, pH 2.9 and pH 7;
- Permeability testing of encapsulating material and surrounding fill material using both de-ionised water and saline water (5,000 ppm) permeameter methods;
- Dispersivity/Reactivity (Emerson Class Number) testing of the leached ash and surrounding material.

In reviewing these data, the ITPR team focussed on the representativeness and density of sampling, including with reference to relevant standards, and ensuring that testing methods were adopted to demonstrate material resilience to chemical conditions. The key outcomes of this review process was to request additional permeability sampling of cap and other encapsulating materials, so as to achieve a volume-based sampling density of 1:5,000 m^3, which accords with the clay characterisation guidance in the BPEM and the use of saline water in permeameter testing, so as to more accurately represent the water quality likely to inundate the CLA in future. Both of these recommendations were adopted by EHS Support and works completed in subsequent field testing programs. It is noted that

the BPEM recommends that the permeability of basal liners is tested with 50,000 ppm NaCl solution to reflect saline leachate that would be expected to be in contact with a basal liner in a conventional clay lined landfill; this was modified with agreement from the ITPR team to 5,000pmm given the clay will be in contact with lake water once submerged, not saline leachate.

The final dataset characterising the physical and chemical characteristics of the CLA and the expected future behaviour of the materials encapsulating the CLA is considered to be a suitably robust basis from which to make predictions about future cap performance.

5.4.2 Groundwater Modelling

Numerical groundwater (and surface water) modelling using the finite element modelling program SEEP/W was undertaken as the primary predictive tool for CLA environmental performance during and post inundation. The modelling objectives were to simulate the rising water body and groundwater levels in and around the CLA and undertake particle tracking of a conservative constituent within the CLA over time, to assess any potential impacts on the surrounding environment.

The ITPR review included consideration of the following:

- The appropriateness of the modelling software selection;
- Adherence to applicable guidelines (i.e. the Australian Groundwater Modelling Guidelines);
- The robustness of the Conceptual Site Model (CSM) used to define the key model inputs and model parameterisation;
- The discretisation of the model domain, including boundary conditions;
- The selection of modelling scenarios and assumptions;
- Model calibration;
- Interpretation of modelling outputs; and
- Sensitivity analysis.

As discussed in **Section 4.5**, the ITPR team relied on the expert support of Dr Stuart Brown in reviewing the groundwater modelling components of the assessment.

The finite element modelling code SEEP/W is a widely used for geotechnical applications and is considered an appropriate platform to achieve the stated modelling objectives. The model environment is a 2D cross-section orientated through the CLA with transient western and eastern boundary conditions of the rising pit lake and recovering regional groundwater levels, respectively. While the rate of rise in these boundary conditions is also a prediction, and in many ways contingent on the final filling strategy, the boundary conditions are considered appropriate in the context of the model objectives. As configured it is considered to align with a Class 1 model confidence level, as defined in the Australian Groundwater Modelling Guidelines. Class 1 models are considered to have a relatively low confidence level; however, in this instance it is considered to be sufficiently rigorous given the setting, margin of safety indicated by the modelling results and relatively modest modelling objectives.

The CSM is considered to be appropriately developed and understood to reasonably inform the development of the model environment. The physical characterisation of the leached ash, encapsulating material and surrounding fill, including additional testing requested by the ITPR team (**Section 5.4.1**) has resulted in a robust and volume-based understanding of the key physical and chemical parameters considered relevant to the submergence of the CLA. Residual uncertainty has been addressed through the model sensitivity analysis process.

Given that the focal point of the modelling is currently unsaturated, the model is unable to be effectively calibrated to a historical dataset or present day conditions. This is consistent with a Class 1 model designation under the Australian Groundwater Modelling Guidelines (Barnett et.al., 2012).

The ITPR team provided considerable feedback on the underlying modelling assumptions, the interpretation of modelling outputs and sensitivity analysis. The primary areas of concern for the ITPR team were the assumptions that the CLA was a dry deposit with no advective potential until the point of inundation and saturation by rising water levels. In reality, the ash deposit is likely to be unsaturated, but large portions of it were placed as a wet slurry, raising the prospect of historic

excursions of solutes from the CLA into the surrounding fill. This was explored through sensitivity analysis applied to particle tracking, whereby hydraulic conductivities within the CLA were increased by three orders of magnitude to more closely approximate the lower hydraulic conductivity of the surrounding fill material, effectively modelling the behaviour of a conservative solute migrating within the higher permeability fill.

Throughout the scenarios utilising the adopted model parameters and subsequent sensitivity analysis, particle movements from within the CLA were shown to be small and substantially less than the distance to receptors, including the developing water body, over a 100 year simulation timeframe. Particle movements assume a conservative solute unaffected by attenuation factors such as adsorption, degradation or diffusion. The movement of many contaminant species would be expected to be slower due to these factors.

Overall the modelling is considered to support the field evidence that the CLA and clay-rich encapsulating material are likely to provide an effective advective impediment to solute migration from the CLA into the surrounding environment over any reasonably foreseeable management timeframe.

5.4.3 Future Monitoring

It is understood the future monitoring requirements will be formally documented in separate monitoring plans and are not described in detail in the CLARA. Rather the CLARA provides the overall monitoring principles and these have been subject to review by the ITPR team. The monitoring requirements relevant to the CLA fall into the following categories:

- Monitoring of pit lake water quality;
- Monitoring of surrounding groundwater quality; and
- Monitoring of CLA cap integrity.

Pit lake water quality, in relation to any impacts from the CLA during and post submergence, is proposed to be monitored in comparison to the Interim WQPTs. The ITPR teams views on this item are discussed in **Section 5.2**. In addition to the targets themselves, the ITPR team also noted a lack of clarity as to how these targets would be applied (i.e. sampling locations, frequencies and target analytes). However, it is understood that these matters will be articulated in a separate monitoring plan.

Surrounding groundwater quality is proposed to be monitored using the existing monitoring well network at the margin of the current mine pit. The ITPR team raised concerns regarding the appropriateness of these locations to monitor the impacts from the CLA. However, in the context that the purpose of the monitoring (and the ITPR team's scope of review) was specific to the activity of submerging the CLA, it is acknowledged that there are practicability constraints in relation to monitoring bores within a waterbody. Furthermore, the CLA lies within a much larger and highly disturbed former mining environment where it may be difficult to discriminate between impacts from the CLA and impacts from other mining induced disturbance. In that context, monitoring locations at the periphery of the mine void do present reasonable sentinel monitoring points to detect excursions to the wider environment.

Similar to the monitoring the pit lake water quality, the CLARA does not articulate the details of the groundwater monitoring program, including frequencies, analytes and contingency actions. These would need to be documented in an appropriate water quality monitoring plan.

Regarding cap integrity during and post lake establishment, it was agreed that an appropriate monitoring regime would be implemented to address the following areas of concern:

- Degradation of the cap through wind-driven wave action and other erosion processes, particularly when the water level coverage of the CLA was shallow; and
- Degradation of the cap through biological processes, including bioturbation (e.g. burrowing organisms).

Similar to other elements of the monitoring program, the CLARA does not articulate these requirements in detail; however, the following commitments have been agreed as part of the ITPR process:

- A monitoring and maintenance program, including cap inspection and repair (if required) will be implemented for the period up until the CLA is fully submerged;
- A program of bathymetric survey, or other similar suitable technology, will be implemented post CLA submergence to confirm the ongoing integrity of the cap (i.e. through monitoring of cap surface elevation), until such time that it is established that the cap is stable.

A detailed monitoring program will need to be established to formalise these commitments including frequencies, trigger levels, contingency actions, reporting requirements and rationalisation/cessation criteria.

5.5 Detailed and Verifiable Confirmation that the Proposal Constitutes Best Available Techniques

EHS Support undertook a literature review of Australian and international examples of long-term coal combustion ash (CCA) management practices, which included some examples of subaqueous deposition of CCA materials.

Most CCA materials globally are dry managed in the sub-surface (i.e. ash landfills) or wet managed in impoundments (i.e. ash ponds), with both methods producing a range of well documented environmental hazards. Increasingly, in jurisdictions including Europe and China, CCA is recycled for use in construction and infrastructure projects. The subaqueous deposition examples were reported from Germany, where ash was deposited in lakes as an amendment to reduce acidity and were presumably uncapped.

On the basis of the review completed by EHS Support, there appear to be few examples of the submergence of a capped CCA deposit; however, the proposal has much in common with the management of dredge spoil which is conducted in subaqueous environments worldwide. In dredge disposal grounds, dredged sediments, often containing heavy metals and other contaminants derived from industrial port environments are deposited in subaqueous impoundments and capped with clean material with the following objectives:

- Physical isolation of the impounded material;
- Stabilisation and prevention of erosion and resuspension in the water body; and
- Reduction of dissolved contaminant flux to the overlying water body.

These objectives are considered to apply equally to the CCA at Anglesea, where it is considered, based on the assessment work to date, that the encapsulating materials are likely to achieve these objectives.

On the balance of the assessment work undertaken, and the assumptions inherent in the proposal, the ITPR team is of the view that the proposed management of the CCA at Anglesea in some cases exceeds the accepted standard for CCA management in ash ponds, which are often unlined, and is comparable to best available techniques as it applies to similar materials in subaqueous environments. It could be argued that dry management or recycling would also represent best available techniques; however, neither are considered reasonably practicable under the logistical circumstances and pre-existing regulatory approvals process.

5.6 Measures taken to Comply with the General Environmental Duty, relevant Environmental Reference Standards and principles of the Environment Protection Act 2017

Measures taken to comply with the GED, and other applicable legislation, is outlined in Section 3 of the CLARA.

The works completed in relation the CLA, including the design and capping and subsequent characterisation and risk assessment process, is considered to be consistent with the GED which is to minimise risks to human health and the environment so far as reasonably practicable. It has been demonstrated to a reasonable level of certainty that the cap and encapsulating materials surrounding the CLA have properties consistent with best practice objectives for landfills in Victoria as relevant. The adoption of best practice ensures that risks are minimised to the extent reasonably practicable and is consistent with the requirements of GED. Further, this approach is comparable to best available technologies and techniques given the environmental and regulatory context.

The ERS is most relevant to the consideration of the surface water and groundwater environmental values adopted. The ITPR team provided some feedback on this element of the work in terms of the application of environmental values to artificial water bodies and ensuring the environmental value of water-based recreation (aesthetic enjoyment) was appropriately considered in the context of the ways in which the community would be able to make use of the future waterbody. The environmental values that are proposed to be protected in the mine water body of water dependent ecosystems and species (consistent with that in the surrounding environment) and water-based recreation (aesthetic enjoyment) are consistent with the use for which the mine water body is intended; it is understood that the relevant regulatory authorities have determined that neither primary nor secondary recreational uses are intended end uses of the water body.

The proposed measures are also in alignment with the principles of environment protection as outlined in the *Environment Protection Act 2017*. Notably the CLA management is consistent with the principle of proportionality, that is, the design, construction, monitoring and maintenance of the CLA have been developed in a way that is proportionate to the risks identified. Characterisation of the ash indicates that the principal environmental risks associated with the CLA are associated with potential leaching of trace metals to the future mine water body and groundwater, albeit at very low rates due to the low permeability of the ash and encapsulating materials. The ITPR team is satisfied that these risks are appropriately mitigated by the encapsulation approach adopted, which would be verified through future monitoring and maintenance (as necessary) programs.

In addition, with regard to the waste hierarchy as outlined in the *Environment Protection Act 2017*, the waste could not be avoided and opportunities for reuse and recycling were not considered reasonable and practicable under the logistical circumstances and pre-existing regulatory approvals process. Recovery of energy is also not applicable. Therefore, the next preferred approach in the waste hierarchy, being containment, has been adopted.

The ITPR team is also of the view that evidence-based decision-making has been applied, and this was emphasised through the process by ensuring that retrospective testing was conducted to address any data gaps. Finally, the approach adopted has considered the uncertainties involved in the characterisation and applied sufficient conservatism in approach. For example, the groundwater modelling includes a sensitivity analysis to evaluate risks under less conservative circumstances. This is consistent with the precautionary principle.

6 Conclusions

Based on the review undertaken the following conclusions are drawn with respect to the review objectives:

- The combined assessment and characterisation work on the physical properties of the CLA is considered to have been completed in accordance with appropriate and relevant legislation, guidance, and industry standards to the extent practicable. The outcomes of this work are considered to be a reasonable basis from which to assess the likely future impacts on the surrounding environment from the submergence of the CLA within the pit lake.
- Numerical modelling has been utilised to make predictions regarding the future environmental performance of the CLA cap and other encapsulating materials. The model it is considered to be sufficiently rigorous given the setting, margin of safety indicated by the modelling results and relatively modest modelling objectives.
- The numerical modelling, together with other lines of evidence including the site-specific physical characterisation of the materials, has been used to inform the risk assessment process. The risk assessment concludes that the activity of submerging the CLA beneath the pit lake represents a low risk of adverse environmental outcomes in both the short and long term.
- In the context of the specific assumptions (**Section 4.1**), the history of regulation and the environmental setting, the ITPR team is of the view that the submergence of the CLA does present a low risk of adverse environmental outcomes for surface water and groundwater and that the approach is consistent with previous regulatory directions and broader principles of environmental protection, including the GED.
- Future monitoring and verification of the environmental performance is considered to be a key tenet of sound environmental management. The CLARA provides the overall monitoring principles which the ITPR team considers appropriate. It is understood that specific detail on the

future monitoring requirements, trigger levels and contingency actions are to be prepared prior to the submergence of the CLA. The ITPR team emphasises that an appropriately detailed water management plan as proposed should be developed and implemented so as to provide a robust framework for future environmental management of the CLA.

7 Closure

Please contact either of the undersigned should you wish to discuss any matter regarding the ITPR.

Yours sincerely,
BlueSphere Environmental Pty Ltd

Dr Matt Edwards
Principal Hydrogeologist
p: +61 (3) 9699 5286
m: +61 (0)448 035 559
e: medwards@bluesphere-enviro.com.au

Dr Darren Bennetts
Principal Hydrogeologist
p: +61 (3) 9699 5286
m: +61 (0)417 156 055
e: dbennetts@bluesphere-enviro.com.au

This report was prepared for the sole use of Alcoa of Australia Limited and should not be relied upon by any other person. None of BlueSphere Environmental Pty Ltd or any of its related entities, employees or directors (each a BlueSphere Person) owes a duty of care (whether in contract, tort, statute or otherwise) to any third party with respect to or in connection with this report and no BlueSphere Person accepts any liability for any loss or damage suffered or costs incurred arising out of or in connection with the use this report by any third party.

The report has been prepared with the objectives and scope of work outlined in the proposal dated 18 February 2022 and subsequent variations. The work was carried out in accordance with the Contract CW2303449 .

The conclusions and recommendations provided in this report are based on available information and it is possible that different conclusions and recommendations could be made should new information become available, or with changing site conditions over time. These opinions, conclusions and recommendations are subject to uncertainty given the potentially complex nature of any subsurface environment. Variation in soil and groundwater conditions may vary significantly between the specific sampling and testing locations and other locations at the site.

The report will not be updated if anything occurs after the date of this report and BlueSphere Environmental Pty Ltd will not be obliged to inform any person of any matter arising or coming to its attention after that date.

Attachments:

Attachment 1 ITPR Comments Register

References:

ANZG 2018. Australian and New Zealand Guidelines for fresh and marine water quality. Australian and New Zealand Governments and Australian State and Territory Governments, Canberra, ACT, Australia.

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EHS Support, 2021. Supplemental Surface Water and Soil investigation Report, Anglesea Alcoa Power Station, April 2021.

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EPA Victoria, 2015, Siting, design, operation and rehabilitation of landfills, Best Practice Environmental Management, Publication 788.3, August 2015.

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Government of Victoria, 2021, Environment Reference Standard, No. S 245, 26 May 2021;

National Environment Protection Council (1999, 2013 revision), National Environment Protection (Assessment of Site Contamination) Measure (NEPM 2013).

Attachment 1

ITPR Comments Register

INDEPENDENT REVIEW COMMENTS REGISTER

Review Comments

Please Note:

This register is provided for the purpose of clarifying issues arising from this independent peer review, and is not to be reproduced in any document prepared by the recipient for distribution, unless expressly authorised by BlueSphere Environmental. The comments provided may not be exhaustive or final and the independent reviewer may have further comments arising from information or advice received subsequent to this review.

Project Name: Independent Technical Peer Review of Hydrogeological M
BlueSphere Job No: 31098.01
Client: Alcoa of Australia Limited
Assessor: EHS Support

Ash Risk Assessment, Hydrogeological Modelling, Former Coal Mine, Anglesea, Victoria

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (6 April 2022)	EHS Support response to Reviewers Comment (6th June 2022)
Conceptual Site Model and Parameterisation					
1	-	General	0	It would be useful to explain how this modelling does (or does not) fit within the Australian Groundwater Modelling Guidelines. This is likely to be of interest to the regulators.	The SEEP/W model is a conservative assessment of the risk of a conservative constituent (particle) migrating from the ash under advective flow. If unacceptable risk were identified as outcomes of the modelling then the model would have been updated to inform the level of risk and this would also be coupled with the modelling described below. However, at this stage and conservatively the risks appear to be low and the coupling with a more detailed numerical model is not warranted. A detailed numerical model is currently in development in accordance with the AGWG. This is a catchment wide (Jan Juc GMA) groundwater model which is being peer reviewed by Hugh Middlemis. The objective of this model is to ascertain if a sustainable pumping rate can be used for mine rehabilitation strategies as well as inform DELWP on Barwon Waters Bulk Entitlement.
2	-	General	0	The model is conceptualised on the basis that the ash is only source of contamination to the surrounding environment. What is the background groundwater quality in the vicinity of the ash deposit and are there other sources of similar contaminants? The nature and condition of the surrounding environment is relevant, in that environmental risks may be perceived to be more tolerable in a disturbed environment compared to a pristine environment. Background is also a relevant consideration in the regulatory framework in Victoria, for example, where background water quality is elevated with respect to a specific parameter, the background becomes the objective.	It is recognised that the ash has been conceptualised as the only source of contaminants in the CSM. Currently there is no groundwater within the vicinty of the ash deposit(with the exception of intermittent water in DBG MB6). The aim of this modelling task was to conduct a high level assessment of the hydraulics of particle flow within the model domain. By using particle tracking (without attenuation or retardation) conservative assessment of constituent migration could be assessed. Dependent on the outcomes of this task, fate and transport modelling of specific constituents and background concentrations could be explored. As the outcome of this task was that particle tracking did not suggest migration of particles from the ash, through the clay-rich layer and into the fill material, it was concluded that a fate and transport modelling assessment was not necessary. This will be re-evaluated depending on the outcome of the revised sensitivity analysis of the fill material permeability.
3	2	Background	0	Reference is made to ash being allowed to "naturally dewater". Can you clarify what the likely fate of the water would have been (i.e. did the supernatant discharge to the pit lake/sump, evaporate or seep into underlying fill).	The dewatering of the ash was a combination of evaporation, lateral seepage into fill material (minimal vertical downward seepage) and direct discharge to the water body. In the shallow fill material, lateral seepage is assumed to be be dominant over vertical (downwards) seepage due to anisotropy of the fill material and evaporative flux. Supplementry analysis (total and leachable fraction) has been conducted in the decant are and discussed within the report.
4	2	Background	0	Reference to "encapulation" implies that the "clay-rich layer" exists above, but also underneath and to the sides of the ash deposit. Is this the case, or is it better conceptualised as a cap only?	The ash is covered by a consolidated clay rich layer. Only the covering layer has been laid down in lifts of approximately 300mm and compacted with the back of a bucket. The minimum 1m thickness of covering clay was tracked with a doser. The north-east boundary of the ash deposit is formed by the historical haul road into the mine pit. This road has been progressively formed using the same clay-rich material (sandy clay) as the covering layer. Beneath the consolidated ash and to the remaining sides fill material exists which range from minor sand lenses to clays. Supplementary permeability tests have been conducted at multiple locations areound the CLA area which verifies low permeability (average <1x10-9 m/s) material surrounding the CLA area
5	2	Background	1	It is understood that an Ash Risk Assessment will be prepared. The modelling report will need to be updated to include a summary of the findings of the Ash Risk Assessment report. This will assist in providing context regarding the significance of the consolidated ash deposit in terms of environmental risks and commensurate management necessary to minimise risks to the environment.	Noted and report can be updated as recommended. Report has been prepared and updated
6	3	Aim and Objectives	0	As above, the precise extent of the clay-rich layer is, to this point in the report, unclear and requires clarification.	Refer to Figure 1 and figure 4 which show the inferred extent of the consolidated ash deposit. This extent will correlate with the extent of the compacted clay-rich layer cover. Supplementary field works have confirmed extent of CLA area
7	4.1	Dispersivity/Reactivity	0	Materials testing undertaken to date (dispersivity and permeability testing) has been undertaken using deionised water. It is recommended that testing also be undertaken using saline water to simulate interaction with water in the pit and groundwater, noting that cation exchange reactions can alter the performance of clay materials.	We note that higher salinity pore water has the potential to alter the performance of the clay (specifically permeability). The ash, fill material and clay-rich material are extremely saline (ECe >16 dS/m) and highly sodic. If dispersion is likely it will occur due to the salinity of the existing clay-rich layer porewater and not just by the action of the ash (or fill material) porewater on the clay-rich material. If there is no dispersivity contrast between ash and clay-rich layer/fill material porewater, is additional material testing for salinity dispersivity warranted? Supplementary permeability tests (both saline and de-ionised water) have been conducted and the results incorporated into the updated report
8	4.2.1/4.2.2	Lithological Characteristics	0	These sections suggest that, in the vicinity of the coal mine the DBF (silts to fine sand) was 20 m thick and the BF was 32 m thick (comprising 20 m of fine-coarse sand and 12m of silt). This would tend to suggest the fill material, the it is understood constitutes re-worked DBF and BF would be relatively sandy. A description of the observed or expected fill profile in the vicinity of the consolidated ash should be described based on the current state of knowledge. This will assist in providing further substantiation regarding the hydraulic properties of the fill material subsequently adopted in the modelling. This should include reference to the pre-existing haul road on the northern margin of the deposit, batter slopes to the east and south, and the constructed berm on the western end of the deposit.	In addition to the in-situ geological descriptions, reference will be made to borelogs where overburden material has been encountered in the vicinity of the mine pit. The borelogs describe the overburden/fill material as mainly clayey sands, sandy clays with occasional sand horizons. Supplementary field works have confirmed the textural characteristics of the fill material as mainly sandy clay
9	5.2	Demon Bluff Group	0	Some comment should be provided in relation to how the K data from Beattie (2003) compare to other published data or text book values. This will assist validating these parameters.	Additional discussion will be added to address this response. Domenico and Schwartz (1990) have published values (m/sec) for clay ($5x10^{-9}$ to $1x10^{-11}$), silt ($2x10^{-5}$ to $1x10^{-9}$) and sand ($6x10^{-4}$ to $9x10^{-7}$). Beattie (2003) values fall within the range of the Domenico and Schwartz (1990) values. Hydraulic conductivities listed in Hazleton and Murphy (2016)* have published values (m/sec) for clay ($1x10^{-9}$), silt ($3x10^{-6}$ to $1x10^{-9}$) and sand ($2x10^{-4}$ to $3x10^{-8}$). Beattie (2003) values fall within the range of the Domenico and Schwartz (1990) and Hazleton and Murphy (2016) values. *Hazleton and Murphy (2016) Interpreting soil test results 3ed Slug test results for selected DBF bores in the power station area can be provided. As part of the recommendations a slug test is being performed on the only saturated bore in the overburden (DBG MB6) and the results will be compared to other slug test data from the shallower bores in competent (natural) DBG material. Additional field sampling and characterisation maybe conducted. The above has been incorporated into the updated report
10	6	CSM	0	Definition of "fast fill" at Paragraph 3 does not seem to describe filling via groundwater extraction, as currently proposed.	The used of extracted groundwater is the preferred option for a fast fill scenario, however, there are other potential sources of water that could be used to achieve a 'fast fill'. Description will be edited to make more explicit that this fast fill scenario uses abstracted UEVF groundwater as the source of water.
11	6	Figure 6-1	0	As above, diagrammatically represented as being completely encupsulated. To what extent does this represent the reality? The nature of the fill material surrounding the consolidated ash should be described.	The conceptual model description will be modified to describe the placed clay-rich layer cover and the clay-rich characteristics of the fill material surround the consolidated ash on the sides and base.
12	8	Model Construction and Input Parameters	0	Construction of the model domain such that the ash and clay rich material constitute one region raises the issue of the fate of water within the ash immediately following placement. The model, as constructed, effectively places water draining from the emplaced ash into contact with the underlying fill material. Clarifying the lithology beneath the consolidated ash (i.e. that a continuous low permeability clay layer is present beneath the ash) is therefore of critical importance.	The conceptual model description will be modified to describe the placed clay-rich layer cover and the clay-rich characteristics of the fill material surround the consolidated ash on the sides and base.
13	8	Model Construction and Input Parameters	0	Hydraulic conductivity inputs (at least for the clay rich material) are based on laboratory permeability tests, rather than pumping tests. Can you comment on the likely impacts of sample disturbance, but also potential macro porosity features such as fissures and cracks in the cap material. Has this been addressed via sensitivity testing?	The clay-rich material and fill material are both distrurbed materials derived from the process of removing overburden during open-cut coal mining. The material has been disturbed prior to taking samples but the process of collecting the samles is unlikely to affect the permeability results bythe introduction of fissures or cracks. Macro porosity changes has been explored through the sensitivity analysis where the permeability of the ash was increased by 3 orders of magnitude (noting that the consolidated ash model region incorporates the clay-rich layer).
14	8	Model Construction and Input Parameters	0	Can you clarify further how the western boundary condition functions as water levels rise? Does the model domain include bathymetric information that allows a water body with a level surface to develop, or is it simplified such the the water level in the model domain is linear from the western boundary condition to the eastern boundary condition?	The water surface that develops in the water body is linear and the equipotential surface (or water table) between the western and eastern boundary conditions is dependant on the material properties and corresponding pore water pressures. During a transient simulation the water level between the western and eastern boundary conditions is not always linear but depending on the length of the transient simulation and the material properties and hydraulic functions, linearity will be achieved at the end of the simulation.
15	8	Model Construction and Input Parameters	0	Recovery in groundwater levels in the DBG is modelled as a linear function, when in reality this might be expected to be more asymptotic. What effect would this simplification have on model predictions, if any? Would it be correct to say that an asymptotic rise could increase the period of time over which hydraulic gradients could slope away from the mine void?	It is recognised that the hydraulic functions are linear and that they are more simplified than what would be expected to occur in an anisotropic model domain. However, the linear hydraulic functions are applied to the boundary of the regions comprising fill material and consolidated ash. The differing material properties of these regions does induce an asymptotic increase in the water table within these regions. It is accepted that non-linearity in the boundary conditions could both decrease or increase the period of time over which hydraulic gradients induce groundwater flow radially away from the water body. However, a linear function provides a reasonable estimate of the rate of groundwater water level recovery in both the fill material and consolidated ash regions.
16	8	Table 8-3	0	Check stated groundwater flow directions - appear incorrect (e.g Scenario 1a West (-39.79) to East (-39)	Scenario 1a has been modelled as an east to west groundwater flow, i.e., eastern boundary condition head -39 mAHD and western boundary condition head -39.79 mAHD. Table 8-3 has been corrected to reflect this.
17	8	Model Construction and Input Parameters	0	Rainfall and evaporation are not considered significant enough components of the water balance to warrant modelling or capture in the recovery functions. Some further rationale would be useful to justify this assumption.	Conceptually (Section 6), rainwater has been considered as part of the water budget within the model domain. However, evaporation and the low permeability of the fill material results in rainfall being a very small contributor to both the development of the water body and infiltration through the unsaturated zone to groundwater. The model setup uses boundary conditions to simulate the development of a water table within the model regions based on a total water head and not a water flux so the omission of the minimal contribution of rainfall (minus evaporation) does not affect the overall outcome. Additionally, the greenamp equation has demonstrated (detailed numerical model) rainwater infiltration is negated by evaporation by capillary rise in the vadose zone. Additional text added to report to justify the assumption
18	8	Model Construction and Input Parameters	0	It should be stated that a key assumption is that the consolidated ash remains a geotechnically stable landform. Whilst not specifically relevant to the modelling, it is anticipated that geotechnical considerations will need to be addressed as part of the ash risk assessment response to EPA. Although beyond our area of expertise, geotechnical advice in relation to bouyancy of the ash deposit, differential settlement induced by the overlying water column and erosion via wave action during filling of the pit may be relevant.	MiningOne have completed these assessments and will be included in the overarching Ash Risk Assessment report. This information will be included as part of the updated MRCP, not the Consolidated Leached Ash Risk Assessment as indicated above
19	9.1	Scenario 1	0	Scenario 1 does not acknowledge the presence of water in the ash itself, which was deposited wet. As per previous comment, the fate of this water should be clarified. Perhaps a further scenario could be incorporated to define the initial conditions, where by a head from the ash layer is applied to the underlying fill material to simulate the initial migration of solutes from the ash into the underlying material. This may then inform refinement of the placement of particles for particle tracking.	The presence of water within the consolidated ash (the residual water content) was considered during the SEEP/W model development. Previous versions of the model allow you to use the sample function estimation method and specify a saturated amd residual water content within material properties. However, the current version only allows input of a saturated water content and a function is applied dependent on the sample material (soil type) selected. Alternatively the user can create a function based on a upper and lower volumetric water content (VWC) value however this is not recommended by Geostudio without using either a closed form solution or a predictive method. To explore the potential infuence a higher residual VWC has on unsaturated flow, a user derived function was used with a VWC range of 0.25 to 0.43. The results for elements within the consolidated ash region and in elements directly surrounding this region in the fill material region were queried for VWC. In Scenario 1b transient conditions 2016 to 2022, the VWC within the cosolidated ash region is at or near saturation while the fill material is close to residual values (0.02). It appears that the consolidated ash is at field capacity and there is no free draining water from the consolidated ash region into the fill material.
20	9.2	Figure 9-8	0	Caption states easterly groundwater flow, but this appears to be contrary to the boundary conditions and the flow vectors	Correct, the groundwater flow is from the east to the west i.e., westerly groundwater flow. Report corrected to reflect this.

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (6 April 2022)	EHS Support response to Reviewers Comment (6th June 2022)
Conceptual Site Model and Parameterisation					
21	9.2.1	Particle Tracking	0	The placement of particles within the ash itself, and only once the ash becomes saturated by groundwater and water body recovery, does not acknowledge that the ash was placed wet and solutes likely exited the ash much earlier than modelled. This requires some consideration as previously suggested. A possible workaround to the lack of convergence when placing particles in unsaturated parts of the model domain, would be to place particles immediately outside the ash to simulate remobilisation of historic discharges from the base of the cell. Further groundwater monitoring of the underlying aquifer may shed light on any historic impacts of this nature.	Particle tracking just outside the consolidated ash region and within the fill material model region will be conducted to explore the potential for seepage from the ash into the surrounding fill material.
22	9.2.1	Particle Tracking	0	The validity of the particle tracking approach could also be tested by modelling seepage through the clay rich layer based on a likely head (albeit declining) that would have developed in the ash post placement. This also calls for clarity on whether the "cap" is present beneath the cell or only above, as previously raised, and what verification there is regarding the properties of this material.	Is the reviewer suggesting simulating a declining head on a clay layer in isolation to the modelling performed? The CSM shows that the water head on the clay-rich cover will be increasing over time (not declining) until a 'steady-state' water body elevation is achieved. Additional explanation will be provided within the report describing the presence of low permeability fill material beneath the consolidated ash and clay-rich material cover on top of the consolidated ash. Additional field sampling to address data gaps has been proposed in the draft SAQP.
23	9.2.1	Particle Tracking	0	This section discusses the failure of the model to converge where particles were placed within unsaturated part of the model. Where convergence is an issue, it is suggested that calculations using first principles (i.e. Darcy velocity assuming saturated conditions) could be used to validate scenarios where this is the case.	Darcy flux calculations indicate 6cm/yr travel distance for a particle within the consolidated per year using a hydraulic gradient of 1. Shallower gradients will induce a lower flux Conceptually, the hydraulic gradient will change considerably as groundwater inundates the consolidated ash until steady state water body elevations are achieved. Gradients that develop are dependant on material properties and the fill scenario (slow or fast).
24	9.2.1	Figure 9-10	0	As above, text refers to an easterly flow direction. The flow vectors can be hard to resolve, but both the flow vectors and boundary conditions on the figure seem to be describing a westerly flow - please clarify.	Correct, the groundwater flow is from the east to the west i.e., westerly groundwater flow. Report corrected to reflect this.
25	9.2.1	Table 9-3	0	As above, placement of particles could be more conservative. Placed just outside the cell to simulate seepage from when the ash was saturated, they would travel considerably further.	As stated above particle tracking just outside the consolidated ash region and within the fill material will be conducted to explore the potential for seepage from the ash into the surrounding fill material.
26	9.4	Sensitivity	0	The model is clearly sensitive to the hydraulic conductivity of the ash and/or surrounding encapsulating clay, which stands to reason. The existance and properties of the clay-rich material underlying the cell would seem to be critical to the assumptions inherent in the model. What physical testing of this material (specifically from beneath the cell) has been undertaken?	Based on the known elevations of the consolidated ash placement, six samples were collected below the consolidated ash and within the underlying fill material. Two of these samples were identified as consolidated ash in the report which was in error and will be corrected in the new draft report. In summary, 7 samples were collected within the clay-rich cover layer, 3 samples on the clay-rich/consolidated ash interface, 10 samples within the consoidated ash, 1 sample within the interface of the consolidated ash/underlying fill material and 6 samples from the underlying fill material. Of these samples 7 ash, 4 clay-rich layer and 1 fill material were tested for permeability and dispersivity. As part of the recommendations a slug test is being performed on the only saturated bore in the overburden (DBG MB6) and the results will be compared to other slug test data from the shallower bores in competent (natural) DBG material. Additional field sampling and characterisation maybe conducted. **Above comment modified 31/05/2022 Supplementary field works have collected additional data to support the ealry assumptions related tot he CSM.
27	10	Summary and concs	0	A key assumption of the modelling is that ash-derived solutes did not exit the cell during the period that the cell was saturated from wet placement. The validity of this assumption should be explored and model scenario (or at least a sensitity test) should be derived to assess the possible outcomes under a scenario where solutes did exit the cell during this period.	As stated above particle tracking just outside the consolidated ash region and within the fill material will be conducted to explore the potential for seepage from the ash into the surrounding fill material. If the outcome of the particle tracking suggests migration within the fill material additional fate and transport assessment could be warranted. Placement of particles just outside the CLA area did not warrant additional F&T modelling
28	10	Summary and concs	0	Particles are shown to move distances that are a small fraction of the model cell size in many cases. Can you clarify how the model calculates these travel distances. Also it would be worth validating these travel distances using first principles - are the particle tracks reasonable based on the prevailing hydraulic parameters?	The particle velocity and movement are calculated by the water/air flux and material porosoty or saturated volumetric water content. Particle movement is the same as advective transport without dispersion. A document 'Seepage Modelling with SEEP/W" has been attached with these comments. Section 13 provides further detail on the water flow PDE's principles and how these are applied to the finite element flow calculations.
29	11	Recommendations	0	If further samples of the clay rich material are to be collected, it would useful to collect samples of the clay underlying the cell for permeability testing, including using a saline eluent. Consideration should also be given to undertaking materials characterisation on the side-walls of the cell. Exploratory drilling can be used with selective permeability testing to provide sufficient spatial coverage, supplementing the existing data. There are opportuntities to convert some exploratory boreholes to monitoring wells (sacrificial) focussed on monitoring the consolidated ash until it becomes submerged. It is expected that EPA would expect groundwater monitoring wells be installed as part of considering the approval.	As noted above 6 samples of the underlying fill material were collected in September 2021. Of these samples 3 under went permeability analysis, reporting hydraulic conductivities of $6x10^{-8}$ to $4x10^{-9}$ m/sec. The need for addiitonal field intrusive investigations, sampling/analysis (refer comment 26) and installation of monitoring wells will be assessed. Supplementary fieldwork was conducted to obtain addiitonal data to support the numerical modelling. Additional bores/wells are not considered necessary at the present moment.
30	11	Recommendations	0	The additional fill material samples (particularly those from beneath the cell) may be able to be used to further assess the possible excursion of ash-derived solutes from the cell historically. This may be able to be assesed through total analysis of the soil, leach testing, cation exchange testing. It would be prudent to consult with a landfill design engineer to ensure that appropriate tests and frequencies are obtained to satisfy expected EPA requirements, noting there are some very specific and nuanced testing requirements in the BPEM (whilst not directly relevant to consolidation of ash, specific elements of the BPEM are expected to provide useful benchmarks for best practice waste containment).	The testing to date has been informed by Steve Cambridge (environmental auditor) and David Ife (landfill engineer specialist). It is noted that additional testing has been considered.
31	Appendix C	Borelogs	0	The borelogs reviewed do not appear to show a specific ash layer, rather silts and clays with what appears to be a minor proportion of ash. Can you please provide further clarification regarding the nature of the ash, is it mixed with overburden material or are there discrete layers that perhaps could be highlighted more clearly on the logs using the graphic log.	Further detail will be provided as to the ash placement activities into the pit and consolidation into the current area. Historically, ash was trucked to the edge of the void and tipped over the edge as solids and solids with ash pond water. This activity entrained overburden material into the ash and it is evident in the photographic logs that the ash does not visually represent traditional ash characteristics (particularly in colour). Aerial photographs will also be provided to visualise the tipping area (as new Figure 2).
32	9.4	Sensitivity Analysis	0	The sensitivity analysis considers variations in the water body fill rate and the hydraulic conductivity of the coal ash fill material. The latter scenario assumes a hydraulic conductivity 3 orders of magnitude higher than the geometric mean of the samples tested (2.9 x 10-6 m/sec versus 2.9 x 10-9 m/sec). This is well outside the range of samples and overly conservative. Also, presumably if long term groundwater flow is towards the water body (and slightly upward), then the solute will be travelling through the backfill material, so it would be more relevant to assess uncertainty in the backfill characteristics.	The comment is noted and additional sensitivity analysis of the back fill material will be conducted which will assess the lower hydraulic conductivities of the fill material. The initial approach is valid as it does assess the higher hydraulic conductivities which are likely associated with the medium and coarse grained sand stringers within the fill material. A sample was atempted to be collected in September 2021, however, due to the unconsolidated nature of the material the sample could not be recovered.
33	9.2.1	Particle Tracking	0	The discussion regarding flow paths and particle tracking on Page 31 is confusing. It states that the flow paths shown in green are not physically or realistically correct if they terminate at the base of the model (which is all but one flow path). They appear to show vertical upward flow through the cell (as do all the small flow vector arrows below the cell). Elsewhere it is stated that groundwater flow is from east to west in late time steps, so does this mean that the groundwater pressures never reach equilibrium during the simulation?	The text will be reworded to make more clear. The discussion will state the differences in particle flow during steady-state and transient simulations. It is also more accurate to state that the hydraulic gradient is mainly east to west and there is an overall net flow of groundwater from the east to the west, however, flow paths witin the model regions are a combination of horizontal and vertical. For flow path terminations at the model boundary this is simulated as a no flow boundary due to the base of the CSM represented by the basal clay. Steady state simulations have been used to show the groundwater pressures at equilibrium whihc some of the transient scenarios to not attain during the simulation period.
34	9.2.1	Particle Tracking	0	The following section (9.2.1) says that “a particle has infinite vectors to flow over time and it is not known what the particle path will be”. While I understand what the modeller is saying here, it might appear to some readers that you can’t predict the flow path, which sort of defeats the purpose of the modelling. I would suggest these sections be re-worded to clarify. Also consider annotating the cross setions to show the flow directions based on particle tracking at the associated time steps. The tables show the groundwater velocity but not clearly the direction.	This text will be reworded to provide additional clarity. Some screen shots of the particle tracking paths will also be provided in the new draft report.

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Project Name: Independent Technical Peer Revie
BlueSphere Job No: 31098.01
Client: Alcoa of Australia Limited
Assessor: EHS Support

Memo, SAQP Data Gap Analysis - Consolidated Ash Risk Assessment

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (17 June 2022)	Assessor's Response (23 June 2022)
1	-	-	0	Preamble: In reviewing the number of proposed samples we have considered the material volumes surrounding the consolidated ash deposit, variability in existing results and typical standards applied to comparable scenarios. For example, the landfill BPEM, whilst not directly comparable to an ash repository, does provide best practice guidance for engineered liners and caps. Section 6.4.1 specifies the following: "properties of the clay (grain size distribution, plasticity index and moisture content) tested once every 5000 m^{3}". The following comments are provided with respect to this guidance, noting that there are other elements of the BPEM related to capping such as level 1 supervision, testing during placement etc that are obviously not relevant. Rather these deviations are considered by the sensitivity analysis of the modelling.	No response necessary
2	-	Objectives and Scope	0	It is understood from your email of 15 June 2022 that permeability testing using a 5000 ppm is proposed. By comparison, the work plan outlies that the porewater salinity is ~2000 ppm. It is agreed that the higher salinity should be adopted as a conservative approach to reflect potential higher salinity that could occur within the filled water body over time due to evaporation.	Understood no further response provided
3	-	Work Plan, as amended by email of 16 June 2022	0	Further to the above, ash pore water is quoted as 2,860 uS/cm (1:5). Is this the EC of the 1:5 extract or has this been converted to pore water salinity?	The laboratory method result is the EC (1:5) and the value represents the maximum concentration reported.This value has then been used to derive a total dissolved solids concentration using a factor of 0.7.
4	-	Work Plan, as amended by email of 16 June 2022	0	In your email of 16 June 2022 you propose to decrease the number of DI permeability tests in favour of saline tests. This is considered to be reasonable as the saline tests are more likely to approximate the real world conditions. It is considered that DI tests could be ommited particularly for the clay rich layer but a sub-set should still be taken for the balance of materials (i.e. haul road etc) for comparative purposes. See comments below.	In total 25 locations will be advanced across the project area to a maximum depth of 6m. Materials encountered will be logged at each location. Number of locations per domain area as follows: Clay rich cover - 3 locations Fill material - 3 locations (same locatios as above) Berm - 2 locations Haul Rd - 9 locations Southern - 9 locations Discharge - 2 locations In summary, permeability tests to be conducted based on comments and discussions with Bluesphere below: Clay rich cover - 3 locations, 5 saline permeameter tests Fill material (below the consolidated ash) - 3 locations, 5 saline permeameter tests Berm - 2 locations, 5 saline permeameter tests, 3 DI permeameter tests Haul Road - 3 locations, 6 saline permeameter tests, 3 DI permeameter tests Southern - 3 locations, 6 saline permeameter tests, 3 DI permeameter tests Chemistry analysis will be conducted on the following: Discharge area - 2 locations, 0 permeameter tests, 6 samples for total chemistry and 4 for leachable fraction analysis at pH values. SAQP will be updated to reflect these changes.
5	-	Work Plan - Table 3, as amended by email of 14 June 2022	0	Clay rich layer: Three DI and three saline permeability tests are proposed for the clay rich layer, in addition to the 4 existing DI tests. Based on a placed volume of ~46,000 m^{3}, this would equate to a testing frequency of 1:7666 m^{3} for tests from individual locations. It is recommended that an additional two permeability tests to that proposed (i.e. five instead of 3 at individual locations) be conducted from this material giving a total of 9 individual tests. This would accord with the BPEM recommended testing frequency of 1:5000 m^{3}.	Agreed, 5 additional saline permeameter tests (at 3 locations) instead of the 3 proposed tests. No additional DI permeameter testing.Samples will be collected within the clay rich cover and fill material up to a maximum depth of 6m. SAQP will be updated to reflect these changes.
6	-	Work Plan - Table 3, as amended by email of 14 June 2022	0	Berm: Six DI and six saline permeability tests are proposed. Based on a placed volume of 24,000 m^{3}, this would equate to a testing frequency from individual locations of 1:4000 m^{3}. It is recommended that an additional one permeability test to that proposed (i.e. 5 instead of 4 at individual locations) be conducted from this material giving a total of 5 individual tests. This would accord with the BPEM recommended testing frequency of 1:5000 m^{3}.	Agreed, 1 less saline permeameter test, 5 tests in total (at 2 locations). Two DI permeameter tests. SAQP will be updated to reflect these changes.
7	-	Work Plan - Table 3, as amended by email of 14 June 2022	0	Haul Road/Southern Fill Material: The Haul Road and Southern Fill Material are considered to be critical elements of the containment system, as they effectively act as side walls. Based on the inferred areas of placed material comprising the haul road and southern fill material, there is a considerable volume of material that would need to be tested if strict compliance with the BPEM was adhered to. Theoretically, only a 1m strip of this material is necessary to meet BPEM standards. Instead, given the length of the perimeters of this material (understood to be ~900 m in total) it is recommended that a reasonable borehole spacing be adopted along these areas (e.g. comparable to that adopted for the clay rich cap which it is understood is based on guidance in AS4482.1-2005). Linking to best practice guidance provides a defensible approach. The testing frequency should also be justified in terms of the side wall material placed.	The volume of fill material in the Haul Rd and Southern area domains has been calculated using the 900m perimeter x 5m depth (1m clay rich cover and 4m consolidated ash thickness) x 1m thickness this equals 4,500m3. Using the methoddology from AS4482.1-2005 in Appendix D and an area of 7,200 m2, the recommended grid spacing between samples is 30m. However, given the presence of the placed clay rich cover and the surrounding low permeability material (as described in the CSM) a grid spacing of 50m has been adopted between locations, a total of 18 locations across these two domains. Each location will enable visual characterisation of materials to a maximum depth of 6m. Permeability testing will be conducted on 18 samples (12 saline and 6 DI water) across the two domains. Samples will be collected to represent the domains both laterally and vertically. SAQP will be updated to reflect these changes.
8	-	Work Plan - Table 3, as amended by email of 14 June 2022	0	Please clarify the thickness of the consolidated ash deposit, and what data this is based on. On revisiting the modelling report, references are made to "an average of 4 m" (Section 6) and "8 m" (Table 8-1). This is important in establishing the sampling density of the encapsulating materials.	The reference to 8m in Table 8-1 of the modelling report is a typographic error. The consolidated ash layer is approximately 4m in thickness and Table 8-1 will be updated to reflect this.
9	-	-	0	The fill material beneath the consolidated ash deposit has reported permeability values ranging between 6 x 10^{-8} m/s and 7 x 10^{-10} m/s. The initial modelling has shown that the model is sensitive to this parameter, albeit not suprisingly when a very conservative K value of 2.9 x 10^{-6} m/s is adopted. In any case, given that the reported permeabilities vary by almost two orders of magnitude and given the relevance to the model, some further testing of the fill beneath the consolidated ash should be conducted. This would assist narrowing the reasonable values to be adopted in the sensitivity analysis. As there are 4 existing tests from this material, ideally an additional 5 tests would be taken from the top 1m of the fill. This may be achieved by extending the three proposed sample locations within the clay rich layer footprint to depth (locations ADBH09 to ADBH11).	Agreed, 5 saline permeameter tests (at the 3 locations). No additional DI permeameter testing. SAQP will be updated to reflect these changes.
10		Work Plan - Table 3, as amended by email of 14 June 2022	0	Further to item 7, how was the decant water discharge spillway constructed and decommissioned. Are there gaps or redundant infrastructure in this perimeter wall? It may be prudent to reposition the nearby borehole to this location.	The spillway was simply a water spill (decant) point that was cut using earthmoving equipment to allow the water to spill out of the consolidation area during the dredging activity. It was repaired on completion using clay placed in and track rolled in approx 300mm lifts.
11	-	-	0	Further to our discussions this week, upon review it is considered that PSD and atteberg testing (plasticity index) (as suggested in Section 6.4.1 of the BPEM are not necessary. These tests are used to inform the quality of clay prior to placement, essentially acting as a proxy for the expected final permeability. In the case of a pre-existing liner, it is the ultimate permeability that is critical.	Agreed and these tests will not be undertaken

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Project Name: Independent Technical Peer Revie
BlueSphere Job No: 31098.01
Client: Alcoa of Australia Limited
Assessor: EHS Support

Memo, Ash Risk Assessment - Supplementary Field Sampling Results

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (20 September 2022)	Assessor's Response (06 October 2022)
1	Permeability Testing			As discussed at our meeting of 15 September 2022, the permeability testing has largely corroborated the hydraulic properties adopted in the modelling and has provided a defensible, volume-based characterisation of the materials encapsulating the ash deposit. We agree that the findings should be incorporated into the modelling report (and model itself, if required) to further justify the adopted parameters. The chemical testing has revealed some interesting observations, which the majority of comments below provided in that regard.	No response necessary
2	Permeability Testing			First paragraph, please note the highest permeability reported for both testing methods was 1 x 10^{-8}, not 7 x 10^{-8}.	I have noticed that some of the sample numbers are incorrect in the memo tables which have been revised. This revision hasn't affected the outcomes of the assessment. The maximum permeability (7 x 10-8 m/sec) was reported at location ADBH17, sample ID ANG-22-0030 (deaired analysis) - refer to Table 1
3	Permeability Testing			The geometric mean for each material group and between different testing methodologies should be provided.	The geometric mean was provided for the material groups although wasn't explicitly stated in the memo. Geometric means for both saline and de-ionised water permeabilities have now been added to the memo.
4	Chemical Testing			The memo concludes that the profile of major and minor ion concentrations (for both total and leachable fractions) is very similar for both clay rich cover material and fill material where ash pond water was historicaly discharged. However, the concentrations are appreciably higher in some cases in the discharge area (e.g. total analysis for Cl, Al, Fe, Mn and leachable analysis (particularly pH=7) for Na, Cl, SO4, Al, Fe, Pb). Variation in total concentrations of Al, Fe and Mn are possibly due to lithological heterogeniety, but the leachable fractions for compounds such as Cl and SO4 may well be due to residual impacts from the discharge of ash pond water. It would be useful to provide some commentary on this, including any materiality to the overall risk profile (which may be low), but also what this may mean for ash pond water that may have drained into the fill material below and adjacent to the ash deposit, when the ash was being dewatered.	It is acknowledged that only one sample of clay-rich cover (ANG-21-0189) has been tested for total and leachable fraction analytes and has been compared to 6 depth dependant samples of fill material (ANG-22-53 to 58) in the consolidated ash discharge area. We would disagree that the concentrations of selected analytes are appreciably higher in the fill material in comparison to the clay rich cover. If the geomean of the selected analytes in the fill material are compared to the clay-rich cover, the differences are mostly marginal (refer to tables below). It is unusual that the de-ionised water leachable fraction concentrations appear to be more elevated than pH2.9 as cations are usually leached at higher concentrations under acidic conditions and anions more strongly leached under neutral to alkaline conditions. However, it should be noted that while pH7 was requested as the leachate pH, the de-ionised water pH is observed to be variable between pH 5 to 7, which affects the comparison of sample results. In comparison the DI water is still at least 2 pH units greater than the pH2.9 leach. Samples ANG-22-0054 and ANG-22-0056 concentrations appear to skew the dataset for leachable aluminium and iron using DI water. Both samples reported the presence of coal and ANG-22-0056 reported 50% interstitial coal in the borelog, which has most likely resulted in elevated chloride, sulfate, aluminium, iron, magnesium and sodium.
5	Chemical Testing			It would be useful to prepare a graph or similar allow for direct comparison between pH 2.9 and pH 7 leachability results. An initial review indicates that the analytes are more leachable at pH 7 than pH 2.9. This should be explained from a geochemical (e.g. mineral stability) standpoint as this will form an important line of evidence regarding potential impacts to the water body which we understand is likely to have acidic pH conditions when filled.	As mentioned above while pH7 was reqested as the leachate pH, the de-ionised water pH is observed to be variable between pH 5 to 7, which affects the comparison of sample results. However, the DI water is still at least 2 pH units greater than the pH 2.9 leach and both the clay-rich cover and discharge area sample respond similarly, i.e. analytes appear to be more soluble at a higher pH (lower acidity conditions). If these results are representative of geochemical conditions in ash porewater (more alkaline), any porewater mixing with the surrounding acidic groundwater (based on DBG MB6 geomean of pH 6.6 but gradually decreasing over time) and more acidic water body (geomean pH 3.65) would be expected to have decreased solubility and less mobility. However, I am still not convinced the results are representative or reproducible and further investigation may be required.
6	Chemical Testing			Last paragraph states that leachable ion concentrations in ash solids have diminished overtime. It is not apparent from the data presented what is the basis for this conclusion.	This observation relates to data provided and discussed within the consolidated ash risk assessment report which will be provided imminently - hopefully this week.
7	Comparison of Ash Leachable Fraction with Water Body and Groundwater Quality			We agree that a comparison of ash leachable fraction with current water body quality results in similar concentrations for many constituents, but it is currently unresolved whether current water body quality is an appropriate or reasonable benchmark. It is noted that many constituents in the ash leachable fraction are substantially elevated relative to groundwater in DBG MB6 (e.g. Al, B, Ca). We understand that the development of performance targets is the subject of a seperate scope of works being undertaken concurrently.	If the water body is to act as a terminal sink for groundwater, once the fill material becomes saturated any constituents from the consolidated ash porewater will migrate towards the water body. Therfore, we selected the water body as a receptor and the water quality has been compared to the ash porewater quality. We accept that the water body water quality may change over time but the performance targets will capture this variation. It is also expected that DBG MB6 groundwater quality will potentially vary over time as the fill material saturates.
8	Comparison of Ash Leachable Fraction with Water Body and Groundwater Quality			Can some further justification be provided as to why sample ANG-21-191 is a representative benchmark for ash, noting that higher concentrations were reported for some analytes (e.g. sodium, chloride, aluminium, iron) in samples from the discharge area at pH 7 (acknowledging those results are not ash per se). It is acknowledged this information may be presented elsewhere, however, it is not evident when this memo is read in isolation.	Sample ANG-21-191 reported the most consistently elevated leachable fraction concentrations (at pH2.9) in comparison to the other 7 samples collected in 2021. Detailed total and leachable fraction analysis will be provided with the consolidated ash risk assessment report.
9	Ash Risk Assessment Updates			We agree with the concluding remarks. Please ensure comments provided on Document 1 of this IRR are also incorporated into the revised modelling report.	Agreed, no further comment.

	ADBH32	ADBH32	ADBH32	ADBH32	ADBH32	ADBH33	ADBH33	ADBH33
Final pH	5.4	6.3	6.1	6	6.6	5.7	5.3	5.5
pH (DI water)	5.6	6.9	6.11	6.06	--	6.75	5.07	6.18

		Soil Totals			
		Chloride	Aluminium	Iron	Manganese
Clay rich cover	mg/kg	100	2,480	4,870	<5
Discharge area geomean	mg/kg	114	2,700	8,590	9

		Leachable fraction at pH 2.9					
		Sodium	Chloride	Sulfate as S	Aluminium	Iron	Lead
Clay rich cover	mg/L	6	5	8	0.9	0.4	<0.1
Discharge area geomean	mg/L	7	4	5	1.5	1.5	<0.1

		Leachable fraction at pH 7					
		Sodium	Chloride	Sulfate as S	Aluminium	Iron	Lead
Clay rich cover	mg/L	1	8	15	2.63	6.07	<0.01
Discharge area geomean	mg/L	5	5	17	7.85	8.17	0.06

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Project Name: Independent Technical Peer Revie
BlueSphere Job No: 31098.01
Client: Alcoa of Australia Limited
Assessor: EHS Support — Memo, Alcoa Anglesea Mine Water Body and Groundwater Water Quality Performance Standards

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (29 September 2022)	Assessor's Response (3 October 2022)	Reviewer's Response (9 December 2022)
1	NA	Water Quality Standards and GED Overview		The purpose of the water quality performance standards should be described. It is understood that they are proposed to be developed to a) verify that the environmental values that are to protected are not being compromised, b) to verify that the consolidated ash deposit is not deleteriously impacting upon surface water quality in the mine water body and c) that potential risks to human health and the environment are being minimised so far as reasonably practicable.	Comment is noted. The purpose of the standards will be further incorporated into the memo.	Noted
2	NA	Water Quality Standards and GED Overview		Further to the above, the introduction would benefit from context regarding the conceptual site model associated with the filling of the mine void, which then informs potential viable exposure pathways relevant to the mine water body. Specifically, it is understood that groundwater will migrate away from the mine void potentially to off-site groundwater receptors whilst the mine water body is in the process of filling (and the adjacent formations recover). Once the groundwater levels have recovered and the mine void becomes a permanent groundwater sink these pathways will no longer exist. Direct exposure pathways associated with the pit such as risks to ecological receptors, and risks associated with potential overtopping during extreme weather events also exist. Enunciating these pathways will assist in deriving and providing rationale for derivation of water quality standards.	Comment is noted. This information is discussed in detail in the draft MCRP report, CHM report and groundwater modelling report. EPA and other relevant authorities/reference groups have been provided with these reports and are familiar with the potential risks associated with filling the mine pit void. The CHM document has been provided to Bluesphere and they have also attended the risk assessement discussions. The memo was developed to provide a snapshot of the framework to develop the water quality performance standards with a summary of baseline data. The contents of this memo will be incorporated into the overarching consolidated ash risk assessment report and will form a more cohesive discussion of risks, pathways and the CSM. Reference to the above documents can be made within the memo in the memo.	Noted
3	NA	Water Quality Standards and GED Overview		Paragraph 3 on page 1: In general this section is slightly confusing in that the discussion switches between surface water and groundwater. It would benefit from some clarification to make it clear when each is being discussed, and why both are relevant to the final development of water quality performance standards.	Comment is noted. This paragraph can be reworded.	Noted
4	NA	Water Quality Standards and GED Overview		Paragraph 3 on page 1: UEVF should be defined, as should its relevance to water quality in the mine water body.	Comment is noted. The relevance of mine water seepage to the upper sands of the UEVF will be discussed. The UEVF in connection with the water body is the unsaturated coal seam - Group A. The Basal Clay confines the lower UEVF. The upper UEVF is very low yielding and consists of approximately 120m clay/coal horizons. Refer to CHM for further detail on the geological CSM.	Noted
5	NA	Water Quality Standards and GED Overview		Last paragraph on page 1: For clarity note the segment of Central Foothills and Coastal Plains applies to surface water only. With respect to groundwater, this segment is only relevant to the environmental value of Water Dependent Ecosystems and Species.	Comment is noted.	Noted
6	NA	Water Quality Standards and GED Overview		The environmental values listed are for groundwater only. It is recommended that the environmental values of surface water are listed separately as they are not the same as those for groundwater.	Comment is noted. The mine water body is disconnected from the surrounding surface water system. Invert level of Lower Anglesea River is 4m AHD; the water body would have to fill to a greater elevation than this invert level to provide a mechanism with which discharge and interaction with the Lower Anglesea River could occur. Also, the consolidated ash is at -8 to -15 mAHD, which is far lower than the invert level of the River. February 2023 - in line with subsequent discussions the risk of overflow of the water body into the lower Anglesea River will be addressed for the MCRP	At a high level it is important to demonstrate that the water body will not present a potential risk to external environments, even if the likelihood of a release is very small. For example, in the unlikely event that overflow from the water body occur and the pH was sufficiently low, it could theoretically cause a fish kill event. The likelihood of this occur is very low, however, the consequence would be catastrophic. Whilst not specifically the focus of this review, justification that the adopted water quality standards would not compromise the external environment would be of comfort to the regulator, even if the likelyhood is very low.
7	NA	Water Quality Standards and GED Overview		Second paragraph on page 2, which discusses the applicability of environmental values as per the ERS. It should be clarified that where background water quality does not support an environmental value, the background water quality becomes the objective (Clause 19(2)). It would be beneficial to clarify the role of GED as per EPA Publication 1992: *"Circumstances where environmental values are not recognised in the ERS still must be managed in accordance with the general environmental duty (GED). This means that a person must still take reasonably practicable measures to minimise risks from pollution and waste to the environment or human health, even where environmental values may not apply in the ERS."*	Comment is noted. If background levels are naturally elevated, the system will be naturally adapted to those levels, and in this catchment there will be no risk of harm at those levels. For clarification we assume you are referring to Clause 16(2) not 19(2) of the ERS. Noted regarding the GED. The statement was made at the start of the memo to recognise Alcoa's general environmental duty. It is also the objective of the revised MCRP (to be developed) to address the minimisation of risks from the mine and water body features. Further text will be added regarding the wording from EPA Publication 1992.	Confirming reference to Clause 19(2), which relates to surface water. 16(2) relates to groundwater. There seems to be a difference in interpretation of the ERS in so far as whether environmental values apply when the background does not meet the generic water quality objectives. In the case of water dependent ecosystems and species, we are of the understanding that it will always apply (consistent with Alcoa's proposal to ensure the water body supports local flora/fauna), apart for those water bodies explicitally prescribed in the ERS.
8	NA	Water Quality Standards and GED Overview		First paragraph on page 3: It should be noted that it is EPA's view that the mine water body is regarded as an artifical lake and therefore is not subject to the exemptions stated in Clause 13(2) of the ERS (refer to letter of 24 March 2022). That is, the mine water body will have some environmental values depending on background water quality and the purpose for which the mine water body is intended. It should be noted that the Water Act 1989 also provides that water bodies should not be polluted with respect to any 'beneficial purpose' that they are reasonably intended to be used. This principal is consistent with application of environmental values and GED in this situation.	The objective of the mine pit lake is that it compliments surrounding natural catchments and environment. This is the development of a safe and stable landform. With native re-vegetation rehabilitation and a mine water body that is consistent with a background surface water quality which local ecosystems are naturally adapted to. It is acknowledged that Alcoa still have a GED, the Consolidated Ash Risk Management and Technical Assessment and the CHM all support this duty.	It is important to note that the proposal is protective of the environmental value of water dependent ecosytems and species consistent with the local catchment (e.g. background becomes the objective).
9	NA	Surface Water		A review of the references provided has not been conducted, however, it is understood that the acidity experienced in the lower Anglesea River is in part a result of human interference. This is of relevance when establishing natural background. Similarly, is there any evidence that human interference has affected natural background quality up-stream of the site?	We acknowledge that Bluesphere have not reviewed the references provided, however, this is not required for this particular document scope. In addition, there is no current or future predicted connection between the water body and Lower Anglesea River or indeed any surrounding surface water feature. The presence of potential and actual acid sulfate soils within Coogoorah Park can excarbate the Lower Anglesea River acidity during low flow but this is downstream of the water body. Historically the ash pond discharges to the River mitigated acidity by increasing pH and water flow, however, since this discharge ceased the River system is re-equilibrating to its naturally acidic nature. February 2023 - usbsequent discussions and edits to Section 4 have resolved this query	At a high level it is important to demonstrate that the water body will not present a potential risk to external environments, even if the likelihood of a release is very small. For example, in the unlikely event that overflow from the water body occur and the pH was sufficiently low, it could theoretically cause a fish kill event. The likelihood of this occur is very low, however, the consequence would be catastrophic. Whilst not specifically the focus of this review, justification that the adopted water quality standards would not compromise the external environment would be of comfort to the regulator, even if the likelyhood is very low.
10	NA	Table 1		For pH the 10th percentile should be calculated rather than the 90th percentile where the intent is to establish a natural background level as it is the lower end of the distribution that is of relevance for pH rather than the upper end (for this data set).	It is acknowledged that the background water quality of the water body (and surrounding catchment) differs from the objectives in the ERS. As specified in ERS the background water quality is the default objective under these circumstances. The indicators specified in the ERS have been selected to protect ecosystems with species that are sensitive to variations in the concentrations of these indicators. It is recognised that the water quality of the water body is a highly modified environment and the indicators selected to monitor the water quality should be indicative of this acidic environment. Minor ions (aluminium, boron, iron and zinc) are synonymous with surface water quality within the Anglesea catchment and aluminium, iron and zinc can contribute to changes in pH. Changes in pH can also affect the solubility of these metals and in turn affect the concentration of total dissolved solids. Therefore, these indicators are constituents of interest (COI) in the geochemical characteristics of the water body. In order to develop an environmental reference point for the water body, water quality performance standards will be calculated using the historical datasets for these COIs. A statistical approach will be adopted which will include using the 90th percentiles for the minor ions and TDS. For pH, the performance standard will be a range comprising the 10th and 90th percentile of the historical dataset.	Noted
11	NA	Mine Water Body		It should be acknowledged that the water quality in the mine water body will change overtime as the proportion of water inputs from various sources changes, and also due to geochemical and hydrodynamic reactions occuring within the mine water body.	Acknowledged, this is presented in the CHM report February 2023 - CHM report is referenced in Section 4	It needs to also denoted in this report.
12	NA	Table 3		The pH values reported to date in the mine water body are acidic. Has any geochemical investigation works been conducted to understand the reactions that are driving this? The drivers for specific water quality parameters should be clearly described as this is of relevance to demonstrating GED (i.e. are there reasonable and practicable measures available to alter such reactions occuring).	The mine water body is acidic due to the same geochemical reactions that influence the natural catchment acidity, oxidation of reduced iron sulfide minerals and hydrolysis of aluminium and iron species (manganese and zinc to a lesser extent). This is discussed in detail wihin the draft MCRP. The draft MCRP did also discuss water body amendment. At the time of drafting the MCRP (2017) connectivity to Salt Creek was proposed. This is no longer proposed and amendments are no longer being discussed. These discussions will be removed from the revised MCRP (in development).	Noted
13	NA	Table 3		It has been noted that boron is elevated in the mine water body compared to up-stream water quality and groundwater. This is significant as natural ecosystems in the area are unlikely to have necessarily adapted to this level of boron. This will need further consideration with regard to potential risk to water dependent ecosystems and species, GED and BATT.	Not with standing the non-connectivity between the water body and surrounding surface water systems, the presence of boron in soils and surface water has been risk assessed. EHS Support (2021) Supplemental Surface Water and Soil Investigation Report has been provided for context of boron presence in the catchment. February 2023 - elevated boron in the water body in comparison to the surrounding catchment is now discussed within the report	This does not appear to have been contemplated in the report. It would seem an important point.
14	NA	Proposed Water Quality Standards		The first paragraph does not appear to align with the proceeding sections (refer to Comment 7). The specific environmental values that are to be protected should be stated. Similarly, rationale should be provided as to why the other environmental values of surface water for the catchment are not applicable.	Under the ERS the relevant EV to be protected are catchment specific. However the water body is an artificial feature and EV do not apply. In addition there is no connectivity to the surrounding surface water catchments, so the EV that apply to the surrounding surface water systems do not apply to the water body. February 2023 - subsequent edits have included the acknowledgement to protect relevant EVs	Noted
15	NA	Proposed Water Quality Standards		Performance standards are proposed to be developed based on 10th and 90th percentiles. Rationale should be provided for this approach given that the ERS adopts 25th and 75th percentiles.	EPA put forward the 10th percentile for pH and also agreed to the use of 10th/90th %ile for deriving performance criteria (EPA letter dated 02/09/2022).	This should be clearly stated so that its basis is shown to have been agreed.
16	NA	Proposed Water Quality Standards		It is understood that the environmental performance standards are to be derived from statistical assessment of monitoring data for the mine void. Is such an approach inherently biased in that it is based on the water quality as it occurs rather than the water quality to be achieved? Further it is anticipated that the water quality will change over time; use of percentile based statistics assume the data oscilate around a value of central tendency.	The aim of creating a safe and stable landform does not include the modification of the water body quality. Water quality will vary over time, however, the water quality will not deteriorate outside of the performance targets derived from the statistical assessement. This will be supported by limnological modelling, to be provided in the revised MCRP (in development).	Noted
17	NA	Proposed Water Quality Standards		Further to comment 15 above, with regard to GED, it is understood that the key risks associated with water quality in the mine water body are: a) Potential impacts to water dependent ecosystems and species that are not adapted to natural background conditions in the catchment; and b) An uncontrolled release to the down-stream environment (e.g. in the event of an extreme rainfall event). c) Potential risks to down-gradient groundwater receptors prior to the establishment of the mine body as a permanent groundwater sink. To that end, it is considered that the background water quality in the Angelsea River down-stream of the site should also be considered and may in fact provide a more appropriate performance measure. In addition, consideration should be given to a separate set of perfrormance measures that are designed to prevent potential risks to off-site groundwater receptors.	We are not entirely sure what this comment is trying to convey: a) are Bluesphere referring to ecosystems in the mine water body or ecosystems associated with discharging groundwater to surface water systems? b) the likelihood of this occuring is very small. Preliminary modelling indicates a recovery level of the water body at around 5m AHD. Overtopping could potentially occur at approximately 10 mAHD, which would require about 4 GL of water to increase the level by 3 m. Given the volume of water required for this to happen, the fact that the mine water quality is similiar to the catchment and that significant dilution would occur with that much rainfall, we consider the risk to be low. c) the preliminary modelling shows that it is not an issue. Refer to CHM. Modelling indicates, short-term, that radial flow from the water body up to 100 m into the DBF and BF before flow reversal back to the water body occurs. Long term the water body is a discharge feature and is not connected to catchment surface water.	At a high level it is important to demonstrate that the water body will not present a potential risk to external environments, even if the likelihood of a release is very small. For example, in the unlikely event that overflow from the water body occur and the pH was sufficiently low, it could theoretically cause a fish kill event. The likelihood of this occur is very low, however, the consequence would be catastrophic. Whilst not specifically the focus of this review, justification that the adopted water quality standards would not compromise the external environment would be of comfort to the regulator, even if the likelyhood is very low.
18	NA	Proposed Water Quality Standards		It is stated that contingency measures will be established to take into account seasonality. Note the use of percentile based statistics are designed to take into account this variability. Further elaboration of what would constitute a contingency measure should be outlined.	The reference to seasonal changes was added as an example, however, will be removed to avoid confusion. Contingency measures will be developed as part of the risk assessment process.	Noted
19	NA	Proposed Water Quality Standards		The second paragraph on page 9 outlines that a risk assessment will be conducted with respect to human health. Please elaborate on what type of risk assessment will be applied, e.g. quantitative human health risk assessment in accordance with the ASC NEPM, or another approach.	Qualitative risk assessment process, refer to Chapter 9 of the consolidated ash risk assessment doxcument which will be provided in the next few days. HH risk assessment will only be conducted if the current risk assessment process indicates there is a risk to HH. The water body is not to be used for human based activities and also there is no ingestion pathway for humans.	Noted
20	NA	Proposed Water Quality Standards		Will geochemical and hydrodynamic modelling be undertaken to predict the likely water quality once the water balance for the mine void is established? This will provide a useful benchmark of expected water quality which monitoring data can then be assessed against.	Limnological modelling is proposed as future work but not necessary for this memo review.	Noted
21	NA	Conclusion		The conclusion should recognise that there are some environmental values that are relevant to the mine water body (refer to Comment 7).	We do not agree with this comment. We suggest further discussion with Bluesphere so they can state which EVs they feel are relevant and justify why they think they are relevant. February 2023 - BlueSphere comment has been acknowledged in subsequent report updates	It is our view that the water body will have some environmental values, those being water dependent ecosystems and species consistent with local background and water-based recreation (aesthetic enjoyment) (i.e. presumably the public will be able to view the lake and it should not be offensive to the senses).
22	NA	Conclusion		The second paragraph discussed the salinity of the groundwater. It is not clear how this relates to the water quality performance standards.	The second paragraph talks about the TDS of UEVF and how it relates to the segment of groundwater and the relevant protected environmental values. We suggest removing reference of the UEVF (below the Basal Clay) and provide more relevant discussion on DBF and BF groundwater quality.	Noted

INDEPENDENT REVIEW COMMENTS REGISTER

Review Comments

Please Note:

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Project Name: Independent Technical Peer Revi
BlueSphere Job No: 31098.01
Client: Alcoa of Australia Limited
Assessor: EHS Support

Consolidated Leached Ash Technical Risk Assessment

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (9 December 2022)	Assessor's Response (Date)	Reviewer's Comment (12 January 2023) following workshop	Report Revision	Reviewer's Comment (10 May 2023) following receipt of Final Report	Assessor's Response (7 June 2023)	Report Revision	Auditor's Comment (9 June 2023)	Reviewer Close Out (Y/N)
1	General		Draft	We note that this document is a consolidation of works that has been previously reported separately, including Document 1, Document 3 and Document 4. Comments previously provided on those documents are therefore considered relevant to the content of this document. To that end there seem to be a number of examples where appropriate responses have been provided in previous IRRs but are not reflected in the report.	We thought these had been all addressed but will check previous responses to ensure agreed responses have been enacted	TBC	Final	ok	No further action			Y
2	1.2		Draft	The opening sentence needs to be broader and address current, and particularly future scenarios (namely the submergence of the ash in the pit lake). As written, seems to apply only to present day.	We will make changes to address this comment Completed	TBC	Final	ok	No further action			Y
3	1.2		Draft	Paragraph 3: indicates a conclusion of low risk from the risk assessment. It would be useful to briefly refer to whose risk framework is being adopted in terms of materiality of consequences etc. Is this an internal Alcoa framework, or something adopted from the regulatorls or Australian Standards.	The RA is an ERR process framework - also refer to comment 31. Will make reference to the ERR process Incuded	TBC	Final	ok	No further action			Y
4	1.2		Draft	Paragraph 4: replace "BlueSphere Consultants" with "BlueSphere Environmental Pty Ltd"	Agreed Completed	TBC	Final	ok	No further action			Y
5	1.2		Draft	With respect to EPAs queries in Table 1-1, we perceive some potential gaps in the work completed or proposed. These are in relation to monitoring of short and long term cap performance. Namely, there may be a gap in the groundwater monitoring network in the vicinity of the CLA to monitor short to medium term performance as the lake fills (i.e. a lack of groundwater bores in the immediate vicinity of the CLA to verify modelling predictions as the CLA is inundated). It is acknowledged that these wells would be eventually lost to the developing water body. Secondly, we think some additional monitoring of cap integrity could be proposed once the CLA is submerged (i.e. bathymetric survey to monitor any changes in cap morphology over time).	We believe that we have a robust network of shallow groundwater wells already established which are appropriately spaced around the water body to monitor water quality changes over time in both the fill material and the DBF. The majority of these wells are dry (except DBG MB6). Installing additional shallow wells in the vicinity of the CLA is also not considered warranted as the modelling predicts limited saturation of the ash material prior to inundation over the CLA area, thereby there is no mechanism for transport of CLA pore water (if this does occur). In support of this is the validation of the clay capping of extremely low permeabilities of 10-9. So based on the numerical model response to rising groundwater levels, is there any point in having monitoring locations in the vicinity of the CLA if the fill material remains unsaturated even when surface inundation occurs? Particularly when the wells would be temporary due to inundation, and also then would present a potential migration path risk in and of themselves. There are erosion control measures in the risk assessment that have been proposed. Unless the erosional risk is considered high, then why would surveying be considered warranted - this said does Bluesphere have any experience in underwater bathymetric surveying that you could share? No additional commiments to monitoing as supported by BlueSphere discussion and response (cell G20)	As discussed, even dry wells in the vicinity of the CLA could verify the modelling predictions and conceptualisation in the short term. However, we do acknowledge the presence of existing groundwater bores at the periphery of the mine void. As discussed, we propose to endorse the concept that future groundwater monitoring is required and will be undertaken without commentary on the appropriateness of the network, frequencies and other details as those will be documented in a subsequent monitoring plan. The regulator may perceive that the existing wells are too far away to monitor specific impacts from the CLA.	Final	We agree that it has been demonstrated that risks of excursion of solutes from the CLA to the surrounding fill material is low based on permeability testing and modelling, particularly in the short term where it is expected that the CLA and surrounding fill will remain unsaturated. However, monitoring of expected performance is still considered to be a reasonable expectation of the regulators and it is our view that the existing bore network at the periphery of the mine void is unsuitable to detect any specific impacts from the CLA, particularly in the short term. We acknowledge that any wells installed at the periphery of the CLA will eventually be lost to the developing water body. It is further acknowledged that any such wells would need to be appropriately decommissioned prior to lake encroachment; however, it expected that any wells would be within the fill material suorrounding the CLA and not within the CLA itself.	Following discussion with BlueSphere, it is agreed that the risk assessment of the CLA area is restricted to the activity of CLA inundation. Under the accelerated fill water strategy, this will be in the order of 2 years. Due to the inundation of the CLA area, the existing network of monitoring wells screened within fill material (DBG MB4, DBG MB5 and DBG MB6) are located as close to the CLA area as practicable and are considered appropriate to measure impacts from the CLA area during the activity of inundation and after the void is filled.The locations have been selected in accordance with safety and stability constraints and cultural heritage sensitivity. Section 1.2 additional text: *Groundwater monitoring wells are located in the vicinity of the CLA area (DBG MB4, DBG MB5 and DBG MB6) and are screened within the clay -rich fill material. These locations have been part of the groundwater monitoring network surrounding the mine area since 2021 and will continue to be monitored as the CLA area is inundated by the water body.* Section 4.8 additional text: *It is acknowledged that in order to verify the assumptions within this report, that groundwater monitoring should be conducted in the vicinity of the CLA area to assess whether pore water migration from the CLA area is occurring. Sentinel wells located in proximity to the CLA area (within 5-10 m) were considered, however, this was not considered practicable for the following reasons:* *•Based on the conditions encountered during the two phases of site investigation in 2021 and 2022, the condition of the ground in the vicinity of the CLA area is uneven and at times saturated making drill rig manoeuvres* ***a significant safety issu****e. Now, 9-10 months on from the last field event, the water body elevation has increased further and is even closer to the CLA area.* *•The process of inundation is potentially within a time period of 2 years, during which wells will need to be decommissioned prior to submergence. This does not provide an adequate time frame to collect a representative dataset as the formation surrounding the CLA saturates.* ***Further the objective of these wells would be to validate any potential seepage from the CLA, and this can't occur if the area is submerged.*** *•Based on the* ***SEEP/W*** *model outcomes the formation may remain unsaturated after inundation, meaning that there will be no groundwater quality to measure.* *Therefore, existing groundwater monitoring wells in the vicinity of the CLA area (DBG MB4, DBG MB5 and DBG MB6) will be used to monitor the potential risks of pore water migration from the CLA area into surrounding fill material during (and after) the inundation period. These wells are screened within the clay -rich fill material and DBF and BF. These locations have been part of the groundwater monitoring network surrounding the mine area since 2021 and will continue to be monitored as the CLA area is inundated by the water body. Due to their locations they will remain even after the water body attains steady-state elevations.* **Monitoring/sampling of the mine pit water body will be undertaken during the filling period and inundation period. Evaluation of the results against WQPT will be used to evaluate whether seepage is occurring from the CLA.**	Final	ok	Y
6	4		Draft	Paragraph 1: refers to "interim" WQPS. May need to explain what is meant by interim, and when/how the final WQPS will be established.	Interim WQPS can be developed based on the current dataset. These could be progressively updated as the dataset increases as monitoring progresses. Final WQPS will be developed when the water body is at steady state or final elevation.	Resolved during discussion. It is understood that this terminology will change.	Final	ok, it is clearer now why interim is being used. We understand there is a framework for developing the final WQPTs, in which the MCRP will require both the filling strategy to be finalised and the development of the final WQPTs.	Refer to response to Item 23. No further action	Final	ok	Y
7	4.1		Draft	Third last paragraph on page 9, refers to environmental values not applying to artificial features. It should be noted that the water body will however need to be protective of flora/fauna support consistent with the local catchment conditions, that is, the environmental value of water dependent ecosystems and species is a protected environmental value.	Can you further clarify that you agree with the commentary around artificial assets, as described in the ERS and as previously agreed with the EPA. Alcoa recognise their responsibilities in accordance with the GED, which includes the protection of relevant environmental values, e.g. water dependant ecosystems and species. However it is stated that the WQPS are based on the baseline water quality of the pit. This baseline sets the benchmark for the protection of interconnected catchment ecosystems that are water dependant. It is further acknowledged that these ecosystems already have adapted to the acidic conditions of the existing surface water systems and catchment.	Resolved during discussion. It is understood that WDES and Aethetics will be considered applicable EVs.	Final	ok, WDES and Aethetics now acknowledged for the water body. Please check wording on aesthetics for off-Site receptors.	Wording has been edited in Table 4-1 and Table 4-2 for off-site receptors (EV-WBR)	Final	ok	Y
8	4.1		Draft	Further to the above, there are a number of instances where it is stated that environmental values do not apply to 'artificial constructed features'. As per previous comment 8 regarding Doc 4, this contrasts with EPA's advice of 24 March 2022. It is our view that it should be acknowledged that the water body will have some environmental values, those being water dependent ecosystems and species and water-based recreation (aesthetic enjoyment) (i.e. presumably the public will be able to view the lake and it should not be offensive to the senses).	In 24 March 2022 EPA comment that they consider artificial lakes to have environmental values, however they acknowledge that there may be local constraints that cause difficulties in protecting all environmental values, therefore these should be considered when setting environmental values. Our position is that MoE is the only relevant environmental value applicable to the artificial lake. Clarification from EPA: For ecosystems the background levels should be adopted by default (regardless of whether they are less than or exceed the objectives in Table 5.4 of the ERS) refer ERS Section 16 cl(2) The final MCRP will address the catchment water balance, which is not the objective of this document. The overall MRCP objective is that the pit is a safe and stable landform. As previously agreed with DELWP (and documented in the draft MCRP - Sept 2017) it states that there are no environmental values related to recreational use (i.e. boating, swimming). Aesthetic enjoyment is also subjective. It is not the intention or expected to create a feature that is offensive to the senses. Aesthetic (or passive recreational use of water bodies) refers to nuisance organisms such as algal growths. This could be addressed in the MRCP. We refer back to the objective of this work, which is solely related to the submergence of the CLA.	Resolved during discussion. It is understood that WDES and Aethetics will be considered applicable EVs.	Final	ok	No further action			Y
9	4.2		Draft	Paragraph 3: notes the identification of "several key hazards". It is important to document by what process these hazards were identified, in order to provide some surety as to the completeness of the list. We understand a workshop was convened with a group of internal/external experts - this process should be summarised.	Agree - the process (ERR risk assessment process and framework) is described later in Section 10, but will review and address the wording to ensure this is clear. Additional text added to Section 4.2	ok	Final	ok	No further action			Y
10	4.3		Draft	With respect to the disconnection between the UEVF (basal sands) and the water body due to an upward gradient existing, please clarify if this also applies, or is likely to apply, once the water body is established.	Once the water body is established and reaches steady state, the water body will act as a groundwater sink. This includes groundwater movement from the UEVF to the water body. This is supported by numerical modelling undertaken in 2017 and 2019 and preliminary modelling using the revised Anglesea Groundwater model which has been deemed fit for purpose by an independent technical review panel (appointed by DELWP). Further, analytical modelling (using the laboratory derived parameters of the basal clay) suggested that during the filling of the water body the level remained 2m higher than the groundwater level and it would take about 7 years for any pressure impacts to migrate through 2m of Basal Clay. Note: During the 6-month UEVF pumping test when the hydraulic gradient was extreme (65m head difference) between the pumped bore screen and the overlying units, no drawdown or change in trend was observed in any overlying units (including those immediately overlying the pumped unit). This gives an indication on the competency of these clay layers between the thin sands of the UEVF. Above text added to report	ok	Final	ok	No further action			Y
11	4.3		Draft	Table 4-1 and 4-2: Please provide a reference for where this data is sourced. Did Alcoa collect this data? It would be useful to provide a statement on the data quality.	Check Paragraph added to provide detail on QAQC and sample collection	TBC	Final	ok, still a little unclear where the surface water data is from. IPR report will note that no independent review of QA/QC protocols has been undertaken.	There has been a change to Table numbering so we assume this comment now refers to Tables 4-4, 4-5, 4-6, 4-7 and 4-8. The data has been collected from monitoirng locations AV2, SV2, MB1 through MB7, MW002, MW008, MW014, MW015, MW016, MW018, MW020, MW021, MW022, MW023, MW024, MW025, MW026, MW027, MW029, MW030, MW031, MW032, MW033, MW034, MW038, MW050, MW052, MW059, MW060, MW062, MW064, MW066, MW069, MW072 and MW073 and finally the water body. The DBG and DBF bore locations have been added to Table 4-7 (as a footnote). QAQC samples have been collected for the UEVF and DBG/BF GMEs. Water body samples are usually singular so no associated QAQC and QAQC has not been conducted on historical sampling (prior to 2015).	Final	ok	Y
12	4.3		Draft	Table 4-3: further to comment above, where is this data sourced and what spatial area does it represent? Is this site-derived or regional data?	Check Edit provided which confirms site location of UEVF basal sand bores	TBC	Final	ok	No further action			Y
13	4.3.1		Draft	Table 4-4: Some of the aluminium numbers seem very high - these appear to be total analyses, rather than filtered samples. Please clarify. Is it possible that some of these data are skewed high by entrainment of particulate matter in unfiltered samples?	Check Observation is correct and data has been reviewed and replaced with dissolved analysis. Clarification sentence added	TBC	Final	ok	No further action			Y
14	4.3.2		Draft	Paragraph 1: replace "recharge" with "discharge"	Editorial Corrected	TBC	Final	ok	No further action			Y
15	4.4		Draft	First sentence: clarify that 10th percentile used for pH	Check	TBC	Final	ok	No further action			Y
16	4.4		Draft	Suggest Tables 4-6, 4-7 and 4-8 be merged together so that it is easier to compare data between the various materials.	Check New tables 4-7 and 4-8 compare all locations together for 90th and 10th percentiles	TBC	Final	ok	No further action			Y

Item	Section No.	Section Heading	Report Revision	Reviewer's Comment (9 December 2022)	Assessor's Response (Date)	Reviewer's Comment (12 January 2023) following workshop	Report Revision	Reviewer's Comment (10 May 2023) following receipt of Final Report	Assessor's Response (7 June 2023)	Report Revision	Auditor's Comment (9 June 2023)	Reviewer Close Out (Y/N)
17	4.4		Draft	The analysis presented here is contingent on the current mine water body quality being acceptable and therefore an appropriate benchmark. Under the fast fill scenario, the water body is expected to be comprised largely (initially at least) of water derived from the UEVF. As such some comparison to the existing quality of that water may also be instructive. Ultimately, it is our view that the most appropriate benchmark is one that representsfis protective of the background surface water quality within the local catchment (i.e. Salt Creek and the Anglesea River) as then it can be argued that the proposal will not preclude the environmental value of water dependent ecosystems and species consistent with the local catchment. The water body water quality is an amalgam of sources, including anthropogenic sources. As such the water quality of the water body is considered to be an arbitrary benchmark and difficult to justify externally. It is a much easier argument to utilise the background surface water quality as the benchmark and we expect the regulators to view this similarly.	There is currently no approved water filling strategy and there is no agreed surface water connectivity between the water body and surrounding surface water catchment. The water filling strategy is subject of separate parallel works as you are aware related to potential for UEVF groundwater. However the over-riding objective is that the water quality will not be worse than it currently is in the water body and the surrounding catchment. In the future additional assessments may be undertaken to evaluate risks to flora/fauna (toxicological surveys) based on the finally agreed water source, however this is an issue for the longer term MRCP (which is expected to include appropriate limnological or similar modelling for long term water quality). First point: No protection required as the pit and the surface water systems are disconnected. Our baseline is the water quality in the artificial water body. Second Point: Environmental value of MoE is acknowledged in relation to the pit, however the water quality performance indicators are already exceeded. Alcoa are evaluating risks to ecosystems through the GED framework (i.e. modelling etc). Ecosystems in the catchment are already adapted to water quality conditions similar or comparable to that of the mine pit. Based on the baseline conditions in the UEVF the water quality is not expected to change significantly from that that exists in the pit now. It is acknowledged that there will be reactions/changes due to oxidation/dissolution. UEVF is an anaerobic system although when discharged to the water body it becomes aerobic and water chemistry will change.	Resolved during discussion. It is understood that catchment background will be adopted.	Final	We acknowledge the decision to retain the existing mine pit water quality as the basis of Interim WQPTs and the reasons given for that decision. With the context that has now been provided, namely that (a) the WQPTs are interim until a filling strategy is finalised, (b) they are intended to relate only to localised impacts from the CLA on the water body and groundwater (and not broader pit lake water or groundwater quality issues), and (c) they are comparable with background catchment water quality with the exception of boron, which has been qualitatively assessed as likely to pose a low risk to relevant receptors, we are of the opinion that the interim WQPTs are appropriate for their intended purpose. Please check 90th percentile for TDS - it is higher than the reported max.	Updated equis report for the water body. 2021 to 2022 used for table as the more recent data has associated QAQC.	Final	ok, our final position on the boron issue will be articulated in the ITPR letter, which is that if final WQPT propose a boron concentrations above catchment background, then a quantitative ecological risk assessment should be conducted to confirm risk to ecological receptors are low and acceptable.	Y
18	4.5		Draft	Paragraph 2 asserts that the naturally occurring background water quality in the DBF&BF exceed the relevant objectives and that as a result the relevant environmental values cannot to be achieved. Where is this established and is it true of all analytes at all locations?	*DSI (April 2021) EHS Support. Section 10, Appendix R,S,T.* states that background (based on a number of relevant located wells) concentrations of Al, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, Zn and TKN exceed Tier 1 screening criteria for one or more protection environmental values, based on Segment B classification. The Power Station is currently under Audit, all works completed in accordance with auditor approved Plans. Above text added	ok	Final	ok, text appears to have been removed.	Agreed, no further action				Y
19	4.5		Draft	Table 4-9: If zinc is a key indicator of ash leachate impact, then a WQPS should be included for it for the DBF&BF. An appropriate background level for zinc in the DBF&BF may need to be established through sampling (i.e. in the power station area), if it is not currently known.	Acknowledged that Zn analysis is limited. This was an oversight and Zn is now included in analytical suites.	ok	Final	ok	No further action				Y
20	4.5		Draft	Paragraph 5 states that WQPSs "will be developed…". Please clarify if both interim and final WQPSs are envisioned and if so, how and when the latter would be derived and applied. Perhaps the terminology should be modified to differentiate between long-term WQPS which are yet to be derived, and Consolidated Leach Ash Water Quality Performance Standards?	The focus of the WQPS memo is to monitor and evaluate potential impacts associated with the CLA. The setting of criteria is based around this objective. The initial standards (or interim) will be developed based on the baseline dataset as data is collected during the development of the water body as the baseline is likely to change dependant on the source of water. Therefore final standards may be different from the interim, but the changes will be solely related to the source of water. Additional water quality parameters (or indicator parameters) may be needed to differentiate between the water types	Resolved during discussion. It is understood that catchment background will be adopted as the basis of the WQPS and the terminology with respect to interim and final will be amended.	Final	ok, it is now clear that they are interim.	Refer to response to Item 23. No further action	Final	ok	Y
21	4.5		Draft	How will the these proposed WQPSs for the mine water be achieved in the long term? As described the lake will be a terminal discharge feature with no out let to the surrounding environment. Will solutes not accumulate in the water body under this scenario? We note that this comment is outside the scope of our review and presume that this issue will be (or has been) addressed through water balance studies, hydrological modelling and/or limnological studies.	Comment is acknowledged. Note that the final MRCP will incorporate the full cycle water balance, whether that is in the form of geochemical modelling, that is yet to be confirmed.	ok	Final	ok	No further action				Y
22	4.6		Draft	First paragraph, refer to comment 8 above and not which environmental values are to be protected. Suggest the second paragraph be re-worded so its context is clear. An introductory sentence would be beneficial to give context…	Check More detail surrounding the preclusion of environmental values has been added to Section 4.1. In addition why most Evs are considered either irrelevant or unsupported…	TBC	Final	ok	No further action				Y
23	4.5		Draft	The mine water quality standards are based on existing water quality in the mine pit. With a fast fill strategy, the water quality would trend toward the UEVF, which would expect to result in a reduction in TDS, Al, B, Fe and Zn concentrations overtime. This would in essence, act to offset any increases in contributions from the CLA. To that end, it would seem that even if porewater from the CLA reached the waterbody, it would be unlikely to be measurable within the context of long-term water quality change occurring in the water body. The standards therefore really only provide an indication of a	The modelling indicates that there is no impact from the CLA. We believe we have demonstrated that there is no CLA pore water emission to the water body based on a fill material permeability of 10-6 m/sec. Fill material median permeability is 10-9 m/sec. TDS is unlikely to change significantly i.e. metals/solids will not drop out but are expected to remain in solution. We agree with the second paragraph although as mentioned above modelling indicates that this will not occur.	ok	Final	As discussed, modelling is a predictive tool that does not obviate the need for monitoring to confirm predictions and assumptions are holding true. It is understood that the finalisation of the filling strategy will prompt the derivation of the final WQPTs, which will need to consider these issues at the appropriate time.	Noted and this statement has been added to Section 4 and Section 11 (the Interim Water Quality Performance Targets and Summary and Conclusions): *It is important to note that the long term WQPTs for the mine water body cannot have not been determined at this time as the mine water body filling strategy has not been finalised. Interim WQPTs have been developed and are included within this assessment. Final WQPTs, these are expected to be included as part of the MRCP (when finalised).*	Final	ok	Y
24	4.5		Draft	It should be stated that the water quality standards are consistent with the background water quality in Salt Creek and the Upper Anglesea River, and therefore the environmental value of water dependent ecosystems and species (that are consistent with the local catchment) would be maintained. This is important as it makes clear to the regulator that this process does not result in a sub-optimal environmental outcome so far as the protected environmental value of water dependent ecosystems and species is concerned.	They are comparable (not consistent) to the surface water catchment, however the environmental values of the surface water systems are not relevant for the evaluation of potential CLA seepage into the pit. The presence of the water body is not going to degrade the surrounding disconnected surface water catchment or the associated environmental values.	Resolved during discussion. It is understood that catchment background will be adopted as the basis of the WQPS.	Final	ok, see Item 17 response	Updated equis report for the water body. 2021 to 2022 used for table as the more recent data has associated QAQC.	Final	ok, see Item 17 response	Y
25	Table 5-2		Draft	The rationale for the adoption of the 5,000 ppm saline solution as agreed should be provided.	Update Footnote 21 expanded to include rationale behind value	TBC	Final	ok	No further action			Y
26	6.3.3		Draft	As per previous comments, if the fast fill scenario is enacted, the water chemistry in the water body is expected to trend towards that of the UEVF, at least in the short term. How would the analysis in Table 6-8 look with the water quality from the UEVF included?	Please refer to Item 17 response	Resolved during discussion. It is understood that catchment background will be adopted.	Final	See Item 23 response	Noted and this statement has been added to Section 4 and Section 11 (the Interim Water Quality Performance Targets and Summary and Conclusions): *It is important to note that the long term WQPTs for the mine water body cann ot be determined at this time as the mine water body filling strategy has not been finalised. Interim WQPTs have been developed and are included within this assessment. Final WQPTs are expected to be included as part of the MRCP finalisation.*	Final	ok	Y
27	7.2.1		Draft	As per comments provided on Document 3, the last paragraph states that impacts from LA water discharge and infiltration did not appear evident in the discharge area; however, there are some substantial differences reported between analyte concentrations in this area and the reference clay-rich cover, particularly at ADBH32 (Na, Cl, SO4, Fe etc.). Is this attributed to heterogeneity in the fill material or evidence of impact? The nature of the analytes (particularly Cl) suggests a possible interaction with ash leachate, rather than a geological origin.	We have discussed the heterogeneity of the fill material, however, we acknowledge there may some limited impact. However it does not change the overall outcomes of the risk assessment. Accept last sentence.	The limited impact should be denoted as discussed.	Final	ok, the acknowledgement added to 7.2.2 should also be added to the end of 7.2.1 as the impact is also evident in the initial samples.	As suggested the acknowledgement has been added to the end of Section 7.2.1.	Final	ok	Y
28	9.1		Draft	The introductory sentence does not appear to be necessary.	Agreed and removed	TBC	Final	ok	No further action			Y
29	9.2		Draft	Note that much of this material is a repeat of information now presented earlier in the document, due the consolidation of previously separate reports. Consider amending.	Agreed and removed section	TBC	Final	ok	No further action			Y
30	9.5.3		Draft	The conceptualisation of the UEVF being a confined aquifer under artesian pressures in the vicinity of the mine void warrants some further discussion. We understand that the DBF&BF are unsaturated in the vicinity of the mine void currently, and that the UEVF is exposed within the mine void (at least to the extent of the coal seam, which marks the top of the UEVF, having been mined out historically). This raises the question as to how groundwater currently enters the mine void (apart from that from the pumping trial) and if it is derived from the UEVF, why the pit lake would not eventually reach the pre-mining artesian levels. We note that this comment is outside the scope of our review and presume that this issue will be (or has been) addressed through water balance studies, hydrological modelling and/or limnological studies.	We agree that this comment is outside the scope of the study but we have provided some additional commentary below. At steady state evaporation will be the primary water loss mechanism from the water body. Further, the artesian heads of the UEVF were found in the basal sand lenses. Drilling in the 1950/60 found evidence of lithostatic pressure (i.e. as you drilled through each coal and clay seam, the pressure would spike). The basal sand lenses are under a lot more pressure than the shallower sand seams. DELWP appointed an independent technical review panel consisting of expert modellers, ecologists, acid mine drainage and groundwater engineers. Their review concluded that the conceptualisation and revised Anglesea Groundwater model is deemed fit for purpose, with one of the objectives of the model being to understand pit water/groundwater interactions. Text added to report	ok	Final	ok	No further action			Y
31	9.6		Draft	As per previous comments, please state that the risk management framework is a DELWP/EPA/regulator-based risk framework. This adds substantial weight to the process used, and goes to the appropriateness of the likelihoods and consequences considered.	Refer to comment 3 Reference provided but inserted to Section 9.5 as numbering has changed with the deletion of Section 9.2	TBC	Final	ok	No further action			Y
32	9.7.1		Draft	Figure 9-8: Potentiometric surface level shown in the UEVF is substantially lower (-45 mAHD) than that stated in the text of Section 9.5.3 (-20 to -16 mAHD). The apparent similarity between the levels in the Fill and the UEVF also raises the question as to the origin of the water in the fill and the water body and the confined nature (or otherwise) in the UEVF in the vicinity of the mine void. We note that this comment is outside the scope of our review and presume that this issue will be (or has been) addressed through water balance studies, hydrological modelling and/or limnological studies.	We agree that this comment is outside the scope of the study but we have provided some additional commentary below. Refer to previous comment. In addition, there was a pumping test occurring in a confined aquifer with relativity low storativity and the potentiometric surface changes dramatically as a response to pump cycles. GWL symbol removed from figures 9-8, 9-9 and 9-10	ok, please check representatioon of the UEVF water level and update if needed. Currently Fig 9-8 indicates a strong downwards gradient between fill and UEVF	Final	ok	No further action			Y
33	9.8		Draft	An introductory sentence is needed to give context to the calculation, i.e. why is the calculation being undertaken and to what end?	Agreed sentence added to Section 9.7 as numbering has changed with the deletion of Section 9.2	TBC	Final	ok	No further action			Y
34	9.10		Draft	Table 9-4: It is not clear how the area of 2,160 m2 for the area of the leached ash has been derived or if this an input to the model. It appears to be an error based on the dimensions provided.	4.6ha? Check 7.0 to 4.6 ha values This was a carry over error and has been corrected to 4.6ha in the table. It has no significance on model outcomes as this value is not used in the numerical moelling only the preliminary conceptualisation	TBC	Final	ok, check final number (4,600 m2 = 0.42 ha). May not be significant	Value amended to 46,000 m2. Change does not impact on the model outcomes.	Final	ok	Y
35	9.11		Draft	We note that some elements of the watertable development predicted in these simulations is considered unlikely to occur in reality. For example they appear to be partly an artefact of the eastern boundary condition providing water to the model more rapidly than the model can effectively transmit, which is unrealistic for the eastern BC as it is the same material at and beyond the boundary as it is in the model domain itself. This is also possibly emphasised by the lack of any modelled flux upwards from the UEVF or incident rainfall, which would also provide water to the model.	The eastern BC is the boundary between the fill material and an unconsolidated natural lithology. The fill material has been compacted and has a higher component of clay. As discussed above leakage from the UEVF is unlikely even though the pressure head is vertically upwards. There is a net loss of water from evapotranspiration, so incident rainfall was not included within the model as discussed within the report. Above text added to report	ok	Final	ok	No further action			Y
36	10.1		Draft	Similar to previous comments, some of the material presented here is a repeat of text included in earlier sections. Consider amending.	Agreed and text has been refined to just reference to risk assessment assumptions and process	TBC	Final	ok	No further action			Y
37	10.1		Draft	Key assumptions may also need to include that the leached ash and encapsulating material remains geotechnically stable and intact during and post establishment of the pit lake and that the cap material in particular is unimpacted by the effects of bioturbation, wave action, settlement and a range of other potential physical, biological and chemical processes.	Agree	ok	Final	ok, we acknowledge the additional assumptions; however, we would prefer the wording in relation to geotechnical stability also included the leached ash and encapsulating material. Current wording appears to exclude it (i.e. "*the landforms surrounding the CLA*"). We consider that any affects of differential hydrostatic pressure on the CLA during inundation is a geotechnical matter and is not being considered here. We therefore need a clear statement that we assume these pressures will not deform or otherwise undermine the integrity of the CLA cap.	This bullet point has been edited to include reference to the CLA area in addition to the surrounding landforms	Final	ok	Y

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38	10.2		Draft	Reference is made here to an Appendix K - Anglesea Mine Ash Assessment, but this is not enclosed with the Appendices provided.	Agreed Now attached as Appendix H	TBC	Final	ok	No further action			Y
39	10.2		Draft	Element 1 receptors at risk include the Anglesea River. It is unclear how this could occur during filling (or afterwards) given the absence of an outlet or connection. Please elaborate on the scenario being contemplated here (i.e. loss of containment during extreme weather or other event)	The receptor is considered as part of the risk process. We included this for completeness in the risk assessment even though there is no real potential likely pathway, really as this may be a question that we anticipate is asked by the regulators as part of their review.	ok, agree it should be considered. Future connection may be highly unlikely, but not impossible.	Final	ok	No further action			Y
40	10.2		Draft	There would seem to be a number of additional risk sources not accounted for in this list. For example, degradation of the capping materials over time through biological processes once the pit lake is established.	What biological processes are you referring to, bioturbidation?	Yes, the burrowing of aquatic organisms during and post lake establishment would be one example of such a potential process. As discussed, the long term presence of the 1.0 m cap would be expected to mitigate this risk; hence the relevance of monitoring its integity periodically (e.g. through bathymetric survey).	Final	ok	No further action			Y
41	Table 10-3		Draft	Reference made to the SEPP (Waters) should be changed to the ERS.	Agreed and completed	TBC	Final	ok	No further action			Y
42	10.4		Draft	It is acknowledged that impacts to a known *current* third party groundwater user are unlikely based on the modelling; however, it should be recognised that unregistered bores or newly installed bores could be established at any time. It would be useful to note how close these could potentially be to the source area (i.e. could they be substantially closer than the 400 m stated here based on known registered users?).	Modelling has shown there is no risk to water quality and groundwater, it is a sink. In addition there is no likelihood that unregistered bores or new bores could be installed within 400m of the CLA area in any direction due to the extent of Alcoa mine and land management area.	The constraints on any future groundwater well installations should be clearly noted.	Final	ok	No further action			Y
43	10.4	Risk Assessment Summary	Draft	In relation to the risk assessment summary, it is considered that if contamination occurred disruption would be more likely in the order of a year (i.e. major consequence). Risk is unchanged given event is appropriately classified as rare.	Can you please clarify further the thoughts or basis for the major consequence?	As discussed, this was related to the likely remediation timeframe being > 1 year	Final	This has been changed in the risk assessment table, however, the text in the last paragraph on pg 127 needs updating also.	Table 10-5 (Element 2.3) and the Risk Assessment Summary section (first bullet point) now agree, in terms of the major consequence associated with potential groundwater remediation taking greater than 1 year.	Final	ok	Y
44	10.4		Draft	We think the conclusions are reasonable based on the evidence presented, insofar as they relate specifically to the likely impacts of the submergence of the encapsulated leached ash in the future pit lake, which is the subject of this review. However, in reviewing the risk assessment it is clear that the broader risks to lake water quality (above and beyond the LA), and how that may impact on the environment and communities could be far more substantial. It assumed that these risks have been/are being assessed separately.	This will be presented in the MRCP, however, we appreciate acknowledgement of objectives of this work. We will add some text to clarify this further for the reader as this may also to be a question raised by others also re the relationship of the subject of this review to the future MRCP.	ok	Final	ok	No further action			Y
45	10.4		Draft	Table 10-5: It is stated that 'Historical water body water quality precludes beneficial uses which is consistent with background surface waters including Anglesea River and Salt Creek.'. Suggest this be re-worded to 'Historical water body quality is consistent with background surface waters including Anglesea River and Salt Creek and therefore environmental value of water dependent ecosystems and species with regard to the local catchment is protected'. This change is recommended as stating that the environmental value (beneficial use) is precluded implies non-compliance with the ERS, however, that does not appear to be the case.	Adjust as suggested Completed	TBC	Final	On further review, including the supplementary report (EHS, 2021c), it is not clear that the claim that "environmental values of water dependant ecosystems and species is protected" can be substantiated with respect to boron. The proposed WQPT for boron (and by extension the lake water quality) is above the guideline level contemplated in the supplementaty report (EHS, 2021c) and there is no documentation of subsequent site specific risk assessment for grazing mammals or other ecological receptors. We suggest that this staement be qualified, with boron noted as an exception that requires further site specific risk assessment.	Additional wording has been added to Section 4.2.1: *However, it is accepted that the boron concentrations considered within EHS Support (2021c) are lower than the interim WQPTs values, particularly for the DBF and BF groundwater and that this groundwater quality data is associated with the power station monitoring network and not in the vicinity of the CLA area. Therefore, further future site-specific risk assessment is proposed to assess the potential risks to ecological receptors from boron sources (in addition to the CLA area). Additional risk assessment will be conducted as part of the MCRP finalisation. .*	Final	ok	Y
46	10.4		Draft	Table 10-5: see previous comments on the performance objectives and the appropriateness of using historical water body water quality as a benchmark.	Refer back to Item 17 response	Resolved during discussion. It is understood that catchment background will be adopted.	Final	See Item 17 response	Updated equis report for the water body. 2021 to 2022 used for table as the more recent data has associated QAQC.	Final	ok	Y
47	10.4		Draft	Table 10-5: There are numerous references to the "licensed mine boundary" as a point of compliance. Will this boundary be defined and recognised in perpetuity, or should a different long term boundary/benchmark be defined?	The licensed mine boundary will remain in effect until Alcoa is in a position to surrender this to the state, which in turn can only be done once the state accepts that Alcoa has met all of its obligations and reduced long term risk to an acceptable level. In effect then, the licensed area will remain in place for as long as it needs to mitigate any risks.	ok	Final	ok	No further action			Y
48	10.4		Draft	Table 10-5: The erosion and sedimentation hazard could conceivably exist post submergence of the ash, particularly when water column heights in the area are relatively low. This could occur through wind and wave driven turbulence and other factors. What monitoring could be implemented to assess this longer term? It may be appropriate, for example, to conduct periodic bathymetry surveys to monitor the cap integrity.	The steady state 12 m water column height is considerable, refer back to risk assessment contingency measures. Re surface water or wave erosion this is low risk due to the very shallow slope of the CLA area as noted in the risk assessment, and is supported by observations onsite. Re bathymetric please refer to Item 5 comments - for further discussion with Bluesphere.	This is outside our area of expertise, but we expect the erosion from wave action could also occur during filling (i.e. when water column heights above the CLA are lower i.e. 0.5, 1, 3 m etc). Risk may be addressable through monitoring (e.g. bathymetric survey).	Final	ok, as discussed, it is understood that the specifics of a post submergence monitoring plan are being developed, however, at a high level it is agreed that most submergence monitoring (e.g. via bathymetric survey) will be undertaken until such time that it is evident that the CLA is stable. Text in Section 10.5 should be updated to reflect this.	Noted, following wording added to Table 10-5, element 3.3: *Post submergence, bathymetric surveillance will be conducted to monitor the elevation and stability of the CLA area.* A post submergence plan will be completed before inundation is complete	Final	ok	Y
49	10.4		Draft	Table 10-5: Regarding erosion and sediment control, whilst beyond the scope of our review, has rock armouring been considered or is it warranted? The integrity of the capping is obviously critical to a number of the assumptions within the modelling and subsequent risk assessment. It is expected that this will be a major consideration for EPA given the fundamentality of capping as a risk minimisation measure.	Monitoring of the cap cover integrity will occur during inundation when erosion is most likely due to surface water or wave erosion, and also refer to Item 48 comments whereby armouring would then not be considered necessary due to the low risk.	Agree that cap degradation is most likely during inundation, but it is still possible post inundation.	Final	ok, See response to Item 48	Noted, following wording added to Table 10-5, element 3.3: *Post submergence, bathymetric surveillance will be conducted to monitor the elevation and stability of the CLA area.* A post submergence plan will be completed before inundation is complete	Final	ok	Y
50	10.4		Draft	Table 10-5: Reference should be made to the dispersity testing as that informs a scenario where ash is mobilised into the water column through erosion and creates an aesthetic issue (i.e. cloud of silty water affecting the amenity of the water body)	Data supports that dispersion is unlikely but it can also be mentioned in this section Completed	TBC	Final	ok	No further action			Y
51	10.4		Draft	Groundwater monitoring is included in the monitoring and reporting program. Note we have not reviewed the locations of and appropriateness of monitoring locations and testing regimes. Monitoring frequencies seem reasonable.	Noted	TBC	Final	ok	No further action			Y
52	11		Draft	We note the usefulness of the literature review in establishing best available technologies and reiterate that this proposal has much in common with disposal of materials at sea, including dredge material disposal grounds.	Noted	TBC	Final	ok	No further action			Y
53	11		Draft	Perhaps note in the modelling summary that under sensitivity analysis particles did move further the 49 m, but still not distances that indicated impacts to receptors	Check and sentence added to Sec 11 summary	TBC	Final	ok	No further action			Y
54	11		Draft	Replace "BlueSphere consulting" with "BlueSphere Environmental"	Agreed and completed	TBC	Final	One reference to BlueSphere Consulting on p.137, should be BlueSphere Environmental	Corrected	Final	ok	Y
55	11		Draft	Suggest remove reference to verifying the location of the CLA as it is understood the focus was to characterise the physical and chemical nature of the CLA.	The location of the CLA did not have a detailed survey and so the field sampling in 2021 and 2022 did contribute to the verification of the CLA area.Concluding paragraph is kept the same and second paragraph after the bullets at the begining of Section 11 has removed the objective of verification.	TBC	Final	ok	No further action			Y
56	1.2	Table 1-1					Final	Item 5 - Please cite the literature review here also as a relevant response item	Noted and following text added to Table 1-1, item 5: *Literature review of national and international examples of (leached) ash management*	Final	ok	Y
57	4.1	Tables 4-1 and 4-1					Final	Where an EV is not relevant, provide substantiation, e.g. no existing registered users, contraints on future use etc Also, should the EV of Water Dependent Ecosystems and Species in relation to groundwater be relevant given in time the waterbody and the groundwater are expected to be in hydraulic connection.	Justification of the relevancy of an environmental value has been provided in Section 4.1 (final paragraphs). Additional summary paragraph has been added. Additional commentary has been added to Table 4-1 (EV - WDES) to state that currently hydraulic connectivity between the water body and the DBF/BF does not exist however this will change in the future: *No – currently the DBF/BF lithological unit surrounding the water body is dry. However, it is acknowledged that the DBF/BF will become saturated in the future, hydraulic connectivity between the water body and the DBF/BF will be established and this environmental value will be realised .*	Final	ok	Y
58	4.2.1						Final	Paragraph 3 - last sentence appears to be a novel approach to quantifying exceedences; we are not sure this approach is consistent with the species sensitivity distribution models used to derive the generic criteria. This approach should either be further substantiated or omitted as it is not critical to the discussion.	This sentence has been removed as suggested.	Final	ok	Y
59	4.2.1						Final	The fourth paragraph refers to risk assessments undertaken in relation to boron. Further discussion should be provided with respect to Boron and exposure models such as grazing mammals ingesting pit lake water. Also refer to Item 45.	Refer to item 45 response	Final	ok	Y
60	4.7						Final	Paragraph 4 states that "the application of interim WQPTs will ensure no deterioration of environmental values and receptors as the water body filling strategy proceeds". Its not clear that this can be substantiated. Perhaps they will help to identify if deterioration, or further deterioration, occurs. This also somewhat contradicts our understanding that the finalisation of the filling strategy will prompt development of the the final WQPTs under the MCRP. Similarly, the statement "The risk to environmental values of water dependent ecosystems and species will be low and manageable using contingency measures.." requires substantiation, particularly with respect to boron and exposure models such as grazing mammals ingesting pit lake water.	Additional wording added to paragraph: The application of interim WQPTs *and the final WQPTs will aid in the identification of any* deterioration of environmental values and receptors as the water body filling strategy proceeds and the CLA area is inundated. As described in the sections above, the environmental values of the surrounding natural catchment must be protected. The risk to environmental values of water dependent ecosystems and species will be low and manageable using contingency measures which will be developed as part of the water body filling strategy. *It is acknowledged that boron concentrations in the water body and (potentially) the DBF and BF are elevated and further site specific risk assessment is proposed to assess the potential risks to ecological receptors from boron sources (in addition to the CLA area). Additional risk assessment will be conducted as part of the MCRP finalisation.*	Final	ok	Y
61	4.8						Final	Suggest adding the words 'apart from aesthetic enjoyment' after the words 'recreational uses'.	Completed	Final	ok	Y
62	7.1						Final	The geometric means should be stated. Also please check discussion in this section and elsewhere (e.g. Section 10.1) which refers to permeabilities all being less than 1 x 10-9 m/s - some values are above this. It is noted that it appears that the correct permeabilities have been used in the modelling.	Geometric means have been added to Table 7-1, Table 7-2 and Table 7-3. Text has been corrected to state: *geomean for each material group is less 2x10-9 m/sec with the exception of the 2021 fill material group. This result is skewed by a sample of organic clay with a permeability of 6x10-8 m/sec which is not representative of the other fill material sample permeabilities. This sample is considered to be an outlier in the dataset, however, has been retained.*	Final	ok	Y
63	10.5						FInal	It is understood that the specifics of a post submergence monitoring plan are being developed, however, at a high level it is agreed that most submergence monitoring (e.g. via bathymetric survey) will be undertaken until such time that it is evident that the CLA is stable. Text in Section 10.5 should be updated to reflect this.	Noted and following text has been added to Section 10.5: *Development of a post submergence plan which will include bathymetric surveillance to monitor the elevation and stability of the CLA area* A post submergence plan will be completed before inundation is complete	Final	ok	Y
64	11						Final	Reference to BATT should be made in the conclusions as this was the purpose of the literature review	This has been added to the fourth bullet point	Final	ok	Y

Appendix B ERR & EPA Correspondence

Department of Economic Development,
Jobs, Transport and Resources

GPO Box 4509
Melbourne Victoria 3001 Australia
Telephone: 03 9651 9999
ecodev.vic.gov.au
DX 210074

Mr Warren Sharp
Anglesea Site Manager
Alcoa of Australia Limited
Camp Road
ANGLESEA VIC 3230

Dear Mr Sharp

RE: ALCOA ANGLESEA – ASH COVERING MANAGEMENT COMMENCEMENT

I refer to Alcoa's letter of 20 November and email of 28 November 2017 in relation to the notification of intention to conduct earthworks to consolidate and cover ash under the current endorsed Mine Work Plan at the former Anglesea coal mine.

Based on the information provided in the covering letter and the *Earthworks Plan Depicting the Design to be Employed to Cover the Ash* (the Earthworks Plan), Earth Resources Regulation (ERR) has a number of questions as to how the works may impact the final rehabilitation and closure of the site.

The questions draw on comments provided to Alcoa following ERR's review of the Alcoa Anglesea Rehabilitation and Closure Plan and whether, in the absence of a response, the works can be considered 'no regrets'. Prior to Alcoa proceeding, ERR is seeking clarification on the following aspects of your intended works and their implication on the overall rehabilitation and closure of the site.

Hydrogeology/Hydrology/Geochemical

In relation to the environmental impact of the in-pit ash disposal, please address the following:

1. The Earthworks Plan makes reference to hydrogeological evaluation and geochemical simulations, however these documents have not been provided (or referenced). Are these the same models that were reviewed as part of the recent review of the Alcoa Anglesea Rehabilitation and Closure Plan 2017? If so, please consider the comments provided in the response in the context of this matter.
2. Alcoa has provided a qualitative description of the Erodible Mine Material (EMM) as having a 'low permeability', however there is no material testing data to support this statement. Similarly, permeability data for the basal clay unit would provide necessary evidence of how this unit will control fluxes.
3. The Earthworks Plan indicates that transport modelling of both the pit water body and the Upper East View Formation (UEVF) groundwater though the ash material in the pit has been simulated. As above, the supporting document has not been provided (or reference).

4. In the recent review of the Alcoa Anglesea Rehabilitation and Closure Plan 2017, the Environment Protection Authority (EPA) identified that further testing was required to characterise the ash (including leachate analysis). This raises concerns regarding the suitability of any modelling in the absence of suitable characterisation of the material.
5. The Earthworks Plan states that 'permeability testing of the compacted ash and cover materials will be used to verify the transport modelling input parameters'. Please provide the permeability values used in the modelling and the testing regime (and method) proposed to validate the model parameters. What happens if compaction is unable to achieve the modelled permeability parameters?

Geotechnical

In the broader context of pit stability, the covering of the ash was not seen as posing a significant risk. However, in order to adequately assess the risk it would have been useful if the earthworks plan was developed in accordance with typical industry practice (e.g. as per the framework outlined in AS 3798 *Guidelines on earthworks for commercial and residential developments*). A map and any modelling information (3D imagery) would also have been useful in understanding where the ash was to be placed in the pit void.

In relation to the consolidation aspects and (potential) implications to long term stability please address the following:

1. Alcoa has provided a qualitative description of the ash but no characterisation of the materials' mechanical properties. This would typically be required in an earthworks plan (as pointed out in ERR's assessment of the Alcoa Anglesea Rehabilitation and Closure Plan).
2. Alcoa states that the ash is expected to consolidate to various levels. How this was assessed in the absence of material properties (as mentioned in point 1)? The consolidation behaviour of any material is typically governed by a parameter referred to as the coefficient of vertical consolidation (Cv).
3. There are references to machinery compacting the ash and EMM to aid in the earthworks process, however owing to the limitations stated above in points 1 and 2, the implications of this has not been quantitatively assessed, and remains an untested assumption.
4. Owing to the points mentioned above, it is unclear how the ash covering works can be considered 'no regrets', i.e. if subsequent trials and testing yield lower parameters than 33 degrees (the friction angle looking to be achieved in the Alcoa Anglesea Rehabilitation and Closure Plan) what are the implications?

If you any questions of wish to discuss our comments further, please contact Andrew Radojkovic on 03 8392 6043 or andrew.radojkovic@eodcev.vic.gov.au

Yours sincerely

A Robinson

Tony Robinson
Director, Regulatory Compliance

29 / 11 / 17

Cc. Carolyn Francis
Environment Protection Authority

VICTORIA State Government

Department of Economic Development,
Jobs, Transport and Resources

GPO Box 4509
Melbourne Victoria 3001 Australia
Telephone: 03 9651 9999
ecodev.vic.gov.au
DX 210074

Mr Warren Sharp
Anglesea Site Manager
Alcoa of Australia Limited
Camp Road
ANGLESEA VIC 3230

Dear Mr Sharp

RE: ALCOA ANGLESEA – ASH COVERING MANAGEMENT COMMENCEMENT

I refer to Alcoa's letter of 20 November and meeting of 30 November 2017 in relation to the notification of intention to conduct earthworks to consolidate and cover ash under the current endorsed Mine Work Plan at the former Anglesea coal mine. Earth Resources Regulation (ERR) has considered your proposal and notes the following:

- Alcoa is proposing to cover the ash as a dust mitigation measure. This will reduce the likelihood of ash dust leaving the site and impacting on the Anglesea township.
- The ash has already been consolidated and will be covered by 1 m of silt and clay overburden which will be compacted by the earthmoving equipment.
- The ash will be relocated to the consolidation area (at the eastern end of the pit void) and will ultimately consist of a 4 m thick horizon between RL -15 and -8 m extending over an area of approximately 7 ha.
- Mine water recovery modelling forecasts that without the re-diversion of Salt Creek that the water level in the pit will not recover to RL -15 m until approximately April 2024.

Based on the information provided in the covering letter, the *Earthworks Plan Depicting the Design to be Employed to Cover the Ash* and subsequent e-mail and attachments of 28 November 2017, ERR is satisfied that the works as described take place between December 2017 and March 2018.

ERR notes that the questions raised in the correspondence of 29 November 2017 relating to the potential impacts of the ash on water chemistry, hydrology, hydrogeology and stability will be considered in Alcoa's revised rehabilitation and closure plan.

If you any questions of wish to discuss our comments further, please contact Andrew Radojkovic on (03) 8392 6043 or andrew.radojkovic@eodcev.vic.gov.au

Yours sincerely

ACRobinson

Tony Robinson
Director, Regulatory Compliance

6 / 12 / 17

Cc. Carolyn Francis, Environment Protection Authority

VICTORIA State Government

20 October 2021

Mr Warren Sharp
Alcoa of Australia Limited
205 Coalmine Road
Anglesea VIC 3230

Dear Mr Sharp,

Approval pathway under the Environment Protection Act 2017

Thank you for your correspondence in relation to an EPA approvals pathway for assessing the detailed design for the ash landfill cap dated 17 September 2021.

Based on the information provided and discussions at the co-regulators forum, EPA understands that the proposal has changed since 2017 and that Alcoa of Australia Limited ("Alcoa") is now pursuing the option of using water from Upper East View Formation to fill the pit with water. An application sent to EPA would need to reflect on this change, including the change in risk. EPA also understands that the ash landfill is intended to be submerged under water, once an approved cap is in place.

EPA's response to the matters raised are noted below. Please note that this information is of a general nature. EPA will determine any future application based on the evidence and information provided at the time of the application.

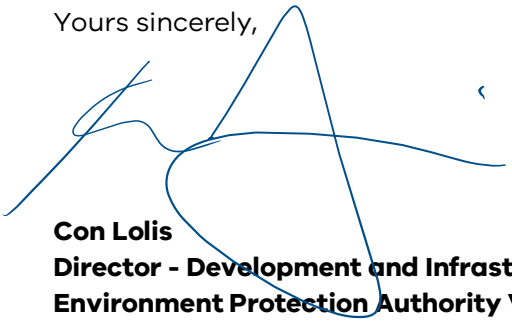
Assessment of landfill cap

To surrender the ash landfill from EPA Operating Licence OL000011429, Alcoa would need to submit an application under the *Environment Protection Act 2017*. EPA's position, based on the available information, is that Alcoa should seek an approval for the landfill cap through the licence surrender process. In that process, the following information should be provided:

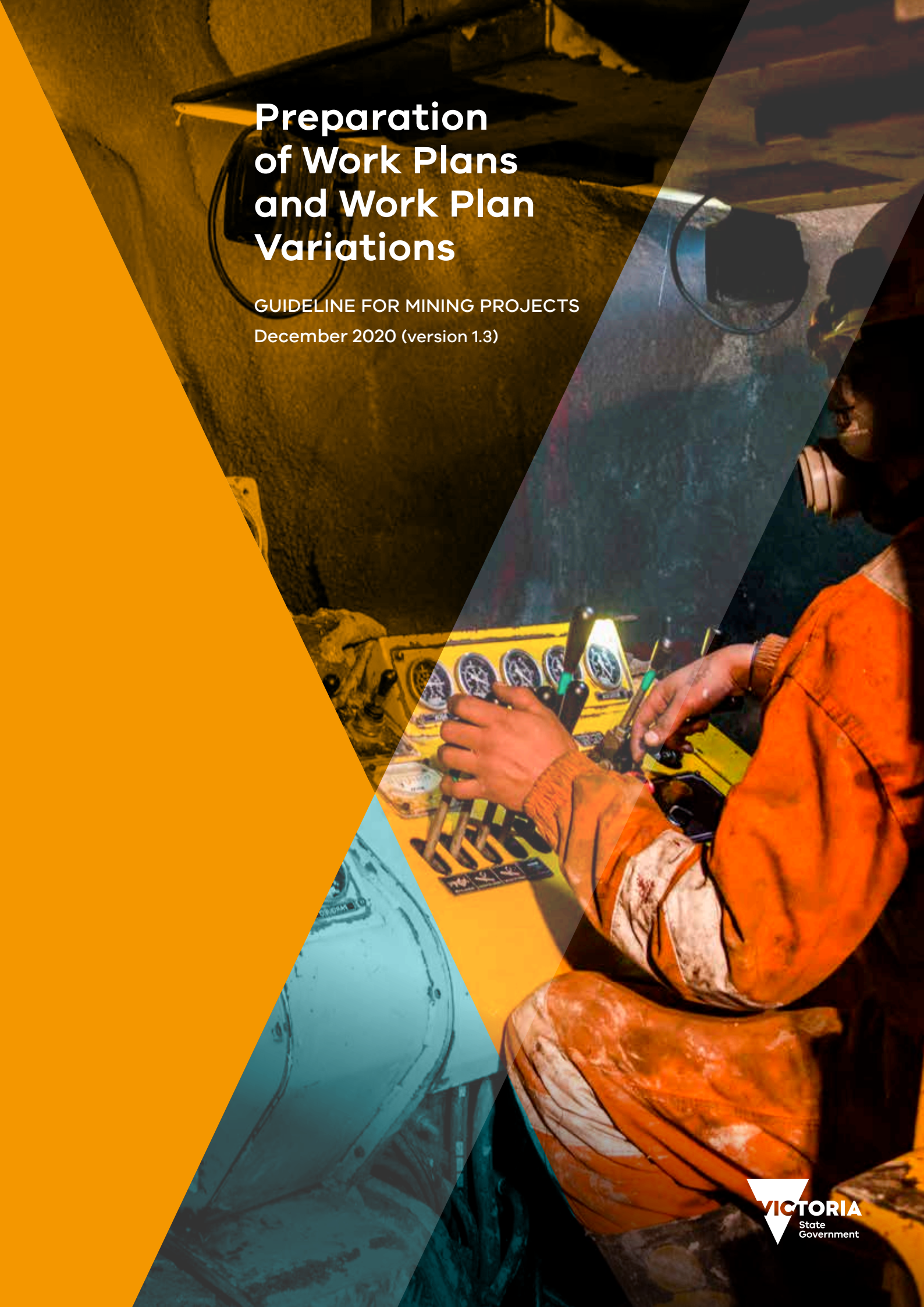
- detailed design of the landfill cap
- a description of the targeted performance (short and long-term) and outcomes of the proposed landfill cap
- information that supports how the proposed cap is able to achieve the targeted performance and outcomes
- monitoring results capable of confirming that the cap is performing in line with targeted performance and outcomes, short and long term
- detailed and verifiable confirmation that the proposal constitutes best available techniques
- independent technical peer-review of a qualified expert (or experts) that have expertise suitable to undertaking a technical peer-review of the proposal
- measures taken to comply with the General Environmental Duty, relevant Environment Reference Standards and principles of the *Environment Protection Act 2017*.

If you need additional information or assistance, please contact Andreas Elvin at Andreas.Elvin@epa.vic.gov.au or on (03) 9695 2942.

Yours sincerely,



Con Lolis
Director - Development and Infrastructure
Environment Protection Authority Victoria



Preparation of Work Plans and Work Plan Variations

GUIDELINE FOR MINING PROJECTS

December 2020 (version 1.3)

VICTORIA
State Government

Authorised for publication by the Head, Resources Branch
Department of Jobs, Precincts and Regions
1 Spring Street Melbourne Victoria 3000
Telephone (03) 9651 9999

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Note:

Feedback or suggestions to improve this guideline may be emailed to Workplan.Approvals@ecodev.vic.gov.au.

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These Guidelines were first released in January 2019. They were updated in September 2019 to reflect changed requirements in the Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019 and updated in December 2020 to clarify that the guideline should be used for an application for a work plan as an outcome of an Environmental Effects Statement.

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Definitions

Term	Definition
Closure	A life-of-operation process which ultimately can culminate in relinquishment. It broadly includes planning, decommissioning, rehabilitation, monitoring and maintenance.
Community	A broad term used to define groups of people, whether they are stakeholders, interest groups or citizen groups. The community may surround a geographic location (community of place), be a community of similar interest (community of practice) or have a special interest or legal interest in the land (community of standing). Community may also refer to a community of flora and fauna i.e. an assemblage of organisms existing together in the wild.
DJPR	Department of Jobs, Precincts and Regions
Disturbed footprint	The area or extent of un-rehabilitated land within the mining licence that has been altered by operations and which has not yet been rehabilitated. The disturbed footprint will vary with time. The current disturbed footprint is that which currently exists. The end of mine life disturbed footprint is the estimated area of disturbance that will exist at the cessation of operations.
End of mine life	The date at which production is proposed to cease under the currently approved work plan.
ERR	Earth Resources Regulation, the principal regulator of mines and quarries in Victoria
Infrastructure Mining Licence*	A mining licence solely for the construction of a facility or other infrastructure to be used for the purpose of mining under another mining licence
Legacy site	A facility or former disturbed footprint within the mining licence which is no longer part of the active operations
Mine*	Any land on which mining is taking place under a licence
Mineral*	Any substance which occurs naturally as part of the earth's crust: a. Including: i. oil shale and coal; and ii. hydrocarbons and mineral oils contained in oil shale or coal or extracted from oil shale or coal by chemical or industrial processes; iii. bentonite; fine clay; kaolin; lignite; minerals in alluvial form including those of titanium, zirconium, rare earth elements and platinoid group elements. iv. quartz crystals; zeolite. b. Excluding water, stone, peat or petroleum.
Mining hazard#	Any mining activity and circumstance that may pose a risk to the environment, to any member of the public or to land, property or infrastructure in the vicinity of work carried out at a mine.
Minister	Victorian Minister for Resources
MRSDA	*Mineral Resources (Sustainable Development) Act 1990*
Plant*	Means buildings, structures, works or other machinery (whether fixed or mobile) and all other installations or equipment used in the doing of work under a licence or an extractive industry work authority.

Term	Definition
Reasonably practicable	'As far as reasonably practicable' under section 40(3)(c) of the MRSDA and Regulation 45 of the Regulations is based on the approach to precaution-based risk analysis under the *Occupational Health and Safety Act 2004*. Under section 20(2) of the Occupational Health and Safety Act 2004, reasonably practicable means: that which is, or was at a particular time, reasonably able to be done to ensure health and safety, taking into account and weighing up all relevant matters including: a. the likelihood of the hazard or the risk concerned eventuating b. the degree of harm that would result if the hazard or risk eventuated c. what the person concerned knows, or ought reasonably to know, about the hazard or risk, and any ways of eliminating or reducing the hazard or risk d. the availability and suitability of ways to eliminate or reduce the hazard or risk e. the cost of eliminating or reducing the hazard or risk.
Regulations	Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019
Rehabilitation	The return of disturbed land to a safe, stable and non-polluting condition to an agreed end use. It broadly involves landform design, construction and shaping; materials characterisation, handling and placement; surface water management and revegetation. It comprises two phases: • Rehabilitation execution – comprising design and permitting plus most of the physical works on sites, such as decommissioning, decontamination and demolition of infrastructure; bulk earthworks; capital works; and topsoiling/revegetation. • Post rehabilitation execution – monitoring, maintenance and land management following the rehabilitation execution phase that extends until rehabilitation objectives have been achieved.
Risk management plan	Regulations 40 and 45 of the Regulations states that a risk management plan is required in a work plan for a mine. The risk management plan includes of a risk treatment plan for each mining hazard that is identified and a risk register.
Risk register	A risk register is a summary table of the risks identified for the mining hazards and includes the inherent and residual risk ratings. It is a component of the risk management plan.
Risk treatment plan	A risk treatment plan addresses the risks associated with one of the mining hazards identified. It specifies: a. The control measures to eliminate or minimise, as far as reasonably practicable, the identified risks associated with the particular mining hazard; b. The objectives, standards or acceptance criteria for those control measures; c. The monitoring program that will measure performance against all the specified objectives, standards and acceptance criteria; and d. The arrangements for reporting on performance against all the specified objectives, standards and acceptance criteria. Risk treatment plans for each of the identified mining hazards and a risk register form the risk management plan.
RRAM	Resource Rights Allocation and Management business portal is the ERR online software application used for the management of licences and work plans. Registered subscribers can use RRAM to apply for a licence, submit a work plan or report, track an application status and pay fees.

Term	Definition
Secondary Consent	Secondary consent allows for an expeditious means of dealing with changes to Planning Permits, but the extent of changes which can be sought are limited and third parties are prevented in becoming involved in the process. Councils generally only allow a permit holder to use this option for minor changes to the Planning Permit. Secondary consent is made available under the wording of a permit which has already been granted and is permissible under permit conditions.
Sensitive receptor	Sensitive receptors are people or other organisms that may have an increased sensitivity or exposure to an emission by virtue of their age and health (e.g. schools, day care centres, hospitals, nursing homes), status (e.g. sensitive or endangered species), proximity to the contamination, dwelling construction, or the facilities they use (e.g. water supply). For the purposes of a work plan the sensitive receptors are described in relation to the environment, any member of the public, or land, property or infrastructure in the vicinity of the proposed work.
Work plan	The work plan is the primary document describing the permitted activities to be undertaken on a mining licence It is intended to provide guidance to operations staff at the mine as well as informing other readers such as council or government officers in order to facilitate decisions, approvals, compliance, and enforcement functions. It must be clear, concise and contain sufficient detail to enable a reader to understand the activities proposed to be undertaken at the site, their potential risks and impacts, and the control or management actions required. For further information relating to a work plan refer to section 40 of the MRSDA.
Work plan variation	If the original scope of work changes after the plan has been approved by ERR, then the work plan needs to be **varied** to include these changes; this is known as a work plan variation.
Work	Any activity that is connected to or is incidental to the mine activities permitted under the approved Mining Licence and work plan.

Note:
** definition in MRSDA*
 # definition in Regulations

1. Background

1.1 What is mining industry?

Mining is the extraction of minerals from land for the purpose of producing them commercially. This includes processing and treating ore.

1.2 What do I need to develop a mining industry project?

Before land can be developed for mining industry, in most cases you will require:

- a **mining licence**;
- an **approved work plan** or compliance with the Code of Practice provision under Part 8A – Section 89A of the *Mineral Resources (Sustainable Development) Act 1990* **(MRSDA)**;
- a **rehabilitation bond**;
- a **planning permit** under the Planning and Environment Act 1987;
- any other licence(s) and/or approval(s) required for the project under other planning and environment legislation;
- the consents of, and **compensation agreements** with, owners and occupiers of the land affected by the project;
- compliance with all the requirements of **section 42** (commencement of work under mining licence or prospecting licence) of the MRSDA; and
- provision of seven days' notice in writing to the Chief Inspector of Mines (ERR Director Regulatory Compliance) and the owners and occupiers of the land affected of the **intention to commence work**.

Exceptions to these requirements are explained in Section 2 of this guideline.

Approval processes under the MRSDA are administered by Earth Resources Regulation (**ERR**) within the Department of Jobs, Precincts and Regions (**DJPR**). Further information about ERR, mining licences, work plans and other related matters is available on the ERR website at http://earthresources.vic.gov.au/earth-resources-regulation.

1.3 Purpose of this guideline

The purpose of this guideline is to provide guidance on the preparation of work plans, work plan variations, and work plan notifications for mining industry projects, to meet Victorian regulatory requirements.

1.4 Scope of this guideline

The scope of this guideline includes:

- when a work plan or work plan variation is required (Section 2);
- when, and with what information, it is recommended to engage with ERR (Section 3);
- the content that needs to be in a work plan (Section 4);
- the content that needs to be in a work plan variation (section 5);
- the steps to seeking assessment of a work plan or work plan variation (Section 6); and
- the notification (administrative update to a work plan) threshold and process (Section 7).

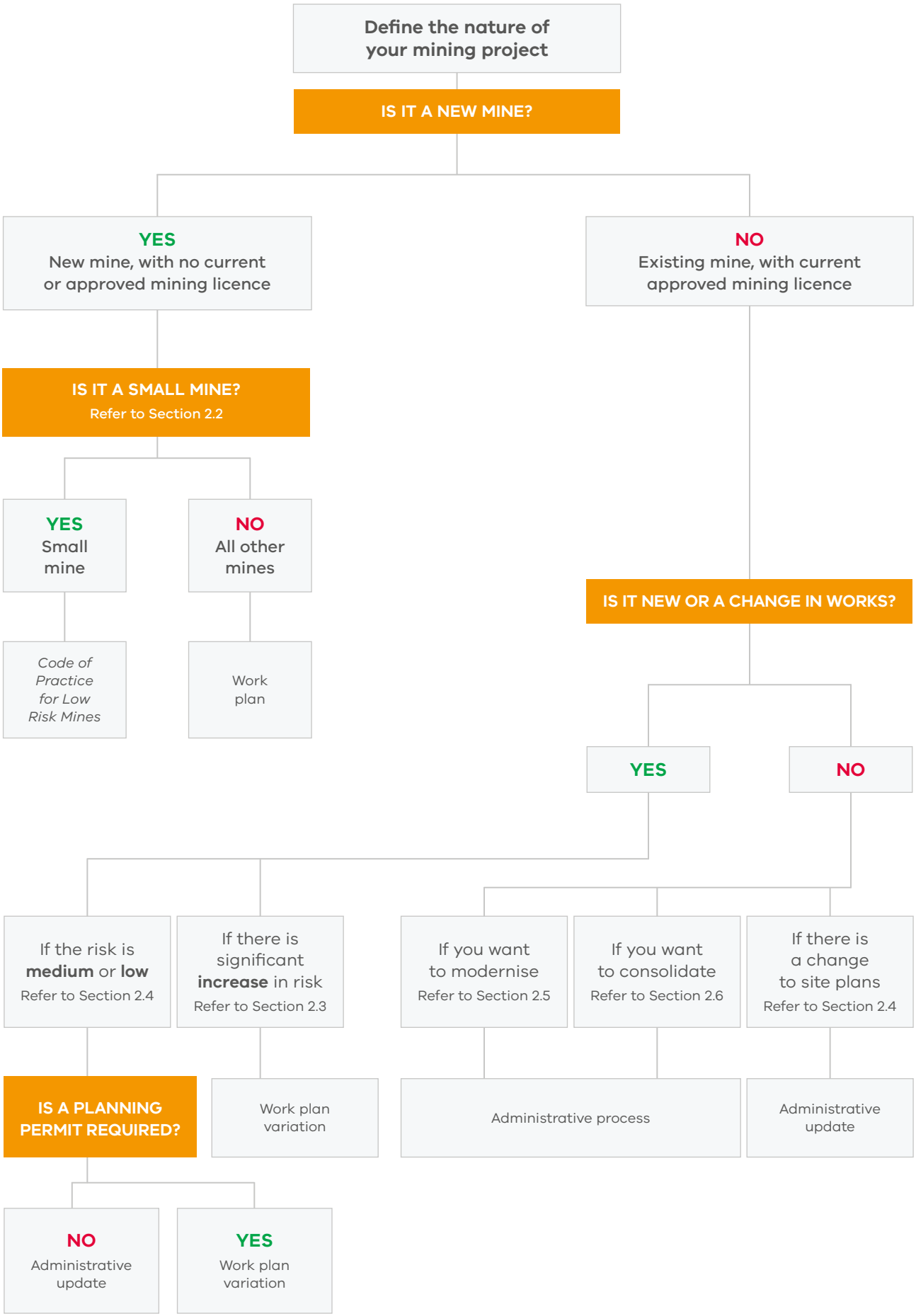
Figure 1 provides a flow chart that you can use to determine what type of application is appropriate in your case, and where to find the relevant information in this guideline.

The scope of this guideline does **not** include:

- requirements for declared mines or coal mines;
- requirements for infrastructure mining licence work plans;
- preparation of extractive industry or exploration work plans;
- assessment of proposed changes to the boundary of an approved mining licence;
- preparation and assessment of rehabilitation bonds.

If you are looking for assistance in these matters, please contact the ERR Licensing Team. Up-to-date contact details can be found at http://earthresources.vic.gov.au/earth-resources/contact-us.

Figure 1: Flow chart to determine your application type and the relevant section of this guideline



2. When is a work plan or work plan variation required?

2.1 What is a work plan?

A work plan is a document that needs to:

- describe the nature and scale of the proposed mining activities
- identify and assess all risks the works may pose to the environment, to the public, or to nearby land, property or infrastructure (known as '**mining hazard**')
- include a risk management plan that specifies the measures the licence holder will use to eliminate or minimise identified risks and monitor performance
- include a community engagement plan
- include a rehabilitation plan.

Section 4 of this guideline provides further detail on the content of a work plan.

2.2 When is a work plan required?

A work plan must be submitted to ERR and approved before any mining activity commences.

However, this requirement does not apply to mining projects that:

- covers an area of 5 hectares or less; **and**
- does not require underground operations, blasting, the clearing of native vegetation or the use of chemical treatments.

If a work plan is **not** required, compliance with the *Code of Practice for Low Risk Mines* (**the Code**) will be required as a condition of the mining licence.

http://earthresources.vic.gov.au/earth-resources-regulation/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/code-of-practice-for-low-risk-mines

If ERR is satisfied that the work proposed does not trigger the need for a work plan, ERR will acknowledge in writing that only compliance with the Code is required.

2.3 What is a work plan variation?

A work plan variation is a document that seeks approval for changes in work that are not consistent with an existing approved work plan.

Section 5 of this guideline provides further detail on the content of a work plan variation.

2.4 When is a work plan variation required?

A work plan variation is required when there is a change in work, or new work is proposed that has not been approved under an existing work plan.

'**Work**' is any activity that is connected to or is incidental to the mining activities permitted under the approved work plan.

A '**change in work**' is work that is not consistent with an existing work plan.

'**New work**' is work that is not approved under the existing work plan, or mining licence.

Changes in work that trigger a work plan variation are those that involve:

- a significant increase in risk;
- a change to the community engagement plan as a result of new work or a change in work; or
- a change to the rehabilitation plan as a result of new work or a change in work.

A '**significant increase in risk**' is where the residual risk (assessed under ERR's risk matrix in Appendix A of this guideline) is categorised as greater than **medium** after factoring in the adequacy of existing controls and the proposed application of additional controls (where these additional controls are listed in guidance material published by ERR, such as those in Appendix C of this guideline).

Section 5.3 of this guideline presents ERR's risk framework and explains how to assess residual risk.

If you are an existing licence holder, you may need to prepare a work plan variation for statutory endorsement as part of a planning permit amendment application. In such cases you should seek advice on planning permit requirements from the relevant planning authority.

2.5 What changes do not require a work plan variation?

If you have an approved work plan, you may consider making a **notification** to ERR for changes to work or new work which do not trigger a work plan variation. Instances that do not trigger a work plan variation include:

- No new risks, and existing risks are categorised (after being assessed under ERR's risk matrix in Appendix A) as **low or medium**;
- Changes to maps or drawings associated with a licence and/or work plan.

Examples of work that may not trigger a work plan variation and are therefore suitable for notification are provided in Appendix D. Section 7 of this guideline outlines the process and information required by ERR to accept a notification.

2.6 How can I modernise my work plan?

There is no requirement to transition a work plan approved prior to 8 December 2015 to a modern one that meets the current requirements of the MRSDA and its Regulations. However, modernising your work plan would simplify any future applications for variation and streamline the consultation process with referral authorities. In most cases, modernising your work plan is purely an **administrative process** (i.e. will not trigger a work plan variation) and will not have implications for existing planning approvals or referrals.

A modern work plan is:

- short, clear and written in plain English;
- fit for purpose, meeting the current requirements of the MRSDA, its Regulations and the needs of the business;
- understandable by all users, including co-regulators;
- detailed enough to describe operations and risks;
- focussed on how risks will be managed; and
- reflects current and planned operational circumstances.

A modern work plan includes:

- an overall description of the site and planned site operation – this is clearly written to accurately describe the key features of the operation, and enable minor on-ground changes that are consistent with the description without further approval;
- a risk management plan – this describes the identified mining hazards, your planned control measures and your monitoring and reporting program;
- a community engagement plan; and
- a site rehabilitation plan.

Modernising a work plan involves adding the key parts which would now be required in a new work plan, which are a mining hazard assessment and a risk management plan.

Modernising a work plan can also involve removing information that is no longer required, such as a lengthy detailed description of proposed work.

A modernised work plan can be approved by ERR without further consultation with a council or referral agencies, because there are no changes that would trigger a work plan variation.

A modern work plan will incur no fee, where no variation is required.

Please contact the ERR Assessment Team prior to preparing your modernised work plan. Up-to-date contact details can be found at http://earthresources.vic.gov.au/earth-resources/contact-us.

2.7 How can I consolidate my work plan and variations?

Many licence holders have work plans with variations that have not been consolidated into a single work plan.

ERR has an **administrative process** to simplify work plans by consolidating relevant work plan content and all variations into a single document. Consolidation involves taking a work plan which was approved before 8 December 2015 and identifying the current components that define the scope of the mining licence.

This consolidation process will involve consultation with licence holders as required.

Consolidation will:

- not change any regulatory requirements on operators or cause existing rights to be amended or revoked;
- not involve a statutory approval process or consultation with the relevant municipal council or referral authorities; and
- incur no fee, where no variation is required.

Once accepted by ERR, the consolidated work plan forms a single document which incorporates all approved works that may be carried out on a site.

ERR will approach selected licence holders to consolidate work plans that contain information that is no longer required due to multiple changes over time. This will involve creating an index and bringing to the front of the work plan all the current arrangements that apply on site. Any ancillary information will then form attachments to the work plan.

It should be noted that ERR may require you to submit a work plan variation if any new or changed hazards or risks that have not been adequately addressed are identified during the consolidation process.

If you are interested in consolidating your work plan and variations, please contact the ERR Assessment Team. Up-to-date contact details can be found at http://earthresources.vic.gov.au/earth-resources/contact-us.

3. What is the recommended pre-submission process?

3.1 Background

The approval process for mining industry work plans and work plan variations depends on whether a planning permit is required.

All new work plans require a planning permit unless the proposed work has been subject to an Environment Effects Statement.

> Proposed work that has been subject to an Environment Effects Statement (EES) under the Environment Effects Act 1978 does not require a planning permit. Use this guideline in preparing an application for work plan as an outcome of an EES. You should contact ERR for advice on the approval process for work plans following an EES.

If the proposed changes to work are compliant with a current planning permit, or secondary consent under an existing planning permit is required, then only the approval steps apply.

If the proposed changes to work require a new planning permit or a planning permit amendment, the MRSDA requires the additional step of statutory endorsement of the work plan or work plan variation by the Department Head or delegate[1] before you submit the proposal to the planning authority for assessment.

3.2 Recommended pre-submission steps

> You are not required to undertake these pre-submission steps. However, these steps are recommended to avoid delays due to misunderstanding of council or referral authority requirements.

The recommended work plan (or work plan variation) pre-submission steps aim to equip you with the information needed to prepare an application that meets statutory requirements.

The recommended pre-submission steps are outlined below and in Figure 2:

1. Contact ERR
2. Submit initial proposal
3. Arrange, conduct and record site meeting
4. Engage relevant agencies
5. Arrange pre-submission briefing with ERR (optional)
6. Submit work plan.

1 e.g. Director, Statutory Authorisations, ERR and referred to as 'the regulator' for the purposes of these guidelines

Figure 2: Recommended pre-submission steps

3.2.1 Contact Earth Resources Regulation

You may contact the ERR Assessments Team via phone or email to briefly outline the nature of your proposed project. A list of ERR contacts is available at https://earthresources.vic.gov.au/about-us/contact-us.

An Assessments Officer will have a discussion with you to understand the nature of the proposed project and explain the process required.

The Assessments Officer will determine if the proposed project is exempt under the MRSDA and does not require a work plan or work plan variation.

If the project requires a work plan (or variation), then ERR will email you the relevant information, such as:

- an *Initial Proposal Information* request;
- ERR work plan expectations; and
- a community engagement plan template and guidance.

3.2.2 Submit initial proposal

You should return the completed initial proposal to ERR by email to Workplan.Approvals@ecodev.vic.gov.au prior to organising the initial site meeting (refer to Section 3.2.3).

When ERR receives the initial proposal an Assessments Officer will be nominated as your primary contact.

The **initial proposal information** to be submitted should include:

- **Description of the operation**

  For a new application: a brief description of the proposed operation and its location (including formal address).

  For work plan variations: a brief description of the existing operation, and details of the new or changing works.

  You should include the following (where relevant) as part of the description of operations:

  - Maximum depth of works (pit and/or underground)
  - For pits, include the batter and bench profile detail
  - Method of processing
  - Annual production estimate (tonnes)
  - Containment dams (water/tailings)
  - Predicted offsite discharges
  - Impact to native vegetation
  - Presence of waterways and potential waterway interception
  - Groundwater interception
  - Blasting.

The initial proposal should be a summary of the available information relevant to the proposal. Site investigations specific to the proposal are not a requirement.

- **Agreements**
  - Evidence that you have reached a commercial and/or compensation agreement with the relevant landholder(s).
- **Planning**
  - An indication of whether a planning permit is required.
  - *Planning Property Report*: current report for all the properties included in the application/tenement area. All pages of the report must be included. Planning Property Reports can be obtained, free of charge, from http://www.land.vic.gov.au.
  - *Land Title Documentation*: current register statement for the Certificates of Title, with copies of plans, for all titles to be included in the tenement area. Most register statements do not include a map, so this must be obtained. In addition, confirmation of any depth limitation on the title(s) is required. Land title documentation can be obtained, for a fee, from https://www.landata.vic.gov.au/.
- **Maps**
  - A map(s) with scale and key showing the location of:
  - The mining licence boundary
    - For a new work plan, the map must also include GDA94 coordinates (easting and northing) for each corner defining the mining licence area
    - For a work plan variation, the map must include the current and proposed extent
  - The extent of the activity footprint (i.e. the extraction area or the extent of the underground mining operations). If this area is changing as a result of a work plan variation, include the current and proposed extent
  - Nearest sensitive offsite receptors
  - The extent of the geotechnical risk zone. ERR guidance on the assessment of geotechnical risks is available at http://earthresources.vic.gov.au/earth-resources-regulation/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/guidance-material-for-the-assessment-of-geotechnical-risks-in-open-pit-mines-and-quarries.
  - Any relevant landform feature (e.g. river) and/or infrastructure (e.g. high voltage power line, road or freeway).

3.2.3 Arrange and conduct site meeting

Aims and objectives

An initial site meeting is considered the most effective way to progress your proposal. The objective of the site meeting is to discuss issues and requirements with the relevant agencies, to help you draft your work plan to successfully gain any required approvals and/or permits.

The initial site meeting aims to bring you together with all the agencies whose areas of responsibility are potentially affected by your proposal, the relevant council and the relevant ERR staff based on your initial proposal information provided. The agencies fall into two groups:

- Statutory referral authorities[2], with the exception of VicRoads in relation to traffic matters
- Other relevant non-statutory referral agencies[3] that ERR considers necessary to aid in making its decision.

The purpose of the initial site meeting is to provide an opportunity for the relevant agencies to understand the potential impacts of your proposal on their area of responsibility, and for you to understand the requirements of each agency and council so that you can address these issues during development of your work plan (or work plan variation) documentation.

Each agency will be invited to point out their requirements regarding the proposed activity (as required by relevant legislation, guidelines or policies). The meeting is often the starting point for ongoing discussions with you and further advice may be provided at a later date. After the meeting the council must advise you in writing if any planning permission is required, which in turn determines the legislative pathway followed by ERR.

The council needs to make an informed decision on the need, or otherwise, for a planning permit or planning permit amendment for your proposal. This decision needs to be made before a work plan (or work plan variation) is submitted.

If council determines that a planning permit is required for your proposal, the work plan (or work plan variation) submission will ultimately be referred to referral authorities[4]. Referral authorities may respond in one of three ways:

- They do not object; or
- They do not object if the work plan (or work plan variation) is subject to conditions; or
- They object.

2 As referred to under Part 6B of the MRSDA and required under the *Planning and Environment Act 1987*

3 As required under Section 77I(3)(d) for comment only.

4 Under the *Planning and Environment Act 1987*, as required under Part 6B of the MRSDA.

Note: The work plan (or work plan variation) may be refused if a referral agency objects.

There is no option for referral authorities to require further changes to a work plan after it is referred. Therefore, it is very important that your work plan (or work plan variation) addresses all the material concerns of the referral authorities before it is referred to them. This makes the discussions at the initial site meeting very important for the ultimate approval of the work plan.

You are strongly encouraged to undertake an initial site meeting, otherwise you may risk refusal of your work plan (or work plan variation) due to the objection of a referral authority.

Attendance at the initial site meeting

The appointed Assessments Officer will review your initial proposal and provide you with an Agency Consultation Checklist with the contact details for all referral authorities. The purpose of this checklist is to identify which parties you should invite to an initial site meeting to discuss the proposal.

It is recommended that you invite ERR, council and all identified statutory referral authorities and other agencies to the initial site meeting.

This process also applies for applications not requiring statutory endorsement, which ERR will refer to relevant agencies for consideration prior to making a decision.

In addition to providing the Agency Consultation Checklist, ERR will:

- Provide details of ERR staff that are recommended to attend the initial site meeting. Including representatives from:
  - the Assessments Team (who will be overseeing the application);
  - the Compliance Team; and
  - the Technical Services Team, depending on the issues and complexity of the proposal; and
- Suggest possible dates for the meeting to be held given ERR staff availability.

It is your responsibility to arrange a meeting with all the referral authorities and other applicable agencies identified by ERR. Ideally this meeting will be conducted on-site, however, if the site is remote the meeting may be convened at the nearest suitable town with an optional site visit prior to the meeting. Sufficient notice should be provided to enable agencies to make arrangements in advance to attend the meeting.

Preparing for the initial site meeting

It is your responsibility to organise and conduct the initial site meeting. ERR generally recommends that the meeting is arranged about four weeks in advance to ensure that the various representatives are available.

You should provide the following information to ERR, council, the referral authorities and other agencies prior to the initial site meeting:

- Details of the meeting time and place
- Land tenure/status/allotment number
- Plan of extraction or disturbed area
- Commodity/resource type
- Size/depth/predicted life of proposed activity
- Estimated total resource
- Brief description of the proposed activity (e.g. pit layout and access, blasting, dams, slimes storage facilities, hazardous waste, native vegetation etc.)
- An initial site meeting agenda – an example is provided in Appendix E1.

A list of the potential questions that may be discussed at the initial site meeting is provided in Appendix E2.

Documentation of initial site meeting outcomes

You should record key outcomes of the initial site meeting and circulate them to all invitees.

The record should include:

- a list of attendees (and those who were an apology)
- a brief summary of the project as described during meeting
- key discussion points and/or issues raised (by each agency)
- key actions.

3.2.4 Engage with relevant agencies and regulators

Early engagement with ERR, relevant referral authorities, other agencies and council is key to the efficient assessment of your proposal.

At the initial site meeting you should initiate discussions with these stakeholders to clarify their requirements and resolve any potential issues. You should notify your nominated ERR Assessments Officer if any agencies provide further advice regarding their requirements for a work plan after the meeting.

You may be required to undertake additional work (e.g. surveys, investigations, or assessments) as a result of comments provided during the meeting. You are responsible for consulting with the relevant stakeholders to ensure that your additional work meets their specific requirements.

ERR recommends that your work plan or work plan variation is submitted within 12 months of the initial site meeting. Any longer and another site meeting is likely to be required to capture current information.

While preparing your work plan, you should progress applications for any other permits, licences or approvals required prior to seeking approval or statutory endorsement under the MRSDA from ERR.

3.2.5 Pre-submission briefing to Earth Resources Regulation (optional)

For some complex work plans and work plan variations it may be beneficial to arrange a pre-submission briefing to ERR. The briefing should be no earlier than two to four weeks prior to submission, and cover details such as:

- modifications (if any) to the proposal since it was last discussed with ERR;
- engagement undertaken with referral authorities and other agencies and the outcomes of that engagement (if any);
- risk assessment and management;
- community engagement; and
- rehabilitation.

4. What needs to be in a work plan?

4.1 Work plan objectives

Submission of a work plan serves two objectives:

1. **Assessment**: It enables ERR to assess whether your work plan should be approved and, if so, any conditions that need to be applied.
2. **Compliance**: It sets out the scope of the approved works and any requirements that you must meet, including monitoring and reporting obligations. It is important that these requirements are clearly described in your work plan, as any ambiguity could result in you inadvertently breaching the MRSDA.

To achieve these objectives, all work plans must include the following key components:

Table 1: Key components of a work plan

Component	Work plans
Description of the nature and scale of the proposed mining activities	A description of all elements of the mine and its setting within the landscape.
Identification and assessment of all risks the mining project may pose to the environment, to the public, or to nearby land, property or infrastructure (known as 'mining hazards')	Identification and assessment of all risks associated with the mine during construction, operation and closure.
Risk management plan that specifies the measures the proponent will use to eliminate or minimise identified risks and monitor performance	A risk management plan for the entire mine during construction, operation and closure. This should include a risk treatment plan for every mining hazard identified.
Community engagement plan	A community engagement plan is a document that clearly identifies relevant communities and describes how, when, and what engagement will occur with those communities during all stages of an exploration project.
Rehabilitation plan	A plan for rehabilitation that covers the entire mining licence.

The information that you need to provide to ERR to meet these requirements is outlined in the following sections.

4.2 A description of the project

The aim of the project description is to define the nature and scale of the proposed mining activities in sufficient detail to:

- set the scope of the approved works
- enable assessment and management of mining hazard(s).

The project description must include:

- mine setting and location of works within the licence boundary
- location of sensitive receptors
- nature of the proposed mining works
- nature of any auxiliary works (e.g. dewatering bores; water treatment plant).

Guidance on how to describe these aspects to comply with Regulation 40 and 42 of the Regulations is provided at Appendix B.

If the required information is not included, ERR may request changes to your work plan, or refuse it. It is essential that all required information is provided to enable an efficient assessment process.

4.3 Risks from proposed works

Your work plan must identify and assess all risks the proposed mining industry project may pose to the environment, to the public, or to nearby land, property or infrastructure (known as **mining hazards**). Rehabilitation hazards must also be identified and assessed.

The identified risk(s) must be eliminated or minimised as far as reasonably practicable with risk treatment plan(s) that specify the measures you will use to eliminate or minimise those risks and monitor performance.

This section provides guidance on the identification, assessment and control of risks associated with proposed mining industry works. Further information about the risk assessment process and risk document templates are provided in Appendices A and C respectively.

Figure 3 provides a summary of the risk assessment process that you should undertake when preparing a work plan.

Figure 3: Risk assessment process for work plans

4.3.1 Identification of mining hazards

You must first identify mining hazards relevant to the proposed activities in accordance with Schedule 14 of the Regulations.

For each relevant mining hazard, a **risk event** or risk events should be identified and described based on your project description. For example, dust may be identified as a hazard relevant to the proposed activity. There may be one or many risk events associated with the hazard. A risk event associated with the dust hazard could be "unacceptable dust emissions generated at the licence boundary".

For each risk event you must also identify the consequence(s) for public safety, the environment, public infrastructure, private infrastructure and community facilities (i.e. the sensitive receptors), should that risk event occur. Sensitive receptors may be located either inside (e.g. heritage, artefact) or outside (e.g. waterways, public roads, fauna) the licence boundary and the pathway from the source of the risk event to the receptor clearly shown.

During the risk assessment process, you must identify:

- the severity of the consequence(s) – i.e. harm or damage to the environment, to any member of the public, or to land, property or infrastructure as a result of your mining activities; and
- the likelihood of the risk event occurring.

Guidance on the suggested risk assessment process is provided at Appendix A.

4.3.2 Inherent and residual risk

During the risk assessment process you will produce a **risk register** that describes and collates the identified risk events, likelihoods and consequences associated with your proposed work plan. These are called **inherent risks** and should be based on the project description.

Effective risk management requires that all risks are eliminated or reduced as far as reasonably practicable. Therefore controls should be identified and applied to each risk to achieve this. This information, including any risks eliminated, should be recorded in the risk register and risk treatment plans. For risks which are inherently **low**, and which cannot be eliminated, the explanation of why they are **low** should be captured based on the project description.

The risk assessment process should then be conducted again, assuming implementation of the identified risk controls. The new likelihoods and consequences should produce a lower risk rating, these are the **residual risks** and should be based on the project description and listed controls. Where a **residual risks** are above medium, additional controls will need to be identified to reduce the risks to an acceptable level.

Both inherent and residual risk ratings should be included in your risk register. An example risk register is provided at Appendix C1.

4.3.3 Risk management plan

Your **risk management plan** should describe and address each mining hazard relevant to your project and the controls for all identified risks (i.e. **risk treatment plans**). The plan should demonstrate that the control(s) are able to reduce the likelihood(s) and/or consequence(s) such that the residual risk is minimised as far as reasonably practicable.

The risk management plan should include:

- a summary of the project, including assumptions and sensitive receptors
- a description of the risk assessment process conducted
- a risk register
- risk treatment plan(s).
- accountable personnel for the implementation, management and review of the risk management plan.

Appendix C2 provides a template risk treatment plan and Appendix C3 provides an example, which sets out the following key elements:

- details of the mining hazard
- a list of key sensitive receptors
- a list of risk events associated with the hazard
- performance standards
- controls to address hazard
- a residual risk assessment and rating
- monitoring.

Many mining hazards will be able to be managed by applying example controls published by ERR (refer to Appendix C4). These example controls have been developed to reflect acceptable industry practice for some hazards, where site-specific investigations and tailored controls are not required.

Appendix C4 provides example controls for:

- Dust and particulates
- Noise
- Erosion and sedimentation
- Soil biological activity
- Site access
- Fire
- Non-mineral waste
- Weeds and pests
- Water
- Imported materials
- Vehicle sediment transport.

You are encouraged to include applicable example controls in your risk treatment plan(s), and to supplement these controls where necessary to minimise your risk rating as far as reasonably practicable.

If your mining hazards are more complex (e.g. blasting, slope instability), they may require technical investigations to develop site-specific controls.

4.4 Community engagement

You have a duty to consult with the community under section 39A of the MRSDA throughout the period of the mining licence.

The objective of your engagement with the community and stakeholders is to ensure that interested parties are informed of your proposed activities and given the opportunity to express how they may be affected. Community and stakeholder engagement is considered fundamental in determining agreed environmental outcomes. Early and continuous community and stakeholder engagement also enables you to understand and manage community and stakeholder expectations and mitigate potential risks which could impact your project.

Your work plan must include a community engagement plan that achieves these objectives. It should be proportionate to the site-specific conditions such as scale, operational activities, and the size and proximity of local communities.

The community engagement plan should include:

- a list of relevant community members and stakeholders
- a description of likely attitudes and expectations
- potential impacts on each of the identified community members/stakeholders
- how community members/stakeholders will be engaged (and at what level)
- a description of your proposed complaint/community feedback handling process, including when and how ERR will be notified
- a timeline for engagement throughout mine life.

For more information on community engagement, refer to ERR's guidelines at http://earthresources.vic.gov.au/earth-resources-regulation/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/community-engagement-guidelines-for-mining-and-mineral-exploration

4.5 Rehabilitation

Planning for what rehabilitation should be undertaken at what stage, is a critical component of managing a mining project. Nationally and internationally, industry-leading practice requires that rehabilitation planning should start before works commence and should continue throughout the life of the mine until final closure and relinquishment.

Closure planning is the objective of Regulation 43 of the Regulations, which specifies that a rehabilitation plan must be included in the work plan.

The rehabilitation plan should include:

- rehabilitation strategy and concept (e.g. security of the site, removal of plant and equipment)
- key assumptions (e.g. water availability, material balance)
- post-relinquishment land uses (e.g. open space parkland, grazing)
- an outline of key rehabilitation activities for each aspect (or domain) of the mine to meet the objective of safe, stable, and sustainable
- rehabilitation risks and their controls (management and mitigation measures).
- Note that new rehabilitation plan requirements will commence from 1 July 2020.

5. What needs to be in a work plan variation?

5.1 Work plan variation objectives

Submission of a work plan variation serves two objectives:

1. **Assessment**: It allows ERR to assess whether your work plan variation should be approved and, if so, any conditions that need to be applied.
2. **Compliance**: It sets out the scope of the approved works and any requirements you must meet, including monitoring and reporting obligations. It is important that these requirements are clearly described in your work plan variation as any ambiguity could result in you inadvertently breaching the MRSDA.

To achieve these objectives all applications to vary a work plan must include the following key components, as required by Regulation 48 of the Regulations:

Table 2: Key components of a work plan variation

Component	Work plan variations
Description of how the proposed variation relates to the current approved work plan.	A description limited to the new or changing works and its setting within your licence boundary.
Description of new or changed mining hazard arising from the proposed changes to the work set out in the work plan that increases the risk to the environment, to any member of the public, to land, property or infrastructure (known as 'mining hazard').	A description of the mining hazards resulting from the new or any change in works.
Description of the proposed change(s) to the risks and risk management plan as a result of the new or changing works.	Consideration of the risks associated with the new or changing works. Updates to your risk management plan to cover the new or changing works, which includes new or updated risk treatment plan(s) associated with the new or changed risks.
Community engagement plan	A plan that outlines plans for engagement with any community member or stakeholder impacted by the new or change in works.
Rehabilitation plan	Updates to your rehabilitation plan as required by the new or change in works.

The information that you need to provide to ERR to meet these requirements is outlined in the following sections:

5.2 A description of the proposed variation

The aim of the description of the proposed variation is to define the nature and scale of the new or changing mining activities in sufficient detail to:

- set the scope of the approved works
- enable the assessment and management of any mining hazard(s).

The description of the proposed variation must include:

- the location of the new or changing works within your licence boundary
- the location of sensitive receptors relevant to the new or changing works
- the nature of the new or changing works proposed and how they relate to the existing approved work plan
- the nature of any new auxiliary works (e.g. dewatering bores, water treatment plant).

Appendix B provides guidance on how you should describe these aspects to comply with Regulation 48 of the Regulations.

> If the required information is not included, ERR may request changes to your work plan variation, or refuse it. It is essential that all required information is provided to enable an efficient assessment process.

5.3 Risks from proposed works

Your work plan variation must identify and assess all risks that the new or changing works may pose to the environment, to the public, or to nearby land, property or infrastructure (known as **mining hazards**).

The identified risks then must be eliminated or minimised as far as reasonably practicable with risk treatment plan(s) that specify the measures you will use to eliminate or minimise those risks and monitor performance.

This section provides guidance on the identification, assessment and control of risks associated with proposed variations to works. Further information about the risk assessment process and risk document templates are provided in Appendices A and C respectively.

Figure 4 provides a summary of the risk assessment process that you must undertake when preparing a work plan variation.

Figure 4: Risk assessment process for work plan variations

5.3.1 Identification of mining hazards

You must identify the mining hazards that may be relevant to the proposed new or changing mining activities in accordance with the requirement of Regulation 48 of the Regulations.

For each relevant mining hazard, a **risk event** or risk events should be described and identified based on the description of the new or changing works. For example, dust may be identified as a hazard relevant to your proposed new or changing works. There may be one or many risk events associated with this hazard. A risk event associated with the dust hazard could be "unacceptable dust emissions generated at the licence boundary."

For each risk event you must also identify the consequence(s) for public safety, the environment, public infrastructure, private infrastructure and community facilities (i.e. the sensitive receptors), should that risk event occur. Sensitive receptors may be located either inside (e.g. heritage, artefact) or outside (e.g. waterways, public roads, fauna) the licence boundary and the pathway from the source of the risk event clearly shown.

During the risk assessment process, you must identify:

- the severity of the consequence(s) – i.e. harm or damage to the environment, to any member of the public, or to land, property or infrastructure due to your new or changing work
- the likelihood of the risk event occurring.

Appendix A provides guidance on the suggested risk assessment process.

5.3.2 Inherent and residual risk

During the risk assessment process you will produce a **risk register** that describes and collates the identified risk events, likelihoods and consequences associated with your work plan variation. These are called **inherent risks** and should be based on the description of the proposed variation.

Effective risk management requires that all risks are eliminated or reduced as far as reasonably practicable. Therefore controls should be identified and applied to each risk to achieve this. This information, including any risks eliminated, should be recorded in the risk register and risk treatment plans. For risks which are inherently **Low**, and which cannot be eliminated, the explanation of why they are **low** should be captured based on the project description.

The risk assessment process should then be conducted again, assuming implementation of the identified risk controls. The new likelihoods and consequences should produce a lower risk rating, these are the **residual risks** and should be based on the project description and listed controls. Where a **residual risks** are above medium, additional controls will need to be identified to reduce the risks to an acceptable level.

Both inherent and residual risk ratings should be included in your risk register. An example risk register is provided at Appendix C1.

5.3.3 Risk management plan

Your **risk management plan** should describe and address each mining hazard relevant to your project and the risk controls for all identified risks (i.e. **risk treatment plans**). The plan should also demonstrate that the control(s) are able to reduce either the likelihood(s) and/or consequence(s) such that the residual risk is minimised *as far as reasonably practicable*.

The risk management plan should include:

- a summary of the project, including assumptions and sensitive receptors
- a description of the risk assessment process conducted
- a risk register
- risk treatment plan(s).

Appendix C2 provides a template risk treatment plan and Appendix C3 provides an example, which sets out the following key elements:

- details of the mining hazard
- a list of key sensitive receptors
- a list of risk events associated with the hazard
- compliance standards
- controls to address the hazard
- residual risk assessment and rating
- monitoring.

Many mining hazards will be able to be managed by applying example controls published by ERR (refer to Appendix C4). These example controls have been developed to reflect acceptable industry practice for some mining hazards, where site-specific investigations and tailored controls are not required.

Appendix C4 provides example controls for:

- Dust and particulates
- Noise
- Erosion and sedimentation
- Soil biological activity
- Site access
- Fire
- Non-mineral waste
- Weeds and pests
- Water
- Imported materials
- Vehicle sediment transport.

You are encouraged to include applicable example controls in your risk treatment plan(s), and to supplement these controls where necessary to minimise your risk rating as far as reasonably practicable.

If your mining hazards are more complex (e.g. blasting, pit or underground instability), they may require technical investigations to develop site-specific controls.

5.4 Community engagement

You have a duty to consult with the community throughout the period of the mining licence under section 39A of the MRSDA.

The objective of your engagement with the community and stakeholders is to ensure that interested parties are informed of the new or changing mining activities and given the opportunity to express how they may be affected. Community and stakeholder engagement is considered fundamental in determining agreed environmental outcomes. Early and continuous community and stakeholder engagement also enables you to understand and manage community and stakeholder expectations and mitigate potential risks which could impact your project.

Your work plan variation must include an updated community engagement plan that achieves these objectives. It should be specific to the new or changing works and be proportionate to the site-specific conditions such as scale, operational activities, and the size and proximity of local communities.

The updated community engagement plan should include:

- a list of relevant community members and stakeholders
- a description of likely attitudes and expectations
- potential impacts on each of the identified community members/stakeholders
- how community members/stakeholders will be engaged (and at what level) for the new or changing works
- a description of your proposed complaint/community feedback handling process, including when and how ERR will be notified
- a timeline for engagement throughout mine life.

For more information on community engagement, refer to ERR's guidelines at http://earthresources.vic.gov.au/earth-resources-regulation/licensing-and-approvals/minerals/guidelines-and-codes-of-practice/community-engagement-guidelines-for-mining-and-mineral-exploration

5.5 Rehabilitation

Planning for what rehabilitation should be undertaken at what stage, is a critical component of managing any mining project. Nationally and internationally, industry-leading practice requires that planning for rehabilitation should start before works commence and should continue throughout the life of the mine until final closure and relinquishment.

For a work plan variation, you should consider whether the new or changing works require a modification or addition to your rehabilitation plan.

If required, your work plan variation must include an updated rehabilitation plan which demonstrates any changes to the closure strategy as a result of the new or changing works. The updated rehabilitation plan must meet the requirements of Regulation 48 of the Regulations. Note that new rehabilitation plan requirements will commence from 1 July 2020.

Your updated rehabilitation plan should include:

- rehabilitation strategy and concept (e.g. security of the site, removal of plant and equipment)
- key assumptions (e.g. water availability, material balance)
- post-relinquishment land uses (e.g. open space parkland, grazing)
- an outline of key rehabilitation activities for each aspect (domain) of the mine to meet the objective of safe, stable, sustainable and visual acceptable
- rehabilitation risks.

6. What is the assessment process?

6.1 Assessment steps

The steps for assessment of a work plan (or work plan variation) are outlined in Table 3. Pathway A or B, is where:

A. mining activities are compliant with a current planning permit for the site or only need secondary consent under an existing planning permit; or

B. mining activities require a planning permit (or planning permit amendment).

Table 3: Assessment steps

Step		A Existing planning permit or secondary consent	B New planning permit (or amendment) required
1	You submit the work plan or work plan variation to ERR via RRAM	**Yes**	**Yes**
2	A fee is payable for submitting the plan (unless the Department Head has directed you to apply for a work plan variation)	**Yes** (go to step 8)	**Yes**
3	ERR has 28 days to assess the plan and: a. require changes; or b. refuse the plan; or c. refer it to a referral authority.	**No**	**Yes**
4	If ERR requires changes to the plan, you must make the changes and return the plan to ERR. Step 3 repeats after the changed plan is received.	**No**	**Yes**
5	Once satisfied that the plan meets statutory requirements, ERR refers the plan to a referral authority. The referral authority has 30 days to: a. not object to statutory endorsement; or b. not object to statutory endorsement if the plan is made subject to conditions; or c. object to statutory endorsement on any specified ground.	**No**	**Yes**
Note: *Should a referral authority fail to respond within 30 days, it is considered to not object to the statutory endorsement of the plan.*			
Note: *ERR cannot make a decision regarding statutory endorsement of the plan which is inconsistent with the advice of a referral authority.*			
6	ERR decides within 28 days of receiving a referral authority response whether to give the plan statutory endorsement, or refuse the plan.	**No**	**Yes**
7	Once the plan has statutory endorsement, you apply to the relevant council for a planning permit. The Victoria Planning Provisions require an application for a planning permit to be accompanied by a copy of a plan that has received statutory endorsement under Part 6B of the MRSDA (Department Head endorsement of work plan or variation to approved work plan).	**No**	**Yes**
8	You advise ERR that planning requirements are satisfied. ERR then has 28 days to: a. approve the work plan with or without conditions; or b. require changes; or c. refuse the plan.	**Yes**	**Yes**

6.2 Post-approval steps

If your work plan (or work plan variation) is approved, you will receive:

1. a letter – DJPR letter from ERR with advice of the approval and next steps, including:
   - information about the rehabilitation bond assessment process
   - an application for licence (for work plans)
2. a statement of reasons – attachment to the letter which provides details on the reasons for the decision
3. conditions – a full list of conditions for approval
4. your work plan – stamped and signed.

7. What is the work plan notification process?

7.1 Background

If you have an approved work plan, a **notification** (administrative update) may be considered for new or changing work where:

- There is **no significant increase** in risk arising from the new or changing work
- Council has been consulted and confirms in writing that the new or changing work does not require an amendment to the planning permit
- Relevant referral agencies have been consulted and confirmed that the new or changing work can be categorised as **low** or **medium** risk.

A '**significant increase in risk**' is where the residual risk (assessed under ERR's risk matrix in Appendix A of this guideline) is categorised as greater than **medium** after factoring in the adequacy of existing controls and the proposed application of additional controls (where these additional controls are listed in guidance material published by ERR, such as those in Appendix C of this guideline).

A list of new or changing works that may be suitable for a notification is provided at Appendix D.

It is recommended that you seek guidance from ERR before preparing a notification to determine whether a notification is appropriate.

7.2 Pre-submission

7.2.1 Assessing risk

Before submitting a notification, you should identify and assess the risk (likelihood and consequence) associated with the new or changing work. The residual risk should be assessed based on the application of existing controls (i.e. those under an approved work plan or work plan variation) and any example controls provided in Appendix C4 of this guideline. Where all residual risks associated with the new or changing work is assessed as **low** or **medium**, then a notification may be appropriate.

7.2.2 Consultation with council

You are required to consult with council to confirm that a variation to the planning permit is not required for the new or changing work. Confirmation from council that no change to the planning permit is required must be provided to ERR with the notification submission.

If an amendment to your planning permit is required, a work plan variation will need to be submitted to ERR instead of a notification. This is because a statutorily endorsed work plan is required to amend the planning permit.

7.2.3 Consultation with other agencies and regulators

Before submitting a notification, you should consult with other agencies and regulators regarding the new or changing work if it is within their jurisdiction. These other agencies and regulators could include catchment management authorities, the EPA, the Department of Environment, Land, Water and Planning and other government departments.

You should provide written confirmation from the relevant agencies and/or regulators that they agree that the new or changing work is low or medium risk and suitable to progress as a notification.

7.3 Submission

When a notification is submitted, ERR will review the new or changing work proposed, confirm the assessment of low or medium residual risk and note the supporting documents from council, other agencies and regulators.

ERR may require you to submit further information or evidence of consultation with these stakeholders.

7.4 Acknowledgement

If accepted, ERR will acknowledge the notification in writing.

7.5 Compliance

Accepted notifications will be included in your work plan for any site audits conducted by ERR during compliance activities.

If you are working outside of the approved notification then you are working outside of your work plan, which is an offence under the MRSDA. In such circumstances ERR has the power to stop work on the site and require the submission of a work plan variation.

Appendices

Appendix A
Risk assessment process

A1 Introduction

The risk assessment process undertaken must be documented in your risk management plan. This is to ensure that all mining hazards have been identified, and associated controls implemented to reduce the risk of harm or damage to the environment, any member of the public, to land, property or infrastructure in the vicinity of your work.

There are three important elements to understand when developing and implementing your risk management plan:

1. A hazard is an activity that poses risk at any time during the life of the mine, including set up/construction, operations/production and rehabilitation/closure.
2. Risk is the possibility of harm or damage that could happen as a result of an event. The level of risk is influenced by two factors, consequence and likelihood.
   a. Consequence is the outcome or impact of an event
   b. Likelihood is the probability of that event occurring.
3. A control is something which eliminates or reduces the consequence and/or likelihood of a risk. Controls can include work processes, engineering measures, and/or equipment.

For each relevant mining hazard, a **risk event(s)** should be identified and described based on the project description (or the description of the proposed variation for a work plan variation). To assess the significance of a risk, its risk rating must be determined by considering its consequence and likelihood.

A2 Consequences

Consequence is the severity of harm the risk event could cause when it occurs. The following questions may assist in establishing the consequences of a risk event:

- What kinds of harm could be caused?
  - A risk event may impact on more than one of the sensitive receptors under consideration: any member of the public, land, property and infrastructure or the environment.
- What factors could influence the severity of harm?
  - The consequence of a risk may vary under different circumstances. For example, weather conditions may increase the consequences of the risk event.
- In what ways could any member of the public be harmed?
- In what ways could any land, property or infrastructure be harmed?
- In what ways could the air, water, soil, vegetation, or flora and fauna species be harmed?

Under the MRSDA ERR has a duty when determining the consequence of a risk event to consider the potential impacts to:

- Members of the public:
  - Public health, safety, amenity and Aboriginal heritage
- Land, property and infrastructure:
  - Neighbouring property, land use and nearby infrastructure such as highways, transmission lines, pipelines, schools and hospitals
- Environment:
  - Air, water, soil, vegetation, and flora and fauna species

The descriptions of the consequence criteria that ERR uses to assess the harm caused by a risk event are provided in Table A1.

Table A1: ERR consequence descriptions

Severity	Consequence for "any member of the public" – public health, safety, amenity and Aboriginal heritage	Consequences for "land, property and infrastructure" *beyond the boundary of the licence area*	Consequences for "the environment" – air, water, soil, vegetation, flora and fauna species *other than for planned and approved disturbances within the licence area*
Critical Hazard has critical impact, in terms of severity and/or duration. Treatment or remediation effort is required, although some effects may be irreversible. Remediation of environmental contamination would require significant private and public resources. Hazard event would be the subject of widespread community outrage.	**Public health and safety:** One or more fatalities or life-threatening injuries or illness. Public exposed to a severely debilitating chronic health impact or life-threatening hazard. One or more injuries resulting in permanent disablement. **Public amenity:** Community or multiple individuals continuously experience major losses of amenity from dust, odour, fumes, noise, or other similar hazards over periods of weeks or longer. **Aboriginal heritage:** Harm to features and/or places of Indigenous cultural value. **Heritage:** Irreversible damage, or destruction of a place, object or historical archaeological site listed on the Commonwealth National Heritage List, Victorian Heritage Register, Victorian Heritage Inventory, or local Heritage Overlay.	**Land and land uses:** Permanent loss of production from primary production land >10 ha. Loss of annual-seasonal primary production from >100 ha of land. Irreversible or long-term environmental damage (with rehabilitation taking years or longer) to >1 ha of National Park or other conservation reserve. **Public and private property:** Total damage to private or public property or infrastructure or loss of income resulting from this damage >$10 million. Total loss of value of private property equivalent to >$10 million. **Services provided by infrastructure:** Important community services (e.g. transport, energy, health, telecommunications, education, water) suspended or significantly disrupted for extended period (weeks or longer).	**Environmental contamination event:** Environmental contamination event (of air, soil-land and/or water) of a magnitude that a State-level incident response is required. Incident response, clean-up and rehabilitation expected to run for years and/or cost ≥$10 million. **Native vegetation, flora species or fauna species:** Environmental contamination event or other form of environmental damage leading to bioregional, State or national extinction of listed threatened species of native flora or fauna or vegetation community. Irreversible or long-term (years) damage or environment harm to ≥10 ha of native vegetation (not listed threatened vegetation community) or to ≥1 ha listed threatened native vegetation community. Deaths of hundreds (or more) of listed native flora or fauna species or native mammals. Contamination or other environmental damage leading to deaths of native fauna well beyond (>1 km) the boundaries of the operation. **Surface water or groundwater:** Contamination of surface water/groundwater aquifer leading to disruption of beneficial uses as defined by SEPP (Waters) for more than year.

Severity	Consequence for "any member of the public" – public health, safety, amenity and Aboriginal heritage	Consequences for "land, property and infrastructure" *beyond the boundary of the licence area*	Consequences for "the environment" – air, water, soil, vegetation, flora and fauna species *other than for planned and approved disturbances within the licence area*
Major Hazard has major impact, in terms of severity, duration and/or frequency of occurrence. Treatment or remediation effort is required. Some effects may be irreversible. Remediation of environmental contamination would require significant private and public resources. Hazard event would be the subject of widespread community concern.	**Public health and safety:** One or more injuries or illness requiring surgery or resulting in long-term disablement. Public exposed to a hazard that results in hospitalisation for treatment from injury or illness. **Public amenity:** Community or multiple individuals regularly experience (weekly-monthly basis) major losses of amenity due to dust, odour, fumes, noise, or other similar hazards for multiple days on end. **Heritage:** Damage to a place, object or historical archaeological site listed on the Commonwealth National Heritage List, Victorian Heritage Register, Victorian Heritage Inventory, or local Heritage Overlay. Removal or relocation of elements associated with places, objects or historical archaeological sites.	**Land and land uses:** Permanent loss of production from primary production land <10 ha. Loss of annual-seasonal primary production from 10–100 ha of land. Irreversible or long-term environmental damage to <1 ha of National Park or other conservation reserve or to ≥10 ha of other public land. Reversible damage to ≥1 ha of National Park or other conservation reserve or to ≥10 ha of other public land. **Public and private property:** Total damage to private or public property or infrastructure or loss of income resulting from this damage $1–10 million. Total loss of value of private property equivalent to $1–10 million. **Services provided by infrastructure:** Important community services (e.g. transport, energy, health, telecommunications, education) suspended or significantly disrupted for days or experiencing minor disruptions for long periods (weeks or longer).	**Environmental contamination event:** Environmental contamination event (of air, soil-land and/or water) of a magnitude that would necessitate a regional emergency management incident response. Clean-up and rehabilitation expected to run for months and/or cost $1–10 million. **Native vegetation, flora species or fauna species:** Environmental contamination event or other form of environmental damage leading to local extinction of listed threatened species of native flora or fauna or vegetation community. Deaths of up to ~100 listed threatened flora or fauna species or native mammals. Major damage or environment harm to 1–10 ha of native vegetation (not listed threatened vegetation community) or to <1 ha listed threatened native vegetation community that will be irreversible or take years to recover from. **Surface water or groundwater:** Contamination of surface water/groundwater aquifer leading to disruption of beneficial uses as defined by SEPP (Waters) for up to one year.

Severity	Consequence for "any member of the public" – public health, safety, amenity and Aboriginal heritage	Consequences for "land, property and infrastructure" *beyond the boundary of the licence area*	Consequences for "the environment" – air, water, soil, vegetation, flora and fauna species *other than for planned and approved disturbances within the licence area*
Moderate Hazard has moderate, noticeable impact, in terms of severity, duration and/or frequency of occurrence. Moderate treatment or remediation effort may be required. Hazard event would be the subject of limited community concern.	**Public health and safety:** One or more injuries or illness requiring treatment by a physician or hospitalisation. Public exposed to a hazard that results in injuries or health effects requiring treatment by a physician. **Public amenity:** Community or multiple individuals regularly (weekly-monthly basis) experience significant loss of amenity from dust, odour, fumes, light, noise, vibration or other similar hazards. **Heritage:** Works to a place, object or historical archaeological site that will not alter the cultural significance as stated on the Commonwealth National Heritage List, Victorian Heritage Register, Victorian Heritage Inventory, or local Heritage Overlay.	**Land and land uses:** Loss of annual-seasonal primary production from <10 ha of land. Short-term (days-weeks) disruption to 10–100 ha of primary production land. Reversible damage to <1 ha of National Park or other conservation reserve or to <10 ha of other public land. **Public and private property:** Individual hazard event causes total damage to private or public property or infrastructure or loss of income resulting from this damage $50k–$1 million. Individual hazard event causes total loss of value of private property equivalent to $50k–$1 million. **Services provided by infrastructure:** Important community services (e.g. transport, energy, health, telecommunications, education) suspended or significantly disrupted for up to 1 day or experiencing minor disruptions for weeks.	**Environmental contamination event:** Environmental contamination event (of air, soil-land and/or water) with clean-up and rehabilitation expected to run for weeks and cost $10k–$1 million. **Native vegetation, flora species or fauna species:** Environmental contamination event or other form of environmental damage leading to deaths of a small number of listed threatened flora or fauna species or native mammals. Reversible damage or environmental harm to <10 ha of non-listed native vegetation community or <1 ha of listed native vegetation community. **Surface water or groundwater:** Localised contamination of surface water/groundwater aquifer leading to disruption of beneficial uses as defined by SEPP (Waters) for weeks to months.

Severity	Consequence for "any member of the public" – public health, safety, amenity and Aboriginal heritage	Consequences for "land, property and infrastructure" *beyond the boundary of the licence area*	Consequences for "the environment" – air, water, soil, vegetation, flora and fauna species *other than for planned and approved disturbances within the licence area*
Minor Hazard is perceived but has minor and typically temporary effects. Some remediation may be required.	**Public health and safety:** One or more injuries or illness requiring first aid treatment. Public exposed to a hazard that could cause injuries or adverse health effects requiring first aid treatment. **Public amenity:** Dust, odour, light, fumes, vibration or other similar hazards infrequently (no more than monthly) have a minor effect on the amenity of the community or individuals **Heritage:** Isolated damage to regionally or locally significant natural or historic heritage features that is readily rectified.	**Land and land uses:** Minor damage to agricultural land or public land not requiring active rehabilitation. Temporary and small-scale disruption to agricultural production (days, 1–10 ha). **Public and private property:** Total damage to private or public property or infrastructure $1–50k. Total loss of value of private property equivalent to $1–50k. **Services provided by infrastructure:** Important community services (e.g. transport, energy, health, telecommunications, education) suspended or significantly disrupted for short period (hours).	**Environmental contamination event:** Minor environmental contamination event (of air, soil-land and/or water). Clean-up and rehabilitation may be required, but can be completed within days. **Native vegetation, flora species or fauna species:** Minor damage or environment harm to <1 ha of native vegetation (not listed threatened vegetation community) that can be recovered in weeks to months. Minor contamination or other environmental damage that affects native fauna populations, but does not kill individuals or disrupt breeding or other important ecological processes. **Surface water or groundwater:** Minor contamination of natural waterway or wetland occurs, but water quality remains within applicable EPA or ANZECC guidelines for existing beneficial uses. Water extraction or diversion reduces surface water flows or groundwater available for environmental uses, but with no detectable effect on dependent species or ecosystems and carried out within terms of water licence.
Insignificant Impacts are barely recognised and/or quickly recovered from. No specific remediation required.	**Public health and safety:** An injury or ailment that does not require medical or first aid treatment. **Public amenity:** Dust, odour, light, fumes, vibration or other similar hazards infrequently (no more than monthly) contribute to a small reduction in the amenity of the community or individuals.	**Land and land uses:** Minor, temporary disruption to primary production (<days) from <1 ha of land. **Public and private property:** Total damage to private or public property or infrastructure <$1k. Total loss of value of private property equivalent to <$1k. **Services provided by infrastructure:** Important community services (e.g. transport, energy, health, tele-communications, education) maintained, but experiencing minor disruptions or delays.	Hazard event with minimal environmental impact and no noticeable effect beyond the immediate occurrence or expression of the hazard.

A3 Likelihood

The next step is to assess the likelihood of the risk event occurring and the associated consequence(s). Likelihood is based on what is known about the risk event and the way circumstances and activities affect the risk event and associated consequence(s).

The likelihood of a risk event occurring during the expected life of the operation is rated by ERR using the likelihood descriptions provided in Table A2.

Table A2: ERR likelihood descriptions

Severity	Description	Probability of event occurring
Almost certain	The risk event is expected to occur in most circumstances.	**90–100%**
Likely	The risk event will probably occur in most circumstances.	**70–90%**
Possible	The risk event might occur at some time.	**30–70%**
Unlikely	The risk event could occur at some time.	**5–30%**
Rare	Highly unlikely, but the risk event may occur in exceptional circumstances.	**0–5%**

In establishing the likelihood of an event, there are some key concepts to consider:

- Has there been a previous occurrence of this risk event?
  - Considering what has happened previously, such as incidents and near misses, can assist in establishing the likelihood. It is important not to just consider your business but think about occurrences across the industry.
- Are there any design features of your project that increase or decrease the likelihood of this risk event occurring?
  - Consider how effective these features are.
- Are you operating or environmental conditions likely to change?
  - Operating or environmental conditions change over time and vary throughout the year. These changes can influence the likelihood of a risk event occurring.
- How does people's behaviour effect the likelihood?
  - The way people act or behave can affect the likelihood of a risk event occurring. For example, they can make mistakes, misuse items or act spontaneously.

A4 Risk Rating

After considering the consequences and likelihood of the risk event, they are used together to determine the risk rating. The risk matrix below is used by ERR to determine the risk rating for each risk event. The purpose of rating risk is to guide decision making on risk management to eliminate or otherwise reduce the risk to an acceptable level.

Figure A1: ERR Risk Matrix

Likelihood						
	Almost Certain	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High
		Insignificant	Minor	Moderate	Major	Critical
		Consequence				

There may be multiple consequences for a single risk event. When this occurs, the highest risk rating (after assessment of consequence and likelihood for each consequence), should be used to categorise the risk rating of the risk event. For example, the risk event may have a consequence for a member of the public rated as **major** and with a likelihood of **rare**; a consequence of **moderate** for land, property and infrastructure and with a likelihood of **likely**; and a **minor** consequence for the environment and with a likelihood of **possible**. This results in individual risk ratings of **medium**, **high** and **medium** respectively. In this instance the overall rating for the risk event is **high**.

Once the risk rating has been established some risks will need to have controls in place to reduce them to an acceptable level. Higher risk levels should take priority. Table A3 provides guidance on what steps need to be taken depending on the risk rating.

Table A3: Risk Rating Acceptability

Risk level	Description
Very High	Totally unacceptable level of risk. Controls must be put in place to reduce the risk to lower levels.
High	Generally unacceptable level of risk. Controls must be put in place to reduce the risk to lower levels or seek specific guidance from ERR.
Medium	May be acceptable provided the risk has been minimised as far as reasonably practicable.
Low	Acceptable level of risk provided the risk cannot be eliminated.

Appendix B

B1 Mining documentation requirements

Table B1: Work plan requirements

Regulation	Required Item	Guidance
42	**Information required in work plans—mining work**	
42(a)	A description of sensitive receptors in relation to the environment, any member of the public, or land, property or infrastructure in the vicinity of the work.	Receptors are considered to be sensitive when they are located in the vicinity of the work. In the vicinity of the work is defined by referring to requirements of separation distances or buffer distances or other quantitative/qualitative references stipulated in legislation, policies, or guidance material relating to those receptors. Describe and specify the location of any residences, public facilities, roads, bridges, pipelines, power lines, easements, parks, reserves, waterways, depth to groundwater, heritage sites, communities or other sensitive receptors in the vicinity of the project area. Sensitive receptors may include (but not limited to): • Residential • Private properties • Community facility • Waterways • Groundwater bores • Groundwater dependant ecosystems • Areas of cultural heritage sensitivity • Significant landscape • Public infrastructure – such as bridges, roads, railways • Parks and reserves • Heritage buildings and features.
42(b)	A location map of the work plan area and areas within 2 km of the work plan area, drawn at an appropriate scale, that shows—	Maps need to be provided so that ERR can assess your proposal in the context of the surrounding site setting, including the identification of sensitive receptors. A series of maps can be prepared to best represent the proposal and information to be presented. The location map should be at a scale of 1:25,000 or at an appropriate scale for showing sensitive receptors within 2km of the proposed licence boundary and should include: • north direction, legend, bar scale, date of and revision date of drawing • boundaries of the proposed licence area (with distances and bearings, or GPS co-ordinates) • buffer radius (circles or elliptical) (at minimum 500m, 1km and 2km) from the proposed licence boundary • an outline of the Geotechnical Risk Zone (GRZ) and any natural and man-made sensitive receptors within the GRZ (refer to ERR Guidance Material for the Assessment of Geotechnical Risks in Open-Pit Mines and Quarries) • the proposed area of disturbance and area of mining.

Regulation	Required Item	Guidance
42(b)(i)	The location of sensitive receptors identified.	The identified sensitive receptors in 42(a) must be shown and labelled on the site maps.
42(b)(ii)	The extent and status of Crown lands and extent of private lands.	Include the extent of Crown lands, private lands, and private land allotments for the proposed work plan area; noting depth limitations if applicable. For Crown lands, display categories (where applicable) – Unavailable Crown land, Restricted Crown land, Unrestricted Crown land.
42(b)(iii)	Residential, commercial and industrial development	This detail can be shown as planning scheme zoning layers, or aerial photography and must be labelled to show the: • location of possibly occupied houses, and community facilities • location of townships, and cadastral boundaries • location of infrastructure, including major and minor roads (with names), bridges, rail lines, pipelines (water, gas, telecommunication), power lines, and easements.
42(b)(iv)	Public facilities and infrastructure.	This includes parks and reserves. This detail can be shown as aerial photography. All features must be labelled.
42(b)(v)	Rivers and streams.	The location of all waterways, and their names.
42(c)	A general description of geological information pertaining to the work, including— (i) stratigraphy; and (ii) any adverse geological structures; and (iii) the minerals to be extracted; and (iv) the estimated mineral resources and ore reserves.	• Describe the geology, geological structure (faults, fractures etc.) • Describe current and past land uses which may impact the proposed design (such as contaminated land, old tailings, underground voids) • Specify the resource type, e.g. gold • An estimate of total reserves within the licence boundary.
42(d)	A general description of the mine operations including—	A description of mine operations is essential to understanding the proposal and identifying the activities that will be undertaken.

Regulation	Required Item	Guidance
42(d)(i)	The method and scale of extraction.	• Provide a general description of extraction methods, including plant and equipment for extraction and haulage • Describe the proposed area and depth of extraction, proposed stages of extraction (if applicable), proposed design of extraction pit including number of benches and working and terminal slope configuration (slope, bench height, berm width). Describe depths and slopes for all parts of the extraction area (if variable) • Specify the total proposed area of disturbance (excavation, processing, roads, etc.) • Specify the volume of extraction excluding topsoil • For work plan variations, describe the current open area and the additional area to be opened • Specify whether any dewatering activities will be undertaken • Specify whether vegetation clearing will be undertaken • Specify whether any blasting activities will be undertaken and, if so, which blasting methods will be applied. Provide detail (days and time) of proposed blasting operations (where applicable). To support the proposal a cross-section of the pit design should be included. The cross-sections are to show geology, and batter design, with proposed bench heights, berm details and both working and terminal batters, for all parts of the extraction area. The cross-section must show elevation relative to sea level (mAHD).
42(d)(ii)	Ore processing methods and facilities.	Provide a general description of processing methods, including plant and equipment, and storage of clean water, process water and tailings.
42(d)(iii)	Waste disposal methods and facilities.	Describe physical and chemical composition of mine waste materials, identifying potential hazardous substances, including the presence of sulphides (if acid sulphate soil has been excavated and/or chemicals will be used in processing). This description is to include any added chemical treatments / flocculating agents. Describe how hazardous materials such as fuel and chemicals will be managed.
42(d)(iv)	Stockpiling facilities.	Specify general location, volume and height of topsoil, overburden, and product stockpiles. Describe the process for removal and stockpiling of topsoil.

Regulation	Required Item	Guidance
42(d)(v)	Other mine infrastructure.	Provide a general description of operational equipment to be used on site, including (but not limited to) operational equipment for extraction, processing (crushing, screening, gravity separation, wet separation, leaching, etc.), and haulage. Describe and show on the Site Layout Plan processes or equipment locations (such as processing plants next to an open pit) that may increase the potential for slope instability. Describe equipment to be used for dewatering (if applicable). Describe the number and location of any water bores and pumps. On a plan, show the location of any workshops, storage sheds, lunchroom, amenities block, site office, weighbridge, laboratory testing, training and meeting rooms, access and haul roads, parking, maintenance hardstand and vehicle wash down.

Regulation	Required Item	Guidance
42(e)	A site map, drawn at an appropriate scale, that shows— (i) the general layout of the mine, associated facilities and infrastructure; and (ii) cross-sections and, in the case of an underground mine, long sections of the proposed extraction area.	Maps need to be provided so as ERR can assess the proposal in the context of the surrounding site setting, including the identification of sensitive receptors. A series of maps can be prepared to best represent the proposal and information to be presented. The Site Layout Plan/s should include: • a scale of 1:1,000, 1:2,500 or other appropriate scale for showing sensitive receptors within the vicinity of the licence area, with northing, legend, bar scale, and drawing & revision dates • licence boundaries, extraction boundaries • cadastral boundaries and any depth limitations • existing surface contours, topographical features, drainage patterns, water courses (including drainage diversion, levee location and design) and vegetation to be removed/retained • plant and equipment (e.g. buildings & surface facilities, location of power generation and/or reticulation, offices & toilets) • extent of: – open cut extraction, with proposed bench heights, berm details and working batters; and/or – underground workings; • outline of the GRZ and any sensitive receptors within the GRZ (for open cut pits only) • sequence / staging / direction of pit extraction • representative cross-sections showing geology and working and terminal batter designs with proposed bench heights, berm details and batter slopes • proposals for landscaping of the licence area, including buffer zones and retained areas of native vegetation • adjoining public road(s), with names • a survey benchmark with a reduced level (if applicable) • access roads • location of water dams, in-pit sumps, slimes dams and pipe lines • location of onsite power lines, gas lines and any other easements • general location of stockpiles for topsoil, overburden and product • general location of any removed vegetation material (such as that to be used for rehabilitation) • location of fuel storage areas, including both above-ground and underground storage tanks • explosives, additives or hazardous waste storage areas • water bores and pumps (if any).
42(f)	In the case of an underground mine, a schematic and description of the workings of underground operations.	Underground Mines Only Provide a schematic and general description of underground operations.

Regulation	Required Item	Guidance
43	**Information required in work plans—rehabilitation plans**	
43(4)(a)	Concepts for the end utilisation of the mine site.	The concept plan should establish expected end use/s of the site and its general characteristics at the completion of rehabilitation. It may consider: • future land uses that do not depend on the need to obtain a planning permit for its use; if the proponent is proposing uses that require a planning permit, such as a land fill, a letter from the relevant waste management group should accompany the proposal (refer to ERR guidelines Imported Materials Management – include reference) • the capability/suitability of the land; describe the land's inherent features, to help demonstrate that the proposed end use is suitable • the possible end land use(s); provide a conceptual statement on final landform based on all available geological, geochemical and biological information • conceptual slope configuration • conceptual rehabilitation of waste dumps, stockpiles, water storages and slimes dam facilities • surface water management for runoff control and erosion prevention • the nature of soils and overburden/waste rock to be used in rehabilitation • evidence that there is sufficient suitable material available to complete the proposed final landform – such as materials balance • any constraints on final land use (e.g. regulatory, physical, agreements with private land owners) • overview of proposed action to confirm rehabilitation strategy with relevant stakeholders.
43(4)(b)	Proposals for the progressive rehabilitation, stabilisation and revegetation of extraction areas, waste disposal areas, stockpile areas, dams and other land affected by the mining work.	The progressive rehabilitation strategy should set out in some detail: • how a progressive rehabilitation strategy will deliver the final landform/land use outcomes • how progressive landscaping will be undertaken so that visual impact is minimised • the timeframe between establishing terminal slope and commencing progressive rehabilitation • the constraints that may limit progressive rehabilitation works • the approach to undertaking progressive rehabilitation (e.g. the availability of suitable material, landscaping, revegetation, the depth of soil stripping, the approximate depth of respread soil, proposed seedbed treatments and the reasons for their selection, proposed revegetation method and the general mix of species, stockpile dimensions) • monitoring and reporting arrangements for assessing and documenting the effectiveness of progressive rehabilitation • process for review and improvement of the Rehabilitation Plan, appropriate to the remaining life of the mining operation.

Regulation	Required Item	Guidance
43(4)(c)	Proposals for landscaping to minimise the visual impact of the mine site.	The rehabilitation plan should include proposals to minimise impacts to visual amenity as far as reasonably practicable during both progressive rehabilitation and final rehabilitation and closure.
43(4)(d)	Proposals for the final rehabilitation and closure of the mine site, including the security of the site and the removal of plant and equipment, taking into account any potential long-term degradation of the environment.	• The proposal for final rehabilitation plan should include: • the timeframe for completing final rehabilitation and closure of the site • whether the proposed final land use is sympathetic to the surrounding landscape (e.g. analysis of the visual impact from critical views) • how proposed final land form may impact on the long-term surface water/groundwater regime • how final security of the work authority area (e.g. water dams/slimes dams etc.) is to be achieved • the proposed rehabilitation method of any mine features (e.g. slimes dams etc.) to ensure the long term physical and chemical integrity of these, including the management of erosion, seepage and potential exposure to contamination • the proposed general plans for the removal of plant and equipment including: – demobilisation of mobile plant, railways, conveyors and temporary facilities – decommissioning of fixed plant, including the removal and disposal of hazardous materials – demolition, refurbishment or reutilisation of buildings or facilities, including description of expected waste and disposal methods • whether permits or approvals from other agencies will be required for the final land use or rehabilitation design • objectives and acceptance criteria to demonstrate achievement of proposed final land use over an appropriate time-frame • proposals for short and long-term monitoring and reporting to be undertaken to demonstrate achievement of final land use.
44	**Information required in work plans—identification of hazards and risks**	
44(a)	If exploration work is to be carried out under the licence, details of exploration hazards that may arise from the exploration work.	For requirements, refer to the guidance in Section 4.3 of the document above.
44(b)	If mining work is to be carried out under the licence, details of mining hazards that may arise from the mining work, including mining hazards arising from— (i) set up or construction; and (ii) operations or production.	For requirements, refer to the guidance in Section 4.3 of the document above.
44(c)	Details of the rehabilitation hazards that may arise from rehabilitation under the licence.	For requirements, refer to the guidance in Section 4.3 of the document above.

Regulation	Required Item	Guidance
44(d)	An explanation of how the identified hazards may harm or damage the sensitive receptors described in the work plan, including evidence to support the assessment of the potential for harm or damage to be caused.	For requirements, refer to the guidance in Section 4.3 of the document above.
44(e)	An assessment of the risks that the identified hazards may pose to identified sensitive receptors, having regard to— (i) the nature of the hazard; and (ii) the likelihood of the hazard causing, or contributing to, any harm or damage; and (iii) the severity or consequence of the harm or damage that may be caused.	For requirements, refer to the guidance in Section 4.3 of the document above.
45	**Information required in work plans—risk management plan**	
45	A risk management plan that sets out what the licensee will do to eliminate or minimise the identified risks as far as reasonably practicable.	For requirements, refer to the guidance in Section 4.3 of the document above.
45(a)	Measures to be applied to eliminate or minimise the risks as far as reasonably practicable.	For requirements, refer to the guidance in Section 4.3 of the document above.
45(b)	The performance standards to be achieved by either individual measures or some combination of measures.	For requirements, refer to the guidance in Section 4.3 of the document above.
45(c)	Management systems, practices and procedures that are to be applied to monitor and manage risks and compliance with performance standards.	For requirements, refer to the guidance in Section 4.3 of the document above.
45(d)	An outline of the roles and responsibilities of personnel accountable for the implementation, management and review of the risk management plan.	For requirements, refer to the guidance in Section 4.3 of the document above.

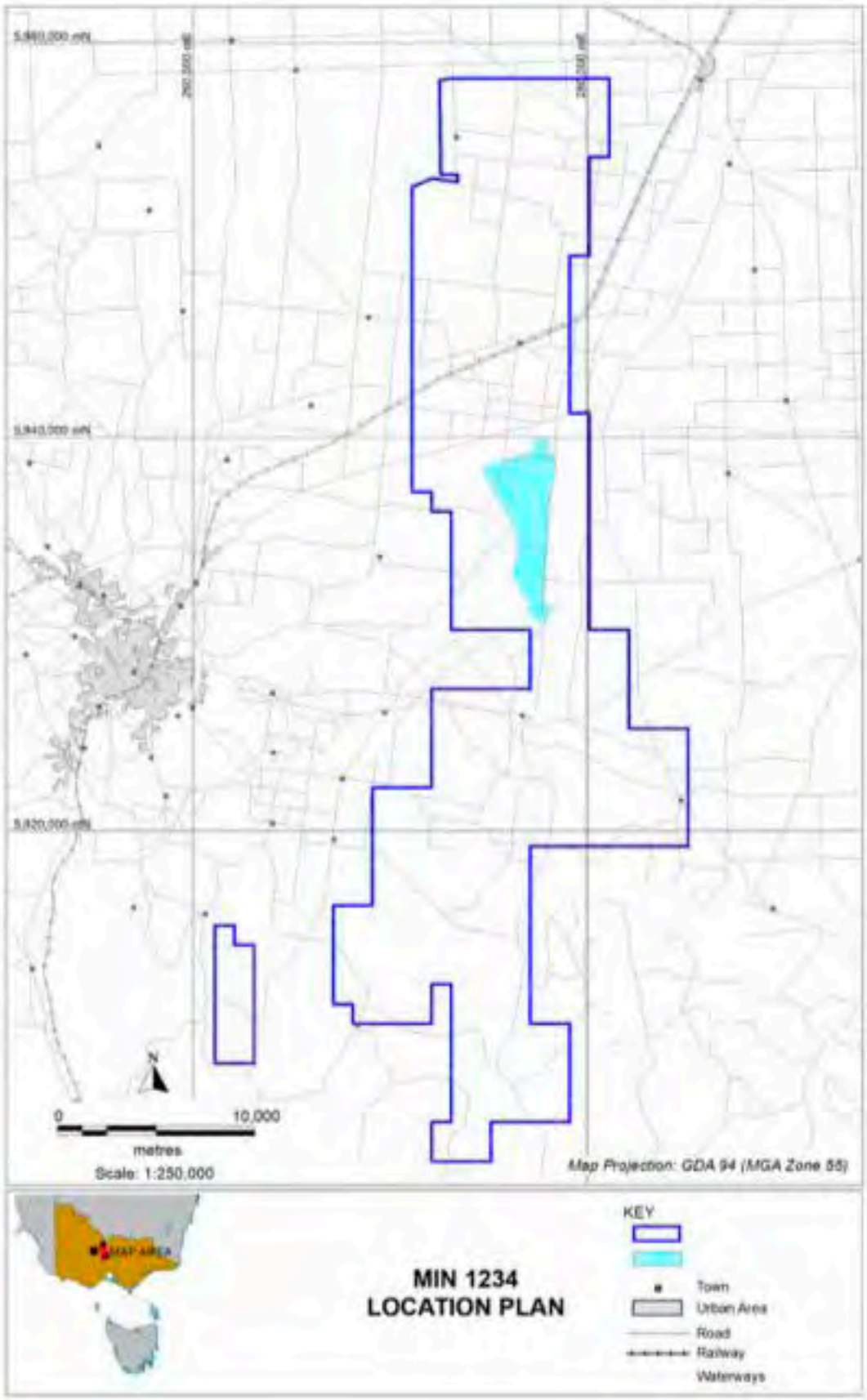
Regulation	Required Item	Guidance
46	**Information required in work plans—community consultation**	
46	A community engagement plan that:	The proponent has a duty to consult with the community under section 39A of the MRSDA throughout the period of the mining licence. The required consultation provides valuable information that contributes to the community engagement plan. The community engagement plan (CEP) should be proportionate to the site-specific conditions such as scale, operational activities, and the size and proximity of local communities. A CEP is to include: • a title page that includes the report name, date, and author's name and contact details • a table of contents and sub-headings • a brief overview of the proposed operations associated with the Work Authority • maps consistent with the requirements outlined in Regulation 42 of the Regulations. For more information, refer to the ERR guidelines *Community Engagement Guidelines for Mining and Mineral Exploration in Victoria*.
46(a)	identifies the community likely to be affected by the work under the licence; and	Include a list of the community and any other stakeholders likely to be affected by the proposed operations, and/or interested in the proposed operations, including landholders, land owners, local government, community groups and Crown land managers.
46(b)	sets out how the licensee will share information with the community; and	Include: • how each of the identified community members/stakeholders will be engaged (and at what level) • proposed information channels/types for the community (newsletters, meetings, facilitated events, web content, social media, dedicated contact person etc.)
46(c)	sets out how the licensee will receive feedback from the community; and	Include proposals for mechanisms to receive and collect feedback about the operations from the community (online, meetings, phone calls etc.)
46(d)	sets out how the licensee will manage complaints and other communications from members of the community; and	Include proposals for mechanisms to manage complaints and other communications about the operations from the community (online, meetings, phone calls etc.)
46(e)	In the case of a work plan for a mining licence that covers an area of more than 5 hectares, sets out how the licensee will—	
46(e)(i)	Identify community attitudes and expectations.	A community engagement plan is to include: • a description of how community attitudes and expectations have been and/or will be identified and documented • a description of likely community and stakeholder attitudes and expectations related to the proposed operations • the potential impacts on each of the identified community members/stakeholders.

Regulation	Required Item	Guidance
46(e)(ii)	Analyse community feedback, taking into account community concerns or expectations.	Include how community feedback will be captured, registered, assessed and responded to (a register or similar that demonstrates how this will be managed) (provide an example)
46(e)(iii)	Register, document and respond to complaints and other communications from members of the community in relation to the mine operations.	Include a description of the proposed complaint/ community feedback handling and response process, including when and how ERR will be notified
48	**Information required in application for variation of work plan**	
48(1)(a)	If changes to the work or rehabilitation set out in the work plan are proposed, a description of any new or changed exploration hazard, mining hazard or rehabilitation hazard arising from the proposed changes that significantly increases the risks posed to— (i) the environment; or (ii) any member of the public; or (iii) land, property or infrastructure in the vicinity of the work or rehabilitation relating to the new or changed hazard.	Describe the proposed change to the work plan, and any new or changing hazard. This may include a change in direction of extraction, moving closer to sensitive receptors, or removal of native vegetation not previously approved.
48(1)(b)	If any new or changed hazard is described under paragraph (a), the information specified in regulations 44 and 45 that relate to the new or changed hazard, including the resulting proposed changes to the work plan.	The hazard assessment and risk management plan must meet the requirements set out in Regulations 44 and 45 of the Regulations. Refer to requirements for work plans in Table B1 above, and details provided in Section 5.3 of this guideline. This must include new or changing hazards as a result of the proposed change to operation.
48(1)(e)	If the application for the proposed variation is lodged on or after 1 July 2019 but before 1 July 2020 and includes new or changed rehabilitation of land disturbed by mining, the information specified in regulation 43(4) that relates to the new or changed rehabilitation, including the resulting proposed changes to the rehabilitation plan in the work plan.	The plan must describe the proposed changes to the rehabilitation plan and describe the planned rehabilitation for the whole site, including on maps and cross sections. The rehabilitation plan must meet the requirements set out in Regulation 43 of the Regulations. Refer to Section 4 of this guideline.

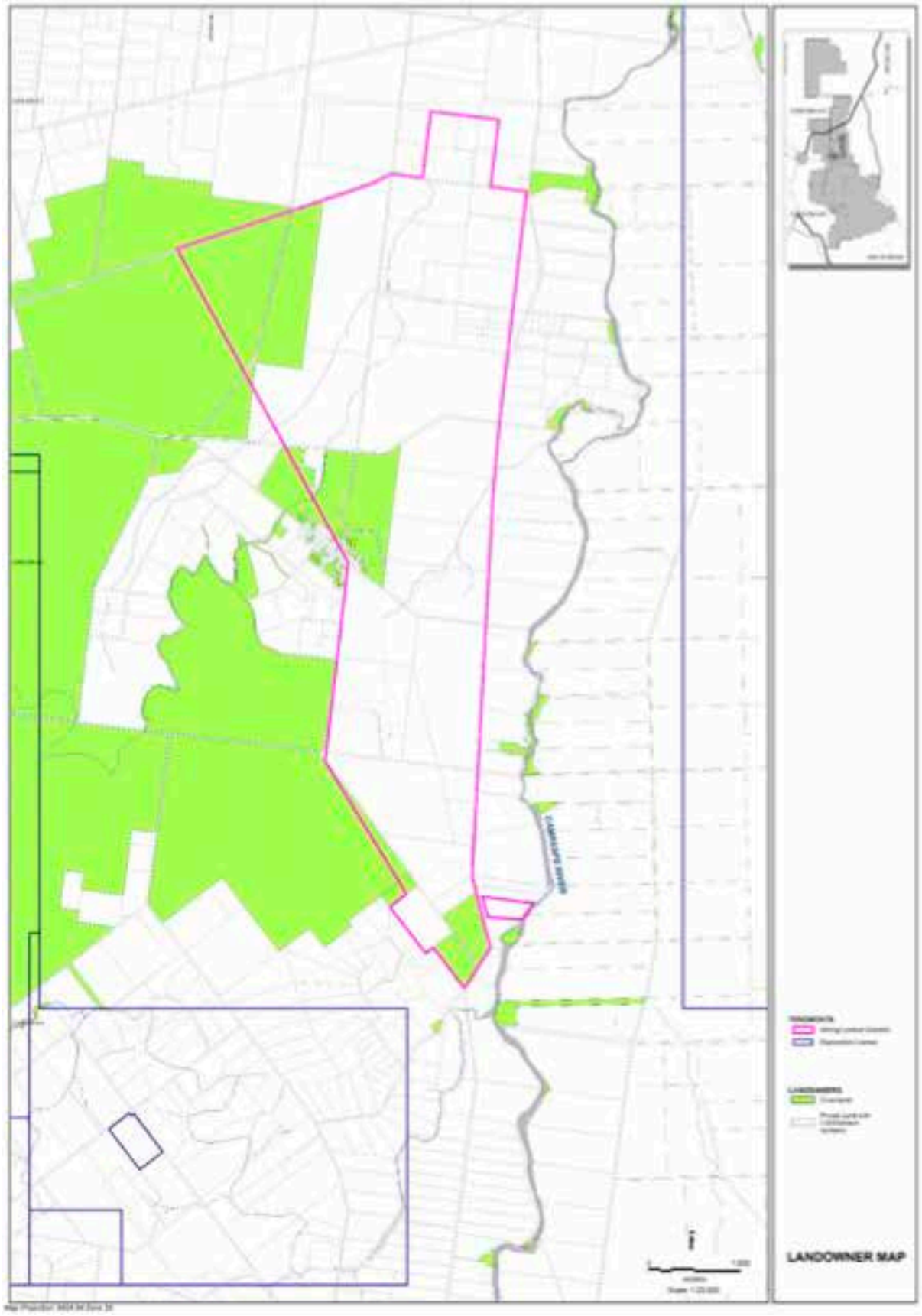
Regulation	Required Item	Guidance
48(1)(g)	If the proposed variation includes or gives rise to any changes relating to community consultation, the proposed changes to the work plan in relation to the information specified in regulation 46.	The community engagement plan must include a description of engagement for the planned changes, i.e. how the proposed changes will be communicated. The community engagement plan must meet the requirements set out in Regulation 46 of the Regulations. Refer to Section 4 of this guideline for information about work plan requirements.
48(1)(h)	If the proposed variation includes any new or changed work to be carried out at a declared mine, the information that relates to, and is applicable to, the proposed changes to the work plan in relation to the requirements and processes set out in Schedule 12.	Declared Mines Only Mining work being carried out on Declared mine sites must include consideration of relevant stability requirements set out in Schedule 12.
48(1)(i)	If the proposed variation includes any new or changed mining work that is the mining of coal, the information that relates to, and is applicable to, the proposed changes to the work plan in relation to the information specified in regulation 40(b)(iii).	Coal Mines Only Mining work being carried out on Coal mine sites must include consideration of relevant fire management plan requirements set out in Schedule 8.
48(1)(j)	A description of how the proposed variation to the work plan relates to the current approved work plan.	Provide summary of reason for plan, including reason for work plan variation, clear details of changes (e.g. change in lateral and vertical extent etc.) from the approved plan and relationship to the approved plan, in both the plan description and on supporting maps.

B2 Example site plans

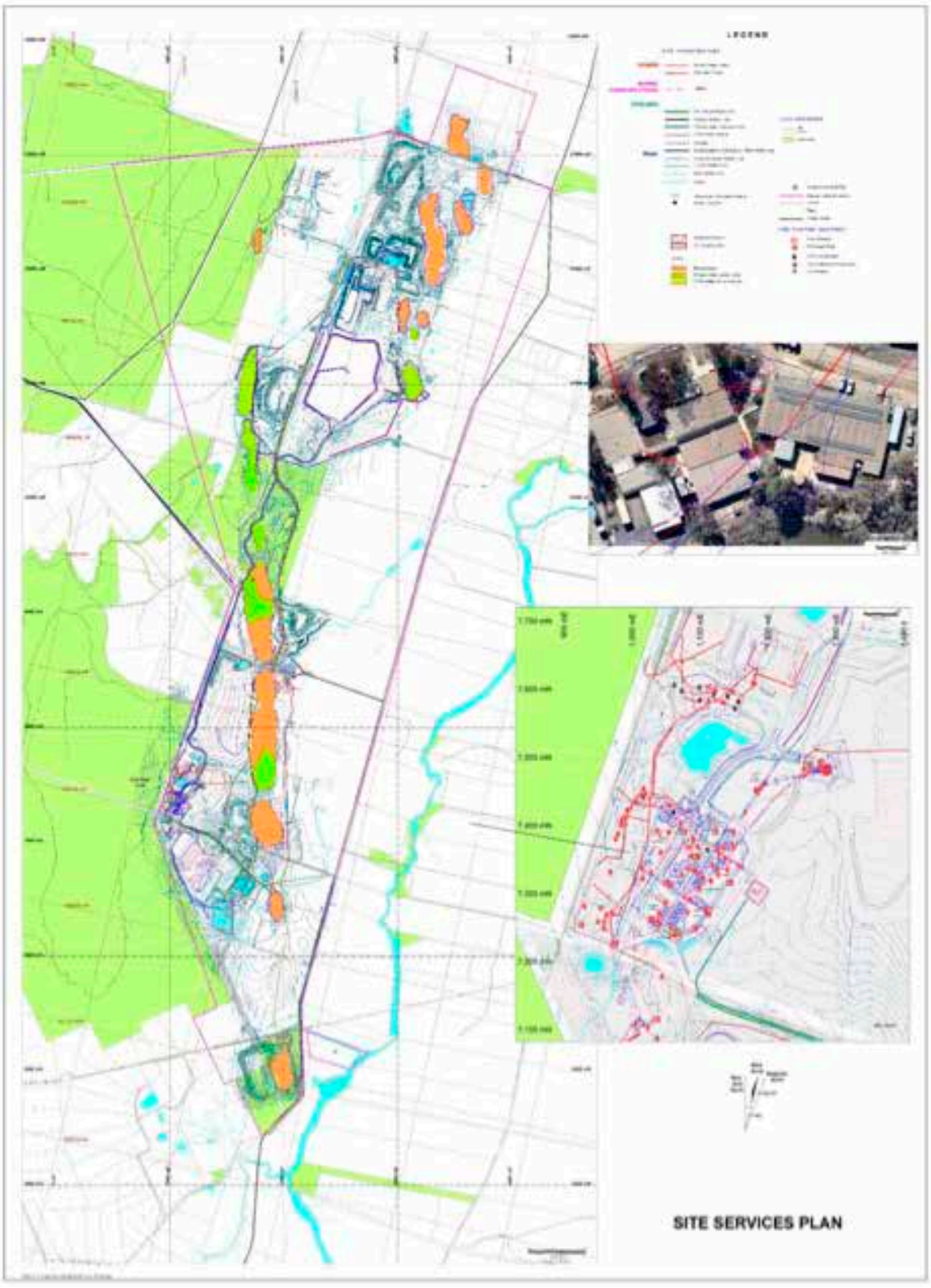
B2-1 – Example of a general location plan



B2-2 – Example of a land owner plan



B2-3 – Example of a site services plan



Appendix C

C1 Example risk register

C1.1 Inherent Risk

During the risk identification and assessment process you should produce a **risk register** that describes and collates the identified risk events, likelihoods and consequences associated with the proposed work plan (or work plan variation). These are called **inherent risks** and should be based on the project description in your work plan, or the project description of the proposed variation in your work plan variation.

Table C1-1: Example risk register showing inherent risk

Hazard	Risk No	Risk Event	Causes/ Background	Receptors	Risk assessment prior to additional risk controls (project inherent risk)		
					Likelihood	Consequence	Risk rating
	1				Rare	Insignificant	Low

Any inherent risks that you have assessed to have a risk rating of medium or above, according to the ERR risk matrix in Appendix A3, will require additional controls to either eliminate the risk or minimise its rating as far as reasonably practicable. Inherent risks that are ranked as Low should include an explanation of the relevant mine design aspects (as outlined in the project or proposed variation description) that result in that low risk rating.

C1.2 Residual Risk

The risk assessment process should then be conducted again, assuming implementation of the identified control(s) for the relevant risk events, with updated likelihoods and consequences. These are called **residual risks** and should be based on the project or proposed variation description and the listed controls.

Table C1-2: Example risk register showing inherent and residual risk

Hazard	Risk No	Risk Event	Causes/ Background	Receptors	Risk assessment prior to additional risk controls (project inherent risk)			Risk assessment after including risk controls (project residual risk)		
					Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating
	1				Rare	Insignificant	Low	Rare	Insignificant	Low

C1.3 Accountable Personnel

List personnel accountable for the implementation, management and review of the Risk Management Plan.

Table C1-3: Example accountable personnel

Personnel	Roles and Responsibilities

C2 Template risk treatment plan

Scope

This risk treatment plan is for the control of:

[Insert Hazard]

A mining hazard means any mining activity and circumstance that may pose a risk to the environment, to any member of the public or to land, property or infrastructure in the vicinity of work carried out at a mine.

Key sensitive receptors

Key sensitive receptors include the environment, any member of the public or land, property or infrastructure in the vicinity of a mine that may be impacted or put at risk by the hazard associated with the mining activity.

The key sensitive receptors associated with this hazard include:

#	Details of the sensitive receptor	Location and proximity to site	How hazard may harm or damage Sensitive Receptor	Evidence to support assessment
1				
2				
3				
4				
5				

[Add or delete rows from the above table as appropriate]

To determine the key sensitive receptors, consider:

- Members of the public – public health, safety, amenity and Aboriginal heritage
- Land, property and infrastructure: neighbouring property as well as nearby infrastructure such as highways, schools and hospitals
- Environment: air, water, soil, vegetation, flora and fauna outside the work area.

Risk events

These are the risk events associated with the hazard. Include an inherent risk rating for each event considering the design proposal of the project.

The project phase options include construction, operation and closure, or a combination. If you feel that the inherent risk for the same risk event will differ in different project phases, then list the risk event for each project phase.

[The likelihood and consequence should be assessed using the descriptors provided by Earth Resources Regulation and the risk rating determined using Earth Resources Regulation's risk matrix.]

#	Details of the risk event	Project phase	Consequence	Likelihood	Inherent risk rating
1					
2					
3					
4					
5					

[Add or delete rows from the above table as appropriate]

Objectives

The objectives are the key aims or goals of the control measures that will be out in place to eliminate or minimise, as far as reasonably practicable, the identified risk events.

[Examples are included in the guidance sheets for managing hazards.]

[Note: Each objective does not need to relate to all of the control measures.]

[Insert Objective]

[Insert Objective]

[Insert Objective]

Compliance standards

The compliance standards are the key best practice standards or guidelines that will be achieved with the control measures in place. These best practice standards or guidelines may come from the EPA, State Environment Protection Policy or other regulatory agencies.

[Examples are included in the guidance sheets for managing hazards.]

[Note: Each compliance standard does not need to relate to all of the control measures.]

The compliance standards for this risk treatment plan are:

[Insert Compliance Standard]

[Insert Compliance Standard]

[Insert Compliance Standard]

Acceptance criteria

The acceptance criteria are the measures by which the control measures will be deemed to be effective in achieving the objective and eliminating or minimising, as far as reasonably practicable, the identified risk events. The acceptance criteria could be to achieve a best practice standard (e.g. an EPA standard).

[Examples are included in the guidance sheets for managing hazards.]

[Note: Each acceptance criteria does not need to relate to all of the control measures.]

The acceptance criteria for this risk treatment plan are:

[Insert Acceptance Criteria]

[Insert Acceptance Criteria]

[Insert Acceptance Criteria]

Controls to address hazard

The control measures are to be designed to eliminate or minimise, as far as reasonably practicable, the identified risk events. The numbers of the risk events being managed by each control should be recorded against the control along with how the control will be implemented.

[Examples are included in the guidance sheets for managing hazards.]

The controls for this risk treatment plan are:

#	Details of controls being used	Risk events being managed (number from above)	Performance standards/measures *(specifying how the control is being implemented – if not implicit in the control)*
1			
2			
3			
4			
5			

[Add or delete rows from the above table as appropriate]

Residual risk assessment

Considering the controls being put in place the assessment of the residual risk associated with the risk events identified for this hazard is shown in the table below.

[The likelihood and consequence should be assessed using the descriptors provided by Earth Resources Regulation and the risk rating determined using Earth Resources Regulation's risk matrix.]

#	Details of the risk event	Phase	Consequence	Likelihood	Residual risk rating
1					
2					
3					
4					
5					

[Add or delete rows from the table below as appropriate]

Monitoring

[List the monitoring of the status or effectiveness of the controls associated with this hazard. Include the aspect being monitored and the detail of the monitoring. Monitoring includes management systems, practices and procedures that are to be applied to monitor and manage risks and compliance with performance standards.]

#	Aspect to be monitored	Details of monitoring
1		
2		
3		

[Add or delete rows from the table below as appropriate]

Reporting

[List the reporting of the monitoring, effectiveness or status of the controls associated with this hazard. Include to whom the reporting will be provided, the frequency of the reporting and how it will be used.]

#	Aspect being reported	Who will the information be reported to and at what frequency?	How will it be used?
1			
2			
3			

[Add or delete rows from the table below as appropriate]

Relevant industry publications

[List any relevant industry publications that support the management and monitoring of this hazard]

#	Document	Source (e.g. URL, appendix number)
1		
2		
3		

[Add or delete rows from the table below as appropriate]

Operator's reference documents

[List any relevant manuals, procedures or other documents that support the management and monitoring of this hazard]

#	Document	Location (e.g. work plan appendix number)
1		
2		
3		

[Add or delete rows from the table below as appropriate]

C3 Example risk treatment plans

Scope

This risk treatment plan is for the control of: *Dust*

A mining hazard means any mining activity and circumstance that may pose a risk to the environment, to any member of the public or to land, property or infrastructure in the vicinity of work carried out at a mine.

Key sensitive receptors

Key sensitive receptors include the environment, any member of the public or land, property or infrastructure in the vicinity of a mine that may be impacted or put at risk by the hazard associated with the mining activity.

The key sensitive receptors associated with this hazard include:

#	Details of the sensitive receptor	Location and proximity to site	How hazard may harm or damage Sensitive Receptor	Evidence to support assessment
1	Property	1km to the north west	Amenity	ERR consequence descriptors
2	Public Amenity		Amenity	ERR consequence descriptors
3				
4				
5				

[Add or delete rows from the above table as appropriate]

To determine the key sensitive receptors, consider:

- Members of the public – public health, safety, amenity and Aboriginal heritage
- Land, property and infrastructure: neighbouring property as well as nearby infrastructure such as highways, schools and hospitals
- Environment: air, water, soil, vegetation, flora and fauna outside the work area.

Risk events

These are the risk events associated with the hazard. Include an inherent risk rating for each event considering the design proposal of the project.

[The likelihood and consequence should be assessed using the descriptors provided by Earth Resources Regulation and the risk rating determined using Earth Resources Regulation's risk matrix.]

#	Details of the risk event	Phase	Consequence	Likelihood	Inherent risk rating
1	Generation of dust from plant and equipment	• Construction • Operation • Rehabilitation	Moderate	Almost Certain	Very High
2	Generation of dust from overburden dumps and stockpiles	• Construction • Rehabilitation	Moderate	Almost Certain	Very High
3	Generation of dust from imported fill material	• Operation	Moderate	Almost Certain	Very High

[Add or delete rows from the above table as appropriate]

Project design

What parts of the project design will impact these risks and potentially reduce the risk rating?

- The activity areas are generally surrounded by trees. The trees reduce the wind speed at ground level which reduces the risk of dust being blown off site.

Objectives

The objectives are the key aims or goals of the control measures that will be out in place to eliminate or minimise, as far as reasonably practicable, the identified risk events.

[Examples are included in the guidance sheets for managing hazards.]

[Note: Each objective does not need to relate to all of the control measures.]

The key objectives of this risk treatment plan are to:

- Reduce or prevent dust generation from onsite activities and materials transport, to the extent practicable.
- Minimise offsite dust impacts on nearby sensitive receptors, including members of the public, residential land uses, and other sensitive land uses or environments.
- Protect the beneficial uses of the air environment as defined in the SEPP (AQM).

Compliance standards

The compliance standards are the key best practice standards or guidelines that will be achieved with the control measures in place. These best practice standards or guidelines may come from the EPA, State Environment Protection Policy or other regulatory agencies.

[Examples are included in the guidance sheets for managing hazards.]

[Note: Each compliance standard does not need to relate to all of the control measures.]

The compliance standards for this risk treatment plan are:

- EPA Protocol for Environmental Management – Mining and Extractive Industries.
- State Environment Protection Policy Air Quality Management (SEPP AQM).
- EPA Guideline: Recommended separation distances for industrial residual air emissions.

Acceptance criteria

The acceptance criteria are the measures by which the control measures will be deemed to be effective in achieving the objective and eliminating or minimising, as far as reasonably practicable, the identified risk events. The acceptance criteria could be to achieve a best practice standard (e.g. an EPA standard).

[Examples are included in the guidance sheets for managing hazards.]

[Note: Each acceptance criteria does not need to relate to all of the control measures.]

The acceptance criteria for this risk treatment plan are:

- No nuisance dust issues experienced by pre-existing, nearby sensitive receptors.
- Dust and particulate emissions do not exceed applicable EPA standards.

Controls to address hazard

The control measures are to be designed to eliminate or minimise, as far as reasonably practicable, the identified risk events. The numbers of the risk events being managed by each control should be recorded against the control along with how the control will be implemented.

[Examples are included in the guidance sheets for managing hazards.]

The controls for this risk treatment plan are:

#	Details of controls being used	Risk events being managed (number from above)	Performance standards/measures *(specifying how the control is being implemented – if not implicit in the control)*
1	Maintain separation between the activity boundary and the property or activity boundary of the nearest sensitive land uses as per EPA Publication 1518 – of 250 m or 500 m.	1, 2, 3	Ensure 250 m buffer retained between operational areas and sensitive receptors.
2	Enclose dust generating equipment (e.g. crushers, conveyors) or fit them with suppression devices to minimise dust emissions. Maintain enclosures or suppression devices to ensure they are operating effectively.	1	Dust suppression devices fitted to all operating dust-generating plant. High level of plant enclosure.
3	Stop dust generating activities (e.g. crushing) where dust suppression devices are not fitted or not operating correctly during very windy conditions.	1	Dust generating activities not undertaken when wind speeds ≥ 60 km/h.
4	Manage onsite roads located within 250 m of a sensitive receptor to minimise dust generation, for example, by sealing or gravelling the road or use of water, polymer or other chemical dust suppressants. Polymer or chemical suppressants to be subject to relevant environmental contamination controls.	1	Onsite roads <100 m from a sensitive receptor are sealed. Chemical dust suppressants are used on onsite roads between 100 m and 250 m from a sensitive receptor.
5	Stabilise soil and overburden stockpiles (e.g. seeded / roughened / mulched) if they will not be disturbed for an extended period. Water or use other dust suppressant agents to prevent dust generation prior to stabilisation.	2	Soil and overburden stockpiles stabilised if not used for 60 days.
6	Cover vehicles carrying dusty materials (soil, sand, rocks etc.) when transferring material to/from the site or treat with water or other dust suppressant to minimise dust generation.	1	Ensure all vehicles have loads covered when exiting site to transfer materials.
7	Install and use wheel wash and/or rumble grids for use by trucks at their main exit points.	1	Wheel wash / rumble grids installed at all site exits.
8	Limit vehicle movements on unsealed or untreated roads/areas to avoid dust generation during windy conditions.	1	Vehicle movements limited to sealed/ watered roads under windy conditions (≥50 km/h)
9	Establish, signpost and enforce speed limits to minimise dust generation from vehicles on roads that are prone to dust generation.	1	Set a 30 km/h speed limit on unsealed roads.

[Add or delete rows from the above table as appropriate]

Residual risk assessment

Considering the controls being put in place the assessment of the residual risk associated with the risk events identified for this hazard is shown in the table below.

[The likelihood and consequence should be assessed using the descriptors provided by Earth Resources Regulation and the risk rating determined using Earth Resources Regulation's risk matrix.]

#	Details of the Risk Event	Phase	Consequence	Likelihood	Residual Risk Rating
1	Generation of dust from plant and equipment	• Construction • Operation • Rehabilitation	Moderate	Possible	Medium
2	Generation of dust from overburden dumps and stockpiles	• Construction • Rehabilitation	Moderate	Possible	Medium
3	Generation of dust from imported fill material	• Operation	Moderate	Possible	Medium

[Add or delete rows from the table below as appropriate]

Monitoring

[List the monitoring of the status or effectiveness of the controls associated with this hazard. Include the aspect being monitored and the detail of the monitoring. Monitoring includes management systems, practices and procedures that are to be applied to monitor and manage risks and compliance with performance standards.]

#	Aspect to be monitored	Details of monitoring
1	Dust deposition at nearest sensitive residential locations	Monitor continuously for 3 months following dust complaint, following applicable EPA guidance.
2	Excessive visible dust being generated on site	Visual observation during windy conditions

[Add or delete rows from the table below as appropriate]

Reporting

[List the reporting of the monitoring, effectiveness or status of the controls associated with this hazard. Include to whom the reporting will be provided, the frequency of the reporting and how it will be used.]

#	Aspect being reported	Who will the information be reported to and at what frequency?	How will it be used?
1	Dust deposition at nearest sensitive residential locations	Report to Community Reference Group quarterly	Use data to confirm presence of dust issue and identify and manage key dust generation activities
2	Excessive visible dust being generated on site	Site management as requested	To manage dust generation activities

[Add or delete rows from the table below as appropriate]

Relevant industry publications

[List any relevant industry publications that support the management and monitoring of this hazard]

#	Document	Source (e.g. URL, appendix number)
1	CMPA Dust Management Guidelines	https://cmpavic.asn.au/downloads/F-PAS-97.pdf
2		

[Add or delete rows from the table below as appropriate]

Operator's reference documents

[List any relevant manuals, procedures or other documents that support the management and monitoring of this hazard]

#	Document	Location (e.g. work plan appendix number)
1	Site plan	Work plan figure 1
2		

[Add or delete rows from the table below as appropriate]

C4 Example controls

Dust

Scope

Guidance to assist applicants to prepare a risk treatment plan for the control of emissions of hazardous and/or nuisance dust or other particulates, particularly beyond the boundary of the licence area.

Key sensitive receptors

Example controls primarily address risks posed to members of the public and residential land uses. Some types of agricultural land use (e.g. wine grapes) and environmental features (e.g. protected flora) may also be highly sensitive to dust.

Objectives

- Reduce or prevent dust generation from onsite activities and materials transport, to the extent practicable
- Minimise offsite dust impacts on nearby sensitive receptors, including members of the public, residential land uses, and other sensitive land uses or environments
- Protect the beneficial uses of the air environment as defined in the SEPP (AQM).

Compliance standards

- EPA Protocol for Environmental Management – Mining and Extractive Industries
- State Environment Protection Policy Air Quality Management (SEPP AQM)
- EPA Guideline: Recommended separation distances for industrial residual air emissions.

Acceptance criteria

- No nuisance dust issues experienced by pre-existing, nearby sensitive receptors
- Dust and particulate emissions do not exceed applicable EPA standards.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. The performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Maintain separation between the dust source and the property or activity boundary of the nearest sensitive land uses as per EPA Publication 1518 – of 250 m or 500 m.	*e.g. Ensure x m buffer retained between operational areas and sensitive receptors.*
2	Enclose dust generating equipment (e.g. crushers, conveyors) or fit them with suppression devices to minimise dust emissions. Maintain enclosures or suppression devices to ensure they are operating effectively.	*e.g. Dust suppression devices fitted to all operating dust-generating plant.* *A high level of plant enclosure.*
3	Stop dust generating activities (e.g. crushing) where dust suppression devices are not fitted or not operating correctly during very windy conditions.	*e.g. Dust generating activities not undertaken when wind speeds ≥ x km/h.*
4	Manage onsite roads located within 250 m of a sensitive receptor to minimise dust generation, for example, by sealing or gravelling the road or use of water, polymer or other chemical dust suppressants. Polymer or chemical suppressants to be subject to relevant environmental contamination controls.	*e.g. Onsite roads <x m from a sensitive receptor are sealed. Chemical dust suppressants are used on onsite roads between x m and y m from a sensitive receptor.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
5	Stabilise soil and overburden stockpiles (e.g. seeded / roughened / mulched) if they will not be disturbed for an extended period. Water or use other dust suppressant agents to prevent dust generation prior to stabilisation.	*e.g. Soil and overburden stockpiles stabilised if not used for x days.*
6	Cover vehicles carrying dusty materials (soil, sand, rocks etc.) when transferring material to/ from the site or treat with water or other dust suppressant to minimise dust generation.	*e.g. Ensure all vehicles have loads covered when exiting site to transfer materials.*
7	Install and use wheel wash and/or rumble grids for use by trucks at their main exit points.	*e.g. Wheel wash / rumble grids installed at all site exits.*
8	Limit vehicle movements on unsealed or untreated roads/areas to avoid dust generation during windy conditions.	*e.g. Vehicle movements limited to sealed/watered roads under windy conditions (≥30 km/h).*
9	Establish, signpost and enforce speed limits to minimise dust generation from vehicles on roads that are prone to dust generation.	*e.g. Set a x km/h speed limit on unsealed roads.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Dust deposition at nearest sensitive residential locations*	*e.g. Monitor continuously for 3 months following dust complaint, following applicable EPA guidance.*
2	*e.g. Excessive visible dust being generated on site.*	*e.g. visual observation during windy conditions*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Dust deposition at nearest sensitive residential locations.*	*e.g. Report to Community Reference Group quarterly.*	*e.g. Use data to confirm presence of dust issue and identify and manage key dust generation activities.*
2	*e.g. Excessive visible dust being generated on site.*	*e.g. Site management as requested.*	*e.g. To manage dust generation activities.*

Dust, silt and clay on roads

Scope

Guidance to assist applicants to prepare a risk treatment plan for the control of risks associated with the carriage and deposition of dust, silt and clay (mud) by vehicles exiting the licence area.

Key sensitive receptors

Example controls primarily address risks posed to members of the public, particularly those using or residing near roads used by traffic exiting the mining operation.

Objectives

- Avoid carriage of dust, silt and clay (mud) by vehicles leaving the licence area.
- Prevent road safety issues from hazards associated with the deposition of dust, silt and clay (mud) onto external roads by traffic from the licence area.

Compliance standards

- *Planning and Environment Act 1979.*
- Planning permit

Acceptance criteria

- Minimise dust, silt and clay (mud) carried by vehicles beyond the boundary of the licence area.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. The performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Install and use wheel wash and/or rumble grids for use by trucks at their main exit points.	*e.g. Vehicle wash or rumble grids installed at the main site exits.*
2	Paving or sealing access roads leaving wheel wash or rumble grids.	*e.g. Paving or sealing installed and maintained.*

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Mud deposition on surrounding roads.*	*e.g. Daily observation.*
2	*e.g. Visible dust emissions on roads.*	*e.g. Daily observation.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Mud deposition on surrounding roads.*	*e.g. Weekly internal reporting increased to daily during wet weather.*	*e.g. Adaptive management during wet weather.*
2	*e.g. Visible dust emissions on roads.*	*e.g. Community Stakeholder Group six monthly.*	*e.g. To assess improvement or maintenance requirements.*

Erosion and sedimentation

Scope

Guidance to assist applicants to prepare a risk treatment plan for the control of erosion and subsequent deposition of sediments. Erosion may take place from stockpiles, constructed embankments, natural slopes and rehabilitated landforms. Sediment deposition may affect the licence area or neighbouring lands and waterways.

Key sensitive receptors

Example controls primarily address risks posed to on and off site environmental features, particularly soils and waterways; as well as water and its beneficial consumptive and environmental uses.

Objectives

- Prevent erosion and sediment runoff from onsite activities.
- Minimise offsite impacts of erosion and sediment run-off on the surrounding environment.
- Protect the beneficial uses of water environments as defined in the SEPP (Waters)
- Minimise the risk of failure of on-site infrastructure (e.g. tailings or slime storages, water storages etc.) due to erosion.

Compliance standards

- State Environment Protection Policy (Waters) (SEPP Waters);
- EPA Guideline 1287 Risk Assessment of Wastewater Discharge to Waterways.
- *Water Act (1989).*
- *Catchment and Land Protection Act (1994).*

Acceptance criteria

- No delivery of sediment to land or waterways outside the licence area beyond what is permitted by the applicable SEPP, water discharge licence and/or appropriate water quality guidelines.
- No unmanaged areas of active soil erosion within the licence area or adjacent areas from site discharges.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. The performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Plan and stage vegetation clearing and earthworks to limit, to the extent practicable given operational requirements, the total surface area of land exposed at one time.	*e.g. < x ha of land disturbed at one time.*
2	Install interception drains upstream and downstream of areas of disturbed ground, including stockpiles and unsealed roads, to minimise surface water flow onto such areas. Contain water carrying sediments from roads or other disturbed areas for suitable treatment.	*e.g. Interception drains constructed and operating effectively.*
3	Design, size and maintain sediment control ponds or other structures to retain water until all sediment from the design storm event has fallen out of suspension.	*e.g. Temporary structures will be designed to accommodate a 1 in x year storm event of y hours. Permanent structures will provide for a 1 in z year storm.* *Compliance with the SEPP suspended particles requirements.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
4	Locate soil and overburden stockpiles away from waterways to minimise the risk of sediment discharge to waterways.	*e.g. Stockpiles located ≥ x m from any waterway.*
5	Stabilise soil and overburden stockpiles (e.g. seeded / roughened / mulched) and other disturbed areas as soon as practicable.	*e.g. Soil and overburden stockpiles and other disturbed areas stabilised if not used for 28 days.*
6	Maintain the angle and height of exposed working faces and/or stockpiles to minimise erosion and sediment generation to the extent practicable.	*e.g. Clay: slope of < x:y (V:H)* *Sand: slope of < x:y (V:H)*
7	Install effective velocity check and/or silt control structures in drainage lines to minimise scouring and sediment generation.	*e.g. Sandbag: drain < x mm deep and ≤ y% slope.* *Rock dam: drain > x mm deep and ≤ y% slope.* *Silt curtains installed.*
8	Plan and construct the final landform to minimise erosion and sediment run-off.	*e.g. Slopes graded to < x:y (V:H).* *Stabilisation measures applied (e.g. mulch, seedlings, geotextiles, etc).*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Effectiveness of sediment control structures.*	*e.g. Condition and operating effectiveness pre-winter and following each major rainfall effectiveness.*
2	*e.g. Compliance with the EPA standard and/or requirements of a discharge licence .*	*e.g. As required by SEPP or discharge licence.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Effectiveness of sediment control structures.*	*e.g. Quarterly report to the Community Reference Group.*	*e.g. Use data to plan maintenance of drainage sediment control features.*
2	*e.g. Compliance with the EPA standard and/or requirements of a discharge licence.*	*e.g. Site management or EPA as required.*	*e.g. To ensure compliance with SEPP or discharge licence requirements.*

Fire

Scope

Guidance to assist applicants to prepare a risk treatment plan to mitigate risks from bushfires burning onto the licence area and from fires igniting on-site and escaping to surrounding areas.

Key sensitive receptors

Example controls address risks posed to members of the public, land and property and the environment.

Objectives

- Control potential sources of fire ignition and activities that could lead to fire ignition and escape on days of elevated fire danger.
- Minimise environmental and human safety risks associated with fires burning onto a licence area.

Compliance standards

- *County Fire Authority Act (1958)*
- Country Fire Authority Regulations (2015)
- *Planning and Environment Act (1987)*
- Code of Practice for Bushfire Management on Public Land (2012).

Acceptance criteria

- Any fire ignitions originating within the licence area are contained within it.
- Grass or bushfires burning onto the licence area do not cause health or safety incidents and result in minimal environmental harm.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	For sites located on bushfire prone land, develop and implement "hot work" procedures for the conduct of activities in the open that are a potential source of fire ignition.	*e.g. Written hot work procedures have been developed.*
2	No "hot work" to be undertaken in the open air on days of Total Fire Ban without a permit from the CFA.	*e.g. No ignition sources used on Total Fire ban days.*
3	Provide fire-fighting equipment in all on-site vehicles and mobile plant and maintain the equipment in good working order.	*e.g. Fire-fighting equipment in all vehicles and maintained as per the maintenance schedule.*
4	Relevant personnel working on sites in bushfire prone areas will be provided with information and training regarding the fire hazard conditions in the area, "hot work" procedures, relevant emergency response procedures and use of applicable equipment.	*e.g. x % of relevant personnel trained within Y month of commencement.*
5	Internal-combustion engines will be fitted with exhaust pipes, mufflers and spark arresters (where consistent with manufacturers specifications) and maintained in good working order.	*e.g. Where consistent with manufacturers specifications engines are fitted with spark arresting devices.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
6	Provide fire-fighting equipment in all site buildings and maintain it in good working order. Equip water carts with pressure pumps and fire fighting hose.	*e.g. Fire-fighting equipment in all site buildings.*
7	Flammable and combustible wastes are removed from the site as soon as practicable.	*e.g. No flammable waste is stockpiled onsite.*
8	For sites located on bushfire prone land, check the National Fire Danger Rating for the area of the site each work day during the prescribed fire danger period. Communicate the hazard rating and any specific instructions to site personnel.	*e.g. Fire Danger Rating checked daily and communicated to site personnel.*
9	Establish and maintain fire breaks around site boundaries in high risk fire areas.	*e.g. Fire breaks installed and maintained. Audit before high risk season.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Hot work approvals.*	*e.g. Establish and maintain a register of hot work approvals and hot works undertaken.*
2	*e.g. Training of personnel in high fire risk area.*	*e.g. Numbers of staff trained.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Hot work approvals.*	*e.g. Monthly internal reporting and safety compliance assurance.*	*e.g. To ensure risks are being managed.*
2	*e.g. Training of personnel in high fire risk area.*	*e.g. Site management annually prior to fire season.*	*e.g. Availability of trained personnel to assist in fire emergency.*

Relevant industry publications

- CFA Bushfire Management Template: Pathway 2 (https://www.cfa.vic.gov.au/plan-prepare/bushfire-management-statement-bms-templates)

Fuel, lubricants and hazardous materials

Scope

Guidance to assist applicants to prepare a risk treatment plan to manage risks associated with the storage, use and handling of fuel, lubricants and hazardous materials to minimise risks to the environment.

Key sensitive receptors

Example controls primarily address risks posed to the environment.

Objectives

- Minimise the risk of fuels, lubricants and hazardous materials released into the environment through leaks, spills and through stormwater runoff.

Compliance standards

- State Environment Protection Policy (Waters). [SEPP Waters]
- State Environment Protection Policy (Prevention and Management of Contaminated Land). [SEPP Contam Land]
- Environment Protection (Scheduled Premises & Exemptions) Regulation (2007)
- Environment Protection (Industrial Waste Resource) Regulations (2009)
- AS1940 – Storage and Handling of Flammable and Combustible Liquids.

Acceptance criteria

- Fuels, lubricants and hazardous materials are stored in accordance with AS 1940
- Compliance with relevant SEPPs.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Design and install bunding and surface sealing of storage area sufficient to hold 125% of the total volume of the hazardous material.	*e.g. Bund height, volume of the bunded area in relation to the amount of substances stored, imperviousness of the bunded area i.e. Impervious material used for lining.*
2	Locate the storage are away from the waterways or areas prone to flooding.	*e.g. Buffer distance between the storage area and the sensitive receptors.*
3	Minimise the amount of fuels, lubricants and hazardous materials stored on site by limiting the volume of hazardous substances stored onsite to the minimum required for the activity.	*e.g. Register established and maintained* *Not more than x L of fuel or hazardous material stored onsite.*
4	Provide spill and leakage protection around areas where fuels, lubricants and hazardous substances are stored and handled. Controls may include: • locating activities on compacted sealed ground; • use of drip trays; • installation of oil/water interceptors in drainage lines; • sedimentation filters / ponds in drainage lines; • construction of earthen bunds etc.	*e.g. All areas protected against spills and leaks.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
5	Underground tanks / sumps for the storage of hazardous substances (such as fuel, waste oils, effluent) are not installed at the site.	*e.g. No underground storage structures are present.*
6	Inspect and maintain spill control equipment.	*e.g. Daily visual inspection and inspection records maintained.*
7	Ensure appropriate clean-up equipment and materials are available.	*e.g. Equipment and materials are available and accessible to all the sites and all the time.*
8	Notify relevant authorities of significant spills or leaks.	*Record of all spill reports maintained.*
9	Ensure drainage from areas where spills may occur is diverted through a sump or interceptor.	*e.g. Sumps/interceptors of adequate capacity are in place.*
10	Manage water and stormwater runoff in and surrounding site to reduce the potential for impacts on environment.	*e.g. Construction and maintenance of onsite drainage.*
11	Provision of fire control equipment and maintained in areas where flammable / combustible hazardous substances are stored.	*e.g. Records of regular maintenance.*

[Note: Values in the performance measure examples are intended to be defined for the site, but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Volume of fuels, lubricants and hazardous materials available at the site.*	*e.g. Regular periodic stocktake (e.g. monthly).*
2	*e.g. Pollution control devices maintained and serviced.*	*e.g. Six monthly audit.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Volume of fuels, lubricants and hazardous materials available at the site.*	*e.g. Register established and maintained, monthly internal reporting.*	*e.g. To determine when higher volumes are being stored on site and further precautions are to be taken.*
2	*e.g. Pollution control devices maintained and serviced.*	*e.g. Results of six monthly audits.*	*e.g. Plan maintenance upgrades as required.*

Imported materials

Scope

Guidance to assist applicants to prepare a risk treatment plan to manage risks associated with the import, storage and/or management of hazardous or non-hazardous solid materials to the licence area.

Key sensitive receptors

Example controls primarily address risks posed to the environment, particularly soils, waterways and related terrestrial and aquatic ecosystems.

Objectives

- Prevent contamination of the site by importing hazardous materials or soils carrying seeds of declared weeds or infested with soil-borne plant diseases.
- Prevent unlicensed importation and storage of domestic or industrial wastes and hazardous materials.

Compliance standards

- *Environment Protection Act (1970)*
- *Catchment and Land Protection Act (1994)*
- *Planning and Environment Act (1979)*
- *Mineral Resources (Sustainable Development) Act (1990)*
- State Environment Protection Policy (Waters) (SEPP Waters)
- Earth Resources Regulation Imported Materials Management Guidelines for Mine and Quarry Operations.
- EPA Publication No. IWRG621 Industrial Waste Resource Guidelines – Soil hazard categorisation and management.
- EPA Publication No. IWRG631 Industrial Waste Resource Guidelines – Solid industrial waste hazard categorisation and management.
- EPA Publication No. IWRG600.2 Industrial Waste Resource Guidelines – Waste Categorisation.
- EPA Publication No. 655.1 Acid Sulfate Soil and Rock.

Acceptance criteria

- The management of imported materials does not detract from beneficial uses of soil, surface water or groundwater within or near the licence area.
- Importation and management of imported materials fully complies with applicable legislative and regulatory requirements.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Obtain any required approvals for the import of materials from local government (via a planning permit) and/or ERR (via a work plan or work plan variation) prior to the commencement of importation of materials.	*e.g. All permits and approvals in place before commencement.*
2	Obtain certification from supplier that imported material meet the requirements for clean fill as defined in the Industrial Waste Resource Regulations (IWRG). Spot check loads to confirm their composition is consistent with their classification.	*e.g. Imported materials meets criteria for clean fill and has appropriate certificates.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
3	Prohibit the import of domestic waste, prescribed industrial wastes and acid sulfate soils or other acid-forming rocks to the site.	*e.g. No domestic or prescribed waste imported to the Licence area.*
4	Weigh and visually inspect each load of material imported to site and record tonnage and source. Segregate materials imported from different sources until they are confirmed as clean and suitable for use.	*e.g. Materials receipt records are maintained.* *Imported materials are segregated until confirmation of their suitability for use within the Licence area.*
5	Only import soil from sites that are known to be free of pathogens and declared weeds (and their seeds). Maintain a register of this information for any soil, fill or similar material imported onto the licence area.	*e.g. Imported soil is verified as weed and pathogen free.*

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Composition of loads of imported materials.*	*e.g. Inspect to confirm material composition is consistent with clean fill definition.*
2	*e.g. Obtain relevant certificates for imported materials.*	*e.g. Maintain a register of certificates for imported material.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Composition of loads of imported materials.*	*e.g. Monthly internal recording and annual external reporting of compliance with licence conditions.*	*e.g. To ensure compliance with licence conditions.*
2	*e.g. Obtain relevant certificates for imported materials.*	*e.g. Community Stakeholder Group every six months.*	*e.g. Provide assurance that no waste or hazardous materials are being deposited on site.*

Noise

Scope

Guidance to assist applicants to prepare a risk treatment plan for the control of noise, particularly as it has potential to affect sensitive receptors beyond the boundary of the licence area.

Key sensitive receptors

Example controls primarily address risks posed to members of the public and residential land uses. Some types of agricultural land use (e.g. horses) and environmental features (e.g. migratory bird breeding areas) may also be highly sensitive to noise.

Objectives

- Reduce noise generation from onsite activities and materials handling to the extent practicable.
- Minimise offsite noise impacts on nearby sensitive receptors, including members of the public, residential land uses and other sensitive land uses or environments.
- Protect the beneficial uses of the air environment as defined in the SEPP N-1.
- Noise experienced by nearby sensitive receptors is within specifications of SEPP N-1 or NIRV guideline.

Compliance standards

- EPA Guideline 1411 – Noise from Industry in Regional Victoria (NIRV).
- State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) (SEPP N-1).

Acceptance criteria

- Noises levels at nearby sensitive receptors do not exceed applicable EPA standards.

Example controls to address hazard

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#	Details of controls being used	**Performance measures** (specifying how the control is being implemented – examples shown below)
1	Locate noise generating plant and equipment away from noise sensitive receptors.	*e.g. Minimum x m buffer distance maintained between operational areas and noise sensitive receptors.*
2	Plan the site layout to screen operational areas from noise sensitive receptors. Where possible: • Locate site access roads away from sensitive receptors; • Use existing features (i.e. topography, vegetation) and/or stockpiles or other constructed features as noise barriers; • Locate noisy equipment away from sensitive receptors; Maintain the minimum buffer / set-back distances specified in the planning permit.	*e.g. Locations with noise generating activities effectively screened from noise sensitive receptors.* *Install vegetated bund walls where required.*
3	To the extent practicable, specify low noise generating equipment when selecting equipment for on-site use.	*e.g. As far as practical all equipment used on site will have a low noise rating.*
4	Maintain (active) site roads in good condition to minimise noise from vehicle traffic over corrugations and pot holes.	*e.g. Corrugations and potholes are remedied as soon as possible to minimise their presence.* *Implement maintenance grading plan.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
5	Where practicable and consistent with manufacturer's specifications, fit (or retain) mobile noise-generating equipment, pneumatic equipment and/ fixed internal combustion engines with noise attenuation devices (e.g. enclosures, baffles, silencers, mufflers etc.) and maintain equipment in good repair.	*e.g. Noise abatement devices fitted to all operational noise generating plant.*
6	Limit materials haulage from the licence area to licenced operating hours and minimise excessive noise levels from dusk to dawn, e.g. drilling.	*e.g. Licenced operating hours:* • *X am – Y pm Mon to Fri.* • *X am till Z pm on Sat.* • *No work on Sun or public holidays.*
7	Turn off plant, equipment and vehicles when not in use for an extended period.	*e.g. No plant, equipment or vehicles remain on when not in use.*
8	Broadcast or loudspeaker system, telephone ringer or other external alarm are not routinely used (except as a warning alarm e.g. for blasting).	*e.g. No external broadcast systems are used.*
9	Fit low frequency reversing noise signals to all applicable mobile plant.	*e.g. All applicable mobile fitted with low frequency reversing noise signals.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Noise at nearest sensitive residential locations comply with the SEPP requirements.*	*e.g. Monitor regularly for 3 months following noise complaint*
2	*e.g. After hours noise levels (dusk to dawn)*	*Assess all after hours noise sources.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Noise at nearest sensitive residential locations.*	*e.g. Monthly Internal reporting for management following a complaint.*	*e.g. Use data to confirm presence of noise issue and identify and manage key noise generation activities.*
2	*e.g. After hours noise levels (dusk to dawn).*	*e.g. Site management as required.*	*e.g. To reduce after hours noise emissions.*

Pests, weeds and diseases

Scope

Guidance to assist applicants to prepare a risk treatment plan to control and avoid introducing weeds, pest animals and/or soil-borne disease to the site of a mine and threatening biodiversity and/or agricultural production values associated with the site and surrounding areas.

Key sensitive receptors

Example controls primarily address risks posed to the environment and primary production land uses.

Objectives

- Protect biodiversity values associated with the licence area.
- Prevent site activities contributing to the proliferation of noxious weeds, plant diseases or pest animals, on or off the licence area

Compliance standards

- *Catchment and Land Protection Act (1994)*
- *Planning and Environment Act (1987)*
- *Public Health and Wellbeing Act (2008)*
- *Agricultural and Veterinary Chemicals (Control of Use) Act (1992)*
- Agricultural and Veterinary Chemicals (Control of Use) Regulations (2007).

Acceptance criteria

- Site operator complies with legislative requirements relating to the control and management of declared noxious weeds and pest animals.
- The mining or extractives operation does not contribute to the spread or proliferation of soil-borne plant diseases.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	**Performance measures** (specifying how the control is being implemented – examples shown below)
1	Eradicate or manage any declared noxious weeds or established pest animals present on the Licence area.	*e.g. Infestations of declared noxious weeds and established pest animals are eradicated or controlled.*
2	Identify pest species habitats within the licence boundary and remove refuge areas (burrows, hollow logs) where practicable and consistent with native vegetation protection requirements.	*e.g. Pest animal habitats are removed or destroyed.*
3	Any soil imported to the site is to be from a location that is known to be free of pathogens, disease and noxious weeds (and their seeds).	*e.g. Imported soil is verified as weed and pathogen free.*
4	Disinfect equipment moved from areas known or suspected to contain Phytophthora cinnamomi. Disinfection is to be carried so that water or other materials from disinfection cannot reach a waterway or contaminate native vegetation habitats.	*e.g. Hygiene procedures are in place and followed in areas with known or suspected Phytophthora cinnamomi presence.*
5	Identify and map areas within the licence boundary that contain declared noxious weeds (under the CaLP Act) and establish exclusion zones until the weeds are controlled and/or the area is fully disturbed by the activity.	*e.g. Areas containing declared weed species are not disturbed by site activities.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
6	Limit vegetation clearing and surface disturbance activities to the minimum required operationally.	*e.g. Limit clearing to ≤ x m in advance of operational areas.*
7	Engage appropriately licenced personnel to conduct any required pesticide application to control weeds and/or pest animals.	*e.g. Only licensed personnel are permitted to apply pesticides.*
8	Stockpile and manage soils from areas with noxious weed infestations separately to other soils to avoid cross contamination.	
9	Vermin management mitigated by the removal of waste, rubbish, etc. by licensed contractor.	*e.g. Regular waste and rubbish collection services in place.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Site flora and fauna for noxious weeds and pests.*	*e.g. Inspect all areas to assess the health of the vegetation and to check for erosion, pest animal browsing damage and weed infestation.*
2		

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Site flora and fauna for noxious weeds and pests.*	*e.g. Monthly internal reporting for management.*	*e.g. For management intervention if rehabilitation areas have emerging weed or pest animal issues.*
2			

Rubbish

Scope

Guidance to assist applicants to prepare a risk treatment plan to manage risks to the environment from the storage and/or management of rubbish or industrial wastes (as defined by EPA) within a licence area. These controls do not apply to prescribed industrial wastes, acid-forming rocks or acid sulphate soils.

Key sensitive receptors

Example controls primarily address risks posed to the environment, but also address amenity for members of the public and nearby residents.

Objectives

- Prevent rubbish and industrial wastes generated by site activities from adversely affecting soil, water or other aspects of the environment.
- Protect the beneficial uses of water and soil environment as defined in relevant State Environment Protection Policies (SEPPs).

Compliance standards

- SEPP (Waters)
- SEPP (Prevention and Management of Contaminated Land)
- Environment Protection (Scheduled Premises & Exemptions) Regulation (2007)
- Environment Protection (Industrial Waste Resource) Regulations (2009).

Acceptance criteria

- Beneficial uses of soil, water and air within and near the licence area are not detrimentally affected by the storage and/or management of rubbish or industrial wastes.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Segregate wastes generated on-site (by type and hazard) for recycling or disposal. Recover and reuse site generated wastes where possible (e.g. mulching of green waste for use in rehabilitation).	*e.g. Waste is segregated at source and is re-used on-site where practicable.*
2	No on-site disposal (or burning) of rubbish and/or prescribed wastes generated from site activities. Use appropriately licenced off-site services / facilities to recycle or dispose of site generated wastes.	*e.g. No domestic or prescribed industrial wastes disposed on-site.*
3	Assess all rubbish and industrial wastes for potential for contamination and manage/ dispose in accordance with EPA requirements.	*e.g. Licensed contractors are used for the disposal of all rubbish and waste material.*
4	Limit the volume and permitted timeframe for wastes to be stored onsite.	*e.g. Waste materials not held on-site for more than x month.*
5	Protect waste storage areas from rainfall and stormwater or flood ingress.	*e.g. Covered waste storage areas and/or bins.*
6	Locate waste storage away from areas of protected habitat and/or waterways.	*e.g. x m buffer distance maintained between waste storage areas and protected habitat and/or waterways.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
7	Develop and implement appropriate training on waste management measures to limit the generation and accumulation of waste on site.	
8	Provide covered bins for temporary on-site storage of rubbish and domestic wastes.	*e.g. Sealed bins provided.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Wastes stored on site.*	*e.g. Quantities, types and location of prescribed wastes stored on site.*
2	*e.g. Approved disposal of wastes.*	*e.g. Register of licensed contractors.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Wastes stored on site.*	*e.g. Monthly internal reporting and safety compliance assurance.*	*e.g. Use in case of fire or other emergency.*
2	*e.g. Approved disposal of wastes.*	*e.g. Regulatory authorities six monthly or as required.*	*e.g. Compliance with SEPP or regulations.*

Site access

Scope

Guidance to assist applicants to prepare a risk treatment plan for unauthorised access to the licence area by members of the public and to provide for safe authorised access.

Key sensitive receptors

Example controls primarily address risks posed to members of the public.

Objectives

- Provide for the safety of members of the public when accessing a licence area.
- Prevent unauthorised access to the licence area by members of the public.

Compliance standards

- Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019
- *Safety on Public Land Act (2004)*
- Licence conditions.

Acceptance criteria

- Boundary of licence area is appropriately marked and secured
- Operating area for mine is secured to minimise chances of unauthorised entry.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Identify, mark and fence the boundary of the licence area in compliance with the MRSD (Mineral Industries) Regulations 2019.	*e.g. The site boundary is identified with compliant boundary markers and fully fenced with lockable access gates.*
2	Lock all gates when site is unattended. Control access to site when site is attended.	*e.g. Site gates locked or otherwise secured.*
3	Design and construct onsite roads to safely accommodate the size and type of vehicles accessing and travelling within the site. Separate any general traffic from any internal haul routes.	*e.g. For one-way traffic, the track should be twice the width of the widest vehicle. For two-way traffic, the track should be three times the width of the widest vehicle.*
4	Install site access safety signage around boundary fence and at all access points.	*e.g. Hazard warnings against unauthorised access.*

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Site entry by members of the public.*	*e.g. Register of all visitors to site.*
2	*e.g. Site security breaches (unauthorised access).*	*e.g. Records kept of site security breaches.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Site entry by members of the public.*	*e.g. Daily internal reporting.*	*e.g. Ensure all visitors have exited site prior to end of operating hours.*
2	*e.g. Site security breaches (unauthorised access).*	*e.g. Reported to site management and regulatory authority as required or six monthly.*	*e.g. Improve site security to limit unauthorised site access.*

Soil biological activity

Scope

Guidance to assist applicants to prepare a risk treatment plan to help maintain the biological activity of undisturbed and stockpiled soils within the licence area. It does not address the storage of contaminated soils or potential acid sulphate soils.

Key sensitive receptors

Example controls primarily address risks posed to on-site soils and the successful rehabilitation of the mine site.

Objectives

- Protect existing soil structure, nutrient levels and biological activity in onsite soils
- Facilitate the rehabilitation of the mine site by maintaining biological activity in stockpiled soils.

Compliance standards

- *Catchment and Land Protection Act (1994).*

Acceptance criteria

- The health of biologically active soil is maintained while it is stockpiled and reused in rehabilitation.

Example Controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Install and use wheel wash and/or rumble grids for use by trucks at their main exit points.	*e.g. Wheel wash and/or rumble grids are installed for use by trucks at their main exit points.*
2	As applicable to the site, segregate each soil layer / type into individual stockpiles for future reuse. This must include surface organic matter and larger woody debris.	*e.g. Individual soil strata (topsoil, overburden, gravel, humus etc) are retained in separate stockpiles.*
3	If possible do not strip soil when it is very dry or saturated.	*e.g. Condition of soil stockpile maintained.*
4	Maintain soil stockpiles at no more than 2 m height.	*e.g. Stockpiles ≤ x m height.*
5	Replace stockpiled soil strata (during rehabilitation) in their original order to maintain the natural soil profile.	*e.g. The soil's original profile is restored during rehabilitation.*
6	Stabilise soil and overburden stockpiles (e.g. seeded / roughened / mulched) if they will not be disturbed for an extended period.	*e.g. Soil and overburden stockpiles are stabilised if not used for x days.*
7	Any soil imported to site must be from a location that is known to be free of pathogens, disease and noxious weeds (and their seeds).	*e.g. Imported soil is verified as weed and pathogen free.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Maintenance of site soil stockpiles.*	*e.g. Quality of stockpile maintained for future reuse on site.*
2	*e.g. Soils imported to the site.*	*e.g. Register of point of origin, location of storage and confirmation of the weed and disease free status of the origin.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Maintenance of site soil stockpiles.*	*e.g. Site management environmental officer on a six monthly basis.*	*e.g. Quality of stockpile maintained for future reuse on site.*
2	*e.g. Soils imported to the site.*	*e.g. Monthly internal reporting.*	*e.g. Trace soils if disease or weed outbreak occurs.*

Stormwater

Scope

Guidance to assist applicants to prepare a risk treatment plan to manage risks associated with the stormwater generated within the site to minimise its impacts on environment and infrastructure.

Key sensitive receptors

Example controls primarily address risks posed to environment, particularly waterways and related ecosystems from the stormwater runoff and the site infrastructure such as roads.

Objectives

- Protect the beneficial uses of the local water environment as defined in the SEPP (Waters)
- Minimise the impact to the onsite roads and other infrastructure due to stormwater runoff.

Compliance standards

- *Water Act (1989)*
- *Catchment and Land Protection Act (1994)*
- *Planning and Environment Act (1979)*
- State Environment Protection Policy (Waters) (SEPP Waters)
- EPA Guideline 1287 Risk Assessment of Wastewater Discharge to Waterways.

Acceptance criteria

- Stormwater is managed to meet the SEPP
- No nuisance stormwater flooding/inundation of roads and other infrastructure.

Example controls to address hazard

*These controls are **suggestions for consideration** by applicants. Some or all may be used, with or without additional controls. Performance measures should be determined by the applicant to specify how the control is to be implemented, where this is not implicit in the details of the control. Performance measures should include relevant specifics such as buffer distances, vehicle speed, the decibel range or the range of particulate matter as appropriate.*

#	Details of controls being used	**Performance measures** (specifying how the control is being implemented – examples shown below)
1	Construct roads with sufficient diversion drains and culverts to ensure that clean stormwater is diverted away from roads.	*e.g. Survey set out of roads and designs where necessary employ surface treatment to reduce erosion.*
2	Ensure that the gradient and orientation of tracks do not cause runoff to be fast flowing.	*e.g. Maintenance of tracks to minimise erosion.*
3	Arrange drainage of roads to be a vegetated area through erosion protection structures.	*e.g. Side and angled drain off collection drains protected against erosion.*
4	Ensure that drainage from an area where fuels/ lubricants/ hazardous material are stored/used is directed to a sump or an interceptor trap.	

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. storm water culverts and discharge points.*	*e.g. Inspect outlet area to assess the potential for contaminated stormwater to exit the site.*
2	*e.g. Erosion control structures.*	*e.g. Inspect and maintain erosion control structures.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. storm water discharge points.*	*e.g. Monthly internal and external reporting.*	*e.g. Management intervention depending on the severity of the incident. For example, notify DEDJTR as soon as practicable after they become aware of a Reportable Event at the site (as defined in the ERR Guidance Note).*
2	*e.g. Erosion control structures.*	*Site management after significant rainfall event or six monthly.*	*e.g. Upgrade or maintain control structures.*

Water

Scope

Guidance to assist applicants to prepare a risk treatment plan for the management of risks associated with the diversion or disturbance of natural path of flows along waterways or drainage lines. It does not deal with the extraction of water from waterways or groundwater, nor the discharge of process water to the environment.

Key sensitive receptors

Example controls primarily address risks posed to the environment, particularly waterways and related ecosystems.

Objectives

- Prevent site activities from adversely affecting local surface and groundwater sources.
- Protect the beneficial uses of the local water environment as defined in the SEPP (Waters)

Compliance standards

- *Water Act (1989)*
- *Catchment and Land Protection Act (1994)*
- *Planning and Environment Act (1979)*
- State Environment Protection Policy (Waters) (SEPP Waters)
- EPA Guideline 1287 Risk Assessment of Wastewater Discharge to Waterways.

Acceptance criteria

- The diversion and return of diverted water to the environment does not detract from beneficial uses of surface water or groundwater.

Example controls to address hazard

*These controls are **suggestions for consideration** for a mining proponent, some or all may be used, with or without additional controls. Performance measures should be determined by the proponent to specify how the control is to be implemented, where this is not implicit in the details of the control. Where required the performance measure should include the specifics of such things as buffer distances, vehicle speed, the decibel range or the range of particulate matter.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
1	Where reasonably practicable, locate the activity outside of areas designated as a floodplain and/or Land Subject to Inundation.	*e.g. Site located outside designated flood zones.*
2	Install diversion drainage structures up-gradient of working areas to prevent clean surface water from entering the site and becoming contaminated.	*e.g. Surface water diversion structures installed and effectively intercepting surface water before it reaches operating areas.*
3	Construct and maintain diversion structures to limit impacts on downstream / offsite surface water flows. (e.g. alteration of drainage pathways, change in flow), including installing scour protection on the outlet of surface water diversion drains.	*e.g. Downstream environmental flow is maintained.*
4	Design onsite diversion drains to accommodate the surface water flows for a 1 in 10 year storm event (10% AEP), based on the area of the up-gradient catchment area.	*e.g. Diversion drains designed for 1 in 10 year storm event.*

#	Details of controls being used	Performance measures (specifying how the control is being implemented – examples shown below)
5	If diversions of water activities require: • extraction of water from a waterway or existing dam; • construction of a dam on a waterway; Ensure an appropriate 'Take & Use Licence' is obtained from the relevant Rural Water Corporation. A "Works on Waterways" approval must be obtained from a Catchment Management Authority for activities involving works on waterways.	*e.g. Ensure an appropriate 'Take & Use Licence' is obtained from the relevant Rural Water Corporation.* *Ensure A "Works on Waterways" approval is obtained from a Catchment Management Authority for activities involving works on waterways.*

[Note: Values in the performance measure examples are intended to be defined for the site but should take into account any compliance standards or acceptance criteria.]

Monitoring

#	Aspect to be monitored	Details of monitoring
1	*e.g. Condition of waterway at outlet of diversion drain.*	*e.g. Inspect outlet area to assess the potential for erosion and the effectiveness of scour protection features.*
2	*e.g. Effectiveness of upstream diversion drainage structures.*	*e.g. Inspected and maintained as required.*

Reporting

#	Aspect to be reported	Who will the information be reported to and at what frequency?	How will it be used?
1	*e.g. Condition of waterway at outlet of diversion drain.*	*e.g. Internal reporting for site management after significant rainfall event or six monthly.*	*e.g. intervention if erosion issues emerge.*
2	*e.g. Effectiveness of upstream diversion drainage structures.*	*e.g. Internal reporting for site management after significant rainfall event or six monthly.*	*e.g. Assess effectiveness and maintenance requirements.*

Relevant industry publications

- CMPA Guidance on Water Management Strategies for the Quarrying Industry

Appendix D
Example works for notification

Examples where no variation to a work plan is triggered

a. **Relocation of a haul road**

A mine operator proposes to relocate a haul road within the licence boundary. There is no change to risk based on the location of nearby sensitive receptors. The mine operator notifies Earth Resources Regulation of the change and updates its work plan to note the new location of the haul road. Where a haul road is moved further away from receptors, this relocation would act as a mitigation measure to reduce risk.

b. **Increase in depth of a pit**

There are circumstances where increasing the depth of a pit will not result in a significant increase in risk. Where the batters retain a designated slope and no groundwater is intercepted, it is unlikely a variation would be triggered.

c. **Modification to plant**

A mine operator may wish to upgrade/modify or move the processing plant further away from sensitive receptors as a mitigation measure to control dust, noise or vibrations. These actions would not trigger a work plan variation.

d. **Changes to the staging of the mine**

In some circumstances changing the staging of the development of a mine may not result in a significant increase in risk. Where there are no changes to the rehabilitation plan and any changes to the native vegetation offset plan can be accommodated it is unlikely that a work plan variation would be needed.

e. **Increase in production rate**

A mine operator may wish to increase the processing rate of the mine. If no significant increase in risk to the sensitive receptors can be demonstrated through recent dust and noise modelling and alterations to traffic management are acceptable to Council a work plan variation may not be triggered.

f. **Increase in extraction area for a pit within the existing licence boundary**

A mine operator may wish to increase their pit footprint using the same mining method as detailed in their work plan. Provided there is no significant increase in risk with vegetation clearance or geotechnical risks to infrastructure and council consents to this under the planning permit it may not trigger a work plan variation. An example would be a pit undertaking shallow extraction with flat batters and with no fixed plant involved. Revised drawings will need to be provided to be read in conjunction with the work plan.

Appendix E

E1 Example site meeting agenda

Site:	
Location (address):	
Date:	
Time:	

Attendees:

Organisation	Name	Position title
Applicant		
Consultant		
ERR		
Council		
DELWP		
EPA		
CMA		
AV		
Heritage Vic		
Water Authority		
Other		

Note: the applicant/consultant will record key site meeting outcomes and circulate them to all invitees.

Agenda:

#	Item	Who
1	Welcome and introduction of attendees	Applicant/Consultant/All
2	Roles and responsibilities	Applicant/Consultant/All
3	Proposal overview	Applicant/Consultant
4	Site description • Current use • Geology • Reserves • Sensitive receptors	Applicant/Consultant
5	Current approvals or licences in place	Applicant/Consultant
6	Proposed mining method • Locations of equipment, dumps and dams (slimes/tailings) • Blasting requirements • Batter angles	Applicant/Consultant
7	Proposed rehabilitation and end use	Applicant/Consultant

#	Item	Who
8	Earth Resources Regulation (ERR) comments and requirements • Work plan requirements? • Potential hazards and risks? – Member of the public – Land, property and infrastructure – Environment • Surface water and groundwater? • Other management plans? – Blast management? – Ground control? – Community engagement? – Rehabilitation? • Final land form and end use • Other?	ERR Representative
9	Council comments and requirements • Planning permit requirements? • Road access and traffic management? • Community consultation?	Council Representative
10	Department of Environment, Land, Water and Planning comments (DELWP) and requirements • Planning overlays? • Flora and fauna reports? • *Environment Protection and Biodiversity Conservation Act 1999*?	DELWP Representative
11	Other regulator/agency comments and requirements • EPA • Local Catchment Management Authority • Aboriginal Affairs Victoria • Heritage Victoria – Heritage overlay? • Other?	Agency Representatives
12	Work plan assessment process • Submitting the work plan • Fees • Assessment • Further information • Reassessment • Referral • Endorsement • Planning permit • Approval • Application for work authority & rehabilitation bond • Grant of work authority • Start work	ERR Representative
13	Next steps	Applicant/Consultant

E2 Example site meeting questions

The following questions or issues may be discussed at the initial site meeting. This checklist will help the Tenement holder identify the information to provide in the work plan.

Discussion Topic	Details
Extraction proposal	• What is the estimated life of the activity? • What is the estimated/anticipated volume of resource per annum (output in tonnes or cubic metres)? • What is the estimated volume of soils and overburden to be disturbed? • What are the operating hours?
General location information	• What road(s) are proposed to be used for entering/exiting the activity area? • Are there any known inherited issues as a result of past or current land use?
Blasting	• Will blasting take place? If so, is it possible that blasting related activity could cause vibrations/noise/fly rock at the boundary of (or beyond) the activity area impacting sensitive receptors or infrastructure, including pipelines?
Noise	• Is it likely that activity area-based noise will be heard at any sensitive receptor?
Dust	• Is it likely the operations will generate dust or spray that will be deposited or emitted outside of the activity area boundary? • Is it likely the operations will generate any other substances listed as Class 1, 2 or 3 indicators under Protocol for Environmental Management (2007) that will be emitted outside of the activity area boundary?
Community facility/ private and public infrastructure	• Are there known above and below ground infrastructure (electricity networks, water mains, designated waters etc.) located near the activity area? • Are there known public roads, bridges or train lines located near the activity area?
Aboriginal Heritage	• Are there any areas of cultural heritage sensitivity or other protected areas in the proposed activity area? • Are any caves or dunes identified in the activity area? • Is a CHMP is required?
Historic heritage	• Does the activity area contain places, sites or objects on the: • Heritage overlay of the relevant planning scheme • Victorian Heritage Register • Victorian Heritage Inventory? • Are there historical heritage sites, structures or artefacts that must be retained as part of the post closure land form?
Flora and fauna	• Is any flora or fauna, including native vegetation, within the activity area to be removed or impacted? • Are there weeds, pests or feral animals within the activity area, or from surrounding areas, that could impact rehabilitation activities and/or potential land uses after closure?
Groundwater	• What is the depth to groundwater and water quality objectives as defined in the SEPP Groundwaters of Victoria? • Where are nearest groundwater users or groundwater sensitive ecosystems? • Will de-watering be required (e.g. lowering the groundwater levels), or will the activity pit intersect the water table? • Will there be any potential effects on existing groundwater quality, and are there third party users of groundwater surrounding the activity? • Are there groundwater-dependent ecosystems located within the specified distances surrounding the activity area? • Is the activity within a Groundwater Restricted Quality Usage Zone, a Water Supply Protection area, or a Groundwater Management Area?

Discussion Topic	Details
Surface water	• What are the water quality objectives for the area defined in the SEPP Waters of Victoria? • Where are nearest water users or water sensitive ecosystems? • Are alterations to surface drainage required (e.g. waterway diversion) and if so, are they going to increase the potential for flooding of adjacent land? • Are soil, overburden or proposed extracted materials (e.g. soils etc.) susceptible to erosion (e.g. caused by clearing of vegetation, problem soils)? • Is there potential for soil and overburden stockpile to cause sedimentation outside of the activity boundary? • Is the activity area located within a potable water catchment?
Dams	• Will there be water storages (e.g. settlement pond, water storage, evaporation pond, bio-retention basin, etc.) or slimes dams on the activity area? • If yes, what is the type, area and embankment height of water storages or slimes dams? • Will the storage or dam be located on a waterway? • Will the dam receive runoff from a catchment upslope of the storage or dam? • Will any of the above storages hold water that is unlikely to meet the SEPP guidelines for surface water or groundwater (or the ANZECC guidelines where a constituent is not specified)? • Will any of the storages meet the criteria of a large dam in accordance with ANCOLD Guidelines? If yes, what is the type, area and embankment height of water storages or slimes dams and it's possible consequence category? • What impact could failure of a water storage or slimes dam have on public safety, infrastructure or the environment?
Geotechnical	• How will slope instability affect public safety, public infrastructure or environmental elements? • How can the site's lithology/geology and structural geology impact on slope stability? E.g. are there any active faults, dykes or shear zones (including adverse jointing) which may affect slope stability? • Is the overburden dispersive which may lead to long term erosion problems around the site? • What influence may seismic activity in the area have on slope stability? • Can elevated water levels in the batters have an impact on slope stability? • Are there areas where a perched water table may exist? • Could the proposed activity operation and excavation methods heighten the potential for slope instability, and would such instability have any impact outside the activity area? • Are there any historical voids (old mine underground workings, shafts, etc.) within the activity area? • Are there other adjacent land uses or features that could create triggers for land instability (e.g. neighbouring property performing blasting, surface water drainage near batter crest etc.)? • Will there be any crest loading, which may affect slope stability, such as an overburden dump or plant equipment situated near the crest of the open pit?
Environment – visual amenity (overburden/ waste rock)	• Will stockpiles and overburden dump be located within the activity area? • If yes, what is the volume of material and what is the proposed height of the largest stockpile/overburden dump?
Waste	• Will process wastewater be stored and treated within the activity area? • Will the operations (extraction and processing) generate hazardous wastes (e.g. grease, oils, putrescible waste, and batteries)?

Discussion Topic	Details
Fuel	• Will fuel (e.g. petrol, diesel) or other chemicals/additives be stored within the activity area? • Will refuelling, fuel storage and maintenance of machinery and equipment occur within activity area.
Acid mine drainage	• Will acid sulphate soils be exposed/oxygenated during the proposed activities? • Is there potential for sulphide minerals to be present or exposed during the proposed activity (such as from overburden, waste and remnant pit shells surfaces)?
Radiation	• Is any part of the operation (extracted or processed material) going to be legally radioactive in accordance with the *Radiation Act 2005*?
Site rehabilitation	• What is proposed for site rehabilitation and closure, and subsequent land use? • What is proposed for pit batter rehabilitation? • How will water storages and slimes dam facilities be rehabilitated? • What is proposed for surface water drainage and discharge from the activity area? • What land management or maintenance activities will be required after closure?

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Appendix C Registered Bore Search

Export - Aquifers

Bore ID	Aquifer from (m)	Aquifer to (m)	Aquifer	Aquifer material	Water from (m)	Water to (m)	Lithology code	Data source	Pumping test date	Pump depth (m)	Pump type	Pumping time (hh:mm)	Drawdown (m)	Recovery time (hh:mm)	Transmissivity (m2/d)	Hydraulic Conductivity (m/d)	Storativity	Yield (L/s)	Test data source	Pumping rate (L/s)
119981									########	0	PUM	30	0	10				5	NOT KNOW	0
119981									########	0	NKN		0					0	NOT KNOW	0
119982									########	0	NKN		0					0	NOT KNOW	0

Export Bores

Bore ID	Parish	Parish No	Longitude (GDA94)	Latitude (GDA94)	Easting (MGA)	Northing (MGA)	Map zone	Elevation (m AHD)	Elevation (digitised)	Constructed Date	Constructed Depth	Authority	Authority Code	Bore type	Use 1	Use 2	Use 3	Monitoring Status	Monitoring Frequency	Initial SWL (m)	Initial EC (mS/cm)	Initial TDS (mg/L)	Driller	Drill rig	Drilling Method	Bore licence no
119981	JAN JUC	2784	144.174782	-38.3908	253252.4	5747043.8	55		6	2/06/1992 0:00	11			Groundwater				N					BASSETT I S		JET	
119982	JAN JUC	2784	144.174782	-38.3908	253252.4	5747043.8	55		6	19/02/1993 0:00	6			Groundwater	Groundwater Investigation			N					RULE, MARK		MECHANICAL AUGER	
300289	ANGAHOOI	2015	144.170568	-38.399653	252914.5	5746049.9	55		48	31/12/1959 0:00	113.7			Groundwater				N					NOT KNOWN			
300296	ANGAHOOI	2015	144.167544	-38.394915	252634.2	5746567.6	55		11	31/12/1959 0:00	65.8			Groundwater				N					NOT KNOWN			
300308	ANGAHOOI	2015	144.174081	-38.394135	253202.5	5746671.7	55		8	31/12/1961 0:00	164.3			Groundwater				N					NOT KNOWN			
300342	ANGAHOOI	2015	144.165127	-38.39435	252421.1	5746623.8	55		11	11/11/1961 0:00	39			Groundwater				N					ALCOA			
300346	ANGAHOOI	2015	144.166036	-38.39865	252515.2	5746149	55		40	11/12/1961 0:00	185.6			Groundwater				N					WMC			
300349	ANGAHOOI	2015	144.172286	-38.394183	253045.9	5746661.6	55		8	12/11/1961 0:00	48.8			Groundwater				N					ALCOA			
300350	ANGAHOOI	2015	144.175797	-38.394367	253353.2	5746650.6	55		6	14/11/1961 0:00	38.4			Groundwater				N					ALCOA			
300361	ANGAHOOI	2015	144.167752	-38.398874	252665.9	5746128.8	55		38	31/12/1963 0:00	112.8			Groundwater				N					ALCOA			
300362	ANGAHOOI	2015	144.171206	-38.39933	252969.1	5746087.4	55		40	31/12/1963 0:00	109.7			Groundwater				N					ALCOA			
300363	ANGAHOOI	2015	144.174649	-38.399777	253271.3	5746047	55		44	31/12/1963 0:00	103.6			Groundwater				N					ALCOA			
300364	ANGAHOOI	2015	144.176365	-38.40001	253422	5746025.8	55		42	31/01/1964 0:00	106.7			Groundwater				N					ALCOA			
300365	ANGAHOOI	2015	144.178092	-38.400233	253573.6	5746005.7	55		40	31/12/1963 0:00	100.6			Groundwater				N					ALCOA			
300366	ANGAHOOI	2015	144.179807	-38.400448	253724.1	5745986.4	55		32	31/01/1964 0:00	93			Groundwater				N					ALCOA			
300388	ANGAHOOI	2015	144.176081	-38.393008	253373.4	5746802.2	55		5	31/03/1964 0:00	39.6			Groundwater				N					ALCOA			
300389	ANGAHOOI	2015	144.177796	-38.393232	253524	5746781.9	55		4	31/03/1964 0:00	30.5			Groundwater				N					ALCOA			
300391	ANGAHOOI	2015	144.172922	-38.399554	253119.7	5746067.2	55		45	11/12/1961 0:00	190.2			Groundwater				N					WMC			
300396	ANGAHOOI	2015	144.175075	-38.393567	253287.4	5746737.4	55		5	30/04/1965 0:00	29.3			Groundwater				N					ALCOA			
300397	ANGAHOOI	2015	144.176791	-38.393791	253438.1	5746717.2	55		4	31/05/1965 0:00	24.4			Groundwater				N					ALCOA			
300400	ANGAHOOI	2015	144.184191	-38.397824	254098.1	5746289.3	55		2	30/06/1965 0:00	33.5			Groundwater				N					ALCOA			
300401	ANGAHOOI	2015	144.184707	-38.395495	254135.3	5746549.2	55		4	30/06/1965 0:00	38.1			Groundwater				N					ALCOA			
300409	ANGAHOOI	2015	144.16982	-38.397475	252841.7	5746289.6	55		29	11/12/1961 0:00	94.5			Groundwater				N					ALCOA			
300410	ANGAHOOI	2015	144.173206	-38.398203	253140	5746217.9	55		37	11/12/1961 0:00	97.5			Groundwater				N					ALCOA			
300411	ANGAHOOI	2015	144.174933	-38.398427	253291.6	5746197.7	55		37	11/12/1961 0:00	94.5			Groundwater				N					ALCOA			
300412	ANGAHOOI	2015	144.178364	-38.398874	253592.8	5746157.2	55		39	11/12/1961 0:00	89.9			Groundwater				N					ALCOA			
300413	ANGAHOOI	2015	144.17149	-38.397971	252989.3	5746239	55		31	11/12/1961 0:00	91.4			Groundwater				N					ALCOA			
300417	ANGAHOOI	2015	144.17866	-38.397524	253614	5746307.8	55		29	11/12/1961 0:00	77.7			Groundwater				N					ALCOA			
300418	ANGAHOOI	2015	144.176944	-38.397291	253463.3	5746329.1	55		25	11/12/1961 0:00	74.7			Groundwater				N					ALCOA			
300424	ANGAHOOI	2015	144.164889	-38.395717	252405	5746471.5	55		14	11/12/1961 0:00	76.8			Groundwater				N					ALCOA			
300425	ANGAHOOI	2015	144.166901	-38.39459	252576.9	5746602	55		9	11/12/1961 0:00	65.5			Groundwater				N					ALCOA			
300430	ANGAHOOI	2015	144.168628	-38.394814	252728.5	5746581.8	55		12	14/03/1963 0:00	64			Groundwater				N					ALCOA			
300433	ANGAHOOI	2015	144.1689	-38.393455	252747.6	5746733.3	55		6	11/12/1961 0:00	59.7			Groundwater				N					ALCOA			
300443	ANGAHOOI	2015	144.177512	-38.394582	253503.7	5746631.3	55		5	11/12/1961 0:00	25.6			Groundwater				N					WMC			
300444	ANGAHOOI	2015	144.170627	-38.393679	252899.3	5746713.1	55		6	11/12/1961 0:00	56.1			Groundwater				N					WMC			
300449	ANGAHOOI	2015	144.169479	-38.399106	252817.5	5746107.7	55		41	11/12/1961 0:00	111.6			Groundwater				N					WMC			
300455	ANGAHOOI	2015	144.174354	-38.392776	253221.8	5746823.3	55		5	11/12/1961 0:00	32.9			Groundwater				N					ALCOA			
300456	ANGAHOOI	2015	144.165185	-38.394357	252426.2	5746623.2	55		11	11/12/1961 0:00	68.6			Groundwater				N					ALCOA			
300457	ANGAHOOI	2015	144.175218	-38.392897	253297.6	5746812.2	55		5	30/04/1965 0:00	23.5			Groundwater				N					ALCOA			
300458	ANGAHOOI	2015	144.175939	-38.393679	253363.3	5746727.3	55		4	31/05/1965 0:00	24.7			Groundwater				N					ALCOA			
300461	ANGAHOOI	2015	144.184484	-38.399537	254129.5	5746100	55		9	11/12/1961 0:00	22.9			Groundwater				N					ROCHE BROS			
300464	ANGAHOOI	2015	144.182524	-38.393743	253938.7	5746737.8	55		5	11/12/1961 0:00	29.6			Groundwater				N					ROCHE BROS			
300468	ANGAHOOI	2015	144.169865	-38.394582	252835.8	5746610.8	55		9	11/12/1967 0:00	71.3			Groundwater				N					ALCOA			
300470	ANGAHOOI	2015	144.174081	-38.394135	253202.5	5746671.7	55		8	11/12/1966 0:00	44.2			Groundwater				N					ALCOA			
300604	ANGAHOOI	2015	144.170627	-38.393679	252899.3	5746713.1	55		6	28/02/1970 0:00	152.4			Groundwater				N					ALCOA			
300609	ANGAHOOI	2015	144.177896	-38.394725	253537.8	5746616.5	55		8	31/03/1970 0:00	181.4			Groundwater				N					ALCOA			
300610	ANGAHOOI	2015	144.183861	-38.395013	254059.8	5746600.4	55		12	31/03/1970 0:00	169.2			Groundwater				N					ALCOA			
300611	ANGAHOOI	2015	144.183818	-38.398195	254066.8	5746247.1	55		4	31/03/1970 0:00	152.4			Groundwater				N					ALCOA			
300612	ANGAHOOI	2015	144.174081	-38.394135	253202.5	5746671.7	55		6	31/03/1970 0:00	152.4			Groundwater				N					ALCOA			
310278	JAN JUC	2784	144.182091	-38.38962	253886.9	5747194.3	55		5	31/12/1962 0:00	110			Groundwater				P					NOT KNOWN			

Export Bores

Headworks / upstand	Headworks height (m)	Collar	Site description	Land use	Data source	Old Bore ID	Site photo	Photo details	Site access	Bore access	Landholder name	Landholder contact	Other source	Comments	Local bore name	Location Accuracy
						30										
						38										
						51										
						8005										
						8011										
						8014										
						8015										
						8026										
						8027										
						8028										
						8029										
						8030										
						8031										
						8053										
						8054										
						8056										
						8062										
						8063										
						8066										
						8067										
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						8084										
						8090										
						8091										
						8096										
						8099										
						8109										
						8110										
						8115										
						8123										
						8124										
						8125										
						8126										
						8130										
						8134										
						8138										
						8140										
						8283										
						8288										
						8289										
						8290										
						8291										
						40										

Export Casing

Bore ID	Casing run	Depth from (m)	Depth to (m)	Material	Diameter (mm)	Comments	Data source
119981	1	-0.3	9.5	P09	100		WMIS import
119982	1	0	1.5	P18	50		WMIS import

Export - Chemistry

Bore ID	Sample ID	Date	Purged	Method	Sampled from	Sampled to	Sampled depth	Sampled by	Analysed by	Source	Other analysis	Sample values
310278		4/04/1962 0:00		AIR LIFTED								Calcium Ions: 24.000,Chloride ions: 385.000,Hardness: 255.000,Nitrate as N: 0.226,Sulphate ions: 158.000,DME Silicate, as SIO3: 4.000,Fe Total: 75.000,Magnesium Ions: 47.000,Total soluble salts: 827.000

Export Condition

Bore ID	Inspection date	Measured depth (m)	Headworks upstand (m)	Measured depth (mbgl)	Comments	Data source
119981	7/07/2011 0:00		0			WMIS import
119982	7/07/2011 0:00		0			WMIS import
300289	7/07/2011 0:00		0			WMIS import
300296	7/07/2011 0:00		0			WMIS import
300308	7/07/2011 0:00		0			WMIS import
300342	7/07/2011 0:00		0			WMIS import
300346	7/07/2011 0:00		0			WMIS import
300349	7/07/2011 0:00		0			WMIS import
300350	7/07/2011 0:00		0			WMIS import
300361	7/07/2011 0:00		0			WMIS import
300362	7/07/2011 0:00		0			WMIS import
300363	7/07/2011 0:00		0			WMIS import
300364	7/07/2011 0:00		0			WMIS import
300365	7/07/2011 0:00		0			WMIS import
300366	7/07/2011 0:00		0			WMIS import
300388	7/07/2011 0:00		0			WMIS import
300389	7/07/2011 0:00		0			WMIS import
300391	7/07/2011 0:00		0			WMIS import
300396	7/07/2011 0:00		0			WMIS import
300397	7/07/2011 0:00		0			WMIS import
300400	7/07/2011 0:00		0			WMIS import
300401	7/07/2011 0:00		0			WMIS import
300409	7/07/2011 0:00		0			WMIS import
300410	7/07/2011 0:00		0			WMIS import
300411	7/07/2011 0:00		0			WMIS import
300412	7/07/2011 0:00		0			WMIS import
300413	7/07/2011 0:00		0			WMIS import
300417	7/07/2011 0:00		0			WMIS import
300418	7/07/2011 0:00		0			WMIS import
300424	7/07/2011 0:00		0			WMIS import
300425	7/07/2011 0:00		0			WMIS import
300430	7/07/2011 0:00		0			WMIS import
300433	7/07/2011 0:00		0			WMIS import
300443	7/07/2011 0:00		0			WMIS import
300444	7/07/2011 0:00		0			WMIS import
300449	7/07/2011 0:00		0			WMIS import
300455	7/07/2011 0:00		0			WMIS import
300456	7/07/2011 0:00		0			WMIS import
300457	7/07/2011 0:00		0			WMIS import
300458	7/07/2011 0:00		0			WMIS import
300461	7/07/2011 0:00		0			WMIS import
300464	7/07/2011 0:00		0			WMIS import
300468	7/07/2011 0:00		0			WMIS import
300470	7/07/2011 0:00		0			WMIS import
300604	7/07/2011 0:00		0			WMIS import
300609	7/07/2011 0:00		0			WMIS import
300610	7/07/2011 0:00		0			WMIS import
300611	7/07/2011 0:00		0			WMIS import
300612	7/07/2011 0:00		0			WMIS import
310278	7/07/2011 0:00		0			WMIS import

Export Lithology

Bore ID	From (m)	To (m)	Lithology	Log type
119981	0	0.2	TOP SOIL	D
119981	0.2	7	RED CLAY	D
119981	7	8	GREY SILT	D
119981	8	11	FAIR TO GOOD SAND	D
119982	0	0.8	FILL CLAYEY SAND GREY	D
119982	0.8	2	SILTY CLAY GREY	D
119982	2	2.3	SILTY SAND GREY	D
119982	2.3	3.1	GREY CLAY	D
119982	3.1	4	ORANGE/BROWN CLAY	D
119982	4	4.5	SILTY SAND	D
119982	4.5	6	GREY SANDY GRAVEL	D

Export Screen

Bore ID	Screen no.	From (m)	To (m)	Material	Diameter (mm)	Aperture (mm)	Lithology	Filter pack	Filter from (m)	Filter to (m)	Comments	Source
119981	1	9.5	11	P09	100							WMIS import
119982	0			FILTER				GRA	1	6		WMIS import
119982	1	1.5	6	P18	50							WMIS import
119982	0			FILTER				BEN	0.7	1		WMIS import

Appendix D CLA Site Photographs

ANGLESEA MINE ASH COVERING PROJECT EVALUATION - October 2018

As detailed in a letter sent to ERR on 20th November 2017 regarding ash covering within the mine, work commenced on this task in late November 2017 and was completed early Q2 2018. The following paragraph from that letter refers to the covering process:

'*While the ash materials provide a potential ameliorating effect on the pH of the water body, Alcoa proposes to use low permeability materials to cover the ash to minimise the risk of unacceptable changes in the long-term water body water quality. Erodible mine material (EMM) comprising silts and clay materials from the overburden disposal activities have historically been backfilled on-site and will be used as the cover material. The overburden material will be placed at a minimum thickness of 1 metre and compacted using the weight of the earthmoving equipment to provide a low permeability layer between the developing water body and ash deposits*.'

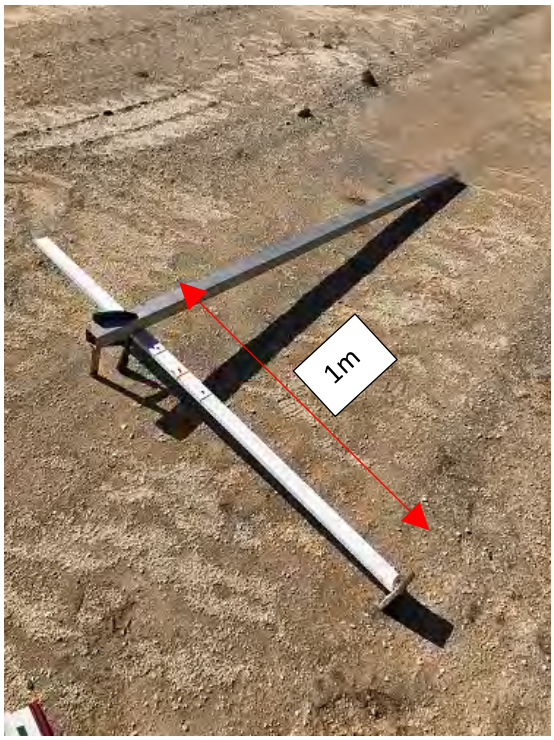
Both the ash disposal and covering process has largely been completed, with the remained exposed ash along the toe of the south wall eventually to be covered by final embankment reprofiling works. The covering process was completed using articulated 40 tonne haul trucks paddock dumping overburden material in a tight pattern and then having the heaps smoothed using a small dozer. This process was developed to ensure the 1 metre integrity without having continuous monitoring and was conservative in the design as the depth of the tipped material was such that it considered issues such as settlement (i.e. always well above the 1 metre target in the loose form).

To demonstrate compliance with the above 1 metre coverage undertaken, retrospective evaluations were undertaken using a small 30 tonne excavator to dig through the covering and expose the first signs of the covered ash. Test holes were completed over the entire covering area on a random and representative basis. The plan below. Note, due to the lack of a more recent aerial photograph, the accompanying plan depicts the test holes on a photograph taken prior to the commencement of the ash covering project.

Prior to measurements being taken, rainfall filled the holes leading to the need for the development of a jig that could be used to safely measure hole depth under the water. The following is a record of the evaluation, replicated the second time once the accumulated rainwater had gone from all but one of the test holes.

As indicated beside the various photographs of the individual holes, all test holes were at or above the minimum 1 metre covering requirement.

Covering Depth Inspection Checks (13/09/2018 & 12/10/2018)



Measuring device used

1	 *1*	Excavation depth is 1m

2	 *2*	Excavation depth is 1m
3	 *3*	Excavation depth is greater than 1m

4	 *4*	Excavation depth is 1m
5	 *5*	Excavation depth is 1m

6	 *6*	Excavation depth is greater than 1m
7	 *7*	Excavation depth is 1m

8	 *8*	Excavation depth is 1m
9	 *9*	Excavation depth is 1m

10	 *10*	Excavation depth is 1m
11	 *11*	Excavation depth is 1m

12	 *12*	Excavation depth is 1m
13	 *13*	Excavation depth is 1m

14	 *14*	Excavation depth is 1m
15	 *15*	Excavation depth is 1m

16	 *16*	Excavation depth is greater than 1m
17	 *17*	Excavation depth is 1m

18	 *18*	Excavation depth is 1m
19	 *19*	Excavation depth is greater than 1m

Appendix E Laboratory Analysis Reports

Split batch of ~~EM16~~

CHAIN OF CUSTODY

ALCOA

Client:	ALCOA OF AUSTRALIA	**Project Description**	Alcoa Anglesea Waters and Solids
Address:	Point Henry Works, Geelong, 3220	**Order No:**	**PO 6681114**
		Preservative:	**As per bottles**
Contact:	**Nicci Marris**	**Date Required:**	**2 day turnaround from receipt (for most analytes)**
Telephone:	(03) 5245 1640	**Electronic Results File:**	**N/A**
Facsimile:			

Laboratory: ALS Environmental (Water Resources Group)
Address: 49 Carr Street, South Geelong 3220/ Springvale
Contact: Mr Frank Matthies/ Bronwyn Sheen
Telephone: (03) 5226 9249
Facsimile: (03) 5229 0242

Split batch of EM1607144.

	Alcoa Sample ID	Lab Ref	Date Sampled	Time Sampled	Sample Type	Table 1 Analytical Schedule for solid sampling	Table 2 Analytical Schedule for water sampling	Table 3 ASLP proposed schedule of tests	Inreg - EPA pwb. 62/.
1	PTH-16-0037	1	20/6/16	0900	W		✓		
2	PTH-16-0038	2	20/6/16	0900	W		✓		
3	PTH-16-0039	3	20/6/16	0900	W		✓		
4	PTH-16-0040	4	20/6/16	0900	W			*	
5	PTH-16-0041	5	20/6/16	0900	S	✓			
6	PTH-16-0042	6	20/6/16	0900	S	✓			
7	PTH-16-0043	7	20/6/16	0900	S	✓			
8	PTH-16-0044	8	20/6/16	0900	S	✓			
9	PTH-16-0045	9 + 13	20/6/16	0900	S			✓*	
10	PTH-16-0046	10	20/6/16	0900	W		✓		
11	PTH-16-0047	11	20/6/16	0900	W			*	
12	PTH-16-0048	12	20/6/16	0900	s	✓			✓
13	PTH-16-0047 and PTH-16-0040 to be used for leachate testing on PTH-16-0045								

Environmental Division
Melbourne
Work Order Reference
EM1607137

Telephone : +61-3-8549 9600

Relinquished by: Nicci Marris			Received by: Bharathi (ALS)	Batch No:	
Signed:	Date: 20/62016	Time: 1000	Signed:	Date: 20/6/16	Time: 13·25

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
	solids			
Laboratory analysis minor ions	Fluoride		chill	to be confirmed by ALS PTY Ltd
Laboratory analysis nutrients	ammonia as N, ammonium as N, nitrate as N, total kjeldahl nitrogen, total phosphorus, total organic carbon, dissolved organic carbon		chill (12 hr holding time for ammonia)	to be confirmed by ALS PTY Ltd
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd
Laboratory analysis (dissolved) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, ferrous iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd

Table 3 ASLP proposed schedule of tests

Solid Sample type	Reagent water
Solid from PTH-16-0045	Water – PTH-16-0047
Solid from PTH-16-0045	Water – PTH-16-0040
Total number of ASLP tests	2

Rec'd by: Bharathi (ALS)
20/6/16 13.25

Bronwyn Sheen

From: Bronwyn Sheen
Sent: Friday, 17 June 2016 3:58 PM
To: 'Marris, Nicci'
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
OK, if we are going to get the samples the day they are taken we can deal with them once they get here. This will change what bottles you need to take for the water samples though, please see the revised list below. This change is necessary as it important not to preserve the samples prior to the filtration.

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic

Just on further thing, the turn around surcharges are listed on the front of the quote, I have confirmed with our laboratory co-ordinator that we could report everything except CEC, PSD, TOC and the AMD parameters on a two day turn around from Monday if you require.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

T +61 3 8549 9600 D +61 3 8549 9636
F +61 3 8549 9626 M +61 4 3817 4359
bronwyn.sheen@alsglobal.com
2-4 Westall Rd
Springvale Vic 3171
Australia

From: Marris, Nicci [mailto:Nicci.Marris@alcoa.com.au]
Sent: Friday, 17 June 2016 3:21 PM
To: Bronwyn Sheen
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Thank you very much Bronwyn,

We can do temperature and pH in the field, but we cannot do the in-field filtration. Can this be done at the Geelong lab prior to the samples being couriered to you?

In regard to the leachate testing, it is one soil leached with two different waters.

I will call through Geelong in the next hour to collect the sample bottles. We will raise a req based on a faster TAT now.

Thanks again
Nicci

From: Bronwyn Sheen [mailto:bronwyn.sheen@alsglobal.com]
Sent: Friday, June 17, 2016 2:32 PM
To: Marris, Nicci <Nicci.Marris@alcoa.com.au>
Subject: EXT: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
Please find attached the quote for this work, there are just a few things to keep in mind.

We will required the field temperature and pH to be detailed on the CoC to enable us to calculate the ammonium.

The DOC, dissolved metals and ferrous iron all need to be field filtered to 0.45 um.

I have sent more bottles that you actually require, breaking down what you need to sample is as follows:

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial (filtered) ← DOC
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic (filtered) ← Dissolved Metals.
1 x 60 ml nitric acid preserved, red, plastic
1 x 60 ml hydrochloric acid preserved, maroon, plastic ← Ferrous.

Soils – per sample
2 x 150 ml soils jars, orange
1 x 500 ml snap lock bag (PSD)
1 x 250 ml snap lock bags (ASS)

Leachates – per sample (I'm not entirely sure if you require two different soils leached or just one soil leached with two different waters.)
2 x 250 ml soils jars , orange
3 x 1lt unpreserved, green, plastic

All of the bottles are jars have been delivered to our Geelong laboratory and are ready for collection whenever you are ready.

Just one more thing, when I originally spoke to Rebecca, she mentioned that you may need the water that is to be used for the leachate filtered prior to the leaching being performed. Is this still required? We could filter it to 0.7um which is the same as the post leaching filtration if required.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

Split batch of EM1607144

CHAIN OF CUSTODY

ALCOA

Client:	ALCOA OF AUSTRALIA	**Project Description**	Alcoa Anglesea Waters and Solids
Address:	Point Henry Works, Geelong, 3220	**Order No:**	**PO 6681114**
Contact:	**Nicci Marris**	**Preservative:**	**As per bottles**
Telephone:	(03) 5245 1640	**Date Required:**	**2 day turnaround from receipt (for most analytes)**
Facsimile:		**Electronic Results File:**	**N/A**

URGENT

SCANNED

Split batch of EM1607144.

Laboratory: ALS Environmental (Water Resources Group)
Address: 49 Carr Street, South Geelong 3220/ Springvale
Contact: Mr Frank Matthies/ Bronwyn Sheen
Telephone: (03) 5226 9249
Facsimile: (03) 5229 0242

	Alcoa Sample ID	Lab Ref	Date Sampled	Time Sampled	Sample Type	Table 1 Analytical Schedule for solid sampling	Table 2 Analytical Schedule for water sampling	Table 3 ASLP proposed schedule of tests	Inreg - EPA Pub. 621.
1	PTH-16-0037	1	20/6/16	0900	W		✓		
2	PTH-16-0038	2	20/6/16	0900	W		✓		
3	PTH-16-0039	3	20/6/16	0900	W		✓		
4	PTH-16-0040	4	20/6/16	0900	W			*	
5	PTH-16-0041	5	20/6/16	0900	S	✓			
6	PTH-16-0042	6	20/6/16	0900	S	✓			
7	PTH-16-0043	7	20/6/16	0900	S	✓			
8	PTH-16-0044	8	20/6/16	0900	S	✓			
13 9	PTH-16-0045	9 + 13	20/6/16	0900	S			✓*	
10	PTH-16-0046	10	20/6/16	0900	W		✓		
11	PTH-16-0047	11	20/6/16	0900	W			*	
12	PTH-16-0048	12	20/6/16	0900	s	✓			✓

PTH-16-0047 and PTH-16-0040 to be used for leachate testing on PTH-16-0045

Environmental Division
Melbourne
Work Order Reference
EM1607137

Telephone : +61-3-8549 9600

Relinquished by: Nicci Marris			Received by: Bharathi (ALS)	Batch No:
Signed:	Date: 20/62016	Time: 1000	Signed:	Date: 20/6/16 Time: 13·25

Table 1 Analytical Schedule for solid sampling

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
Laboratory analysis major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate and carbonate)	NT-1S, NT-2S, ED037	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis miscellaneous	Soluble sulfate	ED040S	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis minor ions	Fluoride	EK040T	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	S-3 plus aluminium, boron, iron, molybdenum and tin	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis physico-chemical	Particle size distribution, moisture content, exchangeable cations, pH, total acidity, total organic carbon	EA055, ED006, ED038, EA002, EP004	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	pH1:2 and EC1:2	AMIRA P387A tests	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Maximum potential acidity (MPA)	Total sulfur Leco determination	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Acid Neutralising Capacity (ANC)	EA013	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Net Acid Producing Potential (NAPP)	ASS-1	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Net Acid Generation (NAG)	EA011	chill	to be confirmed by ALS PTY Ltd

Table 2 Analytical Schedule for water sampling

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
Field parameters	pH, temperature, turbidity, electrical conductivity, dissolved oxygen, redox potential	not applicable	not applicable	not applicable
Laboratory measured 'field' parameters (where instrumentation is not available)	pH, turbidity, electrical conductivity, redox potential	EA005, EA010, EA075, EA045	chill (6 hr holding time for pH)	to be confirmed by ALS PTY Ltd
Laboratory analysis major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate and carbonate), total hardness, total dissolved	NT-14	chill, ALS provided bottle spiked with nitric acid (cations and hardness only)	to be confirmed by ALS PTY Ltd

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
	solids			
Laboratory analysis minor ions	Fluoride		chill	to be confirmed by ALS PTY Ltd
Laboratory analysis nutrients	ammonia as N, ammonium as N, nitrate as N, total kjeldahl nitrogen, total phosphorus, total organic carbon, dissolved organic carbon		chill (12 hr holding time for ammonia)	to be confirmed by ALS PTY Ltd
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd
Laboratory analysis (dissolved) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, ferrous iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd

Table 3 ASLP proposed schedule of tests

Solid Sample type	Reagent water
Solid from PTH-16-0045	Water – PTH-16-0047
Solid from PTH-16-0045	Water – PTH-16-0040
Total number of ASLP tests	2

Rec'd by: Bharathi (ALS)
20/6/16 13.25

Bronwyn Sheen

From: Bronwyn Sheen
Sent: Friday, 17 June 2016 3:58 PM
To: 'Marris, Nicci'
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
OK, if we are going to get the samples the day they are taken we can deal with them once they get here. This will change what bottles you need to take for the water samples though, please see the revised list below. This change is necessary as it important not to preserve the samples prior to the filtration.

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic

Just on further thing, the turn around surcharges are listed on the front of the quote, I have confirmed with our laboratory co-ordinator that we could report everything except CEC, PSD, TOC and the AMD parameters on a two day turn around from Monday if you require.

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1 x 60 ml hydrochloric acid preserved, maroon, plastic ← Fe(II)

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Bronwyn Sheen
Client Services Manager – Springvale
Environmental

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1607137**	Page	: 1 of 21
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS	Contact	:
Address	: Kiora Crescent Lockbag 25, Fairfield YENNORA NSW 2165	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 02 9681 9555	Telephone	: +61-3-8549 9600
Project	: Alcoa Anglesea Waters and Solids	Date Samples Received	: 20-Jun-2016 13:25
Order number	: 6681114	Date Analysis Commenced	: 20-Jun-2016
C-O-C number	: ----	Issue Date	: 23-Jun-2016 17:19
Sampler	: ----		
Site	: Point Henry		
Quote number	: ----		
No. of samples received	: 13		
No. of samples analysed	: 11		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA
WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP074-UT: Particular sample (EM-1607137-012) shows poor surrogates recovery due to the high moisture content.
- EP074-UT/EP071-EM/EP066-EM: Particular sample (EM-1607137-012), LOR has been raised due to the high moisture content.
- EG005C: Leachable Metal blank and LCS outside of criteria due to leaching solution provided. This has been confirmed.
- EP002: Leachable DOC blank Exceeds criteria due to leaching solution provided. This has been confirmed.
- EK061G: Sample EM1607137 #10 and #13 has been diluted for TKN analysis due to sample matrix. LOR's have been raised accordingly.
- EK055G: EM1607137 #13 Ammonia as N by Discrete analyser result for blank leaching solution is 0.18mg/L
- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ED038 (Acidity): NATA accreditation does not cover the performance of this service.
- EG020F: Filtered iron results for EM1607137-010 have been confirmed by re-preparation and re-analysis.
- ALS is not NATA accredited for the analysis of ASLP due to non-NATA accredited leaching solution used.
- Ionic balances were calculated using: major anions - chloride, alkalinity and sulfate; and major cations - calcium, magnesium, potassium and sodium.
- ED045G: The presence of thiocyanate can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.
- This is a split batch of EM1607144 due to the urgent turnaround required for most analytes.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Client sample ID	PTH-16-0045 Leached using PTH-16-0040	PTH-16-0045 Leached using PTH-16-0047	----	----	----
			Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1607137-009	EM1607137-013	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.21**	**8.80**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**9440**	**4170**	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	**6140**	**2710**	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**2370**	**1680**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	**29**	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**87**	**28**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	**14**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**116**	**41**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4540**	**1500**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**931**	**659**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**560**	**641**	----	----	----
Magnesium	7439-95-4	1	mg/L	**237**	**19**	----	----	----
Sodium	7440-23-5	1	mg/L	**1690**	**346**	----	----	----
Potassium	7440-09-7	1	mg/L	**112**	**38**	----	----	----
EG005C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	<0.1	<0.1	----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	----	----	----
Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	----	----	----
Boron	7440-42-8	0.1	mg/L	**29.0**	**7.3**	----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	----	----	----
Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	----	----	----

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Client sample ID	PTH-16-0045 Leached using PTH-16-0040	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
					EM1607137-009	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EG005C: Leachable Metals by ICPAES - Continued									
Lead	7439-92-1	0.1	mg/L		<0.1	<0.1	----	----	----
Manganese	7439-96-5	0.1	mg/L		<0.1	<0.1	----	----	----
Nickel	7440-02-0	0.1	mg/L		<0.1	<0.1	----	----	----
Selenium	7782-49-2	0.05	mg/L		<0.05	<0.05	----	----	----
Tin	7440-31-5	0.1	mg/L		<0.1	<0.1	----	----	----
Vanadium	7440-62-2	0.1	mg/L		<0.1	<0.1	----	----	----
Zinc	7440-66-6	0.1	mg/L		<0.1	<0.1	----	----	----
Molybdenum	7439-98-7	0.1	mg/L		<0.1	<0.1	----	----	----
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.001	mg/L		<0.0010	<0.0010	----	----	----
EG051G: Ferrous Iron by Discrete Analyser									
Ferrous Iron	----	0.05	mg/L		<0.05	<0.05	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	<0.1	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.08**	**0.31**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.12**	**0.03**	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.04**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.16**	**0.03**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.1	<0.5	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**0.2**	<0.5	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**123**	**50.6**	----	----	----
Total Cations	----	0.01	meq/L		**124**	**49.6**	----	----	----
Ionic Balance	----	0.01	%		**0.28**	**1.02**	----	----	----

Analytical Results

Sub-Matrix: **ASLP ZHE LEACHATE** (Matrix: **WATER**)

				Client sample ID	PTH-16-0045 Leached using PTH-16-0040	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit		EM1607137-009	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EP002: Dissolved Organic Carbon (DOC)									
Dissolved Organic Carbon	----	1	mg/L		**2**	**3**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	PTH-16-0045 Leached using PTH-16-0040
			Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00
Compound	CAS Number	LOR	Unit	EM1607137-005	EM1607137-006	EM1607137-007	EM1607137-008	EM1607137-009
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	----	----	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.7	11.2	10.8	10.3	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	661	4060	3770	3420	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	25.7	67.4	73.2	57.6	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	11	109	65	87	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	11	22	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	87	44	54	----
ED038A: Acidity								
Acidity	----	1	mg/kg	5	<1	<1	<1	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	1370	25500	31000	20400	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	150	6100	6490	2560	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	50	8830	10800	6330	----
Magnesium	7439-95-4	10	mg/kg	80	<10	40	50	----
Sodium	7440-23-5	10	mg/kg	590	6490	7060	4580	----
Potassium	7440-09-7	10	mg/kg	50	510	430	350	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	16600	18500	4730	28600	----
Arsenic	7440-38-2	5	mg/kg	<5	16	5	18	----
Barium	7440-39-3	10	mg/kg	50	1740	2140	1070	----
Beryllium	7440-41-7	1	mg/kg	<1	7	1	10	----
Boron	7440-42-8	50	mg/kg	60	2570	1150	2400	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	31	13	5	11	----
Cobalt	7440-48-4	2	mg/kg	<2	13	2	24	----
Copper	7440-50-8	5	mg/kg	<5	10	8	12	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	PTH-16-0045 Leached using PTH-16-0040
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00
					EM1607137-005	EM1607137-006	EM1607137-007	EM1607137-008	EM1607137-009
					Result	Result	Result	Result	Result
EG005T: Total Metals by ICP-AES - Continued									
Iron	7439-89-6	50	mg/kg		**42500**	**68100**	**83800**	**82900**	----
Lead	7439-92-1	5	mg/kg		**10**	**5**	<5	**6**	----
Manganese	7439-96-5	5	mg/kg		**14**	**1080**	**1670**	**1030**	----
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	----
Nickel	7440-02-0	2	mg/kg		**5**	**44**	**19**	**66**	----
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	----
Silver	7440-22-4	2	mg/kg		----	----	----	----	----
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	----
Vanadium	7440-62-2	5	mg/kg		**48**	**21**	<5	**13**	----
Zinc	7440-66-6	5	mg/kg		<5	**81**	**38**	**136**	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	**0.3**	**0.3**	**0.2**	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		----	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	1	mg/kg		----	----	----	----	----
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		**210**	<40	<40	<40	----
EN60: ASLP Leaching Procedure									
Final pH	----	0.1	pH Unit		----	----	----	----	**9.8**
EN60Z: ASLP Leachate - ZHE									
Extraction Fluid pH	----	0.1	pH Unit		----	----	----	----	**5.0**
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	0.1	mg/kg		----	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons									
Benzene	71-43-2	0.2	mg/kg		----	----	----	----	----
Toluene	108-88-3	0.5	mg/kg		----	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		----	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		----	----	----	----	----
Styrene	100-42-5	0.5	mg/kg		----	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		----	----	----	----	----
^ **Sum of monocyclic aromatic hydrocarbons**	----	0.2	mg/kg		----	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	PTH-16-0045 Leached using PTH-16-0040
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00
					EM1607137-005	EM1607137-006	EM1607137-007	EM1607137-008	EM1607137-009
					Result	Result	Result	Result	Result
EP074A: Monocyclic Aromatic Hydrocarbons - Continued									
^ **Total Xylenes**	1330-20-7	0.5	mg/kg		----	----	----	----	----
EP074H: Naphthalene									
Naphthalene	91-20-3	1	mg/kg		----	----	----	----	----
EP074I: Volatile Halogenated Compounds									
Vinyl chloride	75-01-4	0.02	mg/kg		----	----	----	----	----
1.1-Dichloroethene	75-35-4	0.01	mg/kg		----	----	----	----	----
Methylene chloride	75-09-2	0.4	mg/kg		----	----	----	----	----
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg		----	----	----	----	----
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg		----	----	----	----	----
Chloroform	67-66-3	0.02	mg/kg		----	----	----	----	----
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg		----	----	----	----	----
Carbon Tetrachloride	56-23-5	0.01	mg/kg		----	----	----	----	----
1.2-Dichloroethane	107-06-2	0.02	mg/kg		----	----	----	----	----
Trichloroethene	79-01-6	0.02	mg/kg		----	----	----	----	----
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg		----	----	----	----	----
Tetrachloroethene	127-18-4	0.02	mg/kg		----	----	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg		----	----	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg		----	----	----	----	----
Hexachlorobutadiene	87-68-3	0.02	mg/kg		----	----	----	----	----
Chlorobenzene	108-90-7	0.02	mg/kg		----	----	----	----	----
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg		----	----	----	----	----
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg		----	----	----	----	----
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg		----	----	----	----	----
^ **Sum of volatile chlorinated hydrocarbons**	----	0.01	mg/kg		----	----	----	----	----
^ **Sum of other chlorinated hydrocarbons**	----	0.01	mg/kg		----	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)									
2-Chlorophenol	95-57-8	0.03	mg/kg		----	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.03	mg/kg		----	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.03	mg/kg		----	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg		----	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg		----	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg		----	----	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg		----	----	----	----	----

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

				Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	PTH-16-0045 Leached using PTH-16-0040
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00
Compound	CAS Number	LOR	Unit		EM1607137-005	EM1607137-006	EM1607137-007	EM1607137-008	EM1607137-009
					Result	Result	Result	Result	Result
EP075A: Phenolic Compounds (Halogenated) - Continued									
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg		----	----	----	----	----
Pentachlorophenol	87-86-5	0.2	mg/kg		----	----	----	----	----
^ **Sum of Phenols (halogenated)**	----	0.03	mg/kg		----	----	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)									
Phenol	108-95-2	1	mg/kg		----	----	----	----	----
2-Methylphenol	95-48-7	1	mg/kg		----	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg		----	----	----	----	----
2-Nitrophenol	88-75-5	1	mg/kg		----	----	----	----	----
2.4-Dimethylphenol	105-67-9	1	mg/kg		----	----	----	----	----
2.4-Dinitrophenol	51-28-5	5	mg/kg		----	----	----	----	----
4-Nitrophenol	100-02-7	5	mg/kg		----	----	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg		----	----	----	----	----
Dinoseb	88-85-7	5	mg/kg		----	----	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg		----	----	----	----	----
^ **Sum of Phenols (non-halogenated)**	----	1	mg/kg		----	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		----	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg		----	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg		----	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg		----	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg		----	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg		----	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg		----	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg		----	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg		----	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg		----	----	----	----	----
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg		----	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg		----	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		----	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		----	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		----	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	PTH-16-0045 Leached using PTH-16-0040
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00
Compound	CAS Number	LOR	Unit		EM1607137-005	EM1607137-006	EM1607137-007	EM1607137-008	EM1607137-009
					Result	Result	Result	Result	Result
EP075B: Polynuclear Aromatic Hydrocarbons - Continued									
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		----	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		----	----	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		----	----	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		----	----	----	----	----
EP075I: Organochlorine Pesticides									
alpha-BHC	319-84-6	0.03	mg/kg		----	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg		----	----	----	----	----
beta-BHC	319-85-7	0.03	mg/kg		----	----	----	----	----
gamma-BHC	58-89-9	0.03	mg/kg		----	----	----	----	----
delta-BHC	319-86-8	0.03	mg/kg		----	----	----	----	----
Heptachlor	76-44-8	0.03	mg/kg		----	----	----	----	----
Aldrin	309-00-2	0.03	mg/kg		----	----	----	----	----
Heptachlor epoxide	1024-57-3	0.03	mg/kg		----	----	----	----	----
cis-Chlordane	5103-71-9	0.03	mg/kg		----	----	----	----	----
trans-Chlordane	5103-74-2	0.03	mg/kg		----	----	----	----	----
Endosulfan 1	959-98-8	0.03	mg/kg		----	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		----	----	----	----	----
Dieldrin	60-57-1	0.03	mg/kg		----	----	----	----	----
Endrin aldehyde	7421-93-4	0.03	mg/kg		----	----	----	----	----
Endrin	72-20-8	0.03	mg/kg		----	----	----	----	----
Endosulfan 2	33213-65-9	0.03	mg/kg		----	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		----	----	----	----	----
Endosulfan sulfate	1031-07-8	0.03	mg/kg		----	----	----	----	----
4.4`-DDT	50-29-3	0.05	mg/kg		----	----	----	----	----
Methoxychlor	72-43-5	0.03	mg/kg		----	----	----	----	----
^ Sum of organochlorine pesticides	----	0.03	mg/kg		----	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg		----	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg		----	----	----	----	----
^ Chlordane	57-74-9	0.03	mg/kg		----	----	----	----	----
^ Sum of other organochlorine pesticides	----	0.03	mg/kg		----	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		----	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	PTH-16-0045 Leached using PTH-16-0040
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00
Compound	CAS Number	LOR	Unit		EM1607137-005	EM1607137-006	EM1607137-007	EM1607137-008	EM1607137-009
					Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons - Continued									
C10 - C14 Fraction	----	50	mg/kg		----	----	----	----	----
C6 - C10 Fraction	C6_C10	10	mg/kg		----	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg		----	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg		----	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg		----	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	50	mg/kg		----	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg		----	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg		----	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		----	----	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		----	----	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		----	----	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		----	----	----	----	----
EP074S: VOC Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		----	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		----	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		----	----	----	----	----
EP075S: Acid Extractable Surrogates									
Phenol-d6	13127-88-3	0.025	%		----	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.025	%		----	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.025	%		----	----	----	----	----
EP075T: Base/Neutral Extractable Surrogates									
Nitrobenzene-D5	4165-60-0	0.025	%		----	----	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%		----	----	----	----	----
2-Fluorobiphenyl	321-60-8	0.025	%		----	----	----	----	----
Anthracene-d10	1719-06-8	0.025	%		----	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.025	%		----	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PTH-16-0048	PTH-16-0045 Leached using PTH-16-0047	----	----	----
			Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit	EM1607137-012	EM1607137-013	--------	--------	--------
				Result	Result	----	----	----
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.1	----	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	----	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	73.9	----	----	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	----	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	----	----	----	----
ED038A: Acidity								
Acidity	----	1	mg/kg	----	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	----	----	----	----	----
Sodium	7440-23-5	10	mg/kg	----	----	----	----	----
Potassium	7440-09-7	10	mg/kg	----	----	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	----	----
Arsenic	7440-38-2	5	mg/kg	46	----	----	----	----
Barium	7440-39-3	10	mg/kg	----	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	----	----	----	----	----
Boron	7440-42-8	50	mg/kg	----	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	4	----	----	----	----
Chromium	7440-47-3	2	mg/kg	----	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	----	----	----	----	----
Copper	7440-50-8	5	mg/kg	243	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0048	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit		EM1607137-012	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EG005T: Total Metals by ICP-AES - Continued									
Iron	7439-89-6	50	mg/kg		----	----	----	----	----
Lead	7439-92-1	5	mg/kg		**13**	----	----	----	----
Manganese	7439-96-5	5	mg/kg		----	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg		<2	----	----	----	----
Nickel	7440-02-0	2	mg/kg		**566**	----	----	----	----
Selenium	7782-49-2	5	mg/kg		<5	----	----	----	----
Silver	7440-22-4	2	mg/kg		<2	----	----	----	----
Tin	7440-31-5	5	mg/kg		<5	----	----	----	----
Vanadium	7440-62-2	5	mg/kg		----	----	----	----	----
Zinc	7440-66-6	5	mg/kg		**1930**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		**0.7**	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.8	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	1	mg/kg		<1	----	----	----	----
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		**80**	----	----	----	----
EN60: ASLP Leaching Procedure									
Final pH	----	0.1	pH Unit		----	**9.7**	----	----	----
EN60Z: ASLP Leachate - ZHE									
Extraction Fluid pH	----	0.1	pH Unit		----	**5.0**	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	0.1	mg/kg		<0.2	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons									
Benzene	71-43-2	0.2	mg/kg		<0.4	----	----	----	----
Toluene	108-88-3	0.5	mg/kg		<1.0	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		<1.0	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<1.0	----	----	----	----
Styrene	100-42-5	0.5	mg/kg		<1.0	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		<1.0	----	----	----	----
^ Sum of monocyclic aromatic hydrocarbons	----	0.2	mg/kg		<0.2	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0048	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit		EM1607137-012	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons - Continued									
^ Total Xylenes	1330-20-7	0.5	mg/kg		<1.0	----	----	----	----
EP074H: Naphthalene									
Naphthalene	91-20-3	1	mg/kg		<2	----	----	----	----
EP074I: Volatile Halogenated Compounds									
Vinyl chloride	75-01-4	0.02	mg/kg		<0.04	----	----	----	----
1.1-Dichloroethene	75-35-4	0.01	mg/kg		<0.02	----	----	----	----
Methylene chloride	75-09-2	0.4	mg/kg		<0.8	----	----	----	----
trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg		<0.04	----	----	----	----
cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg		<0.02	----	----	----	----
Chloroform	67-66-3	0.02	mg/kg		<0.04	----	----	----	----
1.1.1-Trichloroethane	71-55-6	0.01	mg/kg		<0.02	----	----	----	----
Carbon Tetrachloride	56-23-5	0.01	mg/kg		<0.02	----	----	----	----
1.2-Dichloroethane	107-06-2	0.02	mg/kg		<0.04	----	----	----	----
Trichloroethene	79-01-6	0.02	mg/kg		<0.04	----	----	----	----
1.1.2-Trichloroethane	79-00-5	0.04	mg/kg		<0.08	----	----	----	----
Tetrachloroethene	127-18-4	0.02	mg/kg		<0.04	----	----	----	----
1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg		<0.02	----	----	----	----
1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg		<0.04	----	----	----	----
Hexachlorobutadiene	87-68-3	0.02	mg/kg		<0.04	----	----	----	----
Chlorobenzene	108-90-7	0.02	mg/kg		<0.04	----	----	----	----
1.4-Dichlorobenzene	106-46-7	0.02	mg/kg		<0.04	----	----	----	----
1.2-Dichlorobenzene	95-50-1	0.02	mg/kg		<0.04	----	----	----	----
1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg		<0.02	----	----	----	----
^ Sum of volatile chlorinated hydrocarbons	----	0.01	mg/kg		<0.01	----	----	----	----
^ Sum of other chlorinated hydrocarbons	----	0.01	mg/kg		<0.01	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)									
2-Chlorophenol	95-57-8	0.03	mg/kg		<0.03	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.03	mg/kg		<0.03	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.03	mg/kg		<0.03	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg		<0.03	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg		<0.05	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg		<0.05	----	----	----	----
2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg		<0.03	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0048	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit		EM1607137-012	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EP075A: Phenolic Compounds (Halogenated) - Continued									
2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg		<0.05	----	----	----	----
Pentachlorophenol	87-86-5	0.2	mg/kg		<0.2	----	----	----	----
^ Sum of Phenols (halogenated)	----	0.03	mg/kg		<0.03	----	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)									
Phenol	108-95-2	1	mg/kg		<1	----	----	----	----
2-Methylphenol	95-48-7	1	mg/kg		<1	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg		<1	----	----	----	----
2-Nitrophenol	88-75-5	1	mg/kg		<1	----	----	----	----
2.4-Dimethylphenol	105-67-9	1	mg/kg		<1	----	----	----	----
2.4-Dinitrophenol	51-28-5	5	mg/kg		<5	----	----	----	----
4-Nitrophenol	100-02-7	5	mg/kg		<5	----	----	----	----
2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg		<5	----	----	----	----
Dinoseb	88-85-7	5	mg/kg		<5	----	----	----	----
2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg		<5	----	----	----	----
^ Sum of Phenols (non-halogenated)	----	1	mg/kg		<1	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg		<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg		<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg		<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg		<0.5	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg		<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg		<0.5	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg		<0.5	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg		<0.5	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg		<0.5	----	----	----	----
Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg		<0.5	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0048	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit		EM1607137-012	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons - Continued									
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	----	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	----	----	----	----
EP075I: Organochlorine Pesticides									
alpha-BHC	319-84-6	0.03	mg/kg		<0.03	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg		<0.03	----	----	----	----
beta-BHC	319-85-7	0.03	mg/kg		<0.03	----	----	----	----
gamma-BHC	58-89-9	0.03	mg/kg		<0.03	----	----	----	----
delta-BHC	319-86-8	0.03	mg/kg		<0.03	----	----	----	----
Heptachlor	76-44-8	0.03	mg/kg		<0.03	----	----	----	----
Aldrin	309-00-2	0.03	mg/kg		<0.03	----	----	----	----
Heptachlor epoxide	1024-57-3	0.03	mg/kg		<0.03	----	----	----	----
cis-Chlordane	5103-71-9	0.03	mg/kg		<0.03	----	----	----	----
trans-Chlordane	5103-74-2	0.03	mg/kg		<0.03	----	----	----	----
Endosulfan 1	959-98-8	0.03	mg/kg		<0.03	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	----	----	----	----
Dieldrin	60-57-1	0.03	mg/kg		<0.03	----	----	----	----
Endrin aldehyde	7421-93-4	0.03	mg/kg		<0.03	----	----	----	----
Endrin	72-20-8	0.03	mg/kg		<0.03	----	----	----	----
Endosulfan 2	33213-65-9	0.03	mg/kg		<0.03	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.03	mg/kg		<0.03	----	----	----	----
4.4`-DDT	50-29-3	0.05	mg/kg		<0.05	----	----	----	----
Methoxychlor	72-43-5	0.03	mg/kg		<0.03	----	----	----	----
^ Sum of organochlorine pesticides	----	0.03	mg/kg		<0.03	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.03	mg/kg		<0.03	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg		<0.05	----	----	----	----
^ Chlordane	57-74-9	0.03	mg/kg		<0.03	----	----	----	----
^ Sum of other organochlorine pesticides	----	0.03	mg/kg		<0.03	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<20	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0048	PTH-16-0045 Leached using PTH-16-0047	----	----	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	----	----	----
Compound	CAS Number	LOR	Unit		EM1607137-012	EM1607137-013	--------	--------	--------
					Result	Result	----	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C10 - C14 Fraction	----	50	mg/kg		<100	----	----	----	----
C6 - C10 Fraction	C6_C10	10	mg/kg		<20	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg		740	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg		1820	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg		2560	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	50	mg/kg		<100	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg		2200	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg		1060	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		3260	----	----	----	----
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<100	----	----	----	----
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<20	----	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		104	----	----	----	----
EP074S: VOC Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		67.2	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		68.3	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		55.2	----	----	----	----
EP075S: Acid Extractable Surrogates									
Phenol-d6	13127-88-3	0.025	%		84.3	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.025	%		86.6	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.025	%		95.4	----	----	----	----
EP075T: Base/Neutral Extractable Surrogates									
Nitrobenzene-D5	4165-60-0	0.025	%		101	----	----	----	----
1.2-Dichlorobenzene-D4	2199-69-1	0.025	%		95.0	----	----	----	----
2-Fluorobiphenyl	321-60-8	0.025	%		107	----	----	----	----
Anthracene-d10	1719-06-8	0.025	%		102	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.025	%		100	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	PTH-16-0037	PTH-16-0038	PTH-16-0039	PTH-16-0046	----
			Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	----
Compound	CAS Number	LOR	Unit	EM1607137-001	EM1607137-002	EM1607137-003	EM1607137-010	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.25	8.28	8.22	6.58	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	9870	9560	9360	2120	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	6420	6210	6080	1380	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	0.7	0.8	0.7	161	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	2310	2450	2400	375	----
EA075: Redox Potential								
Redox Potential	----	0.1	mV	255	254	254	-46.0	----
pH Redox	----	0.01	pH Unit	8.55	8.28	8.22	6.58	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	78	65	63	103	----
Total Alkalinity as CaCO3	----	1	mg/L	78	65	63	103	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	4670	4510	4340	146	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	897	866	849	578	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	438	457	450	86	----
Magnesium	7439-95-4	1	mg/L	296	319	311	39	----
Sodium	7440-23-5	1	mg/L	1750	1660	1630	242	----
Potassium	7440-09-7	1	mg/L	106	104	102	28	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.11	0.12	0.10	0.05	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Boron	7440-42-8	0.05	mg/L	24.0	22.8	22.4	0.37	----
Barium	7440-39-3	0.001	mg/L	0.019	0.020	0.017	0.064	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	PTH-16-0037	PTH-16-0038	PTH-16-0039	PTH-16-0046	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	----
Compound	CAS Number	LOR	Unit		EM1607137-001	EM1607137-002	EM1607137-003	EM1607137-010	--------
					Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Cobalt	7440-48-4	0.001	mg/L		**0.001**	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L		**0.012**	**0.011**	**0.012**	**0.958**	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	**0.002**	**0.002**	<0.001	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L		**0.008**	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L		**0.010**	**0.010**	**0.010**	<0.001	----
Tin	7440-31-5	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	**23.9**	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.13**	**0.12**	**0.12**	**0.02**	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Boron	7440-42-8	0.05	mg/L		**26.8**	**25.9**	**26.3**	**0.42**	----
Barium	7440-39-3	0.001	mg/L		**0.020**	**0.022**	**0.023**	**0.067**	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0001**	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L		**0.001**	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L		<0.001	**0.001**	<0.001	**0.002**	----
Copper	7440-50-8	0.001	mg/L		<0.001	<0.001	<0.001	**0.004**	----
Manganese	7439-96-5	0.001	mg/L		**0.016**	**0.016**	**0.017**	**1.06**	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	**0.003**	**0.003**	<0.001	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L		**0.012**	**0.006**	**0.006**	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L		**0.011**	**0.012**	**0.013**	<0.001	----
Tin	7440-31-5	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L		**0.05**	<0.05	<0.05	**28.7**	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EG035T: Total Recoverable Mercury by FIMS									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	PTH-16-0037	PTH-16-0038	PTH-16-0039	PTH-16-0046	----
			Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	----
Compound	CAS Number	LOR	Unit	EM1607137-001	EM1607137-002	EM1607137-003	EM1607137-010	--------
				Result	Result	Result	Result	----
EG035T: Total Recoverable Mercury by FIMS - Continued								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG051G: Ferrous Iron by Discrete Analyser								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	<0.05	**13.5**	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.2**	**0.2**	**0.1**	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	**0.03**	**0.02**	**0.15**	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.05**	**0.10**	<0.01	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.05**	**0.10**	<0.01	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	<0.1	<0.5	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	**0.1**	<0.5	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**124**	**120**	**116**	**21.4**	----
Total Cations	----	0.01	meq/L	**125**	**124**	**122**	**18.7**	----
Ionic Balance	----	0.01	%	**0.36**	**1.75**	**2.51**	**6.62**	----
EP002: Dissolved Organic Carbon (DOC)								
Dissolved Organic Carbon	----	1	mg/L	**4**	**5**	**4**	<1	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**2**	**4**	**3**	<1	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	41	122
EP074S: VOC Surrogates			
1.2-Dichloroethane-D4	17060-07-0	59	119
Toluene-D8	2037-26-5	55	117
4-Bromofluorobenzene	460-00-4	59	123
EP075S: Acid Extractable Surrogates			
Phenol-d6	13127-88-3	28	134
2-Chlorophenol-D4	93951-73-6	27	123
2.4.6-Tribromophenol	118-79-6	25	149
EP075T: Base/Neutral Extractable Surrogates			
Nitrobenzene-D5	4165-60-0	29	125
1.2-Dichlorobenzene-D4	2199-69-1	31	117
2-Fluorobiphenyl	321-60-8	44	136
Anthracene-d10	1719-06-8	53	133
4-Terphenyl-d14	1718-51-0	59	141

ALS Environmental

Automated Guideline Comparison Report

EPA Victoria Publication IWRG 621 (2009) - Table 2: Soil Hazard Categorisation

Work Order	: **EM1607137**	Page	: 1 of 8
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS		
Address	: Kiora Crescent Lockbag 25, Fairfield YENNORA NSW 2165	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: Nicci.Marris@alcoa.com.au	E-mail	: ----
Telephone	: +61 02 9681 9555	Telephone	: +61-3-8549 9600
Facsimile	: +61 02 9892 2817	Facsimile	: +61-3-8549 9601
Project	: Alcoa Anglesea Waters and Solids	Date Received	: 20-Jun-2016 13:25
Order number	: 6681114	Date Analysed	: 20-Jun-2016
C-O-C number	: ----	Date Issued	: 23-Jun-2016 17:19
No. of samples received	: 13		
No. of samples analysed	: 11	Quote number	: ----

General Comments

This guideline comparison report **only** provides evaluation of total concentration data against upper limit thresholds for the 'Fill Material', 'C', 'B' Categories in Table 2 of EPA Publication IWRG621.

This guideline comparison report is **NOT** a soil classification report. Classification of soils as Fill Material, Category C, Category B or Category A requires consideration of a number of other factors including preliminary site investigation, sampling density and statistical calculations, as set out in EPA Publication IWRG 702.
Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

This guideline comparison report only provides evaluation data where chemical parameters specifically listed within the IWRG621 (2009) guideline are analysed by ALS using the **P-16 package in full**.
Red shading is applied where the result is equal to or greater than the guideline upper limit. Red shading is not applied to the 'Summary of Thresholds Reached or Exceeded'.

For the 'Summary of Thresholds Reached or Exceeded' to accurately function, all samples must be analysed and included in the 'Analytical Results' section of the following report. Please verify that all required IDs are listed and analysed.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Summary of Thresholds Reached or Exceeded

EPA Victoria Publication IWRG 621 (2009)

Table 2: Soil Hazard Categorisation Thresholds : Fill Material

Client Sample ID	ALS Sample ID	Compound	Method	LOR	Limits	Result
PTH-16-0048	**EM1607137-012**	Arsenic	EG005T	5	*< 20 mg/kg*	**46 mg/kg**
PTH-16-0048	**EM1607137-012**	Cadmium	EG005T	1	*< 3 mg/kg*	**4 mg/kg**
PTH-16-0048	**EM1607137-012**	Copper	EG005T	5	*< 100 mg/kg*	**243 mg/kg**
PTH-16-0048	**EM1607137-012**	Nickel	EG005T	2	*< 60 mg/kg*	**566 mg/kg**
PTH-16-0048	**EM1607137-012**	Zinc	EG005T	5	*< 200 mg/kg*	**1930 mg/kg**
PTH-16-0048	**EM1607137-012**	C10 - C36 Fraction (sum)	EP071-EM	50	*< 1,000 mg/kg*	**2560 mg/kg**

Analytical Results

Soil Hazard Categorisation and Management

Table 2: Soil Hazard Categorisation Thresholds : Category B

Sub-Matrix: **SOIL**

				Client sample ID	Guideline	Guideline	PTH-16-0048	----	----	----	----
				Sampling date/time			20-Jun-2016 09:00	----	----	----	----
Compound	*Method*	*LOR*	*Unit*		Lower Limit	Upper Limit	EM1607137-012	--------	--------	--------	--------
EA001: pH in soil using 0.01M CaCl extract											
pH (CaCl2)	EA001	0.1	pH Unit		2	12.5	**7.1**	----	----	----	----
EG005T: Total Metals by ICP-AES											
Arsenic	EG005T	5	mg/kg		----	2000	**46**	----	----	----	----
Cadmium	EG005T	1	mg/kg		----	400	**4**	----	----	----	----
Copper	EG005T	5	mg/kg		----	20000	**243**	----	----	----	----
Lead	EG005T	5	mg/kg		----	6000	**13**	----	----	----	----
Molybdenum	EG005T	2	mg/kg		----	4000	<2	----	----	----	----
Nickel	EG005T	2	mg/kg		----	12000	**566**	----	----	----	----
Selenium	EG005T	5	mg/kg		----	200	<5	----	----	----	----
Silver	EG005T	2	mg/kg		----	720	<2	----	----	----	----
Zinc	EG005T	5	mg/kg		----	140000	**1930**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS											
Mercury	EG035T	0.1	mg/kg		----	300	**0.7**	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)											
Hexavalent Chromium	EG048G	0.5	mg/kg		----	2000	<0.8	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser											
Total Cyanide	EK026SF	1	mg/kg		----	10000	<1	----	----	----	----
EK040T: Fluoride Total											
Fluoride	EK040T	40	mg/kg		----	40000	**80**	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons											
Benzene	EP074-UT	0.2	mg/kg		----	16	<0.4	----	----	----	----
Sum of monocyclic aromatic hydrocarbons	EP074-UT-SUM	0.2	mg/kg		----	240	<0.2	----	----	----	----
EP074I: Volatile Halogenated Compounds											
Vinyl chloride	EP074-UT	0.02	mg/kg		----	4.8	<0.04	----	----	----	----
Hexachlorobutadiene	EP074-UT	0.02	mg/kg		----	11	<0.04	----	----	----	----
Sum of other chlorinated hydrocarbons	EP074-UT-SUM	0.01	mg/kg		----	50	<0.01	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)											
Sum of Phenols (halogenated)	EP075-EM-SUM	0.03	mg/kg		----	320	<0.03	----	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)											
Sum of Phenols (non-halogenated)	EP075-EM-SUM	1	mg/kg		----	2200	<1	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons											
Benzo(a)pyrene	EP075-EM	0.5	mg/kg		----	20	<0.5	----	----	----	----

Soil Hazard Categorisation and Management

Table 2: Soil Hazard Categorisation Thresholds : Category B

Sub-Matrix: **SOIL**

				Client sample ID	Guideline	Guideline	**PTH-16-0048**	**----**	**----**	**----**	**----**
				Sampling date/time			20-Jun-2016 09:00	----	----	----	----
Compound	*Method*	*LOR*	*Unit*		Lower Limit	Upper Limit	**EM1607137-012**	--------	--------	--------	--------
EP075B: Polynuclear Aromatic Hydrocarbons - Continued											
Sum of polycyclic aromatic hydrocarbons	EP075-EM-SUM	0.5	mg/kg		----	400	<0.5	**----**	**----**	**----**	**----**
EP075I: Organochlorine Pesticides											
Heptachlor	EP075-EM	0.03	mg/kg		----	4.8	<0.03	**----**	**----**	**----**	**----**
Sum of Aldrin + Dieldrin	EP075-EM-SUM	0.03	mg/kg		----	4.8	<0.03	**----**	**----**	**----**	**----**
Sum of DDD + DDE + DDT	EP075-EM-SUM	0.05	mg/kg		----	50	<0.05	**----**	**----**	**----**	**----**
Chlordane	EP075-EM-SUM	0.03	mg/kg		----	16	<0.03	**----**	**----**	**----**	**----**
Sum of other organochlorine pesticides	EP075-EM-SUM	0.03	mg/kg		----	50	<0.03	**----**	**----**	**----**	**----**
EP080/071: Total Petroleum Hydrocarbons											
C6 - C9 Fraction	EP074-UT	10	mg/kg		----	2600	<20	**----**	**----**	**----**	**----**
C10 - C36 Fraction (sum)	EP071-EM	50	mg/kg		----	40000	**2560**	**----**	**----**	**----**	**----**

Soil Hazard Categorisation and Management

Table 2: Soil Hazard Categorisation Thresholds : Category C

Sub-Matrix: **SOIL**

				Client sample ID	Guideline	Guideline	**PTH-16-0048**	----	----	----	----
				Sampling date/time			20-Jun-2016 09:00	----	----	----	----
Compound	*Method*	*LOR*	*Unit*		Lower Limit	Upper Limit	**EM1607137-012**	--------	--------	--------	--------
EA001: pH in soil using 0.01M CaCl extract											
pH (CaCl2)	EA001	0.1	pH Unit		4	9	**7.1**	----	----	----	----
EG005T: Total Metals by ICP-AES											
Arsenic	EG005T	5	mg/kg		----	500	**46**	----	----	----	----
Cadmium	EG005T	1	mg/kg		----	100	**4**	----	----	----	----
Copper	EG005T	5	mg/kg		----	5000	**243**	----	----	----	----
Lead	EG005T	5	mg/kg		----	1500	**13**	----	----	----	----
Molybdenum	EG005T	2	mg/kg		----	1000	<2	----	----	----	----
Nickel	EG005T	2	mg/kg		----	3000	**566**	----	----	----	----
Selenium	EG005T	5	mg/kg		----	50	<5	----	----	----	----
Silver	EG005T	2	mg/kg		----	180	<2	----	----	----	----
Tin	EG005T	5	mg/kg		----	500	<5	----	----	----	----
Zinc	EG005T	5	mg/kg		----	35000	**1930**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS											
Mercury	EG035T	0.1	mg/kg		----	75	**0.7**	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)											
Hexavalent Chromium	EG048G	0.5	mg/kg		----	500	<0.8	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser											
Total Cyanide	EK026SF	1	mg/kg		----	2500	<1	----	----	----	----
EK040T: Fluoride Total											
Fluoride	EK040T	40	mg/kg		----	10000	**80**	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons											
Benzene	EP074-UT	0.2	mg/kg		----	4	<0.4	----	----	----	----
Sum of monocyclic aromatic hydrocarbons	EP074-UT-SUM	0.2	mg/kg		----	70	<0.2	----	----	----	----
EP074I: Volatile Halogenated Compounds											
Vinyl chloride	EP074-UT	0.02	mg/kg		----	1.2	<0.04	----	----	----	----
Hexachlorobutadiene	EP074-UT	0.02	mg/kg		----	2.8	<0.04	----	----	----	----
Sum of other chlorinated hydrocarbons	EP074-UT-SUM	0.01	mg/kg		----	10	<0.01	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)											
Sum of Phenols (halogenated)	EP075-EM-SUM	0.03	mg/kg		----	10	<0.03	----	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)											
Sum of Phenols (non-halogenated)	EP075-EM-SUM	1	mg/kg		----	560	<1	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons											
Benzo(a)pyrene	EP075-EM	0.5	mg/kg		----	5	<0.5	----	----	----	----

Soil Hazard Categorisation and Management

Table 2: Soil Hazard Categorisation Thresholds : Category C

Sub-Matrix: **SOIL**

				Client sample ID	Guideline	Guideline	**PTH-16-0048**	**----**	**----**	**----**	**----**
				Sampling date/time			20-Jun-2016 09:00	----	----	----	----
Compound	*Method*	*LOR*	*Unit*		Lower Limit	Upper Limit	**EM1607137-012**	--------	--------	--------	--------
EP075B: Polynuclear Aromatic Hydrocarbons - Continued											
Sum of polycyclic aromatic hydrocarbons	EP075-EM-SUM	0.5	mg/kg		----	100	<0.5	**----**	**----**	**----**	**----**
EP075I: Organochlorine Pesticides											
Heptachlor	EP075-EM	0.03	mg/kg		----	1.2	<0.03	**----**	**----**	**----**	**----**
Sum of Aldrin + Dieldrin	EP075-EM-SUM	0.03	mg/kg		----	1.2	<0.03	**----**	**----**	**----**	**----**
Sum of DDD + DDE + DDT	EP075-EM-SUM	0.05	mg/kg		----	50	<0.05	**----**	**----**	**----**	**----**
Chlordane	EP075-EM-SUM	0.03	mg/kg		----	4	<0.03	**----**	**----**	**----**	**----**
Sum of other organochlorine pesticides	EP075-EM-SUM	0.03	mg/kg		----	10	<0.03	**----**	**----**	**----**	**----**
EP080/071: Total Petroleum Hydrocarbons											
C6 - C9 Fraction	EP074-UT	10	mg/kg		----	650	<20	**----**	**----**	**----**	**----**
C10 - C36 Fraction (sum)	EP071-EM	50	mg/kg		----	10000	**2560**	**----**	**----**	**----**	**----**

Soil Hazard Categorisation and Management

Table 2: Soil Hazard Categorisation Thresholds : Fill Material

Sub-Matrix: **SOIL**

				Client sample ID	Guideline	Guideline	**PTH-16-0048**	----	----	----	----
				Sampling date/time			20-Jun-2016 09:00	----	----	----	----
Compound	*Method*	*LOR*	*Unit*		Lower Limit	Upper Limit	**EM1607137-012**	--------	--------	--------	--------
EA001: pH in soil using 0.01M CaCl extract											
pH (CaCl2)	EA001	0.1	pH Unit		4	9	**7.1**	----	----	----	----
EG005T: Total Metals by ICP-AES											
Arsenic	EG005T	5	mg/kg		----	20	**46**	----	----	----	----
Cadmium	EG005T	1	mg/kg		----	3	**4**	----	----	----	----
Copper	EG005T	5	mg/kg		----	100	**243**	----	----	----	----
Lead	EG005T	5	mg/kg		----	300	**13**	----	----	----	----
Molybdenum	EG005T	2	mg/kg		----	40	<2	----	----	----	----
Nickel	EG005T	2	mg/kg		----	60	**566**	----	----	----	----
Selenium	EG005T	5	mg/kg		----	10	<5	----	----	----	----
Silver	EG005T	2	mg/kg		----	10	<2	----	----	----	----
Tin	EG005T	5	mg/kg		----	50	<5	----	----	----	----
Zinc	EG005T	5	mg/kg		----	200	**1930**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS											
Mercury	EG035T	0.1	mg/kg		----	1	**0.7**	----	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)											
Hexavalent Chromium	EG048G	0.5	mg/kg		----	1	<0.8	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser											
Total Cyanide	EK026SF	1	mg/kg		----	50	<1	----	----	----	----
EK040T: Fluoride Total											
Fluoride	EK040T	40	mg/kg		----	450	**80**	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)											
Total Polychlorinated biphenyls	EP066-EM	0.1	mg/kg		----	2	<0.2	----	----	----	----
EP074A: Monocyclic Aromatic Hydrocarbons											
Benzene	EP074-UT	0.2	mg/kg		----	1	<0.4	----	----	----	----
Sum of monocyclic aromatic hydrocarbons	EP074-UT-SUM	0.2	mg/kg		----	7	<0.2	----	----	----	----
EP074I: Volatile Halogenated Compounds											
Sum of volatile chlorinated hydrocarbons	EP074-UT-SUM	0.01	mg/kg		----	1	<0.01	----	----	----	----
EP075A: Phenolic Compounds (Halogenated)											
Sum of Phenols (halogenated)	EP075-EM-SUM	0.03	mg/kg		----	1	<0.03	----	----	----	----
EP075A: Phenolic Compounds (Non-halogenated)											
Sum of Phenols (non-halogenated)	EP075-EM-SUM	1	mg/kg		----	60	<1	----	----	----	----
EP075B: Polynuclear Aromatic Hydrocarbons											
Benzo(a)pyrene	EP075-EM	0.5	mg/kg		----	1	<0.5	----	----	----	----

Soil Hazard Categorisation and Management

Table 2: Soil Hazard Categorisation Thresholds : Fill Material

Sub-Matrix: **SOIL**

				Client sample ID	Guideline	Guideline	**PTH-16-0048**	**----**	**----**	**----**	**----**
				Sampling date/time			20-Jun-2016 09:00	----	----	----	----
Compound	*Method*	*LOR*	*Unit*		Lower Limit	Upper Limit	**EM1607137-012**	--------	--------	--------	--------
EP075B: Polynuclear Aromatic Hydrocarbons - Continued											
Sum of polycyclic aromatic hydrocarbons	EP075-EM-SUM	0.5	mg/kg		----	20	<0.5	**----**	**----**	**----**	**----**
EP075I: Organochlorine Pesticides											
Sum of organochlorine pesticides	EP075-EM-SUM	0.03	mg/kg		----	1	<0.03	**----**	**----**	**----**	**----**
EP080/071: Total Petroleum Hydrocarbons											
C6 - C9 Fraction	EP074-UT	10	mg/kg		----	100	<20	**----**	**----**	**----**	**----**
C10 - C36 Fraction (sum)	EP071-EM	50	mg/kg		----	1000	**2560**	**----**	**----**	**----**	**----**

Note: Red shading is applied where the result is equal to or greater than the Guideline Limit.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1607137**	Page	: 1 of 23
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS	Contact	:
Address	: Kiora Crescent Lockbag 25, Fairfield YENNORA NSW 2165	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 02 9681 9555	Telephone	: +61-3-8549 9600
Project	: Alcoa Anglesea Waters and Solids	Date Samples Received	: 20-Jun-2016
Order number	: 6681114	Date Analysis Commenced	: 20-Jun-2016
C-O-C number	: ----	Issue Date	: 23-Jun-2016
Sampler	: ----		
Site	: Point Henry		
Quote number	: ----		
No. of samples received	: 13		
No. of samples analysed	: 11		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Inorganics, Springvale, VIC
Nancy Wang	Senior Semivolatile Instrument Chemist	Melbourne Organics, Springvale, VIC

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 491825)									
EM1607137-012	PTH-16-0048	EA001: pH (CaCl2)	----	0.1	pH Unit	7.1	7.0	1.42	0% - 20%
EA002 : pH (Soils) (QC Lot: 491880)									
EM1607137-005	PTH-16-0041	EA002: pH Value	----	0.1	pH Unit	6.7	6.8	1.48	0% - 20%
EA010: Conductivity (QC Lot: 491879)									
EM1607137-005	PTH-16-0041	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	661	663	0.302	0% - 20%
EA055: Moisture Content (QC Lot: 491839)									
EM1607137-005	PTH-16-0041	EA055-103: Moisture Content (dried @ 103°C)	----	1	%	25.7	25.8	0.00	0% - 20%
ED037: Alkalinity (QC Lot: 491882)									
EM1607137-005	PTH-16-0041	ED037: Total Alkalinity as CaCO3	----	1	mg/kg	11	11	0.00	0% - 50%
ED038A: Acidity (QC Lot: 491883)									
EM1607137-005	PTH-16-0041	ED038: Acidity	----	1	mg/kg	5	5	0.00	No Limit
ED040S: Soluble Major Anions (QC Lot: 491878)									
EM1607137-005	PTH-16-0041	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	1370	1310	4.28	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 491877)									
EM1607137-005	PTH-16-0041	ED045G: Chloride	16887-00-6	10	mg/kg	150	140	0.00	0% - 50%
ED093S: Soluble Major Cations (QC Lot: 491881)									
EM1607137-005	PTH-16-0041	ED093S: Calcium	7440-70-2	10	mg/kg	50	50	0.00	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	80	80	0.00	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	590	560	5.33	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	50	50	0.00	No Limit
EG005T: Total Metals by ICP-AES (QC Lot: 491828)									
EM1607137-005	PTH-16-0041	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.00	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG005T: Total Metals by ICP-AES (QC Lot: 491828) - continued									
EM1607137-005	PTH-16-0041	EG005T: Barium	7440-39-3	10	mg/kg	50	40	0.00	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	31	35	12.9	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	5	6	0.00	No Limit
		EG005T: Silver	7440-22-4	2	mg/kg	<2	<2	0.00	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	6	26.5	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	10	12	22.3	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	14	15	8.01	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Tin	7440-31-5	5	mg/kg	<5	<5	0.00	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	48	57	18.1	0% - 50%
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	6	0.00	No Limit
		EG005T: Aluminium	7429-90-5	50	mg/kg	16600	18200	9.60	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	60	60	0.00	No Limit
		EG005T: Iron	7439-89-6	50	mg/kg	42500	51300	18.7	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 491829)									
EM1607137-005	PTH-16-0041	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 491884)									
EM1607137-012	PTH-16-0048	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.8	<0.8	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 491826)									
EM1607137-012	PTH-16-0048	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.00	No Limit
EK040T: Fluoride Total (QC Lot: 491827)									
EM1607137-005	PTH-16-0041	EK040T: Fluoride	16984-48-8	40	mg/kg	210	220	5.53	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 491663)									
EM1607082-016	Anonymous	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EM1607146-004	Anonymous	EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EP074A: Monocyclic Aromatic Hydrocarbons (QC Lot: 491821)									
EM1607137-012	PTH-16-0048	EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.4	<0.4	0.00	No Limit
		EP074-UT: Toluene	108-88-3	0.5	mg/kg	<1.0	<1.0	0.00	No Limit
		EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<1.0	<1.0	0.00	No Limit
		EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<1.0	<1.0	0.00	No Limit
		EP074-UT: Styrene	100-42-5	0.5	mg/kg	<1.0	<1.0	0.00	No Limit
		EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<1.0	<1.0	0.00	No Limit
EP074H: Naphthalene (QC Lot: 491821)									
EM1607137-012	PTH-16-0048	EP074-UT: Naphthalene	91-20-3	1	mg/kg	<2	<2	0.00	No Limit
EP074I: Volatile Halogenated Compounds (QC Lot: 491821)									

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP074I: Volatile Halogenated Compounds (QC Lot: 491821) - continued									
EM1607137-012	PTH-16-0048	EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.02	<0.02	0.00	No Limit
		EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.04	<0.04	0.00	No Limit
		EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.08	<0.08	0.00	No Limit
		EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.8	<0.8	0.00	No Limit
EP075A: Phenolic Compounds (Halogenated) (QC Lot: 491662)									
EM1607082-016	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit
EM1607146-004	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/58-90-2	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	<0.2	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075A: Phenolic Compounds (Non-halogenated) (QC Lot: 491662)									
EM1607082-016	Anonymous	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EM1607146-004	Anonymous	EP075-EM: Phenol	108-95-2	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	<1	0.00	No Limit
		EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	<5	0.00	No Limit
		EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	<5	0.00	No Limit
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 491662)									
EM1607082-016	Anonymous	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	0.8	0.8	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EM1607146-004	Anonymous	EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP075B: Polynuclear Aromatic Hydrocarbons (QC Lot: 491662) - continued									
EM1607146-004	Anonymous	EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
		EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.00	No Limit
EP075I: Organochlorine Pesticides (QC Lot: 491662)									
EM1607082-016	Anonymous	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EM1607146-004	Anonymous	EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP075I: Organochlorine Pesticides (QC Lot: 491662) - continued									
EM1607146-004	Anonymous	EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	<0.03	0.00	No Limit
		EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
		EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	<0.05	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 491821)									
EM1607137-012	PTH-16-0048	EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<20	<20	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 491822)									
EM1607137-012	PTH-16-0048	EP071-EM: C15 - C28 Fraction	----	100	mg/kg	740	490	41.2	No Limit
		EP071-EM: C29 - C36 Fraction	----	100	mg/kg	1820	1220	39.6	No Limit
		EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<100	<100	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 491821)									
EM1607137-012	PTH-16-0048	EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<20	<20	0.00	No Limit
		EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 491822)									
EM1607137-012	PTH-16-0048	EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	2200	1500	38.2	0% - 50%
		EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	1060	710	39.4	No Limit
		EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<100	<100	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA005P: pH by PC Titrator (QC Lot: 493091)									
EM1607137-002	PTH-16-0038	EA005-P: pH Value	----	0.01	pH Unit	8.28	8.28	0.00	0% - 20%
EM1607161-003	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.08	7.02	0.851	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 493090)									
EM1607137-001	PTH-16-0037	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	9870	9890	0.202	0% - 20%
EM1607161-004	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	3720	3800	2.13	0% - 20%
EA045: Turbidity (QC Lot: 492450)									
EM1607137-001	PTH-16-0037	EA045: Turbidity	----	0.1	NTU	0.7	0.6	0.00	No Limit
EA075: Redox Potential (QC Lot: 492449)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA075: Redox Potential (QC Lot: 492449) - continued									
EM1607137-001	PTH-16-0037	EA075: Redox Potential	----	0.1	mV	255	255	0.274	0% - 20%
		EA075: pH Redox	----	0.01	pH Unit	8.55	8.58	0.350	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 493093)									
EM1607137-002	PTH-16-0038	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	65	66	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	65	66	0.00	0% - 20%
EM1607161-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	388	388	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	388	388	0.00	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 492650)									
EM1607118-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1830	1720	6.22	0% - 20%
EM1607154-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	313	312	0.320	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 492649)									
EM1607117-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	2020	2050	1.08	0% - 20%
EM1607154-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1060	1040	0.935	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 492519)									
EM1607117-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	434	428	1.49	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	170	157	8.14	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	940	854	9.50	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	47	44	7.68	No Limit
EM1607137-002	PTH-16-0038	ED093F: Calcium	7440-70-2	1	mg/L	457	484	5.73	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	319	336	5.16	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	1660	1760	6.02	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	104	110	5.60	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 492698)									
EM1607137-013	PTH-16-0045 Leached using PTH-16-0047	ED093F: Calcium	7440-70-2	1	mg/L	641	646	0.730	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	19	19	0.00	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	346	349	0.838	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	38	38	0.00	0% - 20%
EG005C: Leachable Metals by ICPAES (QC Lot: 492669)									
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG005C: Leachable Metals by ICPAES (QC Lot: 492669) - continued									
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	29.0	29.2	0.469	0% - 20%
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Tin	7440-31-5	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EG005C: Leachable Metals by ICPAES (QC Lot: 492671)									
EM1607137-013	PTH-16-0045 Leached using PTH-16-0047	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	7.3	7.7	4.84	0% - 20%
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Tin	7440-31-5	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	0.00	No Limit
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 492518)									
EM1607055-008	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.938	0.902	3.91	0% - 20%
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.026	0.024	7.69	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 492518) - continued									
EM1607055-008	Anonymous	EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.015	0.016	0.00	0% - 50%
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.016	0.015	0.00	0% - 50%
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.012	0.014	15.2	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.01	0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.06	0.06	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EM1607092-004	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.006	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 492514)									
EM1606978-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 492514) - continued									
EM1606978-001	Anonymous	EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EM1607117-003	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.675	0.750	10.5	0% - 20%
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	9.50	10.4	8.58	0% - 20%
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	4.17	4.38	4.87	0% - 20%
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.044	0.048	8.39	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	2.41	2.55	5.72	0% - 20%
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	8.87	9.53	7.21	0% - 20%
		EG020A-T: Copper	7440-50-8	0.001	mg/L	8.32	8.95	7.31	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.090	0.097	7.57	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	59.8	64.8	8.02	0% - 20%
		EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	0.032	0.035	9.30	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	6.20	6.52	5.01	0% - 20%
		EG020A-T: Tin	7440-31-5	0.001	mg/L	0.039	0.040	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	27.1	30.2	10.8	0% - 20%
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	1020	1070	5.01	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	0.82	0.88	7.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	19.5	20.8	6.20	0% - 20%
		EG020A-T: Boron	7440-42-8	0.05	mg/L	1.66	1.62	2.32	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	1690	1780	5.06	0% - 20%
EG035C: Leachable Mercury by FIMS (QC Lot: 492655)									
EM1607026-001	Anonymous	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.00	No Limit
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 492520)									
EM1607130-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 492501)									
EM1606978-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EM1607117-005	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	0.0928	0.0907	2.25	0% - 20%
EG051G: Ferrous Iron by Discrete Analyser (QC Lot: 492654)									
EM1607137-001	PTH-16-0037	EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG051G: Ferrous Iron by Discrete Analyser (QC Lot: 492894)									
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 493092)									
EM1607137-002	PTH-16-0038	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EM1607161-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.1	1.1	0.00	0% - 50%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 492404)									
EM1607137-001	PTH-16-0037	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.02	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 492666)									
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.08	0.10	22.2	0% - 50%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 492651)									
EM1607153-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.04	0.03	0.00	No Limit
EM1607118-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	1.36	1.34	0.796	0% - 20%
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 492405)									
EM1607137-001	PTH-16-0037	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 492667)									
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.16	0.15	0.00	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 492738)									
EM1607161-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	205	248	19.0	0% - 20%
EM1607128-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	373	368	1.24	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 492739)									
EM1607128-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	5.22	4.78	8.83	0% - 20%
EM1607161-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.04	<0.01	118	No Limit
EP002: Dissolved Organic Carbon (DOC) (QC Lot: 493089)									
EM1607137-001	PTH-16-0037	EP002: Dissolved Organic Carbon	----	1	mg/L	4	4	0.00	No Limit
EP002: Dissolved Organic Carbon (DOC) (QC Lot: 494406)									
EM1607137-009	PTH-16-0045 Leached using PTH-16-0040	EP002: Dissolved Organic Carbon	----	1	mg/L	2	2	0.00	No Limit
EP002: Dissolved Organic Carbon (DOC) (QC Lot: 494407)									
EM1607137-013	PTH-16-0045 Leached using PTH-16-0047	EP002: Dissolved Organic Carbon	----	1	mg/L	3	3	0.00	No Limit
EP005: Total Organic Carbon (TOC) (QC Lot: 493088)									
EM1607137-001	PTH-16-0037	EP005: Total Organic Carbon	----	1	mg/L	2	2	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010: Conductivity (QCLot: 491879)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	100	95	105
ED037: Alkalinity (QCLot: 491882)								
ED037: Total Alkalinity as CaCO3	----	----	mg/kg	----	200 mg/kg	114	89	119
ED038A: Acidity (QCLot: 491883)								
ED038: Acidity	----	1	mg/kg	<1	100 mg/kg	98.0	70	130
ED040S: Soluble Major Anions (QCLot: 491878)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	----	----	----	----
ED045G: Chloride by Discrete Analyser (QCLot: 491877)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	100	89	111
				<10	5000 mg/kg	99.1	94	110
ED093S: Soluble Major Cations (QCLot: 491881)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	50 mg/kg	102	97	105
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	50 mg/kg	102	96	106
ED093S: Sodium	7440-23-5	10	mg/kg	<10	500 mg/kg	103	94	106
ED093S: Potassium	7440-09-7	10	mg/kg	<10	500 mg/kg	102	94	106
EG005T: Total Metals by ICP-AES (QCLot: 491828)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	6134 mg/kg	101	93	115
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	21.7 mg/kg	90.2	79	113
EG005T: Barium	7440-39-3	10	mg/kg	<10	143 mg/kg	95.9	92	116
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	5.63 mg/kg	101	77	125
EG005T: Boron	7440-42-8	50	mg/kg	<50	33.2 mg/kg	94.1	84	124
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	4.64 mg/kg	87.3	87	115
EG005T: Chromium	7440-47-3	2	mg/kg	<2	43.9 mg/kg	96.2	89	113
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	16 mg/kg	92.8	81	117
EG005T: Copper	7440-50-8	5	mg/kg	<5	32 mg/kg	90.5	90	116
EG005T: Iron	7439-89-6	50	mg/kg	<50	8400 mg/kg	102	96	112
EG005T: Lead	7439-92-1	5	mg/kg	<5	40 mg/kg	88.9	85	107
EG005T: Manganese	7439-96-5	5	mg/kg	<5	130 mg/kg	93.9	87	113
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	7.9 mg/kg	98.1	85	119
EG005T: Nickel	7440-02-0	2	mg/kg	<2	55 mg/kg	93.0	89	111
EG005T: Selenium	7782-49-2	5	mg/kg	<5	5.37 mg/kg	104	93	109
EG005T: Silver	7440-22-4	2	mg/kg	<2	2.1 mg/kg	86.0	80	108
EG005T: Tin	7440-31-5	5	mg/kg	<5	5.2 mg/kg	99.0	94	114
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	29.6 mg/kg	97.1	81	117

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 491828) - continued								
EG005T: Zinc	7440-66-6	5	mg/kg	<5	60.8 mg/kg	95.0	89	111
EG035T: Total Recoverable Mercury by FIMS (QCLot: 491829)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	2.57 mg/kg	92.8	85	103
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 491884)								
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	40 mg/kg	86.2	80	120
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 491826)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	95.1	82	106
EK040T: Fluoride Total (QCLot: 491827)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	950 mg/kg	87.6	75	108
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 491663)								
EP066-EM: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	0.5 mg/kg	116	55	133
EP074A: Monocyclic Aromatic Hydrocarbons (QCLot: 491821)								
EP074-UT: Benzene	71-43-2	0.2	mg/kg	<0.2	2.1 mg/kg	98.6	74	118
EP074-UT: Toluene	108-88-3	0.5	mg/kg	<0.5	2.1 mg/kg	99.9	70	118
EP074-UT: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2.1 mg/kg	97.6	69	117
EP074-UT: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	4.2 mg/kg	96.7	68	116
EP074-UT: Styrene	100-42-5	0.5	mg/kg	<0.5	2.1 mg/kg	98.1	71	117
EP074-UT: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	2.1 mg/kg	95.7	70	116
EP074H: Naphthalene (QCLot: 491821)								
EP074-UT: Naphthalene	91-20-3	1	mg/kg	<1	0.6 mg/kg	98.0	70	130
EP074I: Volatile Halogenated Compounds (QCLot: 491821)								
EP074-UT: Vinyl chloride	75-01-4	0.02	mg/kg	<0.02	0.1 mg/kg	72.4	49	133
EP074-UT: 1.1-Dichloroethene	75-35-4	0.01	mg/kg	<0.01	0.1 mg/kg	92.2	63	133
EP074-UT: Methylene chloride	75-09-2	0.4	mg/kg	<0.4	2.1 mg/kg	90.1	65	131
EP074-UT: trans-1.2-Dichloroethene	156-60-5	0.02	mg/kg	<0.02	0.1 mg/kg	95.7	68	124
EP074-UT: cis-1.2-Dichloroethene	156-59-2	0.01	mg/kg	<0.01	0.1 mg/kg	99.8	74	118
EP074-UT: Chloroform	67-66-3	0.02	mg/kg	<0.02	0.1 mg/kg	99.5	72	118
EP074-UT: 1.1.1-Trichloroethane	71-55-6	0.01	mg/kg	<0.01	0.1 mg/kg	103	67	119
EP074-UT: Carbon Tetrachloride	56-23-5	0.01	mg/kg	<0.01	0.1 mg/kg	76.6	65	119
EP074-UT: 1.2-Dichloroethane	107-06-2	0.02	mg/kg	<0.02	0.1 mg/kg	105	70	122
EP074-UT: Trichloroethene	79-01-6	0.02	mg/kg	<0.02	0.1 mg/kg	99.4	72	124
EP074-UT: 1.1.2-Trichloroethane	79-00-5	0.04	mg/kg	<0.04	0.1 mg/kg	102	74	122
EP074-UT: Tetrachloroethene	127-18-4	0.02	mg/kg	<0.02	0.1 mg/kg	93.5	65	123
EP074-UT: 1.1.1.2-Tetrachloroethane	630-20-6	0.01	mg/kg	<0.01	0.1 mg/kg	96.0	69	119
EP074-UT: 1.1.2.2-Tetrachloroethane	79-34-5	0.02	mg/kg	<0.02	0.1 mg/kg	101	71	125
EP074-UT: Hexachlorobutadiene	87-68-3	0.02	mg/kg	<0.02	0.1 mg/kg	84.6	61	125
EP074-UT: Chlorobenzene	108-90-7	0.02	mg/kg	<0.02	0.1 mg/kg	101	70	130

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP074I: Volatile Halogenated Compounds (QCLot: 491821) - continued								
EP074-UT: 1.4-Dichlorobenzene	106-46-7	0.02	mg/kg	<0.02	0.1 mg/kg	98.5	62	122
EP074-UT: 1.2-Dichlorobenzene	95-50-1	0.02	mg/kg	<0.02	0.1 mg/kg	98.9	65	123
EP074-UT: 1.2.4-Trichlorobenzene	120-82-1	0.01	mg/kg	<0.01	0.1 mg/kg	91.0	53	127
EP075A: Phenolic Compounds (Halogenated) (QCLot: 491662)								
EP075-EM: 2-Chlorophenol	95-57-8	0.03	mg/kg	<0.03	0.5 mg/kg	86.4	27	125
EP075-EM: 2.4-Dichlorophenol	120-83-2	0.03	mg/kg	<0.03	0.5 mg/kg	119	30	136
EP075-EM: 2.6-Dichlorophenol	87-65-0	0.03	mg/kg	<0.03	0.5 mg/kg	98.0	35	121
EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.03	mg/kg	<0.03	0.5 mg/kg	101	43	125
EP075-EM: 2.4.5-Trichlorophenol	95-95-4	0.05	mg/kg	<0.05	0.5 mg/kg	102	42	120
EP075-EM: 2.4.6-Trichlorophenol	88-06-2	0.05	mg/kg	<0.05	0.5 mg/kg	102	42	124
EP075-EM: 2.3.5.6-Tetrachlorophenol	935-95-5	0.03	mg/kg	<0.03	0.5 mg/kg	97.4	30	126
EP075-EM: 2.3.4.5 & 2.3.4.6-Tetrachlorophenol	4901-51-3/5 8-90-2	0.05	mg/kg	<0.05	1 mg/kg	102	44	124
EP075-EM: Pentachlorophenol	87-86-5	0.2	mg/kg	<0.2	0.5 mg/kg	86.2	15	124
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 491662)								
EP075-EM: Phenol	108-95-2	1	mg/kg	<1	0.5 mg/kg	94.5	26	121
EP075-EM: 2-Methylphenol	95-48-7	1	mg/kg	<1	0.5 mg/kg	113	25	133
EP075-EM: 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	1 mg/kg	107	29	130
EP075-EM: 2-Nitrophenol	88-75-5	1	mg/kg	<1	0.5 mg/kg	118	32	136
EP075-EM: 2.4-Dimethylphenol	105-67-9	1	mg/kg	<1	0.5 mg/kg	119	10	142
EP075-EM: 2.4-Dinitrophenol	51-28-5	5	mg/kg	<5	3 mg/kg	115	23	125
EP075-EM: 4-Nitrophenol	100-02-7	5	mg/kg	<5	3 mg/kg	106	43	133
EP075-EM: 2-Methyl-4.6-dinitrophenol	8071-51-0	5	mg/kg	<5	3 mg/kg	114	12	125
EP075-EM: Dinoseb	88-85-7	5	mg/kg	<5	3 mg/kg	104	35	123
EP075-EM: 2-Cyclohexyl-4.6-Dinitrophenol	131-89-5	5	mg/kg	<5	2.5 mg/kg	93.4	10	132
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 491662)								
EP075-EM: Naphthalene	91-20-3	0.5	mg/kg	<0.5	0.5 mg/kg	97.2	38	120
EP075-EM: Acenaphthene	83-32-9	0.5	mg/kg	<0.5	0.5 mg/kg	99.5	46	122
EP075-EM: Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	0.5 mg/kg	103	39	127
EP075-EM: Fluorene	86-73-7	0.5	mg/kg	<0.5	0.5 mg/kg	104	51	125
EP075-EM: Phenanthrene	85-01-8	0.5	mg/kg	<0.5	0.5 mg/kg	105	57	127
EP075-EM: Anthracene	120-12-7	0.5	mg/kg	<0.5	0.5 mg/kg	108	55	127
EP075-EM: Fluoranthene	206-44-0	0.5	mg/kg	<0.5	0.5 mg/kg	102	57	131
EP075-EM: Pyrene	129-00-0	0.5	mg/kg	<0.5	0.5 mg/kg	102	57	131
EP075-EM: Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	0.5 mg/kg	96.1	56	132
EP075-EM: Chrysene	218-01-9	0.5	mg/kg	<0.5	0.5 mg/kg	93.3	58	134
EP075-EM: Benzo(b+j) & Benzo(k)fluoranthene	205-99-2 207-08-9	0.5	mg/kg	<0.5	1 mg/kg	94.4	55	133

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 491662) - continued								
EP075-EM: Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	0.5 mg/kg	90.9	51	135
EP075-EM: Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	0.5 mg/kg	96.6	55	137
EP075-EM: Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	0.5 mg/kg	97.7	54	136
EP075-EM: Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	0.5 mg/kg	97.6	55	137
EP075I: Organochlorine Pesticides (QCLot: 491662)								
EP075-EM: alpha-BHC	319-84-6	0.03	mg/kg	<0.03	0.5 mg/kg	97.7	54	130
EP075-EM: Hexachlorobenzene (HCB)	118-74-1	0.03	mg/kg	<0.03	0.5 mg/kg	108	54	130
EP075-EM: beta-BHC	319-85-7	0.03	mg/kg	<0.03	0.5 mg/kg	90.5	54	134
EP075-EM: gamma-BHC	58-89-9	0.03	mg/kg	<0.03	0.5 mg/kg	97.1	54	132
EP075-EM: delta-BHC	319-86-8	0.03	mg/kg	<0.03	0.5 mg/kg	104	55	131
EP075-EM: Heptachlor	76-44-8	0.03	mg/kg	<0.03	0.5 mg/kg	106	54	128
EP075-EM: Aldrin	309-00-2	0.03	mg/kg	<0.03	0.5 mg/kg	104	54	128
EP075-EM: Heptachlor epoxide	1024-57-3	0.03	mg/kg	<0.03	0.5 mg/kg	110	56	130
EP075-EM: cis-Chlordane	5103-71-9	0.03	mg/kg	<0.03	0.5 mg/kg	108	56	130
EP075-EM: trans-Chlordane	5103-74-2	0.03	mg/kg	<0.03	0.5 mg/kg	108	55	131
EP075-EM: Endosulfan 1	959-98-8	0.03	mg/kg	<0.03	0.5 mg/kg	99.2	53	133
EP075-EM: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	104	54	130
EP075-EM: Dieldrin	60-57-1	0.03	mg/kg	<0.03	0.5 mg/kg	99.2	57	133
EP075-EM: Endrin aldehyde	7421-93-4	0.03	mg/kg	<0.03	0.5 mg/kg	107	16	178
EP075-EM: Endrin	72-20-8	0.03	mg/kg	<0.03	0.5 mg/kg	99.8	40	148
EP075-EM: Endosulfan 2	33213-65-9	0.03	mg/kg	<0.03	0.5 mg/kg	93.6	56	138
EP075-EM: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	98.1	57	135
EP075-EM: Endosulfan sulfate	1031-07-8	0.03	mg/kg	<0.03	0.5 mg/kg	97.6	51	133
EP075-EM: 4.4`-DDT	50-29-3	0.05	mg/kg	<0.05	0.5 mg/kg	95.4	51	133
EP075-EM: Methoxychlor	72-43-5	0.03	mg/kg	<0.03	0.5 mg/kg	88.6	48	136
EP080/071: Total Petroleum Hydrocarbons (QCLot: 491821)								
EP074-UT: C6 - C9 Fraction	----	10	mg/kg	<10	39.6 mg/kg	96.6	64	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 491822)								
EP071-EM: C10 - C14 Fraction	----	50	mg/kg	<50	751 mg/kg	115	72	130
EP071-EM: C15 - C28 Fraction	----	100	mg/kg	<100	3103 mg/kg	110	77	126
EP071-EM: C29 - C36 Fraction	----	100	mg/kg	<100	1482 mg/kg	105	75	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 491821)								
EP074-UT: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	48.9 mg/kg	96.2	64	120
EP074-UT: C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 491822)								
EP071-EM: >C10 - C16 Fraction	----	50	mg/kg	<50	1135 mg/kg	109	75	123
EP071-EM: >C16 - C34 Fraction	----	100	mg/kg	<100	4080 mg/kg	107	77	127

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 491822) - continued								
EP071-EM: >C34 - C40 Fraction	----	100	mg/kg	<100	162 mg/kg	102	43	123

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EA010P: Conductivity by PC Titrator (QCLot: 493090)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	100	95	105
EA045: Turbidity (QCLot: 492450)								
EA045: Turbidity	----	0.1	NTU	<0.1	40 NTU	102	92	106
EA075: Redox Potential (QCLot: 492449)								
EA075: Redox Potential	----	----	mV	----	234 mV	102	90	110
ED037P: Alkalinity by PC Titrator (QCLot: 493093)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	92.9	90	110
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 492650)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	103	90	116
				<1	100 mg/L	104	80	120
ED045G: Chloride by Discrete Analyser (QCLot: 492649)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	103	89	117
				<1	1000 mg/L	98.0	92	112
ED093F: Dissolved Major Cations (QCLot: 492519)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	105	92	108
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	101	92	108
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	100.0	89	107
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	105	89	107
ED093F: Dissolved Major Cations (QCLot: 492698)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	103	92	108
ED093F: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	101	92	108
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	99.8	89	107
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	105	89	107
EG005C: Leachable Metals by ICPAES (QCLot: 492669)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	1 mg/L	104	88	116
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	1 mg/L	93.9	89	121
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	1 mg/L	95.5	88	114
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	1 mg/L	102	90	120
EG005C: Boron	7440-42-8	0.1	mg/L	# 29.9	----	----	----	----
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	1 mg/L	92.0	90	116
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	1 mg/L	93.2	89	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	1 mg/L	91.4	89	113

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG005C: Leachable Metals by ICPAES (QCLot: 492669) - continued								
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	1 mg/L	94.4	89	119
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	1 mg/L	97.3	86	122
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	1 mg/L	103	89	117
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	1 mg/L	96.6	90	114
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	1 mg/L	91.6	90	112
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	1 mg/L	103	89	121
EG005C: Tin	7440-31-5	0.1	mg/L	<0.1	1 mg/L	89.7	88	118
EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	1 mg/L	96.3	88	114
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	1 mg/L	103	87	121
EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	1 mg/L	96.1	89	113
EG005C: Leachable Metals by ICPAES (QCLot: 492671)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	1 mg/L	94.8	88	116
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	1 mg/L	90.5	89	121
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	1 mg/L	99.9	88	114
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	1 mg/L	103	90	120
EG005C: Boron	7440-42-8	0.1	mg/L	# 0.3	----	----	----	----
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	1 mg/L	93.5	90	116
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	1 mg/L	93.6	89	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	1 mg/L	92.4	89	113
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	1 mg/L	92.4	89	119
EG005C: Iron	7439-89-6	0.1	mg/L	# 31.8	1 mg/L	# 3230	86	122
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	1 mg/L	96.3	89	117
EG005C: Manganese	7439-96-5	0.1	mg/L	# 1.1	1 mg/L	# 206	90	114
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	1 mg/L	90.1	90	112
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	1 mg/L	102	89	121
EG005C: Tin	7440-31-5	0.1	mg/L	<0.1	1 mg/L	91.2	88	118
EG005C: Vanadium	7440-62-2	0.1	mg/L	<0.1	1 mg/L	95.8	88	114
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	1 mg/L	87.4	87	121
EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	1 mg/L	94.7	89	113
EG020F: Dissolved Metals by ICP-MS (QCLot: 492518)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	100	93	105
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.0	94	108
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	90.0	85	113
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	95.2	87	107
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.9	86	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	92.6	86	110
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	94.3	88	108
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	90.4	87	107
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	91.6	87	109

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 492518) - continued								
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	88.6	87	109
EG020A-F: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	94.9	86	110
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.6	87	109
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	93.7	87	109
EG020A-F: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	94.8	87	111
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	94.4	85	111
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	99.1	87	107
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.1 mg/L	97.6	84	116
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	100	94	106
EG020T: Total Metals by ICP-MS (QCLot: 492514)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	103	100	108
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	94	116
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	97.8	89	111
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.1 mg/L	103	91	111
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	93.7	90	110
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	98.4	90	110
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.7	91	111
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	95.0	91	109
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	98.2	91	111
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	94.6	91	111
EG020A-T: Molybdenum	7439-98-7	0.001	mg/L	<0.001	0.1 mg/L	107	90	112
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	99.0	91	111
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	95.8	86	110
EG020A-T: Tin	7440-31-5	0.001	mg/L	<0.001	0.1 mg/L	105	91	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	103	90	110
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	105	91	109
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.1 mg/L	104	88	118
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	108	99	109
EG035C: Leachable Mercury by FIMS (QCLot: 492655)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	95.0	84	116
EG035F: Dissolved Mercury by FIMS (QCLot: 492520)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	97.4	83	117
EG035T: Total Recoverable Mercury by FIMS (QCLot: 492501)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	98.2	87	113
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 492654)								
EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	2 mg/L	105	89	111
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 492894)								
EG051G: Ferrous Iron	----	0.05	mg/L	<0.05	2 mg/L	106	89	111

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EK040P: Fluoride by PC Titrator (QCLot: 493092)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	99.7	89	111
EK055G: Ammonia as N by Discrete Analyser (QCLot: 492404)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	97.3	80	115
EK055G: Ammonia as N by Discrete Analyser (QCLot: 492666)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	96.4	80	115
EK057G: Nitrite as N by Discrete Analyser (QCLot: 492651)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	92	108
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 492405)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	107	91	117
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 492667)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	108	91	117
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 492738)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	5 mg/L	104	70	117
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 492739)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	2.21 mg/L	87.6	70	120
EP002: Dissolved Organic Carbon (DOC) (QCLot: 493089)								
EP002: Dissolved Organic Carbon	----	1	mg/L	<1	100 mg/L	94.7	83	115
EP002: Dissolved Organic Carbon (DOC) (QCLot: 494406)								
EP002: Dissolved Organic Carbon	----	1	mg/L	# 2	100 mg/L	95.2	83	115
EP002: Dissolved Organic Carbon (DOC) (QCLot: 494407)								
EP002: Dissolved Organic Carbon	----	1	mg/L	<1	100 mg/L	95.2	83	115
EP005: Total Organic Carbon (TOC) (QCLot: 493088)								
EP005: Total Organic Carbon	----	1	mg/L	<1	100 mg/L	95.0	86	112

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
				Concentration	MS	Low	High
ED045G: Chloride by Discrete Analyser (QCLot: 491877)							
EM1607137-006	PTH-16-0042	ED045G: Chloride	16887-00-6	2000 mg/kg	93.3	93	125
EG005T: Total Metals by ICP-AES (QCLot: 491828)							
EM1607137-006	PTH-16-0042	EG005T: Arsenic	7440-38-2	50 mg/kg	92.4	78	124

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 491828) - continued							
EM1607137-006	PTH-16-0042	EG005T: Barium	7440-39-3	50 mg/kg	# Not Determined	71	135
		EG005T: Beryllium	7440-41-7	50 mg/kg	102	85	125
		EG005T: Cadmium	7440-43-9	50 mg/kg	88.4	84	116
		EG005T: Chromium	7440-47-3	50 mg/kg	93.2	79	121
		EG005T: Copper	7440-50-8	50 mg/kg	98.3	82	124
		EG005T: Lead	7439-92-1	50 mg/kg	77.2	76	124
		EG005T: Manganese	7439-96-5	50 mg/kg	# Not Determined	68	136
		EG005T: Molybdenum	7439-98-7	50 mg/kg	90.9	79	117
		EG005T: Nickel	7440-02-0	50 mg/kg	86.3	78	120
		EG005T: Selenium	7782-49-2	50 mg/kg	89.4	71	125
		EG005T: Vanadium	7440-62-2	50 mg/kg	96.6	76	124
		EG005T: Zinc	7440-66-6	50 mg/kg	84.2	74	128
EG035T: Total Recoverable Mercury by FIMS (QCLot: 491829)							
EM1607137-006	PTH-16-0042	EG035T: Mercury	7439-97-6	5 mg/kg	89.0	76	116
EK040T: Fluoride Total (QCLot: 491827)							
EM1607137-006	PTH-16-0042	EK040T: Fluoride	16984-48-8	400 mg/kg	88.2	70	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 491663)							
EM1607082-019	Anonymous	EP066-EM: Total Polychlorinated biphenyls	----	0.5 mg/kg	113	36	152
EP075A: Phenolic Compounds (Halogenated) (QCLot: 491662)							
EM1607082-032	Anonymous	EP075-EM: 2-Chlorophenol	95-57-8	0.5 mg/kg	76.7	34	118
		EP075-EM: 4-Chloro-3-methylphenol	59-50-7	0.5 mg/kg	84.8	41	139
		EP075-EM: Pentachlorophenol	87-86-5	0.5 mg/kg	37.8	10	144
EP075A: Phenolic Compounds (Non-halogenated) (QCLot: 491662)							
EM1607082-032	Anonymous	EP075-EM: Phenol	108-95-2	0.5 mg/kg	85.2	32	134
		EP075-EM: 2-Nitrophenol	88-75-5	0.5 mg/kg	81.8	13	129
EP075B: Polynuclear Aromatic Hydrocarbons (QCLot: 491662)							
EM1607082-032	Anonymous	EP075-EM: Acenaphthene	83-32-9	0.5 mg/kg	100.0	46	138
		EP075-EM: Pyrene	129-00-0	0.5 mg/kg	# Not Determined	27	169

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 492650)							
EM1607137-001	PTH-16-0037	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	# Not Determined	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED045G: Chloride by Discrete Analyser (QCLot: 492649)							
EM1607117-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 492518)							
EM1607055-008	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	# Not Determined	85	131
		EG020A-F: Beryllium	7440-41-7	0.2 mg/L	98.6	73	141
		EG020A-F: Barium	7440-39-3	0.2 mg/L	92.2	75	127
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	89.1	81	133
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	93.1	71	135
		EG020A-F: Cobalt	7440-48-4	0.2 mg/L	97.9	78	132
		EG020A-F: Copper	7440-50-8	0.2 mg/L	92.7	76	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	92.0	75	133
		EG020A-F: Manganese	7439-96-5	0.2 mg/L	88.4	64	134
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	93.8	73	131
		EG020A-F: Vanadium	7440-62-2	0.2 mg/L	93.4	73	131
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	94.2	75	131
EG020T: Total Metals by ICP-MS (QCLot: 492514)							
EM1606978-001	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	101	82	118
		EG020A-T: Beryllium	7440-41-7	1 mg/L	102	79	121
		EG020A-T: Barium	7440-39-3	1 mg/L	103	80	114
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	97.2	75	129
		EG020A-T: Chromium	7440-47-3	1 mg/L	102	80	118
		EG020A-T: Cobalt	7440-48-4	1 mg/L	103	82	120
		EG020A-T: Copper	7440-50-8	1 mg/L	99.0	81	115
		EG020A-T: Lead	7439-92-1	1 mg/L	99.8	83	121
		EG020A-T: Manganese	7439-96-5	1 mg/L	98.2	73	123
		EG020A-T: Nickel	7440-02-0	1 mg/L	100.0	80	118
		EG020A-T: Vanadium	7440-62-2	1 mg/L	102	81	119
		EG020A-T: Zinc	7440-66-6	1 mg/L	103	74	116
EG035C: Leachable Mercury by FIMS (QCLot: 492655)							
EM1607026-002	Anonymous	EG035C: Mercury	7439-97-6	0.01 mg/L	98.4	84	118
EG035F: Dissolved Mercury by FIMS (QCLot: 492520)							
EM1607155-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	98.5	70	120
EG035T: Total Recoverable Mercury by FIMS (QCLot: 492501)							
EM1607040-023	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	97.6	70	130
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 492654)							
EM1607137-002	PTH-16-0038	EG051G: Ferrous Iron	----	2 mg/L	87.7	70	128

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG051G: Ferrous Iron by Discrete Analyser (QCLot: 492894)							
EM1607137-013	PTH-16-0045 Leached using PTH-16-0047	EG051G: Ferrous Iron	----	2 mg/L	98.8	70	128
EK040P: Fluoride by PC Titrator (QCLot: 493092)							
EM1607137-003	PTH-16-0039	EK040P: Fluoride	16984-48-8	5 mg/L	84.6	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 492404)							
EM1607137-002	PTH-16-0038	EK055G: Ammonia as N	7664-41-7	1 mg/L	111	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 492666)							
EM1607137-013	PTH-16-0045 Leached using PTH-16-0047	EK055G: Ammonia as N	7664-41-7	1 mg/L	122	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 492651)							
EM1607137-001	PTH-16-0037	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	97.0	80	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 492405)							
EM1607137-002	PTH-16-0038	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	97.6	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 492667)							
EM1607137-013	PTH-16-0045 Leached using PTH-16-0047	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	109	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 492738)							
EM1607137-001	PTH-16-0037	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	102	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 492739)							
EM1607137-001	PTH-16-0037	EK067G: Total Phosphorus as P	----	1 mg/L	74.0	70	130
EP002: Dissolved Organic Carbon (DOC) (QCLot: 493089)							
EM1607137-002	PTH-16-0038	EP002: Dissolved Organic Carbon	----	100 mg/L	97.8	75	117
EP005: Total Organic Carbon (TOC) (QCLot: 493088)							
EM1607137-002	PTH-16-0038	EP005: Total Organic Carbon	----	100 mg/L	95.1	80	114

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1607137**	Page	: 1 of 18
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS	Telephone	: +61-3-8549 9600
Project	: Alcoa Anglesea Waters and Solids	Date Samples Received	: 20-Jun-2016
Site	: Point Henry	Issue Date	: 23-Jun-2016
Sampler	: ----	No. of samples received	: 13
Order number	: 6681114	No. of samples analysed	: 11

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Duplicate outliers occur.**
- **Method Blank value outliers exist - please see following pages for full details.**
- **Laboratory Control outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **Surrogate recovery outliers exist for all regular sample matrices - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG005T: Total Metals by ICP-AES	EM1607137--006	PTH-16-0042	**Barium**	7440-39-3	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG005T: Total Metals by ICP-AES	EM1607137--006	PTH-16-0042	**Manganese**	7439-96-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EP075B: Polynuclear Aromatic Hydrocarbons	EM1607082--032	Anonymous	**Pyrene**	129-00-0	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Method Blank (MB) Values							
EG005C: Leachable Metals by ICPAES	QC-492669-001	----	**Boron**	7440-42-8	29.9 mg/L	0.1 mg/L	**Blank result exceeds permitted value**
EG005C: Leachable Metals by ICPAES	QC-492671-001	----	**Boron**	7440-42-8	0.3 mg/L	0.1 mg/L	**Blank result exceeds permitted value**
EG005C: Leachable Metals by ICPAES	QC-492671-001	----	**Iron**	7439-89-6	31.8 mg/L	0.1 mg/L	**Blank result exceeds permitted value**
EG005C: Leachable Metals by ICPAES	QC-492671-001	----	**Manganese**	7439-96-5	1.1 mg/L	0.1 mg/L	**Blank result exceeds permitted value**
EP002: Dissolved Organic Carbon (DOC)	QC-494406-001	----	**Dissolved Organic Carbon**	----	2 mg/L	1 mg/L	**Blank result exceeds permitted value**
Laboratory Control Spike (LCS) Recoveries							
EG005C: Leachable Metals by ICPAES	QC-492671-002	----	**Iron**	7439-89-6	3230 %	86-122%	**Recovery greater than upper control limit**
EG005C: Leachable Metals by ICPAES	QC-492671-002	----	**Manganese**	7439-96-5	206 %	90-114%	**Recovery greater than upper control limit**
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EM1607137--001	PTH-16-0037	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	EM1607117--002	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG020F: Dissolved Metals by ICP-MS	EM1607055--008	Anonymous	**Arsenic**	7440-38-2	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Regular Sample Surrogates

Sub-Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment

Sub-Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Samples Submitted							
EP074S: VOC Surrogates	EM1607137-012	PTH-16-0048	**4-Bromofluorobenzene**	460-00-4	55.2 %	59-123 %	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	----	----	----	22-Jun-2016	21-Jun-2016	**1**

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Hexavalent Chromium by Alkaline Digestion and DA Finish	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	0	1	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Leachable Metals by ICPAES	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved (EA001)							
PTH-16-0048	**20-Jun-2016**	**21-Jun-2016**	27-Jun-2016	✓	**21-Jun-2016**	21-Jun-2016	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002 : pH (Soils)							
Soil Glass Jar - Unpreserved (EA002)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	27-Jun-2016	✓	**21-Jun-2016**	21-Jun-2016	✓
EA010: Conductivity							
Soil Glass Jar - Unpreserved (EA010)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	27-Jun-2016	✓	**21-Jun-2016**	19-Jul-2016	✓
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044, PTH-16-0048	**20-Jun-2016**	**----**	----	----	**20-Jun-2016**	04-Jul-2016	✓
ED037: Alkalinity							
Soil Glass Jar - Unpreserved (ED037)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	17-Dec-2016	✓	**22-Jun-2016**	17-Dec-2016	✓
ED038A: Acidity							
Soil Glass Jar - Unpreserved (ED038)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	17-Dec-2016	✓	**22-Jun-2016**	17-Dec-2016	✓
ED040S : Soluble Sulfate by ICPAES							
Soil Glass Jar - Unpreserved (ED040S)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	18-Jul-2016	✓	**21-Jun-2016**	19-Jul-2016	✓
ED045G: Chloride by Discrete Analyser							
Soil Glass Jar - Unpreserved (ED045G)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	18-Jul-2016	✓	**21-Jun-2016**	19-Jul-2016	✓
ED093S: Soluble Major Cations							
Soil Glass Jar - Unpreserved (ED093S)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**21-Jun-2016**	17-Dec-2016	✓	**21-Jun-2016**	17-Dec-2016	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044, PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	17-Dec-2016	✓	**21-Jun-2016**	17-Dec-2016	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044, PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	18-Jul-2016	✓	**21-Jun-2016**	18-Jul-2016	✓
EG048: Hexavalent Chromium (Alkaline Digest)							
Soil Glass Jar - Unpreserved (EG048G)							
PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	18-Jul-2016	✓	**21-Jun-2016**	27-Jun-2016	✓
EK026SF: Total CN by Segmented Flow Analyser							
Soil Glass Jar - Unpreserved (EK026SF)							
PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	04-Jul-2016	✓	**21-Jun-2016**	04-Jul-2016	✓
EK040T: Fluoride Total							
Soil Glass Jar - Unpreserved (EK040T)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044, PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	18-Jul-2016	✓	**22-Jun-2016**	18-Jul-2016	✓
EN60: ASLP Leaching Procedure							
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60a)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**20-Jun-2016**	**21-Jun-2016**	18-Jul-2016	✓	**----**	----	----
EN60Z: ASLP Leachate - ZHE							
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**20-Jun-2016**	**21-Jun-2016**	04-Jul-2016	✓	**----**	----	----
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066-EM)							
PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	04-Jul-2016	✓	**21-Jun-2016**	30-Jul-2016	✓
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP071-EM)							
PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	04-Jul-2016	✓	**21-Jun-2016**	30-Jul-2016	✓
EP074A: Monocyclic Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP074-UT)							
PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	27-Jun-2016	✓	**21-Jun-2016**	27-Jun-2016	✓
EP075A: Phenolic Compounds (Non-halogenated)							
Soil Glass Jar - Unpreserved (EP075-EM)							
PTH-16-0048	**20-Jun-2016**	**20-Jun-2016**	04-Jul-2016	✓	**21-Jun-2016**	30-Jul-2016	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**20-Jun-2016**	20-Jun-2016	✓
Clear Plastic Bottle - Natural (EA005-P)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**22-Jun-2016**	21-Jun-2016	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**22-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Natural (EA010-P)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**22-Jun-2016**	19-Jul-2016	✓
EA045: Turbidity							
Clear Plastic Bottle - Natural (EA045)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	22-Jun-2016	✓
EA075: Redox Potential							
Clear Plastic Bottle - Natural (EA075)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**20-Jun-2016**	20-Jun-2016	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**22-Jun-2016**	04-Jul-2016	✓
Clear Plastic Bottle - Natural (ED037-P)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**22-Jun-2016**	05-Jul-2016	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Natural (ED041G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**21-Jun-2016**	19-Jul-2016	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Natural (ED045G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**21-Jun-2016**	19-Jul-2016	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F)								
PTH-16-0045 - Leached using PTH-16-0040,	PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**----**	----	----	**21-Jun-2016**	28-Jun-2016	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**----**	----	----	**21-Jun-2016**	18-Jul-2016	✓
EG005C: Leachable Metals by ICPAES								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)								
PTH-16-0045 - Leached using PTH-16-0040,	PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**21-Jun-2016**	18-Dec-2016	✓	**21-Jun-2016**	18-Dec-2016	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**----**	----	----	**21-Jun-2016**	17-Dec-2016	✓
EG020T: Total Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG020A-T)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**21-Jun-2016**	17-Dec-2016	✓	**21-Jun-2016**	17-Dec-2016	✓
EG035C: Leachable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)								
PTH-16-0045 - Leached using PTH-16-0040,	PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**----**	----	----	**21-Jun-2016**	19-Jul-2016	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**----**	----	----	**22-Jun-2016**	18-Jul-2016	✓
EG035T: Total Recoverable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unspecified (EG035T)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**----**	----	----	**21-Jun-2016**	18-Jul-2016	✓
EG051G: Ferrous Iron by Discrete Analyser								
Clear Plastic Bottle - HCl - Filtered (EG051G)								
PTH-16-0045 - Leached using PTH-16-0040,	PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**----**	----	----	**21-Jun-2016**	28-Jun-2016	✓
Clear Plastic Bottle - Natural (EG051G)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**----**	----	----	**21-Jun-2016**	21-Jun-2016	✓
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
PTH-16-0037, PTH-16-0039,	PTH-16-0038, PTH-16-0046	**20-Jun-2016**	**----**	----	----	**22-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Natural (EK040P)								
PTH-16-0045 - Leached using PTH-16-0040,	PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**----**	----	----	**22-Jun-2016**	19-Jul-2016	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**22-Jun-2016**	19-Jul-2016	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	22-Jun-2016	✓
Clear Plastic Bottle - Natural (EK057G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**21-Jun-2016**	23-Jun-2016	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**22-Jun-2016**	19-Jul-2016	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	**22-Jun-2016**	18-Jul-2016	✓	**22-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**22-Jun-2016**	19-Jul-2016	✓	**22-Jun-2016**	19-Jul-2016	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	**22-Jun-2016**	18-Jul-2016	✓	**22-Jun-2016**	18-Jul-2016	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	**22-Jun-2016**	19-Jul-2016	✓	**22-Jun-2016**	19-Jul-2016	✓
EP002: Dissolved Organic Carbon (DOC)							
Amber DOC Filtered- Sulfuric Preserved (EP002)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	18-Jul-2016	✓
Amber DOC Filtered- Sulfuric Preserved (EP002)							
PTH-16-0045 - Leached using PTH-16-0040, PTH-16-0045 - Leached using PTH-16-0047	**21-Jun-2016**	----	----	----	**22-Jun-2016**	19-Jul-2016	✓
EP005: Total Organic Carbon (TOC)							
Amber TOC Vial - Sulfuric Acid (EP005)							
PTH-16-0037, PTH-16-0038, PTH-16-0039, PTH-16-0046	**20-Jun-2016**	----	----	----	**21-Jun-2016**	18-Jul-2016	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acidity in Soil	ED038	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Alkalinity in Soil	ED037	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055-103	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acidity in Soil	ED038	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Alkalinity in Soil	ED037	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Acidity in Soil	ED038	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Method Blanks (MB) - Continued							
Chloride Soluble By Discrete Analyser	ED045G	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	1	100.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	1	100.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	1	1	100.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	1	1	100.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride Soluble By Discrete Analyser	ED045G	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	0	1	0.00	5.00	×	NEPM 2013 B3 & ALS QC Standard
PCB - VIC EPA 448.3 Screen	EP066-EM	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Semivolatile Organic Compounds - Waste Classification	EP075-EM	1	12	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	0	1	0.00	5.00	×	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071-EM	0	1	0.00	5.00	×	NEPM 2013 B3 & ALS QC Standard
Volatile Organic Compounds - Ultra-trace	EP074-UT	0	1	0.00	5.00	×	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	3	6	50.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	2	8	25.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	2	100.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	3	16	18.75	10.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP) - Continued							
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Redox Potential	EA075	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Turbidity	EA045	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	3	6	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	2	8	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	2	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Redox Potential	EA075	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Turbidity	EA045	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Dissolved Organic Carbon	EP002	3	6	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	2	8	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	2	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	16	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Turbidity	EA045	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ferrous Iron by Discrete Analyser	EG051G	2	8	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	0	2	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Higginson 4B1 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
pH (1:5)	EA002	SOIL	In house: Referenced to APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
pH by PC Titrator	EA005-P	SOIL	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3) (Method 104)
Conductivity by PC Titrator	EA010-P	SOIL	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Calculated TDS (from Electrical Conductivity)	EA016	SOIL	In house: Calculation from Electrical Conductivity (APHA 2510 B) using a conversion factor specified in the analytical report. This method is compliant with NEPM (2013) Schedule B(3)
Moisture Content	EA055-103	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Alkalinity in Soil	ED037	SOIL	In house: Referenced to APHA 2320 B Alkalinity is determined and reported on a 1:5 soil/water leach.
Alkalinity by PC Titrator	ED037-P	SOIL	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Acidity in Soil	ED038	SOIL	In house: Referenced to APHA 2310B
Major Anions - Soluble	ED040S	SOIL	In house: Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	SOIL	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	SOIL	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Cations - soluble by ICP-AES	ED093S	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Leachable Metals by ICPAES	EG005C	SOIL	In house: referenced to APHA 3120; USEPA SW 846 - 6010: The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (2013) Schedule B(3)
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3)
Leachable Mercury by FIMS	EG035C	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060A. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ferrous Iron by Discrete Analyser	EG051G	SOIL	In house: Referenced to APHA 3500 Fe-B. A colorimetric determination based on the reaction between phenanthroline and ferrous iron at pH 3.2-3.3 to form an orange-red complex that is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	SOIL	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.

Analytical Methods	Method	Matrix	Method Descriptions
Ammonia as N by Discrete analyser	EK055G	SOIL	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	SOIL	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	SOIL	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Organic Carbon	EP002	SOIL	In house: Referenced to APHA 5310 B. This method is compliant with NEPM (2013) Schedule B(3) . Samples are combusted at high termperature in the presence of an oxidative catalyst. The evolved carbon dioxide is quantified using an IR detector.
PCB - VIC EPA 448.3 Screen	EP066-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3) (Method 504)
TRH - Semivolatile Fraction	EP071-EM	SOIL	In house: Referenced to USEPA SW 846 - 8015A Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
Volatile Organic Compounds - Ultra-trace	EP074-UT	SOIL	In house: Referenced to USEPA SW 846 - 8260B Extracts are analysed by Purge and Trap, Capillary GC/MS in partial SIM/Scan mode. Quantification is by comparison against an established multi-point calibration curves. This method is compliant with NEPM (2013) Schedule B(3) (Method 501)
Volatile Organic Compounds - Ultra-trace - Summations	EP074-UT-SUM	SOIL	Summation of MAHs and VHCs
Semivolatile Organic Compounds - Waste Classification	EP075-EM	SOIL	In house: Referenced to USEPA SW 846 - 8270D Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM (2013) Schedule B(3) (Method 502)
SVOC - Waste Classification (Sums)	EP075-EM-SUM	SOIL	Summations for EP075 (EM variation)
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Calculated TDS (from Electrical Conductivity)	EA016	WATER	In house: Calculation from Electrical Conductivity (APHA 2510 B) using a conversion factor specified in the analytical report. This method is compliant with NEPM (2013) Schedule B(3)
Turbidity	EA045	WATER	In house: Referenced to APHA 2130 B. This method is compliant with NEPM (2013) Schedule B(3)
Redox Potential	EA075	WATER	In house: Ion selective electrode
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ferrous Iron by Discrete Analyser	EG051G	WATER	In house: Referenced to APHA 3500 Fe-B. A colorimetric determination based on the reaction between phenanthroline and ferrous iron at pH 3.2-3.3 to form an orange-red complex that is measured against a five-point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Organic Carbon	EP002	WATER	In house: Referenced to APHA 5310 B. This method is compliant with NEPM (2013) Schedule B(3) . Samples are combusted at high termperature in the presence of an oxidative catalyst. The evolved carbon dioxide is quantified using an IR detector.
Total Organic Carbon	EP005	WATER	In house: Referenced to APHA 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Higginson 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM (2013) Schedule B(3) (Method 103)
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes	EN60a	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
ASLP for Volatile Analytes (Zero Headspace Extraction)	EN60Za	SOIL	In house QWI-EN/60 referenced to AS4439.2 Preparation of Leachates
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Methanolic Extraction of Soils - Ultra-trace.	ORG16-UT	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
Tumbler Extraction of Solids - VIC EPA Screen	ORG17A-EM	SOIL	In house: Mechanical agitation (tumbler). 20g of sample, Na2SO4 and surrogate are extracted with 150mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY

Client:	ALCOA OF AUSTRALIA	**Project Description**	Alcoa Anglesea Waters and Solids
Address:	Point Henry Works, Geelong, 3220	**Order No:**	**PO 6681114**
		Preservative:	**As per bottles**
Contact:	**Nicci Marris**	**Date Required:**	**2 day turnaround from receipt (for most analytes)**
Telephone:	(03) 5245 1640	**Electronic Results File:**	**N/A**
Facsimile:			

Laboratory:	ALS Environmental (Water Resources Group)
Address:	49 Carr Street, South Geelong 3220/ Springvale
Contact:	Mr Frank Matthies/ Bronwyn Sheen
Telephone:	(03) 5226 9249
Facsimile:	(03) 5229 0242

Split batch of EM1607137

Alcoa Sample ID	Lab Ref	Date Sampled	Time Sampled	Sample Type	Table 1 Analytical Schedule for solid sampling	Table 2 Analytical Schedule for water sampling	Table 3 ASLP proposed schedule of tests	Inorg - EPA pno. 62/.
1 PTH-16-0037	–	20/6/16	0900	W		✓		
2 PTH-16-0038	–	20/6/16	0900	W		✓		
3 PTH-16-0039	–	20/6/16	0900	W		✓		
4 PTH-16-0040	–	20/6/16	0900	W			*	
5 PTH-16-0041	1	20/6/16	0900	S	✓			
6 PTH-16-0042	2	20/6/16	0900	S	✓			
7 PTH-16-0043	3	20/6/16	0900	S	✓			
8 PTH-16-0044	4.	20/6/16	0900	S	✓			
9 PTH-16-0045	–	20/6/16	0900	S			✓*	
10 PTH-16-0046	–	20/6/16	0900	W		✓		
11 PTH-16-0047	–	20/6/16	0900	W			*	
12 PTH-16-0048	–	20/6/16	0900	s	✓			✓

PTH-16-0047 and PTH-16-0040 to be used for leachate testing on PTH-16-0045

Environmental Division Melbourne
Work Order Reference
EM1607144 SH 20/6

Telephone : +61-3-8549 9600

Relinquished by: Nicci Marris			Received by: Bharathi (ALS)	Batch No:	
Signed:	Date: 20/6/2016	Time: 1000	Signed:	Date: 20/6/16	Time: 12:20

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
	solids			
Laboratory analysis minor ions	Fluoride		chill	to be confirmed by ALS PTY Ltd
Laboratory analysis nutrients	ammonia as N, ammonium as N, nitrate as N, total kjeldahl nitrogen, total phosphorus, total organic carbon, dissolved organic carbon		chill (12 hr holding time for ammonia)	to be confirmed by ALS PTY Ltd
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd
Laboratory analysis (dissolved) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, ferrous iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd

Table 3 ASLP proposed schedule of tests

Solid Sample type	Reagent water
Solid from PTH-16-0045	Water – PTH-16-0047
Solid from PTH-16-0045	Water – PTH-16-0040
Total number of ASLP tests	2

Rec'd by: Bharath (ALS)
20/6/16 13.25

Bronwyn Sheen

From: Bronwyn Sheen
Sent: Friday, 17 June 2016 3:58 PM
To: 'Marris, Nicci'
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
OK, if we are going to get the samples the day they are taken we can deal with them once they get here. This will change what bottles you need to take for the water samples though, please see the revised list below. This change is necessary as it important not to preserve the samples prior to the filtration.

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic

Just on further thing, the turn around surcharges are listed on the front of the quote, I have confirmed with our laboratory co-ordinator that we could report everything except CEC, PSD, TOC and the AMD parameters on a two day turn around from Monday if you require.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

T +61 3 8549 9600 D +61 3 8549 9636
F +61 3 8549 9626 M +61 4 3817 4359
bronwyn.sheen@alsglobal.com
2-4 Westall Rd
Springvale Vic 3171
Australia

From: Marris, Nicci [mailto:Nicci.Marris@alcoa.com.au]
Sent: Friday, 17 June 2016 3:21 PM
To: Bronwyn Sheen
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Thank you very much Bronwyn,

We can do temperature and pH in the field, but we cannot do the in-field filtration. Can this be done at the Geelong lab prior to the samples being couriered to you?

In regard to the leachate testing, it is one soil leached with two different waters.

I will call through Geelong in the next hour to collect the sample bottles. We will raise a req based on a faster TAT now.

Thanks again
Nicci

From: Bronwyn Sheen [mailto:bronwyn.sheen@alsglobal.com]
Sent: Friday, June 17, 2016 2:32 PM
To: Marris, Nicci <Nicci.Marris@alcoa.com.au>
Subject: EXT: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
Please find attached the quote for this work, there are just a few things to keep in mind.

We will required the field temperature and pH to be detailed on the CoC to enable us to calculate the ammonium.

The DOC, dissolved metals and ferrous iron all need to be field filtered to 0.45 um.

I have sent more bottles that you actually require, breaking down what you need to sample is as follows:

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial (filtered) ← DOC
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic (filtered) ← Dissolved Metals
1 x 60 ml nitric acid preserved, red, plastic
1 x 60 ml hydrochloric acid preserved, maroon, plastic ← Ferrous

Soils – per sample
2 x 150 ml soils jars, orange
1 x 500 ml snap lock bag (PSD)
1 x 250 ml snap lock bags (ASS)

Leachates – per sample (I'm not entirely sure if you require two different soils leached or just one soil leached with two different waters.)
2 x 250 ml soils jars , orange
3 x 1lt unpreserved, green, plastic

All of the bottles are jars have been delivered to our Geelong laboratory and are ready for collection whenever you are ready.

Just one more thing, when I originally spoke to Rebecca, she mentioned that you may need the water that is to be used for the leachate filtered prior to the leaching being performed. Is this still required? We could filter it to 0.7um which is the same as the post leaching filtration if required.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

Split batch of EM1607137

CHAIN OF CUSTODY

ALCOA

Client:	ALCOA OF AUSTRALIA	**Project Description**	Alcoa Anglesea Waters and Solids
Address:	Point Henry Works, Geelong, 3220	**Order No:**	**PO 6681114**
		Preservative:	**As per bottles**
Contact:	**Nicci Marris**	**Date Required:**	**2 day turnaround from receipt (for most analytes)**
Telephone:	(03) 5245 1640	**Electronic Results File:**	**N/A**
Facsimile:			

SCANNED

Laboratory: ALS Environmental (Water Resources Group)
Address: 49 Carr Street, South Geelong 3220/ Springvale
Contact: Mr Frank Matthies/ Bronwyn Sheen
Telephone: (03) 5226 9249
Facsimile: (03) 5229 0242

Alcoa Sample ID	Lab Ref	Date Sampled	Time Sampled	Sample Type	Table 1 Analytical Schedule for solid sampling	Table 2 Analytical Schedule for water sampling	Table 3 ASLP proposed schedule of tests	Inreg - EPA pwo. 621.
PTH-16-0037	–	20/6/16	0900	W		✓		
PTH-16-0038	–	20/6/16	0900	W		✓		
PTH-16-0039	–	20/6/16	0900	W		✓		
PTH-16-0040	–	20/6/16	0900	W			*	
PTH-16-0041	1	20/6/16	0900	S	✓			
PTH-16-0042	2	20/6/16	0900	S	✓			
PTH-16-0043	3	20/6/16	0900	S	✓			
PTH-16-0044	4.	20/6/16	0900	S	✓			
PTH-16-0045	–	20/6/16	0900	S			✓*	
PTH-16-0046	–	20/6/16	0900	W		✓		
PTH-16-0047	–	20/6/16	0900	W			*	
PTH-16-0048	–	20/6/16	0900	s	✓			✓

PTH-16-0047 and PTH-16-0040 to be used for leachate testing on PTH-16-0045

Environmental Division
Melbourne
Work Order Reference
EM1607144
Telephone : +61-3-8549 9600

Relinquished by: Nicci Marris			Received by: Bharathi (ALS)	Batch No:
Signed:	Date: 20/62016	Time: 1000	Signed:	Date: 20/6/16 Time: 13:25

Table 1 Analytical Schedule for solid sampling

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
Laboratory analysis major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate and carbonate)	NT-1S, NT-2S, ED037	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis miscellaneous	Soluble sulfate	ED040S	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis minor ions	Fluoride	EK040T	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	S-3 plus aluminium, boron, iron, molybdenum and tin	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis physico-chemical	Particle size distribution, moisture content, exchangeable cations, pH, total acidity, total organic carbon	EA055, ED006, ED038, EA002, EP004	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	pH1:2 and EC1:2	AMIRA P387A tests	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Maximum potential acidity (MPA)	Total sulfur Leco determination	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Acid Neutralising Capacity (ANC)	EA013	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Net Acid Producing Potential (NAPP)	ASS-1	chill	to be confirmed by ALS PTY Ltd
Laboratory analysis	Net Acid Generation (NAG)	EA011	chill	to be confirmed by ALS PTY Ltd

Table 2 Analytical Schedule for water sampling

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
Field parameters	pH, temperature, turbidity, electrical conductivity, dissolved oxygen, redox potential	not applicable	not applicable	not applicable
Laboratory measured 'field' parameters (where instrumentation is not available)	pH, turbidity, electrical conductivity, redox potential	EA005, EA010, EA075, EA045	chill (6 hr holding time for pH)	to be confirmed by ALS PTY Ltd
Laboratory analysis major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate and carbonate), total hardness, total dissolved	NT-14	chill, ALS provided bottle spiked with nitric acid (cations and hardness only)	to be confirmed by ALS PTY Ltd

Analytical Group	Analytical Parameter	ALS method code (as a guide only, all analytical parameters to be measured and reported)	Sample preservation	Sample volume
	solids			
Laboratory analysis minor ions	Fluoride		chill	to be confirmed by ALS PTY Ltd
Laboratory analysis nutrients	ammonia as N, ammonium as N, nitrate as N, total kjeldahl nitrogen, total phosphorus, total organic carbon, dissolved organic carbon		chill (12 hr holding time for ammonia)	to be confirmed by ALS PTY Ltd
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd
Laboratory analysis (dissolved) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury	NEPM S-3 plus aluminium, boron, iron, ferrous iron, molybdenum and tin	chill, ALS provided bottle spiked with nitric acid	to be confirmed by ALS PTY Ltd

Table 3 ASLP proposed schedule of tests

Solid Sample type	Reagent water
Solid from PTH-16-0045	Water – PTH-16-0047
Solid from PTH-16-0045	Water – PTH-16-0040
Total number of ASLP tests	2

Rec'd by: Bharath (ALS)
20/6/16 13.25

Bronwyn Sheen

From: Bronwyn Sheen
Sent: Friday, 17 June 2016 3:58 PM
To: 'Marris, Nicci'
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
OK, if we are going to get the samples the day they are taken we can deal with them once they get here. This will change what bottles you need to take for the water samples though, please see the revised list below. This change is necessary as it important not to preserve the samples prior to the filtration.

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic

Just on further thing, the turn around surcharges are listed on the front of the quote, I have confirmed with our laboratory co-ordinator that we could report everything except CEC, PSD, TOC and the AMD parameters on a two day turn around from Monday if you require.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

T +61 3 8549 9600 D +61 3 8549 9636
F +61 3 8549 9626 M +61 4 3817 4359
bronwyn.sheen@alsglobal.com
2-4 Westall Rd
Springvale Vic 3171
Australia

From: Marris, Nicci [mailto:Nicci.Marris@alcoa.com.au]
Sent: Friday, 17 June 2016 3:21 PM
To: Bronwyn Sheen
Cc: Rolland, Chris
Subject: RE: RE: Quote for Analytical work - solid and water samples

Thank you very much Bronwyn,

We can do temperature and pH in the field, but we cannot do the in-field filtration. Can this be done at the Geelong lab prior to the samples being couriered to you?

In regard to the leachate testing, it is one soil leached with two different waters.

I will call through Geelong in the next hour to collect the sample bottles. We will raise a req based on a faster TAT now.

Thanks again
Nicci

From: Bronwyn Sheen [mailto:bronwyn.sheen@alsglobal.com]
Sent: Friday, June 17, 2016 2:32 PM
To: Marris, Nicci <Nicci.Marris@alcoa.com.au>
Subject: EXT: RE: Quote for Analytical work - solid and water samples

Hi Nicci,
Please find attached the quote for this work, there are just a few things to keep in mind.

We will required the field temperature and pH to be detailed on the CoC to enable us to calculate the ammonium.

The DOC, dissolved metals and ferrous iron all need to be field filtered to 0.45 um.

I have sent more bottles that you actually require, breaking down what you need to sample is as follows:

Waters – per sample
1 x 500 ml unpreserved, green, plastic
1 x 60 ml sulphuric acid preserved, purple, plastic
1 x 40 ml sulphuric acid preserved, purple, vial (filtered) ← DOC
1 x 40 ml sulphuric acid preserved, purple, vial
1 x 60 ml nitric acid preserved, red, plastic (filtered) ← Dissolved Metals
1 x 60 ml nitric acid preserved, red, plastic
1 x 60 ml hydrochloric acid preserved, maroon, plastic ← Ferrous

Soils – per sample
2 x 150 ml soils jars, orange
1 x 500 ml snap lock bag (PSD)
1 x 250 ml snap lock bags (ASS)

Leachates – per sample (I'm not entirely sure if you require two different soils leached or just one soil leached with two different waters.)
2 x 250 ml soils jars , orange
3 x 1lt unpreserved, green, plastic

All of the bottles are jars have been delivered to our Geelong laboratory and are ready for collection whenever you are ready.

Just one more thing, when I originally spoke to Rebecca, she mentioned that you may need the water that is to be used for the leachate filtered prior to the leaching being performed. Is this still required? We could filter it to 0.7um which is the same as the post leaching filtration if required.

Kind regards,

Bronwyn Sheen
Client Services Manager – Springvale
Environmental

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1607144**	Page	: 1 of 4
Amendment	: **1**		
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS	Contact	: Bronwyn Sheen
Address	: Kiora Crescent Lockbag 25, Fairfield YENNORA NSW 2165	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 02 9681 9555	Telephone	: +61-3-8549 9636
Project	: Alcoa Anglesea Waters and Solids	Date Samples Received	: 20-Jun-2016 13:25
Order number	: 6681114	Date Analysis Commenced	: 22-Jun-2016
C-O-C number	: ----	Issue Date	: 04-Jul-2016 12:06
Sampler	: ----		
Site	: Point Henry		
Quote number	: ----		
No. of samples received	: 4		
No. of samples analysed	: 4		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **29/6/2016: This report has been amended as it has been identified that an incorrect CEC methodology (ED008) has been applied due to a laboratory error. ALS method ED006 has now been scheduled, with results expected to be finalised by Friday, 1 July 2016.**
- This is a split batch of EM1607137 due to an urgent turnaround request for most analytes.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	----
			Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	----
Compound	CAS Number	LOR	Unit	EM1607144-001	EM1607144-002	EM1607144-003	EM1607144-004	--------
				Result	Result	Result	Result	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	0.9	-287	-224	-150	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.2	9.2	9.4	8.4	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	3.1	432	446	290	----
ANC as CaCO3	----	0.1	% CaCO3	0.3	44.0	45.5	29.6	----
Fizz Rating	----	0	Fizz Unit	0	5	5	4	----
EA150: Particle Sizing								
+75µm	----	1	%	18	3	5	25	----
+150µm	----	1	%	11	2	3	19	----
+300µm	----	1	%	8	<1	2	13	----
+425µm	----	1	%	7	<1	2	11	----
+600µm	----	1	%	6	<1	1	8	----
+1180µm	----	1	%	4	<1	<1	5	----
+2.36mm	----	1	%	1	<1	<1	2	----
+4.75mm	----	1	%	<1	<1	<1	<1	----
+9.5mm	----	1	%	<1	<1	<1	<1	----
+19.0mm	----	1	%	<1	<1	<1	<1	----
+37.5mm	----	1	%	<1	<1	<1	<1	----
+75.0mm	----	1	%	<1	<1	<1	<1	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	40	<1	2	3	----
Silt (2-60 µm)	----	1	%	33	96	85	72	----
Sand (0.06-2.00 mm)	----	1	%	25	4	13	22	----
Gravel (>2mm)	----	1	%	2	<1	<1	3	----
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	----
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	4.6	5.2	2.2	7.7	----
Exchangeable Magnesium	----	0.2	meq/100g	4.4	22.5	57.0	3.2	----
Exchangeable Potassium	----	0.2	meq/100g	0.7	<0.2	<0.2	0.3	----
Exchangeable Sodium	----	0.2	meq/100g	0.8	1.8	2.1	2.9	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	PTH-16-0041	PTH-16-0042	PTH-16-0043	PTH-16-0044	----
				Client sampling date / time	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	20-Jun-2016 09:00	----
Compound	CAS Number	LOR	Unit		EM1607144-001	EM1607144-002	EM1607144-003	EM1607144-004	--------
					Result	Result	Result	Result	----
ED006: Exchangeable Cations on Alkaline Soils - Continued									
Cation Exchange Capacity	----	0.2	meq/100g		**10.6**	**29.6**	**61.3**	**14.1**	**----**
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.13**	**4.74**	**7.27**	**4.58**	**----**
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		**0.48**	**2.27**	**1.47**	**9.57**	**----**

Certificate of Analysis

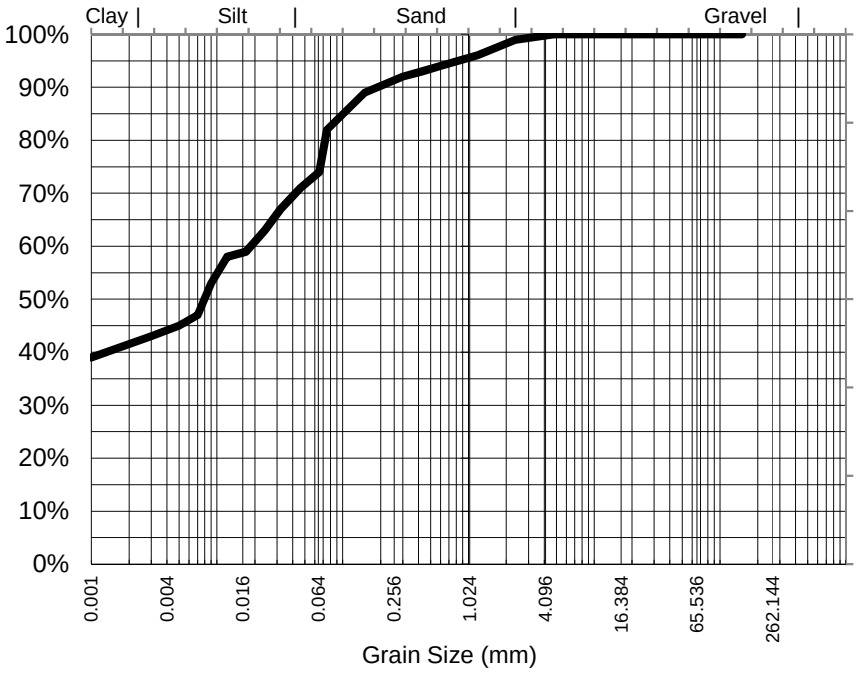
ALS Laboratory Group Pty Ltd
2 Byth Street,
Stafford, QLD 4053
pH 07 3552 8678
fax 07 3352 3662
samples.brisbane@alsglobal.com

ALS Environmental

Brisbane, QLD

CLIENT:	Niccimarris	**DATE REPORTED:**	29-Jun-2016
COMPANY:	ALCOA AUSTRALIA ROLLED PRODUCTS	**DATE RECEIVED:**	20-Jun-2016
ADDRESS:	Kiora Crescent Lockbag 25, Fairfield, YENNORA NSW 2165	**REPORT NO:**	EM1607144-001 / PSD
PROJECT:	Alcoa Anglesea Waters and Soilds	**SAMPLE ID:**	PTH-16-0041

Particle Size Distribution



Particle Size (mm)	Percent Passing
4.75	100%
2.36	99%
1.18	96%
0.600	94%
0.425	93%
0.300	92%
0.150	89%
0.075	82%
Particle Size (microns)	
65	74%
46	71%
32	67%
17	59%
9	53%
5	45%
1	39%

Samples analysed as received.

Median Particle Size (mm)*	0.008

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	24-Jun-16
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:		**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.3 2003	**Hydrometer Type**	ASTM E100

NATA Accreditation: 825 Site: Brisbane
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Satish Trivedi
Soil Chemist
Authorised Signatory

Certificate of Analysis

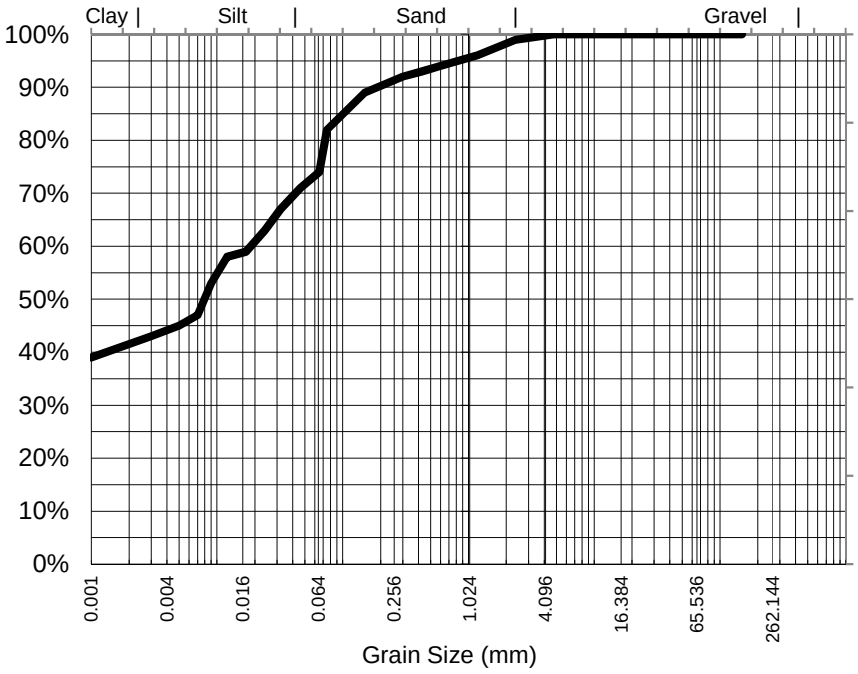
ALS Laboratory Group Pty Ltd
2 Byth Street,
Stafford, QLD 4053
pH 07 3552 8678
fax 07 3352 3662
samples.brisbane@alsglobal.com

ALS Environmental

Brisbane, QLD

CLIENT:	Niccimarris	**DATE REPORTED:**	29-Jun-2016
COMPANY:	ALCOA AUSTRALIA ROLLED PRODUCTS	**DATE RECEIVED:**	20-Jun-2016
ADDRESS:	Kiora Crescent Lockbag 25, Fairfield, YENNORA NSW 2165	**REPORT NO:**	EM1607144-001DUP / PSD
PROJECT:	Alcoa Anglesea Waters and Soilds	**SAMPLE ID:**	PTH-16-0041

Particle Size Distribution



Particle Size (mm)	Percent Passing
4.75	100%
2.36	99%
1.18	96%
0.600	94%
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Particle Size (microns)	
65	74%
46	71%
32	67%
17	59%
9	53%
5	45%
1	39%

Samples analysed as received.

Median Particle Size (mm)*	0.008

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	24-Jun-16
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:		**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.3 2003	**Hydrometer Type**	ASTM E100

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NATA
ACCREDITATION

Satish Trivedi
Soil Chemist
Authorised Signatory

Certificate of Analysis

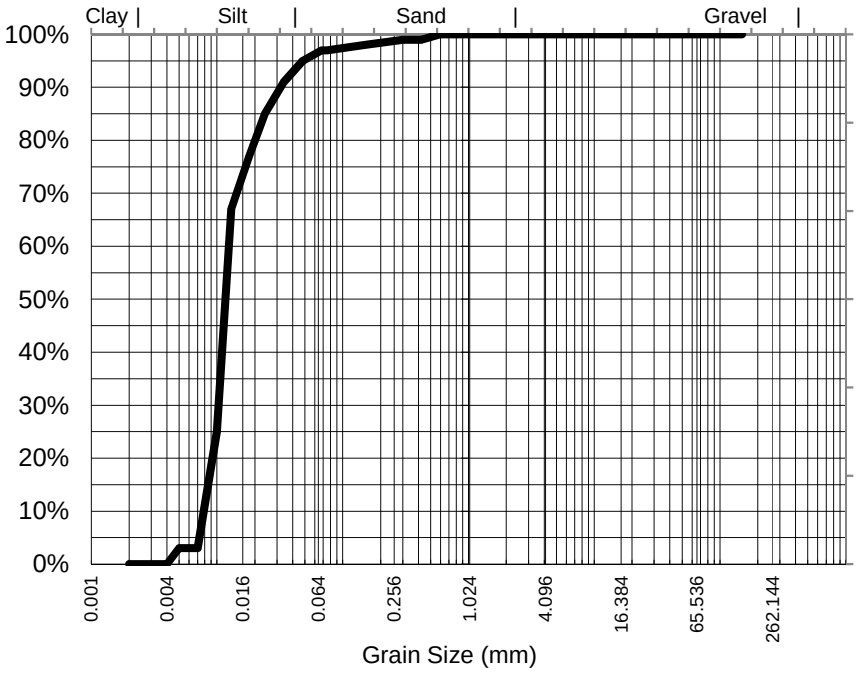
ALS Laboratory Group Pty Ltd
2 Byth Street,
Stafford, QLD 4053
pH 07 3552 8678
fax 07 3352 3662
samples.brisbane@alsglobal.com

ALS Environmental

Brisbane, QLD

CLIENT:	Niccimarris	**DATE REPORTED:**	29-Jun-2016
COMPANY:	ALCOA AUSTRALIA ROLLED PRODUCTS	**DATE RECEIVED:**	20-Jun-2016
ADDRESS:	Kiora Crescent Lockbag 25, Fairfield, YENNORA NSW 2165	**REPORT NO:**	EM1607144-002 / PSD
PROJECT:	Alcoa Anglesea Waters and Soilds	**SAMPLE ID:**	PTH-16-0042

Particle Size Distribution



Particle Size (mm)	Percent Passing
0.600	100%
0.425	99%
0.300	99%
0.150	98%
0.075	97%
Particle Size (microns)	
68	97%
48	95%
34	91%
18	77%
10	25%
5	3%
2	0%

Samples analysed as received.

Median Particle Size (mm)*	0.012

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	24-Jun-16
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:		**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.3 2003	**Hydrometer Type**	ASTM E100

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Satish Trivedi
Soil Chemist
Authorised Signatory

Certificate of Analysis

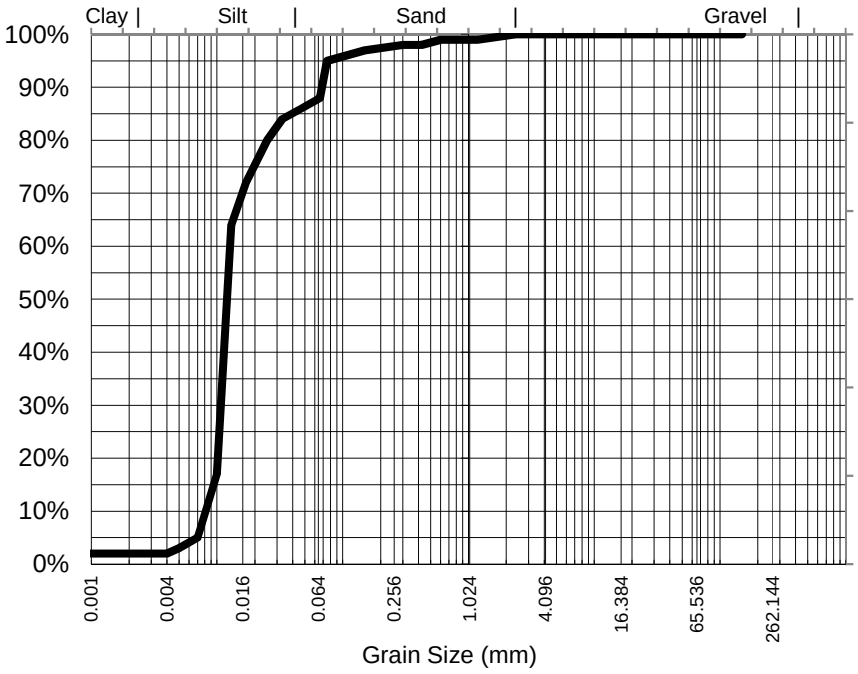
ALS Laboratory Group Pty Ltd
2 Byth Street,
Stafford, QLD 4053
pH 07 3552 8678
fax 07 3352 3662
samples.brisbane@alsglobal.com

ALS Environmental

Brisbane, QLD

CLIENT:	Niccimarris	**DATE REPORTED:**	29-Jun-2016
COMPANY:	ALCOA AUSTRALIA ROLLED PRODUCTS	**DATE RECEIVED:**	20-Jun-2016
ADDRESS:	Kiora Crescent Lockbag 25, Fairfield, YENNORA NSW 2165	**REPORT NO:**	EM1607144-003 / PSD
PROJECT:	Alcoa Anglesea Waters and Soilds	**SAMPLE ID:**	PTH-16-0043

Particle Size Distribution



Particle Size (mm)	Percent Passing
2.36	100%
1.18	99%
0.600	99%
0.425	98%
0.300	98%
0.150	97%
0.075	95%
Particle Size (microns)	
66	88%
47	86%
33	84%
17	72%
10	17%
5	3%
1	2%

Samples analysed as received.

Median Particle Size (mm)*	0.012

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	24-Jun-16
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:		**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.3 2003	**Hydrometer Type**	ASTM E100

NATA Accreditation: 825 Site: Brisbane
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Satish Trivedi
Soil Chemist
Authorised Signatory

Certificate of Analysis

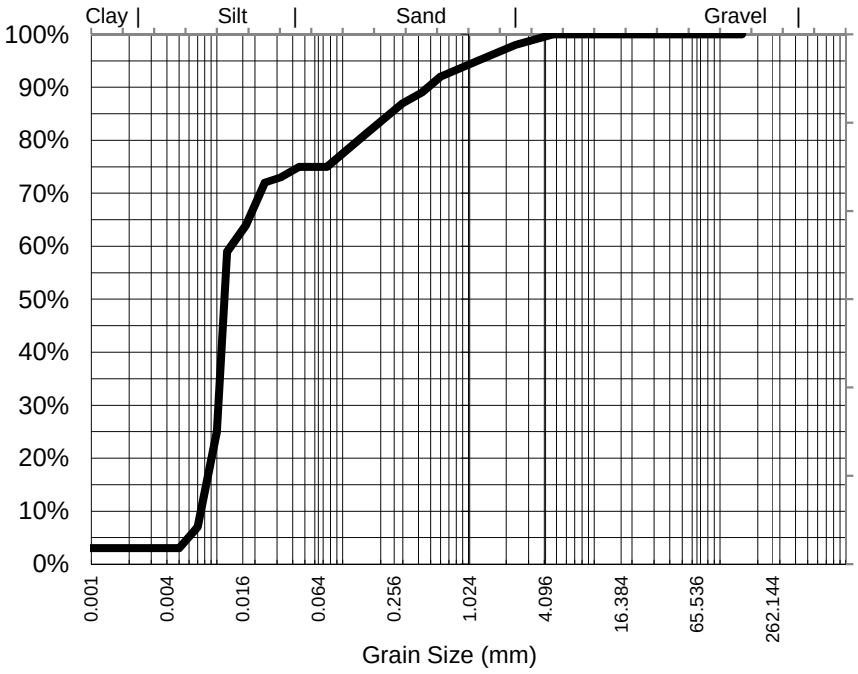
ALS Laboratory Group Pty Ltd
2 Byth Street,
Stafford, QLD 4053
pH 07 3552 8678
fax 07 3352 3662
samples.brisbane@alsglobal.com

ALS Environmental

Brisbane, QLD

CLIENT:	Niccimarris	**DATE REPORTED:**	29-Jun-2016
COMPANY:	ALCOA AUSTRALIA ROLLED PRODUCTS	**DATE RECEIVED:**	20-Jun-2016
ADDRESS:	Kiora Crescent Lockbag 25, Fairfield, YENNORA NSW 2165	**REPORT NO:**	EM1607144-004 / PSD
PROJECT:	Alcoa Anglesea Waters and Soilds	**SAMPLE ID:**	PTH-16-0044

Particle Size Distribution



Particle Size (mm)	Percent Passing
4.75	100%
2.36	98%
1.18	95%
0.600	92%
0.425	89%
0.300	87%
0.150	81%
0.075	75%
Particle Size (microns)	
64	75%
45	75%
32	73%
17	64%
10	25%
5	3%
1	3%

Median Particle Size (mm)*	0.011

Samples analysed as received.

** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results*

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	24-Jun-16
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:		**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.3 2003	**Hydrometer Type**	ASTM E100

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Satish Trivedi
Soil Chemist
Authorised Signatory

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM1607144**	Page	: 1 of 4
Amendment	: **1**		
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS	Telephone	: +61-3-8549 9636
Project	: Alcoa Anglesea Waters and Solids	Date Samples Received	: 20-Jun-2016
Site	: Point Henry	Issue Date	: 04-Jul-2016
Sampler	: ----	No. of samples received	: 4
Order number	: 6681114	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA011: Net Acid Generation							
Pulp Bag (EA011)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**24-Jun-2016**	20-Jun-2017	✓	**24-Jun-2016**	21-Dec-2016	✓
EA013: Acid Neutralising Capacity							
Pulp Bag (EA013)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**24-Jun-2016**	20-Jun-2017	✓	**27-Jun-2016**	21-Dec-2016	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag (EA150H)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**----**	----	----	**28-Jun-2016**	17-Dec-2016	✓
ED006: Exchangeable Cations on Alkaline Soils							
Soil Glass Jar - Unpreserved (ED006)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**30-Jun-2016**	18-Jul-2016	✓	**30-Jun-2016**	18-Jul-2016	✓
ED042T: Total Sulfur by LECO							
Pulp Bag (ED042T)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**22-Jun-2016**	18-Jul-2016	✓	**22-Jun-2016**	18-Jul-2016	✓
EP003: Total Organic Carbon (TOC) in Soil							
Pulp Bag (EP003)							
PTH-16-0041, PTH-16-0042, PTH-16-0043, PTH-16-0044	**20-Jun-2016**	**22-Jun-2016**	18-Jul-2016	✓	**22-Jun-2016**	18-Jul-2016	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acid Neutralising Capacity (ANC)	EA013	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Neutralising Capacity (ANC)	EA013	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Exchangeable Cations on Alkaline Soils	ED006	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Net Acid Production Potential	EA009	SOIL	In house: Referenced to Coastech Research (Canada)(Mod.). NAPP = Acid Production Potential (APP or MAP-Maximum Acid Potential) minus Neutralising Capacity (ANC). NAPP may be +ve, zero or -ve.
Net Acid Generation	EA011	SOIL	In house: Referenced to Miller (1998) Titremetric procedure determines net acidity in a soil following peroxide oxidation. Titrations to both pH 4.5 and pH 7 are reported.
Acid Neutralising Capacity (ANC)	EA013	SOIL	In house: Referenced to USEPA 600/2-78-054, I. Miller (2000). A fizz test is done to semiquanititatively estimate the likely reactivity. The soil is then reacted with an known excess quanitity of an appropriate acid. Titration determines the acid remaining, and the ANC can be calculated from comparison with a blank titration.
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Exchangeable Cations on Alkaline Soils	ED006	SOIL	In house: Referenced to Rayment & Lyons (2011) Method 15C1. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Sulfur - Total as S (LECO)	ED042T	SOIL	In house: Dried and pulverised sample is combusted in a high temperature furnace in the presence of strong oxidants / catalysts. The evolved S (as SO2) is measured by infra-red detector
Total Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automaticaly measured by infra-red detector.

Preparation Methods	Method	Matrix	Method Descriptions
Exchangeable Cations Preparation Method (Alkaline Soils)	ED006PR	SOIL	In house: Referenced to Rayment and Lyons 2011 method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Higginson (1992) method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
Dry and Pulverise (up to 100g)	GEO30	SOIL	#

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM1607144**	Page	: 1 of 3
Amendment	: **1**		
Client	: **ALCOA AUSTRALIA ROLLED PRODUCTS**	Laboratory	: Environmental Division Melbourne
Contact	: MS NICCI MARRIS	Contact	: Bronwyn Sheen
Address	: Kiora Crescent Lockbag 25, Fairfield YENNORA NSW 2165	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 02 9681 9555	Telephone	: +61-3-8549 9636
Project	: Alcoa Anglesea Waters and Solids	Date Samples Received	: 20-Jun-2016
Order number	: 6681114	Date Analysis Commenced	: 22-Jun-2016
C-O-C number	: ----	Issue Date	: 04-Jul-2016
Sampler	: ----		
Site	: Point Henry		
Quote number	: ----		
No. of samples received	: 4		
No. of samples analysed	: 4		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Satishkumar Trivedi	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA011: Net Acid Generation (QC Lot: 496594)									
EB1615804-006	Anonymous	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.00	No Limit
EA013: Acid Neutralising Capacity (QC Lot: 496595)									
EB1615804-006	Anonymous	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	124	125	0.405	0% - 20%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 503515)									
EM1607144-001	PTH-16-0041	ED006: Exchangeable Calcium	----	0.1	meq/100g	4.6	4.7	3.06	0% - 20%
		ED006: Exchangeable Magnesium	----	0.1	meq/100g	4.4	4.5	0.00	0% - 20%
		ED006: Exchangeable Potassium	----	0.1	meq/100g	0.7	0.8	0.00	No Limit
		ED006: Exchangeable Sodium	----	0.1	meq/100g	0.8	0.9	0.00	No Limit
		ED006: Cation Exchange Capacity	----	0.1	meq/100g	10.6	11.0	3.29	0% - 20%
ED042T: Total Sulfur by LECO (QC Lot: 494480)									
EP1605555-016	Anonymous	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.02	80.8	No Limit
EM1607144-001	PTH-16-0041	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.13	0.15	15.2	0% - 50%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 494481)									
EM1607144-001	PTH-16-0041	EP003: Total Organic Carbon	----	0.02	%	0.48	0.48	0.00	0% - 20%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA011: Net Acid Generation (QCLot: 496594)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	19.6 kg H2SO4/t	97.3	70	130
EA013: Acid Neutralising Capacity (QCLot: 496595)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	100 kg H2SO4 equiv./t	95.6	82	120
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 503515)								
ED006: Exchangeable Calcium	----	0.1	meq/100g	<0.1	9.12835 meq/100g	86.7	70	130
ED006: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	6.19651 meq/100g	101	70	130
ED006: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.31015 meq/100g	97.9	70	130
ED006: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.47869 meq/100g	95.4	70	130
ED006: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	16.11371 meq/100g	92.3	70	130
ED042T: Total Sulfur by LECO (QCLot: 494480)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.16 %	108	70	130
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 494481)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	100 %	104	70	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM2118436**

Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: CHRIS SMITT	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: chris.smitt@ehs-support.com	E-mail	: peter.ravlic@alsglobal.com
Telephone	: ----	Telephone	: +6138549 9645
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: Alcoa Anglesea	Page	: 1 of 6
Order number	: ----	Quote number	: EM2021ALCAUS0002 (ME/638/21)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: MATT RUSS		

Dates

Date Samples Received	: 15-Sep-2021 16:55	Issue Date	: 20-Sep-2021
Client Requested Due Date	: 27-Sep-2021	Scheduled Reporting Date	: **27-Sep-2021**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 4	Temperature	: 3.8°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 40 / 23

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	(On Hold) SOIL No analysis requested	SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA013 Acid Neutralising Capacity (ANC)	SOIL - EA014 Total Soluble Salts	SOIL - EG005T (solids) Total Metals by ICP-AES	SOIL - EG035T (solids) Total Mercury by FIMS	SOIL - EK055 (solids) Ammonia as N
EM2118436-001	14-Sep-2021 00:00	ANG-21-0180	✓						
EM2118436-002	14-Sep-2021 00:00	ANG-21-0181		✓	✓	✓	✓	✓	✓
EM2118436-003	14-Sep-2021 00:00	ANG-21-0182		✓	✓	✓	✓	✓	✓
EM2118436-004	13-Sep-2021 00:00	ANG-21-0183	✓						
EM2118436-005	13-Sep-2021 00:00	ANG-21-0184	✓						
EM2118436-006	13-Sep-2021 00:00	ANG-21-0185		✓	✓	✓	✓	✓	✓
EM2118436-007	14-Sep-2021 00:00	ANG-21-0186	✓						
EM2118436-008	14-Sep-2021 00:00	ANG-21-0187		✓	✓	✓	✓	✓	✓
EM2118436-009	14-Sep-2021 00:00	ANG-21-0188	✓						
EM2118436-010	14-Sep-2021 00:00	ANG-21-0189		✓	✓	✓	✓	✓	✓
EM2118436-011	14-Sep-2021 00:00	ANG-21-0190	✓						
EM2118436-012	14-Sep-2021 00:00	ANG-21-0191		✓	✓	✓	✓	✓	✓
EM2118436-013	13-Sep-2021 00:00	ANG-21-0192	✓						
EM2118436-014	13-Sep-2021 00:00	ANG-21-0193		✓	✓	✓	✓	✓	✓
EM2118436-015	14-Sep-2021 00:00	ANG-21-0195	✓						
EM2118436-016	14-Sep-2021 00:00	ANG-21-0196		✓	✓	✓	✓	✓	✓
EM2118436-017	14-Sep-2021 00:00	ANG-21-0197	✓						
EM2118436-018	14-Sep-2021 00:00	ANG-21-0198	✓						
EM2118436-019	14-Sep-2021 00:00	ANG-21-0199	✓						
EM2118436-020	14-Sep-2021 00:00	ANG-21-0200		✓	✓	✓	✓	✓	✓
EM2118436-021	14-Sep-2021 00:00	ANG-21-0201	✓						
EM2118436-022	14-Sep-2021 00:00	ANG-21-0202		✓	✓	✓	✓	✓	✓
EM2118436-023	14-Sep-2021 00:00	ANG-21-0204	✓						
EM2118436-024	14-Sep-2021 00:00	ANG-21-0205		✓	✓	✓	✓	✓	✓
EM2118436-025	14-Sep-2021 00:00	ANG-21-0206	✓						
EM2118436-026	14-Sep-2021 00:00	ANG-21-0207		✓	✓	✓	✓	✓	✓
EM2118436-027	14-Sep-2021 00:00	ANG-21-0208	✓						
EM2118436-028	14-Sep-2021 00:00	ANG-21-0209	✓						
EM2118436-029	14-Sep-2021 00:00	ANG-21-0211	✓						

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	SOIL - EA001 pH (CaCl)	SOIL - EK026SF (Solids) Total Cyanide By Segmented Flow Analyser	SOIL - EK030SF Cyanide Amenable to Chlorination by Segmented	SOIL - EK040T Total Fluoride	SOIL - EN60Za ASLP Leachate (ZHE)	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)
EM2118436-002	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓	✓
EM2118436-003	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓	✓
EM2118436-006	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓	✓
EM2118436-008	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓	✓
EM2118436-010	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓	✓
EM2118436-012	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓	✓
EM2118436-014	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓	✓
EM2118436-016	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓	✓
EM2118436-020	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓	✓
EM2118436-022	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓	✓
EM2118436-024	14-Sep-2021 00:00	ANG-21-0205	✓	✓	✓	✓		✓	✓
EM2118436-026	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	SOIL - EA055-103 Moisture Content	SOIL - ED009-X Anions (Including Iodide)	SOIL - EG048G Total Hexavalent Chromium (Alkaline digestion)	SOIL - EN60a-P ASLP Leachate Procedure - Plastic Leaching	SOIL - NT-11S Total N + Total P	SOIL - NT-2S-EM Major Anions (Cl, SO4) (melb)	SOIL - NT-4S NO2 and NO3
EM2118436-002	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓	✓
EM2118436-003	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓	✓
EM2118436-006	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓	✓
EM2118436-008	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓	✓
EM2118436-010	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓	✓
EM2118436-012	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓	✓
EM2118436-014	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓	✓
EM2118436-016	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓	✓
EM2118436-020	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓	✓
EM2118436-022	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓	✓
EM2118436-024	14-Sep-2021 00:00	ANG-21-0205	✓	✓	✓		✓	✓	✓
EM2118436-026	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	SOIL - EA005: pH pH	SOIL - EA010P Electrical Conductivity (PCT)	SOIL - ED037-P Alkalinity as CaCO3 (PCT)	SOIL - EG005C Leachable Metals by ICPAES	SOIL - EG035C Leachable Mercury	SOIL - EK040-P Fluoride (PCT)	SOIL - EP002 Dissolved Organic Carbon (DOC)
EM2118436-002	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓	✓
EM2118436-003	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓	✓
EM2118436-006	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓	✓
EM2118436-008	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓	✓
EM2118436-010	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓	✓
EM2118436-012	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓	✓
EM2118436-014	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓	✓
EM2118436-016	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓	✓
EM2118436-020	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓	✓
EM2118436-022	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓	✓
EM2118436-026	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓	✓
EM2118436-030	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓	✓
EM2118436-031	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓	✓
EM2118436-032	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓	✓
EM2118436-033	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓	✓
EM2118436-034	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓	✓
EM2118436-035	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓	✓
EM2118436-036	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓	✓
EM2118436-037	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓	✓
EM2118436-038	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓	✓
EM2118436-039	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓	✓
EM2118436-040	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	SOIL - ED045G Chloride by Discrete Analyser	SOIL - ED093C Leachable Major Cations	SOIL - EG050G-C Hexavalent Chromium in TCLP Leachate	SOIL - EK026SF Total Cyanide by Segmented Flow Analyser	SOIL - EK030SF Cyanide Amenable to Chlorination	SOIL - EK055G Ammonia as N By Discrete Analyser	SOIL - NT-11 Total Nitrogen and Total Phosphorus
EM2118436-002	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓	✓
EM2118436-003	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓	✓
EM2118436-006	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓	✓
EM2118436-008	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓	✓
EM2118436-010	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓	✓
EM2118436-012	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓	✓
EM2118436-014	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓	✓
EM2118436-016	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓	✓

			SOIL - ED045G Chloride by Discrete Analyser	SOIL - ED093C Leachable Major Cations	SOIL - EG050G-C Hexavalent Chromium in TCLP Leachate	SOIL - EK026SF Total Cyanide by Segmented Flow Analyser	SOIL - EK030SF Cyanide Amenable to Chlorination	SOIL - EK055G Ammonia as N By Discrete Analyser	SOIL - NT-11 Total Nitrogen and Total Phosphorus
EM2118436-020	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓	✓
EM2118436-022	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓	✓
EM2118436-026	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓	✓
EM2118436-030	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓	✓
EM2118436-031	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓	✓
EM2118436-032	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓	✓
EM2118436-033	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓	✓
EM2118436-034	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓	✓
EM2118436-035	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓	✓
EM2118436-036	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓	✓
EM2118436-037	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓	✓
EM2118436-038	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓	✓
EM2118436-039	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓	✓
EM2118436-040	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	SOIL - EA015H Total Dissolved Solids - Standard Level	SOIL - ED010 Iodide by Ion Selective Electrode (ISE)	SOIL - ED041G Sulfate (Turbidimetric) as SO4 2 by Discrete	SOIL - EN60-DIa-P Deionised Water Leach - Plastic Leaching Vessel	SOIL - EN60Z-DIa Deionised Water Leach - Zero Headspace	SOIL - NT-04 Nitrite and Nitrate
EM2118436-002	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓			✓
EM2118436-003	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓			✓
EM2118436-006	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓			✓
EM2118436-008	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓			✓
EM2118436-010	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓			✓
EM2118436-012	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓			✓
EM2118436-014	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓			✓
EM2118436-016	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓			✓
EM2118436-020	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓			✓
EM2118436-022	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓			✓
EM2118436-026	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓			✓
EM2118436-030	14-Sep-2021 00:00	ANG-21-0181	✓	✓	✓	✓	✓	✓
EM2118436-031	14-Sep-2021 00:00	ANG-21-0182	✓	✓	✓	✓	✓	✓
EM2118436-032	13-Sep-2021 00:00	ANG-21-0185	✓	✓	✓	✓	✓	✓
EM2118436-033	14-Sep-2021 00:00	ANG-21-0187	✓	✓	✓	✓	✓	✓
EM2118436-034	14-Sep-2021 00:00	ANG-21-0189	✓	✓	✓	✓	✓	✓

			SOIL - EA015H Total Dissolved Solids - Standard Level	SOIL - ED010 Iodide by Ion Selective Electrode (ISE)	SOIL - ED041G Sulfate (Turbidimetric) as SO4 2 by Discrete	SOIL - EN60-Dia-P Deionised Water Leach - Plastic Leaching Vessel	SOIL - EN60Z-Dia Deionised Water Leach - Zero Headspace	SOIL - NT-04 Nitrite and Nitrate
EM2118436-035	14-Sep-2021 00:00	ANG-21-0191	✓	✓	✓	✓	✓	✓
EM2118436-036	13-Sep-2021 00:00	ANG-21-0193	✓	✓	✓	✓	✓	✓
EM2118436-037	14-Sep-2021 00:00	ANG-21-0196	✓	✓	✓	✓	✓	✓
EM2118436-038	14-Sep-2021 00:00	ANG-21-0200	✓	✓	✓	✓	✓	✓
EM2118436-039	14-Sep-2021 00:00	ANG-21-0202	✓	✓	✓	✓	✓	✓
EM2118436-040	14-Sep-2021 00:00	ANG-21-0207	✓	✓	✓	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ALL INVOICES

- A4 - AU Tax Invoice (INV)	Email	ap@alcoa.com.au

CHRIS SMITT

- *AU Certificate of Analysis - NATA (COA)	Email	chris.smitt@ehs-support.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	chris.smitt@ehs-support.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	chris.smitt@ehs-support.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	chris.smitt@ehs-support.com
- Chain of Custody (CoC) (COC)	Email	chris.smitt@ehs-support.com
- EDI Format - ENMRG (ENMRG)	Email	chris.smitt@ehs-support.com
- EDI Format - ESDAT (ESDAT)	Email	chris.smitt@ehs-support.com
- Purchase Order Request Letter (PO_Request)	Email	chris.smitt@ehs-support.com

MATT RUSS

- *AU Certificate of Analysis - NATA (COA)	Email	matt.russ@ehs-support.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	matt.russ@ehs-support.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	matt.russ@ehs-support.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	matt.russ@ehs-support.com
- A4 - AU Tax Invoice (INV)	Email	matt.russ@ehs-support.com
- Chain of Custody (CoC) (COC)	Email	matt.russ@ehs-support.com
- EDI Format - ENMRG (ENMRG)	Email	matt.russ@ehs-support.com
- EDI Format - ESDAT (ESDAT)	Email	matt.russ@ehs-support.com

CHAIN OF CUSTODY

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: ALSEnviro.Gladstone@alsglobal.com

MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5755 E: ALSEnviro.Mackay@alsglobal.com

MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 [illegible] Maitland Road Mayfield West NSW 2304 Ph: 02 8784 8555 E: samples.newcastle@alsglobal.com

TOWNSVILLE [illegible] Ph: 07 47[illegible] E: [illegible]@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 08 9209 7655 E: samples[illegible]@alsglobal.com

ALS Laboratory: please tick

CLIENT: Alcoa Australia	TURNAROUND REQUIREMENTS :	☐ Standard TAT (List due date): 1 week TAT	FOR LABORATORY USE ONLY (Circle)
OFFICE: Melbourne	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Alcoa Anglesea	ALS QUOTE NO.: ME/638/21 V2	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
[redacted] ACCOUNTING CODE: TBC	PO#.:	COC: 1	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Chris Smitt	CONTACT PH:	OF: 1	Other comment:
SAMPLER: Matt Russ	SAMPLER MOBILE: 0420863250	RELINQUISHED BY: Matt Russ	RECEIVED BY:
COC Emailed to ALS? YES	EDD(DIGITAL) REQUIRED? [redacted]		
Email Reports to: matt.russ@ehs-support.com and chris.smitt@ehs-support.com Email EDDs to: equis@ehs-support.com, matt.russ@ehs-support.com and chris.smitt@ehs-support.com		DATE/TIME: 15/9/2021	DATE/TIME:
Email Invoice to: matt.russ@ehs-support.com			

RELINQUISHED BY:	RECEIVED BY:
DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: HOLD=Store samples for potential future analysis

	SAMPLE DETAILS MATRIX: Soil (SO), Sediment (SE), surface water (WS), Groundwater (WG), Water QC (WQ), Soil QC (WQ)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).																Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX CODE	SAMPLE TYPE CODE	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	Soil Analysis - As per ME/638/21 V2 Plus CEC	Leachability Analysis - As per ME/638/21 V2			HOLD									HOLD	
1	ANG-21-0180	14-09-21	S		4 x Jars						X										Nutrients = NT-8S plus phosphorus Herbicides = carbamates, phenoxy acid herbicides, synthetic pyrthroids and triazine pesticides (atrazine and simazine Asbestos = Absence / Presence
2 30	ANG-21-0181	14-09-21	S		4 x Jars		X	X													
3 31	ANG-21-0182	14-09-21	S		4 x Jars		X	X													
4	ANG-21-0183	13-09-21	S		4 x Jars						X										
5	ANG-21-0184	13-09-21	S		4 x Jars						X										
6 32	ANG-21-0185	13-09-21	S		4 x Jars		X	X													
7	ANG-21-0186	14-09-21	S		4 x Jars						X										
8 33	ANG-21-0187	14-09-21	S		4 x Jars		X	X													
9	ANG-21-0188	14-09-21	S		4 x Jars						X										
10 34	ANG-21-0189	14-09-21	S		4 x Jars		X	X													
11	ANG-21-0190	14-09-21	S		4 x Jars						X										
12 35	ANG-21-0191	14-09-21	S		4 x Jars		X	X													
13	ANG-21-0192	13-09-21	S		4 x Jars						X										
14 36	ANG-21-0193	13-09-21	S		4 x Jars		X	X													
—	ANG-21-0194	No Sample	S		No Sample						X										No Sample
15	ANG-21-0195	14-09-21	S		4 x Jars						X										
16 37	ANG-21-0196	14-09-21	S		4 x Jars		X	X													
17	ANG-21-0197	14-09-21	S		4 x Jars						X										
18	ANG-21-0198	14-09-21	S		4 x Jars						X										
19	ANG-21-0199	14-09-21	S		4 x Jars						X										
20 38	ANG-21-0200	14-09-21	S		4 x Jars		X	X													
21	ANG-21-0201	14-09-21	S		4 x Jars						X										
22 39	ANG-21-0202	14-09-21	S		4 x Jars		X	X													
—	ANG-21-0203	No Sample	S		No Sample						X										No Sample
23	ANG-21-0204	14-09-21	S		4 x Jars						X										
24	ANG-21-0205	14-09-21	S		4 x Jars		X														
25	ANG-21-0206	14-09-21	S		1 x jar						X										
26 40	ANG-21-0207	14-09-21	S		4 x Jars		X	X													
27	ANG-21-0208	14-09-21	S		4 x Jars						X										
28	ANG-21-0209	14-09-21	S		1 x jar						X										
→	ANG-21-0210	14-09-21	S		4 x Jars		X														Please Send to Eurofins
29	ANG-21-0211	14-09-21	S		4 x Jars						X										
					TOTAL																

Environmental Division
Melbourne
Work Order Reference
EM2118436

Telephone : +61-3-8549 9600

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM2118436**	Page	: 1 of 31
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: CHRIS SMITT	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +6138549 9645
Project	: Alcoa Anglesea	Date Samples Received	: 15-Sep-2021 16:55
Order number	: ----	Date Analysis Commenced	: 20-Sep-2021
C-O-C number	: ----	Issue Date	: 29-Sep-2021 12:38
Sampler	: MATT RUSS		
Site	: ANGLESEA		
Quote number	: ME/638/21		
No. of samples received	: 40		
No. of samples analysed	: 23		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Jarwis Nheu	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED009-X (Standard Anions - Extended Method –by IC): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- EK040-P,ED038-P,EA010-P: EM2118436 #39. Insufficient sample provided to analyse fluoride,conductivity & alkalinity duplicate.
- EK040-P: EM2118436 #6. Insufficient sample provided to analyse fluoride Matrix spilke.
- EG050G-C: EM2118739 sample #28 poor matrix spike recovery for Hexavalent Chromium due to matrix effects. Confirmed by re-analysis.
- EG050G-C: EM2118436 sample #3 poor matrix spike recovery for Hexavalent Chromium due to matrix effects. Confirmed by re-analysis.
- EG048G: EM2118436 sample #3 poor insoluble matrix spike recovery for Hexavalent Chromium due to sample matrix interferences. Confirmed by re-analysis.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- EK061G: EM2118436 #6,12,16,20,26,30,33,35-38,40 Samples required dilution prior to analysis for TKN due to sample matrix. LOR has been adjusted accordingly.
- EA015H: EM2118436 #31, #34, #37-#39: TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- EK061G: EM2118436 #2 & 22 Poor duplicate precision for TKN due to sample heterogeneity. Confirmed by re-extraction and re-analysis.
- EP004: EM2118436 #3: Poor matrix spike recovery for organic matter and total organic carbon due to matrix effects.
- EP004: EM2118436 #3 Poor matrix spike recovery for Organic Matter & Total Organic Carbon due to matrix effects.
- EK067G: EM2118436 #16,22,40 Samples required dilution prior to analysis for Total phosphorus due to sample matrix. LOR has been adjusted accordingly.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- EN60: Where leachable PFAS analysis is requested, centrifugation rather than pressure filtration is used as the default approach for removal of particulates, in line with AS 4439.3.
- EN60-DI: Where leachable PFAS analysis is requested, centrifugation rather than pressure filtration is used as the default approach for removal of particulates, in line with AS 4439.3.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-002	EM2118436-003	EM2118436-006	EM2118436-008	EM2118436-010
					Result	Result	Result	Result	Result
ED010: Iodide by Ion Selective Electrode									
Iodide	20461-54-5	0.5	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**136**	**180**	**498**	**561**	**8**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**4**	**6**	**11**	**15**	**5**
ED093C: Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		**91**	**35**	**406**	**471**	**4**
Magnesium	7439-95-4	1	mg/L		**40**	**72**	**186**	**308**	**5**
Sodium	7440-23-5	1	mg/L		**9**	**7**	**26**	**28**	**6**
Potassium	7440-09-7	1	mg/L		**3**	**2**	**4**	**4**	<1
EG005(ED093)C: Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.1	mg/L		**3.9**	**3.7**	**20.8**	**7.3**	**0.9**
Antimony	7440-36-0	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Barium	7440-39-3	0.1	mg/L		**0.1**	**0.1**	**0.1**	**0.1**	<0.1
Beryllium	7440-41-7	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Boron	7440-42-8	0.1	mg/L		**1.1**	**1.6**	**6.5**	**8.1**	<0.1
Cadmium	7440-43-9	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L		**4.5**	**4.3**	**1.5**	**0.8**	**0.4**
Lead	7439-92-1	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/L		**0.8**	**0.4**	**2.0**	**3.3**	<0.1
Nickel	7440-02-0	0.1	mg/L		<0.1	<0.1	**0.1**	<0.1	<0.1
Selenium	7782-49-2	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	7440-66-6	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
EG050G: Hexavalent Chromium by Discrete Analyser									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.3**	**0.2**	**0.3**	<0.1

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-002	EM2118436-003	EM2118436-006	EM2118436-008	EM2118436-010
					Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.22**	**0.16**	**0.13**	**0.38**	<0.01
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	**0.07**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	**0.07**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.8**	**0.6**	<0.5	**0.4**	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**0.8**	**0.6**	<0.5	**0.4**	<0.1
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.12**	**0.06**	**0.07**	**0.02**	<0.01

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
				Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
					EM2118436-012	EM2118436-014	EM2118436-016	EM2118436-020	EM2118436-022
					Result	Result	Result	Result	Result
ED010: Iodide by Ion Selective Electrode									
Iodide	20461-54-5	0.5	mg/L		<0.5	<0.5	<0.5	<0.5	<0.5
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**760**	**647**	**222**	**975**	**250**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**13**	**15**	**8**	**12**	**8**
ED093C: Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		**635**	**666**	**143**	**1130**	**150**
Magnesium	7439-95-4	1	mg/L		**342**	**352**	**94**	**465**	**98**
Sodium	7440-23-5	1	mg/L		**29**	**29**	**17**	**30**	**20**
Potassium	7440-09-7	1	mg/L		**4**	**6**	**2**	**10**	**2**
EG005(ED093)C: Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.1	mg/L		**14.7**	**12.4**	**3.8**	**4.0**	**13.7**
Antimony	7440-36-0	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Barium	7440-39-3	0.1	mg/L		<0.1	**0.1**	**0.1**	**0.2**	**0.1**
Beryllium	7440-41-7	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Boron	7440-42-8	0.1	mg/L		**10.9**	**10.3**	**2.5**	**17.5**	**3.4**
Cadmium	7440-43-9	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L		**1.0**	**1.0**	**0.9**	**0.8**	**2.2**
Lead	7439-92-1	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/L		**2.3**	**4.0**	**0.8**	**1.7**	**1.0**
Nickel	7440-02-0	0.1	mg/L		**0.1**	**0.1**	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	7440-66-6	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	**0.2**
Molybdenum	7439-98-7	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
EG050G: Hexavalent Chromium by Discrete Analyser									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.2**	**0.2**	<0.1	**0.2**

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
				Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-012	EM2118436-014	EM2118436-016	EM2118436-020	EM2118436-022
					Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.17**	**0.29**	**0.24**	**0.27**	**0.27**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	**0.5**	<0.5	<0.5	**0.5**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		<0.5	**0.5**	<0.5	<0.5	**0.5**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.12**	**0.10**	<0.05	**0.10**	<0.05

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0207	----	----	----	----
				Sampling date / time	14-Sep-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2118436-026	--------	--------	--------	--------
					Result	----	----	----	----
ED010: Iodide by Ion Selective Electrode									
Iodide	20461-54-5	0.5	mg/L		<0.5	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**642**	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**13**	----	----	----	----
ED093C: Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		**563**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**397**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**18**	----	----	----	----
Potassium	7440-09-7	1	mg/L		**4**	----	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.1	mg/L		**18.8**	----	----	----	----
Antimony	7440-36-0	0.1	mg/L		<0.1	----	----	----	----
Arsenic	7440-38-2	0.1	mg/L		<0.1	----	----	----	----
Barium	7440-39-3	0.1	mg/L		**0.1**	----	----	----	----
Beryllium	7440-41-7	0.05	mg/L		<0.05	----	----	----	----
Boron	7440-42-8	0.1	mg/L		**10.0**	----	----	----	----
Cadmium	7440-43-9	0.05	mg/L		<0.05	----	----	----	----
Chromium	7440-47-3	0.1	mg/L		<0.1	----	----	----	----
Cobalt	7440-48-4	0.1	mg/L		<0.1	----	----	----	----
Copper	7440-50-8	0.1	mg/L		<0.1	----	----	----	----
Iron	7439-89-6	0.1	mg/L		**2.3**	----	----	----	----
Lead	7439-92-1	0.1	mg/L		<0.1	----	----	----	----
Manganese	7439-96-5	0.1	mg/L		**3.1**	----	----	----	----
Nickel	7440-02-0	0.1	mg/L		**0.1**	----	----	----	----
Selenium	7782-49-2	0.05	mg/L		<0.05	----	----	----	----
Zinc	7440-66-6	0.1	mg/L		<0.1	----	----	----	----
Molybdenum	7439-98-7	0.1	mg/L		<0.1	----	----	----	----
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	----	----	----	----
EG050G: Hexavalent Chromium by Discrete Analyser									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	----	----	----	----

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0207	----	----	----	----
				Sampling date / time	14-Sep-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2118436-026	--------	--------	--------	--------
					Result	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.30**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		<0.5	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.08**	----	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-030	EM2118436-031	EM2118436-032	EM2118436-033	EM2118436-034
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	148	475	986	1	83
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	382	432	693	860	117
ED010: Iodide by Ion Selective Electrode								
Iodide	20461-54-5	0.5	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	6	16	24	16	<1
Total Alkalinity as CaCO3	----	1	mg/L	6	16	24	16	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	116	213	519	631	15
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	7	10	12	16	9
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	22	18	132	210	<1
Magnesium	7439-95-4	1	mg/L	17	42	35	14	1
Sodium	7440-23-5	1	mg/L	9	8	28	32	8
Potassium	7440-09-7	1	mg/L	2	2	3	3	<1
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
EG050G: Hexavalent Chromium by Discrete Analyser								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	----	<0.01	<0.01	<0.01
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EK030: Cyanide Amenable to Chlorination								
Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.1	0.3	0.2	0.2	0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.12	<0.01	0.10	0.35	0.02
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-030	EM2118436-031	EM2118436-032	EM2118436-033	EM2118436-034
					Result	Result	Result	Result	Result
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.01**	<0.01	<0.01	<0.01	**0.10**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.01**	<0.01	<0.01	<0.01	**0.10**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	**0.2**	<0.1	<0.5	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		<0.5	**0.2**	<0.1	<0.5	**0.1**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.05	**0.02**	**0.02**	**0.06**	**0.01**
EP002: Dissolved Organic Carbon (DOC)									
Dissolved Organic Carbon	----	1	mg/L		**3**	**3**	**2**	**2**	**1**
Sample Preparation Method									
Amount	----	0.1	mL		**1**	**1**	**1**	**1**	**1**
Volume	----	0.1	mL		**1.05**	**1.05**	**1.05**	**1.05**	**1.05**
EG005(ED093)W: Water Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.10	mg/L		**10.0**	**1.03**	**0.74**	**0.99**	**2.63**
Antimony	7440-36-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.01	mg/L		**0.02**	<0.01	<0.01	<0.01	<0.01
Barium	7440-39-3	0.1	mg/L		**0.3**	<0.1	<0.1	<0.1	<0.1
Beryllium	7440-41-7	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Boron	7440-42-8	0.1	mg/L		**0.8**	**1.7**	**4.5**	**4.6**	<0.1
Cadmium	7440-43-9	0.005	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	7440-47-3	0.01	mg/L		**0.04**	<0.01	<0.01	<0.01	**0.01**
Cobalt	7440-48-4	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Copper	7440-50-8	0.01	mg/L		**0.02**	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**8.82**	**1.15**	**0.31**	**0.30**	**6.07**
Lead	7439-92-1	0.01	mg/L		**0.01**	<0.01	<0.01	<0.01	<0.01
Manganese	7439-96-5	0.01	mg/L		**0.09**	**0.05**	**0.02**	<0.01	<0.01
Nickel	7440-02-0	0.01	mg/L		**0.01**	<0.01	<0.01	<0.01	<0.01
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.1	mg/L		**0.3**	**0.2**	**1.0**	**1.2**	<0.1
Tin	7440-31-5	0.01	mg/L		**0.01**	<0.01	<0.01	<0.01	<0.01
Titanium	7440-32-6	0.01	mg/L		**0.11**	**0.05**	**0.03**	**0.02**	**0.14**

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
					EM2118436-030	EM2118436-031	EM2118436-032	EM2118436-033	EM2118436-034
					Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Vanadium	7440-62-2	0.01	mg/L		**0.04**	<0.01	<0.01	<0.01	**0.02**
Zinc	7440-66-6	0.01	mg/L		**0.02**	<0.01	<0.01	<0.01	<0.01
Molybdenum	7439-98-7	0.01	mg/L		**0.01**	<0.01	**0.01**	<0.01	<0.01
Thallium	7440-28-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	7723-14-0	1	mg/L		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
			Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-035	EM2118436-036	EM2118436-037	EM2118436-038	EM2118436-039
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1860	1230	577	1530	619
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	956	848	408	1110	474
ED010: Iodide by Ion Selective Electrode								
Iodide	20461-54-5	0.5	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	18	20	<1	38	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	5	6	47	3	27
Total Alkalinity as CaCO3	----	1	mg/L	23	26	47	41	27
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	960	585	242	758	279
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	32	18	8	8	11
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	430	218	57	331	66
Magnesium	7439-95-4	1	mg/L	4	11	32	2	25
Sodium	7440-23-5	1	mg/L	39	31	16	25	24
Potassium	7440-09-7	1	mg/L	3	4	2	8	2
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
EG050G: Hexavalent Chromium by Discrete Analyser								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EK030: Cyanide Amenable to Chlorination								
Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.1	0.1	0.1	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.11	0.18	0.16	0.20	0.31
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
				Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-035	EM2118436-036	EM2118436-037	EM2118436-038	EM2118436-039
					Result	Result	Result	Result	Result
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	<0.5	<0.5	<0.5	**0.7**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		<0.5	<0.5	<0.5	<0.5	**0.7**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.07**	**0.09**	**0.06**	**0.11**	**0.10**
EP002: Dissolved Organic Carbon (DOC)									
Dissolved Organic Carbon	----	1	mg/L		**2**	**2**	**9**	**3**	**8**
Sample Preparation Method									
Amount	----	0.1	mL		**1**	**1**	**1**	**1**	**1**
Volume	----	0.1	mL		**1.05**	**1.05**	**1.05**	**1.05**	**1.05**
EG005(ED093)W: Water Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.10	mg/L		**0.99**	**0.57**	**1.11**	**2.81**	**0.56**
Antimony	7440-36-0	0.01	mg/L		<0.01	<0.01	<0.01	**0.12**	**0.04**
Arsenic	7440-38-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Barium	7440-39-3	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Beryllium	7440-41-7	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Boron	7440-42-8	0.1	mg/L		**5.3**	**5.4**	**1.8**	**5.5**	**3.3**
Cadmium	7440-43-9	0.005	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	7440-47-3	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	7440-48-4	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Copper	7440-50-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L		**0.15**	**0.18**	**0.53**	**0.24**	**0.27**
Lead	7439-92-1	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	7439-96-5	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	**0.08**
Nickel	7440-02-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Silver	7440-22-4	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.1	mg/L		**2.4**	**1.3**	**0.4**	**2.7**	**0.5**
Tin	7440-31-5	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Titanium	7440-32-6	0.01	mg/L		<0.01	<0.01	**0.04**	<0.01	**0.02**

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
				Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
					EM2118436-035	EM2118436-036	EM2118436-037	EM2118436-038	EM2118436-039
					Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.01	mg/L		**0.02**	<0.01	<0.01	**0.01**	<0.01
Molybdenum	7439-98-7	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	7440-28-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Phosphorus	7723-14-0	1	mg/L		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0207	----	----	----	----
				Sampling date / time	14-Sep-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2118436-040	--------	--------	--------	--------
					Result	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		1310	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		626	----	----	----	----
ED010: Iodide by Ion Selective Electrode									
Iodide	20461-54-5	0.5	mg/L		<0.5	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		5	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		28	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		34	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		647	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		14	----	----	----	----
ED093W: Water Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		252	----	----	----	----
Magnesium	7439-95-4	1	mg/L		5	----	----	----	----
Sodium	7440-23-5	1	mg/L		19	----	----	----	----
Potassium	7440-09-7	1	mg/L		3	----	----	----	----
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	----	----	----	----
EG050G: Hexavalent Chromium by Discrete Analyser									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	----	----	----	----
EK030: Cyanide Amenable to Chlorination									
Cyanide amenable to chlorination	----	0.01	mg/L		<0.01	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		0.1	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.18	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0207	----	----	----	----
				Sampling date / time	14-Sep-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2118436-040	--------	--------	--------	--------
					Result	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.5	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		<0.5	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.05	----	----	----	----
EP002: Dissolved Organic Carbon (DOC)									
Dissolved Organic Carbon	----	1	mg/L		**4**	----	----	----	----
Sample Preparation Method									
Amount	----	0.1	mL		**1**	----	----	----	----
Volume	----	0.1	mL		**1.05**	----	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.10	mg/L		**3.58**	----	----	----	----
Antimony	7440-36-0	0.01	mg/L		**0.01**	----	----	----	----
Arsenic	7440-38-2	0.01	mg/L		<0.01	----	----	----	----
Barium	7440-39-3	0.1	mg/L		<0.1	----	----	----	----
Beryllium	7440-41-7	0.01	mg/L		<0.01	----	----	----	----
Boron	7440-42-8	0.1	mg/L		**5.4**	----	----	----	----
Cadmium	7440-43-9	0.005	mg/L		<0.005	----	----	----	----
Chromium	7440-47-3	0.01	mg/L		<0.01	----	----	----	----
Cobalt	7440-48-4	0.01	mg/L		<0.01	----	----	----	----
Copper	7440-50-8	0.01	mg/L		<0.01	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.14**	----	----	----	----
Lead	7439-92-1	0.01	mg/L		<0.01	----	----	----	----
Manganese	7439-96-5	0.01	mg/L		<0.01	----	----	----	----
Nickel	7440-02-0	0.01	mg/L		<0.01	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Silver	7440-22-4	0.01	mg/L		<0.01	----	----	----	----
Strontium	7440-24-6	0.1	mg/L		**1.4**	----	----	----	----
Tin	7440-31-5	0.01	mg/L		<0.01	----	----	----	----
Titanium	7440-32-6	0.01	mg/L		<0.01	----	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0207	----	----	----	----
				Sampling date / time	14-Sep-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2118436-040	--------	--------	--------	--------
					Result	----	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.01	mg/L		<0.01	----	----	----	----
Molybdenum	7439-98-7	0.01	mg/L		<0.01	----	----	----	----
Thallium	7440-28-0	0.01	mg/L		<0.01	----	----	----	----
Phosphorus	7723-14-0	1	mg/L		<1	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-002	EM2118436-003	EM2118436-006	EM2118436-008	EM2118436-010
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	5.8	7.2	8.0	8.5	4.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1170	2530	2740	2670	2860
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	5.3	6.6	33.3	61.3	6.2
ANC as CaCO3	----	0.1	% CaCO3	0.5	0.7	3.4	6.2	0.6
Fizz Rating	----	0	Fizz Unit	0	0	1	2	1
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	3960	8600	9330	9070	9730
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	14.4	23.1	26.9	21.8	7.6
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	7.4	11.4	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	6.4	2.6	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	0.3	0.4	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	1.9	2.2	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	16.0	16.6	----
ø Exchangeable Calcium Percent	----	0.2	%	----	----	46.5	68.6	----
ø Exchangeable Magnesium Percent	----	0.2	%	----	----	39.8	15.8	----
ø Exchangeable Potassium Percent	----	0.2	%	----	----	1.8	2.4	----
ø Exchangeable Sodium Percent	----	0.2	%	----	----	11.8	13.2	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	1.2	4.3	----
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	21.8	6.5	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	0.6
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	1.3
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	<0.1
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	0.8
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	2.8
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	28.4
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	5.8	0.9	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	4.6	2.0	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-002	EM2118436-003	EM2118436-006	EM2118436-008	EM2118436-010
				Result	Result	Result	Result	Result
ED008: Exchangeable Cations - Continued								
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	----	----	----
Exchangeable Sodium Percent	----	0.1	%	0.8	0.9	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	10.6	3.0	----	----	----
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	1980	3900	8090	5570	380
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	60	80	290	400	100
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	610	170	3090	3250	<10
Magnesium	7439-95-4	10	mg/kg	390	540	820	180	20
Sodium	7440-23-5	10	mg/kg	210	110	590	680	120
Potassium	7440-09-7	10	mg/kg	30	20	60	80	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6460	7560	11100	9500	2480
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	10	14	10	8	<5
Barium	7440-39-3	10	mg/kg	320	230	1380	1190	10
Beryllium	7440-41-7	1	mg/kg	<1	<1	3	2	<1
Boron	7440-42-8	50	mg/kg	<50	70	300	250	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	20	32	20	17	11
Cobalt	7440-48-4	2	mg/kg	4	3	11	6	<2
Copper	7440-50-8	5	mg/kg	5	5	6	5	<5
Iron	7439-89-6	50	mg/kg	17400	20500	31100	24900	4870
Lead	7439-92-1	5	mg/kg	6	8	6	<5	<5
Manganese	7439-96-5	5	mg/kg	34	33	143	183	<5
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	8	5	22	14	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	12	11	33	27	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-002	EM2118436-003	EM2118436-006	EM2118436-008	EM2118436-010
					Result	Result	Result	Result	Result
EG048: Hexavalent Chromium (Alkaline Digest) - Continued									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	1	mg/kg		<1	<1	<1	<1	<1
EK030: Cyanide Amenable to Chlorination									
Cyanide amenable to chlorination	----	1	mg/kg		<1	<1	<1	<1	<1
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		**140**	**260**	**80**	**120**	**130**
EK055: Ammonia as N									
Ammonia as N	7664-41-7	20	mg/kg		<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	**1.9**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	**1.9**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		**510**	**590**	**620**	**730**	**160**
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		**510**	**590**	**620**	**730**	**160**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		**103**	**90**	**185**	**179**	**82**
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)									
Extraction Fluid pH	----	0.1	pH Unit		**2.9**	**2.9**	**2.9**	**2.9**	**2.9**
Final pH	----	0.1	pH Unit		**3.6**	**3.4**	**4.2**	**4.5**	**3.1**
EN60Z: ASLP Leachate - ZHE									
Extraction Fluid pH	----	0.1	pH Unit		**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
EP004: Organic Matter									
Total Organic Carbon	----	0.5	%		**1.5**	**1.2**	**2.1**	**2.4**	<0.5
ED009: Anions									
ø Iodide	20461-54-5	0.05	mg/kg		<0.50	<1.00	<1.00	<0.50	<1.00

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
			Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-012	EM2118436-014	EM2118436-016	EM2118436-020	EM2118436-022
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	9.8	9.1	7.2	9.5	4.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1570	2860	2120	2120	1940
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	133	89.8	22.8	155	13.2
ANC as CaCO3	----	0.1	% CaCO3	13.6	9.2	2.3	15.8	1.3
Fizz Rating	----	0	Fizz Unit	2	2	1	3	1
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	5340	9720	7200	7190	6600
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	40.8	21.6	14.0	37.9	21.1
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	13.6	9.4	5.0	23.7	----
ø Exchangeable Magnesium	----	0.2	meq/100g	1.2	3.3	8.4	2.6	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.4	0.4	0.2	0.6	----
ø Exchangeable Sodium	----	0.2	meq/100g	2.7	1.9	1.1	1.9	----
ø Cation Exchange Capacity	----	0.2	meq/100g	17.9	15.0	14.7	28.9	----
ø Exchangeable Calcium Percent	----	0.2	%	76.1	62.8	33.9	82.2	----
ø Exchangeable Magnesium Percent	----	0.2	%	7.0	21.8	57.1	9.0	----
ø Exchangeable Potassium Percent	----	0.2	%	2.0	2.6	1.5	2.2	----
ø Exchangeable Sodium Percent	----	0.2	%	14.9	12.7	7.5	6.7	----
ø Calcium/Magnesium Ratio	----	0.2	-	10.9	2.9	0.6	9.1	----
ø Magnesium/Potassium Ratio	----	0.2	-	3.4	8.3	37.4	4.1	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	9.4
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	3.5
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	<0.1
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	0.1
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	0.9
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	13.1
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	24800	11500	2900	18200	4060
ED045G: Chloride by Discrete Analyser								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
			Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-012	EM2118436-014	EM2118436-016	EM2118436-020	EM2118436-022
				Result	Result	Result	Result	Result
ED045G: Chloride by Discrete Analyser - Continued								
Chloride	16887-00-6	10	mg/kg	870	420	120	100	240
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	5270	3940	860	3830	1600
Magnesium	7439-95-4	10	mg/kg	40	220	630	20	490
Sodium	7440-23-5	10	mg/kg	1160	600	260	560	490
Potassium	7440-09-7	10	mg/kg	140	80	30	160	40
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	14000	9440	4650	11500	4460
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	12	6	5	9	<5
Barium	7440-39-3	10	mg/kg	150	1350	460	280	360
Beryllium	7440-41-7	1	mg/kg	5	2	<1	4	<1
Boron	7440-42-8	50	mg/kg	810	300	80	770	70
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	12	14	16	5	12
Cobalt	7440-48-4	2	mg/kg	12	13	14	11	4
Copper	7440-50-8	5	mg/kg	9	6	5	<5	<5
Iron	7439-89-6	50	mg/kg	43700	30400	11200	35200	10700
Lead	7439-92-1	5	mg/kg	<5	6	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	385	227	45	208	30
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	32	21	17	30	7
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	50	34	13	19	12
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
EG048: Hexavalent Chromium (Alkaline Digest)								
Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	<1	<1	<1
EK030: Cyanide Amenable to Chlorination								
Cyanide amenable to chlorination	----	1	mg/kg	<1	<1	<1	<1	<1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	50	60	90	<40	90

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
				Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-012	EM2118436-014	EM2118436-016	EM2118436-020	EM2118436-022
					Result	Result	Result	Result	Result
EK055: Ammonia as N									
Ammonia as N	7664-41-7	20	mg/kg		<20	<20	<20	<20	<20
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg		<0.1	<0.1	**0.1**	<0.1	<0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<0.1	<0.1	**0.1**	<0.1	<0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		**590**	**850**	**600**	**2010**	**1560**
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		**590**	**850**	**600**	**2010**	**1560**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		**415**	**169**	**113**	**399**	**154**
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)									
Extraction Fluid pH	----	0.1	pH Unit		**2.9**	**2.9**	**2.9**	**2.9**	**2.9**
Final pH	----	0.1	pH Unit		**4.6**	**4.8**	**3.9**	**5.6**	**3.9**
EN60Z: ASLP Leachate - ZHE									
Extraction Fluid pH	----	0.1	pH Unit		**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
EP004: Organic Matter									
Total Organic Carbon	----	0.5	%		**2.2**	**1.7**	**2.6**	**2.7**	**3.0**
ED009: Anions									
ø Iodide	20461-54-5	0.05	mg/kg		<0.50	<1.00	<0.50	<0.50	<0.50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0205	ANG-21-0207	ANG-21-0181	ANG-21-0182	ANG-21-0185
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-024	EM2118436-026	EM2118436-030	EM2118436-031	EM2118436-032
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	5.4	8.2	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1610	2570	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	8.5	50.3	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	0.9	5.1	----	----	----
Fizz Rating	----	0	Fizz Unit	1	2	----	----	----
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	5470	8740	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	17.8	23.8	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	5.6	11.0	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	4.0	1.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	1.6	0.9	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	11.4	13.4	----	----	----
ø Exchangeable Calcium Percent	----	0.2	%	48.8	82.3	----	----	----
ø Exchangeable Magnesium Percent	----	0.2	%	35.3	9.2	----	----	----
ø Exchangeable Potassium Percent	----	0.2	%	2.0	1.6	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	13.9	6.9	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	1.4	8.9	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	17.4	5.6	----	----	----
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	3450	11700	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	200	260	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	1110	4050	----	----	----
Magnesium	7439-95-4	10	mg/kg	410	140	----	----	----
Sodium	7440-23-5	10	mg/kg	460	360	----	----	----
Potassium	7440-09-7	10	mg/kg	30	60	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-21-0205	ANG-21-0207	ANG-21-0181	ANG-21-0182	ANG-21-0185
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-024	EM2118436-026	EM2118436-030	EM2118436-031	EM2118436-032
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Aluminium	7429-90-5	50	mg/kg		**6460**	**2030**	----	----	----
Antimony	7440-36-0	5	mg/kg		<5	<5	----	----	----
Arsenic	7440-38-2	5	mg/kg		**7**	<5	----	----	----
Barium	7440-39-3	10	mg/kg		**400**	**100**	----	----	----
Beryllium	7440-41-7	1	mg/kg		**1**	<1	----	----	----
Boron	7440-42-8	50	mg/kg		**140**	<50	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg		**13**	**6**	----	----	----
Cobalt	7440-48-4	2	mg/kg		**7**	<2	----	----	----
Copper	7440-50-8	5	mg/kg		<5	<5	----	----	----
Iron	7439-89-6	50	mg/kg		**13600**	**2360**	----	----	----
Lead	7439-92-1	5	mg/kg		<5	<5	----	----	----
Manganese	7439-96-5	5	mg/kg		**60**	**11**	----	----	----
Molybdenum	7439-98-7	2	mg/kg		<2	<2	----	----	----
Nickel	7440-02-0	2	mg/kg		**14**	**3**	----	----	----
Selenium	7782-49-2	5	mg/kg		<5	<5	----	----	----
Zinc	7440-66-6	5	mg/kg		**26**	**5**	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	----	----	----
EG048: Hexavalent Chromium (Alkaline Digest)									
Hexavalent Chromium	18540-29-9	0.5	mg/kg		<0.5	<0.5	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	1	mg/kg		<1	<1	----	----	----
EK030: Cyanide Amenable to Chlorination									
Cyanide amenable to chlorination	----	1	mg/kg		<1	<1	----	----	----
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		**80**	**90**	----	----	----
EK055: Ammonia as N									
Ammonia as N	7664-41-7	20	mg/kg		<20	<20	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg		<0.1	<0.1	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg		<0.1	<0.1	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-21-0205	ANG-21-0207	ANG-21-0181	ANG-21-0182	ANG-21-0185
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00
Compound	CAS Number	LOR	Unit		EM2118436-024	EM2118436-026	EM2118436-030	EM2118436-031	EM2118436-032
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<0.1	<0.1	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		830	460	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		830	460	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		140	133	----	----	----
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)									
Extraction Fluid pH	----	0.1	pH Unit		----	2.9	----	----	----
Final pH	----	0.1	pH Unit		----	4.5	----	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)									
Final pH	----	0.1	pH Unit		----	----	5.1	7.1	8.4
EN60Z: ASLP Leachate - ZHE									
Extraction Fluid pH	----	0.1	pH Unit		----	5.0	----	----	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)									
Final pH	----	0.1	pH Unit		----	----	7.2	8.6	8.9
EP004: Organic Matter									
Total Organic Carbon	----	0.5	%		3.0	1.7	----	----	----
ED009: Anions									
ø Iodide	20461-54-5	0.05	mg/kg		<0.50	<1.00	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0187	ANG-21-0189	ANG-21-0191	ANG-21-0193	ANG-21-0196
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EM2118436-033	EM2118436-034	EM2118436-035	EM2118436-036	EM2118436-037
				Result	Result	Result	Result	Result
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)								
Final pH	----	0.1	pH Unit	**8.7**	**5.6**	**9.7**	**9.4**	**7.5**
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	**9.3**	**8.8**	**10.0**	**9.4**	**7.5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-21-0200	ANG-21-0202	ANG-21-0207	----	----
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	----	----
Compound	CAS Number	LOR	Unit	EM2118436-038	EM2118436-039	EM2118436-040	--------	--------
				Result	Result	Result	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)								
Final pH	----	0.1	pH Unit	**6.9**	**7.2**	**9.5**	**----**	**----**
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	**6.9**	**7.2**	**9.5**	**----**	**----**

Analytical Results

Sub-Matrix: **ZHE LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-21-0181	ANG-21-0182	ANG-21-0185	ANG-21-0187	ANG-21-0189
				Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
					EM2118436-002	EM2118436-003	EM2118436-006	EM2118436-008	EM2118436-010
					Result	Result	Result	Result	Result
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	<0.004	<0.004	<0.004	<0.004
EK030: Cyanide Amenable to Chlorination									
Cyanide amenable to chlorination	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **ZHE LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-21-0191	ANG-21-0193	ANG-21-0196	ANG-21-0200	ANG-21-0202
				Sampling date / time	14-Sep-2021 00:00	13-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
					EM2118436-012	EM2118436-014	EM2118436-016	EM2118436-020	EM2118436-022
					Result	Result	Result	Result	Result
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	<0.004	<0.004	<0.004	<0.004
EK030: Cyanide Amenable to Chlorination									
Cyanide amenable to chlorination	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: ZHE LEACHATE (Matrix: WATER)				Sample ID	ANG-21-0207	----	----	----	----
				Sampling date / time	14-Sep-2021 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2118436-026	--------	--------	--------	--------
					Result	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	----	----	----	----
EK030: Cyanide Amenable to Chlorination									
Cyanide amenable to chlorination	----	0.01	mg/L		<0.01	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA013: Acid Neutralising Capacity

(SOIL) ED009: Anions

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM2118436**	Page	: 1 of 22
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: CHRIS SMITT	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +6138549 9645
Project	: Alcoa Anglesea	Date Samples Received	: 15-Sep-2021
Order number	: ----	Date Analysis Commenced	: 20-Sep-2021
C-O-C number	: ----	Issue Date	: 29-Sep-2021
Sampler	: MATT RUSS		
Site	: ANGLESEA		
Quote number	: ME/638/21		
No. of samples received	: 40		
No. of samples analysed	: 23		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Jarwis Nheu	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 3912939)									
EM2118436-002	ANG-21-0181	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	320	320	0.0	0% - 20%
		EG005T: Chromium	7440-47-3	2	mg/kg	20	22	12.2	0% - 50%
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	5	29.4	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	8	11	33.0	No Limit
		EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	10	10	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	5	8	46.8	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	6	6	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	34	37	8.8	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	12	17	34.0	No Limit
		EG005T: Aluminium	7429-90-5	50	mg/kg	6460	6690	3.5	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
		EG005T: Iron	7439-89-6	50	mg/kg	17400	16200	7.7	0% - 20%
EM2118436-022	ANG-21-0202	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	360	390	8.7	0% - 20%
		EG005T: Chromium	7440-47-3	2	mg/kg	12	18	39.9	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	6	38.5	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	7	11	40.9	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 3912939) - continued									
EM2118436-022	ANG-21-0202	EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	7	29.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	6	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	30	50	48.1	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	12	17	33.4	No Limit
		EG005T: Aluminium	7429-90-5	50	mg/kg	4460	4850	8.5	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	70	110	38.2	No Limit
		EG005T: Iron	7439-89-6	50	mg/kg	10700	12000	11.5	0% - 20%
ED009: Anions (QC Lot: 3913957)									
EM2118436-002	ANG-21-0181	ED009-X: Iodide	20461-54-5	0.05	mg/kg	<0.50	<0.50	0.0	0% - 20%
EM2118436-024	ANG-21-0205	ED009-X: Iodide	20461-54-5	0.05	mg/kg	<0.50	<0.50	0.0	0% - 20%
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 3911335)									
EM2118436-006	ANG-21-0185	EA001: pH (CaCl2)	----	0.1	pH Unit	8.0	8.0	0.0	0% - 20%
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 3912675)									
EM2118436-002	ANG-21-0181	EA001: pH (CaCl2)	----	0.1	pH Unit	5.8	5.9	0.0	0% - 20%
EM2118436-026	ANG-21-0207	EA001: pH (CaCl2)	----	0.1	pH Unit	8.2	8.4	1.6	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 3911321)									
EM2118436-006	ANG-21-0185	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	2740	2690	1.8	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 3911328)									
EM2118364-002	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	306	310	1.3	0% - 20%
EM2118436-026	ANG-21-0207	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	2570	2660	3.6	0% - 20%
EA013: Acid Neutralising Capacity (QC Lot: 3916319)									
EB2124447-002	Anonymous	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	36.4	37.1	2.0	0% - 20%
EB2126404-001	Anonymous	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	18.2	17.2	5.9	0% - 20%
EA013: Acid Neutralising Capacity (QC Lot: 3916323)									
EM2118436-010	ANG-21-0189	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.2	6.9	9.8	0% - 50%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 3913250)									
EM2118436-002	ANG-21-0181	EA055: Moisture Content	----	0.1	%	14.4	15.8	9.3	0% - 50%
EM2118436-024	ANG-21-0205	EA055: Moisture Content	----	0.1	%	17.8	17.7	0.6	0% - 50%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 3914165)									
EM2118436-006	ANG-21-0185	ED006: Calcium/Magnesium Ratio	----	0.1	-	1.2	1.1	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1	-	21.8	20.9	4.0	0% - 20%
		ED006: Exchangeable Calcium Percent	----	0.2	%	46.5	45.4	2.6	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	39.8	40.4	1.5	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 3914165) - continued									
EM2118436-006	ANG-21-0185	ED006: Exchangeable Potassium Percent	----	0.2	%	1.8	1.9	5.5	No Limit
		ED006: Exchangeable Sodium Percent	----	0.2	%	11.8	12.3	4.0	0% - 20%
		ED006: Exchangeable Calcium	----	0.2	meq/100g	7.4	7.6	2.2	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	6.4	6.8	6.2	0% - 20%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.3	0.3	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	1.9	2.0	8.8	0% - 50%
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	16.0	16.7	4.7	0% - 20%
EM2118436-024	ANG-21-0205	ED006: Calcium/Magnesium Ratio	----	0.1	-	1.4	1.3	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1	-	17.4	16.8	3.4	0% - 20%
		ED006: Exchangeable Calcium Percent	----	0.2	%	48.8	47.4	2.9	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	35.3	35.8	1.4	0% - 20%
		ED006: Exchangeable Potassium Percent	----	0.2	%	2.0	2.1	4.8	0% - 50%
		ED006: Exchangeable Sodium Percent	----	0.2	%	13.9	14.7	5.6	0% - 20%
		ED006: Exchangeable Calcium	----	0.2	meq/100g	5.6	5.4	3.3	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	4.0	4.1	0.0	0% - 20%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	0.2	0.2	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	1.6	1.7	0.0	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	11.4	11.4	0.0	0% - 20%
ED007: Exchangeable Cations (QC Lot: 3919242)									
EM2118436-010	ANG-21-0189	ED007: Exchangeable Sodium Percent	----	0.1	%	28.4	28.0	1.3	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	0.6	0.6	0.0	No Limit
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	1.3	1.4	0.0	0% - 50%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	0.8	0.8	0.0	No Limit
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	2.8	2.9	3.6	0% - 20%
ED008: Exchangeable Cations (QC Lot: 3914161)									
EM2118436-002	ANG-21-0181	ED008: Exchangeable Sodium Percent	----	0.1	%	0.8	0.8	0.0	No Limit
		ED008: Exchangeable Calcium	----	0.1	meq/100g	5.8	5.8	0.0	0% - 20%
		ED008: Exchangeable Magnesium	----	0.1	meq/100g	4.6	4.7	0.0	0% - 20%
		ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED008: Cation Exchange Capacity	----	0.1	meq/100g	10.6	10.7	0.0	0% - 20%
EM2118436-022	ANG-21-0202	ED008: Exchangeable Sodium Percent	----	0.1	%	0.9	1.0	0.0	No Limit
		ED008: Exchangeable Calcium	----	0.1	meq/100g	9.4	9.5	0.0	0% - 20%
		ED008: Exchangeable Magnesium	----	0.1	meq/100g	3.5	3.6	0.0	0% - 20%
		ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED008: Exchangeable Sodium	----	0.1	meq/100g	0.1	0.1	0.0	No Limit
		ED008: Cation Exchange Capacity	----	0.1	meq/100g	13.1	13.2	0.8	0% - 20%
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QC Lot: 3913349)									
EM2118436-002	ANG-21-0181	ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	1980	1890	4.8	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QC Lot: 3913349) - continued									
EM2118436-022	ANG-21-0202	ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	4060	3580	12.6	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3911325)									
EM2118436-006	ANG-21-0185	ED045G: Chloride	16887-00-6	10	mg/kg	290	300	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3911330)									
EM2118364-002	Anonymous	ED045G: Chloride	16887-00-6	10	mg/kg	70	70	0.0	No Limit
EM2118436-026	ANG-21-0207	ED045G: Chloride	16887-00-6	10	mg/kg	260	280	8.6	0% - 20%
ED093S: Soluble Major Cations (QC Lot: 3911322)									
EM2118436-006	ANG-21-0185	ED093S: Calcium	7440-70-2	10	mg/kg	3090	3100	0.6	0% - 20%
		ED093S: Magnesium	7439-95-4	10	mg/kg	820	820	0.0	0% - 20%
		ED093S: Sodium	7440-23-5	10	mg/kg	590	600	0.0	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	60	60	0.0	No Limit
ED093S: Soluble Major Cations (QC Lot: 3911334)									
EM2118436-002	ANG-21-0181	ED093S: Calcium	7440-70-2	10	mg/kg	610	600	0.0	0% - 20%
		ED093S: Magnesium	7439-95-4	10	mg/kg	390	390	0.0	0% - 20%
		ED093S: Sodium	7440-23-5	10	mg/kg	210	210	0.0	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	30	30	0.0	No Limit
EM2118436-026	ANG-21-0207	ED093S: Calcium	7440-70-2	10	mg/kg	4050	4060	0.0	0% - 20%
		ED093S: Magnesium	7439-95-4	10	mg/kg	140	150	0.0	0% - 50%
		ED093S: Sodium	7440-23-5	10	mg/kg	360	360	0.0	0% - 20%
		ED093S: Potassium	7440-09-7	10	mg/kg	60	60	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 3912938)									
EM2118436-002	ANG-21-0181	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EM2118436-022	ANG-21-0202	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG048: Hexavalent Chromium (Alkaline Digest) (QC Lot: 3916480)									
EM2118436-002	ANG-21-0181	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
EM2118436-022	ANG-21-0202	EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 3916308)									
EM2118436-002	ANG-21-0181	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.0	No Limit
EM2118457-001	Anonymous	EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	<1	0.0	No Limit
EK030: Cyanide Amenable to Chlorination (QC Lot: 3916309)									
EM2118436-002	ANG-21-0181	EK030SF: Cyanide amenable to chlorination	----	1	mg/kg	<1	<1	0.0	No Limit
EM2118457-001	Anonymous	EK030SF: Cyanide amenable to chlorination	----	1	mg/kg	<1	<1	0.0	No Limit
EK040T: Fluoride Total (QC Lot: 3913343)									
EM2118436-002	ANG-21-0181	EK040T: Fluoride	16984-48-8	40	mg/kg	140	100	32.3	No Limit
EM2118436-022	ANG-21-0202	EK040T: Fluoride	16984-48-8	40	mg/kg	90	100	0.0	No Limit
EK055: Ammonia as N (QC Lot: 3917839)									
EM2118436-002	ANG-21-0181	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EM2118436-024	ANG-21-0205	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3911324)									
EM2118436-006	ANG-21-0185	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3911332)									
EM2118436-002	ANG-21-0181	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EM2118436-026	ANG-21-0207	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3911323)									
EM2118436-006	ANG-21-0185	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3911333)									
EM2118436-002	ANG-21-0181	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EM2118436-026	ANG-21-0207	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3917073)									
EM2118436-002	ANG-21-0181	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	510	# 330	42.3	0% - 20%
EM2118436-022	ANG-21-0202	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	1560	# 940	49.9	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3917072)									
EM2118436-022	ANG-21-0202	EK067G: Total Phosphorus as P	----	2	mg/kg	154	126	19.6	0% - 20%
EM2118436-002	ANG-21-0181	EK067G: Total Phosphorus as P	----	2	mg/kg	103	108	4.9	0% - 20%
EP004: Organic Matter (QC Lot: 3911375)									
EM2118436-002	ANG-21-0181	EP004: Total Organic Carbon	----	0.5	%	1.5	1.3	13.9	No Limit
EM2118436-022	ANG-21-0202	EP004: Total Organic Carbon	----	0.5	%	3.0	2.3	26.2	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED010: Iodide by Ion Selective Electrode (QC Lot: 3915546)									
EM2118251-001	Anonymous	ED010: Iodide	20461-54-5	0.5	mg/L	<0.5	<0.5	0.0	No Limit
EM2118436-014	ANG-21-0193	ED010: Iodide	20461-54-5	0.5	mg/L	<0.5	<0.5	0.0	No Limit
ED010: Iodide by Ion Selective Electrode (QC Lot: 3915547)									
EM2118436-035	ANG-21-0191	ED010: Iodide	20461-54-5	0.5	mg/L	<0.5	<0.5	0.0	No Limit
EM2118739-029	Anonymous	ED010: Iodide	20461-54-5	0.5	mg/L	<0.5	<0.5	0.0	No Limit
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 3915459)									
EM2118436-002	ANG-21-0181	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	3.9	3.9	0.0	0% - 20%
		EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	0.1	0.1	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	1.1	1.1	0.0	0% - 50%
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 3915459) - continued									
EM2118436-002	ANG-21-0181	EG005C: Iron	7439-89-6	0.1	mg/L	4.5	4.5	0.0	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	0.8	0.8	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EM2118436-022	ANG-21-0202	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	13.7	13.8	0.0	0% - 20%
		EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	0.1	0.1	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	3.4	3.5	0.0	0% - 20%
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	2.2	2.2	0.0	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	1.0	1.0	0.0	0% - 50%
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	0.2	0.2	0.0	No Limit
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EG005(ED093)W: Water Leachable Metals by ICPAES. (QC Lot: 3915900)									
EM2118436-030	ANG-21-0181	EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Arsenic	7440-38-2	0.01	mg/L	0.02	0.01	0.0	No Limit
		EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Chromium	7440-47-3	0.01	mg/L	0.04	0.04	0.0	No Limit
		EG005W: Cobalt	7440-48-4	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Copper	7440-50-8	0.01	mg/L	0.02	0.02	0.0	No Limit
		EG005W: Lead	7439-92-1	0.01	mg/L	0.01	<0.01	0.0	No Limit
		EG005W: Manganese	7439-96-5	0.01	mg/L	0.09	0.09	0.0	No Limit
		EG005W: Nickel	7440-02-0	0.01	mg/L	0.01	0.01	0.0	No Limit
		EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Silver	7440-22-4	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Tin	7440-31-5	0.01	mg/L	0.01	<0.01	0.0	No Limit
		EG005W: Titanium	7440-32-6	0.01	mg/L	0.11	0.09	23.5	0% - 50%
		EG005W: Vanadium	7440-62-2	0.01	mg/L	0.04	0.03	0.0	No Limit
		EG005W: Zinc	7440-66-6	0.01	mg/L	0.02	0.02	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)W: Water Leachable Metals by ICPAES. (QC Lot: 3915900) - continued									
EM2118436-030	ANG-21-0181	EG005W: Molybdenum	7439-98-7	0.01	mg/L	0.01	<0.01	0.0	No Limit
		EG005W: Iron	7439-89-6	0.05	mg/L	8.82	8.18	7.4	0% - 20%
		EG005W: Aluminium	7429-90-5	0.1	mg/L	10.0	9.73	3.0	0% - 20%
		EG005W: Barium	7440-39-3	0.1	mg/L	0.3	0.3	0.0	No Limit
		EG005W: Boron	7440-42-8	0.1	mg/L	0.8	0.8	0.0	No Limit
		EG005W: Strontium	7440-24-6	0.1	mg/L	0.3	0.3	0.0	No Limit
EM2118436-039	ANG-21-0202	EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG005W: Antimony	7440-36-0	0.01	mg/L	0.04	0.02	79.2	No Limit
		EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Chromium	7440-47-3	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Cobalt	7440-48-4	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Copper	7440-50-8	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Manganese	7439-96-5	0.01	mg/L	0.08	0.09	0.0	No Limit
		EG005W: Nickel	7440-02-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Silver	7440-22-4	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Tin	7440-31-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Titanium	7440-32-6	0.01	mg/L	0.02	0.03	0.0	No Limit
		EG005W: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Zinc	7440-66-6	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Iron	7439-89-6	0.05	mg/L	0.27	0.28	4.0	No Limit
		EG005W: Aluminium	7429-90-5	0.1	mg/L	0.56	0.58	3.1	No Limit
		EG005W: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005W: Boron	7440-42-8	0.1	mg/L	3.3	3.4	0.0	0% - 20%
		EG005W: Strontium	7440-24-6	0.1	mg/L	0.5	0.6	0.0	No Limit
EA010P: Conductivity by PC Titrator (QC Lot: 3915703)									
EM2118436-003	ANG-21-0182	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	981	978	0.3	0% - 20%
EM2118436-030	ANG-21-0181	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	148	149	0.0	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 3915707)									
EM2118643-009	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	19200	19300	0.8	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3917765)									
EM2118436-030	ANG-21-0181	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	382	386	0.9	0% - 20%
EM2118436-035	ANG-21-0191	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	956	1060	10.0	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 3917766)									
EM2118436-039	ANG-21-0202	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	474	508	6.9	0% - 20%
EM2118810-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1220	1260	3.0	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED037P: Alkalinity by PC Titrator (QC Lot: 3915702)									
EM2118436-003	ANG-21-0182	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
EM2118436-030	ANG-21-0181	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	6	9	35.5	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	6	9	35.5	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3915706)									
EM2118643-009	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	72	71	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	72	71	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3915616)									
EM2118436-002	ANG-21-0181	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	136	143	5.3	0% - 20%
EM2118436-022	ANG-21-0202	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	250	264	5.5	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3915619)									
EM2118436-039	ANG-21-0202	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	279	284	1.7	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 3915615)									
EM2118436-010	ANG-21-0189	ED045G: Chloride	16887-00-6	1	mg/L	5	5	0.0	No Limit
EM2118251-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	9	9	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 3915617)									
EM2118739-030	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	33	33	0.0	0% - 20%
EM2118436-035	ANG-21-0191	ED045G: Chloride	16887-00-6	1	mg/L	32	32	0.0	0% - 20%
ED093C: Leachable Major Cations (QC Lot: 3915458)									
EM2118436-002	ANG-21-0181	ED093C: Calcium	7440-70-2	1	mg/L	91	89	2.5	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	40	39	0.0	0% - 20%
		ED093C: Sodium	7440-23-5	1	mg/L	9	9	0.0	No Limit
		ED093C: Potassium	7440-09-7	1	mg/L	3	3	0.0	No Limit
EM2118436-022	ANG-21-0202	ED093C: Calcium	7440-70-2	1	mg/L	150	153	2.4	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	98	101	3.4	0% - 20%
		ED093C: Sodium	7440-23-5	1	mg/L	20	21	0.0	0% - 20%
		ED093C: Potassium	7440-09-7	1	mg/L	2	2	0.0	No Limit
ED093W: Water Leachable Major Cations (QC Lot: 3916075)									
EM2118436-030	ANG-21-0181	ED093W: Calcium	7440-70-2	1	mg/L	22	23	0.0	0% - 20%
		ED093W: Magnesium	7439-95-4	1	mg/L	17	18	0.0	0% - 50%
		ED093W: Sodium	7440-23-5	1	mg/L	9	10	0.0	No Limit
		ED093W: Potassium	7440-09-7	1	mg/L	2	2	0.0	No Limit
EM2118436-040	ANG-21-0207	ED093W: Calcium	7440-70-2	1	mg/L	252	255	1.3	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED093W: Water Leachable Major Cations (QC Lot: 3916075) - continued									
EM2118436-040	ANG-21-0207	ED093W: Magnesium	7439-95-4	1	mg/L	5	5	0.0	No Limit
		ED093W: Sodium	7440-23-5	1	mg/L	19	19	0.0	0% - 50%
		ED093W: Potassium	7440-09-7	1	mg/L	3	3	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 3923485)									
EM2118436-002	ANG-21-0181	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.0	No Limit
EM2118436-022	ANG-21-0202	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 3923486)									
EM2118436-039	ANG-21-0202	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.0	No Limit
EM2118769-029	Anonymous	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.0	No Limit
EG050G: Hexavalent Chromium by Discrete Analyser (QC Lot: 3918944)									
EM2118436-002	ANG-21-0181	EG050G-C: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM2118436-026	ANG-21-0207	EG050G-C: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EG050G: Hexavalent Chromium by Discrete Analyser (QC Lot: 3918945)									
EM2118436-040	ANG-21-0207	EG050G-C: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 3922517)									
EM2118436-033	ANG-21-0187	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EM2118436-002	ANG-21-0181	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 3923434)									
EM2118436-014	ANG-21-0193	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EM2118800-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.0	No Limit
EK030: Cyanide Amenable to Chlorination (QC Lot: 3922518)									
EM2118436-034	ANG-21-0189	EK030SF: Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM2118436-002	ANG-21-0181	EK030SF: Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK030: Cyanide Amenable to Chlorination (QC Lot: 3923435)									
EM2118436-014	ANG-21-0193	EK030SF: Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM2118800-001	Anonymous	EK030SF: Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3915704)									
EM2118436-003	ANG-21-0182	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.0	No Limit
EM2118436-030	ANG-21-0181	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.1	0.2	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 3915705)									
EM2118643-009	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.4	0.4	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3918145)									
EM2118436-002	ANG-21-0181	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.22	0.24	8.6	0% - 20%
EM2118436-022	ANG-21-0202	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.27	0.28	6.1	0% - 20%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3918147)									
EM2118436-039	ANG-21-0202	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.31	0.31	0.0	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3915614)									
EM2118436-012	ANG-21-0191	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3915614) - continued									
EM2118251-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3915618)									
EM2118739-031	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.02	0.02	0.0	No Limit
EM2118436-035	ANG-21-0191	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3918146)									
EM2118436-002	ANG-21-0181	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM2118436-022	ANG-21-0202	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3918148)									
EM2118769-027	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.24	0.24	0.0	0% - 20%
EM2118436-039	ANG-21-0202	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3915490)									
EM2118436-002	ANG-21-0181	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.8	<0.5	52.8	No Limit
EM2118436-022	ANG-21-0202	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.5	1.2	83.3	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3915492)									
EM2118436-039	ANG-21-0202	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	<0.5	33.7	No Limit
EM2118643-009	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.8	1.2	40.9	0% - 50%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3915489)									
EM2118436-002	ANG-21-0181	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.12	0.16	30.6	No Limit
EM2118436-022	ANG-21-0202	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.05	0.24	131	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3915491)									
EM2118436-039	ANG-21-0202	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.10	0.08	27.2	No Limit
EM2118643-009	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.05	0.10	69.1	No Limit
EP002: Dissolved Organic Carbon (DOC) (QC Lot: 3923840)									
EM2118436-039	ANG-21-0202	EP002: Dissolved Organic Carbon	----	1	mg/L	8	8	0.0	No Limit
Sample Preparation Method (QC Lot: 3915900)									
EM2118436-030	ANG-21-0181	EN25W: Amount	----	0.1	mL	1	1	----	No Limit
		EN25W: Volume	----	0.1	mL	1.05	1.05	----	No Limit
EM2118436-039	ANG-21-0202	EN25W: Amount	----	0.1	mL	1	1	----	No Limit
		EN25W: Volume	----	0.1	mL	1.05	1.05	----	No Limit
Sample Preparation Method (QC Lot: 3916075)									
EM2118436-030	ANG-21-0181	EN25W: Amount	----	0.1	mL	1	1	----	No Limit
		EN25W: Volume	----	0.1	mL	1.05	1.05	----	No Limit
EM2118436-040	ANG-21-0207	EN25W: Amount	----	0.1	mL	1	1	----	No Limit
		EN25W: Volume	----	0.1	mL	1.05	1.05	----	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 3912939)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	15910 mg/kg	88.8	70.0	130
EG005T: Antimony	7440-36-0	5	mg/kg	<5	2.57 mg/kg	112	70.0	130
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	123 mg/kg	110	70.0	130
EG005T: Barium	7440-39-3	10	mg/kg	<10	99.3 mg/kg	95.2	70.0	130
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	0.67 mg/kg	92.5	70.0	130
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	1.23 mg/kg	61.2	50.0	130
EG005T: Chromium	7440-47-3	2	mg/kg	<2	20.2 mg/kg	104	70.0	130
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	11.2 mg/kg	89.3	70.0	130
EG005T: Copper	7440-50-8	5	mg/kg	<5	55.9 mg/kg	98.5	70.0	130
EG005T: Iron	7439-89-6	50	mg/kg	<50	33227 mg/kg	108	70.0	130
EG005T: Lead	7439-92-1	5	mg/kg	<5	62.4 mg/kg	95.6	70.0	130
EG005T: Manganese	7439-96-5	5	mg/kg	<5	590 mg/kg	89.9	70.0	130
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	2.19 mg/kg	84.7	70.0	130
EG005T: Nickel	7440-02-0	2	mg/kg	<2	15.4 mg/kg	97.1	70.0	130
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Zinc	7440-66-6	5	mg/kg	<5	162 mg/kg	78.3	70.0	130
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel) (QCLot: 3911610)								
EN60-DIa-P: Final pH	----	0.1	pH Unit	6.0	----	----	----	----
ED009: Anions (QCLot: 3913957)								
ED009-X: Iodide	20461-54-5	0.05	mg/kg	<0.05	2.5 mg/kg	92.6	76.0	114
EA001: pH in soil using 0.01M CaCl extract (QCLot: 3911335)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	98.8	101
				----	7 pH Unit	100	99.3	101
EA001: pH in soil using 0.01M CaCl extract (QCLot: 3912675)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	98.8	101
				----	7 pH Unit	99.7	99.3	101
EA010: Conductivity (1:5) (QCLot: 3911321)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	101	94.5	105
EA010: Conductivity (1:5) (QCLot: 3911328)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	101	94.5	105
EA013: Acid Neutralising Capacity (QCLot: 3916319)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	49 kg H2SO4 equiv./t	100	82.0	120

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EA013: Acid Neutralising Capacity (QCLot: 3916323)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	9.9 kg H2SO4 equiv./t	94.5	82.0	120
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 3914165)								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	33 meq/100g	80.6	66.6	101
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	32 meq/100g	75.6	66.9	120
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	2.2 meq/100g	89.7	72.8	119
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	5.6 meq/100g	82.1	67.5	112
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	----	----	----	----
ED006: Exchangeable Calcium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Magnesium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Potassium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Calcium/Magnesium Ratio	----	0.1	-	<0.1	----	----	----	----
ED006: Magnesium/Potassium Ratio	----	0.1	-	<0.1	----	----	----	----
ED007: Exchangeable Cations (QCLot: 3919242)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.13 meq/100g	96.7	80.0	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.96 meq/100g	104	72.2	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.01 meq/100g	111	77.4	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.86 meq/100g	119	89.2	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED008: Exchangeable Cations (QCLot: 3914161)								
ED008: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.44 meq/100g	93.6	70.0	130
ED008: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.65 meq/100g	96.3	70.0	130
ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.83 meq/100g	106	83.4	130
ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.31 meq/100g	114	85.2	130
ED008: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QCLot: 3913349)								
ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	<50	3000 mg/kg	101	86.1	116
ED045G: Chloride by Discrete Analyser (QCLot: 3911325)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	99.1	85.5	120
				<10	5000 mg/kg	108	85.5	120
ED045G: Chloride by Discrete Analyser (QCLot: 3911330)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	98.5	85.5	120
				<10	5000 mg/kg	106	85.5	120
ED093S: Soluble Major Cations (QCLot: 3911322)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	25 mg/kg	100	91.0	118
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	25 mg/kg	97.4	85.9	116
ED093S: Sodium	7440-23-5	10	mg/kg	<10	250 mg/kg	97.4	85.9	117
ED093S: Potassium	7440-09-7	10	mg/kg	<10	250 mg/kg	94.7	84.6	116

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
ED093S: Soluble Major Cations (QCLot: 3911334)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	25 mg/kg	103	91.0	118
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	25 mg/kg	103	85.9	116
ED093S: Sodium	7440-23-5	10	mg/kg	<10	250 mg/kg	99.5	85.9	117
ED093S: Potassium	7440-09-7	10	mg/kg	<10	250 mg/kg	95.8	84.6	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3912938)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.64 mg/kg	77.2	70.0	130
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 3916480)								
EG048G: Hexavalent Chromium	18540-29-9	0.5	mg/kg	<0.5	20 mg/kg	80.6	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 3916308)								
EK026SF: Total Cyanide	57-12-5	1	mg/kg	<1	20 mg/kg	95.0	70.0	130
EK030: Cyanide Amenable to Chlorination (QCLot: 3916309)								
EK030SF: Cyanide amenable to chlorination	----	1	mg/kg	<1	40 mg/kg	106	70.0	130
EK040T: Fluoride Total (QCLot: 3913343)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	400 mg/kg	91.5	75.2	110
EK055: Ammonia as N (QCLot: 3917839)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	94.1	83.0	109
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3911324)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	107	88.9	113
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3911332)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	100	88.9	113
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3911323)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	99.8	89.5	119
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3911333)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	110	89.5	119
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3917073)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	500 mg/kg	94.0	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3917072)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	221 mg/kg	92.1	78.3	127
EN60Z: ASLP Leachate - ZHE (QCLot: 3916537)								
EN60Za: Extraction Fluid pH	----	0.1	pH Unit	5.0	----	----	----	----
EN60Z: ASLP Leachate - ZHE (QCLot: 3919025)								
EN60Za: Extraction Fluid pH	----	0.1	pH Unit	5.0	----	----	----	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction) (QCLot: 3916542)								
EN60Z-DIa: Final pH	----	0.1	pH Unit	7.4	----	----	----	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction) (QCLot: 3919024)								
EN60Z-DIa: Final pH	----	0.1	pH Unit	7.0	----	----	----	----

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP004: Organic Matter (QCLot: 3911375)								
EP004: Total Organic Carbon	----	0.5	%	<0.5	43.5 %	95.3	70.0	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED010: Iodide by Ion Selective Electrode (QCLot: 3915546)								
ED010: Iodide	20461-54-5	0.5	mg/L	<0.5	1 mg/L	98.1	80.0	120
ED010: Iodide by Ion Selective Electrode (QCLot: 3915547)								
ED010: Iodide	20461-54-5	0.5	mg/L	<0.5	1 mg/L	98.0	80.0	120
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 3915459)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	1 mg/L	100	82.3	116
EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	----	----	----	----
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	1 mg/L	106	85.4	117
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	1 mg/L	102	80.9	111
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	1 mg/L	109	87.4	118
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	----	----	----	----
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	1 mg/L	103	83.6	112
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	1 mg/L	101	82.4	115
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	1 mg/L	102	83.1	117
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	1 mg/L	100	84.0	116
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	1 mg/L	105	79.8	119
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	1 mg/L	106	84.6	119
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	1 mg/L	101	83.6	117
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	1 mg/L	101	82.6	117
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	1 mg/L	100	80.4	118
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	1 mg/L	101	81.8	119
EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	1 mg/L	100	80.3	114
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 3915900)								
EG005W: Aluminium	7429-90-5	0.1	mg/L	<0.10	1 mg/L	107	83.6	116
EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	1 mg/L	108	80.5	119
EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	1 mg/L	107	86.2	119
EG005W: Barium	7440-39-3	0.1	mg/L	<0.1	1 mg/L	107	81.4	113
EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	1 mg/L	107	88.8	116
EG005W: Boron	7440-42-8	0.1	mg/L	<0.1	1 mg/L	107	85.8	121
EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	1 mg/L	107	84.6	118
EG005W: Chromium	7440-47-3	0.01	mg/L	<0.01	1 mg/L	107	82.4	115
EG005W: Cobalt	7440-48-4	0.01	mg/L	<0.01	1 mg/L	107	83.0	117
EG005W: Copper	7440-50-8	0.01	mg/L	<0.01	1 mg/L	107	85.2	113
EG005W: Iron	7439-89-6	0.05	mg/L	<0.05	1 mg/L	107	81.3	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 3915900) - continued								
EG005W: Lead	7439-92-1	0.01	mg/L	<0.01	1 mg/L	107	82.3	115
EG005W: Manganese	7439-96-5	0.01	mg/L	<0.01	1 mg/L	106	83.5	115
EG005W: Nickel	7440-02-0	0.01	mg/L	<0.01	1 mg/L	107	83.6	116
EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	1 mg/L	107	78.9	117
EG005W: Silver	7440-22-4	0.01	mg/L	<0.01	----	----	----	----
EG005W: Strontium	7440-24-6	0.1	mg/L	<0.1	1 mg/L	107	84.4	112
EG005W: Tin	7440-31-5	0.01	mg/L	<0.01	1 mg/L	107	82.6	114
EG005W: Titanium	7440-32-6	0.01	mg/L	<0.01	1 mg/L	107	83.1	112
EG005W: Vanadium	7440-62-2	0.01	mg/L	<0.01	1 mg/L	107	84.0	111
EG005W: Zinc	7440-66-6	0.01	mg/L	<0.01	1 mg/L	107	83.2	118
EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	1 mg/L	107	82.2	113
EA010P: Conductivity by PC Titrator (QCLot: 3915703)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	113	85.0	119
EA010P: Conductivity by PC Titrator (QCLot: 3915707)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	112	85.0	119
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3917765)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2000 mg/L	99.4	91.0	110
				<10	293 mg/L	106	91.0	110
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 3917766)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	2000 mg/L	98.4	91.0	110
				<10	293 mg/L	98.3	91.0	110
ED037P: Alkalinity by PC Titrator (QCLot: 3915702)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	85.0	116
ED037P: Alkalinity by PC Titrator (QCLot: 3915706)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	85.0	116
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3915616)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.8	117
				<1	500 mg/L	111	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3915619)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	99.5	85.8	117
				<1	500 mg/L	113	80.0	120
ED045G: Chloride by Discrete Analyser (QCLot: 3915615)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	97.9	85.0	115
				<1	1000 mg/L	104	85.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 3915617)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	96.4	85.0	115
				<1	1000 mg/L	106	85.0	122

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
ED093C: Leachable Major Cations (QCLot: 3915458)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	114	80.0	120
ED093C: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	108	80.0	120
ED093C: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	109	80.0	120
ED093C: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	101	80.0	120
ED093W: Water Leachable Major Cations (QCLot: 3916075)								
ED093W: Calcium	7440-70-2	1	mg/L	<1	5 mg/L	107	80.0	120
ED093W: Magnesium	7439-95-4	1	mg/L	<1	5 mg/L	116	80.0	120
ED093W: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	117	80.0	120
ED093W: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	107	80.0	120
EG035C: Leachable Mercury by FIMS (QCLot: 3923485)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	106	72.0	115
EG035C: Leachable Mercury by FIMS (QCLot: 3923486)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	88.1	72.0	115
EG050G: Hexavalent Chromium by Discrete Analyser (QCLot: 3918944)								
EG050G-C: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	0.5 mg/L	99.8	80.0	120
EG050G: Hexavalent Chromium by Discrete Analyser (QCLot: 3918945)								
EG050G-C: Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	0.5 mg/L	99.6	80.0	120
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 3922517)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	94.0	77.7	116
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 3923434)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	92.9	77.7	116
EK030: Cyanide Amenable to Chlorination (QCLot: 3922518)								
EK030SF: Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	0.2 mg/L	86.4	70.0	130
EK030: Cyanide Amenable to Chlorination (QCLot: 3923435)								
EK030SF: Cyanide amenable to chlorination	----	0.01	mg/L	<0.01	0.2 mg/L	75.8	70.0	130
EK040P: Fluoride by PC Titrator (QCLot: 3915704)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	95.8	80.8	118
EK040P: Fluoride by PC Titrator (QCLot: 3915705)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	104	80.8	118
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3918145)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	104	84.1	116
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3918147)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	102	84.1	116
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3915614)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	93.0	90.9	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3915618)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3915618) - continued								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	93.4	90.9	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3918146)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	109	90.0	117
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3918148)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	106	90.0	117
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3915490)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	5 mg/L	72.9	70.0	117
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3915492)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	5 mg/L	93.4	70.0	117
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3915489)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	2.21 mg/L	93.2	71.9	114
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3915491)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	2.21 mg/L	91.8	71.9	114
EP002: Dissolved Organic Carbon (DOC) (QCLot: 3923839)								
EP002: Dissolved Organic Carbon	----	1	mg/L	<1	100 mg/L	86.6	83.0	115
EP002: Dissolved Organic Carbon (DOC) (QCLot: 3923840)								
EP002: Dissolved Organic Carbon	----	1	mg/L	<1	100 mg/L	83.5	83.0	115
Sample Preparation Method (QCLot: 3915900)								
EN25W: Amount	----	0.1	mL	1	mL		----	----
EN25W: Volume	----	0.1	mL	1.05	mL		----	----
Sample Preparation Method (QCLot: 3916075)								
EN25W: Amount	----	0.1	mL	1	mL		----	----
EN25W: Volume	----	0.1	mL	1.05	mL		----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 3912939)							
EM2118436-003	ANG-21-0182	EG005T: Arsenic	7440-38-2	50 mg/kg	99.0	78.0	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	98.0	79.7	116
		EG005T: Chromium	7440-47-3	50 mg/kg	111	79.0	121
		EG005T: Copper	7440-50-8	250 mg/kg	101	80.0	120
		EG005T: Lead	7439-92-1	250 mg/kg	99.5	80.0	120

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 3912939) - continued							
EM2118436-003	ANG-21-0182	EG005T: Nickel	7440-02-0	50 mg/kg	98.0	78.0	120
		EG005T: Zinc	7440-66-6	250 mg/kg	97.0	80.0	120
ED009: Anions (QCLot: 3913957)							
EM2118436-003	ANG-21-0182	ED009-X: Iodide	20461-54-5	50 mg/kg	98.0	70.0	130
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QCLot: 3913349)							
EM2118436-003	ANG-21-0182	ED040N: Sulfate as SO4 2-	14808-79-8	3000 mg/kg	84.7	84.0	116
ED045G: Chloride by Discrete Analyser (QCLot: 3911325)							
EM2118436-014	ANG-21-0193	ED045G: Chloride	16887-00-6	2000 mg/kg	122	93.0	125
ED045G: Chloride by Discrete Analyser (QCLot: 3911330)							
EM2118436-002	ANG-21-0181	ED045G: Chloride	16887-00-6	2000 mg/kg	122	93.0	125
EG035T: Total Recoverable Mercury by FIMS (QCLot: 3912938)							
EM2118436-003	ANG-21-0182	EG035T: Mercury	7439-97-6	0.5 mg/kg	95.8	76.0	116
EG048: Hexavalent Chromium (Alkaline Digest) (QCLot: 3916480)							
EM2118436-003	ANG-21-0182	EG048G: Hexavalent Chromium	18540-29-9	20 mg/kg	# 50.9	58.0	114
EM2118436-003	ANG-21-0182	EG048G: Hexavalent Chromium	18540-29-9	20 mg/kg	59.6	58.0	114
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 3916308)							
EM2118436-003	ANG-21-0182	EK026SF: Total Cyanide	57-12-5	20 mg/kg	124	70.0	130
EK030: Cyanide Amenable to Chlorination (QCLot: 3916309)							
EM2118436-003	ANG-21-0182	EK030SF: Cyanide amenable to chlorination	----	40 mg/kg	104	70.0	130
EK040T: Fluoride Total (QCLot: 3913343)							
EM2118436-003	ANG-21-0182	EK040T: Fluoride	16984-48-8	400 mg/kg	92.5	70.0	130
EK055: Ammonia as N (QCLot: 3917839)							
EM2118436-003	ANG-21-0182	EK055: Ammonia as N	7664-41-7	50 mg/kg	91.0	80.0	110
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3911324)							
EM2118436-014	ANG-21-0193	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	104	84.0	128
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3911332)							
EM2118436-003	ANG-21-0182	EK057G: Nitrite as N (Sol.)	14797-65-0	2.5 mg/kg	106	84.0	128
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3911323)							
EM2118436-014	ANG-21-0193	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	95.0	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3911333)							
EM2118436-003	ANG-21-0182	EK059G: Nitrite + Nitrate as N (Sol.)	----	2.5 mg/kg	109	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3917073)							
EM2118436-003	ANG-21-0182	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	70.3	70.0	130

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Acceptable Limits (%) Low	Acceptable Limits (%) High
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3917072)							
EM2118436-003	ANG-21-0182	EK067G: Total Phosphorus as P	----	100 mg/kg	92.2	70.0	130
EP004: Organic Matter (QCLot: 3911375)							
EM2118436-003	ANG-21-0182	EP004: Total Organic Carbon	----	1.309 %	# 59.3	70.0	120

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Acceptable Limits (%) Low	Acceptable Limits (%) High
ED010: Iodide by Ion Selective Electrode (QCLot: 3915546)							
EM2118251-021	Anonymous	ED010: Iodide	20461-54-5	1 mg/L	84.1	80.0	120
ED010: Iodide by Ion Selective Electrode (QCLot: 3915547)							
EM2118436-036	ANG-21-0193	ED010: Iodide	20461-54-5	1 mg/L	99.1	80.0	120
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 3915459)							
EM2118436-003	ANG-21-0182	EG005C: Aluminium	7429-90-5	1 mg/L	99.1	84.9	119
		EG005C: Arsenic	7440-38-2	1 mg/L	106	88.0	124
		EG005C: Barium	7440-39-3	1 mg/L	101	85.1	119
		EG005C: Beryllium	7440-41-7	1 mg/L	109	86.9	123
		EG005C: Cadmium	7440-43-9	1 mg/L	101	82.5	114
		EG005C: Chromium	7440-47-3	1 mg/L	99.6	82.7	115
		EG005C: Cobalt	7440-48-4	1 mg/L	101	80.8	117
		EG005C: Copper	7440-50-8	1 mg/L	100	88.4	121
		EG005C: Iron	7439-89-6	1 mg/L	# Not Determined	77.9	122
		EG005C: Lead	7439-92-1	1 mg/L	102	80.1	115
		EG005C: Manganese	7439-96-5	1 mg/L	101	79.2	115
		EG005C: Nickel	7440-02-0	1 mg/L	100	81.7	116
		EG005C: Selenium	7782-49-2	1 mg/L	103	83.7	120
		EG005C: Zinc	7440-66-6	1 mg/L	100	77.5	123
		EG005C: Molybdenum	7439-98-7	1 mg/L	98.6	80.3	116
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 3915900)							
EM2118436-031	ANG-21-0182	EG005W: Aluminium	7429-90-5	1 mg/L	111	80.0	124
		EG005W: Arsenic	7440-38-2	1 mg/L	116	83.0	121
		EG005W: Barium	7440-39-3	1 mg/L	111	83.6	117
		EG005W: Beryllium	7440-41-7	1 mg/L	118	90.0	120
		EG005W: Cadmium	7440-43-9	1 mg/L	112	87.5	115
		EG005W: Chromium	7440-47-3	1 mg/L	109	80.7	115
		EG005W: Cobalt	7440-48-4	1 mg/L	111	86.0	112
		EG005W: Copper	7440-50-8	1 mg/L	114	81.7	118
		EG005W: Iron	7439-89-6	1 mg/L	114	86.0	115

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 3915900) - continued							
EM2118436-031	ANG-21-0182	EG005W: Lead	7439-92-1	1 mg/L	115	82.6	119
		EG005W: Manganese	7439-96-5	1 mg/L	109	86.0	117
		EG005W: Nickel	7440-02-0	1 mg/L	110	81.4	117
		EG005W: Selenium	7782-49-2	1 mg/L	111	80.0	120
		EG005W: Strontium	7440-24-6	1 mg/L	110	85.1	114
		EG005W: Tin	7440-31-5	1 mg/L	106	86.0	113
		EG005W: Vanadium	7440-62-2	1 mg/L	109	85.7	112
		EG005W: Zinc	7440-66-6	1 mg/L	115	83.2	119
		EG005W: Molybdenum	7439-98-7	1 mg/L	112	82.7	113
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3915616)							
EM2118436-003	ANG-21-0182	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	78.4	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3915619)							
EM2118436-040	ANG-21-0207	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	# Not Determined	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3915615)							
EM2118251-021	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	98.8	70.0	142
ED045G: Chloride by Discrete Analyser (QCLot: 3915617)							
EM2118436-036	ANG-21-0193	ED045G: Chloride	16887-00-6	400 mg/L	104	70.0	142
EG035C: Leachable Mercury by FIMS (QCLot: 3923485)							
EM2118436-003	ANG-21-0182	EG035C: Mercury	7439-97-6	0.01 mg/L	106	84.0	118
EG035C: Leachable Mercury by FIMS (QCLot: 3923486)							
EM2118436-040	ANG-21-0207	EG035C: Mercury	7439-97-6	0.01 mg/L	90.9	84.0	118
EG050G: Hexavalent Chromium by Discrete Analyser (QCLot: 3918944)							
EM2118436-003	ANG-21-0182	EG050G-C: Hexavalent Chromium	18540-29-9	0.5 mg/L	# 1.1	71.7	128
EG050G: Hexavalent Chromium by Discrete Analyser (QCLot: 3918945)							
EM2118739-028	Anonymous	EG050G-C: Hexavalent Chromium	18540-29-9	0.5 mg/L	# 67.3	71.7	128
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 3922517)							
EM2118436-003	ANG-21-0182	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	97.7	70.0	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 3923434)							
EM2118436-016	ANG-21-0196	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	94.0	70.0	130
EK030: Cyanide Amenable to Chlorination (QCLot: 3922518)							
EM2118436-003	ANG-21-0182	EK030SF: Cyanide amenable to chlorination	----	0.2 mg/L	71.5	70.0	130
EK030: Cyanide Amenable to Chlorination (QCLot: 3923435)							
EM2118436-020	ANG-21-0200	EK030SF: Cyanide amenable to chlorination	----	0.2 mg/L	86.9	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK040P: Fluoride by PC Titrator (QCLot: 3915705)							
EM2118643-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	82.8	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3918145)							
EM2118436-003	ANG-21-0182	EK055G: Ammonia as N	7664-41-7	1 mg/L	72.4	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3918147)							
EM2118436-040	ANG-21-0207	EK055G: Ammonia as N	7664-41-7	1 mg/L	123	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3915614)							
EM2118251-021	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	98.6	80.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3915618)							
EM2118436-036	ANG-21-0193	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	100	80.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3918146)							
EM2118436-003	ANG-21-0182	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	94.4	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3918148)							
EM2118436-040	ANG-21-0207	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	94.4	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3915490)							
EM2118436-003	ANG-21-0182	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	96.0	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3915492)							
EM2118436-040	ANG-21-0207	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	100	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3915489)							
EM2118436-003	ANG-21-0182	EK067G: Total Phosphorus as P	----	1 mg/L	87.6	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3915491)							
EM2118436-040	ANG-21-0207	EK067G: Total Phosphorus as P	----	1 mg/L	86.0	70.0	130
EP002: Dissolved Organic Carbon (DOC) (QCLot: 3923840)							
EM2118436-040	ANG-21-0207	EP002: Dissolved Organic Carbon	----	100 mg/L	85.5	75.0	117
Sample Preparation Method (QCLot: 3915900)							
EM2118436-031	ANG-21-0182	EN25W: Amount	----	mL		0	0
		EN25W: Volume	----	mL		0	0

- **No Matrix Spike (MS) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM2118436**	Page	: 1 of 25
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: CHRIS SMITT	Telephone	: +6138549 9645
Project	: Alcoa Anglesea	Date Samples Received	: 15-Sep-2021
Site	: ANGLESEA	Issue Date	: 29-Sep-2021
Sampler	: MATT RUSS	No. of samples received	: 40
Order number	: ----	No. of samples analysed	: 23

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Duplicate outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EM2118436--002	ANG-21-0181	**Total Kjeldahl Nitrogen as N**	----	42.3 %	0% - 20%	**RPD exceeds LOR based limits**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	EM2118436--022	ANG-21-0202	**Total Kjeldahl Nitrogen as N**	----	49.9 %	0% - 20%	**RPD exceeds LOR based limits**
Matrix Spike (MS) Recoveries							
EG048: Hexavalent Chromium (Alkaline Digest)	EM2118436--003	ANG-21-0182	**Hexavalent Chromium**	18540-29-9	50.9 %	58.0-114%	**Recovery less than lower data quality objective**
EP004: Organic Matter	EM2118436--003	ANG-21-0182	**Total Organic Carbon**	----	59.3 %	70.0-120%	**Recovery less than lower data quality objective**

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG005(ED093)C: Leachable Metals by ICPAES	EM2118436--003	ANG-21-0182	**Iron**	7439-89-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EM2118436--040	ANG-21-0207	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG050G: Hexavalent Chromium by Discrete Analyser	EM2118436--003	ANG-21-0182	**Hexavalent Chromium**	18540-29-9	1.1 %	71.7-128%	**Recovery less than lower data quality objective**
EG050G: Hexavalent Chromium by Discrete Analyser	EM2118739--028	Anonymous	**Hexavalent Chromium**	18540-29-9	67.3 %	71.7-128%	**Recovery less than lower data quality objective**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Dissolved Organic Carbon	1	11	9.09	10.00	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	3	40	7.50	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Fluoride by PC Titrator	1	40	2.50	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA001: pH in soil using 0.01M CaCl extract								
Soil Glass Jar - Unpreserved (EA001)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	20-Sep-2021	✓	**20-Sep-2021**	20-Sep-2021	✓
Soil Glass Jar - Unpreserved (EA001)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**21-Sep-2021**	21-Sep-2021	✓	**21-Sep-2021**	21-Sep-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	20-Sep-2021	✓	**20-Sep-2021**	18-Oct-2021	✓
Soil Glass Jar - Unpreserved (EA010)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**20-Sep-2021**	21-Sep-2021	✓	**20-Sep-2021**	18-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EA013: Acid Neutralising Capacity								
Soil Glass Jar - Unpreserved (EA013)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**23-Sep-2021**	13-Sep-2022	✓	**23-Sep-2021**	22-Mar-2022	✓
Soil Glass Jar - Unpreserved (EA013)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**23-Sep-2021**	14-Sep-2022	✓	**23-Sep-2021**	22-Mar-2022	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**----**	----	----	**21-Sep-2021**	27-Sep-2021	✓
Soil Glass Jar - Unpreserved (EA055)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**----**	----	----	**21-Sep-2021**	28-Sep-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
ED006: Exchangeable Cations on Alkaline Soils								
Soil Glass Jar - Unpreserved (ED006)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**21-Sep-2021**	11-Oct-2021	✓	**23-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (ED006)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**21-Sep-2021**	12-Oct-2021	✓	**23-Sep-2021**	12-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
ED007: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED007)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**23-Sep-2021**	11-Oct-2021	✓	**23-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (ED007)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**23-Sep-2021**	12-Oct-2021	✓	**23-Sep-2021**	12-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
ED008: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED008)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**23-Sep-2021**	11-Oct-2021	✓	**23-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (ED008)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**23-Sep-2021**	12-Oct-2021	✓	**23-Sep-2021**	12-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED009: Anions								
Soil Glass Jar - Unpreserved (ED009-X)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**22-Sep-2021**	11-Oct-2021	✓	**22-Sep-2021**	20-Oct-2021	✓
Soil Glass Jar - Unpreserved (ED009-X)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**22-Sep-2021**	12-Oct-2021	✓	**22-Sep-2021**	20-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Soil Glass Jar - Unpreserved (ED040N)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**22-Sep-2021**	12-Mar-2022	✓	**22-Sep-2021**	12-Mar-2022	✓
Soil Glass Jar - Unpreserved (ED040N)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**22-Sep-2021**	13-Mar-2022	✓	**22-Sep-2021**	13-Mar-2022	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
ED045G: Chloride by Discrete Analyser								
Soil Glass Jar - Unpreserved (ED045G)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	11-Oct-2021	✓	**21-Sep-2021**	18-Oct-2021	✓
Soil Glass Jar - Unpreserved (ED045G)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**20-Sep-2021**	12-Oct-2021	✓	**21-Sep-2021**	18-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
ED093S: Soluble Major Cations								
Soil Glass Jar - Unpreserved (ED093S)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	12-Mar-2022	✓	**21-Sep-2021**	12-Mar-2022	✓
Soil Glass Jar - Unpreserved (ED093S)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**20-Sep-2021**	13-Mar-2022	✓	**21-Sep-2021**	13-Mar-2022	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG005(ED093)T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**21-Sep-2021**	12-Mar-2022	✓	**22-Sep-2021**	12-Mar-2022	✓
Soil Glass Jar - Unpreserved (EG005T)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**21-Sep-2021**	13-Mar-2022	✓	**22-Sep-2021**	13-Mar-2022	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**21-Sep-2021**	11-Oct-2021	✓	**22-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (EG035T)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**21-Sep-2021**	12-Oct-2021	✓	**22-Sep-2021**	12-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EG048: Hexavalent Chromium (Alkaline Digest)								
Soil Glass Jar - Unpreserved (EG048G)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**22-Sep-2021**	11-Oct-2021	✓	**23-Sep-2021**	29-Sep-2021	✓
Soil Glass Jar - Unpreserved (EG048G)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**22-Sep-2021**	12-Oct-2021	✓	**23-Sep-2021**	29-Sep-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EK026SF: Total CN by Segmented Flow Analyser								
Soil Glass Jar - Unpreserved (EK026SF)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**22-Sep-2021**	27-Sep-2021	✓	**23-Sep-2021**	06-Oct-2021	✓
Soil Glass Jar - Unpreserved (EK026SF)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**22-Sep-2021**	28-Sep-2021	✓	**23-Sep-2021**	06-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK030: Cyanide Amenable to Chlorination								
Soil Glass Jar - Unpreserved (EK030SF)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**22-Sep-2021**	27-Sep-2021	✓	**23-Sep-2021**	06-Oct-2021	✓
Soil Glass Jar - Unpreserved (EK030SF)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**22-Sep-2021**	28-Sep-2021	✓	**23-Sep-2021**	06-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EK040T: Fluoride Total								
Soil Glass Jar - Unpreserved (EK040T)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**21-Sep-2021**	11-Oct-2021	✓	**23-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (EK040T)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**21-Sep-2021**	12-Oct-2021	✓	**23-Sep-2021**	12-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EK055: Ammonia as N								
Soil Glass Jar - Unpreserved (EK055)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**----**	----	----	**23-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (EK055)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**----**	----	----	**23-Sep-2021**	12-Oct-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							
EK057G: Nitrite as N by Discrete Analyser								
Soil Glass Jar - Unpreserved (EK057G)								
ANG-21-0185,	ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	20-Sep-2021	✓	**20-Sep-2021**	22-Sep-2021	✓
Soil Glass Jar - Unpreserved (EK057G)								
ANG-21-0181,	ANG-21-0182,	**14-Sep-2021**	**20-Sep-2021**	21-Sep-2021	✓	**20-Sep-2021**	22-Sep-2021	✓
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0205,	ANG-21-0207							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK059G)							
ANG-21-0185, ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	11-Oct-2021	✓	**20-Sep-2021**	22-Sep-2021	✓
Soil Glass Jar - Unpreserved (EK059G)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0205, ANG-21-0207	**14-Sep-2021**	**20-Sep-2021**	12-Oct-2021	✓	**20-Sep-2021**	22-Sep-2021	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Soil Glass Jar - Unpreserved (EK061G)							
ANG-21-0185, ANG-21-0193	**13-Sep-2021**	**27-Sep-2021**	11-Oct-2021	✓	**27-Sep-2021**	25-Oct-2021	✓
Soil Glass Jar - Unpreserved (EK061G)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0205, ANG-21-0207	**14-Sep-2021**	**27-Sep-2021**	12-Oct-2021	✓	**27-Sep-2021**	25-Oct-2021	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK067G)							
ANG-21-0185, ANG-21-0193	**13-Sep-2021**	**27-Sep-2021**	11-Oct-2021	✓	**27-Sep-2021**	25-Oct-2021	✓
Soil Glass Jar - Unpreserved (EK067G)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0205, ANG-21-0207	**14-Sep-2021**	**27-Sep-2021**	12-Oct-2021	✓	**27-Sep-2021**	25-Oct-2021	✓
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)							
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60a-P)							
ANG-21-0185, ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	11-Oct-2021	✓	**----**	----	----
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60a-P)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**14-Sep-2021**	**20-Sep-2021**	12-Oct-2021	✓	**----**	----	----

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)							
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60-DIa-P)							
ANG-21-0185, ANG-21-0193	**13-Sep-2021**	**20-Sep-2021**	11-Oct-2021	✓	**----**	----	----
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60-DIa-P)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**14-Sep-2021**	**20-Sep-2021**	12-Oct-2021	✓	**----**	----	----
EN60Z: ASLP Leachate - ZHE							
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za)							
ANG-21-0185	**13-Sep-2021**	**22-Sep-2021**	27-Sep-2021	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za)							
ANG-21-0193	**13-Sep-2021**	**23-Sep-2021**	27-Sep-2021	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191	**14-Sep-2021**	**22-Sep-2021**	28-Sep-2021	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Za)							
ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**14-Sep-2021**	**23-Sep-2021**	28-Sep-2021	✓	**----**	----	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)							
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Z-DIa)							
ANG-21-0185	**13-Sep-2021**	**22-Sep-2021**	27-Sep-2021	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Z-DIa)							
ANG-21-0193	**13-Sep-2021**	**23-Sep-2021**	27-Sep-2021	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Z-DIa)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191	**14-Sep-2021**	**22-Sep-2021**	28-Sep-2021	✓	**----**	----	----
ZHE Leach: 14 day HT(e.g. CN, BTEX) (EN60Z-DIa)							
ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**14-Sep-2021**	**23-Sep-2021**	28-Sep-2021	✓	**----**	----	----
EP004: Organic Matter							
Soil Glass Jar - Unpreserved (EP004)							
ANG-21-0185, ANG-21-0193	**13-Sep-2021**	**27-Sep-2021**	11-Oct-2021	✓	**27-Sep-2021**	11-Oct-2021	✓
Soil Glass Jar - Unpreserved (EP004)							
ANG-21-0181, ANG-21-0182, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0205, ANG-21-0207	**14-Sep-2021**	**27-Sep-2021**	12-Oct-2021	✓	**27-Sep-2021**	12-Oct-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	18-Oct-2021	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**----**	----	----	**23-Sep-2021**	27-Sep-2021	✓
ED010: Iodide by Ion Selective Electrode							
Clear Plastic Bottle - Natural (ED010)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207, ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	18-Oct-2021	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	04-Oct-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
ED093C: Leachable Major Cations								
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093C)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**22-Sep-2021**	18-Oct-2021	✓	**22-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207								
ED093W: Water Leachable Major Cations								
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093W)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**22-Sep-2021**	18-Oct-2021	✓	**22-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207								

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG005(ED093)C: Leachable Metals by ICPAES							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**22-Sep-2021**	19-Mar-2022	✓	**22-Sep-2021**	19-Mar-2022	✓
EG005(ED093)W: Water Leachable Metals by ICPAES							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005W)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**22-Sep-2021**	19-Mar-2022	✓	**22-Sep-2021**	19-Mar-2022	✓
EG035C: Leachable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207, ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**----**	----	----	**27-Sep-2021**	18-Oct-2021	✓
EG050G: Hexavalent Chromium by Discrete Analyser							
Clear Plastic Bottle - NaOH (EG050G-C)							
ANG-21-0181, ANG-21-0182, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207, ANG-21-0181, ANG-21-0185, ANG-21-0187, ANG-21-0189, ANG-21-0191, ANG-21-0193, ANG-21-0196, ANG-21-0200, ANG-21-0202, ANG-21-0207	**20-Sep-2021**	**----**	----	----	**23-Sep-2021**	18-Oct-2021	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK026SF: Total CN by Segmented Flow Analyser								
Opaque plastic bottle - NaOH (EK026SF)								
ANG-21-0181,	ANG-21-0182,	**22-Sep-2021**	**----**	----	----	**25-Sep-2021**	06-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0181,	ANG-21-0182,							
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191							
Opaque plastic bottle - NaOH (EK026SF)								
ANG-21-0193,	ANG-21-0196,	**23-Sep-2021**	**----**	----	----	**27-Sep-2021**	07-Oct-2021	✓
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
EK030: Cyanide Amenable to Chlorination								
Opaque plastic bottle - NaOH (EK030SF)								
ANG-21-0181,	ANG-21-0182,	**22-Sep-2021**	**----**	----	----	**25-Sep-2021**	06-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0181,	ANG-21-0182,							
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191							
Opaque plastic bottle - NaOH (EK030SF)								
ANG-21-0193,	ANG-21-0196,	**23-Sep-2021**	**----**	----	----	**27-Sep-2021**	07-Oct-2021	✓
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**----**	----	----	**27-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**----**	----	----	**22-Sep-2021**	22-Sep-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**----**	----	----	**23-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**22-Sep-2021**	18-Oct-2021	✓	**23-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
ANG-21-0181,	ANG-21-0182,	**20-Sep-2021**	**22-Sep-2021**	18-Oct-2021	✓	**23-Sep-2021**	18-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191,							
ANG-21-0193,	ANG-21-0196,							
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207,	ANG-21-0181,							
ANG-21-0182,	ANG-21-0185,							
ANG-21-0187,	ANG-21-0189,							
ANG-21-0191,	ANG-21-0193,							
ANG-21-0196,	ANG-21-0200,							
ANG-21-0202,	ANG-21-0207							
EP002: Dissolved Organic Carbon (DOC)								
Amber DOC Filtered- Sulfuric Preserved (EP002)								
ANG-21-0181,	ANG-21-0182,	**22-Sep-2021**	**----**	----	----	**27-Sep-2021**	20-Oct-2021	✓
ANG-21-0185,	ANG-21-0187,							
ANG-21-0189,	ANG-21-0191							
Amber DOC Filtered- Sulfuric Preserved (EP002)								
ANG-21-0193,	ANG-21-0196,	**23-Sep-2021**	**----**	----	----	**27-Sep-2021**	21-Oct-2021	✓
ANG-21-0200,	ANG-21-0202,							
ANG-21-0207								

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acid Neutralising Capacity (ANC)	EA013	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Buchi Ammonia	EK055	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	3	12	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	3	17	**17.65**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	3	16	**18.75**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	2	3	**66.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	3	12	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	3	13	**23.08**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	3	22	**13.64**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions (Extended Method)	ED009-X	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Neutralising Capacity (ANC)	EA013	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Buchi Ammonia	EK055	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	4	17	**23.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	16	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	4	22	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions (Extended Method)	ED009-X	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
ASLP for Volatile Analytes (Zero Headspace Extraction)	EN60Za	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Buchi Ammonia	EK055	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Deionised Water Leach - Plastic Leaching Vessel	EN60-Dla-P	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Deionised Water Leach - Zero Headspace Extraction	EN60Z-Dla	2	11	**18.18**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	16	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions (Extended Method)	ED009-X	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Matrix Spikes (MS)							
Buchi Ammonia	EK055	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	17	**11.76**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	2	12	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	2	13	**15.38**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Standard Anions (Extended Method)	ED009-X	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	3	22	**13.64**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	4	31	**12.90**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	1	11	**9.09**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	3	40	**7.50**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Leachable	EG050G-C	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Iodide by Ion Selective Electrode (ISE)	ED010	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	4	35	**11.43**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	4	22	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	3	22	**13.64**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	4	30	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	28	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP) - Continued							
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	4	40	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	38	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	2	11	**18.18**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Leachable	EG050G-C	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Iodide by Ion Selective Electrode (ISE)	ED010	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	22	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	28	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	2	11	**18.18**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Leachable	EG050G-C	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Iodide by Ion Selective Electrode (ISE)	ED010	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	28	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	40	**2.50**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Hexavalent Chromium by Discrete Analyser - Leachable	EG050G-C	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Iodide by Ion Selective Electrode (ISE)	ED010	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	38	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	30	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	40	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Conductivity by PC Titrator	EA010-P	SOIL	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Acid Neutralising Capacity (ANC)	EA013	SOIL	In house: Referenced to USEPA 600/2-78-054, I. Miller (2000). A fizz test is done to semiquanititatively estimate the likely reactivity. The soil is then reacted with an known excess quanitity of an appropriate acid. Titration determines the acid remaining, and the ANC can be calculated from comparison with a blank titration.
Total Soluble Salts	EA014	SOIL	In house: The concentration of Total Soluble Salts in a soil is calculated from the Electrical conductivity of a water extract. This method is compliant with NEPM Schedule B(3).
Total Dissolved Solids (High Level)	EA015H	SOIL	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Standard Anions (Extended Method)	* ED009-X	SOIL	In-house: Referenced to APHA 4110. A soil sample is leached with 1 part to five parts of deionised water and the leachate subject to analysis by ion chromatography with conductivity detection. This method is compliant with NEPM Schedule B(3).
Iodide by Ion Selective Electrode (ISE)	ED010	SOIL	In house: A high ionic strength of the liquid sample is maintained with the addition of sodium nitrate and Iodide is measured with an ion selective electrode.
Alkalinity by PC Titrator	ED037-P	SOIL	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Sulfate - Calcium Phosphate Soluble	ED040N	SOIL	In house: The sample is extracted with a calcium phosphate solution. The phosphate ion displaces the adsorbed sulfate while calcium ions depress the extraction of interfering S from soil organic matter. SO4 in the extract is determined by ICPAES and reported as dry weight in the original soil. This method is compliant with NEPM Schedule B(3).
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	SOIL	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA seal method 2 017-1-L
Leachable Major Cations	ED093C	SOIL	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations in leachates are determined by either ICP-AES or ICP-MS techniques.
Cations - soluble by ICP-AES	ED093S	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3).
Water Leachable Major Cations	ED093W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010; ALS QWI-EN/EG005, QWI-EN/ED093. The ICPAES technique quickly breaks the sample down into atoms and ions under extremely hot plasma. Atoms are then ionised, emitting a characteristic spectrum. The spectrometer then separates the wavelengths, prior to comparison of intensities against matrix matched standards for quantification.
Leachable Metals by ICPAES	EG005C	SOIL	In house: referenced to APHA 3120; USEPA SW 846 - 6010: The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Water Leachable Metals by ICPAES	EG005W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Leachable Mercury by FIMS	EG035C	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).

Analytical Methods	Method	Matrix	Method Descriptions
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Hexavalent Chromium by Alkaline Digestion and DA Finish	EG048G	SOIL	In house: Referenced to USEPA SW846, Method 3060. Hexavalent chromium is extracted by alkaline digestion. The digest is determined by photometrically by automatic discrete analyser, following pH adjustment. The instrument uses colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM Schedule B(3)
Hexavalent Chromium by Discrete Analyser - Leachable	EG050G-C	SOIL	In house: Referenced to APHA 3500 Cr-A & B. Hexavalent chromium is determined directly on leachate samples by Descrete Analyser as received by pH adjustment and colour development using dephenylcarbazide. Each run of samples is measured against a five-point calibration curve. This method is compliant with NEPM Schedule B(3).
Total Cyanide by Segmented Flow Analyser	EK026SF	SOIL	In house: Referenced to APHA 4500-CN C / ASTM D7511 / ISO 14403. Caustic leachates of soil samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM Schedule B(3).
Cyanide Amenable to Chlorination (Segmented Flow Analyser)	EK030SF	SOIL	In house: Referenced to APHA 4500-CN G (prep), 4500-CN O (det.). The sample is pretreated by contact with chlorine (as hypochlorite) prior to determination of total cyanide. The measured parameter is the difference between total cyanide determined on an untreated sample and total cyanide determined post-chlorination. This method is compliant with NEPM Schedule B(3)
Fluoride by PC Titrator	EK040P	SOIL	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.
Buchi Ammonia	EK055	SOIL	In house: Referenced to APHA 4500-NH3 B&G, H Samples are steam distilled (Buchi) prior to analysis and quantified using titration, FIA or Discrete Analyser.
Ammonia as N by Discrete analyser	EK055G	SOIL	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO3- F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results.

Analytical Methods	Method	Matrix	Method Descriptions
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	SOIL	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Dissolved Organic Carbon	EP002	SOIL	In house: Referenced to APHA 5310 B. This method is compliant with NEPM Schedule B(3). Samples are combusted at high termperature in the presence of an oxidative catalyst. The evolved carbon dioxide is quantified using an IR detector.
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
NaOH leach for CN in Soils	CN-PR	SOIL	In house: APHA 4500 CN. Samples are extracted by end-over-end tumbling with NaOH.
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method (Alkaline Soils)	ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Calcium Phosphate Extraction for Sulphate as SO4 2-	ED040NPR	SOIL	The sample is extracted with a calcium phosphate solution. The phosphate ion displaces the adsorbed sulphate while calcium ions depress the extraction of interfering S from soil organic matter. SO4 in the extract is determined by ICPAES and reported as dry weight in the original soil. This method is compliant with NEPM Schedule B(3).
Alkaline digestion for Hexavalent Chromium	EG048PR	SOIL	In house: Referenced to USEPA SW846, Method 3060A.
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals in DI Water Leachate	EN25W	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
1:5 solid / water leach following drying at 40°C	EN34-AD	SOIL	10 g of 40°C dried soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes - Plastic Leaching Vessel	EN60a-P	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates.
Deionised Water Leach - Plastic Leaching Vessel	EN60-DIa-P	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
ASLP for Volatile Analytes (Zero Headspace Extraction)	EN60Za	SOIL	In house QWI-EN/60 referenced to AS4439.2 Preparation of Leachates
Deionised Water Leach - Zero Headspace Extraction	EN60Z-DIa	SOIL	In house QWI-EN/60 referenced to AS4439.2 Preparation of Leachates
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3).

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4979 7944 E: ALSEnviro.Gladstone@alsglobal.com

MACKAY 78/79 Caldwell Drive Age QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com

MUDGEE 1/28 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Garbutt QLD 4814 Ph: 07 4796 0600 E: samples.townsville@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

MAITLAND 585 Maitland Road Mayfield West NSW 2304 Ph: 02 4968 9433 E: samples.newcastle@alsglobal.com

WOLLONGONG 4/19-21 Ralph Black Drive, Mt Wollongong NSW 2500 E: samples.wollongong@alsglobal.com

CLIENT: Alcoa Australia	TURNAROUND REQUIREMENTS :	☐ Standard TAT (List due date): 1 week TAT	FOR LABORATORY USE ONLY (Circle)
OFFICE: Melbourne	Standard TAT may be longer for some tests e.g. Ultra Trace Organics	☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Alcoa Anglesea	ALS QUOTE NO.: ME/638/21 V2	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
FACILITY CODE: TBC	PO#,:	COUNTRY OF ORIGIN: Australia	COC: 1 Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Chris Smitt	CONTACT PH:		OF: 1 Other comment:
SAMPLER: Matt Russ	SAMPLER MOBILE: 0420863250	RELINQUISHED BY:	RECEIVED BY:
COC Emailed to ALS? YES	EDD and EHS EQEDD FORMAT	Matt Russ	
Email Reports to: matt.russ@ehs-support.com and chris.smitt@ehs-support.com Email EDDs to: equis@ehs-support.com, matt.russ@ehs-support.com and chris.smitt@ehs-support.com		DATE/TIME:	DATE/TIME:
Email Invoice to: matt.russ@ehs-support.com		15/9/2021	

RELINQUISHED BY: JW of ALS 20/9 DATE/TIME:

RECEIVED BY: DATE/TIME:

18

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: HOLD=Store samples for potential future analysis

	SAMPLE DETAILS MATRIX: Soil (SO), Sediment (SE), surface water (WS), Groundwater (WG), Water QC (WQ), Soil QC (WQ)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).											Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX CODE	SAMPLE TYPE CODE	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	Soil Analysis - As per ME/638/21 V2 Plus CEC	Leachability Analysis - As per ME/638/21 V2		HOLD						HOLD	Nutrients = NT-8S plus phosphorus Herbicides = carbamates, phenoxy acid herbicides, synthetic pyrithroids and triazine pesticides (atrazine and simazine Asbestos = Absence / Presence
1	ANG-21-0180	14-09-21	S		4 x Jars					X							
2 30	ANG-21-0181	14-09-21	S		4 x Jars		X	X									
3 31	ANG-21-0182	14-09-21	S		4 x Jars		X	X									
4	ANG-21-0183	13-09-21	S		4 x Jars					X							
5	ANG-21-0184	13-09-21	S		4 x Jars					X							
6 32	ANG-21-0185	13-09-21	S		4 x Jars		X	X									
7	ANG-21-0186	14-09-21	S		4 x Jars					X							
8 33	ANG-21-0187	14-09-21	S		4 x Jars		X	X									
9	ANG-21-0188	14-09-21	S		4 x Jars					X							
10 34	ANG-21-0189	14-09-21	S		4 x Jars		X	X									
11	ANG-21-0190	14-09-21	S		4 x Jars					X							
12 35	ANG-21-0191	14-09-21	S		4 x Jars		X	X									
13	ANG-21-0192	13-09-21	S		4 x Jars					X							
14 36	ANG-21-0193	13-09-21	S		4 x Jars		X	X									
—	ANG-21-0194	No Sample	S		No Sample					X							No Sample
15	ANG-21-0195	14-09-21	S		4 x Jars					X							
16 37	ANG-21-0196	14-09-21	S		4 x Jars		X	X									
17	ANG-21-0197	14-09-21	S		4 x Jars					X							
18	ANG-21-0198	14-09-21	S		4 x Jars					X							
19	ANG-21-0199	14-09-21	S		4 x Jars					X							
20 38	ANG-21-0200	14-09-21	S		4 x Jars		X	X									
21	ANG-21-0201	14-09-21	S		4 x Jars					X							
22 39	ANG-21-0202	14-09-21	S		4 x Jars		X	X									
—	ANG-21-0203	No Sample	S		No Sample					X							No Sample
23	ANG-21-0204	14-09-21	S		4 x Jars					X							
24	ANG-21-0205	14-09-21	S		4 x Jars		X										
25	ANG-21-0206	14-09-21	S		1 x jar					X							
26 40	ANG-21-0207	14-09-21	S		4 x Jars		X	X									
27	ANG-21-0208	14-09-21	S		4 x Jars					X							
28	ANG-21-0209	14-09-21	S		1 x jar					X							
—	ANG-21-0210	14-09-21	S		4 x Jars		X										Please Send to Eurofins
29	ANG-21-0211	14-09-21	S		4 x Jars					X							
					TOTAL												

Environmental Division
Melbourne
Work Order Reference
EM2118436

Telephone : +61-3-8549 9600

C 20/9/21-4pm
JLE
4.1
+0.5
4.6
Cooler

926015
21/9/21

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

RE: Eurofins Sample Receipt Advice - Report 826015 : Site ALCOA ANGLESEA

Matt Russ <matt.russ@ehs-support.com>

Tue 21/09/2021 8:42 AM

To: #AU_CAU001_EnviroSampleVic <EnviroSampleVic@eurofins.com>
Cc: Chris Smitt <Chris.Smitt@ehs-support.com>; Michael Morrison <MichaelMorrison@eurofins.com>

EXTERNAL EMAIL*

Hi,

Please see analysis below. Please also do CEC.

Many thanks

Parameter	ALS Code	Technique/ Method Reference	Limit Of Reporting (LOR)
Total Mercury	EG035T (solids)	APHA 3112 Hg - B	0.1 mg/kg
1:5 Leach	EN34	In house	0.1 g
Electrical Conductivity (1:5)	EA010 (solids)	Various	1 µS/cm
Ammonia as N	EK055 (solids)	APHA 4500-NH3 B/G/H	20 mg/kg
Total Metals -Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Zn	EG005T (solids)	USEPA 6010	1 - 50 mg/kg
Total Cyanide	EK026SF (Solids)	Various	1 mg/kg
Total Fluoride	EK040T	In house	40 mg/kg
Organic Matter & Total Organic Carbon (Calc.) (Walkley Black)	EP004 (Carbon)	AS1289.4.1.1	0.5 %
pH (CaCl)	EA001	Various	0.1 pH Unit
Cyanide Amenable to Chlorination	EK030SF	Various	1 mg/kg
Major Cations (Ca, Mg, Na, K)	NT-1S	USEPA 6010, In house	10 mg/kg, 1 %
Total Hexavalent Chromium (Alkaline digestion)	EG048G	USEPA 3060	0.5 mg/kg
Total N + Total P	NT-11S	Various	1 %, 0.1 - 20 mg/kg
Iodide	ED009-X	APHA 4110	0.05 mg/kg
NO2 and NO3	NT-4S	Various	1 %, 0.1 mg/kg
Major Anions (Cl, SO4) (melb)	NT-2S-EM	Various	Various
Alkalinity - Acid Neutralising Capacity (ANC)	EA013	USEPA 600/2-78-054 & Miller	Various
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	In house	0.1 g
Total Soluble Salts	EA014	Calculation	5 mg/kg

826015
21/9/21

Matt Russ
Project Hydrogeologist | B.Eng (Env)(Hons) / B.Env Sci

e. matt.russ@ehs-support.com
p. 0420 863 250
o. Geelong, Victoria
w. ehs-support.com

EHS Support

RE: Eurofins Sample Receipt Advice - Report 826015 : Site ALCOA ANGLESEA

Matt Russ <matt.russ@ehs-support.com>
Wed 22/09/2021 4:12 PM
To: #AU_CAU001_EnviroSampleVic <EnviroSampleVic@eurofins.com>
Cc: Chris Smitt <Chris.Smitt@ehs-support.com>

EXTERNAL EMAIL*

Hi,

Please ignore the 1:5 leach and drying at 85 degrees bagging and labelling.

Please complete all other listed analysis plus CEC.

826015
C/O EF
22/9/21.

Many thanks,

Matt Russ
Project Hydrogeologist | B.Eng (Env)(Hons) / B.Env Sci

e. matt.russ@ehs-support.com
p. 0420 863 250
o. Geelong, Victoria
w. ehs-support.com

EHS Support

From: EnviroSampleVic@eurofins.com <EnviroSampleVic@eurofins.com>
Sent: Tuesday, 21 September 2021 1:45 PM
To: Matt Russ <matt.russ@ehs-support.com>
Cc: Chris Smitt <Chris.Smitt@ehs-support.com>
Subject: Eurofins Sample Receipt Advice - Report 826015 : Site ALCOA ANGLESEA

PLEASE CONFIRM 1:5 LEACH AND DRYING AT 85 DEGREES BAGGING AND LABELLING (ASS)

Dear Valued Client,

Please find attached a Sample Receipt Advice (SRA), a Summary Sheet and a scanned copy of your Chain-of-Custody (COC). It is important that you check this documentation to ensure that the details are correct such as the Client Job Number, Turn Around Time, any comments in the Notes section and sample numbers as well as the requested analysis. If there are any irregularities then please contact your Eurofins Analytical Services Manager as soon as possible to make certain that they get changed.

Regards

Joanne Devine
Sample Receipt

eurofins | Environment Testing

www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

Eurofins Environment Testing NZ Limited
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Sample Receipt Advice

Company name:	EHS Support Pty Ltd
Contact name:	Matt Russ
Project name:	ALCOA ANGLESEA
Project ID:	Not provided
Turnaround time:	5 Day
Date/Time received	Sep 20, 2021 4:00 PM
Eurofins reference	826015

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✓	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
✗	Split sample sent to requested external lab.
✗	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Michael Morrison on phone : 03 8564 5933 or by email: MichaelMorrison@eurofins.com

Results will be delivered electronically via email to Matt Russ - matt.russ@ehs-support.com.

Note: A copy of these results will also be delivered to the general EHS Support Pty Ltd email address.

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

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ABN: 50 005 085 521

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6 Monterey Road
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IANZ # 1327

Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: EHS Support Pty Ltd
Address: 6/468 St Kilda Rd
Melbourne
VIC 3004

Project Name: ALCOA ANGLESEA

Order No.:
Report #: 826015
Phone: 03 9646 8615
Fax:

Received: Sep 20, 2021 4:00 PM
Due: Sep 28, 2021
Priority: 5 Day
Contact Name: Matt Russ

Eurofins Analytical Services Manager : Michael Morrison

Sample Detail	Acid Neutralising Capacity (ANCbt)	Aluminium	Ammonia (as N)	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chloride	Chromium	Chromium (hexavalent)	Cobalt	Copper	Cyanide (amenable)	Cyanide (total)	Fluoride (Total)	Iodide	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Nitrate (as N)	Nitrite (as N)	Organic Matter %	pH (units)(1:5 soil:CaCl2 extract at 25°C as	Phosphorus	Potassium	Selenium	Sodium	Sulphate (as SO4)	Total Organic Carbon	Total Soluble Salts*	Zinc	Total Nitrogen Set (as N)	Moisture Set	Cation Exchange Capacity
Melbourne Laboratory - NATA # 1261 Site # 1254		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Sydney Laboratory - NATA # 1261 Site # 18217																			X																							
Brisbane Laboratory - NATA # 1261 Site # 20794	X																																								
Mayfield Laboratory - NATA # 1261 Site # 25079																																									
Perth Laboratory - NATA # 2377 Site # 2370																																					X				
External Laboratory																																									
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																						
1	ANG-21-0210	Sep 14, 2021		Soil	M21-Se40682	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

EHS Support Pty Ltd
6/468 St Kilda Rd
Melbourne
VIC 3004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Matt Russ**

Report **826015-S**
Project name ALCOA ANGLESEA
Received Date Sep 20, 2021

Client Sample ID			**ANG-21-0210**
Sample Matrix			**Soil**
Eurofins Sample No.			**M21-Se40682**
Date Sampled			**Sep 14, 2021**
Test/Reference	LOR	Unit	
Ammonia (as N)	5	mg/kg	5.5
Chloride	5	mg/kg	200
Chromium (hexavalent)	1	mg/kg	< 1
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	1200
Cyanide (amenable)	5	mg/kg	< 5
Cyanide (total)	5	mg/kg	< 5
Fluoride (Total)	100	mg/kg	< 100
Iodide	5	mg/kg	< 5
Nitrate & Nitrite (as N)	5	mg/kg	< 5
Nitrate (as N)	5	mg/kg	< 5
Nitrite (as N)	5	mg/kg	< 5
Organic Matter %	0.01	% w/w	11
pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	0.1	pH Units	6.4
Sulphate (as SO4)	30	mg/kg	1000
Total Kjeldahl Nitrogen (as N)	10	mg/kg	690
Total Nitrogen (as N)*	10	mg/kg	690
Total Organic Carbon	0.1	%	5.2
Total Soluble Salts*		mg/kg	980
Phosphorus	5	mg/kg	110
Acid Neutralising Capacity (ANCbt)	0.01	% CaCO3	1.3
% Moisture	1	%	20
Heavy Metals			
Aluminium	20	mg/kg	6900
Antimony	10	mg/kg	< 10
Arsenic	2	mg/kg	6.1
Barium	10	mg/kg	370
Beryllium	2	mg/kg	< 2
Boron	10	mg/kg	73
Cadmium	0.4	mg/kg	< 0.4
Chromium	5	mg/kg	14
Cobalt	5	mg/kg	8.1
Copper	5	mg/kg	< 5
Iron	20	mg/kg	12000
Lead	5	mg/kg	< 5
Manganese	5	mg/kg	39
Mercury	0.1	mg/kg	< 0.1

Client Sample ID			ANG-21-0210
Sample Matrix			**Soil**
Eurofins Sample No.			**M21-Se40682**
Date Sampled			**Sep 14, 2021**
Test/Reference	LOR	Unit	
Heavy Metals			
Molybdenum	5	mg/kg	< 5
Nickel	5	mg/kg	12
Selenium	2	mg/kg	< 2
Zinc	5	mg/kg	23
Alkali Metals			
Calcium	5	mg/kg	2800
Magnesium	5	mg/kg	2100
Potassium	5	mg/kg	200
Sodium	5	mg/kg	520
Cation Exchange Capacity			
Cation Exchange Capacity	0.05	meq/100g	8.9

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Ammonia (as N)	Melbourne	Sep 23, 2021	28 Days
- Method: APHA 4500-NH3 Ammonia Nitrogen by FIA			
Chloride	Melbourne	Sep 23, 2021	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Chromium (hexavalent)	Melbourne	Sep 23, 2021	28 Days
- Method: APHA 3500-Cr Hexavalent Chromium- (Extraction:- USEPA3060)			
Cyanide (amenable)	Melbourne	Sep 23, 2021	14 Days
- Method: Cyanide (Amenable) :- as per APHA 45 CN-G			
Cyanide (total)	Melbourne	Sep 23, 2021	14 Days
- Method: LTM-INO-4020 Total Free WAD Cyanide by CFA			
Fluoride (Total)	Melbourne	Sep 25, 2021	28 Days
- Method: LTM-INO-4150 Determination of Total Fluoride PART B – ISE			
Iodide	Sydney	Sep 24, 2021	28 Days
- Method: In-house method LTM-INO-4270 Anions by Ion Chromatography			
Nitrate (as N)	Melbourne	Sep 23, 2021	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrite (as N)	Melbourne	Sep 23, 2021	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Organic Matter %	Melbourne	Sep 27, 2021	5 Days
- Method: APHA 2540E Fixed and Volatile Solids Ignited at 550C			
pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	Melbourne	Sep 23, 2021	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Sep 23, 2021	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Total Organic Carbon	Melbourne	Sep 25, 2021	28 Days
- Method: LTM-INO-4060 Total Organic Carbon in water and soil			
Total Soluble Salts*	Perth	Sep 21, 2021	0 Day
- Method: APHA 2540			
Phosphorus	Melbourne	Sep 23, 2021	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon and Phosphorus by ICP-AES			
Acid Neutralising Capacity (ANCbt)	Brisbane	Sep 27, 2021	0 Days
- Method: Acid Neutralising Capacity (Acid reacted and Back-Titration) - Method 19A2			
Heavy Metals	Melbourne	Sep 23, 2021	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Alkali Metals	Melbourne	Sep 23, 2021	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon Phosphorus by ICP-AES			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Melbourne	Sep 23, 2021	7 Days
- Method: LTM-INO-4030 Conductivity			
Cation Exchange Capacity	Melbourne	Sep 25, 2021	180 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N)	Melbourne	Sep 23, 2021	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Total Kjeldahl Nitrogen (as N)	Melbourne	Sep 23, 2021	28 Days
- Method: APHA 4500-Norg B,D Total Kjeldahl Nitrogen by FIA			
% Moisture	Melbourne	Sep 21, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
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16 Mars Road
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Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
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NZBN: 9429046024954

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35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
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Christchurch
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: EHS Support Pty Ltd
Address: 6/468 St Kilda Rd
Melbourne
VIC 3004

Project Name: ALCOA ANGLESEA

Order No.:
Report #: 826015
Phone: 03 9646 8615
Fax:

Received: Sep 20, 2021 4:00 PM
Due: Sep 28, 2021
Priority: 5 Day
Contact Name: Matt Russ

Eurofins Analytical Services Manager : Michael Morrison

Sample Detail	Acid Neutralising Capacity (ANCbt)	Aluminium	Ammonia (as N)	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chloride	Chromium	Chromium (hexavalent)	Cobalt	Copper	Cyanide (amenable)	Cyanide (total)	Fluoride (Total)	Iodide	Iron	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Nitrate (as N)	Nitrite (as N)	Organic Matter %	pH (units)(1:5 soil:CaCl2 extract at 25°C as	Phosphorus	Potassium	Selenium	Sodium	Sulphate (as SO4)	Total Organic Carbon	Total Soluble Salts*	Zinc	Total Nitrogen Set (as N)	Moisture Set	Cation Exchange Capacity
Melbourne Laboratory - NATA # 1261 Site # 1254		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Sydney Laboratory - NATA # 1261 Site # 18217																			X																							
Brisbane Laboratory - NATA # 1261 Site # 20794	X																																								
Mayfield Laboratory - NATA # 1261 Site # 25079																																									
Perth Laboratory - NATA # 2377 Site # 2370																																					X				
External Laboratory																																									
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																																						
1	ANG-21-0210	Sep 14, 2021		Soil	M21-Se40682	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs..

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Ammonia (as N)	mg/kg	< 5			5	Pass	
Chloride	mg/kg	< 5			5	Pass	
Chromium (hexavalent)	mg/kg	< 1			1	Pass	
Cyanide (amenable)	mg/kg	< 5			5	Pass	
Cyanide (total)	mg/kg	< 5			5	Pass	
Fluoride (Total)	mg/kg	< 100			100	Pass	
Iodide	mg/kg	< 5			5	Pass	
Nitrate & Nitrite (as N)	mg/kg	< 5			5	Pass	
Nitrate (as N)	mg/kg	< 5			5	Pass	
Nitrite (as N)	mg/kg	< 5			5	Pass	
Sulphate (as SO4)	mg/kg	< 30			30	Pass	
Phosphorus	mg/kg	< 5			5	Pass	
Method Blank							
Heavy Metals							
Aluminium	mg/kg	< 20			20	Pass	
Antimony	mg/kg	< 10			10	Pass	
Arsenic	mg/kg	< 2			2	Pass	
Barium	mg/kg	< 10			10	Pass	
Beryllium	mg/kg	< 2			2	Pass	
Boron	mg/kg	< 10			10	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Cobalt	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Iron	mg/kg	< 20			20	Pass	
Lead	mg/kg	< 5			5	Pass	
Manganese	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Molybdenum	mg/kg	< 5			5	Pass	
Nickel	mg/kg	< 5			5	Pass	
Selenium	mg/kg	< 2			2	Pass	
Zinc	mg/kg	< 5			5	Pass	
Method Blank							
Alkali Metals							
Calcium	mg/kg	< 5			5	Pass	
Magnesium	mg/kg	< 5			5	Pass	
Potassium	mg/kg	< 5			5	Pass	
Sodium	mg/kg	< 5			5	Pass	
Method Blank							
Cation Exchange Capacity							
Cation Exchange Capacity	meq/100g	< 0.05			0.05	Pass	
LCS - % Recovery							
Ammonia (as N)	%	108			70-130	Pass	
Chloride	%	96			70-130	Pass	
Chromium (hexavalent)	%	96			70-130	Pass	
Cyanide (total)	%	124			70-130	Pass	
Fluoride (Total)	%	110			70-130	Pass	
Nitrate & Nitrite (as N)	%	107			70-130	Pass	
Nitrate (as N)	%	107			70-130	Pass	
Nitrite (as N)	%	108			70-130	Pass	
Sulphate (as SO4)	%	109			70-130	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Total Organic Carbon			%	100			70-130	Pass	
LCS - % Recovery									
Heavy Metals									
Aluminium			%	96			80-120	Pass	
Antimony			%	98			80-120	Pass	
Arsenic			%	84			80-120	Pass	
Barium			%	99			80-120	Pass	
Beryllium			%	91			80-120	Pass	
Boron			%	83			80-120	Pass	
Cadmium			%	120			80-120	Pass	
Chromium			%	93			80-120	Pass	
Cobalt			%	95			80-120	Pass	
Copper			%	93			80-120	Pass	
Iron			%	92			80-120	Pass	
Lead			%	96			80-120	Pass	
Manganese			%	94			80-120	Pass	
Mercury			%	110			80-120	Pass	
Molybdenum			%	93			80-120	Pass	
Nickel			%	90			80-120	Pass	
Selenium			%	86			80-120	Pass	
Zinc			%	85			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chromium (hexavalent)	M21-Se39626	NCP	%	107			70-130	Pass	
Cyanide (total)	M21-Se35885	NCP	%	28			70-130	Fail	Q08
Fluoride (Total)	M21-Se45277	NCP	%	87			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Antimony	M21-Se40505	NCP	%	103			75-125	Pass	
Arsenic	M21-Se40505	NCP	%	95			75-125	Pass	
Barium	M21-Se40505	NCP	%	126			75-125	Fail	Q08
Beryllium	M21-Se40505	NCP	%	100			75-125	Pass	
Boron	M21-Se40505	NCP	%	105			75-125	Pass	
Cadmium	M21-Se40505	NCP	%	108			75-125	Pass	
Chromium	M21-Se40505	NCP	%	109			75-125	Pass	
Cobalt	M21-Se40505	NCP	%	110			75-125	Pass	
Copper	M21-Se40505	NCP	%	104			75-125	Pass	
Lead	M21-Se40505	NCP	%	115			75-125	Pass	
Manganese	M21-Se51048	NCP	%	112			75-125	Pass	
Mercury	M21-Se40505	NCP	%	104			75-125	Pass	
Molybdenum	M21-Se40505	NCP	%	106			75-125	Pass	
Nickel	M21-Se40505	NCP	%	107			75-125	Pass	
Selenium	M21-Se40505	NCP	%	95			75-125	Pass	
Zinc	M21-Se43713	NCP	%	96			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Ammonia (as N)	M21-Se40682	CP	mg/kg	5.5	5.9	7.0	30%	Pass	
Chromium (hexavalent)	M21-Se44674	NCP	mg/kg	< 1	< 1	<1	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	M21-Se41313	NCP	uS/cm	1200	1100	8.1	30%	Pass	
Cyanide (total)	M21-Se43262	NCP	mg/kg	< 5	< 5	<1	30%	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Fluoride (Total)	M21-Se45279	NCP	mg/kg	360	140	88	30%	Fail	Q15
Nitrate & Nitrite (as N)	M21-Se40682	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Nitrate (as N)	M21-Se40682	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Nitrite (as N)	M21-Se40682	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Total Organic Carbon	M21-Fe32604	NCP	%	1.3	1.1	22	30%	Pass	
Acid Neutralising Capacity (ANCbt)	S21-Se37226	NCP	% CaCO3	N/A	N/A	N/A	30%	Pass	
% Moisture	M21-Se40532	NCP	%	14	13	7.0	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M21-Se40505	NCP	mg/kg	19000	19000	<1	30%	Pass	
Antimony	M21-Se40505	NCP	mg/kg	< 10	< 10	<1	30%	Pass	
Arsenic	M21-Se40505	NCP	mg/kg	4.6	4.7	2.0	30%	Pass	
Barium	M21-Se40505	NCP	mg/kg	93	93	<1	30%	Pass	
Beryllium	M21-Se40505	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Boron	M21-Se40505	NCP	mg/kg	12	11	7.0	30%	Pass	
Cadmium	M21-Se40505	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M21-Se40505	NCP	mg/kg	25	25	<1	30%	Pass	
Cobalt	M21-Se40505	NCP	mg/kg	8.6	8.6	<1	30%	Pass	
Copper	M21-Se40505	NCP	mg/kg	14	14	<1	30%	Pass	
Iron	M21-Se40505	NCP	mg/kg	23000	23000	1.0	30%	Pass	
Lead	M21-Se40505	NCP	mg/kg	23	23	1.0	30%	Pass	
Manganese	M21-Se40505	NCP	mg/kg	470	470	<1	30%	Pass	
Mercury	M21-Se40505	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Molybdenum	M21-Se40505	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Nickel	M21-Se40505	NCP	mg/kg	14	14	<1	30%	Pass	
Selenium	M21-Se40505	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Zinc	M21-Se40505	NCP	mg/kg	53	60	11	30%	Pass	
Duplicate									
Cation Exchange Capacity				Result 1	Result 2	RPD			
Cation Exchange Capacity	S21-Se46805	NCP	meq/100g	8.1	7.6	6.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q08	The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Michael Morrison	Analytical Services Manager
Charl Du Preez	Senior Analyst-Inorganic (NSW)
Emily Rosenberg	Senior Analyst-Metal (VIC)
Myles Clark	Senior Analyst-SPOCAS (QLD)
Rhys Thomas	Senior Analyst-Inorganic (WA)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521
Phone: +61 3 8564 5000
e.mail: EnviroRemittances@eurofins.com

Tax Invoice

EHS Support Pty Ltd
907/57 Bay St
Port Melbourne
VIC 3207

Purchase Order #: Not provided
Invoice #: 646530
Date: Oct 05, 2021
Report #: 826015
Project Name: ALCOA ANGLESEA
Contact: Matt Russ

Description	Quantity	Price	Total	Notes
Solid Samples				
Acid Neutralising Capacity (ANCbt)	1	$32.00	$32.00	
Alk Metals				
Ca, Mg, K, Na	1	$20.00	$20.00	
Ammonia (as N)	1	$16.00	$16.00	
Cation Exchange Capacity	1	$45.00	$45.00	
Chloride	1	$11.00	$11.00	
Chromium (hexavalent)	1	$25.00	$25.00	
Cyanide (amenable)	1	$0.00	$0.00	
Cyanide (total)	1	$16.00	$16.00	
Fluoride (Total)	1	$25.00	$25.00	
Iodide	1	$45.00	$45.00	
Metals				
Bo, Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Hg, Mo, Ni, Se, Zn, Fe	1	$32.00	$32.00	
Nitrate (as N)	1	$11.00	$11.00	
Nitrite (as N)	1	$11.00	$11.00	
Organic Matter %	1	$24.00	$24.00	
pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	1	$8.00	$8.00	
Phosphorus	1	$11.00	$11.00	
Sulphate (as SO4)	1	$11.00	$11.00	
Total Nitrogen Set (as N)	1	$32.00	$32.00	
Total Organic Carbon	1	$30.00	$30.00	
Total Soluble Salts*	1	$0.00	$0.00	
Handling Charge	1	$30.00	$30.00	

Nett Total	$435.00
GST	$43.50
Total Inc GST	$478.50

This invoice is subject to Eurofins General Terms of Sales. Copies available on request or at http://environment.eurofins.com.au

Please detach and return with payment to:
Postal:
Eurofins Environment Testing
6 Monterey Road
Dandenong South
Victoria, 3175

Please EFT Payments to:
Eurofins Environment Testing
BSB 063-498
Acct No: 10057019
e.mail Remittances:
EnviroRemittances@eurofins.com

Invoice Number : 646530
Amount Inc GST : $478.50

TERMS STRICTLY 30 DAYS

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091716
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071555

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole** **ANG-21-0184**	**Sample depth (m):** - **Client sample ref:**
Project reference:		**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(CL) Sandy CLAY, low plasticity, orange- grey, fine to coarse sand, trace fine gravel	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	27/09/21
Temperature (°C):	19.2°
Type of water used:	Distilled

Observations / Notes

Reaction with $BaCl_2$ indicates presence of gypsum

Emerson class number

Class 4

Emerson Class:	Definition / Notes
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: NLobb
Date reported: **05/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091716_R071555
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

For ISSUE

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091717
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071556

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole** **ANG-21-0185**	**Sample depth (m):** - **Client sample ref:**
Project reference:		**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(Cl) Sandy CLAY, medium plasticity, dark brown, fine to coarse sand, trace fine gravel	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	27/09/21
Temperature (°C):	19.2°
Type of water used:	Distilled

Observations / Notes

Reaction with HCl indicates presence of calcites

Emerson class number

Class 4

Emerson Class:	Definition / Notes
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: NLobb
Date reported: **05/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091717_R071556
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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Nick Lobb - Senior Technician

For ISSUE

This test was carried out in accordance with AS 1289.3.8.1-2017. Test results relate only to the specimens tested.

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091718
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071557

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole** **ANG-21-0187**	**Sample depth (m):** - **Client sample ref:**
Project reference:		**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(CH) Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	27/09/21
Temperature (°C):	19.2°
Type of water used:	Distilled

Observations / Notes

Reaction with HCl inidcates presence of calcites

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: NLobb
Date reported: **05/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091718_R071557
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing
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Nick Lobb - Senior Technician

For ISSUE

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091719	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071979		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0189**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(SC) Clayey SAND, fine to coarse grained, brown, low plasticity clay	**Sampling co-ordinates**		**Reduced Level**
		Easting (m)	**Northing (m)**	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with BaCl2 indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091719_R071979
Approved signatory:

NATA

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David Giltinan - Senior Technician

For issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091720
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071980

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole** **ANG-21-0191**	**Sample depth (m):** 0.00 - 0.00 **Client sample ref:**
Project reference:	Aloca Anglesea	**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(CI) CLAY, medium plasticity, brown orange	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Slight dispersion of one particle

Emerson class number
Class 2

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091720_R071980
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For issue

This test was carried out in accordance with AS 1289.3.8.1-2017. Test results relate only to the specimens tested.

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091721	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071981		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0193**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(Cl) Sandy CLAY, medium plasticity, dak grey, fine to coarse grained sand	**Sampling co-ordinates**		**Reduced Level**
		Easting (m)	**Northing (m)**	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with BaCl2 indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091721_R071981
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

David Giltinan - Senior Technician

For issue

This test was carried out in accordance with AS 1289.3.8.1-2017. Test results relate only to the specimens tested.

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091722
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071982

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole** **ANG-21-0195**	**Sample depth (m):** 0.00 - 0.00 **Client sample ref:**
Project reference:	Aloca Anglesea	**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(MH) SILT, low plasticity, pale brown, with fine to coarse grained sand	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with BaCl2 indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091722_R071982
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For Issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091723	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071983		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0196**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(CL) Sandy CLAY, low plasticity, dark brown, fine to coarse grained sand, with fine grained gravel	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with BaCl2 indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091723_R071983
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For Issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091724	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071984		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0197**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(SC) Clayey SAND, fine to coarse grained, dark brown, low plasticity clay	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with BaCl2 indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091724_R071984
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091725	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071985		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0200**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(SP) SAND, fine to coarse grained, black, with low plasticity clay	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with HCl indicates presence of calcites

Emerson class number

Class 4

Emerson Class:	Definition / Notes
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091725_R071985
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
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David Giltinan - Senior Technician

For issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

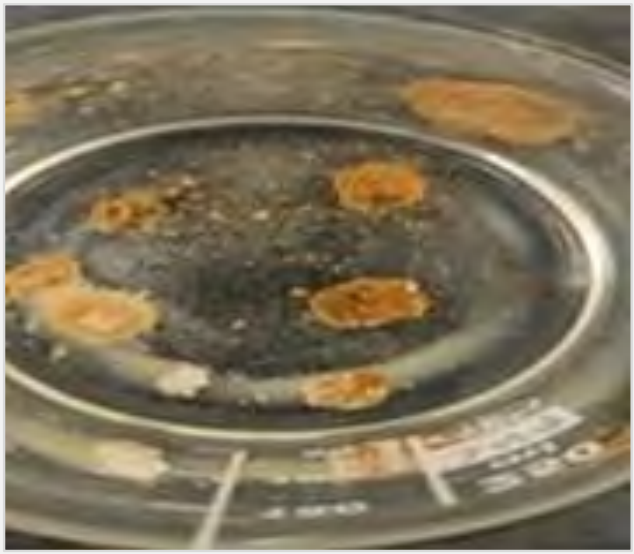
GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091726	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071986		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0201**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(SC) Clayey SAND, fine to coarse gained, brown, low plasticity clay	**Sampling co-ordinates**		**Reduced Level**
		Easting (m)	**Northing (m)**	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference



Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Emerson class number
Class 2

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091726_R071986
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For Issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

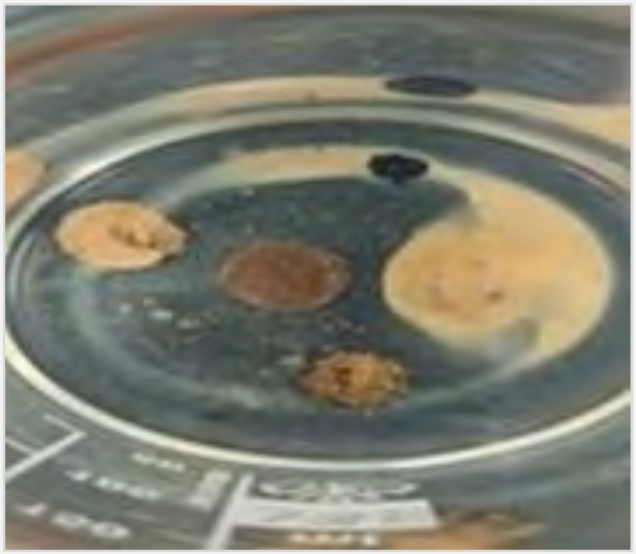
GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091727	**Golder Associates Pty Ltd** **MELBOURNE GEOTECHNICAL LABORATORY** Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Client:	EHS Support				
Client address:	26 Rutland St, Newtown VIC 3220				
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071987		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0202**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(Cl) Sandy CLAY, medium plasticity, dark brown, fine to coarse grained sand, with fine grained gravel	**Sampling co-ordinates**		**Reduced Level**
		Easting (m)	**Northing (m)**	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference



Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Emerson class number
Class 2

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091727_R071987
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For Issue

This test was carried out in accordance with AS 1289.3.8.1-2017. Test results relate only to the specimens tested.

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091728	**Golder Associates Pty Ltd** **MELBOURNE GEOTECHNICAL LABORATORY** Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121
Client:	EHS Support			
Client address:	26 Rutland St, Newtown VIC 3220			
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071988	
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0207**	**Sample depth (m):** 0.00 - 0.00 **Client sample ref:**
Project reference:	Aloca Anglesea	**Loc. ref.:**	-	

Specimen description (Based on visual and tactile assessment)	(CI) Sandy CLAY, medium plasticity, dark brown/pale grey, fine to coarse grained sand, with fine grained gravel	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Distilled

Observations / Notes

Reaction with HCl indicates presence of calcites

Emerson class number

Class 4

Emerson Class:	Definition / Notes
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091728_R071988
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

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David Giltinan - Senior Technician

For issue

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091729	**Golder Associates Pty Ltd**	
Client:	EHS Support			**MELBOURNE GEOTECHNICAL LABORATORY**	
Client address:	26 Rutland St, Newtown VIC 3220			Building 7, Botanicca Corporate Park 570 - 588 Swan Street Richmond, Victoria 3121	
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071989		
Project name:	Alcoa Anglesea	**Exploratory Hole**	**ANG-21-0211**	**Sample depth (m):**	0.00 - 0.00
				Client sample ref:	
Project reference:	Aloca Anglesea	**Loc. ref.:**	-		

Specimen description (Based on visual and tactile assessment)	(CI) CLAY, medium plasticity, brown	**Sampling co-ordinates**		**Reduced Level**
		Easting (m)	**Northing (m)**	

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	05/10/21
Temperature (°C):	20.0°
Type of water used:	Disrilled

Observations / Notes

Reaction with HCl indicates presence of calcites

Emerson class number

Class 4

Emerson Class:	Definition / Notes
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: DGiltinan
Date reported: **13/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091729_R071989
Approved signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
Accredited for compliance with ISO/IEC 17025 - Testing

THIS DOCUMENT SHALL ONLY BE REPRODUCED IN FULL

David Giltinan - Senior Technician

For issue

This test was carried out in accordance with AS 1289.3.8.1-2017. Test results relate only to the specimens tested.

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091714
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071553

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole**	**Sample depth (m):** -
		ANG-21-0181	**Client sample ref:**
Project reference:		**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(CL) Sandy CLAY, low plasticity, dark brown mottled orange, fine to coarse grained sand, trace fine gravel	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	27/09/21
Temperature (°C):	19.2°
Type of water used:	Distilled

Observations / Notes

Reaction with $BaCl_2$ indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: NLobb
Date reported: **05/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091714_R071553
Approved signatory:

NATA

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Nick Lobb - Senior Technician

For ISSUE

Soils testing - Report of Emerson class number
Soil classification
AS 1289.3.8.1-2017

GOLDER
MEMBER OF WSP

Test request ID:	**TRM21-0544**	**Lab sample ID:**	LMEL2021091715
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**1772660-038-002**	**Lab report ref.:**	LMEL_21071554

Golder Associates Pty Ltd
MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exploratory Hole**	**Sample depth (m):** -
		ANG-21-0182	**Client sample ref:**
Project reference:		**Loc. ref.:**	-

Specimen description (Based on visual and tactile assessment)	(SM) Silty SAND, fine to coarse grained, brown, trace fine gravel, low plasticity silt	**Sampling co-ordinates** Easting (m)	Northing (m)	**Reduced Level**

TEST REPORT - SUMMARY OF ANALYSIS

Visual reference

Date sampled:	**Unknown - tested as rcvd.**
Date tested:	27/09/21
Temperature (°C):	19.2°
Type of water used:	Distilled

Observations / Notes

Reaction with $BaCl_2$ indicates presence of gypsum

Emerson class number
Class 4

Emerson Class:	**Definition / Notes**
Class 1	*Air-dried crumbs of soil show a strong dispersing reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 minutes. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.*
Class 2	*Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.*
Class 3	*The soil remoulded at the plastic limit disperses in water.*
Class 4	*The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.*
Class 5	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 10 minutes.*
Class 6	*The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to floculate within 10 minutes.*
Class 7	*The air-dried crumbs of soil remain coherent in water and swell.*
Class 8	*The air-dried crumbs of soil remain coherent in water and do not swell.*

Definitions:
ND = Not determined

Test performed by: NMD
Result reviewed by: NLobb
Date reported: **05/10/2021**

Cert. ref.: 1772660-038-002__TRM21-0544_Emerson_LMEL2021091715_R071554
Approved signatory:

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Nick Lobb - Senior Technician

For ISSUE

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091714
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	
Project name:	Alcoa Anglesea	**Exporatory Hole**	ANG-21-0181
Project reference:			
Specimen description:	(CI) Sandy CLAY, medium plasticity, dark brown mottled orange, fine to coarse grained sand, trace fine gravel		

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Richmond, Victoria 3121

Sample depth (m):	-
Client sample ref:	
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

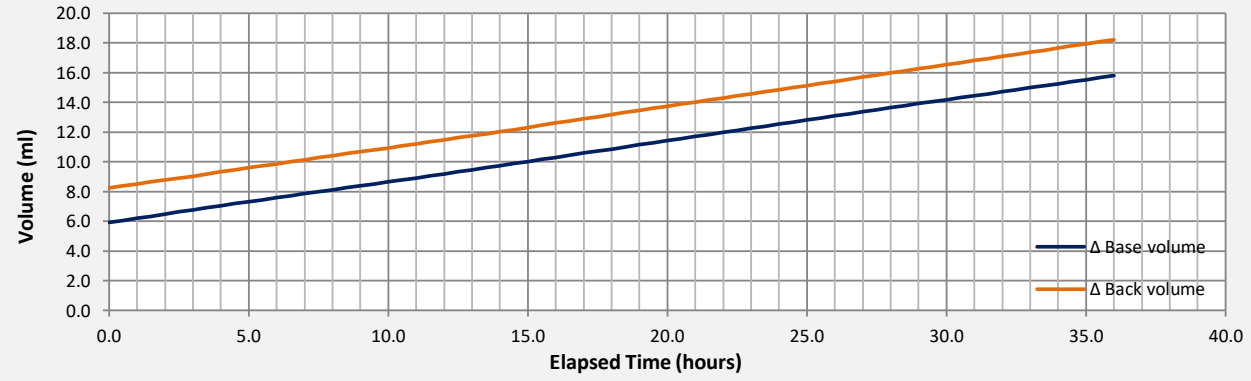
Specimen before testing	
Height [H] (mm)	63.6
Diameter [D] (mm)	63.2
[D]:[H]	1:1.01
Mass (g)	393.1
Moisture Content:	27.3%
Dry Density (t/m^3):	1.55
Assumed Porosity (%)	41.6%
Assumed Pore Volume (mL)	83.1

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	100.0%
Saturation B value:	97%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	22.8%
Permeability: (m/s)	**8E-10**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 5/10/21

Cert. Ref.: 1772660-038-002_ANG-21-0181_21091714_TRM21-0544_PERM_R21071558 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091716
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0184**
Project reference:			
Specimen description:	(CL) Sandy CLAY, low plasticity, mottled orange grey, fine to coarse sand, trace fine gravel		

Sample depth (m):	-
Client sample ref:	-
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

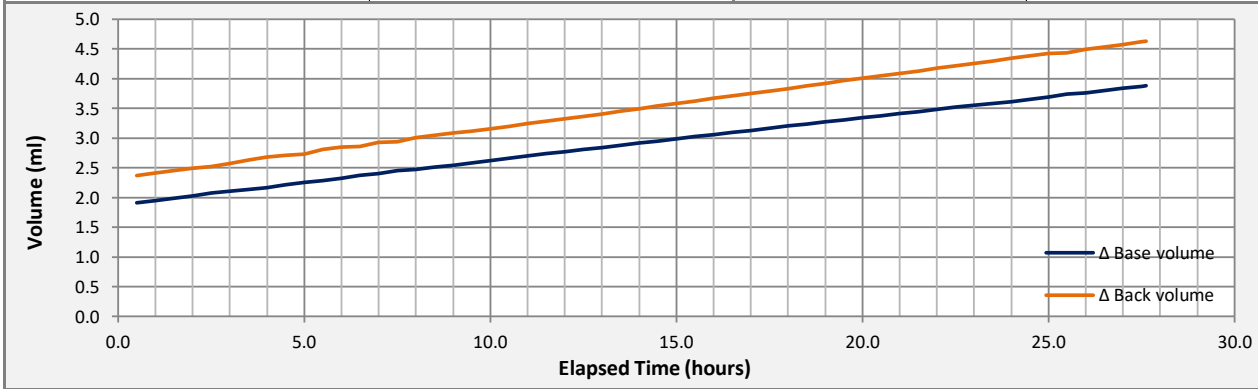
Specimen before testing	
Height [H] (mm)	63.7
Diameter [D] (mm)	63.8
[D]:[H]	1:1
Mass (g)	453.2
Moisture Content:	10.3%
Dry Density (t/m^3):	2.02
Assumed Porosity (%)	23.7%
Assumed Pore Volume (mL)	48.2

Compaction Details	
Method	
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	87.6%
Saturation B value:	99%
Confining Pressure (kPa):	1550
Inlet Pressure (kPa):	1510
Outlet Pressure (kPa):	1490
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	11.6%
Permeability: (m/s)	**2E-10**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **5/10/21**

Cert. Ref.: 1772660-038-002_ANG-21-0184_21091716_TRM21-0544_PERM_R21071559

Approved Signatory:

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NATA accreditation number: 1961 - Site:1250 - Melbourne
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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen

Constant head method using a flexible wall permeameter

AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091717
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	
Project name:	Alcoa Anglesea	**Exporatory Hole**	ANG-21-0185
Project reference:			
Specimen description:	(CI) Sandy CLAY, medium plasticity, dark brown, fine to coarse grained sand, trace fine gravel		

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570 - 588 Swan Street
Richmond, Victoria 3121

Sample depth (m):	-
Client sample ref:	
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

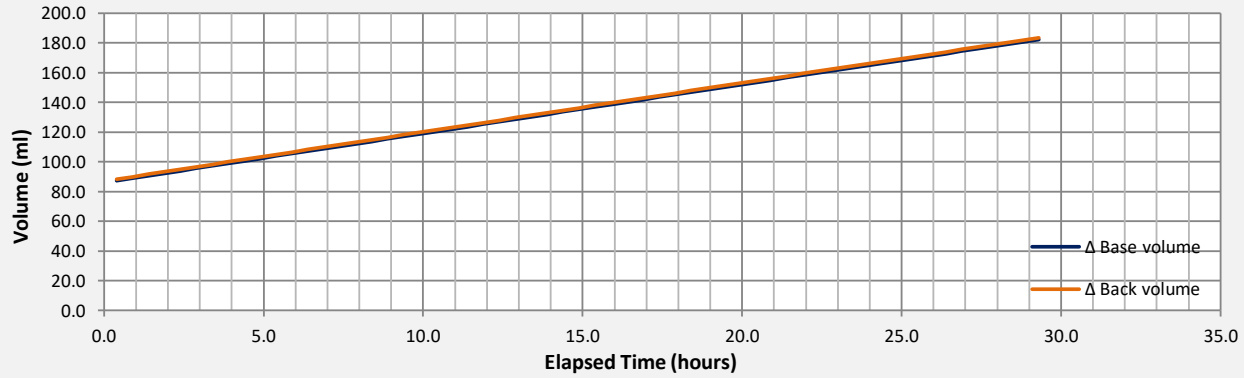
Specimen before testing	
Height [H] (mm)	63.7
Diameter [D] (mm)	63.7
[D]:[H]	1:1
Mass (g)	393.8
Moisture Content:	22.3%
Dry Density (t/m^3):	1.59
Assumed Porosity (%)	40.1%
Assumed Pore Volume (mL)	81.5

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	88.1%
Saturation B value:	98%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	23.2%
Permeability: (m/s)	**9E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 5/10/21

Cert. Ref.: 1772660-038-002_ANG-21-0185_21091717_TRM21-0544_PERM_R21071560 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091718
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0187**
Project reference:			
Specimen description:	(CH) Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand		

Sample depth (m):	-
Client sample ref:	
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

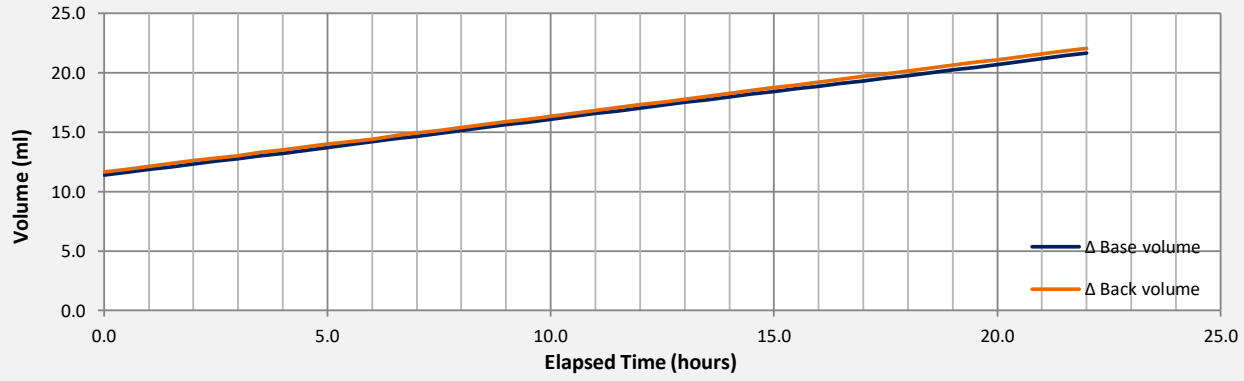
Specimen before testing	
Height [H] (mm)	63.8
Diameter [D] (mm)	63.7
[D]:[H]	1:1
Mass (g)	384.0
Moisture Content:	32.9%
Dry Density (t/m^3):	1.42
Assumed Porosity (%)	48.3%
Assumed Pore Volume (mL)	98.2

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	96.8%
Saturation B value:	97%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	28.2%
Permeability: (m/s)	**1E-09**



Notes: Specimen prepared from a u63 tube sample, provided by the client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **5/10/21**

Cert. Ref.: 1772660-038-002_ANG-21-0187_21091718_TRM21-0544_PERM_R21071561 **Approved Signatory:**

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen

Constant head method using a flexible wall permeameter

AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091719
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0189**
Project reference:			
Specimen description:	(CI) Sandy CLAY, medium plasticity, orange-brown, trace fine gravel, fine to coarse sand		

Sample depth (m):	-
Client sample ref:	
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

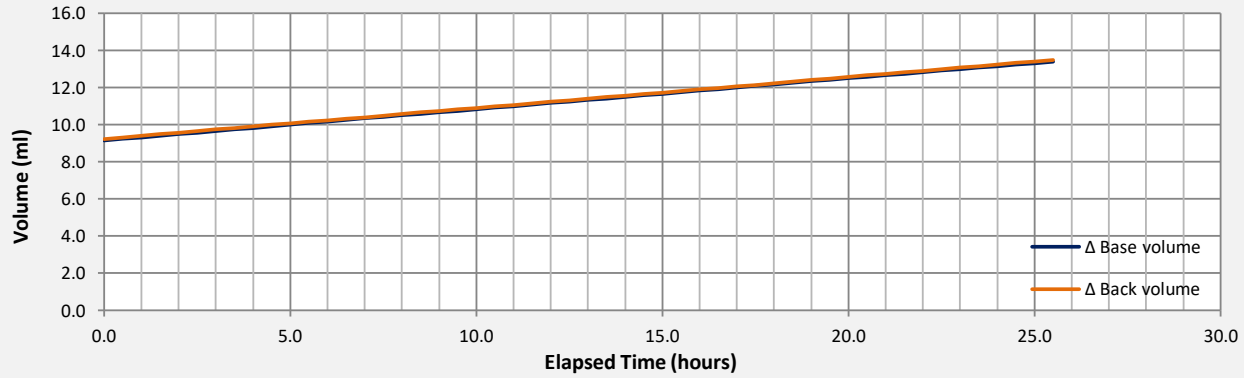
Specimen before testing	
Height [H] (mm)	63.2
Diameter [D] (mm)	64.4
[D]:[H]	1:0.98
Mass (g)	460.7
Moisture Content:	9.9%
Dry Density (t/m^3):	2.04
Assumed Porosity (%)	23.1%
Assumed Pore Volume (mL)	47.5

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	87.1%
Saturation B value:	100%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	10.6%
Permeability: (m/s)	**4E-10**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 5/10/21

Cert. Ref.: 1772660-038-002_ANG-21-0189_21091719_TRM21-0544_PERM_R21071562 **Approved Signatory:**

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091720
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0191**
Project reference:			
Specimen description:	(CL) Sandy CLAY, low plasticity, dark brown, fine to coarse sand, trace fine gravel		

Sample depth (m):	-
Client sample ref:	
Location:	-
Phase / Locale:	-
Sample type:	Undisturbed

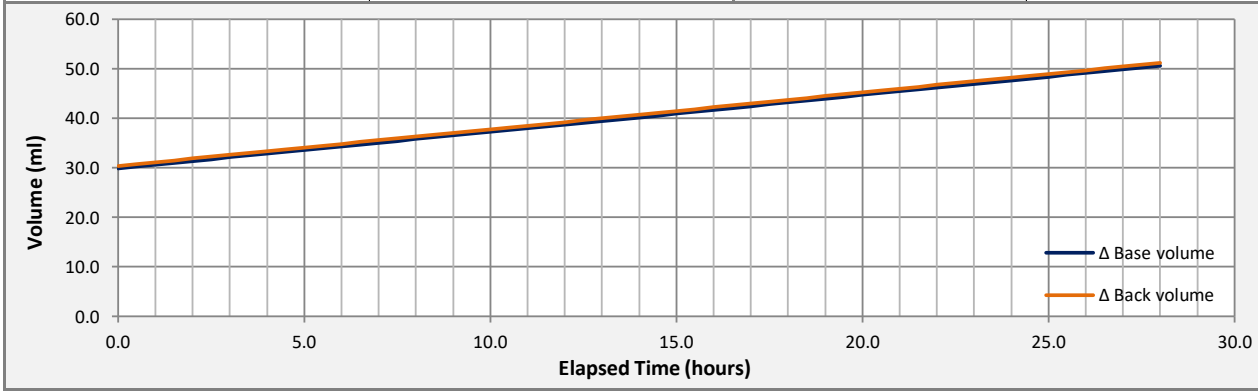
Specimen before testing		**Compaction Details**	
Height [H] (mm)	63.4	**Method**	-
Diameter [D] (mm)	63.1	**Material retained on 19mm sieve (g):**	-
[D]:[H]	1:1.01	**Optimum Moisture Content:**	-
Mass (g)	382.9	**Maximum Dry Density (t/m^3):**	-
Moisture Content:	20.1%	**Target moisture content to OMC:**	-
Dry Density (t/m^3):	1.61	**Target dry density relative to MDD:**	-
Assumed Porosity (%)	39.3%	**Laboratory Moisture Ratio:**	-
Assumed Pore Volume (mL)	77.9	**Laboratory Density Ratio:**	-

Pre-test photo

Post-test photo

Permeability test details

Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	82.2%
Saturation B value:	99%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	27.9%
Permeability: (m/s)	**2E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 5/10/21

Cert. Ref.: 1772660-038-002_ANG-21-0191_21091720_TRM21-0544_PERM_R21071563 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen

Constant head method using a flexible wall permeameter

AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091721
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0193**
Project reference:	-		
Specimen description:	(CH) Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand		

Sample depth (m):	-
Client sample ref:	
Location:	Anglesea
Phase / Locale:	-
Sample type:	Undisturbed

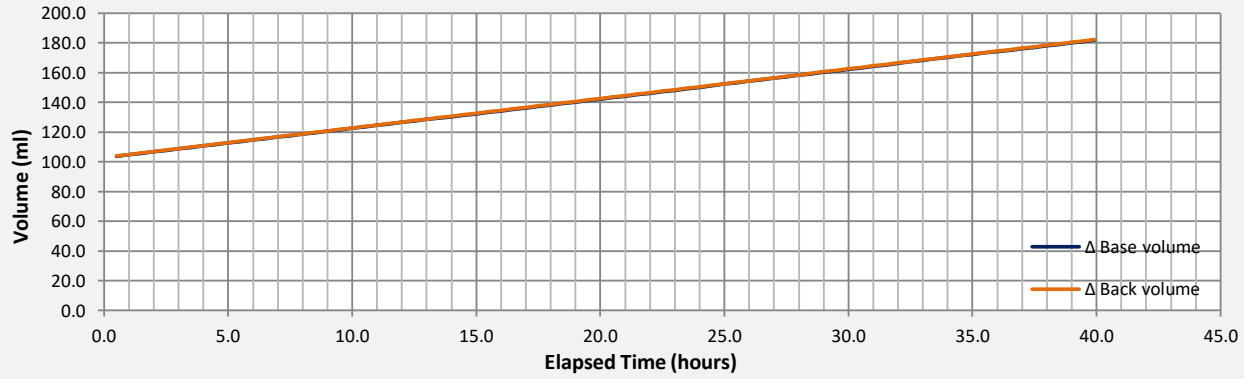
Specimen before testing	
Height [H] (mm)	63.3
Diameter [D] (mm)	63.6
[D]:[H]	1:0.99
Mass (g)	364.6
Moisture Content:	34.6%
Dry Density (t/m^3):	1.35
Assumed Porosity (%)	49.2%
Assumed Pore Volume (mL)	98.8

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	94.9%
Saturation B value:	99%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	33.3%
Permeability: (m/s)	**5E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **16/10/21**

Cert. Ref.: 1772660-038-002_ANG-21-0193_21091721_TRM21-0544_PERM_R21072074

Approved Signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091722
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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MELBOURNE GEOTECHNICAL LABORATORY
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0195**
Project reference:			
Specimen description:	(CH) CLAY, high plasticity, mottled grey and brown		

Sample depth (m):	-
Client sample ref:	
Location:	Anglesea
Phase / Locale:	-
Sample type:	Undisturbed

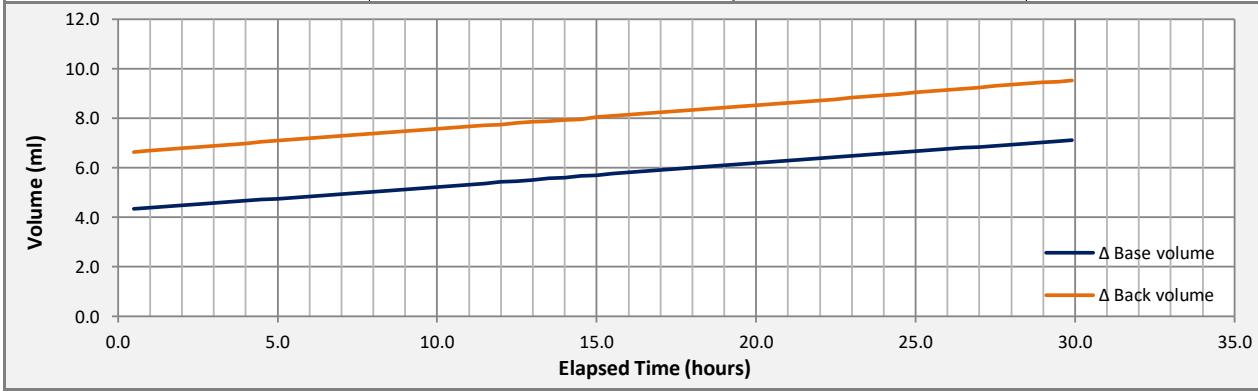
Specimen before testing	
Height [H] (mm)	64.4
Diameter [D] (mm)	63.4
[D]:[H]	1:1.02
Mass (g)	432.3
Moisture Content:	16.0%
Dry Density (t/m^3):	1.83
Assumed Porosity (%)	30.8%
Assumed Pore Volume (mL)	62.6

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	95.2%
Saturation B value:	100%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	19.4%
Permeability: (m/s)	**3E-10**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **16/10/21**

Cert. Ref.: 1772660-038-002_ANG-21-0195_21091722_TRM21-0544_PERM_R21072080 **Approved Signatory:**

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	**TRM21-0544**	**Lab sample ID:**	**LMEL2021091723**
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	**772660-038-00**	**Project reference:**	

Golder Associates Pty Ltd
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Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0196**
Project reference:	-		
Specimen description:	(SC) Clayey SAND, fine to coarse grained, brown mottled orange, medium plasticity clay		

Sample depth (m):	-
Client sample ref:	
Location:	**Anglesea**
Phase / Locale:	-
Sample type:	Undisturbed

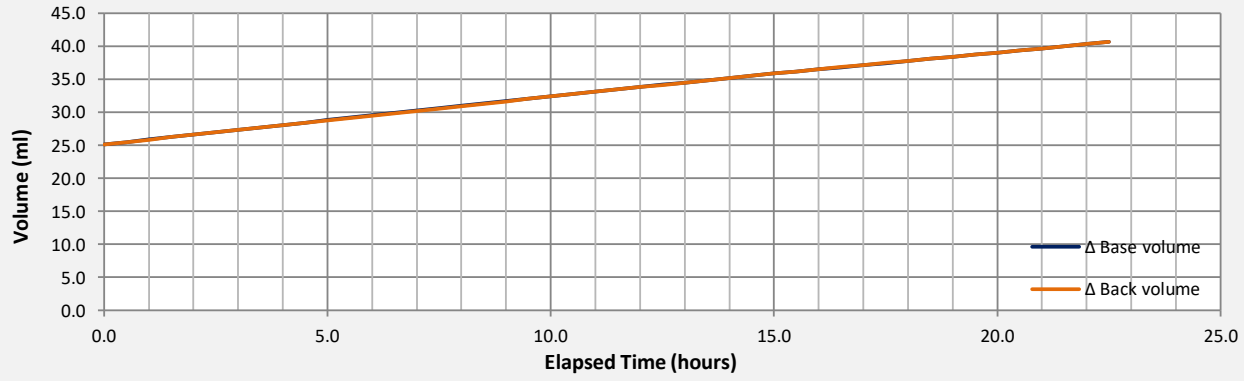
Specimen before testing	
Height [H] (mm)	63.3
Diameter [D] (mm)	63.5
[D]:[H]	1:1
Mass (g)	422.5
Moisture Content:	12.0%
Dry Density (t/m^3):	1.88
Assumed Porosity (%)	29.0%
Assumed Pore Volume (mL)	58.2

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	77.7%
Saturation B value:	99%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	15.3%
Permeability: (m/s)	**2E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:**	LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:**	**16/10/21**

Cert. Ref.: **1772660-038-002_ANG-21-0196_21091723_TRM21-0544_PERM_R21072075**
Approved Signatory:

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	**TRM21-0544**	**Lab sample ID:**	**LMEL2021091724**
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0197**
Project reference:	-		
Specimen description:	(CI) Sandy CLAY, medium plasticity, dark brown mottled orange, fine to coarse grained sand		

Sample depth (m):	-
Client sample ref:	
Location:	**Anglesea**
Phase / Locale:	-
Sample type:	Undisturbed

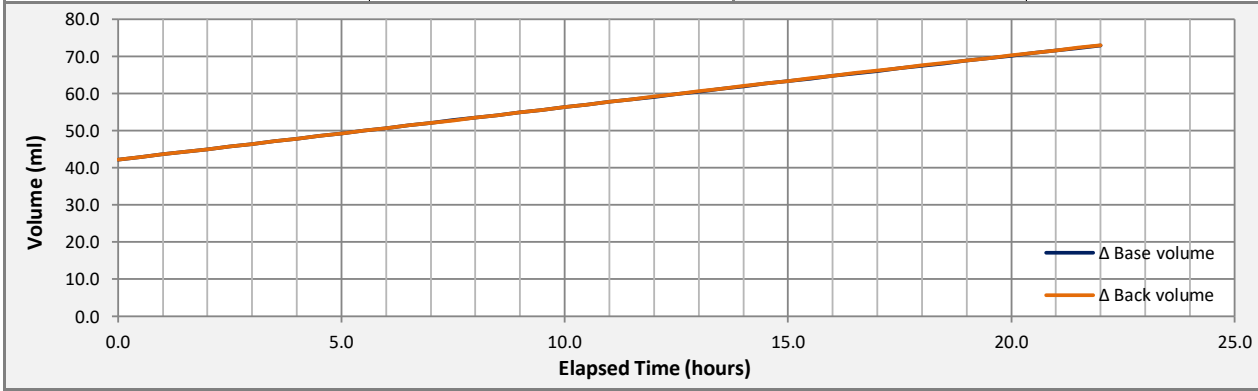
Specimen before testing	
Height [H] (mm)	63.5
Diameter [D] (mm)	63.4
[D]:[H]	1:1
Mass (g)	374.0
Moisture Content:	19.8%
Dry Density (t/m^3):	1.56
Assumed Porosity (%)	41.2%
Assumed Pore Volume (mL)	82.4

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	74.9%
Saturation B value:	99%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	26.3%
Permeability: (m/s)	**4E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **16/10/21**

Cert. Ref.: **1772660-038-002_ANG-21-0197_21091724_TRM21-0544_PERM_R21072076**

Approved Signatory:

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NATA accreditation number: 1961 - Site:1250 - Melbourne
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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen
Constant head method using a flexible wall permeameter
AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091726
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	
Project name:	Alcoa Anglesea	**Exporatory Hole**	ANG-21-0201
Project reference:			
Specimen description:	(CI) Sandy CLAY, medium plasticity, orange-brown, trace fine gravel, fine to coarse grained sand		

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570 - 588 Swan Street
Richmond, Victoria 3121

Sample depth (m):	-
Client sample ref:	
Location:	Anglesea
Phase / Locale:	-
Sample type:	Undisturbed

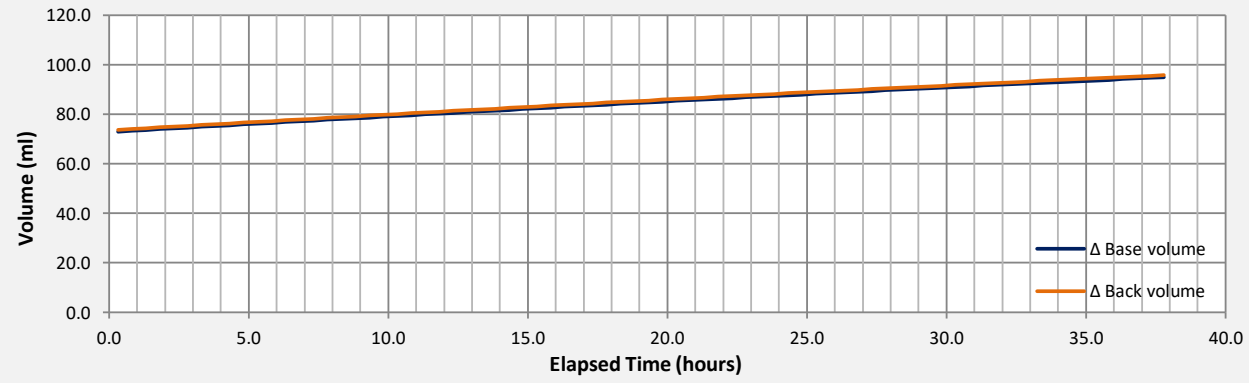
Specimen before testing	
Height [H] (mm)	63.4
Diameter [D] (mm)	63.2
[D]:[H]	1:1
Mass (g)	441.5
Moisture Content:	13.0%
Dry Density (t/m^3):	1.97
Assumed Porosity (%)	25.8%
Assumed Pore Volume (mL)	51.4

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	98.6%
Saturation B value:	100%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	12.0%
Permeability: (m/s)	**2E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **16/10/21**

Cert. Ref.: 1772660-038-002_ANG-21-0201_21091726_TRM21-0544_PERM_R21072081 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne
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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen

Constant head method using a flexible wall permeameter

AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091727
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	
Project name:	Alcoa Anglesea	**Exporatory Hole**	ANG-21-0202
Project reference:			
Specimen description:	(CH) Sandy CLAY, high plasticity, brown, fine to coarse grained sand		

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Richmond, Victoria 3121

Sample depth (m):	-
Client sample ref:	
Location:	Anglesea
Phase / Locale:	-
Sample type:	Undisturbed

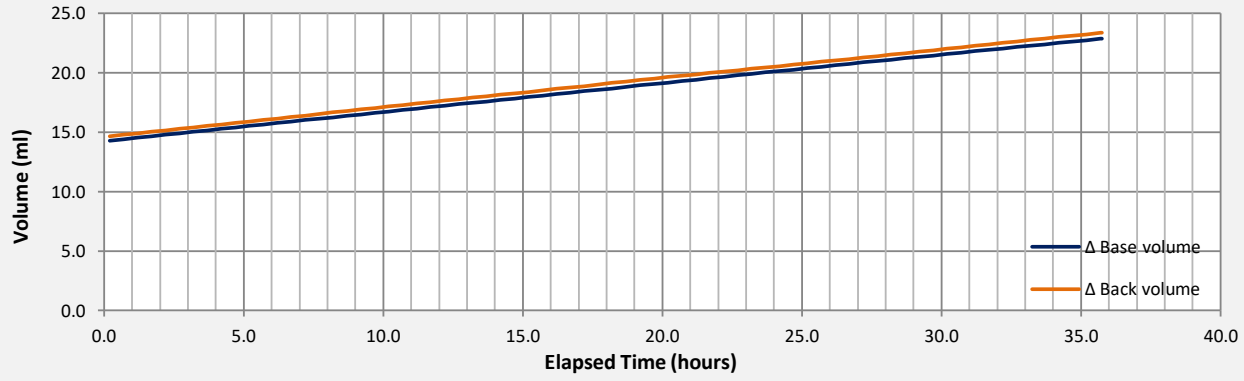
Specimen before testing	
Height [H] (mm)	62.8
Diameter [D] (mm)	62.8
[D]:[H]	1:1
Mass (g)	387.4
Moisture Content:	28.1%
Dry Density (t/m^3):	1.56
Assumed Porosity (%)	41.3%
Assumed Pore Volume (mL)	80.3

Compaction Details	
Method	
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	100.0%
Saturation B value:	100%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	25.0%
Permeability: (m/s)	**7E-10**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** 16/10/21

Cert. Ref.: 1772660-038-002_ANG-21-0202_21091727_TRM21-0544_PERM_R21072079 **Approved Signatory:**

NATA

NATA accreditation number: 1961 - Site:1250 - Melbourne

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

Soil testing - Determination of permeability of a saturated specimen

Constant head method using a flexible wall permeameter

AS 1289.6.7.3-2016

GOLDER MEMBER OF WSP

Test request #:	TRM21-0544	**Lab sample ID:**	LMEL2021091728
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

Golder Associates Pty Ltd

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Building 7, Botanicca Corporate Park

570 - 588 Swan Street

Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0207**
Project reference:	-		
Specimen description:	(CH) Sandy CLAY, high plasticity, dark brown, fine to coarse grained sand, trace fine gravel		

Sample depth (m):	-
Client sample ref:	
Location:	Anglesea
Phase / Locale:	-
Sample type:	Undisturbed

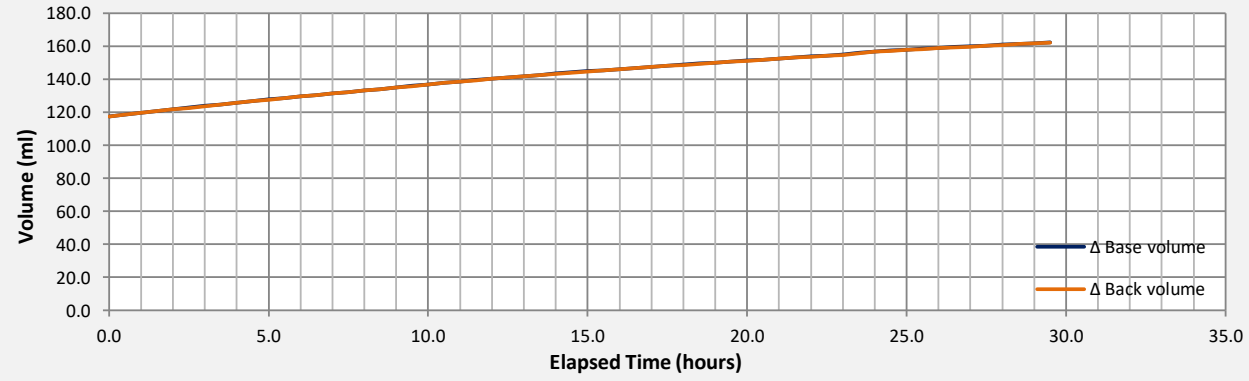
Specimen before testing	
Height [H] (mm)	62.8
Diameter [D] (mm)	62.8
[D]:[H]	1:1
Mass (g)	369.3
Moisture Content:	28.8%
Dry Density (t/m^3):	1.47
Assumed Porosity (%)	44.4%
Assumed Pore Volume (mL)	86.5

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	95.6%
Saturation B value:	98%
Confining Pressure (kPa):	1050
Inlet Pressure (kPa):	1010
Outlet Pressure (kPa):	990
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	20
Moisture content after test:	27.1%
Permeability: (m/s)	**4E-09**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **16/10/21**

Cert. Ref.: 1772660-038-002_ANG-21-0207_21091728_TRM21-0544_PERM_R21072077 **Approved Signatory:**

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Soil testing - Determination of permeability of a saturated specimen

Constant head method using a flexible wall permeameter

AS 1289.6.7.3-2016

GOLDER
MEMBER OF WSP

Test request #:	**TRM21-0544**	**Lab sample ID:**	**LMEL2021091729**
Client:	EHS Support		
Client address:	26 Rutland St, Newtown VIC 3220		
Project ID:	772660-038-00	**Project reference:**	

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570 - 588 Swan Street
Richmond, Victoria 3121

Project name:	Alcoa Anglesea	**Exporatory Hole**	**ANG-21-0211**
Project reference:	-		
Specimen description:	(OL) Organic CLAY, low plasticity, dark brown, with fine to coarse sand		

Sample depth (m):	-
Client sample ref:	
Location:	**Anglesea**
Phase / Locale:	-
Sample type:	Undisturbed

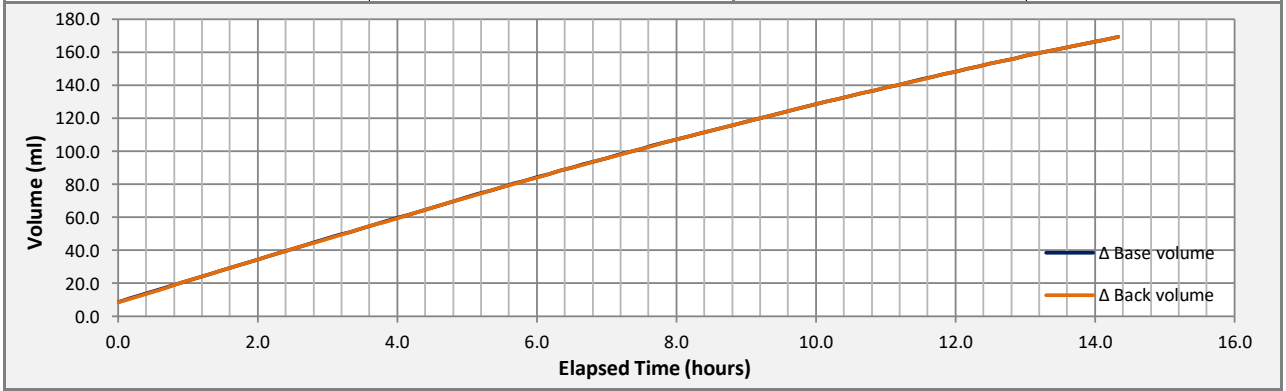
Specimen before testing	
Height [H] (mm)	62.6
Diameter [D] (mm)	62.7
[D]:[H]	1:1
Mass (g)	305.7
Moisture Content:	91.7%
Dry Density (t/m^3):	0.82
Assumed Porosity (%)	68.9%
Assumed Pore Volume (mL)	133.2

Compaction Details	
Method	-
Material retained on 19mm sieve (g):	-
Optimum Moisture Content:	-
Maximum Dry Density (t/m^3):	-
Target moisture content to OMC:	-
Target dry density relative to MDD:	-
Laboratory Moisture Ratio:	-
Laboratory Density Ratio:	-

Pre-test photo

Post-test photo

Permeability test details	
Permeant used:	Distilled water
Method of saturation:	Back pressure saturation
Estimate of initial saturation:	100.0%
Saturation B value:	100%
Confining Pressure (kPa):	1550
Inlet Pressure (kPa):	1505
Outlet Pressure (kPa):	1495
Mean effective stress (kPa):	50
Hydraulic Head (kPa):	10
Moisture content after test:	71.5%
Permeability: (m/s)	**6E-08**



Notes: Specimen prepared from a u63 tube sample, provided by client

Definitions:	**Specimen Prepared by:**	LM	**Test Performed by:** LM/NL
ND = Not Determined	**Results Reviewed by:**	NLobb	**Date Reported:** **16/10/21**

Cert. Ref.: **1772660-038-002_ANG-21-0211_21091729_TRM21-0544_PERM_R21072078**

Approved Signatory:

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Nick Lobb - Senior Technician

Phone: +61 (03) 8862 3500 **Fax:** +61 (03) 8862 3501 **E-mail:** melbgeolab@golder.com.au **Web:** www.golder.com.au

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ALS (MELBOURNE: 2-4 Westall Road Springvale VIC 3171, Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com)

Environmental Division Melbourne

Work Order Reference

EM2212813

Telephone : + 61-3-8549 9600

CLIENT: Alcoa		TURNAROUND REQUIREMENTS :	Standard
OFFICE:			
PROJECT: Anglesea Ash Risk Assessment C03568		ALS QUOTE NO.:	ME/260/22 V3
FACILITY CODE:	PO#.:	COUNTRY OF ORIGIN:	Australia
PROJECT MANAGER: Rebecca Fraser	CONTACT PH: 0452 197 352		
SAMPLER: Andrew Minard/Clare Hogan	SAMPLER MOBILE: 0437 585 820/0493 361 188		
COC Emailed to ALS? (YES / NO)	EDD and EHS EQEDD FORMAT		

Email Reports to: rebecca.fraser@ehs-support.com; nicci.maris@alcoa.com

Email EDDs to: equis@ehs-support.com; rebecca.fraser@ehs-support.com; nicci.maris@alcoa.com

Email Invoice to: nicci.maris@alcoa.com

BER (Circle)			
FOR LABORATORY USE ONLY (Circle)			
Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt		°C	
Other comment:			

RELINQUISHED BY:	RECEIVED BY:
CLARE HOGAN	Andrew
DATE/TIME: 4/7/22	DATE/TIME: 4-7-22 1828
RELINQUISHED BY:	RECEIVED BY:
DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: HOLD=Store samples for potential future analysis -

ALS USE ONLY	SAMPLE DETAILS (MATRIX: Soil (SO), Sediment (SE), surface water (WS), Groundwater (WG), Water QC (WQ), Soil QC (WQ))				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX CODE	SAMPLE TYPE CODE	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	SOILS (as per ME/260/22 V3)	ALSP procedure as per ME/260/22 V3 at pH2.9 - remove DOC	ALSP procedure as per ME/260/22 V at pH7 - remove DOC					HOLD	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	ANG-22-0026		SO	N	150ml jar	3								HOLD	
2	ANG-22-0028		SO	N	150ml jar	3								HOLD	
3	ANG-22-0031		SO	N	~~150ml jar~~ 250mL JAR	~~3~~ 2								HOLD	
~~1~~	~~ANG-22-0033~~		SO	N	150ml jar	3								HOLD	
~~1~~	~~ANG-22-0036~~		SO	N	150ml jar	3								HOLD	
~~1~~	~~ANG-22-0038~~		SO	N	150ml jar	3								HOLD	
~~1~~	~~ANG-22-0041~~		SO	N	150ml jar	3								HOLD	
~~1~~	~~ANG-22-0043~~		SO	N	150ml jar	3								HOLD	
4	ANG-22-0046		SO	N	150ml jar	3								HOLD	
5	ANG-22-0050		SO	N	150ml jar	3								HOLD	
6	ANG-22-0052		SO	N	150ml jar	3								HOLD	
16 7	ANG-22-0053		SO	N	150ml jar	3	X	X	X						Remove DOC from ALSP
17 8	ANG-22-0054		SO	N	150ml jar	3	X	X	X						Remove DOC from ALSP
18 9	ANG-22-0055		SO	N	150ml jar	3	X	X	X						Remove DOC from ALSP
19 10	ANG-22-0055_DUP		SO	~~N~~ FP	150ml jar	3	X	X	X						Remove DOC from ALSP
→	ANG-22-0055_TRIP		SO	~~N~~ FD2	150ml jar	3	Please forward to Eurofins MGT with attached COC								
20 11	ANG-22-0056		SO	N	150ml jar	3	X	X	X						Remove DOC from ALSP
21 12	ANG-22-0057		SO	N	150ml jar	3	X	X	X						Remove DOC from ALSP
22 13	ANG-22-0058		SO	N	250 ~~150ml~~ jar	~~3~~ 2	X	X	X						Remove DOC from ALSP
14	ANG-22-0102		SO	N	250mL jar	2								X	
15	ANG-22-0103		SO	N	250mL jar	2								X	
					TOTAL	57	8	7	7	0	0	0	0	11	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM2212813**

Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: rebecca.fraser@ehs-support.com	E-mail	: peter.ravlic@alsglobal.com
Telephone	: ----	Telephone	: +6138549 9645
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: Anglesea Ash Risk Assessment C03568	Page	: 1 of 5
Order number	: ----	Quote number	: EM2021ALCAUS0002 (ME/260/22 V3)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Anglesea		
Sampler	: ANDREW MINARD, CLARE HOGAN		

Dates

Date Samples Received	: 04-Jul-2022 18:28	Issue Date	: 06-Jul-2022
Client Requested Due Date	: 11-Jul-2022	Scheduled Reporting Date	: **11-Jul-2022**

Delivery Details

Mode of Delivery	: Client Drop Off	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 1.5°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 22 / 14

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	(On Hold) SOIL No analysis requested	SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA014 Total Soluble Salts	SOIL - ED037 Alkalinity in Soil	SOIL - EG005T (solids) Total Metals by ICP-AES	SOIL - EG035T (solids) Total Mercury by FIMS	SOIL - EK040T Total Fluoride
EM2212813-001	01-Jul-2022 00:00	ANG-22-0026	✓						
EM2212813-002	01-Jul-2022 00:00	ANG-22-0028	✓						
EM2212813-003	04-Jul-2022 00:00	ANG-22-0031	✓						
EM2212813-004	01-Jul-2022 00:00	ANG-22-0046	✓						
EM2212813-005	01-Jul-2022 00:00	ANG-22-0050	✓						
EM2212813-006	01-Jul-2022 00:00	ANG-22-0052	✓						
EM2212813-007	01-Jul-2022 00:00	ANG-22-0053		✓	✓	✓	✓	✓	✓
EM2212813-008	04-Jul-2022 00:00	ANG-22-0054		✓	✓	✓	✓	✓	✓
EM2212813-009	04-Jul-2022 00:00	ANG-22-0055		✓	✓	✓	✓	✓	✓
EM2212813-010	04-Jul-2022 00:00	ANG-22-0055_DUP		✓	✓	✓	✓	✓	✓
EM2212813-011	04-Jul-2022 00:00	ANG-22-0056		✓	✓	✓	✓	✓	✓
EM2212813-012	04-Jul-2022 00:00	ANG-22-0057		✓	✓	✓	✓	✓	✓
EM2212813-013	04-Jul-2022 00:00	ANG-22-0058		✓	✓	✓	✓	✓	✓
EM2212813-014	04-Jul-2022 00:00	ANG-22-0102	✓						
EM2212813-015	04-Jul-2022 00:00	ANG-22-0103	✓						

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	SOIL - AG-1 EM Only Agricultural (CEC) Soil Suite 1 (pretest air dried)	SOIL - EA001 pH (CaCl)	SOIL - EA055-103 Moisture Content	SOIL - EK040-P Fluoride (Auto Titrator)	SOIL - EN60a-P ASLP Leachate Procedure - Plastic Leaching	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S-EM Major Anions (Cl, SO4) (melb)
EM2212813-007	01-Jul-2022 00:00	ANG-22-0053	✓	✓	✓	✓	✓	✓	✓
EM2212813-008	04-Jul-2022 00:00	ANG-22-0054	✓	✓	✓	✓	✓	✓	✓
EM2212813-009	04-Jul-2022 00:00	ANG-22-0055	✓	✓	✓	✓	✓	✓	✓
EM2212813-010	04-Jul-2022 00:00	ANG-22-0055_DUP	✓	✓	✓	✓	✓	✓	✓
EM2212813-011	04-Jul-2022 00:00	ANG-22-0056	✓	✓	✓	✓	✓	✓	✓
EM2212813-012	04-Jul-2022 00:00	ANG-22-0057	✓	✓	✓	✓	✓	✓	✓
EM2212813-013	04-Jul-2022 00:00	ANG-22-0058	✓	✓	✓	✓	✓	✓	✓
EM2212813-016	01-Jul-2022 00:00	ANG-22-0053				✓			
EM2212813-017	01-Jul-2022 00:00	ANG-22-0054				✓			

			SOIL - AG-1 EM Only Agricultural (CEC) Soil Suite 1 (pretest air dried)	SOIL - EA001 pH (CaCl)	SOIL - EA055-103 Moisture Content	SOIL - EK040-P Fluoride (Auto Titrator)	SOIL - EN60a-P ASLP Leachate Procedure - Plastic Leaching	SOIL - NT-1S Major Cations (Ca, Mg, Na, K)	SOIL - NT-2S-EM Major Anions (Cl, SO4) (melb)
EM2212813-018	01-Jul-2022 00:00	ANG-22-0055				✓			
EM2212813-019	01-Jul-2022 00:00	ANG-22-0055_DUP				✓			
EM2212813-020	01-Jul-2022 00:00	ANG-22-0056				✓			
EM2212813-021	01-Jul-2022 00:00	ANG-22-0057				✓			
EM2212813-022	01-Jul-2022 00:00	ANG-22-0058				✓			

Matrix: **SOIL**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	SOIL - EA005P pH (Auto Titrator)	SOIL - EA010P Electrical Conductivity (Auto Titrator)	SOIL - ED037-P Alkalinity as CaCO3 (Auto Titrator)	SOIL - ED045G Chloride by Discrete Analyser	SOIL - ED093C Leachable Major Cations	SOIL - EG005C Leachable Metals by ICPAES	SOIL - EG035C Leachable Mercury
EM2212813-007	01-Jul-2022 00:00	ANG-22-0053	✓	✓	✓	✓	✓	✓	✓
EM2212813-008	04-Jul-2022 00:00	ANG-22-0054	✓	✓	✓	✓	✓	✓	✓
EM2212813-009	04-Jul-2022 00:00	ANG-22-0055	✓	✓	✓	✓	✓	✓	✓
EM2212813-010	04-Jul-2022 00:00	ANG-22-0055_DUP	✓	✓	✓	✓	✓	✓	✓
EM2212813-011	04-Jul-2022 00:00	ANG-22-0056	✓	✓	✓	✓	✓	✓	✓
EM2212813-012	04-Jul-2022 00:00	ANG-22-0057	✓	✓	✓	✓	✓	✓	✓
EM2212813-013	04-Jul-2022 00:00	ANG-22-0058	✓	✓	✓	✓	✓	✓	✓
EM2212813-016	01-Jul-2022 00:00	ANG-22-0053	✓	✓	✓	✓	✓	✓	✓
EM2212813-017	01-Jul-2022 00:00	ANG-22-0054	✓	✓	✓	✓	✓	✓	✓
EM2212813-018	01-Jul-2022 00:00	ANG-22-0055	✓	✓	✓	✓	✓	✓	✓
EM2212813-019	01-Jul-2022 00:00	ANG-22-0055_DUP	✓	✓	✓	✓	✓	✓	✓
EM2212813-020	01-Jul-2022 00:00	ANG-22-0056	✓	✓	✓	✓	✓	✓	✓
EM2212813-021	01-Jul-2022 00:00	ANG-22-0057	✓	✓	✓	✓	✓	✓	✓
EM2212813-022	01-Jul-2022 00:00	ANG-22-0058	✓	✓	✓	✓	✓	✓	✓

Matrix: **SOIL**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	SOIL - EA015H Total Dissolved Solids - Standard Level	SOIL - ED041G Sulfate (Turbidimetric) as SO4 2 by Discrete	SOIL - EN60-Dia-P Deionised Water Leach - Plastic Leaching Vessel
EM2212813-007	01-Jul-2022 00:00	ANG-22-0053	✓	✓	
EM2212813-008	04-Jul-2022 00:00	ANG-22-0054	✓	✓	
EM2212813-009	04-Jul-2022 00:00	ANG-22-0055	✓	✓	
EM2212813-010	04-Jul-2022 00:00	ANG-22-0055_DUP	✓	✓	
EM2212813-011	04-Jul-2022 00:00	ANG-22-0056	✓	✓	
EM2212813-012	04-Jul-2022 00:00	ANG-22-0057	✓	✓	
EM2212813-013	04-Jul-2022 00:00	ANG-22-0058	✓	✓	
EM2212813-016	01-Jul-2022 00:00	ANG-22-0053	✓	✓	✓
EM2212813-017	01-Jul-2022 00:00	ANG-22-0054	✓	✓	✓
EM2212813-018	01-Jul-2022 00:00	ANG-22-0055	✓	✓	✓
EM2212813-019	01-Jul-2022 00:00	ANG-22-0055_DUP	✓	✓	✓
EM2212813-020	01-Jul-2022 00:00	ANG-22-0056	✓	✓	✓
EM2212813-021	01-Jul-2022 00:00	ANG-22-0057	✓	✓	✓
EM2212813-022	01-Jul-2022 00:00	ANG-22-0058	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ALL INVOICES		
- A4 - AU Tax Invoice (INV)	Email	ap@alcoa.com.au
EQUIS EDD		
- *AU Certificate of Analysis - NATA (COA)	Email	equis@ehs-support.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	equis@ehs-support.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	equis@ehs-support.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	equis@ehs-support.com
- Chain of Custody (CoC) (COC)	Email	equis@ehs-support.com
- EDI Format - ENMRG (ENMRG)	Email	equis@ehs-support.com
- EDI Format - ESDAT (ESDAT)	Email	equis@ehs-support.com
NICCI MARRIS		
- *AU Certificate of Analysis - NATA (COA)	Email	Nicci.Marris@alcoa.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	Nicci.Marris@alcoa.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	Nicci.Marris@alcoa.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	Nicci.Marris@alcoa.com
- A4 - AU Tax Invoice (INV)	Email	Nicci.Marris@alcoa.com
- Chain of Custody (CoC) (COC)	Email	Nicci.Marris@alcoa.com
- EDI Format - ENMRG (ENMRG)	Email	Nicci.Marris@alcoa.com
- EDI Format - ESDAT (ESDAT)	Email	Nicci.Marris@alcoa.com
PETER RAVLIC		
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	peter.ravlic@alsglobal.com
- Chain of Custody (CoC) (COC)	Email	peter.ravlic@alsglobal.com
REBECCA FRASER		
- *AU Certificate of Analysis - NATA (COA)	Email	rebecca.fraser@ehs-support.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	rebecca.fraser@ehs-support.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	rebecca.fraser@ehs-support.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	rebecca.fraser@ehs-support.com
- Chain of Custody (CoC) (COC)	Email	rebecca.fraser@ehs-support.com
- EDI Format - ENMRG (ENMRG)	Email	rebecca.fraser@ehs-support.com
- EDI Format - ESDAT (ESDAT)	Email	rebecca.fraser@ehs-support.com
- Purchase Order Request Letter (PO_Request)	Email	rebecca.fraser@ehs-support.com

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM2212813**	Page	: 1 of 15
Amendment	: **1**		
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +6138549 9645
Project	: Anglesea Ash Risk Assessment C03568	Date Samples Received	: 04-Jul-2022 18:28
Order number	: ----	Date Analysis Commenced	: 07-Jul-2022
C-O-C number	: ----	Issue Date	: 13-Jul-2022 16:41
Sampler	: ANDREW MINARD, CLARE HOGAN		
Site	: Anglesea		
Quote number	: ME/260/22 V3		
No. of samples received	: 22		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Jarwis Nheu	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- Amendment (13/7/22):This report has been amended to remove leachable TDS results which may not be indicative due to leaching solution involved with leach method
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).
- EN60: Where leachable PFAS analysis is requested, centrifugation rather than pressure filtration is used as the default approach for removal of particulates, in line with AS 4439.3.
- EN60-DI: Where leachable PFAS analysis is requested, centrifugation rather than pressure filtration is used as the default approach for removal of particulates, in line with AS 4439.3.

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0056
			Sampling date / time	01-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2212813-007	EM2212813-008	EM2212813-009	EM2212813-010	EM2212813-011
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	3.05	3.17	2.96	2.94	3.10
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	433	489	472	477	445
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	<1	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	6	6	3	3	5
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	1	16	5	5	2
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	4	2	2	1	4
Magnesium	7439-95-4	1	mg/L	5	9	4	4	11
Sodium	7440-23-5	1	mg/L	4	26	6	5	7
Potassium	7440-09-7	1	mg/L	<1	1	<1	<1	<1
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	6.2	1.0	0.8	0.7	2.0
Antimony	7440-36-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	7440-39-3	0.1	mg/L	0.2	0.1	<0.1	<0.1	0.2
Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L	0.7	3.2	1.5	0.9	0.8
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0056
				Sampling date / time	01-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit		EM2212813-007	EM2212813-008	EM2212813-009	EM2212813-010	EM2212813-011
					Result	Result	Result	Result	Result
EG005(ED093)C: Leachable Metals by ICPAES - Continued									
Molybdenum	7439-98-7	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	**0.1**	<0.1	**0.2**	**0.2**

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)			Sample ID	ANG-22-0057	ANG-22-0058	----	----	----
			Sampling date / time	04-Jul-2022 00:00	04-Jul-2022 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM2212813-012	EM2212813-013	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**3.00**	**2.93**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**476**	**501**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**5**	**6**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**4**	**5**	----	----	----
ED093C: Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	<1	<1	----	----	----
Magnesium	7439-95-4	1	mg/L	**2**	**2**	----	----	----
Sodium	7440-23-5	1	mg/L	**5**	**6**	----	----	----
Potassium	7440-09-7	1	mg/L	<1	<1	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.1	mg/L	**1.0**	**1.2**	----	----	----
Antimony	7440-36-0	0.1	mg/L	<0.1	<0.1	----	----	----
Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	----	----	----
Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	----	----	----
Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	----	----	----
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	----	----	----
Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	----	----	----
Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	----	----	----
Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	----	----	----
Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	----	----	----
Iron	7439-89-6	0.1	mg/L	**2.5**	**2.6**	----	----	----
Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	----	----	----
Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	----	----	----
Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	----	----	----
Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	----	----	----
Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	----	----	----

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)			Sample ID	**ANG-22-0057**	**ANG-22-0058**	**----**	**----**	**----**
			Sampling date / time	04-Jul-2022 00:00	04-Jul-2022 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM2212813-012**	**EM2212813-013**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES - Continued								
Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	**----**	**----**	**----**
EG035C: Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0010	mg/L	<0.0010	<0.0010	**----**	**----**	**----**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	**----**	**----**	**----**

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0056
			Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2212813-016	EM2212813-017	EM2212813-018	EM2212813-019	EM2212813-020
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.60	6.90	6.11	6.06	6.75
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	57	152	38	39	64
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	6	13	2	2	6
Total Alkalinity as CaCO3	----	1	mg/L	6	13	2	2	6
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	15	123	7	7	30
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	2	45	5	5	3
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	1	2	<1	<1	2
Magnesium	7439-95-4	1	mg/L	2	15	<1	<1	6
Sodium	7440-23-5	1	mg/L	2	23	5	5	6
Potassium	7440-09-7	1	mg/L	<1	5	<1	<1	2
EG035W: Water Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.2	0.6	0.1	<0.1	0.5
EG005(ED093)W: Water Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.10	mg/L	9.92	80.5	1.19	1.23	32.2
Antimony	7440-36-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.06
Arsenic	7440-38-2	0.01	mg/L	<0.01	0.02	<0.01	<0.01	0.01
Barium	7440-39-3	0.1	mg/L	<0.1	0.5	<0.1	<0.1	0.2
Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	7440-47-3	0.01	mg/L	0.01	0.16	<0.01	<0.01	0.08
Cobalt	7440-48-4	0.01	mg/L	<0.01	0.01	<0.01	<0.01	<0.01
Copper	7440-50-8	0.01	mg/L	<0.01	0.01	<0.01	<0.01	<0.01
Iron	7439-89-6	0.05	mg/L	5.81	74.0	1.69	1.66	25.3
Lead	7439-92-1	0.01	mg/L	<0.01	0.09	<0.01	<0.01	0.04

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0056
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00
					EM2212813-016	EM2212813-017	EM2212813-018	EM2212813-019	EM2212813-020
					Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Manganese	7439-96-5	0.01	mg/L		**0.01**	**0.07**	<0.01	<0.01	**0.04**
Nickel	7440-02-0	0.01	mg/L		<0.01	**0.02**	<0.01	<0.01	**0.02**
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.01	mg/L		**0.01**	**0.03**	<0.01	<0.01	**0.03**
Molybdenum	7439-98-7	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Sample ID	ANG-22-0057	ANG-22-0058	----	----	----
			Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM2212813-021	EM2212813-022	--------	--------	--------
				Result	Result	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**5.07**	**6.18**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**42**	**40**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	**2**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	<1	**2**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**7**	**9**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**4**	**4**	----	----	----
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	<1	<1	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	**1**	----	----	----
Sodium	7440-23-5	1	mg/L	**4**	**4**	----	----	----
Potassium	7440-09-7	1	mg/L	<1	<1	----	----	----
EG035W: Water Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	**0.1**	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES								
Aluminium	7429-90-5	0.10	mg/L	**1.24**	**5.95**	----	----	----
Antimony	7440-36-0	0.01	mg/L	**0.01**	<0.01	----	----	----
Arsenic	7440-38-2	0.01	mg/L	<0.01	<0.01	----	----	----
Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	----	----	----
Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	----	----	----
Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	----	----	----
Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	----	----	----
Chromium	7440-47-3	0.01	mg/L	<0.01	**0.02**	----	----	----
Cobalt	7440-48-4	0.01	mg/L	<0.01	<0.01	----	----	----
Copper	7440-50-8	0.01	mg/L	<0.01	<0.01	----	----	----
Iron	7439-89-6	0.05	mg/L	**1.73**	**9.54**	----	----	----
Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-22-0057	ANG-22-0058	----	----	----
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EM2212813-021	EM2212813-022	--------	--------	--------
					Result	Result	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Manganese	7439-96-5	0.01	mg/L		**0.01**	**0.01**	----	----	----
Nickel	7440-02-0	0.01	mg/L		<0.01	<0.01	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.01	mg/L		**0.01**	**0.01**	----	----	----
Molybdenum	7439-98-7	0.01	mg/L		<0.01	<0.01	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0056
			Sampling date / time	01-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2212813-007	EM2212813-008	EM2212813-009	EM2212813-010	EM2212813-011
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	4.1	4.9	5.0	5.0	4.0
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	5.5	5.6	5.3	5.6	5.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	75	328	144	150	102
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	149	230	289	155	160
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	256	1120	490	509	346
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.1	18.1	17.3	17.7	18.3
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.8	0.8	0.4	0.3	0.8
Exchangeable Magnesium	----	0.1	meq/100g	1.2	4.6	1.0	0.9	4.0
Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.2	0.2	<0.1	0.1
Exchangeable Sodium	----	0.1	meq/100g	0.3	3.0	0.7	0.6	0.9
Cation Exchange Capacity	----	0.1	meq/100g	2.3	8.7	2.2	1.9	5.9
Exchangeable Sodium Percent	----	0.1	%	12.0	34.5	30.9	32.5	16.0
ED037: Alkalinity								
Hydroxide Alkalinity as CaCO3	DMO-210-001	5	mg/kg	<5	<5	<5	<5	<5
Carbonate Alkalinity as CaCO3	3812-32-6	5	mg/kg	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO3	71-52-3	5	mg/kg	<5	228	<5	<5	<5
Total Alkalinity as CaCO3	----	5	mg/kg	<5	228	<5	<5	<5
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	130	110	210	210	110
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	360	130	140	160
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	20	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	40	310	130	140	90
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-22-0053	ANG-22-0054	ANG-22-0055	ANG-22-0055_DUP	ANG-22-0056
				Sampling date / time	01-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit		EM2212813-007	EM2212813-008	EM2212813-009	EM2212813-010	EM2212813-011
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Aluminium	7429-90-5	50	mg/kg		1810	10500	3520	2280	5300
Antimony	7440-36-0	5	mg/kg		<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		10	20	<10	<10	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		4	15	10	10	16
Cobalt	7440-48-4	2	mg/kg		<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg		<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg		3430	11900	17800	20500	8330
Lead	7439-92-1	5	mg/kg		<5	8	<5	<5	6
Manganese	7439-96-5	5	mg/kg		<5	12	11	11	9
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg		<2	3	<2	<2	2
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg		<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		<40	80	<40	60	160
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)									
Extraction Fluid pH	----	0.1	pH Unit		2.9	2.9	2.9	2.9	2.9
Final pH	----	0.1	pH Unit		3.1	3.0	3.1	3.0	3.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0057	ANG-22-0058	ANG-22-0053	ANG-22-0054	ANG-22-0055
			Sampling date / time	04-Jul-2022 00:00	04-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2212813-012	EM2212813-013	EM2212813-016	EM2212813-017	EM2212813-018
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	4.2	4.5	----	----	----
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	4.8	4.9	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	136	228	----	----	----
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	82	110	----	----	----
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	462	774	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	17.6	16.8	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.1	0.2	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	0.3	0.4	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.3	0.4	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	0.8	1.0	----	----	----
Exchangeable Sodium Percent	----	0.1	%	36.9	39.0	----	----	----
ED037: Alkalinity								
Hydroxide Alkalinity as CaCO3	DMO-210-001	5	mg/kg	<5	<5	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	5	mg/kg	<5	<5	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	5	mg/kg	<5	<5	----	----	----
Total Alkalinity as CaCO3	----	5	mg/kg	<5	<5	----	----	----
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	190	200	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	90	150	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	----	----	----
Magnesium	7439-95-4	10	mg/kg	<10	20	----	----	----
Sodium	7440-23-5	10	mg/kg	120	170	----	----	----
Potassium	7440-09-7	10	mg/kg	<10	<10	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0057	ANG-22-0058	ANG-22-0053	ANG-22-0054	ANG-22-0055
			Sampling date / time	04-Jul-2022 00:00	04-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2212813-012	EM2212813-013	EM2212813-016	EM2212813-017	EM2212813-018
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Aluminium	7429-90-5	50	mg/kg	1140	1480	----	----	----
Antimony	7440-36-0	5	mg/kg	<5	<5	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5	<5	----	----	----
Barium	7440-39-3	10	mg/kg	<10	<10	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	<1	----	----	----
Boron	7440-42-8	50	mg/kg	<50	<50	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	4	4	----	----	----
Cobalt	7440-48-4	2	mg/kg	<2	<2	----	----	----
Copper	7440-50-8	5	mg/kg	<5	<5	----	----	----
Iron	7439-89-6	50	mg/kg	8380	6880	----	----	----
Lead	7439-92-1	5	mg/kg	<5	<5	----	----	----
Manganese	7439-96-5	5	mg/kg	<5	6	----	----	----
Molybdenum	7439-98-7	2	mg/kg	<2	<2	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	<2	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	<5	----	----	----
Zinc	7440-66-6	5	mg/kg	<5	<5	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	----	----	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	<40	<40	----	----	----
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)								
Extraction Fluid pH	----	0.1	pH Unit	2.9	2.9	----	----	----
Final pH	----	0.1	pH Unit	3.0	3.0	----	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)								
Final pH	----	0.1	pH Unit	----	----	5.4	6.3	6.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0055_DUP	ANG-22-0056	ANG-22-0057	ANG-22-0058	----
			Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	----
Compound	CAS Number	LOR	Unit	EM2212813-019	EM2212813-020	EM2212813-021	EM2212813-022	--------
				Result	Result	Result	Result	----
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)								
Final pH	----	0.1	pH Unit	**6.0**	**5.7**	**5.3**	**5.5**	**----**

QUALITY CONTROL REPORT

Work Order	: **EM2212813**	Page	: 1 of 11
Amendment	: **1**		
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +6138549 9645
Project	: Anglesea Ash Risk Assessment C03568	Date Samples Received	: 04-Jul-2022
Order number	: ----	Date Analysis Commenced	: 07-Jul-2022
C-O-C number	: ----	Issue Date	: 13-Jul-2022
Sampler	: ANDREW MINARD, CLARE HOGAN		
Site	: Anglesea		
Quote number	: ME/260/22 V3		
No. of samples received	: 22		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Jarwis Nheu	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Nikki Stepniewski	Senior Inorganic Instrument Chemist	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 4444185)									
EM2212733-001	Anonymous	EG005T: Barium	7440-39-3	10	mg/kg	180	160	9.8	0% - 50%
		EG005T: Lead	7439-92-1	5	mg/kg	65	42	41.9	0% - 50%
EM2212813-007	ANG-22-0053	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	10	10	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	4	4	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	<2	2	0.0	No Limit
		EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Aluminium	7429-90-5	50	mg/kg	1810	1760	2.9	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
		EG005T: Iron	7439-89-6	50	mg/kg	3430	3190	7.1	0% - 20%
EM2212733-001	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	44	38	16.0	0% - 20%
		EG005T: Cobalt	7440-48-4	2	mg/kg	18	16	12.4	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 4444185) - continued									
EM2212733-001	Anonymous	EG005T: Nickel	7440-02-0	2	mg/kg	62	62	0.0	0% - 20%
		EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	8	5	42.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	34	30	14.2	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	397	368	7.6	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	92	74	21.6	0% - 50%
		EG005T: Aluminium	7429-90-5	50	mg/kg	15700	14000	11.3	0% - 20%
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
		EG005T: Iron	7439-89-6	50	mg/kg	36500	32300	12.2	0% - 20%
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 4445212)									
EM2212781-004	Anonymous	EA001: pH (CaCl2)	----	0.1	pH Unit	7.3	7.3	0.0	0% - 20%
EM2212813-010	ANG-22-0055_DUP	EA001: pH (CaCl2)	----	0.1	pH Unit	5.0	4.9	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 4444215)									
EM2212813-007	ANG-22-0053	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	75	87	14.1	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 4444430)									
EM2212782-002	Anonymous	EA055: Moisture Content	----	0.1	%	23.3	23.4	0.0	0% - 20%
EM2212828-001	Anonymous	EA055: Moisture Content	----	0.1	%	18.6	22.0	16.8	0% - 20%
ED007: Exchangeable Cations (QC Lot: 4445734)									
EM2212813-007	ANG-22-0053	ED007: Exchangeable Sodium Percent	----	0.1	%	12.0	11.9	0.9	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	0.8	0.8	0.0	No Limit
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	1.2	1.2	0.0	0% - 50%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	0.3	0.3	0.0	No Limit
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	2.3	2.3	0.0	0% - 20%
ED037: Alkalinity (QC Lot: 4444216)									
EM2212813-007	ANG-22-0053	ED037: Total Alkalinity as CaCO3	----	5	mg/kg	<5	<5	0.0	No Limit
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QC Lot: 4444224)									
EM2212813-007	ANG-22-0053	ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	130	140	8.9	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 4444217)									
EM2212813-007	ANG-22-0053	ED045G: Chloride	16887-00-6	10	mg/kg	20	30	0.0	No Limit
ED093S: Soluble Major Cations (QC Lot: 4444218)									
EM2212813-007	ANG-22-0053	ED093S: Calcium	7440-70-2	10	mg/kg	<10	<10	0.0	No Limit
		ED093S: Magnesium	7439-95-4	10	mg/kg	20	20	0.0	No Limit
		ED093S: Sodium	7440-23-5	10	mg/kg	40	40	0.0	No Limit
		ED093S: Potassium	7440-09-7	10	mg/kg	<10	<10	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 4444184)									
EM2212813-007	ANG-22-0053	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 4444184) - continued									
EM2212733-001	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK040T: Fluoride Total (QC Lot: 4444206)									
EM2212733-001	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	160	140	15.2	No Limit
EM2212781-013	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	100	100	0.0	No Limit

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 4450109)									
EM2212743-001	Anonymous	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	0.08	0.08	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Antimony	7440-36-0	0.1	mg/L	1.2	1.2	0.0	0% - 50%
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	1.7	1.7	0.0	0% - 50%
		EG005C: Boron	7440-42-8	0.1	mg/L	1.0	1.0	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	0.3	0.3	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	0.5	0.5	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	7.2	7.1	1.8	0% - 20%
		EG005C: Iron	7439-89-6	0.1	mg/L	15.0	14.9	0.9	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	0.6	0.6	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	0.8	0.8	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	0.1	0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	56.6	56.7	0.0	0% - 20%
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EM2212813-013	ANG-22-0058	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	1.2	1.2	0.0	0% - 50%
		EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	2.6	2.7	0.0	0% - 20%
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)W: Water Leachable Metals by ICPAES. (QC Lot: 4450115)									
EM2212812-002	Anonymous	EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Chromium	7440-47-3	0.01	mg/L	0.12	0.13	0.0	0% - 50%
		EG005W: Cobalt	7440-48-4	0.01	mg/L	0.05	0.05	0.0	No Limit
		EG005W: Copper	7440-50-8	0.01	mg/L	0.06	0.05	0.0	No Limit
		EG005W: Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Manganese	7439-96-5	0.01	mg/L	0.56	0.57	2.1	0% - 20%
		EG005W: Nickel	7440-02-0	0.01	mg/L	0.31	0.31	0.0	0% - 20%
		EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Zinc	7440-66-6	0.01	mg/L	0.17	0.17	0.0	0% - 50%
		EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Iron	7439-89-6	0.05	mg/L	100	102	1.6	0% - 20%
		EG005W: Aluminium	7429-90-5	0.1	mg/L	18.5	18.8	1.8	0% - 20%
		EG005W: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005W: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EM2213065-002	Anonymous	EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Chromium	7440-47-3	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Cobalt	7440-48-4	0.01	mg/L	0.02	0.02	0.0	No Limit
		EG005W: Copper	7440-50-8	0.01	mg/L	0.06	0.06	0.0	No Limit
		EG005W: Lead	7439-92-1	0.01	mg/L	0.02	0.02	0.0	No Limit
		EG005W: Manganese	7439-96-5	0.01	mg/L	0.32	0.33	0.0	0% - 20%
		EG005W: Nickel	7440-02-0	0.01	mg/L	0.05	0.05	0.0	No Limit
		EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Zinc	7440-66-6	0.01	mg/L	0.16	0.16	0.0	0% - 50%
		EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Iron	7439-89-6	0.05	mg/L	18.7	18.7	0.1	0% - 20%
		EG005W: Aluminium	7429-90-5	0.1	mg/L	4.96	4.95	0.0	0% - 20%
		EG005W: Barium	7440-39-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005W: Boron	7440-42-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EA005P: pH by PC Titrator (QC Lot: 4450298)									
EM2212813-020	ANG-22-0056	EA005-P: pH Value	----	0.01	pH Unit	6.75	6.78	0.4	0% - 20%
EM2212813-007	ANG-22-0053	EA005-P: pH Value	----	0.01	pH Unit	3.05	3.05	0.0	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 4450300)									
EM2212813-020	ANG-22-0056	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	64	64	0.0	0% - 20%
EM2212813-007	ANG-22-0053	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	433	440	1.6	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED037P: Alkalinity by PC Titrator (QC Lot: 4450297)									
EM2212813-020	ANG-22-0056	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	6	7	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	6	7	0.0	No Limit
EM2212813-007	ANG-22-0053	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4450212)									
EM2212813-007	ANG-22-0053	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	6	6	0.0	No Limit
EM2212813-018	ANG-22-0055	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	7	7	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 4450211)									
EM2212813-007	ANG-22-0053	ED045G: Chloride	16887-00-6	1	mg/L	1	1	0.0	No Limit
EM2212813-018	ANG-22-0055	ED045G: Chloride	16887-00-6	1	mg/L	5	5	0.0	No Limit
ED093C: Leachable Major Cations (QC Lot: 4450110)									
EM2212813-007	ANG-22-0053	ED093C: Calcium	7440-70-2	1	mg/L	4	4	0.0	No Limit
		ED093C: Magnesium	7439-95-4	1	mg/L	5	5	0.0	No Limit
		ED093C: Sodium	7440-23-5	1	mg/L	4	3	0.0	No Limit
		ED093C: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
ED093W: Water Leachable Major Cations (QC Lot: 4450116)									
EM2212813-016	ANG-22-0053	ED093W: Calcium	7440-70-2	1	mg/L	1	1	0.0	No Limit
		ED093W: Magnesium	7439-95-4	1	mg/L	2	2	0.0	No Limit
		ED093W: Sodium	7440-23-5	1	mg/L	2	2	0.0	No Limit
		ED093W: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 4451193)									
EM2212743-001	Anonymous	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EG035W: Water Leachable Mercury by FIMS (QC Lot: 4451194)									
EM2212813-016	ANG-22-0053	EG035W: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 4450299)									
EM2212813-020	ANG-22-0056	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.5	0.5	0.0	No Limit
EM2212813-007	ANG-22-0053	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 4444185)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	15910 mg/kg	84.0	70.0	130
EG005T: Antimony	7440-36-0	5	mg/kg	<5	2.57 mg/kg	78.3	70.0	130
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	123 mg/kg	102	70.0	130
EG005T: Barium	7440-39-3	10	mg/kg	<10	99.3 mg/kg	93.3	70.0	130
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	0.67 mg/kg	106	70.0	130
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	1.23 mg/kg	61.8	50.0	130
EG005T: Chromium	7440-47-3	2	mg/kg	<2	20.2 mg/kg	103	70.0	130
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	11.2 mg/kg	91.9	70.0	130
EG005T: Copper	7440-50-8	5	mg/kg	<5	55.9 mg/kg	97.2	70.0	130
EG005T: Iron	7439-89-6	50	mg/kg	<50	33227 mg/kg	113	70.0	130
EG005T: Lead	7439-92-1	5	mg/kg	<5	62.4 mg/kg	98.5	70.0	130
EG005T: Manganese	7439-96-5	5	mg/kg	<5	590 mg/kg	103	70.0	130
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	2.19 mg/kg	88.6	70.0	130
EG005T: Nickel	7440-02-0	2	mg/kg	<2	15.4 mg/kg	103	70.0	130
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Zinc	7440-66-6	5	mg/kg	<5	162 mg/kg	79.8	70.0	130
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel) (QCLot: 4448290)								
EN60-DIa-P: Final pH	----	0.1	pH Unit	7.0	----	----	----	----
EA001: pH in soil using 0.01M CaCl extract (QCLot: 4445212)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	99.5	98.8	101
				----	7 pH Unit	100	99.3	101
EA010: Conductivity (1:5) (QCLot: 4444215)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	101	94.5	105
ED007: Exchangeable Cations (QCLot: 4445734)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.13 meq/100g	86.7	80.0	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.96 meq/100g	86.7	72.2	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.01 meq/100g	98.3	77.4	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.86 meq/100g	109	89.2	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED037: Alkalinity (QCLot: 4444216)								
ED037: Total Alkalinity as CaCO3	----	----	mg/kg	----	1000 mg/kg	90.2	89.5	108
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QCLot: 4444224)								
ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	<50	3000 mg/kg	102	86.1	116

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED045G: Chloride by Discrete Analyser (QCLot: 4444217)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	98.4	85.5	120
				<10	5000 mg/kg	102	85.5	120
ED093S: Soluble Major Cations (QCLot: 4444218)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	250 mg/kg	95.2	80.0	120
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	250 mg/kg	99.8	80.0	120
ED093S: Sodium	7440-23-5	10	mg/kg	<10	250 mg/kg	97.2	80.0	120
ED093S: Potassium	7440-09-7	10	mg/kg	<10	250 mg/kg	93.7	80.0	120
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4444184)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.64 mg/kg	94.4	70.0	130
EK040T: Fluoride Total (QCLot: 4444206)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	400 mg/kg	82.1	75.2	110

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 4450109)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	5 mg/L	107	80.0	120
EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	0.2 mg/L	110	80.0	120
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	1 mg/L	102	80.0	120
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	1 mg/L	97.7	80.0	120
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	1 mg/L	93.8	80.0	120
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	5 mg/L	115	80.0	120
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	1 mg/L	86.7	80.0	120
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	1 mg/L	91.6	80.0	120
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	1 mg/L	87.2	80.0	120
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	1 mg/L	102	80.0	120
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	5 mg/L	91.6	80.0	120
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	1 mg/L	86.2	80.0	120
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	1 mg/L	86.7	80.0	120
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	1 mg/L	88.3	80.0	120
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	1 mg/L	93.3	80.0	120
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	1 mg/L	86.8	80.0	120
EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	1 mg/L	93.6	80.0	120
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4450115)								
EG005W: Aluminium	7429-90-5	0.1	mg/L	<0.10	0.5 mg/L	96.2	80.0	120
EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	0.02 mg/L	114	80.0	120
EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	0.1 mg/L	105	80.0	120
EG005W: Barium	7440-39-3	0.1	mg/L	<0.1	0.1 mg/L	99.6	80.0	120
EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	0.1 mg/L	99.6	80.0	120

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4450115) - continued								
EG005W: Boron	7440-42-8	0.1	mg/L	<0.1	0.5 mg/L	102	80.0	120
EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	0.1 mg/L	97.2	80.0	120
EG005W: Chromium	7440-47-3	0.01	mg/L	<0.01	0.1 mg/L	95.8	80.0	120
EG005W: Cobalt	7440-48-4	0.01	mg/L	<0.01	0.1 mg/L	95.9	80.0	120
EG005W: Copper	7440-50-8	0.01	mg/L	<0.01	0.1 mg/L	96.6	80.0	120
EG005W: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	98.4	80.0	120
EG005W: Lead	7439-92-1	0.01	mg/L	<0.01	0.1 mg/L	95.3	80.0	120
EG005W: Manganese	7439-96-5	0.01	mg/L	<0.01	0.1 mg/L	95.7	80.0	120
EG005W: Nickel	7440-02-0	0.01	mg/L	<0.01	0.1 mg/L	98.1	80.0	120
EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	94.4	80.0	120
EG005W: Zinc	7440-66-6	0.01	mg/L	<0.01	0.1 mg/L	100	80.0	120
EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	0.1 mg/L	96.6	80.0	120
EA005P: pH by PC Titrator (QCLot: 4450298)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	99.5	98.8	101
				----	7 pH Unit	100	99.3	101
EA010P: Conductivity by PC Titrator (QCLot: 4450300)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	99.1	85.0	119
ED037P: Alkalinity by PC Titrator (QCLot: 4450297)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	99.8	85.0	116
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4450212)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	100	85.8	117
				<1	500 mg/L	102	80.0	120
ED045G: Chloride by Discrete Analyser (QCLot: 4450211)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	94.9	85.0	115
				<1	1000 mg/L	100	85.0	122
ED093C: Leachable Major Cations (QCLot: 4450110)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	500 mg/L	93.6	80.0	120
ED093C: Magnesium	7439-95-4	1	mg/L	<1	500 mg/L	95.2	80.0	120
ED093C: Sodium	7440-23-5	1	mg/L	<1	500 mg/L	96.0	80.0	120
ED093C: Potassium	7440-09-7	1	mg/L	<1	500 mg/L	90.4	80.0	120
ED093W: Water Leachable Major Cations (QCLot: 4450116)								
ED093W: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	94.8	80.0	120
ED093W: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	99.3	80.0	120
ED093W: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	95.8	80.0	120
ED093W: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	91.2	80.0	120
EG035C: Leachable Mercury by FIMS (QCLot: 4451193)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	110	72.0	115
EG035W: Water Leachable Mercury by FIMS (QCLot: 4451194)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG035W: Water Leachable Mercury by FIMS (QCLot: 4451194) - continued								
EG035W: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	96.4	75.6	119
EK040P: Fluoride by PC Titrator (QCLot: 4450299)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	96.4	80.8	118

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 4444185)							
EM2212733-002	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	99.9	78.0	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	100	79.7	116
		EG005T: Chromium	7440-47-3	50 mg/kg	108	79.0	121
		EG005T: Copper	7440-50-8	250 mg/kg	110	80.0	120
		EG005T: Lead	7439-92-1	250 mg/kg	98.7	80.0	120
		EG005T: Nickel	7440-02-0	50 mg/kg	90.6	78.0	120
		EG005T: Zinc	7440-66-6	250 mg/kg	96.8	80.0	120
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QCLot: 4444224)							
EM2212813-008	ANG-22-0054	ED040N: Sulfate as SO4 2-	14808-79-8	3000 mg/kg	97.0	84.0	116
ED045G: Chloride by Discrete Analyser (QCLot: 4444217)							
EM2212813-008	ANG-22-0054	ED045G: Chloride	16887-00-6	2000 mg/kg	109	93.0	125
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4444184)							
EM2212733-002	Anonymous	EG035T: Mercury	7439-97-6	0.5 mg/kg	105	76.0	116
EK040T: Fluoride Total (QCLot: 4444206)							
EM2212733-002	Anonymous	EK040T: Fluoride	16984-48-8	400 mg/kg	103	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 4450109)							
EM2212743-002	Anonymous	EG005C: Arsenic	7440-38-2	1 mg/L	99.6	80.0	120
		EG005C: Barium	7440-39-3	1 mg/L	90.2	80.0	120
		EG005C: Beryllium	7440-41-7	1 mg/L	89.6	80.0	120
		EG005C: Cadmium	7440-43-9	0.25 mg/L	81.7	80.0	120
		EG005C: Chromium	7440-47-3	1 mg/L	86.2	80.0	120
		EG005C: Cobalt	7440-48-4	1 mg/L	82.8	80.0	120

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 4450109) - continued							
EM2212743-002	Anonymous	EG005C: Copper	7440-50-8	1 mg/L	96.3	80.0	120
		EG005C: Lead	7439-92-1	1 mg/L	82.8	80.0	120
		EG005C: Nickel	7440-02-0	1 mg/L	81.9	80.0	120
		EG005C: Zinc	7440-66-6	1 mg/L	# Not Determined	80.0	120
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4450115)							
EM2212813-016	ANG-22-0053	EG005W: Arsenic	7440-38-2	1 mg/L	92.9	80.0	120
		EG005W: Barium	7440-39-3	1 mg/L	95.3	80.0	120
		EG005W: Beryllium	7440-41-7	1 mg/L	94.7	80.0	120
		EG005W: Cadmium	7440-43-9	0.25 mg/L	94.1	80.0	120
		EG005W: Chromium	7440-47-3	1 mg/L	91.8	80.0	120
		EG005W: Cobalt	7440-48-4	1 mg/L	92.3	80.0	120
		EG005W: Copper	7440-50-8	1 mg/L	92.0	80.0	120
		EG005W: Lead	7439-92-1	1 mg/L	92.6	80.0	120
		EG005W: Nickel	7440-02-0	1 mg/L	92.5	80.0	120
		EG005W: Zinc	7440-66-6	1 mg/L	91.8	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4450212)							
EM2212813-008	ANG-22-0054	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	83.5	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4450211)							
EM2212813-008	ANG-22-0054	ED045G: Chloride	16887-00-6	400 mg/L	101	70.0	142
EG035C: Leachable Mercury by FIMS (QCLot: 4451193)							
EM2212743-002	Anonymous	EG035C: Mercury	7439-97-6	0.01 mg/L	114	84.0	118
EG035W: Water Leachable Mercury by FIMS (QCLot: 4451194)							
EM2212813-017	ANG-22-0054	EG035W: Mercury	7439-97-6	0.01 mg/L	91.6	78.0	120
EK040P: Fluoride by PC Titrator (QCLot: 4450299)							
EM2212813-009	ANG-22-0055	EK040P: Fluoride	16984-48-8	5 mg/L	82.4	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM2212813**	Page	: 1 of 15
Amendment	: **1**		
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Telephone	: +6138549 9645
Project	: Anglesea Ash Risk Assessment C03568	Date Samples Received	: 04-Jul-2022
Site	: Anglesea	Issue Date	: 13-Jul-2022
Sampler	: ANDREW MINARD, CLARE HOGAN	No. of samples received	: 22
Order number	: ----	No. of samples analysed	: 14

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG005(ED093)C: Leachable Metals by ICPAES	EM2212743--002	Anonymous	**Zinc**	7440-66-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA002-AD: pH (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved							
ANG-22-0053		----	----	----	11-Jul-2022	07-Jul-2022	**4**
Soil Glass Jar - Unpreserved							
ANG-22-0054,	ANG-22-0055,	----	----	----	11-Jul-2022	07-Jul-2022	**4**
ANG-22-0055_DUP,	ANG-22-0056,						
ANG-22-0057,	ANG-22-0058						

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
ANG-22-0053,	ANG-22-0054,	----	----	----	11-Jul-2022	08-Jul-2022	**3**
ANG-22-0055,	ANG-22-0055_DUP,						
ANG-22-0056,	ANG-22-0057,						
ANG-22-0058,	ANG-22-0053,						
ANG-22-0054,	ANG-22-0055,						
ANG-22-0055_DUP,	ANG-22-0056,						
ANG-22-0057,	ANG-22-0058						

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved (EA001)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	08-Jul-2022	✓	**07-Jul-2022**	07-Jul-2022	✓
Soil Glass Jar - Unpreserved (EA001)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	11-Jul-2022	✓	**07-Jul-2022**	07-Jul-2022	✓
EA002-AD: pH (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved (EA002-AD)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	08-Jul-2022	✓	**11-Jul-2022**	07-Jul-2022	×
Soil Glass Jar - Unpreserved (EA002-AD)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	11-Jul-2022	✓	**11-Jul-2022**	07-Jul-2022	×
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved (EA010)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	08-Jul-2022	✓	**07-Jul-2022**	04-Aug-2022	✓
Soil Glass Jar - Unpreserved (EA010)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	11-Jul-2022	✓	**07-Jul-2022**	04-Aug-2022	✓
EA010-AD: Conductivity (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved (EA010-AD)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	08-Jul-2022	✓	**11-Jul-2022**	04-Aug-2022	✓
Soil Glass Jar - Unpreserved (EA010-AD)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	11-Jul-2022	✓	**11-Jul-2022**	04-Aug-2022	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055)							
ANG-22-0053	**01-Jul-2022**	**----**	----	----	**07-Jul-2022**	15-Jul-2022	✓
Soil Glass Jar - Unpreserved (EA055)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**----**	----	----	**07-Jul-2022**	18-Jul-2022	✓
ED006: Exchangeable Cations on Alkaline Soils							
Soil Glass Jar - Unpreserved (ED006)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	29-Jul-2022	✓	**11-Jul-2022**	29-Jul-2022	✓
Soil Glass Jar - Unpreserved (ED006)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	01-Aug-2022	✓	**11-Jul-2022**	01-Aug-2022	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED007: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED007)								
ANG-22-0053		**01-Jul-2022**	**07-Jul-2022**	29-Jul-2022	✓	**11-Jul-2022**	29-Jul-2022	✓
Soil Glass Jar - Unpreserved (ED007)								
ANG-22-0054,	ANG-22-0055,	**04-Jul-2022**	**07-Jul-2022**	01-Aug-2022	✓	**11-Jul-2022**	01-Aug-2022	✓
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED008: Exchangeable Cations								
Soil Glass Jar - Unpreserved (ED008)								
ANG-22-0053		**01-Jul-2022**	**07-Jul-2022**	29-Jul-2022	✓	**11-Jul-2022**	29-Jul-2022	✓
Soil Glass Jar - Unpreserved (ED008)								
ANG-22-0054,	ANG-22-0055,	**04-Jul-2022**	**07-Jul-2022**	01-Aug-2022	✓	**11-Jul-2022**	01-Aug-2022	✓
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED037: Alkalinity								
Soil Glass Jar - Unpreserved (ED037)								
ANG-22-0053		**01-Jul-2022**	**07-Jul-2022**	28-Dec-2022	✓	**08-Jul-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (ED037)								
ANG-22-0054,	ANG-22-0055,	**04-Jul-2022**	**07-Jul-2022**	31-Dec-2022	✓	**08-Jul-2022**	31-Dec-2022	✓
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Soil Glass Jar - Unpreserved (ED040N)								
ANG-22-0053		**01-Jul-2022**	**07-Jul-2022**	28-Dec-2022	✓	**07-Jul-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (ED040N)								
ANG-22-0054,	ANG-22-0055,	**04-Jul-2022**	**07-Jul-2022**	31-Dec-2022	✓	**07-Jul-2022**	31-Dec-2022	✓
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED045G: Chloride by Discrete Analyser								
Soil Glass Jar - Unpreserved (ED045G)								
ANG-22-0053		**01-Jul-2022**	**07-Jul-2022**	29-Jul-2022	✓	**08-Jul-2022**	04-Aug-2022	✓
Soil Glass Jar - Unpreserved (ED045G)								
ANG-22-0054,	ANG-22-0055,	**04-Jul-2022**	**07-Jul-2022**	01-Aug-2022	✓	**08-Jul-2022**	04-Aug-2022	✓
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED093S: Soluble Major Cations								
Soil Glass Jar - Unpreserved (ED093S)								
ANG-22-0053		**01-Jul-2022**	**07-Jul-2022**	28-Dec-2022	✓	**07-Jul-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (ED093S)								
ANG-22-0054,	ANG-22-0055,	**04-Jul-2022**	**07-Jul-2022**	31-Dec-2022	✓	**07-Jul-2022**	31-Dec-2022	✓
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	28-Dec-2022	✓	**08-Jul-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (EG005T)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	31-Dec-2022	✓	**08-Jul-2022**	31-Dec-2022	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	29-Jul-2022	✓	**08-Jul-2022**	29-Jul-2022	✓
Soil Glass Jar - Unpreserved (EG035T)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	01-Aug-2022	✓	**08-Jul-2022**	01-Aug-2022	✓
EK040T: Fluoride Total							
Soil Glass Jar - Unpreserved (EK040T)							
ANG-22-0053	**01-Jul-2022**	**07-Jul-2022**	29-Jul-2022	✓	**11-Jul-2022**	29-Jul-2022	✓
Soil Glass Jar - Unpreserved (EK040T)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**07-Jul-2022**	01-Aug-2022	✓	**11-Jul-2022**	01-Aug-2022	✓
EN60: ASLP Leaching Procedure - Inorganics/PFAS (Plastic Vessel)							
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60a-P)							
ANG-22-0053	**01-Jul-2022**	**08-Jul-2022**	29-Jul-2022	✓	**----**	----	----
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60a-P)							
ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**04-Jul-2022**	**08-Jul-2022**	01-Aug-2022	✓	**----**	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/PFAS (Plastic Vessel)							
Non-Volatile Leach: 28 day HT(e.g. Hg, CrVI) (EN60-DIa-P)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**01-Jul-2022**	**08-Jul-2022**	29-Jul-2022	✓	**----**	----	----

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P)								
ANG-22-0053,	ANG-22-0054,	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	08-Jul-2022	×
ANG-22-0055,	ANG-22-0055_DUP,							
ANG-22-0056,	ANG-22-0057,							
ANG-22-0058,	ANG-22-0053,							
ANG-22-0054,	ANG-22-0055,							
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P)								
ANG-22-0053,	ANG-22-0054,	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	05-Aug-2022	✓
ANG-22-0055,	ANG-22-0055_DUP,							
ANG-22-0056,	ANG-22-0057,							
ANG-22-0058,	ANG-22-0053,							
ANG-22-0054,	ANG-22-0055,							
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P)								
ANG-22-0053,	ANG-22-0054,	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	22-Jul-2022	✓
ANG-22-0055,	ANG-22-0055_DUP,							
ANG-22-0056,	ANG-22-0057,							
ANG-22-0058,	ANG-22-0053,							
ANG-22-0054,	ANG-22-0055,							
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
ANG-22-0053,	ANG-22-0054,	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	05-Aug-2022	✓
ANG-22-0055,	ANG-22-0055_DUP,							
ANG-22-0056,	ANG-22-0057,							
ANG-22-0058,	ANG-22-0053,							
ANG-22-0054,	ANG-22-0055,							
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058, ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0056, ANG-22-0055_DUP, ANG-22-0057, ANG-22-0058	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	05-Aug-2022	✓
ED093C: Leachable Major Cations							
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093C)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**08-Jul-2022**	**11-Jul-2022**	05-Aug-2022	✓	**11-Jul-2022**	05-Aug-2022	✓
ED093W: Water Leachable Major Cations							
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093W)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**08-Jul-2022**	**11-Jul-2022**	05-Aug-2022	✓	**11-Jul-2022**	05-Aug-2022	✓
EG005(ED093)C: Leachable Metals by ICPAES							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**08-Jul-2022**	**11-Jul-2022**	04-Jan-2023	✓	**11-Jul-2022**	04-Jan-2023	✓
EG005(ED093)W: Water Leachable Metals by ICPAES							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005W)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**08-Jul-2022**	**11-Jul-2022**	04-Jan-2023	✓	**11-Jul-2022**	04-Jan-2023	✓
EG035C: Leachable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)							
ANG-22-0053, ANG-22-0054, ANG-22-0055, ANG-22-0055_DUP, ANG-22-0056, ANG-22-0057, ANG-22-0058	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	05-Aug-2022	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035W: Water Leachable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035W)								
ANG-22-0053,	ANG-22-0054,	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	05-Aug-2022	✓
ANG-22-0055,	ANG-22-0055_DUP,							
ANG-22-0056,	ANG-22-0057,							
ANG-22-0058								
EK040P: Fluoride by PC Titrator								
Clear Plastic Bottle - Natural (EK040P)								
ANG-22-0053,	ANG-22-0054,	**08-Jul-2022**	**----**	----	----	**11-Jul-2022**	05-Aug-2022	✓
ANG-22-0055,	ANG-22-0055_DUP,							
ANG-22-0056,	ANG-22-0057,							
ANG-22-0058,	ANG-22-0053,							
ANG-22-0054,	ANG-22-0055,							
ANG-22-0055_DUP,	ANG-22-0056,							
ANG-22-0057,	ANG-22-0058							

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity in Soil	ED037	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	3	19	**15.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity in Soil	ED037	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Cations - soluble by ICP-AES	ED093S	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Deionised Water Leach - Plastic Leaching Vessel	EN60-Dla-P	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride Soluble By Discrete Analyser	ED045G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Matrix Spikes (MS) - Continued							
Total Mercury by FIMS	EG035T	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Water Leachable Major Cations	ED093W	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
pH (1:5) on 40°C dried soil	EA002-AD	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on 40°C dried soil after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3)
pH by Auto Titrator	EA005-P	SOIL	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples dried at 40°C using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Conductivity by Auto Titrator	EA010-P	SOIL	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Soluble Salts	EA014	SOIL	In house: The concentration of Total Soluble Salts in a soil is calculated from the Electrical conductivity of a water extract. This method is compliant with NEPM Schedule B(3).
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Alkalinity in Soil	ED037	SOIL	In house: Referenced to APHA 2320 B Alkalinity is determined and reported on a 1:5 soil/water leach.
Alkalinity by Auto Titrator	ED037-P	SOIL	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate - Calcium Phosphate Soluble	ED040N	SOIL	In house: The sample is extracted with a calcium phosphate solution. The phosphate ion displaces the adsorbed sulfate while calcium ions depress the extraction of interfering S from soil organic matter. SO4 in the extract is determined by ICPAES and reported as dry weight in the original soil. This method is compliant with NEPM Schedule B(3).

Analytical Methods	Method	Matrix	Method Descriptions
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	SOIL	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
Leachable Major Cations	ED093C	SOIL	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations in leachates are determined by either ICP-AES or ICP-MS techniques.
Cations - soluble by ICP-AES	ED093S	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3).
Water Leachable Major Cations	ED093W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010; ALS QWI-EN/EG005, QWI-EN/ED093. The ICPAES technique quickly breaks the sample down into atoms and ions under extremely hot plasma. Atoms are then ionised, emitting a characteristic spectrum. The spectrometer then separates the wavelengths, prior to comparison of intensities against matrix matched standards for quantification.
Leachable Metals by ICPAES	EG005C	SOIL	In house: referenced to APHA 3120; USEPA SW 846 - 6010: The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Water Leachable Metals by ICPAES	EG005W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Leachable Mercury by FIMS	EG035C	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Water Leachable Mercury by FIMS	EG035W	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by Auto Titrator	EK040P	SOIL	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method (Alkaline Soils)	ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Calcium Phosphate Extraction for Sulphate as SO4 2-	ED040NPR	SOIL	The sample is extracted with a calcium phosphate solution. The phosphate ion displaces the adsorbed sulphate while calcium ions depress the extraction of interfering S from soil organic matter. SO4 in the extract is determined by ICPAES and reported as dry weight in the original soil. This method is compliant with NEPM Schedule B(3).
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
Digestion for Total Recoverable Metals in DI Water Leachate	EN25W	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
1:5 solid / water leach following drying at 40°C	EN34-AD	SOIL	10 g of 40°C dried soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes - Plastic Leaching Vessel	EN60a-P	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates.
Deionised Water Leach - Plastic Leaching Vessel	EN60-DIa-P	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM2221404**	Page	: 1 of 16
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +6138549 9645
Project	: Anglesea Ash Risk Assessment C03568	Date Samples Received	: 04-Jul-2022 06:28
Order number	: 7293974	Date Analysis Commenced	: 02-Nov-2022
C-O-C number	: ----	Issue Date	: 07-Nov-2022 17:52
Sampler	: ANDREW MINARD, CLARE HOGAN		
Site	: Anglesea		
Quote number	: ME/260/22 V3		
No. of samples received	: 12		
No. of samples analysed	: 12		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- EG035W: EM2221404#8 Poor matrix spike recovery for water leachable mercury due to sample matrix. Confirmed by re-extraction and re-analysis.
- EN60-DIa-G: EM2221404 Due to limited sample for leach analysis, a scaled down amount of 50g into 1000mL was used for samples #1/7 & 6/12.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: **ASLP LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
					EM2221404-001	EM2221404-002	EM2221404-003	EM2221404-004	EM2221404-005
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**3.54**	**2.97**	**3.11**	**3.13**	**3.20**
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**880**	**503**	**512**	**518**	**480**
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		<1	<1	<1	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L		<1	<1	<1	<1	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**111**	**1**	**15**	**29**	**7**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**11**	**9**	**12**	**6**	**5**
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.4**	<0.1	**0.1**	**0.2**	**0.3**

Analytical Results

Sub-Matrix: ASLP LEACHATE (Matrix: WATER)				Sample ID	ANG-22-0103	----	----	----	----
				Sampling date / time	04-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2221404-006	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**2.68**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1440**	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		<1	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		<1	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**391**	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**12**	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	----	----	----	----

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
					EM2221404-007	EM2221404-008	EM2221404-009	EM2221404-010	EM2221404-011
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		5.99	5.96	6.08	5.20	6.05
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		444	113	168	140	130
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		7	6	5	<1	7
Total Alkalinity as CaCO3	----	1	mg/L		7	6	5	<1	7
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		152	12	83	45	106
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		16	15	51	11	78
ED093W: Water Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		24	<1	4	10	3
Magnesium	7439-95-4	1	mg/L		14	3	7	6	5
Sodium	7440-23-5	1	mg/L		18	7	16	5	11
Potassium	7440-09-7	1	mg/L		2	2	4	2	3
EG035W: Water Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	0.0001	0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		0.4	0.3	0.4	0.2	0.3
EG005(ED093)W: Water Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.10	mg/L		2.76	30.6	40.8	11.6	52.6
Antimony	7440-36-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	7440-38-2	0.01	mg/L		<0.01	<0.01	0.03	<0.01	0.04
Barium	7440-39-3	0.1	mg/L		0.2	0.1	0.4	0.3	0.3
Beryllium	7440-41-7	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.02
Boron	7440-42-8	0.1	mg/L		1.2	<0.1	<0.1	0.4	<0.1
Cadmium	7440-43-9	0.005	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	7440-47-3	0.01	mg/L		0.04	0.16	0.12	0.02	0.11
Cobalt	7440-48-4	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.01
Copper	7440-50-8	0.01	mg/L		<0.01	<0.01	0.03	<0.01	0.04
Iron	7439-89-6	0.05	mg/L		2.09	49.9	37.1	7.42	28.8
Lead	7439-92-1	0.01	mg/L		<0.01	0.02	0.04	<0.01	0.04

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
					EM2221404-007	EM2221404-008	EM2221404-009	EM2221404-010	EM2221404-011
					Result	Result	Result	Result	Result
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Manganese	7439-96-5	0.01	mg/L		**0.02**	<0.01	**1.67**	**1.10**	**0.82**
Nickel	7440-02-0	0.01	mg/L		<0.01	<0.01	**0.02**	**0.01**	**0.06**
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.01	mg/L		**0.03**	**0.05**	**0.04**	**0.02**	**0.06**
Molybdenum	7439-98-7	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-22-0103	----	----	----	----
				Sampling date / time	04-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2221404-012	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**2.86**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1060**	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		<1	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		<1	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**302**	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**9**	----	----	----	----
ED093W: Water Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		**11**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**14**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**14**	----	----	----	----
Potassium	7440-09-7	1	mg/L		<1	----	----	----	----
EG035W: Water Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	----	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.10	mg/L		**18.2**	----	----	----	----
Antimony	7440-36-0	0.01	mg/L		<0.01	----	----	----	----
Arsenic	7440-38-2	0.01	mg/L		<0.01	----	----	----	----
Barium	7440-39-3	0.1	mg/L		<0.1	----	----	----	----
Beryllium	7440-41-7	0.01	mg/L		<0.01	----	----	----	----
Boron	7440-42-8	0.1	mg/L		**0.8**	----	----	----	----
Cadmium	7440-43-9	0.005	mg/L		<0.005	----	----	----	----
Chromium	7440-47-3	0.01	mg/L		<0.01	----	----	----	----
Cobalt	7440-48-4	0.01	mg/L		**0.10**	----	----	----	----
Copper	7440-50-8	0.01	mg/L		<0.01	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.82**	----	----	----	----
Lead	7439-92-1	0.01	mg/L		<0.01	----	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)				Sample ID	ANG-22-0103	----	----	----	----
				Sampling date / time	04-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2221404-012	--------	--------	--------	--------
					Result	----	----	----	----
EG005(ED093)W: Water Leachable Metals by ICPAES - Continued									
Manganese	7439-96-5	0.01	mg/L		**0.75**	----	----	----	----
Nickel	7440-02-0	0.01	mg/L		**0.11**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.01	mg/L		**0.37**	----	----	----	----
Molybdenum	7439-98-7	0.01	mg/L		<0.01	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
			Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2221404-001	EM2221404-002	EM2221404-003	EM2221404-004	EM2221404-005
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	7.7	5.8	4.0	4.0	3.8
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	7.6	7.5	5.2	5.0	5.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1630	142	363	502	163
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	1600	154	370	405	277
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	5540	482	1230	1710	554
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	12.4	10.8	16.7	15.4	36.4
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	4.6	<0.2	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	5.5	<0.2	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	1.3	0.3	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	11.6	0.3	----	----	----
ø Exchangeable Calcium Percent	----	0.2	%	40.1	<0.2	----	----	----
ø Exchangeable Magnesium Percent	----	0.2	%	47.5	<0.2	----	----	----
ø Exchangeable Potassium Percent	----	0.2	%	1.2	<0.2	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	11.2	100	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	<0.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	0.8	----	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	<0.2	<0.2	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	1.6
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	3.4
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	0.1
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	2.3
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	12.6
Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	31.2
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	0.8	2.8	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	2.6	1.0	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
			Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2221404-001	EM2221404-002	EM2221404-003	EM2221404-004	EM2221404-005
				Result	Result	Result	Result	Result
ED008: Exchangeable Cations - Continued								
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.2	<0.1	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	0.8	<0.1	----
Exchangeable Sodium Percent	----	0.1	%	----	----	16.6	1.6	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	4.7	4.0	----
ED037: Alkalinity								
Hydroxide Alkalinity as CaCO3	DMO-210-001	5	mg/kg	<5	<5	<5	<5	<5
Carbonate Alkalinity as CaCO3	3812-32-6	5	mg/kg	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO3	71-52-3	5	mg/kg	155	10	17	<5	38
Total Alkalinity as CaCO3	----	5	mg/kg	155	10	17	<5	38
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	2370	120	260	700	240
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	160	140	270	90	530
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	830	<10	<10	200	<10
Magnesium	7439-95-4	10	mg/kg	470	<10	<10	100	<10
Sodium	7440-23-5	10	mg/kg	420	140	360	140	190
Potassium	7440-09-7	10	mg/kg	30	<10	<10	40	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6120	2760	5470	1700	10000
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	8	<5	5	<5	16
Barium	7440-39-3	10	mg/kg	280	<10	50	50	90
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	5
Boron	7440-42-8	50	mg/kg	50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	19	12	14	5	23
Cobalt	7440-48-4	2	mg/kg	4	<2	<2	<2	2
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	6
Iron	7439-89-6	50	mg/kg	15000	3930	6690	2490	23700
Lead	7439-92-1	5	mg/kg	7	<5	6	<5	6
Manganese	7439-96-5	5	mg/kg	21	<5	10	<5	8
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	7	<2	3	<2	13

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
Compound	CAS Number	LOR	Unit		EM2221404-001	EM2221404-002	EM2221404-003	EM2221404-004	EM2221404-005
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Selenium	7782-49-2	5	mg/kg		<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg		**8**	<5	**5**	<5	**12**
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		**0.1**	<0.1	<0.1	<0.1	**0.1**
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		**120**	**60**	**160**	**50**	**80**
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)									
Extraction Fluid pH	----	0.1	pH Unit		**2.9**	**2.9**	**2.9**	**2.9**	**2.9**
Final pH	----	0.1	pH Unit		**3.6**	**3.0**	**3.1**	**3.2**	**3.2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0103	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052
			Sampling date / time	04-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00
Compound	CAS Number	LOR	Unit	EM2221404-006	EM2221404-007	EM2221404-008	EM2221404-009	EM2221404-010
				Result	Result	Result	Result	Result
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	**4.0**	----	----	----	----
EA002-AD: pH (Soils) dried at 40°C								
pH Value	----	0.1	pH Unit	**2.4**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**369**	----	----	----	----
EA010-AD: Conductivity (Soils) dried at 40°C								
Electrical Conductivity @ 25°C	----	1	µS/cm	**4310**	----	----	----	----
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	**1250**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**42.6**	----	----	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**2.1**	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	**0.6**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	**0.2**	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	**1.2**	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	**15.7**	----	----	----	----
ED037: Alkalinity								
Hydroxide Alkalinity as CaCO3	DMO-210-001	5	mg/kg	<5	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	5	mg/kg	<5	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	5	mg/kg	<5	----	----	----	----
Total Alkalinity as CaCO3	----	5	mg/kg	<5	----	----	----	----
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)								
Sulfate as SO4 2-	14808-79-8	50	mg/kg	**13000**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**110**	----	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	**190**	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	**70**	----	----	----	----
Sodium	7440-23-5	10	mg/kg	**190**	----	----	----	----
Potassium	7440-09-7	10	mg/kg	**40**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	ANG-22-0103	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052
				Sampling date / time	04-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00
Compound	CAS Number	LOR	Unit		EM2221404-006	EM2221404-007	EM2221404-008	EM2221404-009	EM2221404-010
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Aluminium	7429-90-5	50	mg/kg		**4260**	----	----	----	----
Antimony	7440-36-0	5	mg/kg		<5	----	----	----	----
Arsenic	7440-38-2	5	mg/kg		<5	----	----	----	----
Barium	7440-39-3	10	mg/kg		**130**	----	----	----	----
Beryllium	7440-41-7	1	mg/kg		<1	----	----	----	----
Boron	7440-42-8	50	mg/kg		<50	----	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg		**4**	----	----	----	----
Cobalt	7440-48-4	2	mg/kg		**7**	----	----	----	----
Copper	7440-50-8	5	mg/kg		<5	----	----	----	----
Iron	7439-89-6	50	mg/kg		**5780**	----	----	----	----
Lead	7439-92-1	5	mg/kg		<5	----	----	----	----
Manganese	7439-96-5	5	mg/kg		<5	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg		<2	----	----	----	----
Nickel	7440-02-0	2	mg/kg		**15**	----	----	----	----
Selenium	7782-49-2	5	mg/kg		<5	----	----	----	----
Zinc	7440-66-6	5	mg/kg		**20**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	----	----
EK040T: Fluoride Total									
Fluoride	16984-48-8	40	mg/kg		<40	----	----	----	----
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)									
Extraction Fluid pH	----	0.1	pH Unit		**2.9**	----	----	----	----
Final pH	----	0.1	pH Unit		**2.7**	----	----	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)									
Final pH	----	0.1	pH Unit		**----**	**7.9**	**7.8**	**6.4**	**5.8**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ANG-22-0031	ANG-22-0103	----	----	----
			Sampling date / time	04-Jul-2022 00:00	04-Jul-2022 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EM2221404-011	EM2221404-012	--------	--------	--------
				Result	Result	----	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)								
Final pH	----	0.1	pH Unit	**5.8**	**2.9**	----	----	----

Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	ANG-22-0026	ANG-22-0028	ANG-22-0050	ANG-22-0052	ANG-22-0031
				Sampling date / time	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	01-Jul-2022 00:00	04-Jul-2022 00:00
					EM2221404-001	EM2221404-002	EM2221404-003	EM2221404-004	EM2221404-005
					Result	Result	Result	Result	Result
ED093C: Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		**63**	<1	**5**	**24**	**7**
Magnesium	7439-95-4	1	mg/L		**48**	**2**	**9**	**7**	**10**
Sodium	7440-23-5	1	mg/L		**28**	**11**	**21**	**7**	**16**
Potassium	7440-09-7	1	mg/L		**4**	<1	**2**	**2**	**1**
EG005(ED093)C: Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.1	mg/L		**4.4**	**0.2**	**1.4**	**3.3**	**5.2**
Antimony	7440-36-0	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	7440-38-2	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Barium	7440-39-3	0.1	mg/L		**0.2**	<0.1	**0.1**	**0.2**	**0.2**
Beryllium	7440-41-7	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Boron	7440-42-8	0.1	mg/L		**2.2**	**0.3**	**0.2**	**0.3**	<0.1
Cadmium	7440-43-9	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	7440-47-3	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	7440-48-4	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Copper	7440-50-8	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Iron	7439-89-6	0.1	mg/L		**0.5**	**0.1**	**0.4**	**0.4**	**0.4**
Lead	7439-92-1	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	7439-96-5	0.1	mg/L		**0.3**	<0.1	<0.1	<0.1	<0.1
Nickel	7440-02-0	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	7782-49-2	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	7440-66-6	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	7439-98-7	0.1	mg/L		<0.1	<0.1	<0.1	<0.1	<0.1
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	ANG-22-0103	----	----	----	----
				Sampling date / time	04-Jul-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EM2221404-006	--------	--------	--------	--------
					Result	----	----	----	----
ED093C: Leachable Major Cations									
Calcium	7440-70-2	1	mg/L		**13**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**14**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**20**	----	----	----	----
Potassium	7440-09-7	1	mg/L		<1	----	----	----	----
EG005(ED093)C: Leachable Metals by ICPAES									
Aluminium	7429-90-5	0.1	mg/L		**31.9**	----	----	----	----
Antimony	7440-36-0	0.1	mg/L		<0.1	----	----	----	----
Arsenic	7440-38-2	0.1	mg/L		<0.1	----	----	----	----
Barium	7440-39-3	0.1	mg/L		<0.1	----	----	----	----
Beryllium	7440-41-7	0.05	mg/L		<0.05	----	----	----	----
Boron	7440-42-8	0.1	mg/L		**0.8**	----	----	----	----
Cadmium	7440-43-9	0.05	mg/L		<0.05	----	----	----	----
Chromium	7440-47-3	0.1	mg/L		<0.1	----	----	----	----
Cobalt	7440-48-4	0.1	mg/L		**0.1**	----	----	----	----
Copper	7440-50-8	0.1	mg/L		<0.1	----	----	----	----
Iron	7439-89-6	0.1	mg/L		**1.4**	----	----	----	----
Lead	7439-92-1	0.1	mg/L		<0.1	----	----	----	----
Manganese	7439-96-5	0.1	mg/L		**0.2**	----	----	----	----
Nickel	7440-02-0	0.1	mg/L		**0.1**	----	----	----	----
Selenium	7782-49-2	0.05	mg/L		<0.05	----	----	----	----
Zinc	7440-66-6	0.1	mg/L		**0.4**	----	----	----	----
Molybdenum	7439-98-7	0.1	mg/L		<0.1	----	----	----	----
EG035C: Leachable Mercury by FIMS									
Mercury	7439-97-6	0.0010	mg/L		<0.0010	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EM2221404**	Page	: 1 of 12
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Contact	: Peter Ravlic
Address	: POINT HENRY WORKS P.O.BOX 460 GEELONG VIC, AUSTRALIA 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +6138549 9645
Project	: Anglesea Ash Risk Assessment C03568	Date Samples Received	: 04-Jul-2022
Order number	: 7293974	Date Analysis Commenced	: 02-Nov-2022
C-O-C number	: ----	Issue Date	: 07-Nov-2022
Sampler	: ANDREW MINARD, CLARE HOGAN		
Site	: Anglesea		
Quote number	: ME/260/22 V3		
No. of samples received	: 12		
No. of samples analysed	: 12		

Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Eric Chau	Metals Team Leader	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 4677274)									
EM2221404-001	ANG-22-0026	EG005T: Barium	7440-39-3	10	mg/kg	280	300	7.9	0% - 20%
		EG005T: Aluminium	7429-90-5	50	mg/kg	6120	6570	7.1	0% - 20%
		EG005T: Iron	7439-89-6	50	mg/kg	15000	16200	7.8	0% - 20%
EM2221404-001	ANG-22-0026	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	19	16	15.2	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	4	5	30.1	No Limit
		EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	7	9	34.5	No Limit
		EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	8	6	15.6	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	<5	8	43.8	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	7	5	25.5	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	21	33	44.2	No Limit
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	8	13	47.6	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	50	70	31.3	No Limit
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 4677261)									
EM2221404-001	ANG-22-0026	EA001: pH (CaCl2)	----	0.1	pH Unit	7.7	7.7	0.0	0% - 20%
EA002-AD: pH (Soils) dried at 40°C (QC Lot: 4677255)									
EM2221404-001	ANG-22-0026	EA002-AD: pH Value	----	0.1	pH Unit	7.6	7.6	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 4677257)									
EM2221404-001	ANG-22-0026	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	1630	1590	2.5	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA010-AD: Conductivity (Soils) dried at 40°C (QC Lot: 4677256)									
EM2221404-001	ANG-22-0026	EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	1600	1580	0.9	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 4677232)									
EM2221404-001	ANG-22-0026	EA055: Moisture Content	----	0.1	%	12.4	12.7	2.6	0% - 50%
ED006: Exchangeable Cations on Alkaline Soils (QC Lot: 4677265)									
EM2221404-001	ANG-22-0026	ED006: Calcium/Magnesium Ratio	----	0.1	-	0.8	0.8	0.0	No Limit
		ED006: Magnesium/Potassium Ratio	----	0.1	-	<0.2	<0.2	0.0	No Limit
		ED006: Exchangeable Calcium Percent	----	0.2	%	40.1	40.8	1.7	0% - 20%
		ED006: Exchangeable Magnesium Percent	----	0.2	%	47.5	48.2	1.5	0% - 20%
		ED006: Exchangeable Potassium Percent	----	0.2	%	1.2	<0.2	143	No Limit
		ED006: Exchangeable Sodium Percent	----	0.2	%	11.2	11.0	1.9	0% - 20%
		ED006: Exchangeable Calcium	----	0.2	meq/100g	4.6	4.4	5.1	0% - 20%
		ED006: Exchangeable Magnesium	----	0.2	meq/100g	5.5	5.2	5.3	0% - 20%
		ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	0.0	No Limit
		ED006: Exchangeable Sodium	----	0.2	meq/100g	1.3	1.2	8.7	No Limit
		ED006: Cation Exchange Capacity	----	0.2	meq/100g	11.6	10.8	6.8	0% - 20%
ED007: Exchangeable Cations (QC Lot: 4677264)									
EM2221404-005	ANG-22-0031	ED007: Exchangeable Sodium Percent	----	0.1	%	31.2	31.3	0.4	0% - 20%
		ED007: Exchangeable Calcium	----	0.1	meq/100g	1.6	1.6	0.0	0% - 50%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	3.4	3.4	0.0	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.1	0.1	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	2.3	2.3	0.0	0% - 20%
		ED007: Cation Exchange Capacity	----	0.1	meq/100g	12.6	12.6	0.0	0% - 20%
ED008: Exchangeable Cations (QC Lot: 4685451)									
EM2221404-003	ANG-22-0050	ED008: Exchangeable Sodium Percent	----	0.1	%	16.6	16.6	0.0	0% - 20%
		ED008: Exchangeable Calcium	----	0.1	meq/100g	0.8	0.8	0.0	No Limit
		ED008: Exchangeable Magnesium	----	0.1	meq/100g	2.6	2.6	0.0	0% - 20%
		ED008: Exchangeable Potassium	----	0.1	meq/100g	0.2	0.2	0.0	No Limit
		ED008: Exchangeable Sodium	----	0.1	meq/100g	0.8	0.8	0.0	No Limit
		ED008: Cation Exchange Capacity	----	0.1	meq/100g	4.7	4.8	0.0	0% - 20%
ED037: Alkalinity (QC Lot: 4677258)									
EM2221404-001	ANG-22-0026	ED037: Total Alkalinity as CaCO3	----	5	mg/kg	155	160	3.5	0% - 20%
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QC Lot: 4677667)									
EM2221401-001	Anonymous	ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	170	160	11.3	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 4677259)									
EM2221404-001	ANG-22-0026	ED045G: Chloride	16887-00-6	10	mg/kg	160	160	0.0	0% - 50%
ED093S: Soluble Major Cations (QC Lot: 4677260)									
EM2221404-001	ANG-22-0026	ED093S: Calcium	7440-70-2	10	mg/kg	830	800	3.9	0% - 20%
		ED093S: Magnesium	7439-95-4	10	mg/kg	470	460	2.2	0% - 20%
		ED093S: Sodium	7440-23-5	10	mg/kg	420	420	0.0	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED093S: Soluble Major Cations (QC Lot: 4677260) - continued									
EM2221404-001	ANG-22-0026	ED093S: Potassium	7440-09-7	10	mg/kg	30	30	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 4677273)									
EM2221404-001	ANG-22-0026	EG035T: Mercury	7439-97-6	0.1	mg/kg	0.1	0.2	0.0	No Limit
EK040T: Fluoride Total (QC Lot: 4677262)									
EM2221404-001	ANG-22-0026	EK040T: Fluoride	16984-48-8	40	mg/kg	120	140	14.2	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)C: Leachable Metals by ICPAES (QC Lot: 4681590)									
EM2221404-001	ANG-22-0026	EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	<0.05	0.0	No Limit
		EG005C: Aluminium	7429-90-5	0.1	mg/L	4.4	4.4	0.0	0% - 20%
		EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Barium	7440-39-3	0.1	mg/L	0.2	0.2	0.0	No Limit
		EG005C: Boron	7440-42-8	0.1	mg/L	2.2	2.2	0.0	0% - 20%
		EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Iron	7439-89-6	0.1	mg/L	0.5	0.5	0.0	No Limit
		EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Manganese	7439-96-5	0.1	mg/L	0.3	0.3	0.0	No Limit
		EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	<0.1	0.0	No Limit
		EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EG005(ED093)W: Water Leachable Metals by ICPAES. (QC Lot: 4680577)									
EM2221404-007	ANG-22-0026	EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Chromium	7440-47-3	0.01	mg/L	0.04	0.03	37.2	No Limit
		EG005W: Cobalt	7440-48-4	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Copper	7440-50-8	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Lead	7439-92-1	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Manganese	7439-96-5	0.01	mg/L	0.02	0.01	0.0	No Limit
		EG005W: Nickel	7440-02-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG005W: Zinc	7440-66-6	0.01	mg/L	0.03	0.02	0.0	No Limit
		EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)W: Water Leachable Metals by ICPAES. (QC Lot: 4680577) - continued									
EM2221404-007	ANG-22-0026	EG005W: Iron	7439-89-6	0.05	mg/L	2.09	1.88	10.4	0% - 20%
		EG005W: Aluminium	7429-90-5	0.1	mg/L	2.76	2.44	12.3	0% - 20%
		EG005W: Barium	7440-39-3	0.1	mg/L	0.2	0.1	0.0	No Limit
		EG005W: Boron	7440-42-8	0.1	mg/L	1.2	1.1	0.0	0% - 50%
EA005P: pH by PC Titrator (QC Lot: 4680689)									
EM2221404-002	ANG-22-0028	EA005-P: pH Value	----	0.01	pH Unit	2.97	2.97	0.0	0% - 20%
EM2221404-012	ANG-22-0103	EA005-P: pH Value	----	0.01	pH Unit	2.86	2.84	0.7	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 4680688)									
EM2221404-002	ANG-22-0028	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	503	506	0.8	0% - 20%
EM2221404-012	ANG-22-0103	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	1060	1090	2.5	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 4680687)									
EM2221404-002	ANG-22-0028	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
EM2221404-012	ANG-22-0103	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	<1	<1	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4683919)									
EM2221404-001	ANG-22-0026	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	111	112	0.9	0% - 20%
EM2221404-010	ANG-22-0052	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	45	45	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 4683920)									
EM2221404-001	ANG-22-0026	ED045G: Chloride	16887-00-6	1	mg/L	11	11	0.0	0% - 50%
EM2221404-010	ANG-22-0052	ED045G: Chloride	16887-00-6	1	mg/L	11	11	0.0	0% - 50%
ED093C: Leachable Major Cations (QC Lot: 4681589)									
EM2221404-001	ANG-22-0026	ED093C: Calcium	7440-70-2	1	mg/L	63	62	0.0	0% - 20%
		ED093C: Magnesium	7439-95-4	1	mg/L	48	48	0.0	0% - 20%
		ED093C: Sodium	7440-23-5	1	mg/L	28	28	0.0	0% - 20%
		ED093C: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
ED093W: Water Leachable Major Cations (QC Lot: 4680578)									
EM2221404-007	ANG-22-0026	ED093W: Calcium	7440-70-2	1	mg/L	24	24	0.0	0% - 20%
		ED093W: Magnesium	7439-95-4	1	mg/L	14	14	0.0	0% - 50%
		ED093W: Sodium	7440-23-5	1	mg/L	18	18	0.0	0% - 50%
		ED093W: Potassium	7440-09-7	1	mg/L	2	2	0.0	No Limit
EG035C: Leachable Mercury by FIMS (QC Lot: 4680769)									
EM2221404-001	ANG-22-0026	EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0010	<0.0010	0.0	No Limit
EG035W: Water Leachable Mercury by FIMS (QC Lot: 4680770)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG035W: Water Leachable Mercury by FIMS (QC Lot: 4680770) - continued									
EM2221404-007	ANG-22-0026	EG035W: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 4680690)									
EM2221404-002	ANG-22-0028	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.0	No Limit
EM2221404-012	ANG-22-0103	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 4677274)								
EG005T: Aluminium	7429-90-5	50	mg/kg	<50	15910 mg/kg	103	70.0	130
EG005T: Antimony	7440-36-0	5	mg/kg	<5	2.57 mg/kg	92.4	70.0	130
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	123 mg/kg	92.9	70.0	130
EG005T: Barium	7440-39-3	10	mg/kg	<10	99.3 mg/kg	88.0	70.0	130
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	0.67 mg/kg	93.4	70.0	130
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	1.23 mg/kg	84.1	50.0	130
EG005T: Chromium	7440-47-3	2	mg/kg	<2	20.2 mg/kg	94.2	70.0	130
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	11.2 mg/kg	82.4	70.0	130
EG005T: Copper	7440-50-8	5	mg/kg	<5	55.9 mg/kg	85.6	70.0	130
EG005T: Iron	7439-89-6	50	mg/kg	<50	33227 mg/kg	92.9	70.0	130
EG005T: Lead	7439-92-1	5	mg/kg	<5	62.4 mg/kg	81.9	70.0	130
EG005T: Manganese	7439-96-5	5	mg/kg	<5	590 mg/kg	81.3	70.0	130
EG005T: Molybdenum	7439-98-7	2	mg/kg	<2	2.19 mg/kg	76.0	70.0	130
EG005T: Nickel	7440-02-0	2	mg/kg	<2	15.4 mg/kg	88.4	70.0	130
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Zinc	7440-66-6	5	mg/kg	<5	162 mg/kg	71.1	70.0	130
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel) (QCLot: 4679007)								
EN60-DIa-G: Final pH	----	0.1	pH Unit	7.0	----	----	----	----
EA001: pH in soil using 0.01M CaCl extract (QCLot: 4677261)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	101	98.8	101
				----	7 pH Unit	99.6	99.3	101
EA002-AD: pH (Soils) dried at 40°C (QCLot: 4677255)								
EA002-AD: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.8	101
				----	7 pH Unit	100	99.3	101
EA010: Conductivity (1:5) (QCLot: 4677257)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	99.9	94.5	105
EA010-AD: Conductivity (Soils) dried at 40°C (QCLot: 4677256)								
EA010-AD: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	102	90.0	110
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 4677265)								
ED006: Exchangeable Calcium	----	0.2	meq/100g	<0.2	33 meq/100g	70.0	66.6	101
ED006: Exchangeable Magnesium	----	0.2	meq/100g	<0.2	32 meq/100g	70.8	66.9	120
ED006: Exchangeable Potassium	----	0.2	meq/100g	<0.2	2.2 meq/100g	93.1	72.8	119
ED006: Exchangeable Sodium	----	0.2	meq/100g	<0.2	5.6 meq/100g	81.4	67.5	112

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
ED006: Exchangeable Cations on Alkaline Soils (QCLot: 4677265) - continued								
ED006: Cation Exchange Capacity	----	0.2	meq/100g	<0.2	----	----	----	----
ED006: Exchangeable Calcium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Magnesium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Potassium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Exchangeable Sodium Percent	----	0.2	%	<0.2	----	----	----	----
ED006: Calcium/Magnesium Ratio	----	0.1	-	<0.1	----	----	----	----
ED006: Magnesium/Potassium Ratio	----	0.1	-	<0.1	----	----	----	----
ED007: Exchangeable Cations (QCLot: 4677264)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.13 meq/100g	87.7	80.0	130
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.96 meq/100g	103	72.2	130
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.01 meq/100g	102	77.4	130
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.86 meq/100g	128	89.2	130
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED008: Exchangeable Cations (QCLot: 4677263)								
ED008: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.44 meq/100g	91.5	70.0	130
ED008: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.65 meq/100g	95.4	70.0	130
ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.83 meq/100g	110	83.4	130
ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.31 meq/100g	109	85.2	130
ED008: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED008: Exchangeable Cations (QCLot: 4685451)								
ED008: Exchangeable Calcium	----	0.1	meq/100g	<0.1	24.44 meq/100g	90.8	70.0	130
ED008: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.65 meq/100g	94.4	70.0	130
ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.83 meq/100g	110	83.4	130
ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	0.31 meq/100g	108	85.2	130
ED008: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	----	----	----	----
ED037: Alkalinity (QCLot: 4677258)								
ED037: Total Alkalinity as CaCO3	----	----	mg/kg	----	1000 mg/kg	104	89.5	108
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QCLot: 4677667)								
ED040N: Sulfate as SO4 2-	14808-79-8	50	mg/kg	<50	3000 mg/kg	104	86.1	116
ED045G: Chloride by Discrete Analyser (QCLot: 4677259)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	102	85.5	120
				<10	5000 mg/kg	106	85.5	120
ED093S: Soluble Major Cations (QCLot: 4677260)								
ED093S: Calcium	7440-70-2	10	mg/kg	<10	250 mg/kg	97.7	80.0	120
ED093S: Magnesium	7439-95-4	10	mg/kg	<10	250 mg/kg	93.4	80.0	120
ED093S: Sodium	7440-23-5	10	mg/kg	<10	250 mg/kg	98.6	80.0	120
ED093S: Potassium	7440-09-7	10	mg/kg	<10	250 mg/kg	92.9	80.0	120
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4677273)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4677273) - continued								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.64 mg/kg	87.5	70.0	130
EK040T: Fluoride Total (QCLot: 4677262)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	400 mg/kg	81.5	75.2	110

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 4681590)								
EG005C: Aluminium	7429-90-5	0.1	mg/L	<0.1	5 mg/L	109	80.0	120
EG005C: Antimony	7440-36-0	0.1	mg/L	<0.1	0.2 mg/L	120	80.0	120
EG005C: Arsenic	7440-38-2	0.1	mg/L	<0.1	1 mg/L	112	80.0	120
EG005C: Barium	7440-39-3	0.1	mg/L	<0.1	1 mg/L	98.7	80.0	120
EG005C: Beryllium	7440-41-7	0.05	mg/L	<0.05	1 mg/L	112	80.0	120
EG005C: Boron	7440-42-8	0.1	mg/L	<0.1	5 mg/L	112	80.0	120
EG005C: Cadmium	7440-43-9	0.05	mg/L	<0.05	1 mg/L	99.0	80.0	120
EG005C: Chromium	7440-47-3	0.1	mg/L	<0.1	1 mg/L	103	80.0	120
EG005C: Cobalt	7440-48-4	0.1	mg/L	<0.1	1 mg/L	101	80.0	120
EG005C: Copper	7440-50-8	0.1	mg/L	<0.1	1 mg/L	113	80.0	120
EG005C: Iron	7439-89-6	0.1	mg/L	<0.1	5 mg/L	103	80.0	120
EG005C: Lead	7439-92-1	0.1	mg/L	<0.1	1 mg/L	97.3	80.0	120
EG005C: Manganese	7439-96-5	0.1	mg/L	<0.1	1 mg/L	95.9	80.0	120
EG005C: Nickel	7440-02-0	0.1	mg/L	<0.1	1 mg/L	99.8	80.0	120
EG005C: Selenium	7782-49-2	0.05	mg/L	<0.05	1 mg/L	110	80.0	120
EG005C: Zinc	7440-66-6	0.1	mg/L	<0.1	1 mg/L	95.7	80.0	120
EG005C: Molybdenum	7439-98-7	0.1	mg/L	<0.1	1 mg/L	104	80.0	120
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4680577)								
EG005W: Aluminium	7429-90-5	0.1	mg/L	<0.10	0.5 mg/L	95.9	80.0	120
EG005W: Antimony	7440-36-0	0.01	mg/L	<0.01	0.02 mg/L	109	80.0	120
EG005W: Arsenic	7440-38-2	0.01	mg/L	<0.01	0.1 mg/L	102	80.0	120
EG005W: Barium	7440-39-3	0.1	mg/L	<0.1	0.1 mg/L	86.7	80.0	120
EG005W: Beryllium	7440-41-7	0.01	mg/L	<0.01	0.1 mg/L	106	80.0	120
EG005W: Boron	7440-42-8	0.1	mg/L	<0.1	0.5 mg/L	109	80.0	120
EG005W: Cadmium	7440-43-9	0.005	mg/L	<0.005	0.1 mg/L	97.7	80.0	120
EG005W: Chromium	7440-47-3	0.01	mg/L	<0.01	0.1 mg/L	107	80.0	120
EG005W: Cobalt	7440-48-4	0.01	mg/L	<0.01	0.1 mg/L	96.5	80.0	120
EG005W: Copper	7440-50-8	0.01	mg/L	<0.01	0.1 mg/L	95.7	80.0	120
EG005W: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	108	80.0	120
EG005W: Lead	7439-92-1	0.01	mg/L	<0.01	0.1 mg/L	92.7	80.0	120
EG005W: Manganese	7439-96-5	0.01	mg/L	<0.01	0.1 mg/L	93.5	80.0	120

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4680577) - continued								
EG005W: Nickel	7440-02-0	0.01	mg/L	<0.01	0.1 mg/L	97.8	80.0	120
EG005W: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	89.9	80.0	120
EG005W: Zinc	7440-66-6	0.01	mg/L	<0.01	0.1 mg/L	116	80.0	120
EG005W: Molybdenum	7439-98-7	0.01	mg/L	<0.01	0.1 mg/L	108	80.0	120
EA005P: pH by PC Titrator (QCLot: 4680689)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.8	101
				----	7 pH Unit	101	99.3	101
EA010P: Conductivity by PC Titrator (QCLot: 4680688)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	107	85.0	119
ED037P: Alkalinity by PC Titrator (QCLot: 4680687)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	88.3	85.0	116
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4683919)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	108	85.8	117
				<1	500 mg/L	105	80.0	120
ED045G: Chloride by Discrete Analyser (QCLot: 4683920)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	105	85.0	115
				<1	1000 mg/L	106	85.0	122
ED093C: Leachable Major Cations (QCLot: 4681589)								
ED093C: Calcium	7440-70-2	1	mg/L	<1	500 mg/L	103	80.0	120
ED093C: Magnesium	7439-95-4	1	mg/L	<1	500 mg/L	98.1	80.0	120
ED093C: Sodium	7440-23-5	1	mg/L	<1	500 mg/L	95.0	80.0	120
ED093C: Potassium	7440-09-7	1	mg/L	<1	500 mg/L	81.7	80.0	120
ED093W: Water Leachable Major Cations (QCLot: 4680578)								
ED093W: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	91.5	80.0	120
ED093W: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	92.7	80.0	120
ED093W: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	91.7	80.0	120
ED093W: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	86.9	80.0	120
EG035C: Leachable Mercury by FIMS (QCLot: 4680769)								
EG035C: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	91.0	72.0	115
EG035W: Water Leachable Mercury by FIMS (QCLot: 4680770)								
EG035W: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	86.0	75.6	119
EK040P: Fluoride by PC Titrator (QCLot: 4680690)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	102	80.8	118

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 4677274)							
EM2221404-002	ANG-22-0028	EG005T: Arsenic	7440-38-2	50 mg/kg	90.4	78.0	124
		EG005T: Cadmium	7440-43-9	50 mg/kg	90.9	79.7	116
		EG005T: Chromium	7440-47-3	50 mg/kg	87.3	79.0	121
		EG005T: Copper	7440-50-8	250 mg/kg	91.4	80.0	120
		EG005T: Lead	7439-92-1	250 mg/kg	91.8	80.0	120
		EG005T: Nickel	7440-02-0	50 mg/kg	91.4	78.0	120
		EG005T: Zinc	7440-66-6	250 mg/kg	92.3	80.0	120
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM) (QCLot: 4677667)							
EM2221401-016	Anonymous	ED040N: Sulfate as SO4 2-	14808-79-8	3000 mg/kg	98.5	84.0	116
ED045G: Chloride by Discrete Analyser (QCLot: 4677259)							
EM2221404-002	ANG-22-0028	ED045G: Chloride	16887-00-6	2000 mg/kg	124	93.0	125
EG035T: Total Recoverable Mercury by FIMS (QCLot: 4677273)							
EM2221404-002	ANG-22-0028	EG035T: Mercury	7439-97-6	0.5 mg/kg	99.2	76.0	116
EK040T: Fluoride Total (QCLot: 4677262)							
EM2221404-002	ANG-22-0028	EK040T: Fluoride	16984-48-8	400 mg/kg	78.7	70.0	130

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)C: Leachable Metals by ICPAES (QCLot: 4681590)							
EM2221404-002	ANG-22-0028	EG005C: Arsenic	7440-38-2	1 mg/L	111	80.0	120
		EG005C: Barium	7440-39-3	1 mg/L	98.3	80.0	120
		EG005C: Beryllium	7440-41-7	1 mg/L	115	80.0	120
		EG005C: Cadmium	7440-43-9	0.25 mg/L	109	80.0	120
		EG005C: Chromium	7440-47-3	1 mg/L	107	80.0	120
		EG005C: Cobalt	7440-48-4	1 mg/L	108	80.0	120
		EG005C: Copper	7440-50-8	1 mg/L	107	80.0	120
		EG005C: Lead	7439-92-1	1 mg/L	106	80.0	120
		EG005C: Nickel	7440-02-0	1 mg/L	107	80.0	120
		EG005C: Zinc	7440-66-6	1 mg/L	106	80.0	120
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4680577)							
EM2221404-008	ANG-22-0028	EG005W: Arsenic	7440-38-2	1 mg/L	106	80.0	120
		EG005W: Barium	7440-39-3	1 mg/L	91.8	80.0	120
		EG005W: Beryllium	7440-41-7	1 mg/L	108	80.0	120
		EG005W: Cadmium	7440-43-9	0.25 mg/L	101	80.0	120
		EG005W: Chromium	7440-47-3	1 mg/L	96.9	80.0	120
		EG005W: Cobalt	7440-48-4	1 mg/L	99.3	80.0	120
		EG005W: Copper	7440-50-8	1 mg/L	95.9	80.0	120

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG005(ED093)W: Water Leachable Metals by ICPAES. (QCLot: 4680577) - continued							
EM2221404-008	ANG-22-0028	EG005W: Lead	7439-92-1	1 mg/L	102	80.0	120
		EG005W: Nickel	7440-02-0	1 mg/L	100	80.0	120
		EG005W: Zinc	7440-66-6	1 mg/L	98.8	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4683919)							
EM2221404-004	ANG-22-0052	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	100 mg/L	91.7	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4683920)							
EM2221404-004	ANG-22-0052	ED045G: Chloride	16887-00-6	400 mg/L	107	70.0	142
EG035C: Leachable Mercury by FIMS (QCLot: 4680769)							
EM2221404-002	ANG-22-0028	EG035C: Mercury	7439-97-6	0.01 mg/L	94.9	84.0	118
EG035W: Water Leachable Mercury by FIMS (QCLot: 4680770)							
EM2221404-008	ANG-22-0028	EG035W: Mercury	7439-97-6	0.01 mg/L	# 32.9	78.0	120
EK040P: Fluoride by PC Titrator (QCLot: 4680690)							
EM2221404-003	ANG-22-0050	EK040P: Fluoride	16984-48-8	5 mg/L	82.1	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EM2221404**	Page	: 1 of 16
Client	: **ALCOA Australia**	Laboratory	: Environmental Division Melbourne
Contact	: REBECCA FRASER	Telephone	: +6138549 9645
Project	: Anglesea Ash Risk Assessment C03568	Date Samples Received	: 04-Jul-2022
Site	: Anglesea	Issue Date	: 07-Nov-2022
Sampler	: ANDREW MINARD, CLARE HOGAN	No. of samples received	: 12
Order number	: 7293974	No. of samples analysed	: 12

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG035W: Water Leachable Mercury by FIMS	EM2221404--008	ANG-22-0028	**Mercury**	7439-97-6	32.9 %	78.0-120%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved							
ANG-22-0026, ANG-22-0050,	ANG-22-0028, ANG-22-0052	02-Nov-2022	08-Jul-2022	**117**	----	----	----
Soil Glass Jar - Unpreserved							
ANG-22-0031,	ANG-22-0103	02-Nov-2022	11-Jul-2022	**114**	----	----	----
EA002-AD: pH (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved							
ANG-22-0026, ANG-22-0050,	ANG-22-0028, ANG-22-0052	02-Nov-2022	08-Jul-2022	**117**	07-Nov-2022	03-Nov-2022	**4**
Soil Glass Jar - Unpreserved							
ANG-22-0031,	ANG-22-0103	02-Nov-2022	11-Jul-2022	**114**	07-Nov-2022	03-Nov-2022	**4**
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved							
ANG-22-0026, ANG-22-0050,	ANG-22-0028, ANG-22-0052	02-Nov-2022	08-Jul-2022	**117**	----	----	----
Soil Glass Jar - Unpreserved							
ANG-22-0031,	ANG-22-0103	02-Nov-2022	11-Jul-2022	**114**	----	----	----
EA010-AD: Conductivity (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved							
ANG-22-0026, ANG-22-0050,	ANG-22-0028, ANG-22-0052	02-Nov-2022	08-Jul-2022	**117**	----	----	----
Soil Glass Jar - Unpreserved							
ANG-22-0031,	ANG-22-0103	02-Nov-2022	11-Jul-2022	**114**	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved							
ANG-22-0026, ANG-22-0050,	ANG-22-0028, ANG-22-0052	----	----	----	02-Nov-2022	15-Jul-2022	**110**
Soil Glass Jar - Unpreserved							
ANG-22-0031,	ANG-22-0103	----	----	----	02-Nov-2022	18-Jul-2022	**107**
ED006: Exchangeable Cations on Alkaline Soils							

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
ED006: Exchangeable Cations on Alkaline Soils - Analysis Holding Time Compliance						
Soil Glass Jar - Unpreserved						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	02-Nov-2022	29-Jul-2022	**96**	07-Nov-2022	29-Jul-2022	**101**
Soil Glass Jar - Unpreserved						
ANG-22-0031, ANG-22-0103	02-Nov-2022	01-Aug-2022	**93**	07-Nov-2022	01-Aug-2022	**98**
ED007: Exchangeable Cations						
Soil Glass Jar - Unpreserved						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	07-Nov-2022	29-Jul-2022	**101**	07-Nov-2022	29-Jul-2022	**101**
Soil Glass Jar - Unpreserved						
ANG-22-0031, ANG-22-0103	07-Nov-2022	01-Aug-2022	**98**	07-Nov-2022	01-Aug-2022	**98**
ED008: Exchangeable Cations						
Soil Glass Jar - Unpreserved						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	07-Nov-2022	29-Jul-2022	**101**	07-Nov-2022	29-Jul-2022	**101**
Soil Glass Jar - Unpreserved						
ANG-22-0031, ANG-22-0103	07-Nov-2022	01-Aug-2022	**98**	07-Nov-2022	01-Aug-2022	**98**
ED045G: Chloride by Discrete Analyser						
Soil Glass Jar - Unpreserved						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	02-Nov-2022	29-Jul-2022	**96**	----	----	----
Soil Glass Jar - Unpreserved						
ANG-22-0031, ANG-22-0103	02-Nov-2022	01-Aug-2022	**93**	----	----	----
EG035T: Total Recoverable Mercury by FIMS						
Soil Glass Jar - Unpreserved						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	02-Nov-2022	29-Jul-2022	**96**	03-Nov-2022	29-Jul-2022	**97**
Soil Glass Jar - Unpreserved						
ANG-22-0031, ANG-22-0103	02-Nov-2022	01-Aug-2022	**93**	03-Nov-2022	01-Aug-2022	**94**
EK040T: Fluoride Total						
Soil Glass Jar - Unpreserved						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	02-Nov-2022	29-Jul-2022	**96**	04-Nov-2022	29-Jul-2022	**98**
Soil Glass Jar - Unpreserved						
ANG-22-0031, ANG-22-0103	02-Nov-2022	01-Aug-2022	**93**	04-Nov-2022	01-Aug-2022	**95**
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)						
Non-Volatile Leach: 14 day HT(e.g. SV organics)						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	03-Nov-2022	15-Jul-2022	**111**	----	----	----

Matrix: **SOIL**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel) - Analysis						
Non-Volatile Leach: 14 day HT(e.g. SV organics)						
ANG-22-0031, ANG-22-0103	03-Nov-2022	18-Jul-2022	**108**	----	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)						
Non-Volatile Leach: 14 day HT(e.g. SV organics)						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	03-Nov-2022	15-Jul-2022	**111**	----	----	----
Non-Volatile Leach: 14 day HT(e.g. SV organics)						
ANG-22-0031, ANG-22-0103	03-Nov-2022	18-Jul-2022	**108**	----	----	----

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103, ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103	----	----	----	04-Nov-2022	03-Nov-2022	**1**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved (EA001)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	08-Jul-2022	×	**02-Nov-2022**	03-Nov-2022	✓
Soil Glass Jar - Unpreserved (EA001)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	11-Jul-2022	×	**02-Nov-2022**	03-Nov-2022	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002-AD: pH (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved (EA002-AD) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	08-Jul-2022	×	**07-Nov-2022**	03-Nov-2022	×
Soil Glass Jar - Unpreserved (EA002-AD) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	11-Jul-2022	×	**07-Nov-2022**	03-Nov-2022	×
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved (EA010) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	08-Jul-2022	×	**03-Nov-2022**	30-Nov-2022	✓
Soil Glass Jar - Unpreserved (EA010) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	11-Jul-2022	×	**03-Nov-2022**	30-Nov-2022	✓
EA010-AD: Conductivity (Soils) dried at 40°C							
Soil Glass Jar - Unpreserved (EA010-AD) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	08-Jul-2022	×	**07-Nov-2022**	30-Nov-2022	✓
Soil Glass Jar - Unpreserved (EA010-AD) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	11-Jul-2022	×	**07-Nov-2022**	30-Nov-2022	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	----	----	----	**02-Nov-2022**	15-Jul-2022	×
Soil Glass Jar - Unpreserved (EA055) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	----	----	----	**02-Nov-2022**	18-Jul-2022	×
ED006: Exchangeable Cations on Alkaline Soils							
Soil Glass Jar - Unpreserved (ED006) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	29-Jul-2022	×	**07-Nov-2022**	29-Jul-2022	×
Soil Glass Jar - Unpreserved (ED006) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	01-Aug-2022	×	**07-Nov-2022**	01-Aug-2022	×
ED007: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED007) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**07-Nov-2022**	29-Jul-2022	×	**07-Nov-2022**	29-Jul-2022	×
Soil Glass Jar - Unpreserved (ED007) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**07-Nov-2022**	01-Aug-2022	×	**07-Nov-2022**	01-Aug-2022	×
ED008: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED008) ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**07-Nov-2022**	29-Jul-2022	×	**07-Nov-2022**	29-Jul-2022	×
Soil Glass Jar - Unpreserved (ED008) ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**07-Nov-2022**	01-Aug-2022	×	**07-Nov-2022**	01-Aug-2022	×

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037: Alkalinity							
Soil Glass Jar - Unpreserved (ED037)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	28-Dec-2022	✓	**03-Nov-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (ED037)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	31-Dec-2022	✓	**03-Nov-2022**	31-Dec-2022	✓
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)							
Soil Glass Jar - Unpreserved (ED040N)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**03-Nov-2022**	28-Dec-2022	✓	**03-Nov-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (ED040N)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**03-Nov-2022**	31-Dec-2022	✓	**03-Nov-2022**	31-Dec-2022	✓
ED045G: Chloride by Discrete Analyser							
Soil Glass Jar - Unpreserved (ED045G)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	29-Jul-2022	×	**04-Nov-2022**	30-Nov-2022	✓
Soil Glass Jar - Unpreserved (ED045G)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	01-Aug-2022	×	**04-Nov-2022**	30-Nov-2022	✓
ED093S: Soluble Major Cations							
Soil Glass Jar - Unpreserved (ED093S)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	28-Dec-2022	✓	**03-Nov-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (ED093S)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	31-Dec-2022	✓	**03-Nov-2022**	31-Dec-2022	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	28-Dec-2022	✓	**03-Nov-2022**	28-Dec-2022	✓
Soil Glass Jar - Unpreserved (EG005T)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	31-Dec-2022	✓	**03-Nov-2022**	31-Dec-2022	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	29-Jul-2022	×	**03-Nov-2022**	29-Jul-2022	×
Soil Glass Jar - Unpreserved (EG035T)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	01-Aug-2022	×	**03-Nov-2022**	01-Aug-2022	×
EK040T: Fluoride Total							
Soil Glass Jar - Unpreserved (EK040T)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**02-Nov-2022**	29-Jul-2022	×	**04-Nov-2022**	29-Jul-2022	×
Soil Glass Jar - Unpreserved (EK040T)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**02-Nov-2022**	01-Aug-2022	×	**04-Nov-2022**	01-Aug-2022	×

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EN60: ASLP Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)							
Non-Volatile Leach: 14 day HT(e.g. SV organics) (EN60a-G)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**03-Nov-2022**	15-Jul-2022	×	**----**	----	----
Non-Volatile Leach: 14 day HT(e.g. SV organics) (EN60a-G)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**03-Nov-2022**	18-Jul-2022	×	**----**	----	----
EN60-DI: Bottle Leaching Procedure - Inorganics/Non-Volatile Organics (Glass Vessel)							
Non-Volatile Leach: 14 day HT(e.g. SV organics) (EN60-DIa-G)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052	**01-Jul-2022**	**03-Nov-2022**	15-Jul-2022	×	**----**	----	----
Non-Volatile Leach: 14 day HT(e.g. SV organics) (EN60-DIa-G)							
ANG-22-0031, ANG-22-0103	**04-Jul-2022**	**03-Nov-2022**	18-Jul-2022	×	**----**	----	----

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103, ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103	**03-Nov-2022**	**----**	----	----	**04-Nov-2022**	03-Nov-2022	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103, ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103	**03-Nov-2022**	**----**	----	----	**04-Nov-2022**	01-Dec-2022	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103, ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103	**03-Nov-2022**	**----**	----	----	**04-Nov-2022**	17-Nov-2022	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**----**	----	----	**07-Nov-2022**	01-Dec-2022	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103,							
ANG-22-0026,	ANG-22-0028,							
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**----**	----	----	**07-Nov-2022**	01-Dec-2022	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103,							
ANG-22-0026,	ANG-22-0028,							
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							
ED093C: Leachable Major Cations								
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093C)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**04-Nov-2022**	01-Dec-2022	✓	**05-Nov-2022**	01-Dec-2022	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							
ED093W: Water Leachable Major Cations								
Clear Plastic Bottle - Nitric Acid; Unfiltered (ED093W)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**04-Nov-2022**	01-Dec-2022	✓	**04-Nov-2022**	01-Dec-2022	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							
EG005(ED093)C: Leachable Metals by ICPAES								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005C)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**04-Nov-2022**	02-May-2023	✓	**05-Nov-2022**	02-May-2023	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							
EG005(ED093)W: Water Leachable Metals by ICPAES								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG005W)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**04-Nov-2022**	02-May-2023	✓	**04-Nov-2022**	02-May-2023	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							
EG035C: Leachable Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035C)								
ANG-22-0026,	ANG-22-0028,	**03-Nov-2022**	**----**	----	----	**04-Nov-2022**	01-Dec-2022	✓
ANG-22-0050,	ANG-22-0052,							
ANG-22-0031,	ANG-22-0103							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035W: Water Leachable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035W)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103	**03-Nov-2022**	**----**	----	----	**04-Nov-2022**	01-Dec-2022	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103, ANG-22-0026, ANG-22-0028, ANG-22-0050, ANG-22-0052, ANG-22-0031, ANG-22-0103	**03-Nov-2022**	**----**	----	----	**04-Nov-2022**	01-Dec-2022	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity in Soil	ED037	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5) on 40°C dried soil	EA002-AD	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity in Soil	ED037	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Cations - soluble by ICP-AES	ED093S	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	2	3	**66.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5) on 40°C dried soil	EA002-AD	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Cations - soluble by ICP-AES	ED093S	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride Soluble By Discrete Analyser	ED045G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Deionised Water Leach - Glass Leaching Vessel	EN60-DIa-G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Exchangeable Cations	ED007	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations on Alkaline Soils	ED006	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations with pre-treatment	ED008	2	3	**66.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride Soluble By Discrete Analyser	ED045G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate - Calcium Phosphate Soluble	ED040N	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by Auto Titrator	EA005-P	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Control Samples (LCS) - Continued							
Water Leachable Major Cations	ED093W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by Auto Titrator	EA010-P	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Major Cations	ED093C	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Major Cations	ED093W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by Auto Titrator	EK040P	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Mercury by FIMS	EG035C	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Leachable Metals by ICPAES	EG005C	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Mercury by FIMS	EG035W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Water Leachable Metals by ICPAES	EG005W	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
pH (1:5) on 40°C dried soil	EA002-AD	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on 40°C dried soil after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3)
pH by Auto Titrator	EA005-P	SOIL	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM Schedule B(3)
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5) on 40°C dried soil	EA010-AD	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples dried at 40°C using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Conductivity by Auto Titrator	EA010-P	SOIL	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM Schedule B(3)
Total Soluble Salts	EA014	SOIL	In house: The concentration of Total Soluble Salts in a soil is calculated from the Electrical conductivity of a water extract. This method is compliant with NEPM Schedule B(3).
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Alkalinity in Soil	ED037	SOIL	In house: Referenced to APHA 2320 B Alkalinity is determined and reported on a 1:5 soil/water leach.
Alkalinity by Auto Titrator	ED037-P	SOIL	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate - Calcium Phosphate Soluble	ED040N	SOIL	In house: The sample is extracted with a calcium phosphate solution. The phosphate ion displaces the adsorbed sulfate while calcium ions depress the extraction of interfering S from soil organic matter. SO4 in the extract is determined by ICPAES and reported as dry weight in the original soil. This method is compliant with NEPM Schedule B(3).

Analytical Methods	Method	Matrix	Method Descriptions
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	SOIL	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
Leachable Major Cations	ED093C	SOIL	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations in leachates are determined by either ICP-AES or ICP-MS techniques.
Cations - soluble by ICP-AES	ED093S	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3).
Water Leachable Major Cations	ED093W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010; ALS QWI-EN/EG005, QWI-EN/ED093. The ICPAES technique quickly breaks the sample down into atoms and ions under extremely hot plasma. Atoms are then ionised, emitting a characteristic spectrum. The spectrometer then separates the wavelengths, prior to comparison of intensities against matrix matched standards for quantification.
Leachable Metals by ICPAES	EG005C	SOIL	In house: referenced to APHA 3120; USEPA SW 846 - 6010: The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Water Leachable Metals by ICPAES	EG005W	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. The ICPAES technique ionises leachate sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM Schedule B(3).
Leachable Mercury by FIMS	EG035C	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Water Leachable Mercury by FIMS	EG035W	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the TCLP solution. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Fluoride by Auto Titrator	EK040P	SOIL	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl2 extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl2 and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method (Alkaline Soils)	ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
Calcium Phosphate Extraction for Sulphate as SO4 2-	ED040NPR	SOIL	The sample is extracted with a calcium phosphate solution. The phosphate ion displaces the adsorbed sulphate while calcium ions depress the extraction of interfering S from soil organic matter. SO4 in the extract is determined by ICPAES and reported as dry weight in the original soil. This method is compliant with NEPM Schedule B(3).
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
Digestion for Total Recoverable Metals in TCLP Leachate	EN25C	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
Digestion for Total Recoverable Metals in DI Water Leachate	EN25W	SOIL	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
1:5 solid / water leach following drying at 40°C	EN34-AD	SOIL	10 g of 40°C dried soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
ASLP for Non & Semivolatile Analytes - Glass Leaching Vessel	EN60a-G	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates
Deionised Water Leach - Glass Leaching Vessel	EN60-DIa-G	SOIL	In house QWI-EN/60 referenced to AS4439.3 Preparation of Leachates

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).

Rebatch

Client / Client code: ALCAUS
Project: ANGLESEA ASH RISK ASSESSMENT C03568
Project Manager: REBECCA FRASER
Date /time sample rec: 4/07/2022 18:28
Date/time Instructions rec: 28/10/2022 14:56
Due date: Friday, 7 October 2022
Due date surcharge: **STANDARD**

CS Contact: PETER RAVLIC
Additional Information:

PLEASE INCLUDE RECIPIENTS FROM ORIGIONAL WORKORDER INTO REBATCH. THANK YOU!

Environmental Division
Melbourne
Work Order Reference
EM2221404

Telephone : +61-3-8549 9600

	Sample information							Analysis										
								Standard					Leach					
New Lab ID	Client ID	Sampling Date / Time	Previous Work Order Reference	Previous ALS ID	Tray Number(s)	Container	Number of Containers	ME-260-22 V3 - Soil Anaysis Table					ME-260-22 V3 - Leachate analysis table @ pH 2.9	ME-260-22 V3 - Leachate analysis table @ pH 7				Shortest Holding time expiry
1	ANG-22-0026	1/07/2022	EM2212813	1	HS: 1934-35	JAR	3	X					X	X				29-Jul-22
2	ANG-22-0028	1/07/2022	EM2212813	2	HS: 1934-35	JAR	3	X					X	X				29-Jul-22
3	ANG-22-0050	1/07/2022	EM2212813	5	HS: 1934-35	JAR	3	X					X	X				29-Jul-22
4	ANG-22-0052	1/07/2022	EM2212813	6	HS: 1934-35	JAR	3	X					X	X				29-Jul-22
5	ANG-22-0031	4/07/2022	EM2212813	3	HS: 1934-35	JAR	2	X					X	X				01-Aug-22
6	ANG-22-0103	4/07/2022	EM2212813	16	HS: 1934-35	JAR	2	X					X	X				01-Aug-22
						TOTAL	16											

MS: 7279
7280

71

CHAIN OF CUSTODY — Eurofins MGT

CLIENT: Alcoa	TURNAROUND REQUIREMENTS : Standard	FOR LABORATORY USE ONLY (Circle)	
OFFICE:		Custody Seal Intact?	Yes / No / N/A
PROJECT: Anglesea Ash Risk Assessment C03568	QUOTE:	Free ice / frozen ice bricks present upon receipt?	Yes / No / N/A
SITE: Anglesea PURCHASE ORDER NO.:	COUNTRY OF ORIGIN: Australia	COC SEQUENCE NUMBER (Circle) COC: 1 OF: 1	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Rebecca Fraser CONTACT PH: 0452 197 352			Other comment:
SAMPLER: Andrew Minard/Clare Hogan SAMPLER MOBILE: 0437 585 820/0493 361 188	RELINQUISHED BY:	RECEIVED BY: Andrew	RELINQUISHED BY: JW (ALS)
COC Emailed to ALS? (YES / NO) EDD and EHS EQEDD FORMAT	DATE/TIME:	DATE/TIME: 4-7-22 1828	DATE/TIME: 6/7
Email Reports to: rebecca.fraser@ehs-support.com Email EDDs to: equis@ehs-support.com; rebecca.fraser@ehs-support.com; nicci.maris@alcoa.com			RECEIVED BY: DATE/TIME:
Email Invoice to: nicci.maris@alcoa.com			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: HOLD=Store samples for potential future analysis -

ALS USE ONLY	SAMPLE DETAILS — MATRIX: Soil (SO), Sediment (SE), surface water (WS), Groundwater (WG), Water QC (WQ), Soil QC (WQ)				CONTAINER INFORMATION		ANALYSIS REQUIRED Including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).						Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX CODE	SAMPLE TYPE CODE	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	pH (CaCl2), EC (1:5), total metals (Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn), total fluoride, major ions (Ca, Mg, Na, K, SO4, Cl), alkalinity, TSS, CEC, exchangeable ions and ANC	ALSP procedure at pH2.9 - pH, EC, alkalinity, TSS, metals (Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn), fluoride, major ions (Ca, Mg, Na, K, SO4, Cl), alkalinity, TDS (gravimetric)	ALSP procedure at pH7 - pH, EC, alkalinity, TSS, metals (Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn), fluoride, major ions (Ca, Mg, Na, K, SO4, Cl), alkalinity, TDS (gravimetric)			HOLD	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	ANG-22-0055_TRIP		SO	N	150ml jar	3	X	X	X				
								903790 7/7/22 TY					
								7/7/22 8:15AM O 5.3 -0.1 5.2 TY COC					
					TOTAL	3	1	1	1	0	0	0	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

eurofins | Environment Testing

www.eurofins.com.au EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd

ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	4/52 Industrial Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield East NSW 2304
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	PO Box 60 Wickham 2293
Tel: +61 3 8564 5000	Tel: +61 3 8564 5000	Tel: +61 2 9900 8400	Tel: +61 2 6113 8091	Tel: +61 7 3902 4600	Tel: +61 2 4968 8448
NATA# 1261 Site# 1254	NATA# 1261 Site# 1254	NATA# 1261 Site# 18217		NATA# 1261 Site# 20794	NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd

ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

Auckland	Christchurch
35 O'Rorke Road	43 Detroit Drive
Penrose,	Rolleston,
Auckland 1061	Christchurch 7675
Tel: +64 9 526 45 51	Tel: 0800 856 450
IANZ# 1327	IANZ# 1290

Sample Receipt Advice

Company name:	EHS Support Pty Ltd
Contact name:	Rebecca Fraser
Project name:	ANGLESEA ASH RISK ASSESSMENT C03568
Project ID:	Not provided
Turnaround time:	5 Day
Date/Time received	Jul 7, 2022 8:15 AM
Eurofins reference	903790

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✓	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✗	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
✗	Split sample sent to requested external lab.
✗	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Michael Morrison on phone : 03 8564 5933 or by email: MichaelMorrison@eurofins.com

Results will be delivered electronically via email to Rebecca Fraser - rebecca.fraser@ehs-support.com.

Note: A copy of these results will also be delivered to the general EHS Support Pty Ltd email address.

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Sydney
179 Magowar Road
Girraween
NSW 2145
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46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
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Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: EHS Support Pty Ltd
Address: 6/468 St Kilda Rd
Melbourne
VIC 3004

Project Name: ANGLESEA ASH RISK ASSESSMENT C03568

Order No.:
Report #: 903790
Phone: 03 9646 8615
Fax:

Received: Jul 7, 2022 8:15 AM
Due: Jul 14, 2022
Priority: 5 Day
Contact Name: Rebecca Fraser

Eurofins Analytical Services Manager : Michael Morrison

Sample Detail						Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Fluoride (Total)	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	pH (1:5 Aqueous extract at 25°C as rec.)	pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	Selenium	Total Suspended Solids Dried at 103°C–105°C	Zinc	AUS Leaching Procedure	Moisture Set	Cation Exchange Capacity	Eurofins Suite B11E: Cl/SO4/Alkalinity	Eurofins Suite B11C: Na/K/Ca/Mg	Total Dissolved Solids Dried at 180°C ± 2°C
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																											
1	ANG-22-0055_TRIP	Not Provided		Soil	M22-Jl0012613	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	
2	ANG-22-0055_TRIP	Not Provided		AUS Leachate - pH 2.9	M22-Jl0012614	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X
3	ANG-22-0055_TRIP	Not Provided		AUS Leachate - Reagent Water	M22-Jl0012615	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X
Test Counts						3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3	3	3	2	1	3	3	3	2

EHS Support Pty Ltd
6/468 St Kilda Rd
Melbourne
VIC 3004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Rebecca Fraser**

Report **903790-L**
Project name ANGLESEA ASH RISK ASSESSMENT C03568
Received Date Jul 07, 2022

Client Sample ID			**ANG-22-0055_TRIP**	**ANG-22-0055_TRIP**
Sample Matrix			**AUS Leachate - pH 2.9**	**AUS Leachate - Reagent Water**
Eurofins Sample No.			**M22-Jl0012614**	**M22-Jl0012615**
Date Sampled			**Not Provided**[I12]	**Not Provided**[I12]
Test/Reference	LOR	Unit		
Chloride (1:5 aqueous extract)			5.2	6.3
Fluoride (Total)	0.2	mg/L	< 0.2	< 0.2
Sulphate as SO4 (1:5 aqueous extract)			1.4	4.8
Total Dissolved Solids (calculated from EC)*	10	mg/L	230	29
Alkalinity (speciated)				
Bicarbonate Alkalinity (as CaCO3)	20	mg/L	< 20	< 20
Carbonate Alkalinity (as CaCO3)	20	mg/L	< 20	< 20
Hydroxide Alkalinity (as CaCO3)	20	mg/L	< 20	< 20
Total Alkalinity (as CaCO3)	20	mg/L	< 20	< 20
Heavy Metals				
Aluminium	0.05	mg/L	0.18	1.8
Antimony	0.05	mg/L	< 0.05	< 0.05
Arsenic	0.01	mg/L	< 0.01	0.03
Barium	0.5	mg/L	< 0.5	< 0.5
Beryllium	0.01	mg/L	< 0.01	< 0.01
Boron	0.05	mg/L	0.38	0.33
Cadmium	0.01	mg/L	< 0.01	< 0.005
Chromium	0.01	mg/L	< 0.01	< 0.01
Cobalt	0.05	mg/L	< 0.05	< 0.01
Copper	0.01	mg/L	0.02	< 0.01
Iron	0.05	mg/L	< 0.05	1.8
Lead	0.01	mg/L	< 0.01	0.06
Manganese	0.005	mg/L	< 0.005	< 0.05
Mercury	0.001	mg/L	< 0.001	< 0.001
Molybdenum	0.05	mg/L	< 0.05	< 0.01
Nickel	0.01	mg/L	< 0.01	< 0.01
Selenium	0.05	mg/L	< 0.05	< 0.05
Zinc	0.01	mg/L	0.02	0.14
Alkali Metals				
Calcium	0.5	mg/L	< 0.5	< 0.5
Magnesium	0.5	mg/L	< 0.5	< 0.5
Potassium	0.5	mg/L	< 0.5	0.9
Sodium	0.5	mg/L	< 1	8.0

Client Sample ID			ANG-22-0055_TRIP	ANG-22-0055_TRIP
Sample Matrix			AUS Leachate - pH 2.9	AUS Leachate - Reagent Water
Eurofins Sample No.			M22-JI0012614	M22-JI0012615
Date Sampled			Not Provided[I12]	Not Provided[I12]
Test/Reference	LOR	Unit		
AUS Leaching Procedure				
Leachate Fluid[C01]		comment	2.0	4.0
pH (initial)	0.1	pH Units	N/A	N/A
pH (Leachate fluid)	0.1	pH Units	2.9	6.6
pH (off)	0.1	pH Units	3.6	6.0

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins Suite B11E: Cl/SO4/Alkalinity			
Chloride (1:5 aqueous extract)	Melbourne	Jul 15, 2022	0 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Sulphate as SO4 (1:5 aqueous extract)	Melbourne	Jul 15, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser (1:5 extract)			
Alkalinity (speciated)	Melbourne	Jul 07, 2022	14 Days
- Method: LTM-INO-4250 Alkalinity by Electrometric Titration			
Fluoride (Total)	Melbourne	Jul 07, 2022	28 Days
- Method: LTM-INO-4150 Determination of Total Fluoride PART B – ISE			
Total Dissolved Solids (calculated from EC)*	Melbourne	Jul 07, 2022	28 Days
- Method: LTM-INO-4030 Conductivity			
Heavy Metals	Melbourne	Jul 08, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Eurofins Suite B11C: Na/K/Ca/Mg	Melbourne	Jul 08, 2022	180 Days
- Method: LTM-MET-3010 Alkali Metals by ICP-AES			
AUS Leaching Procedure			
pH (initial)	Melbourne	Jul 08, 2022	0 Days
- Method: LTM-GEN-7010 Leaching Procedure for Soils & Solid Wastes			
pH (Leachate fluid)	Melbourne	Jul 08, 2022	0 Days
- Method: LTM-GEN-7010 Leaching Procedure for Soils & Solid Wastes			
pH (off)	Melbourne	Jul 08, 2022	0 Days
- Method: LTM-GEN-7010 Leaching Procedure for Soils & Solid Wastes			

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Sydney
179 Magowar Road
Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
Unit 1,2 Dacre Street
Mitchell
ACT 2911
Tel: +61 2 6113 8091

Brisbane
1/21 Smallwood Place
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QLD 4172
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Tel: +61 2 4968 8448
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Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
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Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: EHS Support Pty Ltd
Address: 6/468 St Kilda Rd
Melbourne
VIC 3004

Project Name: ANGLESEA ASH RISK ASSESSMENT C03568

Order No.:
Report #: 903790
Phone: 03 9646 8615
Fax:

Received: Jul 7, 2022 8:15 AM
Due: Jul 14, 2022
Priority: 5 Day
Contact Name: Rebecca Fraser

Eurofins Analytical Services Manager : Michael Morrison

Sample Detail						Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Fluoride (Total)	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	pH (1:5 Aqueous extract at 25°C as rec.)	pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	Selenium	Total Suspended Solids Dried at 103°C–105°C	Zinc	AUS Leaching Procedure	Moisture Set	Cation Exchange Capacity	Eurofins Suite B11E: Cl/SO4/Alkalinity	Eurofins Suite B11C: Na/K/Ca/Mg	Total Dissolved Solids Dried at 180°C ± 2°C
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																											
1	ANG-22-0055_TRIP	Not Provided		Soil	M22-Jl0012613	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	
2	ANG-22-0055_TRIP	Not Provided		AUS Leachate - pH 2.9	M22-Jl0012614	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X
3	ANG-22-0055_TRIP	Not Provided		AUS Leachate - Reagent Water	M22-Jl0012615	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X
Test Counts						3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	1	3	3	3	2	1	3	3	3	2

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
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Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

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CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
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TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
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QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

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NOTE: pH duplicates are reported as a range not as RPD

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PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Heavy Metals							
Aluminium	mg/L	< 0.05			0.05	Pass	
Antimony	mg/L	< 0.05			0.05	Pass	
Arsenic	mg/L	< 0.01			0.01	Pass	
Barium	mg/L	< 0.5			0.5	Pass	
Beryllium	mg/L	< 0.01			0.01	Pass	
Boron	mg/L	< 0.05			0.05	Pass	
Cadmium	mg/L	< 0.005			0.005	Pass	
Chromium	mg/L	< 0.01			0.01	Pass	
Cobalt	mg/L	< 0.01			0.01	Pass	
Copper	mg/L	< 0.01			0.01	Pass	
Iron	mg/L	< 0.05			0.05	Pass	
Lead	mg/L	< 0.01			0.01	Pass	
Manganese	mg/L	< 0.05			0.05	Pass	
Mercury	mg/L	< 0.001			0.001	Pass	
Molybdenum	mg/L	< 0.01			0.01	Pass	
Nickel	mg/L	< 0.01			0.01	Pass	
Selenium	mg/L	< 0.05			0.05	Pass	
Zinc	mg/L	< 0.01			0.01	Pass	
Method Blank							
Alkali Metals							
Calcium	mg/L	< 0.5			0.5	Pass	
Magnesium	mg/L	< 0.5			0.5	Pass	
Potassium	mg/L	< 0.5			0.5	Pass	
Sodium	mg/L	< 0.5			0.5	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Heavy Metals				Result 1					
Aluminium	M22-Jl0012653	NCP	%	102			75-125	Pass	
Antimony	M22-Jl0012653	NCP	%	102			75-125	Pass	
Arsenic	M22-Jl0012653	NCP	%	98			75-125	Pass	
Barium	M22-Jl0012653	NCP	%	101			75-125	Pass	
Beryllium	M22-Jl0012653	NCP	%	99			75-125	Pass	
Cadmium	M22-Jl0012653	NCP	%	98			75-125	Pass	
Chromium	M22-Jl0012653	NCP	%	96			75-125	Pass	
Cobalt	M22-Jl0012653	NCP	%	97			75-125	Pass	
Copper	M22-Jl0012653	NCP	%	97			75-125	Pass	
Iron	M22-Jl0012653	NCP	%	98			75-125	Pass	
Lead	M22-Jl0012653	NCP	%	104			75-125	Pass	
Manganese	M22-Jl0012653	NCP	%	113			75-125	Pass	
Mercury	M22-Jl0012653	NCP	%	96			75-125	Pass	
Molybdenum	M22-Jl0012653	NCP	%	95			75-125	Pass	
Nickel	M22-Jl0012653	NCP	%	96			75-125	Pass	
Selenium	M22-Jl0012653	NCP	%	99			75-125	Pass	
Zinc	M22-Jl0012653	NCP	%	103			75-125	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Fluoride (Total)	S22-Jl0012858	NCP	mg/L	1.1	1.3	21	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M22-JI0012653	NCP	mg/L	0.17	0.12	33	30%	Fail	Q15
Antimony	M22-JI0012653	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Arsenic	M22-JI0012653	NCP	mg/L	0.04	0.04	6.4	30%	Pass	
Barium	M22-JI0012653	NCP	mg/L	0.7	0.7	1.5	30%	Pass	
Beryllium	M22-JI0012653	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Boron	M22-JI0009432	NCP	mg/L	1.1	1.1	6.3	30%	Pass	
Cadmium	M22-JI0012653	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	
Chromium	M22-JI0012653	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Cobalt	M22-JI0012653	NCP	mg/L	0.06	0.05	3.1	30%	Pass	
Copper	M22-JI0012653	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Iron	M22-JI0012653	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Lead	M22-JI0012653	NCP	mg/L	0.15	0.15	1.1	30%	Pass	
Manganese	M22-JI0012653	NCP	mg/L	3.6	3.6	<1	30%	Pass	
Mercury	M22-JI0012653	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Molybdenum	M22-JI0012653	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Nickel	M22-JI0012653	NCP	mg/L	0.05	0.05	1.8	30%	Pass	
Selenium	M22-JI0012653	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Zinc	M22-JI0012653	NCP	mg/L	1.5	1.5	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
I12	Where sampling date has not been provided, Eurofins | Environment Testing is not able to determine whether analysis has been performed within recommended holding times.
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Michael Morrison	Analytical Services Manager
Mary Makarios	Senior Analyst-Inorganic
Scott Beddoes	Senior Analyst-Inorganic
Scott Beddoes	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Eurofins shall not be liable for loss, cost, damages or expenses incurred by the client, or any other person or company, resulting from the use of any information or interpretation given in this report. In no case shall Eurofins be liable for consequential damages including, but not limited to, lost profits, damages for failure to meet deadlines and lost production arising from this report. This document shall not be reproduced except in full and relates only to the items tested. Unless indicated otherwise, the tests were performed on the samples as received.

EHS Support Pty Ltd
6/468 St Kilda Rd
Melbourne
VIC 3004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Rebecca Fraser**

Report **903790-S**
Project name ANGLESEA ASH RISK ASSESSMENT C03568
Received Date Jul 07, 2022

Client Sample ID			**ANG-22-0055_TRIP**
Sample Matrix			**Soil**
Eurofins Sample No.			**M22-Jl0012613**
Date Sampled			**Not Provided**[I12]
Test/Reference	LOR	Unit	
Chloride (1:5 aqueous extract)	5	mg/kg	96
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	630
Fluoride (Total)	100	mg/kg	< 100
pH (units)(1:5 soil:CaCl2 extract at 25 °C as rec.)	0.1	pH Units	6.8
Sulphate as SO4 (1:5 aqueous extract)	10	mg/kg	97
% Moisture	1	%	17
Alkalinity (speciated)			
Bicarbonate Alkalinity (as CaCO3)	20	mg/kg	< 20
Carbonate Alkalinity (as CaCO3)	20	mg/kg	< 20
Hydroxide Alkalinity (as CaCO3)	20	mg/kg	< 20
Total Alkalinity (as CaCO3)	50	mg/kg	< 50
Heavy Metals			
Aluminium	20	mg/kg	2800
Antimony	10	mg/kg	< 10
Arsenic	2	mg/kg	4.4
Barium	10	mg/kg	< 10
Beryllium	2	mg/kg	< 2
Boron	10	mg/kg	< 10
Cadmium	0.4	mg/kg	< 0.4
Chromium	5	mg/kg	10
Cobalt	5	mg/kg	< 5
Copper	5	mg/kg	< 5
Iron	20	mg/kg	14000
Lead	5	mg/kg	< 5
Manganese	5	mg/kg	< 5
Mercury	0.1	mg/kg	< 0.1
Molybdenum	5	mg/kg	< 5
Nickel	5	mg/kg	< 5
Selenium	2	mg/kg	< 2
Zinc	5	mg/kg	< 5
Cation Exchange Capacity			
Cation Exchange Capacity	0.05	meq/100g	3.0

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Eurofins Sample No.			**M22-Jl0012613**
Date Sampled			**Not Provided**[I12]
Test/Reference	LOR	Unit	
Alkali Metals			
Calcium	5	mg/kg	47
Magnesium	5	mg/kg	130
Potassium	5	mg/kg	130
Sodium	5	mg/kg	140
Acid Neutralising Capacity (ANCbt)			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	0.01	% CaCO3	0.08

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins Suite B11E: Cl/SO4/Alkalinity			
Chloride (1:5 aqueous extract)	Melbourne	Jul 07, 2022	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Sulphate as SO4 (1:5 aqueous extract)	Melbourne	Jul 07, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser (1:5 extract)			
Alkalinity (speciated)	Melbourne	Jul 07, 2022	14 Days
- Method: LTM-INO-4250 Alkalinity by Electrometric Titration			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Melbourne	Jul 07, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
Cation Exchange Capacity	Melbourne	Jul 08, 2022	28 Days
- Method: LTM-MET-3060 Cation Exchange Capacity by bases & Exchangeable Sodium Percentage			
Fluoride (Total)	Melbourne	Jul 08, 2022	28 Days
- Method: LTM-INO-4150 Determination of Total Fluoride PART A – CIC			
pH (units)(1:5 soil:CaCl2 extract at 25 °C as rec.)	Melbourne	Jul 07, 2022	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Heavy Metals	Melbourne	Jul 07, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Eurofins Suite B11C: Na/K/Ca/Mg	Melbourne	Jul 07, 2022	180 Days
- Method: LTM-MET-3010 Alkali Metals by ICP-AES			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	Brisbane	Jul 08, 2022	0 Days
- Method: Acid Neutralising Capacity (Acid reacted and Back-Titration) - Method 19A2			
% Moisture	Melbourne	Jul 07, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261 Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
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Sydney
179 Magowar Road
Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

Canberra
Unit 1,2 Dacre Street
Mitchell
ACT 2911
Tel: +61 2 6113 8091

Brisbane
1/21 Smallwood Place
Murarrie
QLD 4172
Tel: +61 7 3902 4600
NATA# 1261 Site# 20794

Newcastle
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Tel: +61 2 4968 8448
NATA# 1261 Site# 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 45 51
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: 0800 856 450
IANZ# 1290

Company Name: EHS Support Pty Ltd
Address: 6/468 St Kilda Rd
Melbourne
VIC 3004

Project Name: ANGLESEA ASH RISK ASSESSMENT C03568

Order No.:
Report #: 903790
Phone: 03 9646 8615
Fax:

Received: Jul 7, 2022 8:15 AM
Due: Jul 14, 2022
Priority: 5 Day
Contact Name: Rebecca Fraser

Eurofins Analytical Services Manager : Michael Morrison

Sample Detail						Aluminium	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Fluoride (Total)	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	pH (1:5 Aqueous extract at 25°C as rec.)	pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)	Selenium	Total Suspended Solids Dried at 103°C–105°C	Zinc	AUS Leaching Procedure	Moisture Set	Cation Exchange Capacity	Eurofins Suite B11E: Cl/SO4/Alkalinity	Eurofins Suite B11C: Na/K/Ca/Mg	Total Dissolved Solids Dried at 180°C ± 2°C
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																																
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																											
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2	ANG-22-0055_TRIP	Not Provided		AUS Leachate - pH 2.9	M22-Jl0012614	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X
3	ANG-22-0055_TRIP	Not Provided		AUS Leachate - Reagent Water	M22-Jl0012615	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X
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2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride (1:5 aqueous extract)	mg/kg	< 5			5	Pass	
Fluoride (Total)	mg/kg	< 100			100	Pass	
Sulphate as SO4 (1:5 aqueous extract)	mg/kg	< 10			10	Pass	
Method Blank							
Heavy Metals							
Aluminium	mg/kg	< 20			20	Pass	
Antimony	mg/kg	< 10			10	Pass	
Arsenic	mg/kg	< 2			2	Pass	
Barium	mg/kg	< 10			10	Pass	
Beryllium	mg/kg	< 2			2	Pass	
Boron	mg/kg	< 10			10	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Cobalt	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Iron	mg/kg	< 20			20	Pass	
Lead	mg/kg	< 5			5	Pass	
Manganese	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Molybdenum	mg/kg	< 5			5	Pass	
Nickel	mg/kg	< 5			5	Pass	
Selenium	mg/kg	< 2			2	Pass	
Zinc	mg/kg	< 5			5	Pass	
Method Blank							
Cation Exchange Capacity							
Cation Exchange Capacity	meq/100g	< 0.05			0.05	Pass	
Method Blank							
Alkali Metals							
Calcium	mg/kg	< 5			5	Pass	
Magnesium	mg/kg	< 5			5	Pass	
Potassium	mg/kg	< 5			5	Pass	
Sodium	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Chloride (1:5 aqueous extract)	%	127			70-130	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	%	96			70-130	Pass	
Fluoride (Total)	%	88			70-130	Pass	
Sulphate as SO4 (1:5 aqueous extract)	%	114			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium	%	113			80-120	Pass	
Antimony	%	107			80-120	Pass	
Arsenic	%	106			80-120	Pass	
Barium	%	108			80-120	Pass	
Beryllium	%	115			80-120	Pass	
Boron	%	107			80-120	Pass	
Cadmium	%	103			80-120	Pass	
Chromium	%	111			80-120	Pass	
Cobalt	%	112			80-120	Pass	
Copper	%	112			80-120	Pass	
Iron	%	117			80-120	Pass	
Lead	%	115			80-120	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Manganese			%	110			80-120	Pass	
Mercury			%	112			80-120	Pass	
Molybdenum			%	109			80-120	Pass	
Nickel			%	106			80-120	Pass	
Selenium			%	108			80-120	Pass	
Zinc			%	110			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Fluoride (Total)	M22-JI0014259	NCP	%	113			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Aluminium	M22-JI0013927	NCP	%	106			75-125	Pass	
Antimony	M22-JI0014202	NCP	%	102			75-125	Pass	
Arsenic	M22-JI0014202	NCP	%	102			75-125	Pass	
Barium	M22-JI0014202	NCP	%	104			75-125	Pass	
Beryllium	M22-JI0014202	NCP	%	111			75-125	Pass	
Boron	M22-JI0014202	NCP	%	92			75-125	Pass	
Cadmium	M22-JI0014202	NCP	%	98			75-125	Pass	
Chromium	M22-JI0014202	NCP	%	101			75-125	Pass	
Cobalt	M22-JI0014202	NCP	%	105			75-125	Pass	
Copper	M22-JI0014202	NCP	%	109			75-125	Pass	
Iron	M22-JI0013927	NCP	%	94			75-125	Pass	
Lead	M22-JI0014202	NCP	%	106			75-125	Pass	
Manganese	M22-JI0014202	NCP	%	118			75-125	Pass	
Mercury	M22-JI0014202	NCP	%	105			75-125	Pass	
Molybdenum	M22-JI0014202	NCP	%	109			75-125	Pass	
Nickel	M22-JI0014202	NCP	%	105			75-125	Pass	
Selenium	M22-JI0014202	NCP	%	102			75-125	Pass	
Zinc	M22-JI0014202	NCP	%	101			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	M22-JI0012613	CP	uS/cm	630	120	<1	30%	Pass	
Fluoride (Total)	M22-JI0014964	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
pH (units)(1:5 soil:CaCl2 extract at 25 °C as rec.)	M22-JI0012613	CP	pH Units	6.8	6.6	pass	30%	Pass	
% Moisture	M22-JI0012546	NCP	%	25	26	3.4	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M22-JI0014202	NCP	mg/kg	26000	27000	1.4	30%	Pass	
Antimony	M22-JI0014201	NCP	mg/kg	< 10	< 10	<1	30%	Pass	
Arsenic	M22-JI0014201	NCP	mg/kg	6.0	6.3	5.5	30%	Pass	
Barium	M22-JI0014201	NCP	mg/kg	120	110	15	30%	Pass	
Beryllium	M22-JI0014201	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Boron	M22-JI0014201	NCP	mg/kg	< 25	< 25	<1	30%	Pass	
Cadmium	M22-JI0014201	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M22-JI0014201	NCP	mg/kg	22	18	17	30%	Pass	
Cobalt	M22-JI0014201	NCP	mg/kg	5.5	< 5	10	30%	Pass	
Copper	M22-JI0014201	NCP	mg/kg	18	20	9.8	30%	Pass	
Iron	M22-JI0014201	NCP	mg/kg	17000	14000	18	30%	Pass	
Lead	M22-JI0014201	NCP	mg/kg	46	41	11	30%	Pass	
Manganese	M22-JI0014202	NCP	mg/kg	240	240	<1	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Mercury	M22-Jl0014201	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Molybdenum	M22-Jl0014201	NCP	mg/kg	< 5	< 5	<1	30%	Pass	
Nickel	M22-Jl0014201	NCP	mg/kg	7.4	< 5	51	30%	Fail	Q15
Selenium	M22-Jl0014201	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Zinc	M22-Jl0014201	NCP	mg/kg	58	48	19	30%	Pass	
Duplicate									
Acid Neutralising Capacity (ANCbt)				Result 1	Result 2	RPD			
Acid Neutralising Capacity - (ANCbt) (NLM-5.2)	M22-Jl0012613	CP	% CaCO3	0.08	0.11	28	20%	Fail	Q15

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
I12	Where sampling date has not been provided, Eurofins | Environment Testing is not able to determine whether analysis has been performed within recommended holding times.
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Michael Morrison	Analytical Services Manager
Caitlin Breeze	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Inorganic
Mary Makarios	Senior Analyst-Metal
Scott Beddoes	Senior Analyst-Inorganic
Scott Beddoes	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AA
Location:	ANGLESEA	Test date:	05-Jul-22
		Page:	1

Sample identification		#S1
Borehole / test pit		ANG-22-0015
Depth, m		-
Sample diameter	mm	63.40
Sample height	mm	63.16
Specimen wet density	t/m3	2.055
Specimen dry density	t/m3	1.90
Before moisture content	%	8.3
After moisture content	%	12.3
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	7.E-08
Water type		5,000ppm NaCl Solution
Specimen description		clayey SAND,fine to coarse, brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

NATA Accredited Laboratory No. 15055
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Date of issue
21/07/2022

Pelin Atas Erden
Approved Signatory

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A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AB
Location:	ANGLESEA	Test date:	05-Jul-22
		Page:	1

Sample identification		#S2
Borehole / test pit		ANG-22-0016
Depth, m		-
Sample diameter	mm	63.50
Sample height	mm	63.10
Specimen wet density	t/m3	2.008
Specimen dry density	t/m3	1.69
Before moisture content	%	18.9
After moisture content	%	23.3
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	1.E-09
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium plasticity, mottled brown, grey, black
Notes:		U63TUBE
Sampling Method		

Comments

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A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AC
Location:	ANGLESEA	Test date:	06-Jul-22
		Page:	1

Sample identification		#S3
Borehole / test pit		ANG-22-0017
Depth, m		-
Sample diameter	mm	63.30
Sample height	mm	63.90
Specimen wet density	t/m3	2.047
Specimen dry density	t/m3	1.48
Before moisture content	%	38.3
After moisture content	%	32.0
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	2.E-10
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, low to medium plasticity, mottled brown, grey, black, yellow, with sand
Notes:		U63 TUBE
Sampling Method		

Comments

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Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AD
Location:	ANGLESEA	Test date:	06-Jul-22
		Page:	1

Sample identification		#S4
Borehole / test pit		ANG-22-0018
Depth, m		-
Sample diameter	mm	63.20
Sample height	mm	62.92
Specimen wet density	t/m3	1.512
Specimen dry density	t/m3	0.93
Before moisture content	%	62.8
After moisture content	%	60.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	5.E-09
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium plasticity, brown, trace sand
Notes:		U63 TUBE
Sampling Method		

Comments

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28/07/2022

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Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AE
Location:	ANGLESEA	Test date:	08-Jul-22
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Sample identification		#S5
Borehole / test pit		ANG-22-0019
Depth, m		-
Sample diameter	mm	63.70
Sample height	mm	63.12
Specimen wet density	t/m3	2.031
Specimen dry density	t/m3	1.69
Before moisture content	%	20.5
After moisture content	%	21.3
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	1.E-09
Water type		5,000ppm NaCl Solution
Specimen description		sandy silty CLAY, low to medium plasticity, mottled brown, grey, black, white
Notes:		U63 TUBE
Sampling Method		

Comments

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Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AF
Location:	ANGLESEA	Test date:	13-Jul-22
		Page:	1

Sample identification		#S6
Borehole / test pit		ANG-22-0020
Depth, m		-
Sample diameter	mm	63.42
Sample height	mm	64.62
Specimen wet density	t/m3	2.063
Specimen dry density	t/m3	1.80
Before moisture content	%	14.9
After moisture content	%	17.1
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	9.E-09
Water type		5,000ppm NaCl Solution
Specimen description		sandy CLAY, low to medium plasticity, brown
Notes:		U63 TUBE
Sampling Method		

Comments

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Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AG
Location:	ANGLESEA	Test date:	13-Jul-22
		Page:	1

Sample identification		#S7
Borehole / test pit		ANG-22-0021
Depth, m		-
Sample diameter	mm	63.14
Sample height	mm	63.34
Specimen wet density	t/m3	2.098
Specimen dry density	t/m3	1.85
Before moisture content	%	13.1
After moisture content	%	16.1
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	1.E-08
Water type		5,000ppm NaCl Solution
Specimen description		sandy CLAY, low to medium plasticity, brown
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
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Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AH
Location:	ANGLESEA	Test date:	13-Jul-22
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Sample identification		#S8
Borehole / test pit		ANG-22-0022
Depth, m		-
Sample diameter	mm	63.62
Sample height	mm	64.20
Specimen wet density	t/m3	2.072
Specimen dry density	t/m3	1.89
Before moisture content	%	9.9
After moisture content	%	13.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	4.E-10
Water type		5,000ppm NaCl Solution
Specimen description		sandy CLAY, low to medium plasticity, brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AI
Location:	ANGLESEA	Test date:	13-Jul-22
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Sample identification		#S9
Borehole / test pit		ANG-22-0023
Depth, m		-
Sample diameter	mm	63.42
Sample height	mm	63.90
Specimen wet density	t/m3	2.054
Specimen dry density	t/m3	1.71
Before moisture content	%	20.1
After moisture content	%	22.8
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	2.E-10
Water type		5,000ppm NaCl Solution
Specimen description		CLAY, low to medium plasticity, dark brown
Notes:		U63 TUBE
Sampling Method		

Comments

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GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AJ
Location:	ANGLESEA	Test date:	15-Jul-22
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Sample identification		#S10
Borehole / test pit		ANG-22-0024
Depth, m		-
Sample diameter	mm	63.22
Sample height	mm	63.26
Specimen wet density	t/m3	1.824
Specimen dry density	t/m3	1.34
Before moisture content	%	35.7
After moisture content	%	31.8
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	7.E-10
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium to high plasticity, brown, trace gravel, trace sand
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
21/07/2022

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GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AK
Location:	ANGLESEA	Test date:	09-Jul-22
		Page:	1

Sample identification		#S11
Borehole / test pit		ANG-22-0025
Depth, m		-
Sample diameter	mm	63.46
Sample height	mm	63.22
Specimen wet density	t/m3	2.099
Specimen dry density	t/m3	1.83
Before moisture content	%	14.8
After moisture content	%	15.9
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	4.E-10
Water type		de-aired - filtered
Specimen description		silty sandy CLAY, medium plasticity, brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
21/07/2022

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Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AL
Location:	ANGLESEA	Test date:	15-Jul-22
		Page:	1

Sample identification		#S11
Borehole / test pit		ANG-22-0025
Depth, m		-
Sample diameter	mm	63.46
Sample height	mm	63.22
Specimen wet density	t/m3	2.099
Specimen dry density	t/m3	1.83
Before moisture content	%	14.8
After moisture content	%	15.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	3.E-10
Water type		5,000ppm NaCl Solution
Specimen description		silty sandy CLAY, medium plasticity, brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
21/07/2022

Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AM
Location:	ANGLESEA	Test date:	20-Jul-22
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Sample identification		#S12
Borehole / test pit		ANG-22-0027
Depth, m		-
Sample diameter	mm	63.32
Sample height	mm	63.12
Specimen wet density	t/m3	2.082
Specimen dry density	t/m3	1.92
Before moisture content	%	8.7
After moisture content	%	15.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	3.E-09
Water type		5,000ppm NaCl Solution
Specimen description		sandy CLAY, medium to high plasticity, brown
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
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Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AN
Location:	ANGLESEA	Test date:	20-Jul-22
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Sample identification		#S13
Borehole / test pit		ANG-22-0029
Depth, m		-
Sample diameter	mm	63.20
Sample height	mm	62.65
Specimen wet density	t/m3	1.975
Specimen dry density	t/m3	1.76
Before moisture content	%	12.1
After moisture content	%	15.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	4.E-08
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium plasticity, mottled brown, yellow, with sand, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AO
Location:	ANGLESEA	Test date:	09-Jul-22
		Page:	1

Sample identification		#S14
Borehole / test pit		ANG-22-0030
Depth, m		-
Sample diameter	mm	62.98
Sample height	mm	63.32
Specimen wet density	t/m3	1.822
Specimen dry density	t/m3	1.61
Before Moisture content	%	13.5
After Moisture content	%	NA
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	7.E-08
Water type		de-aired - filtered
Specimen description		clayey SAND, fine to coarse grained, grey
Notes:		
Sampling Method		U63 TUBE

Comments

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Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AP
Location:	ANGLESEA	Test date:	20-Jul-22
		Page:	1

Sample identification		#S15
Borehole / test pit		ANG-22-0032
Depth, m		-
Sample diameter	mm	63.36
Sample height	mm	63.40
Specimen wet density	t/m3	2.112
Specimen dry density	t/m3	1.85
Before moisture content	%	13.9
After moisture content	%	15.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	5.E-10
Water type		5,000ppm NaCl Solution
Specimen description		silty sandy CLAY, medium to high plasticity, brown, with gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AQ
Location:	ANGLESEA	Test date:	25-Jul-22
		Page:	1

Sample identification		# S16
Borehole / test pit		ANG-22-0034
Depth, m		-
Sample diameter	mm	62.84
Sample height	mm	63.00
Specimen wet density	t/m3	2.029
Specimen dry density	t/m3	1.79
Before moisture content	%	13.1
After moisture content	%	19.4
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	7.E-10
Water type		de-aired - filtered
Specimen description		clayey SAND, fine to coarse, brown, fines of low to medium plasticity
Notes:		
Sampling Method		U63 TUBE

Comments: Sampled by client, tested as received

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Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AR
Location:	ANGLESEA	Test date:	25-Jul-22
		Page:	1

Sample identification		# S16
Borehole / test pit		ANG-22-0034
Depth, m		-
Sample diameter	mm	62.84
Sample height	mm	63.00
Specimen wet density	t/m3	2.029
Specimen dry density	t/m3	1.79
Before moisture content	%	13.1
After moisture content	%	19.4
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	2.E-10
Water type		5,000ppm NaCl Solution
Specimen description		clayey SAND, fine to coarse, brown, fines of low to medium plasticity
Notes:		
Sampling Method		U63 TUBE
Comments		Sampled by client, tested as received

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Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AS
Location:	ANGLESEA	Test date:	26-Jul-22
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Sample identification		# S17
Borehole / test pit		ANG-22-0035
Depth, m		-
Sample diameter	mm	63.00
Sample height	mm	62.94
Specimen wet density	t/m3	1.471
Specimen dry density	t/m3	1.13
Before moisture content	%	30.1
After moisture content	%	42.4
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	4.E-08
Water type		de-aired - filtered
Specimen description		silty SAND, fine to coarse, black
Notes:		
Sampling Method		U63 TUBE

Comments: Sampled by client, tested as received

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Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AT
Location:	ANGLESEA	Test date:	26-Jul-22
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Sample identification		# S17
Borehole / test pit		ANG-22-0035
Depth, m		-
Sample diameter	mm	63.00
Sample height	mm	62.94
Specimen wet density	t/m3	1.471
Specimen dry density	t/m3	1.13
Before moisture content	%	30.1
After moisture content	%	42.4
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	9.E-09
Water type		5,000ppm NaCl Solution
Specimen description		silty SAND, fine to coarse,black
Notes:		
Sampling Method		U63 TUBE

Comments: Sampled by client, tested as received

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Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AU
Location:	ANGLESEA	Test date:	20-Jul-22
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Sample identification		#S18
Borehole / test pit		ANG-22-0037
Depth, m		-
Sample diameter	mm	63.12
Sample height	mm	63.20
Specimen wet density	t/m3	2.089
Specimen dry density	t/m3	1.72
Before moisture content	%	21.5
After moisture content	%	15.9
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	1.E-09
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, high plasticity, mottled brown, dark grey, trace sand
Notes:		U63 TUBE
Sampling Method		

Comments

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Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AV
Location:	ANGLESEA	Test date:	21-Jul-22
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Sample identification		#S19
Borehole / test pit		ANG-22-0039
Depth, m		-
Sample diameter	mm	63.26
Sample height	mm	63.62
Specimen wet density	t/m3	1.621
Specimen dry density	t/m3	1.04
Before moisture content	%	56.0
After moisture content	%	59.3
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	1.E-09
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium to high plasticity, brown, trace gravel, trace sand
Notes:		U63 TUBE
Sampling Method		

Comments

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Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AW
Location:	ANGLESEA	Test date:	26-Jul-22
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Sample identification		#S20
Borehole / test pit		ANG-22-0040
Depth, m		-
Sample diameter	mm	63.12
Sample height	mm	62.64
Specimen wet density	t/m3	1.460
Specimen dry density	t/m3	0.96
Before moisture content	%	52.4
After moisture content	%	59.3
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	2.E-09
Water type		de-aired - filtered
Specimen description		clayey SILT, medium plasticity, brown
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
9/08/2022

Pelin Atas Erden
Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AX
Location:	ANGLESEA	Test date:	26-Jul-22
		Page:	1

Sample identification		#S20
Borehole / test pit		ANG-22-0040
Depth, m		-
Sample diameter	mm	63.12
Sample height	mm	62.64
Specimen wet density	t/m3	1.460
Specimen dry density	t/m3	0.96
Before moisture content	%	52.4
After moisture content	%	59.3
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	2.E-09
Water type		5,000ppm NaCl Solution
Specimen description		clayey SILT,medium plasticity,brown
Notes:		U63 TUBE
Sampling Method		

Comments

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Approved Signatory

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A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AY
Location:	ANGLESEA	Test date:	26-Jul-22
		Page:	1

Sample identification		#S21
Borehole / test pit		ANG-22-0042
Depth, m		-
Sample diameter	mm	63.10
Sample height	mm	62.92
Specimen wet density	t/m3	1.556
Specimen dry density	t/m3	0.91
Before moisture content	%	71.9
After moisture content	%	65.0
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	2.E-09
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY,medium-high plasticity, dark brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
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A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	AZ
Location:	ANGLESEA	Test date:	29-Jul-22
		Page:	1

Sample identification		#S22
Borehole / test pit		ANG-22-0044
Depth, m		-
Sample diameter	mm	63.00
Sample height	mm	62.66
Specimen wet density	t/m3	1.982
Specimen dry density	t/m3	1.60
Before Moisture content	%	24.1
After Moisture content	%	31.0
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	8.E-10
Water type		de-aired - filtered
Specimen description		silty CLAY, medium plasticity, grey, with sand
Notes:		
Sampling Method		U63 tube

Comments

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Date of issue
15/08/2022

Pelin Atas Erden
Approved Signatory

GroundScience
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13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BA
Location:	ANGLESEA	Test date:	29-Jul-22
		Page:	1

Sample identification		#S22
Borehole / test pit		ANG-22-0044
Depth, m		-
Sample diameter	mm	63.00
Sample height	mm	62.66
Specimen wet density	t/m3	1.982
Specimen dry density	t/m3	1.60
Before moisture content	%	24.1
After moisture content	%	
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	7.E-10
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium plasticity, grey, with sand
Notes:		
Sampling Method		U63 TUBE

Comments

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GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BB
Location:	ANGLESEA	Test date:	01-Aug-22
		Page:	1

Sample identification		#S23
Borehole / test pit		ANG-22-0045
Depth, m		-
Sample diameter	mm	63.34
Sample height	mm	63.88
Specimen wet density	t/m3	2.022
Specimen dry density	t/m3	1.71
Before moisture content	%	18.5
After moisture content	%	20.1
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	9.E-11
Water type		de-aired - filtered
Specimen description		silty CLAY, medium to high plasticity, brown
Notes:		
Sampling Method		U63 TUBE
Comments		Sampled by client, tested as received

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Approved Signatory

A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BC
Location:	ANGLESEA	Test date:	01-Aug-22
		Page:	1

Sample identification		#S23
Borehole / test pit		ANG-22-0045
Depth, m		-
Sample diameter	mm	63.34
Sample height	mm	63.88
Specimen wet density	t/m3	2.022
Specimen dry density	t/m3	1.71
Before moisture content	%	18.5
After moisture content	%	20.1
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	8.E-11
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium to high plasticity, brown
Notes:		
Sampling Method		U63 TUBE
Comments		Sampled by client, tested as received

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15/08/2022

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13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BD
Location:	ANGLESEA	Test date:	26-Jul-22
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Sample identification		#S24
Borehole / test pit		ANG-22-0047
Depth, m		-
Sample diameter	mm	63.08
Sample height	mm	62.86
Specimen wet density	t/m3	2.088
Specimen dry density	t/m3	1.81
Before moisture content	%	15.5
After moisture content	%	14.8
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	4.E-10
Water type		5,000ppm NaCl Solution
Specimen description		sandy CLAY,medium to high plasticity, brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

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Date of issue
9/08/2022

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Approved Signatory

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A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BE
Location:	ANGLESEA	Test date:	04-Aug-22
		Page:	1

Sample identification		#S25
Borehole / test pit		ANG-22-0048
Depth, m		-
Sample diameter	mm	62.86
Sample height	mm	63.16
Specimen wet density	t/m3	2.001
Specimen dry density	t/m3	1.53
Before moisture content	%	31.2
After moisture content	%	22.8
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	98
PERMEABILITY	m/sec	2.E-10
Water type		de-aired - filtered
Specimen description		silty CLAY, medium plasticity, brown, trace gravel
Notes:		
Sampling Method		U63 TUBE

Comments

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 15055
Accredited for compliance with ISO/IEC 17025 - Testing

Date of issue
15/08/2022

Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BF
Location:	ANGLESEA	Test date:	04-Aug-22
		Page:	1

Sample identification		#S25
Borehole / test pit		ANG-22-0048
Depth, m		-
Sample diameter	mm	62.89
Sample height	mm	63.18
Specimen wet density	t/m3	1.975
Specimen dry density	t/m3	1.51
Before moisture content	%	31.2
After moisture content	%	22.8
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	2.E-10
Water type		5,000ppm NaCl Solution
Specimen description		silty CLAY, medium plasticity, brown, trace gravel
Notes:		
Sampling Method		

Comments

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 15055
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15/08/2022

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PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BG
Location:	ANGLESEA	Test date:	04-Aug-22
		Page:	1

Sample identification		#S26
Borehole / test pit		ANG-22-0049
Depth, m		-
Sample diameter	mm	63.52
Sample height	mm	63.04
Specimen wet density	t/m3	1.343
Specimen dry density	t/m3	0.82
Before Moisture content	%	64.2
After Moisture content	%	NA
Cell pressure	kPa	560
Inlet pressure	kPa	520
Outlet pressure	kPa	500
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	100
PERMEABILITY	m/sec	2.E-08
Water type		de-aired - filtered
Specimen description		clayey SILT, low to medium plasticity, brown, with sand
Notes:		
Sampling Method		U63 TUBE
Comments		Sampled by client, tested as received

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 15055
Accredited for compliance with ISO/IEC 17025 - Testing

Date of issue
15/08/2022

Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BH / TP
Location:	ANGLESEA	Test date:	04-Aug-22
		Page:	1

Sample identification		#S26
Borehole / test pit		ANG-22-0049
Depth, m		-
Sample diameter	mm	63.52
Sample height	mm	63.24
Specimen wet density	t/m3	1.386
Specimen dry density	t/m3	0.84
Before moisture content	%	64.2
After moisture content	%	NA
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	3.E-08
Water type		5,000ppm NaCl Solution
Specimen description		clayey SILT, low to medium plasticity, brown, with sand
Notes:		
Sampling Method		U63 TUBE
Comments		Sampled by client, tested as received

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 15055
Accredited for compliance with ISO/IEC 17025 - Testing

Date of issue
15/08/2022

Pelin Atas Erden
Approved Signatory

GroundScience
A C N 105 704 078
13 Brock Street Thomastown VIC, P 03 9464 4617 Email reception@groundscience.com.au

PERMEABILITY - CONSTANT HEAD (Triaxial method) AS1289 6.7.3

Client :	EHS SUPPORT (PORT MELBOURNE)	Job No.	GS6455/1
Project:	ANGLESEA ASH RISK ASSESSMENT C03568	Report No.	BI
Location:	ANGLESEA	Test date:	27-Jul-22
		Page:	1

Sample identification		#S27
Borehole / test pit		ANG-22-0051
Depth, m		-
Sample diameter	mm	62.76
Sample height	mm	62.90
Specimen wet density	t/m3	2.050
Specimen dry density	t/m3	1.74
Before moisture content	%	18.1
After moisture content	%	19.0
Cell pressure	kPa	550
Inlet pressure	kPa	510
Outlet pressure	kPa	490
Mean effective stress	kPa	50
Hydraulic head	kPa	20
Saturation	%	96
PERMEABILITY	m/sec	3.E-10
Water type		5,000ppm NaCl Solution
Specimen description		sandy CLAY, low to medium plasticity, dark brown, trace gravel
Notes:		U63 TUBE
Sampling Method		

Comments

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 15055
Accredited for compliance with ISO/IEC 17025 - Testing

Date of issue
10/08/2022

Pelin Atas Erden
Approved Signatory

Appendix F Sample QA/QC

RPD Calculations for Quality Check Samples

Project Name: Anglesea Ash Risk Assessment Site Investigation July 2022
Client: Alcoa
Project Number: AUS_C03568
EPA Number: N/A
Site Address: Coalmine Road, Anglesea Victoria
Project Manager: Rebecca Fraser

AS 4482.1-2005 *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil- Non-volatile and Semi-volatile Compounds* (Standards Australia, 2005) states that the typical RPD which can be expected from acceptable field duplicates is < ± 30-50% of the mean concentration of the analyte, where the results are greater than ten times the limit of reporting (LOR).

Analyte	Units	LOR (ALS)	ALS analysis ANG-21-0202	Eurofins analysis ANG-21-0210 FS of 202	Primary & triplicate RPD %
Sample date			14/09/2021	14/09/2021	
% Moisture	%	1	21.1	20	5%
Acid Neutralising Capacity (ANCbt)	% CaCO3	0.1	1.3	1.3	0%
Ammonia (as N)	mg/kg	20	<20	5.5	114%
Chloride	mg/kg	10	240	200	18%
Chromium (hexavalent)	mg/kg	0.5	<0.5	< 1	0%
Conductivity (1:5 aqueous extract at 25°C as rec.)	mg/kg	1	1940	1200	47%
Cyanide (amenable)	mg/kg	0.5	<1	< 5	0%
Cyanide (total)	mg/kg	1	<1	< 5	0%
Fluoride (Total)	mg/kg	40	90	< 100	11%
Iodide	mg/kg	0.05	<0.5	< 5	0%
Nitrate & Nitrite (as N)	mg/kg	0.1	<0.1	< 5	0%
Nitrate (as N)	mg/kg	0.1	<0.1	< 5	0%
Nitrite (as N)	mg/kg	0.1	<0.1	< 5	0%
Organic Matter %	%		NR	11	NC
pH (units)(1:5 soil:CaCl2 extract at 25°C as rec.)		0.1	4.4	6.4	37%
Phosphorus	mg/kg	2	154	110	33%
Sulphate (as SO4)	mg/kg	50	4060	1000	121%
Total Kjeldahl Nitrogen (as N)	mg/kg	20	1560	690	77%
Total Nitrogen (as N)*	mg/kg	20	1560	690	77%
Total Organic Carbon	%	0.5	3	5.2	54%
Total Soluble Salts*	mg/kg	5	6600	980	148%

Environmental Quality Control Check

Project Details:

PROJECT: Anglesea Ash Risk Assessment Site Investigation September 2021
CLIENT: ALCOA
PROJECT NUMBER: AUS_C03568
EPA NUMBER: N/A
SITE ADDRESS: COALMINE ROAD, ANGLESEA VICTORIA
PROJECT MANAGER: REBECCA FRASER
REPORT REVIEWED:
ALS EM2118436 September 2021
Eurofins 826015 September 2021

Fieldworks Conducted:

- **2021 September soil sampling within the consolidated ash area**
- **Ten primary and 1 triplicate samples collected for totals and leachable fraction (pH2.9 and deionised water) analysis**

Laboratories Used:

PRIMARY: ALS
SECONDARY: Eurofins

Laboratory Batch Numbers:

PRIMARY: ALS EM2118436 September 2021
SECONDARY: Eurofins 826015 September 2021

Data Quality Objectives:

- Preserve, store and transport soil samples so that sample integrity is not compromised
- The minimum number of sample duplicates and triplicates are collected and analysed
- Relative percentage differences (RPDs) between field sample, duplicates and triplicates within acceptable range
- Laboratory analyses meet internal laboratory quality control procedures

1.0 Soil Sampling

	Yes	No	Comment
1. Was the soil sampling methodology adequate?	☒	☐	
2. Were soil bore samples collected directly from push tubes?	☒	☐	
3. Were the soil sampling locations adequate?	☒	☐	
4. Does the sample density confirm to Australian Standard 4482.1?	☒	☐	AS4482.1 not relevant for this sampling event as the objective for sampling and analysis was to sample and analyse clay-rich cover and consolidated ash
5. Were samples composited?	☐	☒	
6. Were samples adequately selected for analysis based on field observations?	☒	☐	Sample selection based on mbgl and known extent of clay-rich cover and consolidated ash
7. Were samples selected for analysis from adequate depth ranges?	☒	☐	Where field conditions allowed and up to 9.4 mbgl
8. Were samples analysed for adequate analytical suites?	☒	☐	Analytes were selected based on indicator analytes in ash and a comprehensive suite including nutrients and cation exchange capacity
9. Were appropriate decontamination procedures used?	☒	☐	Nitrile gloves were used and replaced for each sample location
10. Were equipment calibration records provided?	☒	☐	n/a
11. Were sample locations clearly marked on a plan or collected by GPS?	☒	☐	
12. Were soil samples compared against relevant criteria	☐	☒	n/a
13. Where relevant, did soil sampling comply with the relevant SAQP?	☐	☒	SAQP not developed for this sampling event

Comments:

None

Soil sampling was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

2.0 Field Quality Control - Soil

2.1 Soil QC Sample Summary:

	ALS	Eurofins
Laboratory Reference	EM2118436	826015
1. Number of days sampling	2	
2. Sampling Dates	13/09/2021 to 14/09/2021 inclusive	
3. Total Number of primary samples analysed	10	-
4. Number of Rinsate Blanks	-	-
5. Number of Field Blanks	-	-
6. Number of Trip Blanks	-	-
7. Number of Field Duplicates (blind)	-	-
8. Number of Field Triplicates (split)	-	1

2.2 Soil Analytical Suites:

Soil - Totals

	Number of primary samples analysed	Number of duplicate samples analysed	Number of triplicate samples analysed
Metals[1]	10	-	1
Major ions[2]	10	-	1
Fluoride, iodide, cyanide	10	-	1
Nutrients[3]	10	-	1
CEC	10	-	1
pH, EC, TSS	10	-	1

Notes:

1- Metals – Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn
2- Major ions – Ca, Mg, Na, K, SO4, Cl,
3- Nutrients – ammonia, nitrite, nitrate, total kjeldahl nitrogen, phosphorus

Soil – Leachable Fraction

	Number of primary samples analysed	Number of duplicate samples analysed	Number of triplicate samples analysed
Metals[1]	10	-	1
Major ions[2]	10	-	1
Fluoride, iodide, cyanide	10	-	1
Nutrients[3]	10	-	1
CEC	10	-	1

	Number of primary samples analysed	Number of duplicate samples analysed	Number of triplicate samples analysed
pH, EC	10	-	1

Notes:

1- Metals – Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn
2- Major ions – Ca, Mg, Na, K, SO4, Cl
3- Nutrients – ammonia, nitrite, nitrate, total kjeldahl nitrogen, phosphorus

3.0 Precision and Sample Handling

	Yes	No	Comment
1. Were NATA registered laboratories used?	☒	☐	
2. Did the laboratory perform the requested tests?	☒	☐	
3. Were the laboratory methods adopted NATA endorsed?	☐	☒	ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
4. Were the laboratory reporting limits satisfactory?	☒	☐	
5. Was the NATA Seal on the reports?	☒	☐	
6. Were the reports signed by an authorised person?	☒	☐	
7. Were the samples in proper custody between the field and laboratory?	☒	☐	
8. Were the samples properly and adequately preserved?	☒	☐	
9. Were the samples received by the laboratory in good condition?	☒	☐	
10. Were the samples received by the laboratory chilled?	☒	☐	
11. Were samples analysed within the specified holding times?	☒	☐	

Comments:

None

Precision and sample handling was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

3.1 Soil Field QC Assessment:

	Yes	No	Comment
1. Were an adequate number of blanks analysed?	No blanks collected or required		N/A
2. Were the analytical suites for the blank samples adequate?			
3. Were the blank sample results free of contamination?			
4. Were an adequate number of replicate samples analysed?	☒	☐	
5. Were the analytical suites for the replicate samples adequate?	☒	☐	
6. Were the replicate RPDs within acceptable limits?	☐	☒	Many of the results were reported below LOR
7. Were any elevated RPDs adequately explained?	☒	☐	Differences between laboratory LORs account for most elevated RPDs

Comments:

- Many of the RPDs were outside acceptable limits due to results being below the limit of reporting (LOR), and LORs differing between laboratory methods. RPDs greater than 50% were also reported on results which were less than 10 times the LOR. Remaining RPDs exceeding 50% do not affect the overall usability of the laboratory analytical results.

Field QC for soil was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

4.0 Laboratory Internal Quality Control – Soil and Waters

	Primary Lab Batch: EM2212813	Secondary Lab Batch: 903790
1. Were all the laboratory method blanks free of contamination?	Yes	Only 1 sample analysed no QC provided
2. Number of the laboratory duplicate outliers?	2	
3. Number of the laboratory control sample (LCS) outliers?	0	
4. Number of the surrogate recovery outliers?	0	
3. Number of matrix spike (MS) outliers?	6	
4. Number of laboratory quality control sample frequency outliers?	5	

Comments:

Laboratory duplicate outliers exist for total kjeldahl nitrogen. Matrix spike recovery for soils less than lower data quality objective for hexavalent chromium and total organic carbon.
Matrix spike recovery level for waters not determined for iron and sulfate (as SO42-). Background level greater than or equal to the 4x spike level. Matrix spike recovery for water less than lower data quality objective for hexavalent chromium.
Laboratory quality control sample frequency outliers in waters for dissolved organic carbon and fluoride.
This is not expected to affect the validity of the results as acceptable recovers were achieved in the laboratory control sample analyses.

Laboratory Internal QC for soil and waters was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

5.0 Data Usability

Following a detailed review of the field and laboratory Quality Control it is considered that the assessment has provided acceptable QA/QC results and the data of the sampling and analysis program are usable with the modifications detailed below.

QC Conclusion:

☐ Data is directly usable

☒ Data is usable noting the following comments

☐ Data is usable after the following modifications

☐ Data is not usable

Comments:

Many of the RPDs were outside acceptable limits due to results being below the LOR, and LORs differing between laboratory methods. RPDS greater than 50% were also reported on results which were less than 10 times the LOR. One laboratory outlier was reported, however EHS Support considers that the field duplicate and ALS quality assurance and quality control discrepancies do not affect the overall usability of the laboratory analytical results, given the overall Data Quality Objectives were met:

Data Quality Objective	Acceptance Criteria	Comments
Preserve, store and transport soil samples so that sample integrity is not compromised	Use esky seals where provided by laboratory Clearly fill in labels with project details Provide copy of the chain of custody (COC) in a waterproof bag Use ice to chill samples to 0 – 6 °C	Attempt to chill was evident for all samples. ALS reported temperature of 3.8 °C. Security seals reported intact by ALS Note: Triplicate sample forwarded by ALS to Eurofins
The minimum number of sample duplicates and triplicates are collected and analysed	Requirement of duplicate and triplicate collection of 1 in 20 samples.	Duplicate and triplicate sample collected at a rate above minimum requirements
Relative percentage differences (RPDs) between field sample, duplicates and triplicates within acceptable range	For results >10 times LOR the RPD between 30-50% of analyte mean concentration No RPD range applied for results <10 times the LOR	Many results were reported below the LOR The RPDs which exceed 50% do not affect the overall usability of the laboratory analytical results
Laboratory analyses meet internal laboratory quality control procedures	MS and LCS - Generally 70-130% for inorganics/metals Blanks - < LOR Duplicates – 5 times LOR 0-50% RPD is acceptable.	All ALS laboratory analyses met the quality control, with the exception of: Laboratory duplicate outliers exist for total kjeldahl nitrogen. Matrix spike recovery for soils less than lower data quality objective for hexavalent chromium and total organic carbon. Matrix spike recovery level for waters not determined for iron and sulfate (as SO42-). Background level greater than or equal to the 4x spike level. Matrix spike recovery for water less than lower data quality objective for hexavalent chromium. Laboratory quality control sample frequency outliers in waters for dissolved organic carbon and fluoride. This is not expected to affect the validity of the results as acceptable recovers were achieved in the laboratory control sample analyses.

References

Quality control procedures have been adopted from the following guidance.

EPA Victoria (2009) Sampling and Analysis of Waters, Wastewaters, Soils and Wastes. Industrial Waste Resources Guidelines IWRG701

NEPM (1999) National Environment Protection (Assessment of Site Contamination) Measure. (ASC NEPM) As amended 2013

Standards Association of Australia. (2005). AS4482.1:2005 Guide to the Sampling and Investigation of Potentially Contaminated Soil: Non-volatile and Semi-volatile Compounds. Standards Australia.

USEPA (2002) Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8), EPA/240/R-02/004. Reissued 2008

RPD Calculations for Quality Check Samples

Project Name: Anglesea Ash Risk Assessment Site Investigation July 2022
Client: Alcoa
Project Number: AUS_C03568
EPA Number: N/A
Site Address: Coalmine Road, Anglesea Victoria
Project Manager: Rebecca Fraser

AS 4482.1-2005 *Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil- Non-volatile and Semi-volatile Compounds* (Standards Australia, 2005) states that the typical RPD which can be expected from acceptable field duplicates is < ± 30-50% of the mean concentration of the analyte, where the results are greater than ten times the limit of reporting (LOR).

Analyte grouping/Analyte	Units	LOR (ALS)		ALS analysis ANG-22-0055		ALS analysis ANG-22-0055_DUP		Eurofins analysis ANG-22-0055_TRIP	Primary & duplicate RPD %	Primary & triplicate RPD %
Sample date				4/07/2022		4/07/2022		4/07/2022		
Chloride	mg/L	1		**5**		**5**		**6.3**	0%	23%
Fluoride (Total)	pH units	0.01		**0.1**	**<**	0.1	<	0.2	0%	0%
pH (units)	mg/L	1		**6.11**		**6.06**		**6**	1%	1%
Sulfate as SO4	mg/L	1		**7**		**7**		**4.8**	0%	37%
Alkali Metals										
Calcium	mg/L	1	<	1	<	1	<	0.5	0%	0%
Magnesium	mg/L	1	<	1	<	1	<	0.5	0%	0%
Potassium	mg/L	1	<	1	<	1	<	0.5	0%	0%
Sodium	mg/L	1		**5**		**5**		1	0%	133%
Alkalinity (speciated)										
Bicarbonate Alkalinity (as CaCO3)	mg/L	1		**2**		**2**	**<**	20	0%	164%
Carbonate Alkalinity (as CaCO3)	mg/L	1	<	1	<	1	**<**	20	0%	0%
Hydroxide Alkalinity (as CaCO3)	mg/L	1	<	1	<	1	**<**	20	0%	0%
Total Alkalinity (as CaCO3)	mg/L	1		**2**		**2**	**<**	20	0%	164%
Heavy Metals										
Aluminium	mg/L	0.05		**1.19**		**1.23**		**1.8**	3%	38%
Antimony	mg/L	0.1	<	0.1	<	0.1	<	0.05	0%	0%
Arsenic	mg/L	0.05	<	0.1	<	0.1		**0.03**	0%	108%
Barium	mg/L	0.1	<	0.1	<	0.1	<	0.5	0%	0%
Beryllium	mg/L	0.1	<	0.05	<	0.05	<	0.01	0%	0%
Boron	mg/L	0.1	<	0.1	<	0.1		**0.33**	0%	107%
Cadmium	mg/L	0.1	<	0.05	<	0.05	<	0.005	0%	0%
Chromium	mg/L	0.1	<	0.1	<	0.1	<	0.01	0%	0%
Cobalt	mg/L	0.1	<	0.1	<	0.1	<	0.05	0%	0%

Environmental Quality Control Check

Project Details:

PROJECT: Anglesea Ash Risk Assessment Site Investigation June/July 2022
CLIENT: ALCOA
PROJECT NUMBER: AUS_C03568
EPA NUMBER: N/A
SITE ADDRESS: COALMINE ROAD, ANGLESEA VICTORIA
PROJECT MANAGER: REBECCA FRASER
REPORT REVIEWED:
ALS EM2212813 July 2022
Eurofins 903790 July 2022

Fieldworks Conducted:

- **2022 June/July soil sampling in the vicinity of consolidated ash area conducted in accordance with 2022 June SAQP**
- **Six primary, 1 duplicate and 1 triplicate samples collected for totals and leachable fraction (pH2.9 and deionised water) analysis**

Laboratories Used:

PRIMARY: ALS
SECONDARY: Eurofins

Laboratory Batch Numbers:

PRIMARY: ALS EM2212813 July 2022
SECONDARY: Eurofins 903790 July 2022

Data Quality Objectives:

- Preserve, store and transport soil samples so that sample integrity is not compromised
- The minimum number of sample duplicates and triplicates are collected and analysed
- Relative percentage differences (RPDs) between field sample, duplicates and triplicates within acceptable range
- Laboratory analyses meet internal laboratory quality control procedures

1.0 Soil Sampling

	Yes	No	Comment
1. Was the soil sampling methodology adequate?	☒	☐	
2. Were soil bore samples collected directly from push tubes?	☒	☐	
3. Were the soil sampling locations adequate?	☒	☐	
4. Does the sample density confirm to Australian Standard 4482.1?	☒	☐	AS4482.1 not relevant for this sampling event as the objective for sampling and analysis was to evaluate the impacts of the former discharge on underlying fill material
5. Were samples composited?	☐	☒	
6. Were samples adequately selected for analysis based on field observations?	☒	☐	Sample selection based on mbgl as detailed within the SAQP
7. Were samples selected for analysis from adequate depth ranges?	☒	☐	As outlined in the SAQP, where field conditions allowed
8. Were samples analysed for adequate analytical suites?	☒	☐	Analytes were selected based on indicator analytes in ash and ash pond water/leachate
9. Were appropriate decontamination procedures used?	☒	☐	Nitrile gloves where used and replaced for each sample location
10. Were equipment calibration records provided?	☒	☐	n/a
11. Were sample locations clearly marked on a plan or collected by GPS?	☒	☐	
12. Were soil samples compared against relevant criteria	☐	☒	n/a
13. Where relevant, did soil sampling comply with the relevant SAQP?	☒	☐	

Comments:

None

Soil sampling was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

2.0 Field Quality Control - Soil

2.1 Soil QC Sample Summary:

	ALS	Eurofins
Laboratory Reference	EM2212813	903790
1. Number of days sampling	4	
2. Sampling Dates	29/06/2022 to 04/04/2022 inclusive	
3. Total Number of primary samples analysed	7	-
4. Number of Rinsate Blanks	-	-
5. Number of Field Blanks	-	-
6. Number of Trip Blanks	-	-
7. Number of Field Duplicates (blind)	1	-
8. Number of Field Triplicates (split)	-	1

2.2 Soil Analytical Suites:

Soil - Totals

	Number of primary samples analysed	Number of duplicate samples analysed	Number of triplicate samples analysed
Metals[1]	7	1	1
Major ions[2]	7	1	1
Fluoride	7	1	1
CEC	7	1	1
pH, EC, TSS	7	1	1

Notes:

1- Metals – Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn
2- Major ions – Ca, Mg, Na, K, SO4, Cl, alkalinity (speciated)

Soil – Leachable Fraction

	Number of primary samples analysed	Number of duplicate samples analysed	Number of triplicate samples analysed
Metals[1]	7	1	1
Major ions[2]	7	1	1
Fluoride	7	1	1
CEC	7	1	1
pH, EC	7	1	1

Notes:

1- Metals – Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, Zn
2- Major ions – Ca, Mg, Na, K, SO4, Cl, alkalinity (speciated)

3.0 Precision and Sample Handling

	Yes	No	Comment
1. Were NATA registered laboratories used?	☒	☐	
2. Did the laboratory perform the requested tests?	☒	☐	
3. Were the laboratory methods adopted NATA endorsed?	☐	☒	ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006. ED037 (Alkalinity): NATA accreditation does not cover the performance of this service
4. Were the laboratory reporting limits satisfactory?	☒	☐	
5. Was the NATA Seal on the reports?	☒	☐	
6. Were the reports signed by an authorised person?	☒	☐	
7. Were the samples in proper custody between the field and laboratory?	☒	☐	
8. Were the samples properly and adequately preserved?	☒	☐	
9. Were the samples received by the laboratory in good condition?	☒	☐	
10. Were the samples received by the laboratory chilled?	☒	☐	
11. Were samples analysed within the specified holding times?	☒	☐	There was an ALS holding time breach for pH (EA002-AD), however, samples were delivered in time for analysis (3 days prior to due date)

Comments:

None

Precision and sample handling was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

3.1 Soil Field QC Assessment:

	Yes	No	Comment
1. Were an adequate number of blanks analysed?	No blanks collected or required		N/A
2. Were the analytical suites for the blank samples adequate?			
3. Were the blank sample results free of contamination?			
4. Were an adequate number of replicate samples analysed?	☒	☐	
5. Were the analytical suites for the replicate samples adequate?	☒	☐	
6. Were the replicate RPDs within acceptable limits?	☐	☒	Many of the results were reported below LOR
7. Were any elevated RPDs adequately explained?	☒	☐	Differences between laboratory LORs account for most elevated RPDs

Comments:

- Many of the RPDs were outside acceptable limits due to results being below the limit of reporting (LOR), and LORs differing between laboratory methods. RPDs greater than 50% were also reported on results which were less than 10 times the LOR. Remaining RPDs exceeding 50% do not affect the overall usability of the laboratory analytical results.

Field QC for soil was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

4.0 Laboratory Internal Quality Control – Soil and Water

	Primary Lab Batch: EM2212813	Secondary Lab Batch: 903790
1. Were all the laboratory method blanks free of contamination?	Yes	Only 1 sample analysed no QC provided
2. Number of the laboratory duplicate outliers?	0	
3. Number of the laboratory control sample (LCS) outliers?	0	
4. Number of the surrogate recovery outliers?	0	
3. Number of matrix spike (MS) outliers?	1	
4. Number of laboratory quality control sample frequency outliers?	0	

Comments:

Matrix spike recovery level in water not determined for leachable zinc. Background level greater than or equal to the 4x spike level. This is not expected to affect the validity of the results as acceptable recovers were achieved in the laboratory control sample analyses.

Laboratory Internal QC for soil was:

☒ Satisfactory ☐ Partially Satisfactory ☐ Unsatisfactory

5.0 Data Usability

Following a detailed review of the field and laboratory Quality Control it is considered that the assessment has provided acceptable QA/QC results and the data of the sampling and analysis program are usable with the modifications detailed below.

QC Conclusion:

☐ Data is directly usable

☒ Data is usable noting the following comments

☐ Data is usable after the following modifications

☐ Data is not usable

Comments:

Many of the RPDs were outside acceptable limits due to results being below the LOR, and LORs differing between laboratory methods. RPDS greater than 50% were also reported on results which were less than 10 times the LOR. One laboratory outlier was reported, however EHS Support considers that the field duplicate and ALS quality

assurance and quality control discrepancies do not affect the overall usability of the laboratory analytical results, given the overall Data Quality Objectives were met:

Data Quality Objective	Acceptance Criteria	Comments
Preserve, store and transport soil samples so that sample integrity is not compromised	Use esky seals where provided by laboratory Clearly fill in labels with project details Provide copy of the chain of custody (COC) in a waterproof bag Use ice to chill samples to 0 – 6 °C	Attempt to chill was evident for all samples. ALS reported temperature of 1.5 °C. Security seals reported intact by ALS Note: Triplicate sample forwarded by ALS to Eurofins
The minimum number of sample duplicates and triplicates are collected and analysed	Requirement of duplicate and triplicate collection of 1 in 20 samples.	Duplicate and triplicate sample collected at a rate above minimum requirements
Relative percentage differences (RPDs) between field sample, duplicates and triplicates within acceptable range	For results >10 times LOR the RPD between 30-50% of analyte mean concentration No RPD range applied for results <10 times the LOR	Many results were reported below the LOR The RPDs which exceed 50% do not affect the overall usability of the laboratory analytical results
Laboratory analyses meet internal laboratory quality control procedures	MS and LCS - Generally 70-130% for inorganics/metals Blanks - < LOR Duplicates – 5 times LOR 0-50% RPD is acceptable.	All ALS laboratory analyses met the quality control, with the exception of the matrix spike recovery level which was not determined for leachable zinc. This is not expected to affect the validity of the results as acceptable recovers were achieved in the laboratory control sample analyses.

References

Quality control procedures have been adopted from the following guidance.

EPA Victoria (2009) Sampling and Analysis of Waters, Wastewaters, Soils and Wastes. Industrial Waste Resources Guidelines IWRG701

NEPM (1999) National Environment Protection (Assessment of Site Contamination) Measure. (ASC NEPM) As amended 2013

Standards Association of Australia. (2005). AS4482.1:2005 Guide to the Sampling and Investigation of Potentially Contaminated Soil: Non-volatile and Semi-volatile Compounds. Standards Australia.

USEPA (2002) Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8), EPA/240/R-02/004. Reissued 2008

Appendix G Bore Logs 2021 and 2022

EHS Support

Drilling Log
Soil Bore ID: ADBH01

Comments

Project: Anglesea - Ash Risk Assessment		Client: Alcoa of Australia Limited	
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 7.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252551.0	Northing (m): 5746311.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			ANG-21-0180 0.50 m			CL-ML	Silty CLAY: brown - orange, low plasticity, soft, with trace fine grained sub-rounded to subangular sands and siltstone fragments
1.0						CL-ML	Silty CLAY: dark brown - dark grey, medium plasticity, soft, some ash, trace coal fragments
1.5			ANG_21_0181 (FD = ANG_21_0204) 1.50 m				
2.0						CL-ML	Silty CLAY: brown - orange, medium plasticity, soft, no ash or coal fragments
2.5						CL-ML	Silty CLAY: dark grey, low to medium plasticity, soft, trace fine grained sands, trace ash and coal fragments
3.0							
3.5							
4.0			ANG_21_0182 4.00 m			CH	CLAY: pale brown-grey, high plasticity, soft to firm
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH01

Comments

Project: Anglesea - Ash Risk Assessment		Client: Alcoa of Australia Limited	
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 7.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252551.0	Northing (m): 5746311.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
5.5			ANG_21_0208 5.00 m			CL	CLAY with COAL: dark brown-black, low-medium plasticity, soft to firm, brittle coal fragments
6.0						CL-ML	Silty CLAY: dark brown - grey, low plasticity, soft, trace subangular sub-rounded sands, with coal fragments
6.5							
7.0						CL-ML	Silty CLAY: brown - orange, medium plasticity, soft-firm, with trace fine grained sands.
7.5				7.50 m			Hole Terminated at 7.50 m Target depth reached
8.0							
8.5							
9.0							
9.5							
10.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: ADBH02

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 13-Sep-21	Date Finished: 13-Sep-21	Total Depth (mbgs): 4.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252611.0	Northing (m): 5746335.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			ANG-21-0184 0.00 m			SPG	Gravelly SAND: pale brown - orange, coarse grained sands, loose, subangular to sub-rounded, well graded
						CLS	Sandy CLAY: brown - pale brown, low - medium plasticity, stiff, fine - coarse grained sands, poorly graded
0.5							
1.0			ANG-21-0183 1.00 m			CL-ML	Silty CLAY: dark brown - grey - dark grey, very fine grey silts (possible ash), low plasticity clays
1.5						CH	CLAY: dark brown - black, medium to high plasticity, soft, moist, with very fine silt content (possible ash). Increasing silt content with depth
2.0							
2.5							
3.0							
3.5							
4.0			ANG-21-0185 4.00 m				
4.5				4.50 m			Hole Terminated at 4.50 m Target depth reached
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH03

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 9.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252655.0	Northing (m): 5746326.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			ANG_21_0186 0.30 m			SP-SM	Silty SAND: brown-pale brown, fine grained, poorly graded, loose, with trace low plasticity clays. Becoming moist with increasing clay content at 1 m
1.0							
1.5						CL-ML	Silty CLAY: brown-dark brown, medium to high plasticity, soft to firm, moist, with trace ash and coal fragments at 3 m
2.0							
2.5							
3.0			ANG_21_0187 3.00 m				
3.5							
4.0							
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH03

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 9.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252655.0	Northing (m): 5746326.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
5.5						CH	CLAY: pale brown - grey, high plasticity, very soft, wet, no ash. Sand encountered between 6 and 6.4 m (refer to below)
6.0			ANG_21_0188 6.00 m				
6.5						SP	SAND: Orange - red, fine grained, subangular to sub-rounded, loose. Poor recovery on SSA, observed at base of U63. Depth interval of sand is approximate
7.0			ANG_21_0206 7.00 m			CL	CLAY with COAL: dark brown - black, low to medium plasticity, brittle coal fragments, soft to firm
7.5							
8.0						CL-ML	Silty CLAY: dark brown to grey, low plasticity, soft, with trace subangular to sub-rounded sands. Increasing plasticity with depth
8.5							
9.0			ANG_21_0207 9.00 m				
9.5				9.40 m			Hole Terminated at 9.40 m Target depth reached
10.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH04

Comments

Project: Anglesea - Ash Risk Assessment		Client: Alcoa of Australia Limited	
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252671.0	Northing (m): 5746393.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			ANG_21_0189 0.20 m			CLS	Sandy CLAY: brown to pale brown, low to medium plasticity, fine to coarse grained subangular sands, poorly graded
1.0			ANG_21_0190 1.00 m			CL-ML	Silty CLAY: grey to dark grey, low plasticity, moist, with very fine silts (possibly ash) and trace coal
						CL-ML	Silty CLAY: brown to dark brown with some grey mottling, medium to high plasticity, soft, moist

0.5 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH04

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 8.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252671.0	Northing (m): 5746393.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
5.5			ANG_21_0191 5.00 m			CH	CLAY: brown-dark brown, medium to high plasticity, soft, moist
6.0							
6.5							
7.0							
7.5						CH	CLAY: pale brown, high plasticity, soft, wet to saturated, with very fine grained sands at base of soil bore
8.0				8.00 m			Hole Terminated at 8.00 m Target depth reached
8.5							
9.0							
9.5							
10.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB:GLB Log EHS-AU GROUNDWATER WELL GINT - ASH RISK ASSESSMENT.GPJ <<DrawingFile>> 5/20/2022 11:13 10.02.00.04 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH05

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 13-Sep-21	Date Finished: 13-Sep-21	Total Depth (mbgs): 4.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252742.0	Northing (m): 5746362.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			ANG_21_0192 0.30 m			CL-ML	Silty CLAY: brown, medium plasticity, soft, slightly moist
1.0						CL-ML	Silty CLAY: dark brown to dark grey, medium plasticity, possible ash (trace), moist
1.5						CL-ML	Silty CLAY: light brown, medium plasticity, moist
2.0						CL-ML	Silty CLAY: dark grey to black, medium to high plasticity, soft, evidence of synthetic fibers at 3.5 m (possible fiber glass from conduit)
2.5							
3.0							
3.5							
4.0			ANG_21_0193 4.00 m				
4.5				4.40 m			Hole Terminated at 4.40 m Target depth reached
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB:GLB Log EHS-AU GROUNDWATER WELL GINT - ASH RISK ASSESSMENT.GPJ <<DrawingFile>> 5/20/2022 11:13 10.02.00.04 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH06

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 9.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252765.0	Northing (m): 5746440.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0			ANG_21_0195 0.00 m			CL-ML	Silty CLAY: grey to pale brown with orange mottles, low plasticity, soft
						CLS	Sandy CLAY: orange to pale brown, low plasticity with fine grained poorly graded sands
2.0						CL-ML	Silty CLAY: grey, low to medium plasticity, soft, dry with trace coal fragments and reworked high plasticity grey clays
3.0			ANG_21_0196 3.00 m			ML	Clayey SILT: dark grey to black, fine silts, low plasticity clays, loose with brittle coal fragments
4.0						SP-SM	Silty SAND: pale brown, fine to medium grained, subangular to sub-rounded, loose
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB:GLB Log EHS-AU GROUNDWATER WELL GINT - ASH RISK ASSESSMENT.GPJ <<DrawingFile>> 5/20/2022 11:13 10.02.00.04 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH06

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 9.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252765.0	Northing (m): 5746440.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
5.5						ML	Clayey SILT: dark grey to black, fine silts, low plasticity clays, loose with brittle coal fragments
6.0							
6.5							
7.0							
7.5							
8.0						CH	CLAY: brown to pale brown, high plasticity, soft, moist
8.5			ANG_21_0209 8.50 m			SP	SAND: white to pale grey, fine to medium grained, subangular, loose, dry. Limited sample taken due to poor recovery
9.0			ANG_21_0197 9.00 m			CH	CLAY: dark brown to dark grey, high plasticity, firm and dry
9.5				9.40 m			Hole Terminated at 9.40 m Target depth reached
10.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB:GLB Log EHS-AU GROUNDWATER WELL GINT - ASH RISK ASSESSMENT.GPJ <<DrawingFile>> 5/20/2022 11:13 10.02.00.04 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH07

Comments

Project: Anglesea - Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 8.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252811.0	Northing (m): 57436375.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5						SC	Clayey SAND: orange to light brown, coarse grained, subangular to sub-rounded, poorly graded, trace low plasticity clays. Lower depth of this layer is 1-1.4 m
1.0			ANG_21_0198 1.00 m				
1.5						CL-ML	Silty CLAY: dark brown to black, medium plasticity, trace fine grained sands. Upper depth of this layer is between 1-1.4 m
2.0							
2.5							
3.0						CLS	Sandy CLAY: brown to grey, low plasticity, fine to medium grained sands
3.5							
4.0			ANG_21_0199 4.00 m			CL-ML	Silty CLAY: dark brown to dark grey, low to medium plasticity, trace fine grained sands. Becoming wet and very soft and sticky at 6 m
4.5							
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB:GLB Log EHS-AU GROUNDWATER WELL GINT - ASH RISK ASSESSMENT.GPJ <<DrawingFile>> 5/20/2022 11:13 10.02.00.04 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH07

Comments

Project: Anglesea - Ash Risk Assessment		Client: Alcoa of Australia Limited	
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 8.40	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252811.0	Northing (m): 57436375.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
5.5						CL-ML	Silty CLAY: dark brown to dark grey, low to medium plasticity, trace fine grained sands. Becoming wet and very soft and sticky at 6 m *(continued)*
6.0							
6.5							
7.0			ANG_21_0200 7.00 m			MLS	Sandy SILT: black to dark grey, loose, trace low plasticity clays, coarse grained subangular sands. Possible Ash. Possible coal weathered from solid stem auger. Poor recovery in U63
7.5						CH	Clay: grey, high plasticity, soft, moist
8.0			ANG_21_0211 8.00 m				
8.5				8.40 m			Hole Terminated at 8.40 m Target depth reached
9.0							
9.5							
10.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH08

Comments

Project: Anglesea - Ash Risk Assessment		Client: Alcoa of Australia Limited	
Location: Anglesea		Project No.: AUS##C03568_2021	
Date Started: 14-Sep-21	Date Finished: 14-Sep-21	Total Depth (mbgs): 4.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m): 252827.0	Northing (m): 5746431.0
Hole Dia. (mm): 100	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: None	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South West Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: MR	Checked By: CS

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0.5			ANG_21_0201 0.30 m			SM	Silty SAND: light brown to orange, fine to medium grained sands, loose, trace low plasticity clays
1.0						CL-ML	Silty CLAY: dark brown to grey with orange mottling, medium plasticity, soft, moist with trace fine to medium grained sands
1.5							
2.0							
2.5							
3.0						CH	CLAY: dark brown, medium to high plasticity, soft, moist, trace silts
3.5							
4.0			ANG_21_0202 (FD = ANG_21_205 / FS = ANG_21_210) 4.00 m			CL-ML	Silty CLAY: dark brown to dark grey to black, medium plasticity, moist, soft, trace silts and possible ash with brittle coal fragments
4.5				4.50 m			Hole Terminated at 4.50 m Target depth reached
5.0							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH09

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 30-Jun-22	Date Finished: 30-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			ANG-22-0015 0.00 m			SC	Clayey SAND: fine to coarse grained, pale brown, firm, moist, with clay - low plasticity, firm, moist.
			ANG-22-0016 0.50 m				
1						ML-MH	SILT: fine to coarse grained, dark brown to grey, loose, slightly moist, with interstitial clay - medium plasticity, grey, firm.
						ML-MH	becomes moist with dark brown clay.
2							
3						CI-ML	Silty CLAY: medium plasticity, dark brown to grey, soft, moist, with some coal/gravel.
4						CI-ML	becomes low plasticity.
5			ANG-22-0017 5.00 m			CI-ML	becomes mottled orange, red and dark brown, with interstitial coal.
			ANG-22-0018 5.50 m				
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH10

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 30-Jun-22	Date Finished: 30-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			ANG-22-0019 0.50 m			SM	Silty SAND: fine to coarse grained, dark brown, firm, moist, with interstitial clay - medium plasticity, pale grey to dark brown.
1						CH	Sandy CLAY: high plasticity, grey to dark grey with white mottling, moist, soft, with sand - fine to coarse, poorly sorted, loose.
						CH	increasing clay content.
2						ML-MH	SILT: fine to coarse grained, black with some clay - medium plasticity, moist, soft.
3						CI-ML	Silty CLAY: medium plasticity, brown to orange, soft, moist, with some sand - fine grained, loose.
						CI-ML	becomes dark grey with trace angular gravels to 1.5 mm.
4						CI-ML	with some gravels.
						CI-ML	becomes brown to orange.
5			ANG-22-0020 5.00 m ANG-22-0021 5.50 m			SC	Clayey SAND: fine to coarse grained, orange, well sorted, medium plasticity clay, soft, moist.
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH11

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			ANG-22-0022 0.00 m			SC	Clayey SAND: fine to coarse grained, brown to dark brown, loose, slightly moist, medium plasticity clay, grey to brown.
			ANG-22-0023 0.50 m				
1						CH-MH	Silty CLAY: medium to high plasticity, pale grey, soft, moist.
						SC	Clayey SAND: fine to coarse grained, dark brown to grey, loose, moist, medium plasticity clay, orange to brown and some gravels, rounded to 5 mm.
2						CH-MH	Silty CLAY: high plasticity, pale grey with red and orange mottling, firm, moist.
						Cl	Sandy CLAY: medium plasticity, dark brown to grey, soft to slightly firm, moist, with some gravels to 5 mm and interstitial coal.
3						Cl	becomes soft with trace orange and brown.
4						Cl	with trace pale grey.
5			ANG-22-0024 5.00 m			Cl	becomes grey, moist to wet, very soft, with no gravel.
						CH	Sandy CLAY: high plasticity, dark brown to black, soft, moist, with interstitial coal and some coarse grained sand.
6				6.00 m		SC	Clayey SAND: fine to coarse grained, dark brown to black, loose, moist to wet, medium to high plasticity clay, dark brown. Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH12

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						CL	Sandy CLAY: low plasticity, brown to grey, firm to stiff, dry to slightly moist, with 30% quartz gravels, rounded to 5 mm.
1						CL	becomes red to orange, stiff.
2						CL	lens of coarse quartz sand.
						SC	Clayey SAND: fine to coarse grained,white to brown, loose, moist, with quartz gravels, rounded to 8 mm.
3						CH-MH	Silty CLAY: high plasticity, grey, soft, moist.
						SC	Clayey SAND: fine to medium grained, yellow to orange, loose, moist to wet.
						SC	with subangular quartz gravels to 8 mm.
4						CH	Sandy CLAY: high plasticity, pale grey, soft, moist.
						SC	Clayey SAND: fine to medium grained, orange to pale brown with high plasticity clay, grey, soft, moist.
5						SC	becomes wet.
						CI	Sandy CLAY: medium plasticity, brown to grey, stiff, moist, with fine grained sand.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH13

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			ANG-22-0026 0.50 m			SC	Clayey SAND: fine to coarse grained, dark brown to grey, loose, slightly moist, with some quartz gravels, subrounded to 8 mm and low plasticity clay.
1			ANG-22-0025 1.00 m			SC	becomes dark brown to black.
						Cl	Sandy CLAY: medium plasticity, brown to dark brown and orange, soft, moist, fine to coarse grained sand with some rounded quartz gravels to 5 mm.
2						Cl	becomes light brown to orange.
3						Cl	becomes low plasticity, pale grey with red and orange mottling and increasing sand content.
4						SC	Clayey SAND: fine to coarse grained, pale brown to grey, loose, moist with low plasticity clay.
5			ANG-22-0028 5.00 m			SC	becomes fine grained sand, pale brown to orange.
			ANG-22-0027 5.50 m			SM	Silty SAND: fine grained, yellow to orange, loose, moist, with some medium plasticity clay and rounded gravels to 25 mm.
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH14

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						CL	Sandy CLAY: low plasticity, brown with grey and orange, firm to stiff, dry, with 30% subrounded quartz gravels to 7 mm.
1						CI	becomes medium plasticity.
2						SC	Clayey SAND: fine to coarse grained, orange to red and brown, loose/soft, moist, with medium plasticity clay.
3						CI	lens of sandy CLAY: medium plasticity, with fine grained sand, brown orange and red mottling, stiff, moist.
						CI	with traces of white.
						CI	Sandy CLAY: medium plasticity, orange with red and brown mottling, stiff, moist, with fine grained sand.
4						SC	Clayey SAND: fine to medium grained, orange to red and brown, loose, moist, with soft, medium plasticity clay.
5							
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH15

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						CL	Sandy CLAY: low plasticity, dark brown/brown/grey mottling, firm to stiff, dry to slightly moist, with interstitial coal and some rounded quartz gravel to 8 mm.
2						CI	becomes medium plasticity.
3						SC	Clayey SAND: fine to medium grained, orange to red and pale grey, firm, slightly moist.
5						CI	with some quartz gravels, rounded to 8 mm.
6							Hole Terminated at 6.00 m Target depth reached

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH16

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						CL	Sandy CLAY: low plasticity, brown to dark brown with orange mottling, firm, slightly moist, with some rounded quartz gravels to 8 mm.
						SC	Clayey SAND: fine to coarse grained, light brown and grey mottling, firm, slightly moist, with some gravels and interstitial coal.
1						CL	Sandy CLAY: low plasticity, dark brown to grey, firm, dry to slightly moist, with interstitial coal.
2						CL	becomes moist
						CL	with trace white and pale grey
						CL	becomes orange
						CL	becomes dark grey to black with increased coal content.
3						SC	Clayey SAND: fine to coarse grained, orange to red, firm, slightly moist, clay: low plasticity, white.
4							
5							
						CL	Sandy CLAY: low plasticity, orange with grey and red mottling, firm, slightly moist, with fine to medium grained sand.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH17

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 04-Jul-22	Date Finished: 04-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						SC	Clayey SAND: fine to coarse grained, orange to red, loose, moist, with low plasticity clay and some quartz gravels, rounded to 5 mm.
1			ANG-22-0029 1.00 m			SC	becomes pale brown to yellow/orange
2			ANG-22-0031 2.00 m ANG-22-0030 2.50 m			Cl	Sandy CLAY: medium plasticity, dark grey/black to brown, slightly firm, moist, with coal.
3						Cl	becomes pale grey to brown with traces of orange, with increasing sand content.
4						Cl	becomes pale brown to grey with fine grained sand.
5						Cl	becomes pale brown to orange.
6			ANG-22-0034 5.50 m	6.00 m		Cl	with traces of red.
7							Hole Terminated at 6.00 m Target depth reached
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH18

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 04-Jul-22	Date Finished: 04-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						CL	Sandy CLAY: low plasticity, orange/brown to grey, firm, moist, with fine to coarse grained sand and gravels to 5 mm.
						SC	Clayey SAND: fine to coarse grained, dark grey to black, firm, slightly moist, with gravels.
						Cl	Sandy CLAY: medium plasticity, grey with red and brown mottling, firm, moist, with gravels and coal to 5 mm.
1						Cl-ML	Silty CLAY: medium to high plasticity, grey, soft, moist.
						Cl	Sandy CLAY: medium plasticity, grey with red and brown mottling, firm, moist, with gravels.
						Cl	becomes brown with orange and pale grey mottling, with coal.
2						SC	Clayey SAND: fine to coarse grained, brown/pale grey and orange, firm, moist.
3						SC	becomes grey with orange and black, with fine to medium grained sand
						CL-ML	Silty CLAY: low plasticity, pale grey.
4						Cl-ML	becomes medium plasticity, orange and grey.
						SC	Clayey SAND: fine to coarse grained, grey with orange and brown, firm, moist.
5						CH	Sandy CLAY: medium to high plasticity, brown with orange and grey mottling, with interstitial coal and fine to coarse grained sand.
						CH	becomes dark brown and orange.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH19

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 04-Jul-22	Date Finished: 04-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						Cl	Sandy CLAY: medium plasticity, orange/brown to grey, soft, moist, with some rounded quartz gravels to 5 mm.
						SC	Clayey SAND: fine to coarse grained, dark brown to grey, firm, slightly moist, with 30% rounded quartz gravels to 5 mm and coal.
1						SC	with trace medium grained, yellow to pale brown sand.
2						Cl	Sandy CLAY: medium plasticity, brown to orange with trace red and white, firm, moist to slightly wet, with some coal.
						Cl	becomes soft.
3						Cl	becomes orange with some quartz gravels to 10 mm.
4						SC	Clayey SAND: fine to coarse grained, orange and pale grey, firm, moist with trace gravels.
						SC	Lens of Silty CLAY: medium plasticity, white, firm.
5						SC	with interstitial coal.
						Cl	Sandy CLAY: medium plasticity, brown to orange with red, firm, moist, with fine grained sand.
						SW	SAND: fine to medium grained, orange with white and red, loose, moist.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH20

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 29-Jun-22	Date Finished: 29-Jun-22	Total Depth (mbgs): 5.50	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						SW-SM	Silty SAND: fine to coarse grained, grey to brown, loose, dry, with trace angular to subrounded gravels to 10 mm.
						SW-SM	with trace clay.
1						CH	Sandy CLAY: high plasticity, brown to grey with black, fine to coarse grained sand.
2			ANG-22-0032 2.00 m				
			ANG-22-0033 2.50 m				
3						CH-MH	Silty CLAY: high plasticity, brown to grey, with some angular to subrounded gravels to 5 mm.
4							
5						SM	Silty SAND: fine to medium grained, pale grey, well sorted, loose, dry, with trace angular to subrounded gravels to 10 mm. Hole terminated due to uncertainty around sampling in potential ash.
				5.50 m			Hole Terminated at 5.50 m Target depth reached
6							
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH20A

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 04-Jul-22	Date Finished: 04-Jul-22	Total Depth (mbgs): 7.20	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						Cl	Sandy CLAY: medium plasticity, orange/brown, firm, moist, with fine to medium grained sand.
						Cl	becomes dark brown to grey with coal and trace quartz gravels.
1						Cl	with interstitial coal/ash.
						SC	Clayey SAND: fine to coarse grained, grey to dark grey, loose, moist, with 20% quartz gravels to 12 mm.
2						SC	becomes dark brown to grey.
						Cl	Sandy CLAY: medium plasticity, orange/brown to grey, firm, moist, with quartz gravels, interstitial ash and coal throughout.
3						Cl	becomes brown to grey
4			ANG-22-0102 4.60 m				
5						Cl	becomes orange to brown
			ANG-22-0103 5.60 m			GW	Coal gravel: GRAVEL: black, coarse, angular, coal.
6							
7						SC	Clayey SAND: fine to coarse grained, brown to orange, loose, moist, with some rounded quartz gravels to 10 mm.
				7.20 m			Hole Terminated at 7.20 m Target depth reached
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH21

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 29-Jun-22	Date Finished: 29-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						CH-MH	Silty CLAY: high plasticity, brown to grey, firm, dry, with trace gravels.
						CH-MH	becomes black to brown.
1						CH-MH	with coal.
						CH-MH	Silty CLAY: high plasticity, brown to orange, firm, moist, with trace sand.
						CH-MH	becomes pale grey to grey, with some coal.
2						CL	Gravelly CLAY: low plasticity, black to grey, with trace coal gravels to 5 mm.
3						CH-MH	Silty CLAY: high plasticity, brown to pale grey, firm to stiff, moist, with trace gravels.
						CH	Sandy CLAY: high plasticity, dark grey/dark brown to brown, soft, with fine grained sand.
4							
5						CH	with trace coal.
						CH-MH	Silty CLAY: high plasticity, grey to black with brown and white, firm, wet, with trace angular to subrounded gravels to 5 mm and trace coal.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH22

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 29-Jun-22	Date Finished: 29-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						ML-MH	SILT: black, with some clay: high plasticity, moist, soft.
1			ANG-22-0035 1.00 m ANG-22-0036 1.50 m			CH-MH	Silty CLAY: high plasticity, black to orange, soft, moist, with trace angular gravels to 10 mm.
2						CH-MH	with silt and coal.
						CH-MH	becomes grey and black, with trace sand.
3							
4							
5			ANG-22-0037 5.00 m ANG-22-0038 5.50 m			CH-MH	becomes grey, black and red, with trace wood fragments.
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH23

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 30-Jun-22	Date Finished: 30-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						SW-SM	Silty SAND: fine to coarse grained, pale brown, soft/loose, moist, with 20% quartz gravels, rounded to subangular to 15 mm and trace gravels to 30 mm.
1						CL	Sandy CLAY: low plasticity, dark brown, firm, dry to slightly moist.
						CH	becomes moist with interstitial ash/coal.
2						CI-ML	Silty CLAY: medium plasticity, brown to grey, firm, moist.
						CI	Sandy CLAY: medium plasticity, dark brown to brown, firm, moist to wet, with trace coal.
3							
4							
5						CI	becomes brown to pale brown.
6						CI	becomes dark brown to black with higher coal content.
							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/8/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH24

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 30-Jun-22	Date Finished: 30-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						SW-SM	Silty SAND: fine to coarse grained, pale brown to brown with some rounded quartz gravels to 5 mm.
1						CH-MH	Silty CLAY: high plasticity, brown to grey, firm, moist, with some subrounded gravels to 5 mm.
2						Cl	Gravelly CLAY: medium plasticity, grey to dark brown, angular to subrounded gravels to 5 mm.
						Cl-ML	Silty CLAY: medium plasticity, pale brown to grey, soft, moist.
3						Cl-ML	becomes firm with some fine to coarse grained sand.
						Cl-ML	becomes mottled white to pale brown with no sand or gravels.
4						CL	Gravelly CLAY: low plasticity, grey to brown, 1 - 2 mm angular gravels.
5						SW-SM	Silty SAND: fine to coarse grained, pale brown, loose, moist.
						CH-MH	Silty CLAY: high plasticity, grey, firm, moist to wet.
6						CH-MH	becomes medium plasticity, soft, wet.
							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH25

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 30-Jun-22	Date Finished: 30-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): 1.00	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						SW-SM	Silty SAND: fine to coarse grained, pale brown, soft/loose, moist, with some rounded quartz gravels to 8 mm.
1 ▽			ANG-22-0039 1.00 m			Cl	Sandy CLAY: medium plasticity, dark brown to brown, soft, moist, with trace coal.
						Cl	Sandy CLAY: medium plasticity, dark brown/grey, soft to firm, wet, with trace orange/red mottling.
2			ANG-22-0041 2.00 m			Cl	becomes soft.
			ANG-22-0040 2.50 m				
3						CL	Sandy CLAY: low plasticity, mottled brown and grey, firm, moist.
						CL	becomes silty, medium plasticity, soft, with trace pink.
4			ANG-22-0044 4.00 m			SW-SM	Silty SAND: fine to coarse grained, pale brown, loose, wet, with some rounded quartz gravels to 6 mm.
						CL	Sandy CLAY: low plasticity,dark brown to grey with trace pale grey and orange, soft, wet.
5							
						CL	increasing sand content.
6				6.00 m		Cl-ML	Silty CLAY: medium plasticity, dark brown to grey, soft, wet, with trace sand and subangular gravels to 5 mm.
							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH26

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 30-Jun-22	Date Finished: 30-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						SW-SM	Silty SAND: fine to medium grained, brown to pale brown, soft, moist, with some rounded quartz gravels to 10 mm.
						Cl	Sandy CLAY: medium plasticity, pale brown to brown, soft, moist, with coarse grained sand.
						Cl	CLAY: medium plasticity, pale grey to white, soft.
1						SC	Clayey SAND: fine to coarse grained, pale brown to brown, soft, with medium plasticity clay.
						SC	becomes brown, wet.
						SC	becomes pale brown.
2						Cl	Sandy CLAY: medium plasticity, dark brown to grey, soft, moist, with trace gravels.
3						Cl	becomes dark grey with trace orange mottling.
4						Cl	with some gravel.
						SC	Clayey SAND: fine to coarse grained, pale brown, soft, moist, with some coal.
						Cl-ML	Silty CLAY: medium plasticity, dark brown to grey, soft, moist, with interstitial coal.
5						Cl-ML	becomes wet.
6						SC	Clayey SAND: fine to coarse grained, pale brown, soft, moist, with medium plasticity clay.
							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH27

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 29-Jun-22	Date Finished: 29-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						SW-SM	Silty SAND: fine to medium grained, brown to pale brown, loose, with some rounded quartz gravels to 2 mm.
1						SW-SM	with some high plasticity clay.
2						SC	Clayey SAND: fine to coarse grained, pale brown to brown, soft, with trace quartz gravels to 2 mm.
						CI-ML	Silty CLAY: medium plasticity, dark grey, soft, wet.
						CH	Sandy CLAY: high plasticity, brown to grey, soft, wet.
3						CH	Silty CLAY: high plasticity, dark grey.
4						SC	Clayey SAND: fine to coarse grained, brown to pale brown, with some gravels and trace coal.
						CI-ML	Silty CLAY: medium plasticity, grey, soft, wet.
5						CI-ML	with some ash.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH28

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 29-Jun-22	Date Finished: 29-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						SW-SM	Silty SAND: fine to medium grained, brown to pale brown, loose, with some rounded quartz gravels to 2 mm.
1			ANG-22-0042 1.00 m			SC	Clayey SAND: fine to coarse grained, pale brown to brown, moist, with trace quartz gravels.
						CI-ML	Silty CLAY: medium plasticity, brown to dark brown, soft.
2			ANG-22-0043 2.00 m			CL-CI	Sandy CLAY: dark grey to brown, with trace sand and gravel.
						CL-ML	Silty CLAY: low plasticity, dark grey to brown, soft, wet.
3							
						CL	Sandy CLAY: low plasticity, dark grey, soft, wet, with trace angular gravels to 5 mm.
4							
						CI-ML	Silty CLAY: medium plasticity, brown to grey, soft, wet, with trace angular gravels to 5 mm.
5						CI-ML	Sandy CLAY: medium plasticity, brown to grey, soft, wet.
						CI-ML	becomes light brown.
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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Drilling Log
Soil Bore ID: ADBH29

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 29-Jun-22	Date Finished: 29-Jun-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 35	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Push Tube	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: AM	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						SW-SM	Silty SAND: fine to coarse grained, brown to pale brown, loose, with some rounded quartz gravels to 5 mm.
1						SW-SM	becomes dark grey, with increased gravels.
						CH-MH	Silty CLAY: high plasticity, grey to brown, soft, moist.
2						CH-MH	becomes dark grey, wet.
						CH	Gravelly CLAY: high plasticity, dark grey, soft, moist, with angular gravels to 5 mm, likely coal.
3						CH-MH	Silty CLAY: high plasticity, grey to brown, soft, moist.
						CH-MH	with trace angular gravels to 5 mm.
4						CH-MH	no gravels present.
5						CH-MH	Silty CLAY: high plasticity, dark grey to brown with red, soft, moist, with some sand: fine to coarse grained, brown, loose, dry.
6							Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH30

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Shaun	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
			ANG-22-0046 0.50 m			CI-ML	Sandy CLAY: medium plasticity, dark brown to brown and grey, soft to slightly firm, moist, with fine grained sand. Traces of coal and silty clay: high plasticity, grey, soft.
1			ANG-22-0045 1.00 m			CI-ML	coal content increasing.
						CI-ML	with trace pale grey and orange.
2							
3			ANG-22-0047 3.00 m			CI-ML	becomes dark brown to orange, soft, with increasing sand content.
						CI-ML	becomes dark brown, with 10% gravel/coal.
4							
5						CI-CH	Sandy CLAY: medium to high plasticity, grey to brown, very soft, moist to slightly wet.
			ANG-22-0048 5.50 m				
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH31

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
0						CL	Sandy CLAY: low plasticity, dark brown to grey, firm, slightly moist, with some subrounded quartz gravel to 5 mm and coal.
1						CL	with trace orange and pale grey
2						CL	becomes medium plasticity
			ANG-22-0050 2.50 m			CL	becomes grey with increased sand content.
3			ANG-22-0049 3.00 m			CH-MH	Silty CLAY: high plasticity,light brown to grey, soft to slightly firm, moist to slightly wet, very fine silt, with trace coal.
						CH-MH	becomes medium plasticity
4						CL-CI	Sandy CLAY: low to medium plasticity, dark brown to grey, soft, moist to slightly wet, with trace coal and gravel.
						CL-CI	increased sand content, loose.
5			ANG-22-0052 5.00 m			SC	Clayey SAND: fine to coarse grained, dark brown to orange and grey, loose and soft, clay: medium plasticity, with some coal and gravel.
			ANG-22-0051 5.50 m				
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

EHS 1.02.1 LIB.GLB Log EHS-AU GROUNDWATER WELL ALCOA ANGLESEA ASH RISK ASSESSMENT_ADBH09-ADBH33.GPJ <<DrawingFile>> 30/9/2022 17:10 10.03.00.09 Datgel | Lib: EHS 1.02.1 2020-09-22 Prj: EHS 1.02.1 2020-09-22

EHS Support

Drilling Log
Soil Bore ID: ADBH32

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 01-Jul-22	Date Finished: 01-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						CL	Sandy CLAY: low plasticity, dark grey to brown, slightly firm, moist, with interstitial coal and trace sand: fine grained, orange.
1			ANG-22-0053 1.00 m			SC	Clayey SAND: fine to coarse grained, light brown to orange and dark brown, loose, moist, clay: low plasticity, with 20% rounded quartz gravels to 8 mm.
						SC	becomes dark grey to brown, moist to slightly wet.
2						CI	Sandy CLAY: medium plasticity, grey to dark brown and trace orange, firm, moist to slightly wet, coarse grained sand, with interstitial coal.
						CI	becomes medium to high plasticity.
3			ANG-22-0054 3.00 m				
						CI	increasing sand content becomes pale brown to orange.
4						SC	Clayey SAND: fine to coarse grained, pale brown to orange, loose, wet, clay: low plasticity, with trace gravels.
5			ANG-22-0055 5.00 m ANG-22-0055_DUP 5.00 m ANG-22-0055_TRIP 5.00 m				
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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EHS Support

Drilling Log
Soil Bore ID: ADBH33

Comments

Project: Alcoa Anglesea Ash Risk Assessment	Client: Alcoa of Australia Limited		
Location: Anglesea Power Station		Project No.: AUS_C03568	
Date Started: 04-Jul-22	Date Finished: 04-Jul-22	Total Depth (mbgs): 6.00	
Ground Surface (m AHD): N/A	Top Casing (m AHD): N/A	Easting (m):	Northing (m):
Hole Dia. (mm): 125	Water Level Initial (mbgs): N/A	Water Level Static (mbgs): N/A	Coord. System: MGA94 Zone 55
Concrete Coring (Y/N): N	NDD (mbgs): N/A	Headworks: N/A	Headworks height (mm): N/A
Screen Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Casing Dia. (mm): N/A	Length (m): N/A	Type/Size (mm): N/A	
Drilling Co.: South Western Drilling	Drill Rig: Geoprobe 7730DT	Method: Solid Auger	Bore Permit #: N/A
Drilled By: Brett	Driller's License: N/A	Logged By: CH	Checked By: RF

Depth (m)	Well Completion	PID (ppm)	Sample Collected	% Recovery	Graphic Log	USCS Classification	Material Description
						Cl	Sandy CLAY: medium plasticity, dark brown and orange, soft, moist, with fine to coarse grained sand.
1			ANG-22-0056 1.00 m			Cl	becomes grey to brown with orange and red mottling, with 50% interstitial coal.
						Cl	becomes black with trace orange, slightly wet, high coal content.
2						Cl	becomes firm.
						Cl	with trace rounded gravels to 6 mm.
3			ANG-22-0057 3.00 m			SC	Clayey SAND: fine to coarse grained, pale brown to orange, loose, slightly wet, clay: medium plasticity, orange to grey.
						Cl	Sandy CLAY: medium plasticity, grey to orange, soft, slightly wet, fine to coarse grained sand.
4						Cl	becomes wet.
5			ANG-22-0058 5.00 m			Cl	with some rounded quartz gravels to 8 mm.
6				6.00 m			Hole Terminated at 6.00 m Target depth reached
7							
8							

Concrete | Cuttings | Grout | Bentonite | Sand | Gravel

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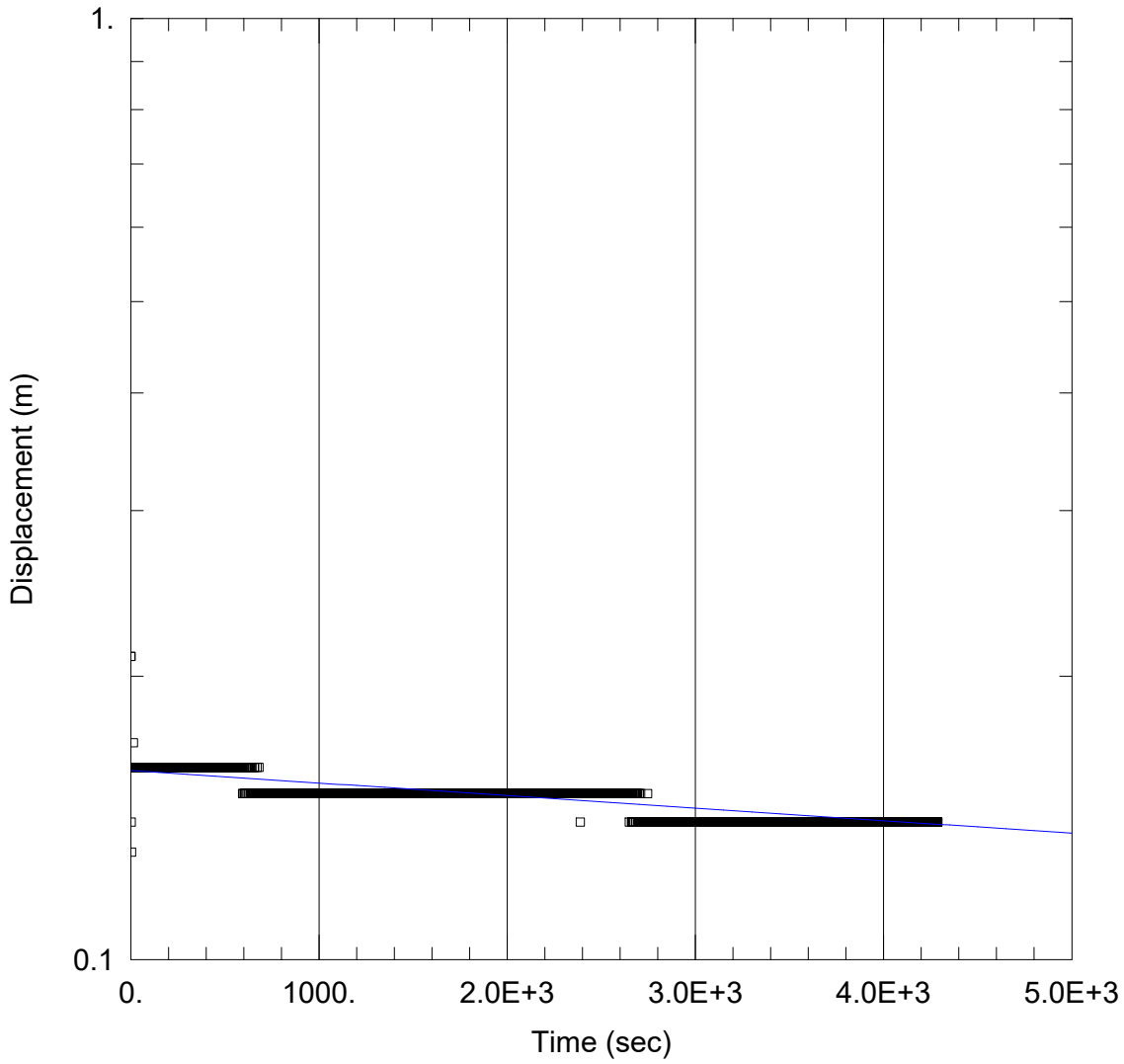
Appendix H Numerical Model Files

Numerical model files available as digital .gsz files only

Appendix I Falling Head Slug Tests



WELL TEST ANALYSIS

Data Set: C:\...\DBG MB6 Falling Head Test.aqt
Date: 05/31/22 Time: 17:15:23

PROJECT INFORMATION

Company: EHS Support
Client: Alcoa
Location: Anglesea
Test Well: DBG MB6
Test Date: 31 May 2022

AQUIFER DATA

Saturated Thickness: 9.64 m Anisotropy Ratio (Kz/Kr): 0.2

WELL DATA (DBG MB6)

Initial Displacement: 0.21 m
Total Well Penetration Depth: 9.64 m
Casing Radius: 0.05 m
Static Water Column Height: 9.64 m
Screen Length: 3. m
Well Radius: 0.1075 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01113 m/day y0 = 0.1588 m

Appendix J MRCP Appendix K Anglesea Mine Risk Assessment

EHS Support

Technical Appendix M
Anglesea Mine
Ash Assessment

Prepared for:
Alcoa

September 2017

Draft and Confidential

consider it done

DRAFT AND CONFIDENTIAL
Anglesea Mine
Ash Assessment - Alcoa Anglesea Mine Closure Plan

Prepared by:
EHS Support Pty Ltd

DOCUMENT CONTROL

PROJECT DETAILS

Project No.:	C001751
Report Revision No.:	3
Date of Issue:	06 September 2017
Project Manager	Chris Smitt
Project Director	Nigel Goulding

REPORT DETAILS

Title:	Technical Appendix M – Ash Assessment
Main Author(s)	Chris Smitt / Rebecca Fraser / Nigel Goulding
Client	Alcoa
Client Contact	Chris Rolland

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06 September 2017	1 (e)	Alcoa of Australia	Chris Rolland	Draft

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ACRONYMS

ANZECC	Australia The Australian and New Zealand Environment Conservation Council, Guidelines for Fresh and Marine Water Quality
AHD	Australian Height Datum
ANC	Acid Neutralizing Capacity
ASLP	Australian Standard Leaching Procedure
CEC	Cation Exchange Capacity
DAF	Dilution Attenuation Factor
EVG	Eastern View Group
EQO	Environmental Quality Objectives
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
NAPP	Net Acid Production Potential
NAG	Net Acid Generation
NEPM	National Environmental Protection Measure
MPA	Maximum Acid Potential
UEVF	Upper Eastern View Formation
LEVF	Lower Eastern View Formation
RSL	Regional Screening Level
SEPP	State Environmental Planning Policy
WoV	Water of Victoria

KEY TERMS OF REFERENCE

Stratification:

This report makes mention of lake or water body stratification. Where stratification is mentioned throughout the text, the following can be inferred: At different times of the year and/or under surface water flow regimes, the water body may experience "stratification" where three distinct layers occur throughout its vertical profile: Epilimnion: (top); Metalimnion: (middle); and Hypolimnion: (base). When a water body becomes stratified, generally the more anoxic, lower pH and higher dissolved metal concentrations are anticipated in deeper portions of the water body (the Metalimnion and Hypolimnion) with the upper layer (Epilimnion) experiencing higher alkalinity and pH. Further, rarely will a water body exhibit "stratification" all year around with various degrees of seasonal mixing, including complete mixing, occurring between the individual layers.

Alkaline Horizon:

Where the term "Alkaline horizon" is referenced, the following can be inferred. When a waterbody exhibits strong stratification, minimal mixing between the Metalimnion (middle of the water body) and Epilimnion (top of the water body) occurs. This results in higher alkalinity and pH water in the upper parts of the water body (Epilimnion).

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1.0 INTRODUCTION

The long-term goal for the rehabilitation of the coal pit void is the creation of a pit water body. Extraction of groundwater in the vicinity of the pit void by Alcoa ceased in early 2016 and the rebound of groundwater levels will gradually flood the pit void. Groundwater and rainfall will contribute to the filling of the pit void which analytical solutions estimate will take greater than 20 years and empirical models indicate longer filling time. The slow filling of the pit void increases the risk of acidity generation from materials within the pit void such as overburden and spoil, the exposed unworked coal seams within the pit walls and ultimately the materials that will be disturbed and moved into the pit as the pit walls are stabilised.

As part of the phased decommissioning of the Alcoa Anglesea power station facility and the rehabilitation of the coal pit void, ash from the ash ponds was relocated from the Power Station site to a designated area of the coal pit void. Ash was produced from the burning of brown coal (mined from the adjacent coal pit) and was settle and stored within Ash Ponds 1. Approximately 1,500,000 tons of ash has been historically placed within the pit and the more recent 125,000 tonnes placed in the pit making up 8% of the total ash. Alcoa has a licence issued by Victoria EPA which permits them to dispose of ash into the mine (EPA Victoria, 2007). Ash which has been historically stored within ash pond one (1) on the power station site. The majority of ash has been relocated with some residual materials with ash pond 1 currently being excavated and transported to the pit. All ash management works will be completed in 2017.

The ash from the recent ash removal activity has been placed in the eastern portion of the coal mine pit (near the existing Ash Piles) in an area of approximately 7 hectares. Based on topographical information for the area, the ash will be placed at an elevation of between -15 m Australian Height Datum (AHD) and -10 m AHD. Alcoa dredged and pumped these materials to a designated location and is allowing these materials to dewater and naturally consolidate. Once the materials are dry Alcoa is planning to compact these materials and then place up to 1 m of overburden materials (comprising silts and clays) over the ash materials. While the ash materials provide a potential ameliorating effect on the acidity of the water body, low permeability materials will be placed over the ash to prevent dissolution of metals and further degradation of water quality. Silt and clay materials from the historical mining activities have historically been stockpiled on-site and in combination with soils in close proximity to the ash pit will be used as cover. These materials will be placed in lifts and compacted to provide a barrier between the developing lake and ash deposits and limit the flux in surface water or groundwater.

The hydrogeologic evaluations and geochemical simulations detailed within this report have been developed to assess the potential long-term impacts associated with the recent placement of Ash within the mine pit. The ash material will be encapsulated with clay spoil and the flux to groundwater is limited by the presence of a low permeability basal clay unit within the base of the pit. Similarly, the placement of cover materials over the ash will limit interactions within the water body. The assessment provided below was conducted using a staged approach including soil sampling and Ash Pond water sampling and analysis, preliminary screening of data and geochemical modelling. Based on these assessments the potential for impacts on groundwater and surface water quality is considered limited and water quality is anticipated to be consistent with background and/or the existing conditions within the pit water body.

Environmental monitoring will be conducted to verify and validate the findings of this assessment and in combination with the short-term alkaline additions and the establishment of natural processes within the pit water body it is anticipated that water quality will improve over time. Future environmental monitoring will include:

- pH, nutrient and dissolved metal loading of Salt Creek prior to discharge into the pit water body
- pH, nutrients and metal speciation and distribution (horizontally and vertically within the pit water body and outflows from the water body.

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Future sampling will assess the quality of the water body and discharge outflows against the SEPP and ANZECC criteria. This program of sampling is discussed further in the Water Monitoring, Management and Contingency Plan (**EHS Support 2017(c)**).

1.1 Assessment Framework

The assessment of ash has been conducted in a staged manner to provide multiple lines of evidence in the assessment of the ash properties and potential impacts on surface water and groundwater quality. This has included:

1.1.1 Stage 1 - Sample collection and characterisation

Sample collection and laboratory analysis of solid and aqueous samples completed between June 2016 and May 2017:

- Anthropogenic ash material from ash pond 1
- Ash pond water from ash pond 1
- Upper Eastern View Formation (UEVF) groundwater from Well bore 15
- Australian Standard Leachate Procedure (ASLP) analysis on interaction between ash solids and ash pond water and ash solids and UEVF groundwater.
- Pit water body quality

The sample results are evaluated against generic criteria and in particular the leach testing and pond water results are compared to relevant surface water and groundwater criteria to identify chemicals of potential concern (COPCs) and determine what Dilution Attenuation Factors (DAFs) would be required in the environment to achieve regulatory criteria.

Ash pond water and ASLP results from ash pond solids and ash pond reagent water were compared to observe whether the ash pond water was in equilibrium with the ash pond solids. This would support the selection of ash pond water quality as the ash pond pore water in the transport simulation experiments.

1.1.2 Stage 2: Hydrogeologic Flux Assessment

This assessment uses hydrogeologic data for the site to quantify the fluxes during mine closure from surface water to groundwater (after re-diversion of Salt Creek) and from groundwater to surface water after establishment of the lake. Using these fluxes, the DAF for the fluxes from the Ash management areas and the receiving water bodies to determine if potential ASLP and Ash Pond water sample analytical results could result in exceedances of criteria.

This assessment was in addition to the groundwater modelling which evaluated the nature of groundwater/surface water interactions and advective transport of recharged surface water away from the pit void.

1.1.3 Stage 3 - Geochemical transport simulations

Geochemical transport simulations were used to look at the potentially chemical influences the ash solids in the base of the pit have on porewater. The porewater could represent UEVF groundwater flowing under a discharge scenario from the UEVF aquifer into the pit water body. Porewater could also comprise pit water body which could recharge through the ash material and into the UEVF aquifer. The aqueous and leachable analyses collected during Stage 1 were to be used in PHREEQC transport scenarios between the following solutions and solids using the hydrogeologic properties and DAF developed in Stage 2.

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A transport and exchange surface simulation was used to estimate the mass transport of a solution through the ash material. The direction of flow will either be from the UEVF aquifer into the pit water body or from the pit water body into the UEVF aquifer. The simulated effluent solutions from each transport scenario were then be mixed (using the ratios from Stage 2) with solutions representative of the pit water body and UEVF groundwater to determine the resulting concentrations in the receiving environment.

The stages of assessment are preliminary based on the groundwater and surface water quality collected during 2016 and 2017. As detailed within EHS Support 2017(o), additional characterisation of groundwater and surface water will be undertaken and this information will be used to refine and verify the concepts and evaluations presented in this review. This will take into account the future amendment activities which will modify the water quality of the pit water body.

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2.0 BACKGROUND

2.1 Historical Characterisation of Ash Materials

The Ash in the ponds was sourced from the ash materials generated from the furnace and electrostatic precipitators. The combined load of furnace ash and fly ash was transported by water sluices through piping to the Ash Ponds with the water recycled back into the process. In addition to the ash solids small volumes of water purification solids (iron and other impurities) were managed in the Ash ponds. It is unknown what the proportion of furnace ash to fly ash was deposited in the ash ponds, however, they are now likely to have mixed as a result of the sluicing to the ponds.

Historical characterisation of the Ash materials has been conducted by Alcoa and indicates that fly ash is enriched with trace metals reflecting with non-volatile metals accumulating in the Ash materials and or bound within the alkaline waste stream. Table 2-1 and Table 2-3 provide the chemical testing of the dry ash materials. Notable are the very low concentrations (< 10 mg/kg) of antimony, cadmium, chromium (hexavalent), mercury, molybdenum selenium, silver and tin. Arsenic, copper, lead and vanadium concentrations were also low (< 50 mg/kg).

Table 2-1: Major compound and element chemical composition of fly ash prior to mixture with water. Analysed by Alcoa in 2002 (Beattie, 2003)

Major compounds	% dry basis
Al_2O_3	5.13
CaO	18.63
MgO	17.55
Fe_2O_3	13.3
Na_2O	2.65
K_2O	0.19
TiO_2	0.09
SiO_2	14.58
SO_3	18.18
Cl	0.02
C	4.23
Bulk density (kg/m^3)	904

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Table 2-2: Trace element chemical composition of fly ash prior to mixture with water. Analysed by Alcoa in 2002 (Beattie, 2003) and 2006-2011 median values (GHD, 2012 53V audit)

Trace elements	mg/kg dry basis (2002)	mg/kg dry basis (2006-2011) median
As	7.5	19.5
Ag	4.2	3.2
B	4,148	3,133
Ba	2,974	7,035
Be	7.2	22.5
Cd	3.6	1.5
Cl	150	73
Cr (total)	29	23
Cr (VI)	<0.5	ND
Cu	11	36.5
Co	13	103
F	75	39
Hg	0.3	0.2
Mn	991	999
Mo	1.2	2
Ni	67	242
P	416	-
Pb	14	22
Sn	23	4.9
Se	7.4	5.3
Sb	0.67	1.1
V	12	20
Zn	105	367

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As shown in Table 2-3, the majority of minor ions with the ash are not soluble are reported below the limit of reporting (based on the limit of reporting at the time of analysis) in ash pond 1 water. These include: aluminium, arsenic, beryllium, cadmium, chromium, copper, cobalt, fluoride, iron, mercury, nickel, phosphorus, lead, tin, antimony, vanadium and zinc. This is most likely due to the pH of the ash ponds, which is not conducive for the solubility of most metals. Total dissolved solids are elevated mainly due to the major ion concentrations.

On the basis of the historical testing, the key constituents with potential to leach from the ash materials at high concentrations is limited to boron.

Table 2-3: Major and trace element chemical composition of ash pond 1 effluent. Analysed by Alcoa in 1999 (Beattie, 2003)

Element	mg/L
pH	9.5
Na	850
Ca	630
Mg	200
Cl	910
Sulfate	2,678 (date unknown)
Alkalinity total as CaCO3	<1
TDS	5,400
TSS	7
PO3	<0.5
Al	<0.005
As	<0.005
B	36
Ba	0.061
Be	<0.005
Br	1.1
Cd	<0.005
Cr	<0.005
Cu	<0.005
Co	<0.005
F	<0.5
Fe	<0.1
Hg	<0.001
Mn	0.1 (date unknown)
Mo	0.007
Ni	<0.005
P	<0.1
Pb	<0.005
Sn	<0.005
Se	0.006
Sb	<0.005
V	<0.005
Zn	<0.005

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2.2 Hydrogeology and Pit water body Geochemistry

Regional geology/hydrogeology of interest comprises two main hydrogeological units; the Eastern View Group (EVG) and the overlying Demons Bluff Group (DBG). The coal sequences targeted by the mine comprise the upper portions of the Upper East View Formation (UEVF). **Figure 2-1** provides a geological cross-section from the Otway ranges to the coast. The section indicates the location of the site and the coal beds relative to the water bearing sequences of the UEVF. The Lower East View Formation (LEVF), which has potable extraction wells, is located at depth and is separated from the UEVF by an aquitard (the middle east view formation, MEVF). Activities within the pit water body have no potential to impact on water quality within the LEVF.

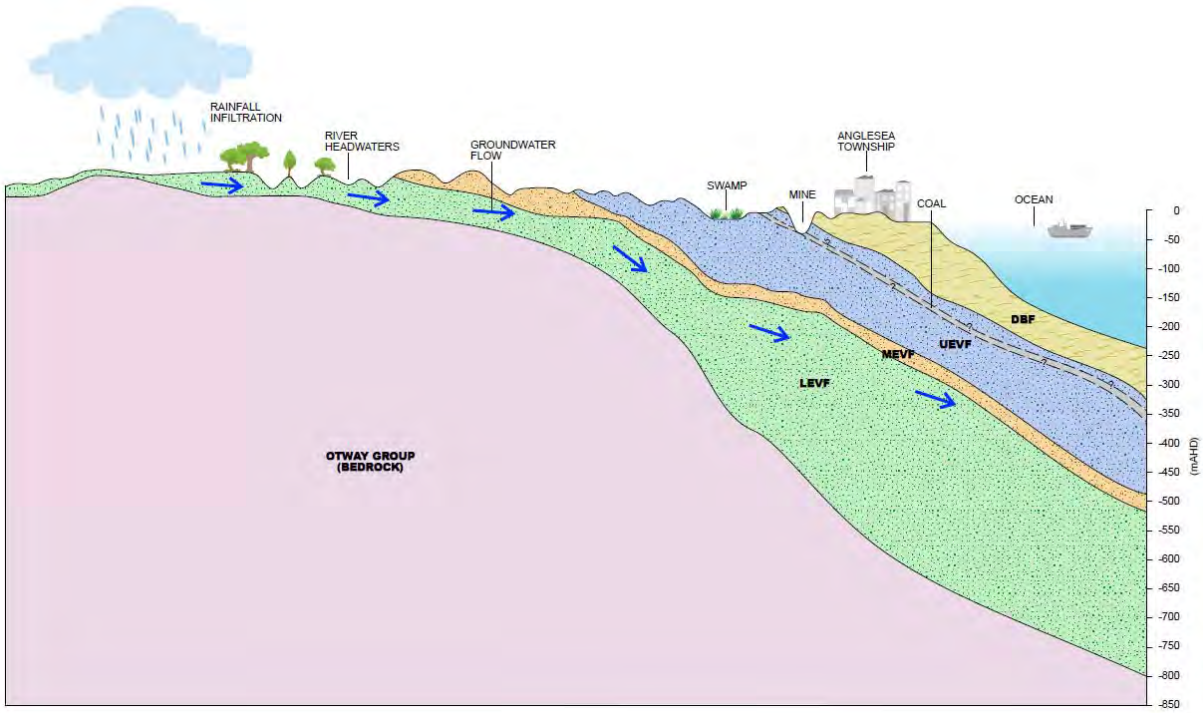

Figure 2-1 Regional Hydrogeological Cross-Section (Northwest to Southeast)

A basal clay unit is present beneath the main coal seam mined at the site and will separate the ash materials from the underlying UEVF. This unit which is between 3 to 10 m thick is plastic and exhibits low hydraulic conductivity.

As detailed in EHS Supports (2016), pumping of the UEVF for the provision of water to the power station and dewatering of the pit to facilitate mining has led to the development of a large cone of depression under the pit. The pit which was excavated to a depth of greater than -40 m AHD currently has a water level at around -38 m AHD with lake levels primarily a function of groundwater inflow (from the underlying UEVF) into the pit. Under this framework, groundwater flows are upward and therefore the potential for the flux of constituents from the buried Ash into the UEVF is considered limited and unlikely.

The planned pit closure approach involves rediversion of Salt Creek into the pit to accelerate both recharge of the underlying aquifer and pit water body filling. Under this framework, episodic flows from Salt Creek into the pit would result in lake levels higher than the underlying groundwater levels and potential flux (recharge) of the underlying UEVF.

The current pit water body quality is acidic (with a pH around 3) with the underlying groundwater exhibiting a pH of 5. Groundwater contact with oxidized pyritic materials and oxidation of iron-rich

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water is responsible for the decline in pH. Alcoa has implemented a range of works to limit acid production including the covering of coals with spoils to limit oxidation and as the lake fills and oxygen is precluded from entering soils with acid production rates anticipated to decline over time. In addition, Alcoa is proposing to undertake the active management of pit water body pH, seeking to maintain the pH during filling at above 5.

If rediversion of Salt Creek into the pit water body is approved, then ultimately the water quality of the water body will be a function of surface water quality. Calculations of pit filling indicate filling times with surface water will be approximately 20 years with groundwater only and 5 years with groundwater and surface water (Salt Creek only). On this basis, at least 75% of the water within the lake would be sourced from Salt Creek.

2.3 Background Surface Water Quality

Following the diversion of Salt Creek into the pit water body, the water quality within the lake will primarily be a function of surface water inflows. The 53V Audit (GHD, 2012) noted that inflows of low pH water were the result of acid drainage from the upper catchment (Marshy and Salt Creeks). The low pH of water from both creeks is likely to result in a broad range of metals being present in surface water at elevated concentrations. General discussion of the data for Salt Creek and Marshy Creek is provided below.

Salt Creek is an ephemeral surface water system and is dry during periods of low flow and/or drought (GHD, 2012). The pH of water within Salt Creek is usually less than pH 4 (net acidic) with electrical conductivity (EC) of between 1,220 – 2,330 µS/cm. Boron, zinc, iron and aluminium are generally observed (refer to **Table 2-4**) to exceed the relevant guideline limits (freshwater ecosystems).

The Upper Anglesea River (sometimes referred to as Marshy Creek) is located upstream of the former power station facility. Similar to Salt Creek, the surface water pH is usually less than pH 4 (net acidic) with EC in Marsh Creek between 1,320 – 2,800 µS/cm). Boron, zinc, iron and aluminium within Marshy Creek generally exceed the relevant guideline limits (Australian and New Zealand Environment Conservation Council [ANZECC] maintenance of ecosystems – freshwater 95% protection). Further discussion on the water quality of Salt Creek and the Upper Anglesea River is provided in the sections below.

2.4 Conceptual Exposure Model and Beneficial Uses

In accordance with the Department of Health and Ageing and enHealth Council, Commonwealth of Australia (enHealth, 2010) and National Environmental Protection Measure (NEPM, 2013) a key component of assessing potential risks is defining a conceptual exposure model. As noted described above the key contaminant transport pathways are associated with migration of constituents into surface water within the pit water body and groundwater (the UEVF) underlying the pit.

Direct human and ecological contact with the Ash Materials is considered an incomplete pathway as the materials will be placed below -10 m AHD (and therefore below the level of the final lake) and will also be covered with silts and clays. Further other criteria, including Effects Screening Levels (ESLs, for terrestrial receptors), management criteria are also not applicable in this type of setting. A generic screening of soils against direct contact and leachability criteria has been provided in the sections below for reference only.

In accordance with the State Environmental Protection Policy (SEPP), protected beneficial uses are defined based on general water characteristics. The SEPP for Waters of Victoria requires that surface waters be of a suitable quality and quantity to support that use or value. The beneficial uses for each segment of the water environment are marked in **Table 2-4** below (using a tick) and the relevant

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segments for the site and vicinity (as determined within the 53V Audit 2012) are highlighted. Further discussion of each of the segments based on the 53V Audit are provided in the subsections below.

Where natural background surface water conditions do not meet the SEPPs list of environmental quality objectives (EQOs) for the listed beneficial uses of the segment rivers and streams, the background levels are used to define the EQOs*; (Pg 12; Gazette 26/02/1988, SEPP WoV).* As noted above background pH and dissolved metals (Boron, zinc, iron and aluminium) in Salt Creek and the Upper Anglesea River exceed applicable ANZECC water quality standards

Table 2-4 Protected Beneficial Uses of Surface Water

Beneficial Uses	**Aquatic Reserves**	**Wetlands and Lakes**	**Rivers & Streams**					**Marine & Estuarine**				
			Highlands	**Forests-A**	**Forests-B**	**Cleared Hills & Coastal Plains**	**Murray & Western Plains**	**Estuaries & Inlets**	**Open Coasts**	**Port Phillip Bay**	**Western Port**	**Gippsland Lakes**
Aquatic ecosystems that are:												
Largely unmodified	✔		✔	✔	✔				✔	F6	F8	F3
Slightly to moderately modified		✔				✔	✔	✔				
Highly modified												
Water suitable for:												
Primary contact recreation	✔	✔	✔	✔	✔	✔	✔	✔	✔			
Secondary contact recreation	✔	✔	✔	✔	✔	✔	✔	✔	✔			
Aesthetic enjoyment	✔	✔	✔	✔	✔	✔	✔	✔	✔			
Indigenous cultural and spiritual values	✔	✔	✔	✔	✔	✔	✔	✔	✔			
Non-indigenous cultural and spiritual values	✔	✔	✔	✔	✔	✔	✔	✔	✔			
Agriculture and irrigation		✔	✔	✔	✔	✔	✔					
Aquaculture		✔		✔	✔	✔	✔	✔	✔			
Industrial and commercial use				✔	✔	✔	✔	✔	✔			
Human consumption after appropriate treatment		✔	✔	✔	✔	✔	✔					
Fish, crustacea & molluscs for human consumption		✔	✔	✔	✔	✔	✔	✔	✔			

Green shading – beneficial use segment upstream of site
Blue shading – beneficial use segment downstream of site

In the 53 V Audit (2012) for the site the following classifications were applied to the site by the Auditor:

- Salt and Marshy Creeks upstream of the Alcoa site – Forest-B (Otway Ranges)
- At the confluence of flows from Marshy and Salt Creeks and the licensed discharge (SP1) - Wetlands.
- Downstream of the mixing zone and within the Anglesea River – 'Estuaries and inlets' segment

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The groundwater SEPP defines a range of beneficial uses based on Total Dissolved Solids (TDS) in groundwater. The lower the TDS, the greater the range of potentially beneficial uses (**Table 2-5**). Based on water quality data collected by Alcoa, the groundwater within the UEVF is classified as Segment B.

Table 2-5 Protected beneficial uses of the segments

Beneficial Uses	Segments (mg/L TDS)				
	A1 (0-500)	A2 (501-1,000)	B (1,001-3,500)	C (3,501-13,000)	D (greater than 13,000)
1. Maintenance of ecosystems	✓	✓	✓	✓	✓
2. Potable water supply:					
Desirable	✓				
Acceptable		✓			
3. Potable mineral water supply	✓	✓	✓		
4. Agriculture, parks and gardens	✓	✓	✓		
5. Stock watering	✓	✓	✓	✓	
6. Industrial water use	✓	✓	✓	✓	✓
7. Primary contact recreation (e.g. bathing, swimming)	✓	✓	✓	✓	
8. Buildings and structures	✓	✓	✓	✓	✓

*consolidated version of the State Environment Protection Policy (Groundwaters of Victoria) 2002

In accordance with the SEPPs, water quality objectives for the protected beneficial uses are primarily sourced from 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality', Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ, 2000). Criteria utilised for each of the beneficial uses listed above include with applicable criteria are included in **Table 2-6** below:

- Maintenance of ecosystems beneficial use – the ANZECC/ARMCANZ (2000) 95% protection level trigger values for freshwater have been used, which are applicable to ecosystems that could be classified as slightly to moderately disturbed.
- Potable water supply – not applicable based on groundwater and surface water classification
- Potential mineral water supply – not applicable as the site is not located in a mineral springs district (Department of Minerals and Energy (1981), Groundwater Resources Map, 1981, 1:1,000,000 scale).
- Agriculture, parks and gardens – ANZECC/ARMCANZ (2000) Irrigation Water Guidelines.
- Stock watering – ANZECC/ARMCANZ (2000) Livestock Drinking Water Guidelines
- Industrial Water Use – ANZECC/ARMCANZ (2000) provides no specific guidance values and quality requirements are highly specific to the type of process. No criteria have been included in Table 2-6.
- Primary contact recreation – Australian Drinking Water Guidelines (ADWG, 2004) have been used as a generic guideline value however these are highly conservative.
- Buildings and Structures – There are no concentration based criteria and none have been included in Table 2-6.

In accordance with the SEPP, where background water quality precludes potential beneficial uses water quality objectives are defined as background. The background water quality for the UEVF and surface water in the catchment is provided as **Table 2-7.**

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Table 2-6 Adopted Water Assessment Criteria (mg/L)

Constituent	Maintenance of Ecosystems (modified ecosystems)[1]	Agriculture Parks and Gardens[2]	Stock Watering[3]	Primary Contact and Recreation[4]	Dutch General Guidelines		NEPM GIL's[5] Freshwater	NEPM GILs/ Drinking Water
					Target value	Intervention value		
Aluminium	NE[6]	NE	NE	NE	NE	NE	0.055[7]	NE
Arsenic	0.013[8]	0.1	0.5	0.007	0.01	0.06	0.024[9]/0.0138	0.01
Barium	NE	NE	NE	700	0.05	0.625	2[10]	2
Boron	0.37	0.5	5	4	NE	NE	0.37	4
Cadmium	0.0002	0.01	0.01	0.002	0.0004	0.006	0.0002	0.002
Chromium	0.001[11]	0.19	1	0.05	0.001	0.03	0.00111	0.05
Copper	0.0014	0.2	0.5	1	0.015	0.075	0.0014	2
Lead	0.0034	2	0.1	0.001	0.015	0.075	0.0034	0.01
Iron	ID[12]	ID	ID	ID	NE	NE	NE	NE
Manganese	1.9	0.2	NE	0.1	NE	NE	1.9	0.5
Molybdenum	0.034[13]	ID	ID	ID	0.005	0.3	0.0510	0.05
Mercury	0.0006	0.002	0.002	0.001	0.00005	0.0003	0.0006	0.001
Nickel	0.011	0.2	1	0.002	0.015	0.075	0.011	0.02
Selenium	0.011	0.05	0.02	0.01	NE	NE	0.005	0.01
Tin	ID	ID	ID	ID	NE	NE	NE	NE
Vanadium	0.006	0.5	ID	ID	NE	NE	0.1[14]	NE
Zinc	0.008	2000	20	3	0.065	0.8	0.008	NE
Total Dissolved Solids	3,500	3,500	3,500	3,500	NE	NE	3,500	
Sulfate	ID	ID	1,000	2,500[15]	NE	NE	50010	500
Nitrate	31.9	ID	400	500[16]	NE	NE	0.7	
Benzene	0.95	NE	NE	0.001	0.0002	0.03	0.95	
Toluene	NE	NE	NE	0.005	0.007	1	NE	

[1] ANZECC (2000) – Modified Ecosystems (95%)
[2] ANZECC (2000) National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality
[3] Australian Drinking Water Guidelines (ADWG, 2004)
[4] Dutch intervention Criteria (1999)
[5] Fresh Waters
[6] NE- not established
[7] at pH>6.5
[8] Arsenic V
[9] Arsenic III
[10] Drinking water
[11] Chromium VI
[12] ID – Insufficient data to derive a reliable value
[13] Low reliability trigger value
[14] Marine water
[15] Selected value is 10x the aesthetic drinking water standard
[16] Selected value is 10x the health drinking water standard

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Constituent	Maintenance of Ecosystems (modified ecosystems)[1]	Agriculture Parks and Gardens[2]	Stock Watering[3]	Primary Contact and Recreation[4]	Dutch General Guidelines		NEPM GIL's[5] Freshwater	NEPM GILs/ Drinking Water
					Target value	Intervention value		
Ethylbenzene	NE	NE	NE	0.003	0.004	0.15	NE	
Xylene	0.55	NE	NE	0.02	0.0002	0.07	0.35	
TPH (C10-C36)	NE	NE	NE	NE	NE	0.06	NE	

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Table 2-7: Background Groundwater and Surface Water Quality

Constituent	Maintenance of Ecosystems (modified ecosystems)[17]	Agriculture Parks and Gardens[18]	Stock Watering[19]	Primary Contact and Recreation[20]	Median Concentrations 2009 - 2017 (Surface Water, mg/L)			Median Concentrations 1989 - 2016 (Groundwater, mg/L)
					Pit Water Body (total analyses)	Salt Creek, SV2 (total)	Upper Anglesea River, AV2 (total)	UEVF (total)
pH[21]	6.5 - 8	6 – 9	6 - 9	5 - 9	3.69	3.87	3.39	**5.79**
Aluminium	0.055	5	5	0.2	1.3	59.3	254	**0.14**
Arsenic	0.013	0.1	0.5	0.007	<0.006	0.003	0.031	<0.001
Boron	0.37	1	5	4	2.38	0.22	<0.05	0.08
Cadmium	0.0002	0.01	0.01	0.002	0.002	0.00051	0.001	<0.0002
Chromium	0.001	0.19	1	0.05	0.0015	0.0035	0.069	<0.001
Copper	0.0014	0.2	0.5	1	0.0055	0.00065	0.005	<0.001
Lead	0.0034	2	0.1	0.001	0.002	0.002	0.012	<0.001
Manganese	1.9	0.2		0.1	0.38	1.535	3.14	0.97
Mercury	0.0006	0.002	0.002	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	0.034[22]				<0.001	<0.001	<0.001	<0.001
Nickel	0.011	0.2	1	0.002	0.03	0.563	1.29	0.004
Selenium	0.011	0.05	0.02	0.01	0.008	0.00095	0.14	<0.001
Vanadium	0.006	0.5			<0.006	0.01	<0.01	<0.001
Zinc	0.008	2	20	3	0.1	0.932	1.37	0.01
TDS	3,500	3,500	3,500	3,500	1,950	722	1,618	1018
Sulfate			1,000	2,500[23]	815	520	3,260	146
Nitrate	0.032				<0.01	<0.01	<0.01	<0.01
Total Nitrogen	0.5				0.3	1.3	Not measured	<0.5
Ammonia	0.02				0.04	0.025	0.02	0.15
Total Phosphate	0.05				Not measured	Not measured	Not measured	Not measured
Total Reactive Phosphate	0.02				Not measured	Not measured	Not measured	Not measured

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[17] ANZECC (2000) – Modified Ecosystems (95%)
[18] ANZECC (2000) National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality
[19] Australian Drinking Water Guidelines (ADWG, 2004)
[20] ANZECC (2000) National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality
[21] ANZECC (2000) National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality
[22] Low reliability trigger value
[23] Selected value is 10x the health drinking water standard

3.0 STAGE ONE – FIELD SAMPLE COLLECTION AND CHARACTERISATION

3.1 Field Sample Collection

The samples collected from Ash pond 1 have been used to provide detailed chemical information on the characteristics of the ash material and clay material used to construct the perimeter berm of ash pond 1. The ash ponds were constructed during the late 1950's and detailed records are not available regarding the material and engineering used to construct the ash ponds. The berm was only sampled in one location to confirm the material used to construct the berm wall. The berm material will not be excavated and transported to the pit void, it will remain in-situ and covered with locally available soils. Decommissioning of the ash ponds will provide further information on the construction and extent of the ash pond basal and sidewall containment engineering. The solid and aqueous samples have been restricted to three samples (in different locations). The decision to take this number of samples was based on the consistent geochemical quality of the lignite coal that was combusted to form the ash. The results of this sampling and analysis event has also been compared to historical ash analytical results to confirm the anticipated homogeneity.

Ash solid and aqueous samples were collected during June 2016 (refer to **Table 3-1** below).

Table 3-1: Solid and Aqueous samples

Sample Location	Sample Type	Sample Analytical Test	Number of Sample Locations	Total number of Samples
Ash Pond 1	Solid - perimeter berm	Solid characterisation and Ash solid and ash pond water leachate procedure	1	1
	Solid - main pond		3	3
	Surface Water - ash pond 1 water	Pond Water characterisation and Ash solid and ash pond water leachate procedure	3	3

The solid and aqueous samples were subjected to a detailed solid and wet chemistry analytical schedule (refer to **Table 3-2** and **Table 3-3**).

Table 3-2: Analytical Schedule for solid sampling

Analytical Group	Analytical Parameter
Laboratory analysis major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate and carbonate)
Laboratory analysis miscellaneous	Soluble sulfate
Laboratory analysis minor ions	Fluoride
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury
Laboratory analysis (soluble) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury
Laboratory analysis physico-chemical	Particle size distribution (ash solids only), moisture content, exchangeable cations, pH, total acidity, total organic carbon
Laboratory analysis	pH1:2 and EC1:2
Laboratory analysis	Maximum potential acidity (MPA)

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Analytical Group	Analytical Parameter
Laboratory analysis	Acid Neutralising Capacity (ANC)
Laboratory analysis	Net Acid Producing Potential (NAPP)
Laboratory analysis	Net Acid Generation (NAG)

Table 3-3: Analytical Schedule for aqueous sampling

Analytical Group	Analytical Parameter
Field parameters	pH, temperature, turbidity, electrical conductivity, dissolved oxygen, redox potential
Laboratory measured 'field' parameters (where instrumentation is not available)	pH, turbidity, electrical conductivity, redox potential
Laboratory analysis major ions	Calcium, magnesium, sodium, potassium, sulfate, chloride, alkalinity (total, bicarbonate and carbonate), total hardness, total dissolved solids
Laboratory analysis minor ions	Fluoride
Laboratory analysis nutrients	ammonia as N, ammonium as N, nitrate as N, total kjeldahl nitrogen, total phosphorus, total organic carbon, dissolved organic carbon
Laboratory analysis (total) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury
Laboratory analysis (dissolved) metals	Aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, ferrous iron (dissolved), manganese, molybdenum, nickel, tin, lead, vanadium, zinc and mercury

A modified Australian Standard Leachate Procedure (ASLP) was also used to derive 'leachate' solutions from the mixing of ash solids with either UEVF groundwater or ash pond water.

3.2 Laboratory Analytical Results

The ash pond water samples have been characterised for water types and major ion distribution relationships using the AQaq program. AQqa (part of the Rockware group of software programmes) can be used to check the internal consistency and carbonate equilibria of data sets and plot a variety of graphs including Piper plots. It can also be used to compare between replicates or samples for low variances. Piper plots have been prepared using AQqa and are discussed in **Section 3.2.1.3**. Solid samples have been characterised using ternary diagrams for cation and anion distributions. The sample locations are provided **as Figure 3-1**.

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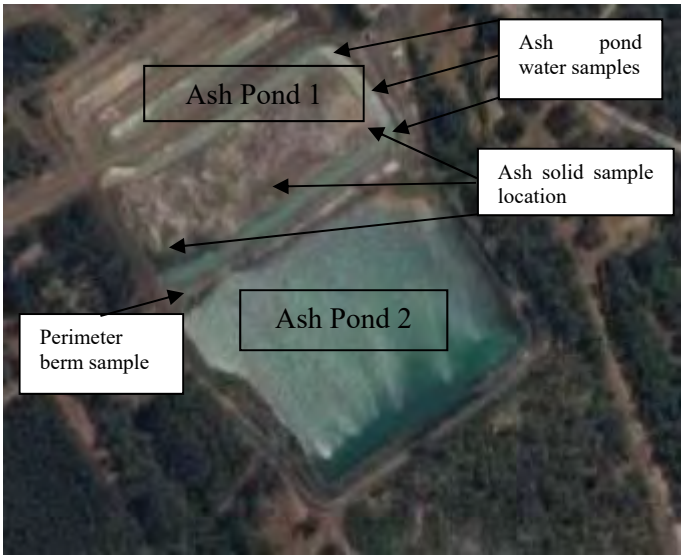

Figure 3-1 Ash solid and pond sample locations

It is noted that within some of analytical reporting for total and dissolved analytes, occasionally the dissolved concentration is higher than the total concentration. These results have been reviewed by quality control procedures and the differences reported are within the experimental variation of the analytical methods.

3.2.1 Ash Solids

As described above, three (3) samples of ash solids were collected from Ash Pond 1 and one (1) sample from the perimeter berm of Ash Pond 1 and analysed for the constituents list in **Table 3-2**. Two split samples of an ash solids replicate sample (PTH-16-0045 is a replicate of PTH-16-0042) were used in a modified ALSP test which used replicate samples of UEVF groundwater (PTH-16-0047 is a replicate of PTH-16-0046) and ash pond water (PTH-16-0040 is a replicate of PTH-16-0039) as the reagent waters (**Section 3.2.2**). The resulting leachate was then analysed using the same suite of analytical parameters used for other aqueous samples (refer to **Table 3-3**).

The results of the ash solid sample analyses are provided in **Attachment 1, Tables B-1 to B-4**.

The results of the ash solid ASLP leachate analyses are provided in **Attachment 1, Table B-5 to Table B-7**.

3.2.1.1 Physical Characteristics

The samples collected from within the Ash Pond are typically fine-grained with greater than 70% reported between 2 to 60 µm (silt fraction). The berm sample had a more uniform particle size distribution between clay, silt and sand and a much higher clay fraction than the Ash Pond samples. The Ash pond samples display a variable cation exchange capacity, with location 2 sample reporting 61.3 meq/100g and location 3 reporting 14.1 meq/100g. Location 1 and 2 samples are dominated by exchangeable magnesium, in contrast to location 3 and berm samples which are low in exchangeable magnesium. All samples report low exchangeable sodium, potassium calcium (refer to **Attachment 1, Table B-1).** The fine-grained characteristics of the ash solids and berm samples are likely to create a low hydraulic conductivity layer when deposited in Anglesea Pit. The presence of silts and clays has the potential to provide attenuation in the form of sorption surfaces for metal cations and major ions (sodium, potassium, calcium and magnesium).

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3.2.1.2 Ash Acid and Alkaline Generating Characteristics

Several tests were conducted on the Ash to characterise the acid producing and acid neutralizing potential. These tests included:

1. Total sulfur
2. Maximum Acid Potential (MPA)
3. Acid neutralizing capacity (ANC) expressed as percentage $CaCO_3$ and kg of H_2SO_4 equivalents per tonne
4. Net acid generation (NAG) at pH 4.5 and pH 7
5. Net acid production potential (NAPP)
6. Fizz rating

Initial pH screening tests (pHF and pHFOX tests) were not undertaken on the samples to determine the degree of acidity (unlike the native lithology solid samples [EHS Support, 2017b]). This was based on the historical geochemical characterisation of the ash and its anticipated alkaline nature.

The maximum potential acidity (MPA) can be estimated from the total sulfur content, although it is a conservative approach because it assumes all sulfur generates acidity under oxidising conditions. All the ash samples contained low amounts of sulfur (refer to **Attachment 1, Table B-2**). A conservative assessment of acidity potential using the sulfur concentrations estimates that low potential acidity production is possible.

ANC measures the amount of acid a sample can neutralise. The consumption of acidity by a sample is determined and expressed as kg H_2SO_4 equivalents/tonne. This reports the ability of a sample to neutralise (using its buffering capacity) any acidity generated. ANC is elevated in the ash solids so net acidity production potential (NAPP) is unlikely from the ash samples. The fizz rating for all three ash samples was reported as a 'very strong reaction' and Locations 1 and 2 were rated 5 where ANC is >400 Kg H_2SO_4/t.

Net acid generation (NAG) directly evaluates the generation of sulfuric acid within a sample. The NAG procedure includes a final titration to pH 4.5 and finally pH 7. The reported titration value at pH 4.5 includes acidity due to free acid (sulfuric acid, H_2SO_4) in addition to soluble iron and aluminium. The titration value at pH 7 also includes metallic ions that precipitate as hydroxides between pH 4.5 and 7. The results of the net acid generation (NAG) tests also support the low probability of acid production potential with the ash samples. The berm sample results are slightly different to the ash samples. Berm material reported negligible sulfur (0.13%), low MPA and ANC.

Net acid production potential (NAPP) represents the theoretical balance of a samples capacity to generate acid (MPA) and its capacity to neutralise (ANC). If the MPA is less than ANC, then the NAPP is negative and the sample may have sufficient ANC to prevent acid generation. However, if the MPA exceeds the ANC then the NAPP is positive and the same may be acid generating. All three ash samples report negative NAPP values, whereas the berm sample records a slight possibility of NAPP (0.9 kg H_2SO_4/t).

The acid forming potential is plotted as **Figure 3-2**, which shows locations 1, 2 and 3 as non-acid forming and the berm material on the boundary of non-acid forming and uncertain. Even if the berm material is capable of generating acidity the potential amounts are negligible and will be neutralized by the higher ratio of ash solid to berm material.

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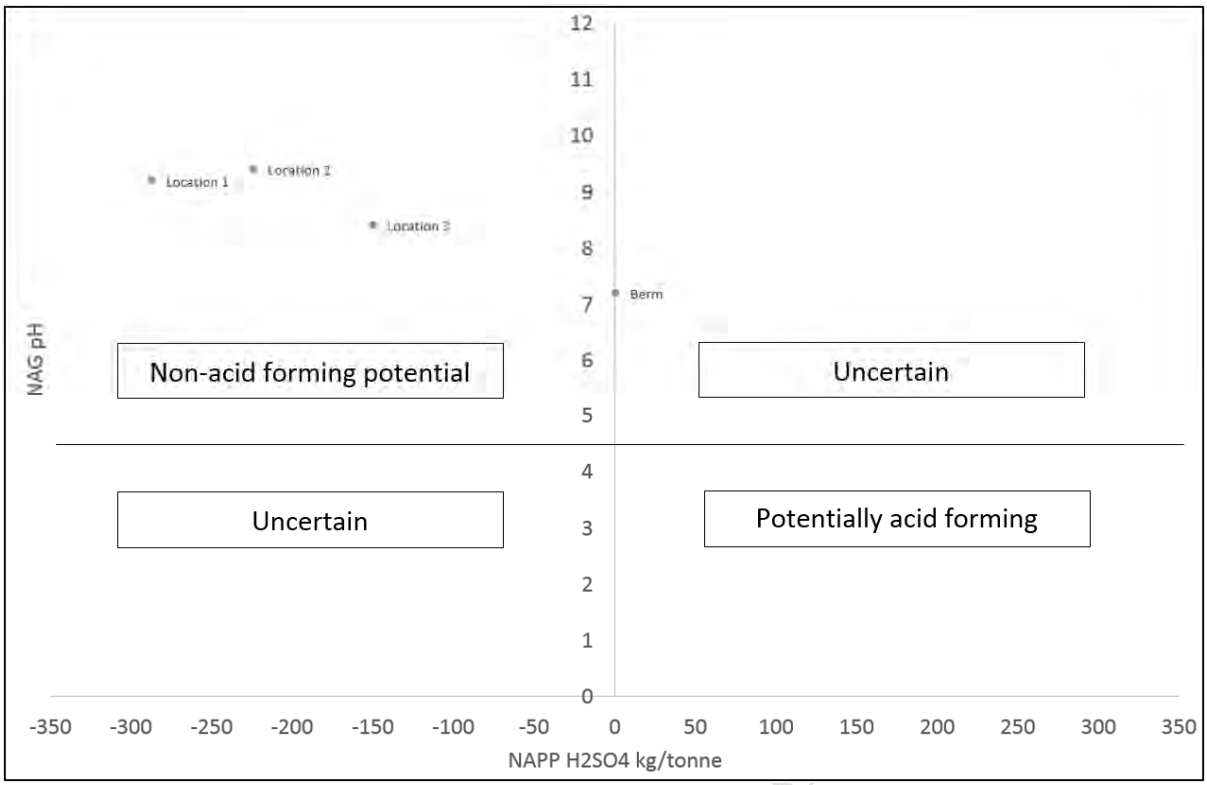

Figure 3-2: Ash Pond and Berm samples - Acid Forming Potential Plot

In summary, the ash material represents an elevated capacity for acid neutralisation and when initially deposited in the Anglesea Pit will provide buffering capacity to mitigate the effects of acidity produced from geogenic pyritic materials. In the short-term the ash deposits in the pit void will be covered with clay overburden material from the Demons Bluff Group (DBG) overlying the coal (Seam A). The clay component of the DBG was identified and segregated during the development of the coal mine based on the requirements of future rehabilitation works

3.2.1.3 Major Ions

The major ion concentrations (mg/kg) for the ash and berm samples are plotted as ternary diagrams in **Figure 3-3**.

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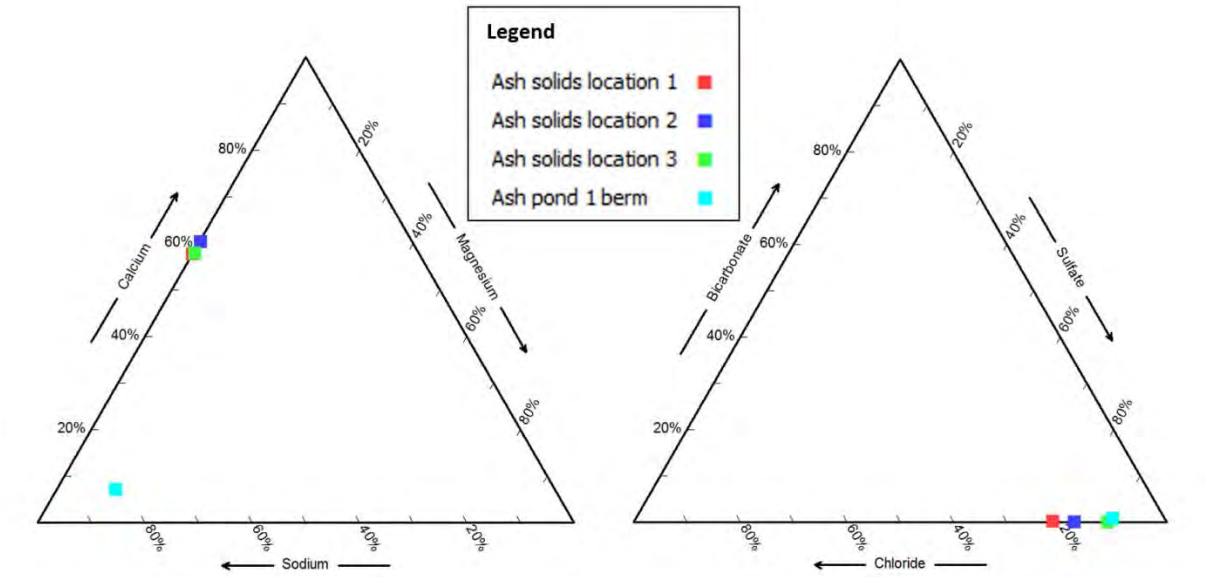

Figure 3-3: Ash pond solids and berm samples – Ternary diagram Major Cations (mg/kg)

The ternary diagram is similar to a Piper plot where the relative mass concentrations are plotted for cations and anions. It is evident from the cation plot that the ratio of calcium, magnesium and sodium is different between the ash solid and berm samples. The berm sample reports a lower calcium and sodium and higher magnesium concentration than the ash solid samples. This is likely to be related to the type of material used to construct the berm wall. The anion ratios appear to plot closely for all four (4) samples, in particular samples collected from Location 3 and the berm. This is due to the dominance of sulfate over chloride and bicarbonate in the samples and is not related to any similarity between the ash solid and berm samples major ion concentrations. The major ion and total organic carbon concentrations, electrical conductivity and pH are provided in **Figure 3-4** and **Attachment 1, Table B-4**.

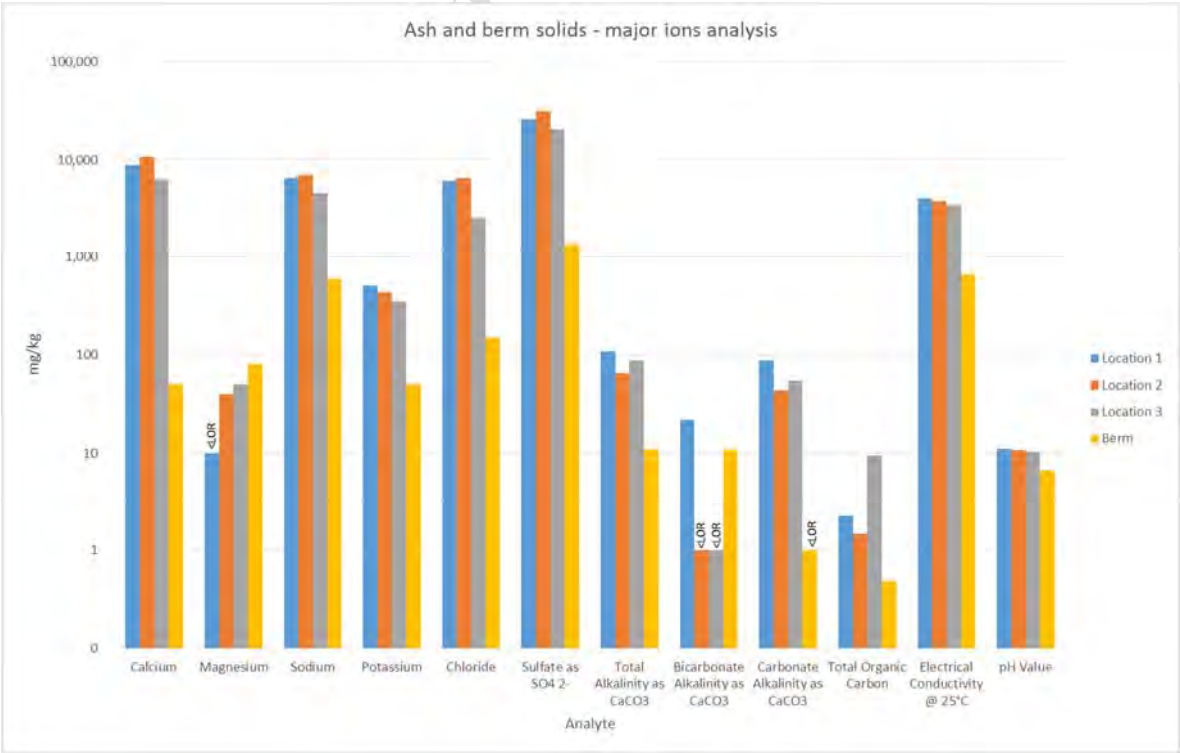

Figure 3-4: Ash pond solids and berm samples – major ions, organic carbon and physico-chemical analytes

The presence of organic carbon in the ash solids is unlikely to be related to be related to the source material (coal) due to the combustion process. The ash ponds are vegetated and the process of decaying vegetation will release organic carbon into the ponds and sediment.

3.2.1.4 Metals, metalloids and minor anions

The ash solid samples are characterised by elevated concentrations of aluminium, barium, boron, iron and manganese. The berm also reports elevated aluminium and iron but low (by comparison) boron, barium and manganese concentrations (refer to Table B-3). The ternary plot in **Figure 3-5**, illustrates the variability in metal and metalloid distribution between the locations within ash pond 1 and in the berm.

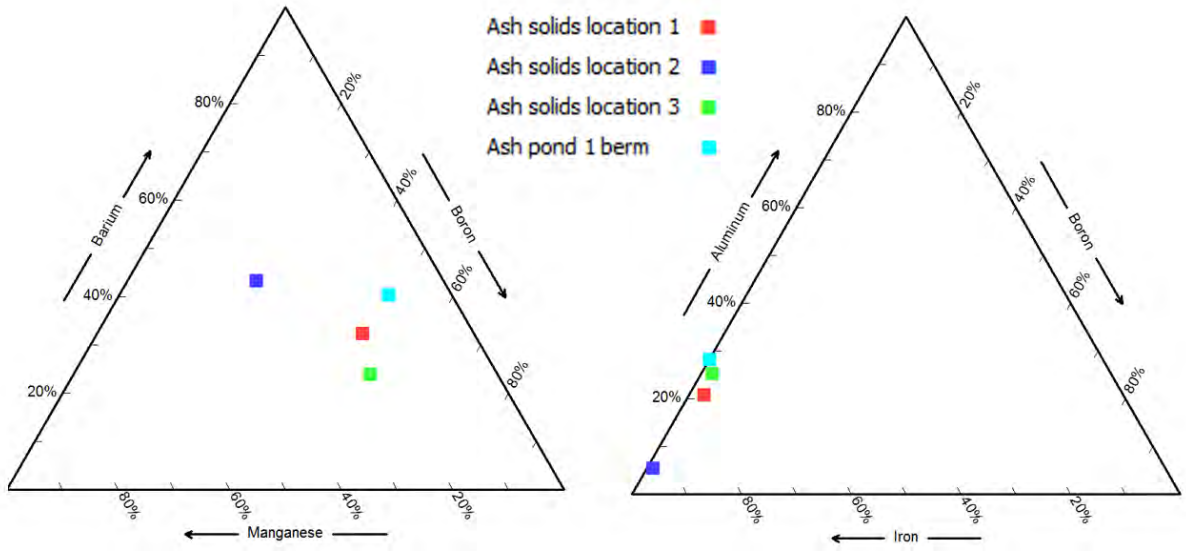

Figure 3-5: Ash pond solids and berm samples – Ternary diagram metals and metalloids (mg/kg)

Cadmium, molybdenum, tin and selenium all reported concentrations below the laboratory limit of reporting (LOR), refer to **Figure 3-6**.

The analytical results for ash solids fall within similar ranges of concentrations presented in previously published references (Beattie, 2003 and GHD, 2012).

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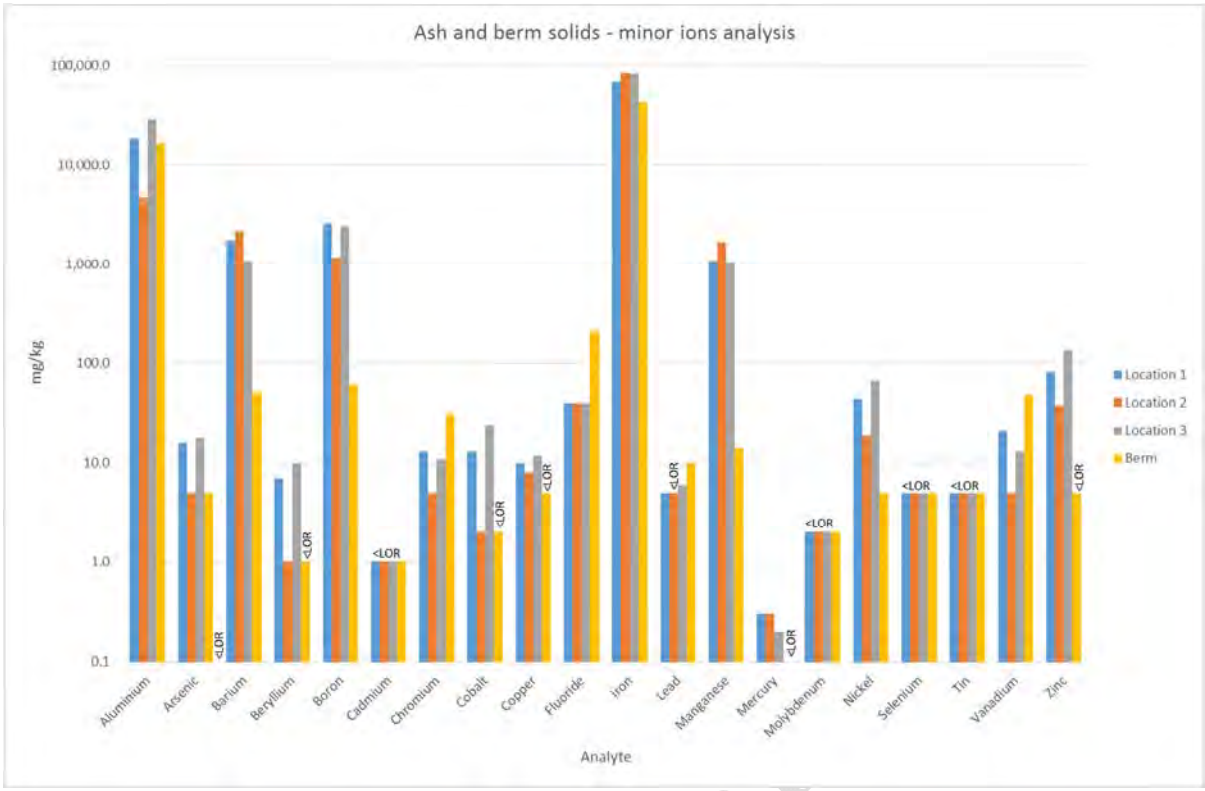

Figure 3-6: Ash pond solids and berm samples – minor ions

3.2.2 Ash Pond Solids – ASLP Results

Two (2) samples of ash solid material were leached using UEVF groundwater and ash pond 1 surface water as reagent waters. The ASLP method was used for the leachate procedure but instead of using a laboratory derived reagent water (pH 5), site representative reagent waters were used. The site derived reagent waters, UEVF groundwater and ash pond water, were selected because UEVF groundwater may come into contact with ash solid material when it is deposited into Anglesea pit. The ash pond water has been in contact with the ash solid material for an extended period of time (years to decades). The comparison between ash pond water and the leachable analyses provides an indication of the equilibrium between the ash pond water and solid material and future porewater characteristics within the ash material at the base of the Anglesea pit.

Analytes which reported variances between the reagent water and leachable results concentrations have been plotted as **Figure 3-7** and **Figure 3-8**.

The results of the ash solid sample analyses are provided in **Attachment 1, Tables B-5 to B-7**.

3.2.2.1 Reagent Water 1 – Ash Pond 1 water

The ASLP results for the ash pond water and ash solids indicate that the main variances between the analyses are related to alkalinity and pH. The pH is observed to increase from pH 8.22 (ash pond water) to pH 9.8 (leachate). Accompanying the increase in pH, are increases in carbonate and hydroxide alkalinity and a decrease in bicarbonate alkalinity. The changes in relative abundancy of alkalinity species is as expected with the change in pH. It is likely that the increase in pH initially occurred when water came into contact with the ash material within the ponds. Over time, the hydroxide species would have been scavenged by metal cations to form insoluble precipitates, which in turn would have decreased the pH. As observed within **Figure 3-7**, most of the analytes report negligible changes between ash pond water and the resulting leachate. This supports the hypothesis that the ash pond water is anticipated to be in equilibrium with the ash solids within Ash Pond 1.

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3.2.2.2 Reagent Water 2 – UEVF groundwater

The ASLP results for the UEVF groundwater and ash solids report an increase from pH 6.58 (ash pond water) to pH 8.8 (leachate). The leachate pH is observed to be lower than that reported for the ash pond water leachate result. The leachate is likely buffered against greater pH increases due to the precipitation of iron (oxy)hydroxides which produces acidity. As observed in **Figure 3-8**, iron concentrations decrease to non-detectable levels in the leachate. Increases in boron, calcium, potassium, sodium, sulfate, carbonate, ammonia and dissolved organic carbon are reported in the leachate. Magnesium and bicarbonate concentrations are lower in the leachate in comparison to the UEVF groundwater. The changes in major cation concentrations is likely to be related to cation exchange reactions on the ash solid surface. Reduced nitrogen species are elevated in the leachate, which may be related to reduction of organic carbon during the ASLP. As discussed in **Section 3.2.1.4**, the ash solids are characterised by elevated concentrations of aluminium, barium, boron, iron and manganese. Only boron is reported to be elevated in the leachate which is due to its anionic form over the observed pH range. Aluminium, barium, iron and manganese all form solubility limiting phases over the pH range reported and are expected to precipitate as insoluble phases.

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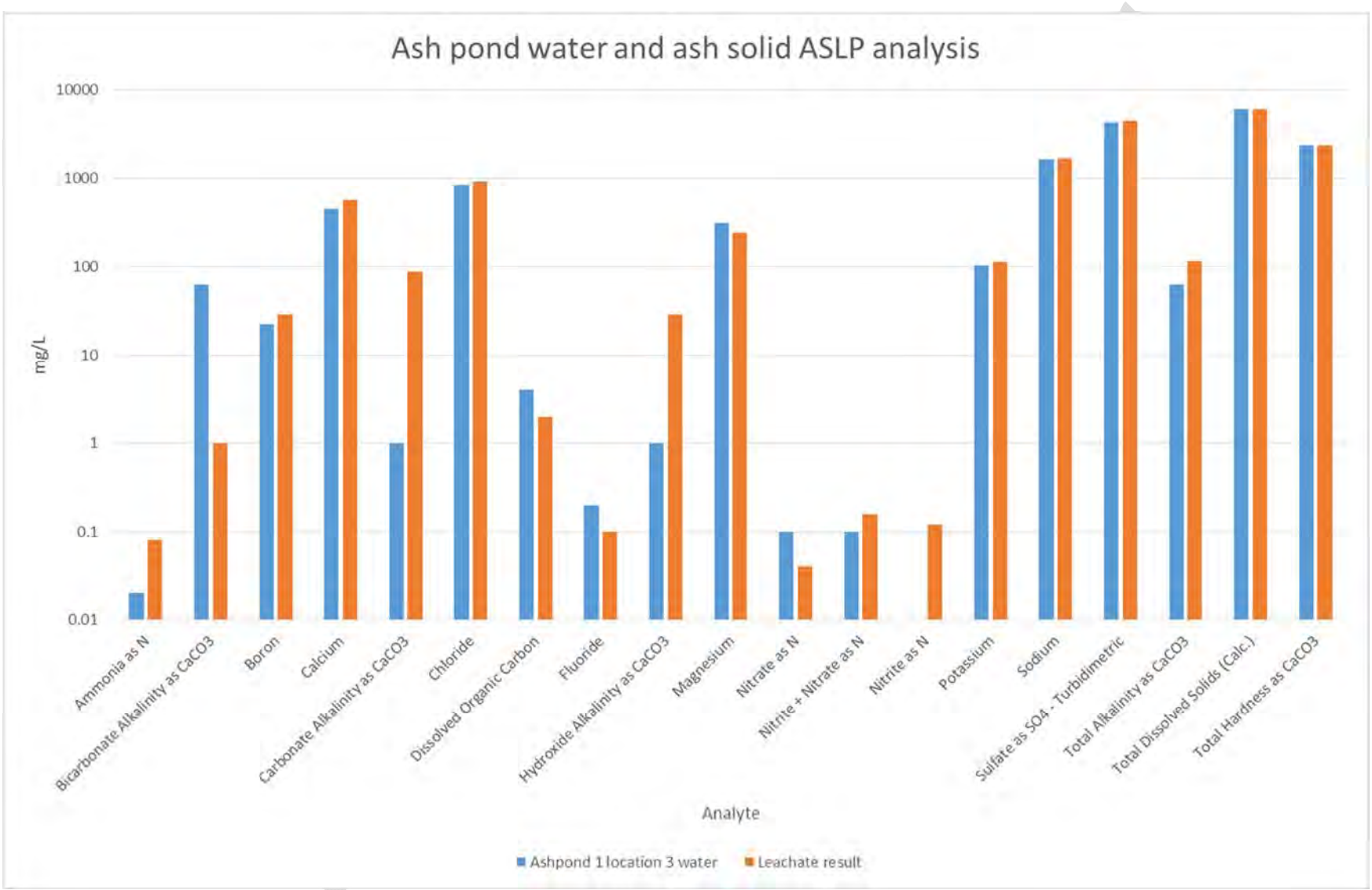

Figure 3-7: Ash pond water and Ash Solid ASLP results

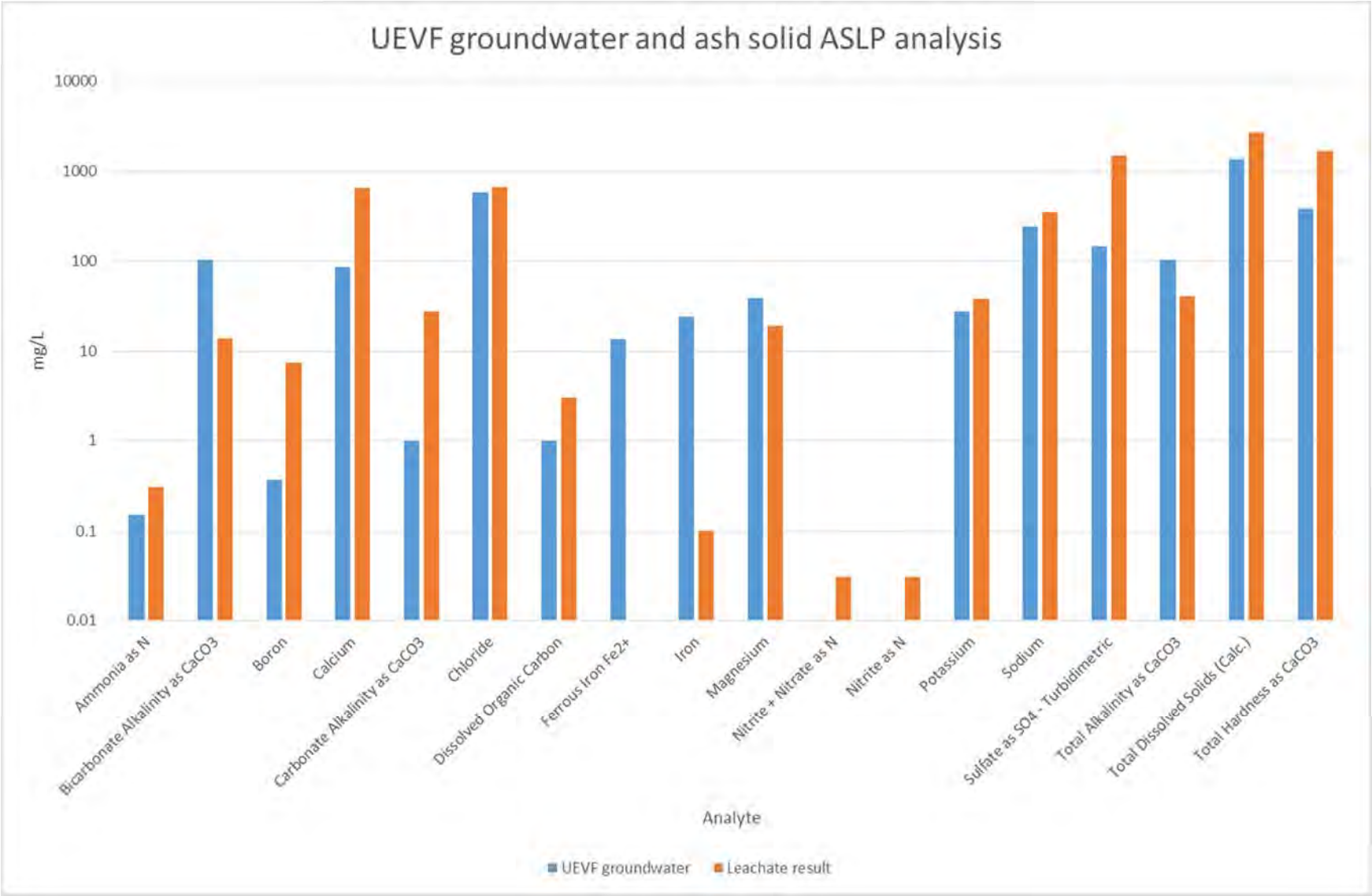

Figure 3-8: UEVF groundwater and Ash Solid ASLP results

3.2.3 Ash pond water and UEVF groundwater

The comparison of analyte distributions within the UEVF groundwater and ash pond water has been evaluated. Groundwater is expected to be in equilibrium with the UEVF aquifer lithology and the ash is derived from the burning of coal sourced from the UEVF. Groundwater derived from the UEVF aquifer was also used in ash slurrying processes historically carried out at the former facility. It is therefore anticipated that similar chemistry will be observed between the UEVF groundwater and ash pond water.

Three (3) samples of ash pond water were collected from ash pond 1 and one (1) sample from well bore 15 (WS4) which is screened within the UEVF aquifer. A range of analysis was carried out on the water samples which included:

1. Major ions;
2. Total and dissolved minor anions; and
3. Nutrients.

3.2.3.1 Major Ions

Major ions for four (4) samples have been graphed as a Piper plot. These comprise one (1) sample from the UEVF groundwater and three (3) samples from Ash pond 1.

As observed in **Figure 3-9** the cation ratios for the UEVF and ash pond water are very similar with sodium as the dominant cation. The similar cation ratios are indicative of the bedrock mineralogy influences where the UEVF groundwater resides and which is also the source of the coal (burnt to produce the ash). The anionic ratios display the dominance of the sulfate ion (in the ash pond water) and the chloride ion (within the UEVF groundwater). As a result, the UEVF groundwater plots as a sodium chloride water type and the ash pond water is a sodium sulfate water type. All the ash pond samples are supersaturated with calcium carbonate which is a function of the pH (average pH 8.25). The UEVF groundwater reports a lower pH 6.58 and is under saturated with respect to calcium carbonate.

Major ion distribution is very similar between the UEVF groundwater and ash pond water as observed in **Figure 3-10** and **Figure 3-11**, although there is an order of magnitude concentration difference between groundwater and ash pond water quality.

3.2.3.2 Minor Ions

The UEVF groundwater is characterised by low to non-detectable concentrations of minor ions. Total and dissolved arsenic, beryllium, cadmium, chromium (dissolved only), cobalt, copper (dissolved only), lead, mercury, molybdenum, nickel, selenium, tin, vanadium and zinc are all reported below the laboratory LOR. Iron, manganese and boron (total and dissolved) report the highest concentrations in this suite of analyses (refer to **Figure 3-12**).

The ash pond water is also characterised by low to non-detectable concentrations of minor ions. Total and dissolved arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, selenium, tin and vanadium are all reported at or below the laboratory LOR. Minor ion distribution is dominated by boron (> 10 mg/L), followed by aluminium, barium and manganese (refer to **Figure 3-13**).

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3.2.3.3 Nutrients

Nutrients reported within the UEVF groundwater sample were all below the laboratory LOR except for Ammonia (as N) which recorded a value of 0.15 mg/L. A plot has not been prepared for UEVF groundwater nutrient concentrations.

As discussed in Section **3.2.1.3**, the organic carbon measured within the ash solids is most likely to be derived from vegetation growing within the ash ponds. Organic carbon is also detected within the ash pond water (refer to **Figure 3-14**), in association with low concentrations of ammonia (as N) and nitrate (as N).

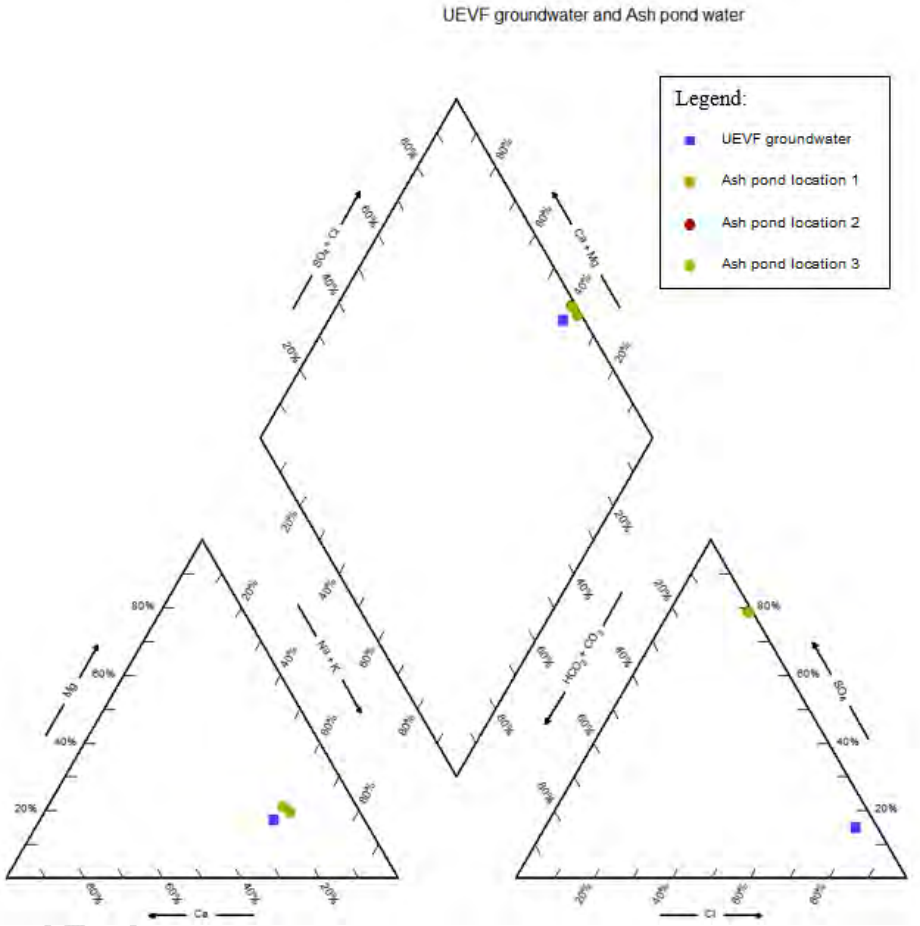

Figure 3-9: Piper plot UEVF groundwater and ash pond surface water locations

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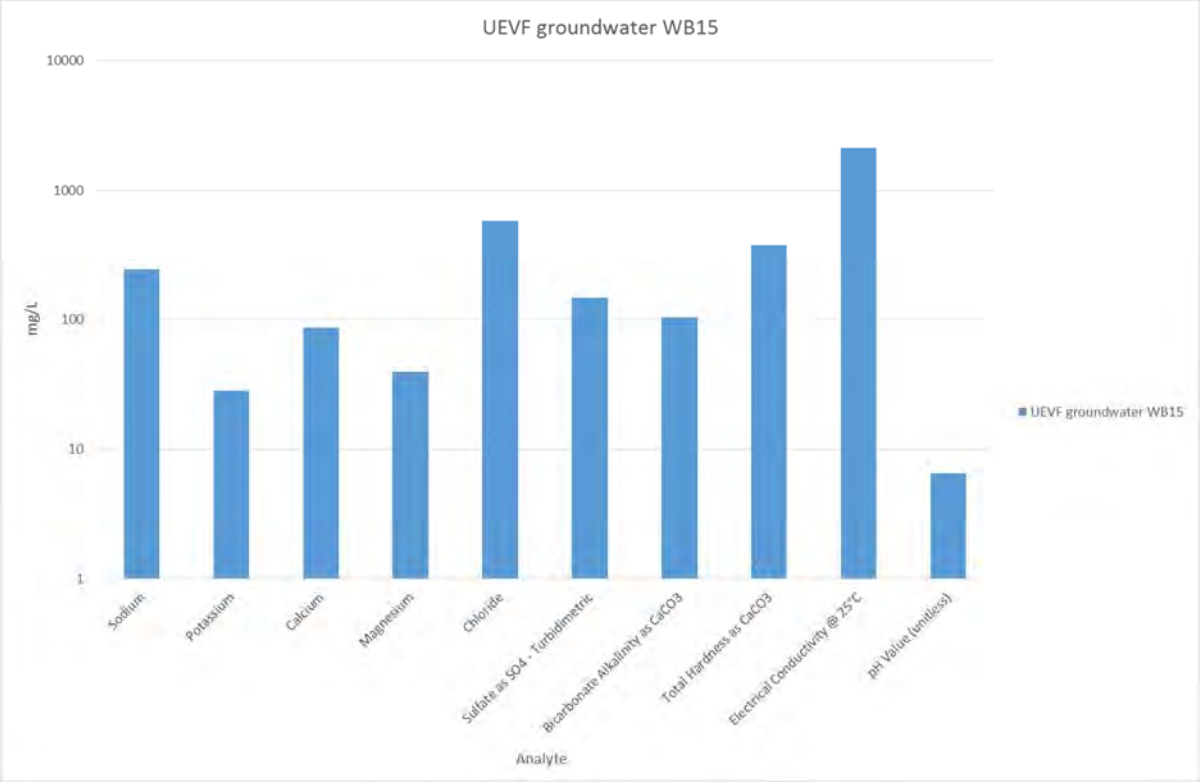

Figure 3-10: UEVF groundwater major ions and physico-chemical parameters

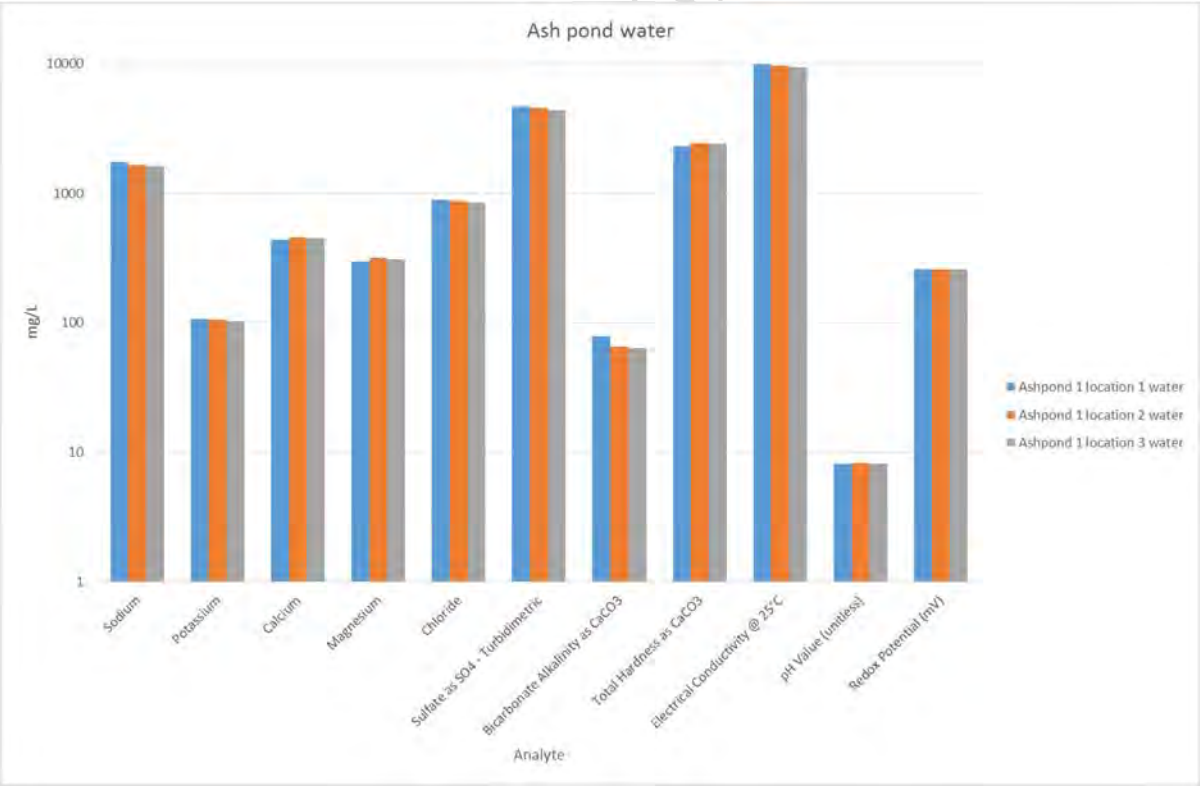

Figure 3-11: Ash pond water major ions and physico-chemical parameters

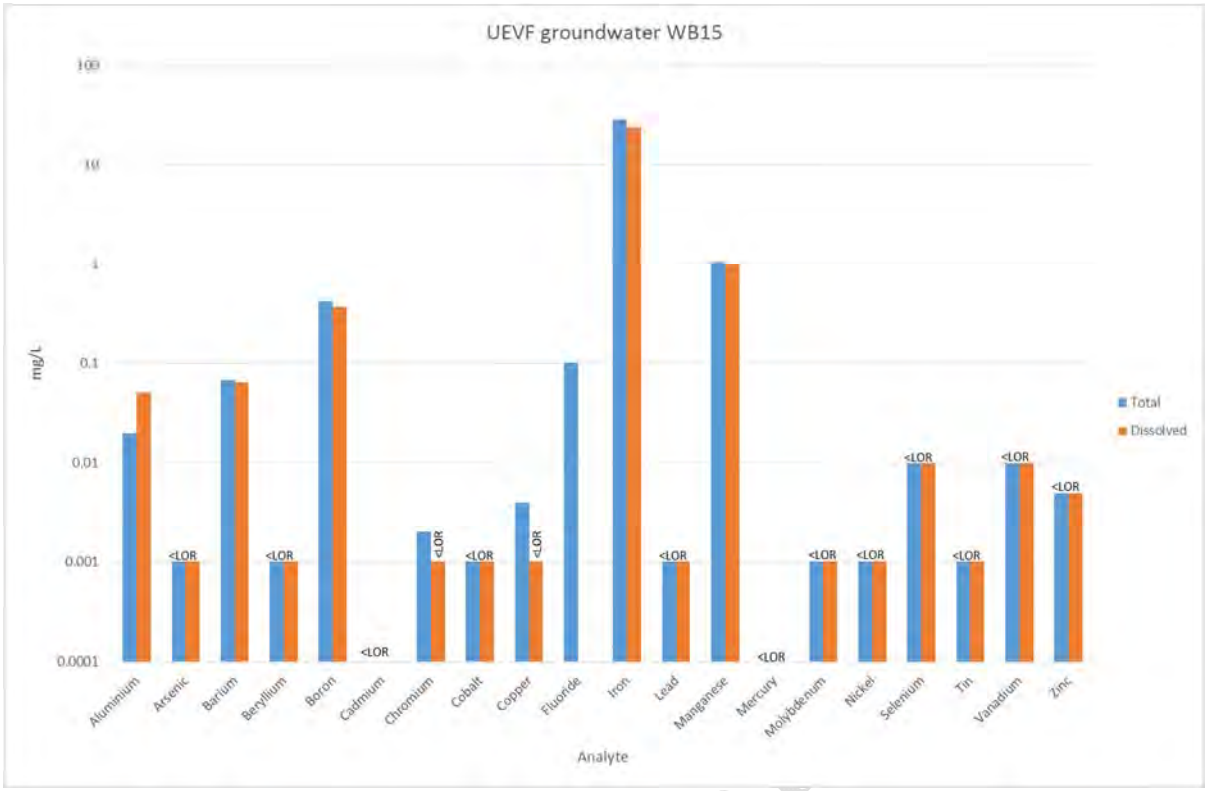

Figure 3-12: UEVF groundwater total and dissolved minor ion concentrations

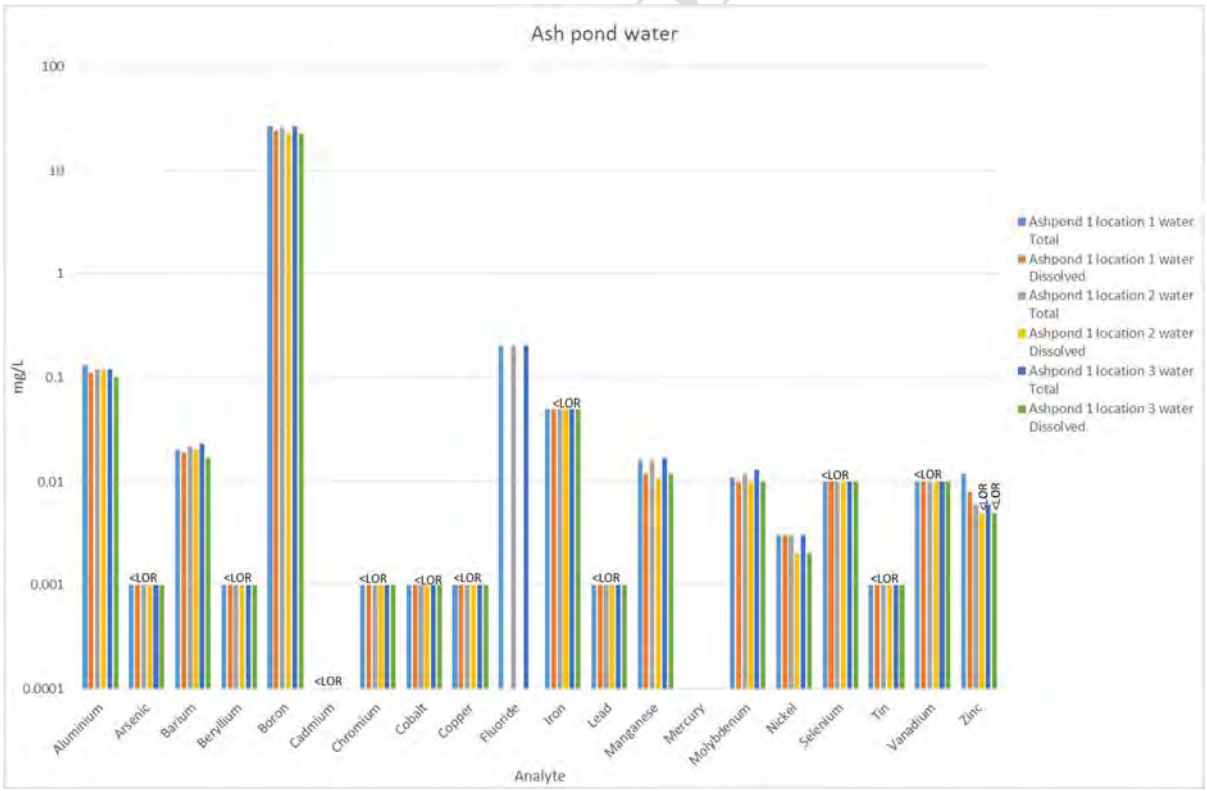

Figure 3-13: Ash pond water total and dissolved minor ion concentrations

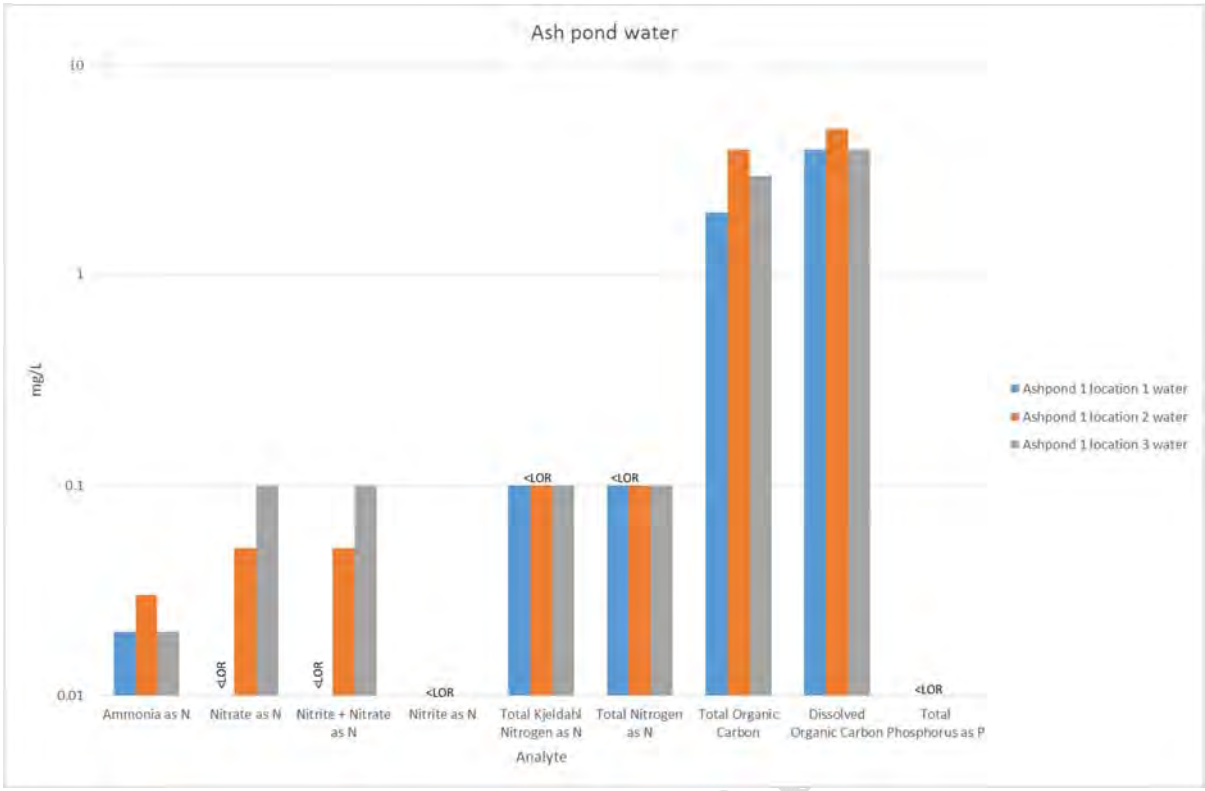

Figure 3-14: Ash pond water nutrient concentrations

3.3 Assessment of ASLP and Pond Water Samples against Screening Criteria

Consistent with the discussion above, direct contact with the Ash materials and Pond 2 iron floc, after placement and lake filling, is considered an incomplete exposure pathway and therefore the soil sampling results were not screened against regulatory criteria. Assessment of soil and sediment data relative to leaching to groundwater criteria indicates that a range of metals in the ash and floc materials exceed generic leaching to groundwater screening criteria (NEPM and USEPA RSLs) for the protection of drinking water quality. It should be noted that this assessment methodology is highly conservative with the low permeability and high pH and Cation Exchange Capacity (CEC) of the ash limiting the potential leaching of metals. Considering this limitation, a direct assessment of leaching potential (ASLP testing) was conducted using Pond water and UEVF groundwater.

ASLP testing conducted using Ash pond (and associated pore water within the Ash materials) and the lower pH of the UEVF indicated limited leaching potential for metals from the ash materials. The leachate from these tests indicated that the majority of metals were strongly bound to the ash matrix. Boron, ammonia, nitrate/nitrite were the only constituents detected in the leachate from the ASLP. However, it should be noted that the reporting limits for a number of other metals were above generic water screening criteria.

Assessment of the exceedances relative to relevant and applicable criteria indicates that only Boron exceeded potentially applicable groundwater and surface water criteria. It is noted that the detection limits for a number of other metals were higher than the screening criteria. The DAF required for Boron to achieve groundwater and surface water criteria is small and was calculated to be only 7.25 and 78.38, respectively.

For the other trace metals with reporting limits above the very low generic screening criteria, it should be noted that the water quality criteria are naturally exceeded for metals in surface water (aluminium, boron and zinc and likely other metals exceed maintenance of aquatic ecosystems criteria)..

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The Ash Pond water samples (collected from water in direct contact with ash) provided lower analytical reporting limits and confirm the results of the ASLP testing with only aluminium (maximum 0.12 mg/L) and boron (maximum 24 mg/L) exceeding the water quality criteria (refer **Table 2-7**). This indicates that only boron is leachable and exhibits s mobility. Using these values the DAF for Boron to comply with regulatory criteria are 6 and 64, for groundwater and surface water respectively. These values are similar to the values calculated with the ASLP results.

It should be noted that this assessment is highly conservative as it does not consider geochemical reactions within the ash or other stratigraphic units. However, the assessment is suitable for identifying constituents of potential concern.

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4.0 STAGE TWO – HYDROGEOLOGIC CONCEPTUALISATION OF FLUXES

As described above, the management of ash is being conducted in a designated area of the mine pit. The ash materials will be covered by spoil comprising silts and clays removed during the mining operation. The block model below conceptualizes the placement and cover of the ash materials and ultimate the future situation where the ash management area is submerged beneath the lake. The key hydrogeologic controls on fluxes are the low permeability of the basal clay, the ash materials themselves and the silts and clays that will be used to cover the ash.

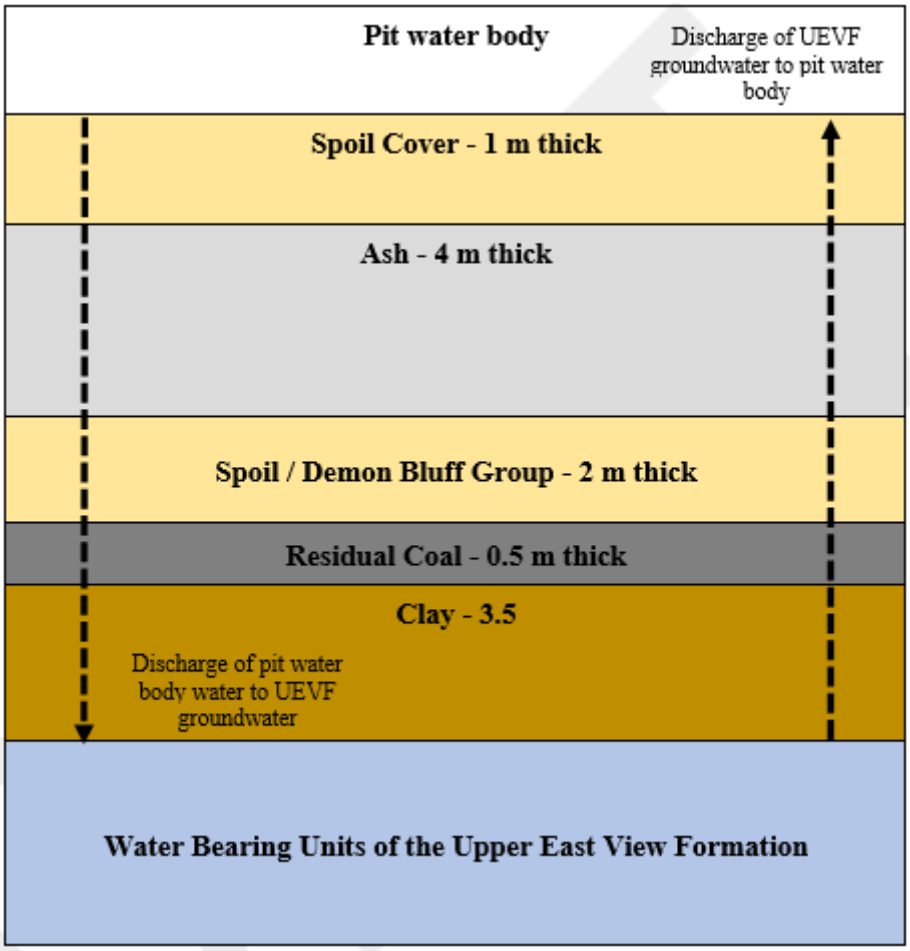

Figure 4-1: Block Model

Included in the simple block model (**Figure 5-1**) are the anticipated flow pathways between the pit water body and the UEVF aquifer associated with the diversion of Salt Creek (strong downward gradients) and steady state conditions (weak upward gradients in response to evaporation only.

It should be noted that this simple block model was conducted in addition to the numerical modelling (EHS Support 2017(e)) which assessed advective transport and determined that transport of constituents in groundwater would not occur away from the pit and if Barwon Water commenced pumping from the LEVF advective travel times would be very long (> 4,000 years).

4.1 Inputs and Assumptions

Darcy's Law (Eq 1) was used to calculate the flux of water that passes through the Ash layer (either upwards or downwards) as well as the pore space velocity

$$\text{Darcy Flux} = q = Ki \quad \text{and} \quad \text{Pore Space Velocity} = v = \frac{q}{\eta} \qquad (1)$$

Where K = Hydraulic conductivity (m/d); i = hydraulic gradient; and η = formation porosity (-).

The horizontal hydraulic conductivity (Kx) for each unit were adopted from EHS Support (2017f) with the exception of the top 1m cover. Whilst this cover generally comprises of the Demon Bluff Group (DBG) sediments, this cover will generally have a higher clay content (pers com Chris Rolland 2017) and also will be compacted in parts by heavy machinery. As such it was conservatively estimated to have an order of magnitude lower K than the broader DBG. For the remaining units, an anisotropy of Kx:Ky (1:10) was used define vertical hydraulic conductivity (Kv).

The hydrogeological parameters are presented in **Table 4-1** and **Table 4-2** and the cross-sectional area of permitted ash placement was estimated to be a maximum of 110,000 m^2 (refer **Figure 4-2**– note although other field data indicates it may be closure to 70,000 m^2). The thicknesses and depth of the clay unit below the residual coal seam presented in **Figure 4-1**, was obtained from geotechnical bore log GT2016-03 located, refer to **Figure 4-2**.

The hydraulic gradients were calculated by assuming the following:

4.1.1 Upward Gradient (Movement from UEVF to Pit water body)

Once the Lake reaches a steady state condition where groundwater heads will be roughly in equilibrium with the lake level, an upward gradient will exist where evaporation of the lake surface will be the major driver of this gradient. To calculate this gradient, the difference in head between the lake level and the groundwater elevation was divided across the distance between the bottom and the top of the Ash (-15mAHD, to -10mAHD).

4.1.2 Downward Gradient (Movement from Pit water body to UEVF)

As the Pit water body fills with surface water, there will be a gradient from Pit water body to groundwater. This is expected as lake levels are anticipated to be higher than the groundwater elevations, refer to **Figure 4-3**. To calculate this gradient, the thickness of the materials between the base of the Pit water body and the top of the UEVF was divided by the modelled maximum head difference between the UEVF (upper sands) and the Lake level. This was estimated to be 17m, refer to **Figure 4-3**. It should be noted that this is the maximum gradient and based on travel times through the basal clay (approaching 2.5 years) a lower average gradient could be used in the calculations. Further this gradient will only occur for the short time period of lake filling (when groundwater levels are lower than surface water levels).

Therefore, the resulting gradient is 17m/11m = 1.5

For each scenario, the resulting Darcy flux is presented in **Table 4-1** and **Table 4-2**.

The fluxes are a function of the areas of the ash management area and the total pit area. The ash management area makes up 90,000 m2 of the total pit area of 1,280,000 m2 which is effectively 7% of the total area.

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Furthermore, using Eq 1, and adopting modelled layer porosities, **Table 4-1** and **Table 4-2** present pore space velocities (and in turn conservative particle travel time) for each scenario above.

It should be noted that the current day scenario of Flux from UEVF to Pit water body was not modelled as UEVF groundwater is currently not in communication with the base of the Ash. The current recovering groundwater heads for the UEVF (upper sands) are ~-26m AHD (refer **EHS Support 2017(a,d)**. Referring to **EHS Support 2017(e)** UEVF heads will not reach -14mAHD (base of the ash layer) for approximately 20 months or sometime early 2019). It is anticipated that the surface water diversion will be commissioned prior to this time (estimated to be Q3, 2018) and as a result, Pit water body levels should remain higher than UEVF groundwater until near steady State time is achieved.

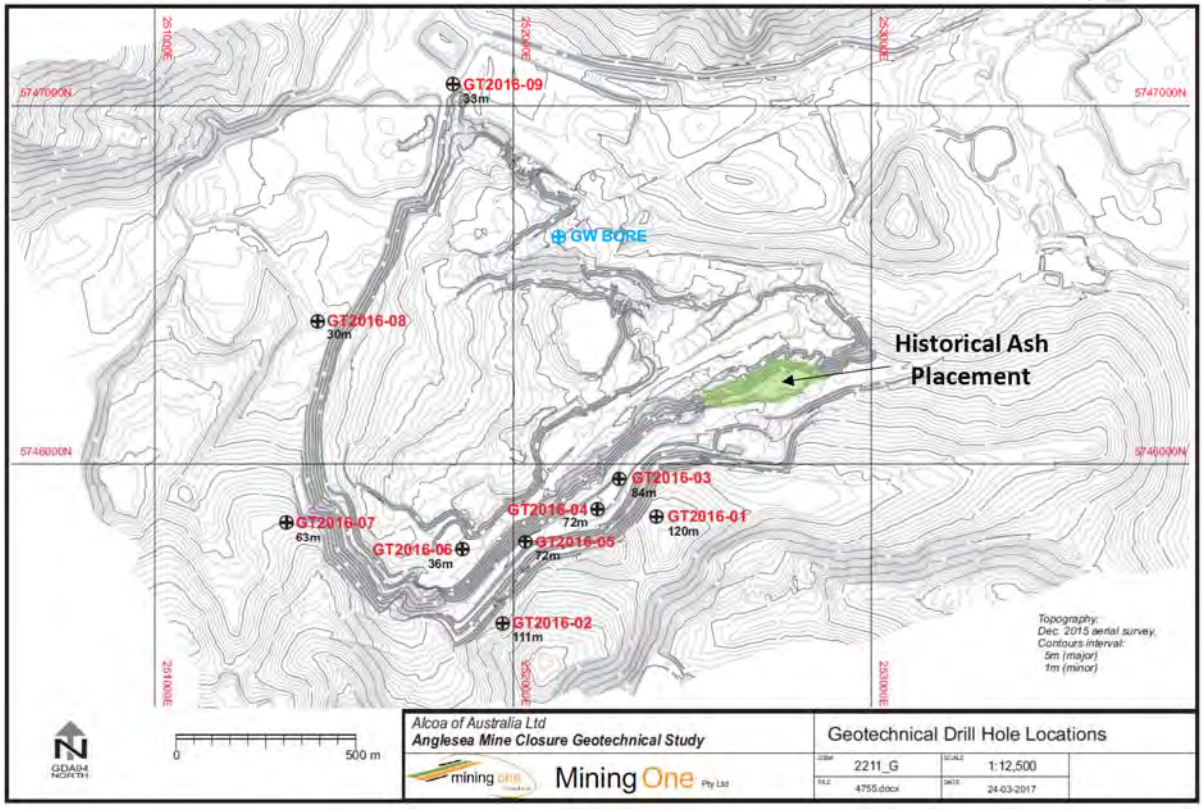

Figure 4-2: Historical Placement of Ash (Modified from Mining One 2017)[l]

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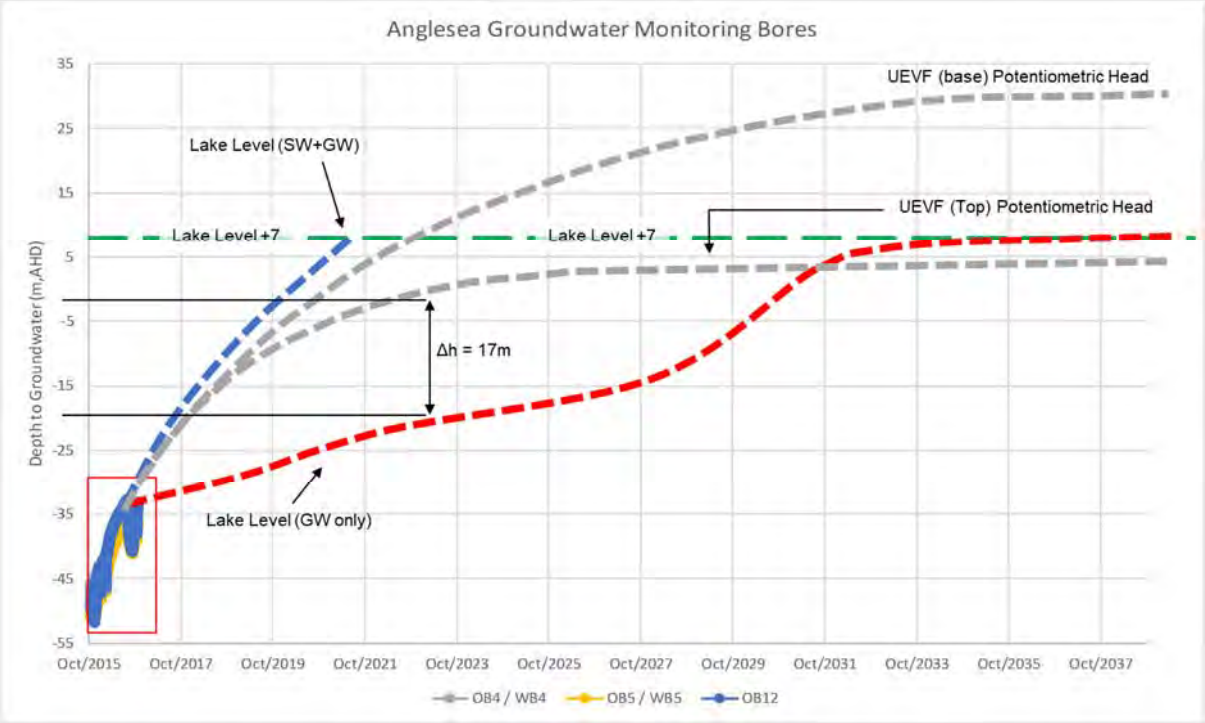

Figure 4-3: Modelled Groundwater and Pit water body Level Recovers (refer EHS Support 2017(e)

4.2 Analytical Block Model Results

Based on the simplified assumptions using areas and calculations of groundwater flux (based on heads and the hydraulic properties of the underlying aquifers) as presented above, dilution attenuation factors (DAFs) can be calculated. The block model (**Figure 4-4**) conceptualises the sequence of lithologies along the flow pathway between the pit water body and the UEVF aquifer. The characteristics of each lithological layer is summarised in **Table 4-1** and **Table 4-2**.

Based on the relationship between the vertical and horizontal flow volumes of water within the clay and underlying UEVF layers, DAFs have been calculated for the upward recharge and downward discharge of water flow.

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Table 4-1: Calculated fluxes of groundwater upward recharge into pit void

Layer	Thickness	Kh (m/day)	Kv (m/day)	Porosity (%)	Vertical Gradient	Q (m3/d)	Vertical seepage velocity (m/d)	Time (yrs)
Cover	1	0.25	0.025	12%	0.06	135	0.01	0.22
Ash	4	0.0864	0.0864	18%	0.06		0.02	0.38
Spoil	2	0.5	0.05	12%	0.06		0.02	0.22
Residual Coal	0.5	0.02	0.021	3%	0.06		0.03	0.03
Clay	3.5	3.00E-03	3.00E-04	5%	0.06	1.6	0.000	26.64
Outside Ash Area – UEVF through overlying units	5	0.85	0.1	18%	0.06	21.4	0.02	
Total Seepage Time for Ash Areas (yrs)								27.5

Table 4-2: Calculated fluxes of pit water body downward discharge into UEVF

Layer	Thickness	Kh (m/day)	Kv (m/day)	Porosity (fraction)	Vertical Gradient	Q (m3/d)	Vertical seepage velocity (m/d)	Time (yrs)
Spoil	1	0.025	0.025	12%	1.5		0.31	0.01
Ash	4	0.09	0.09	18%	1.5	40.5	0.75	0.01
Spoil	2	0.5	0.05	12%	1.5		0.63	0.01
Residual Coal	0.5	0.02	0.021	3%	1.5		1.05	0.00
Clay	3.5	3E-03	3E-04	5%	1.5		0.009	1.07
Outside Ash Area - Spoil/Residual Coal/Clay.into UEVF	5	0.85	0.1	18%	1.5	535.5	0.83	
Total Seepage Time for Ash Areas (yrs)								1.10

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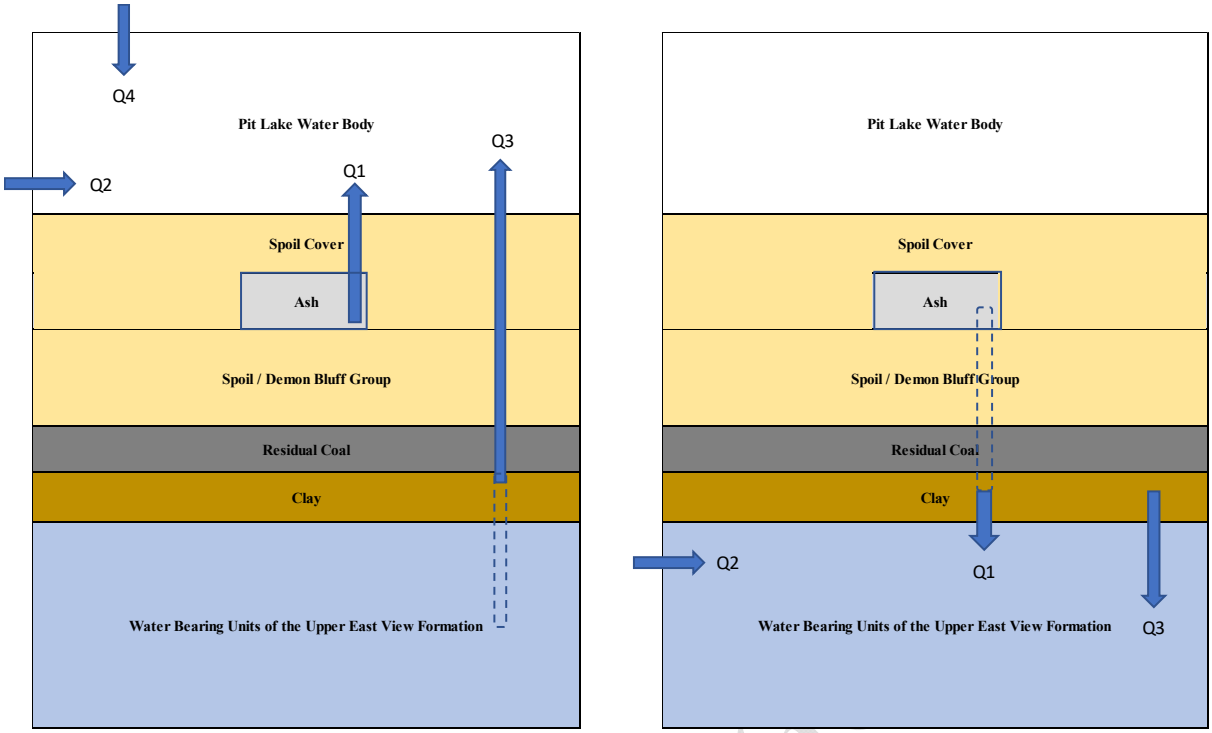

Figure 4-4: Flux Conceptualizations to calculate the DAF. (Left) Upward gradient Scenario (Right) Downward gradient scenario

Dilution attenuation can be described as the flux of water flowing through a mixing zone, divided by the flux of groundwater flowing through the source zone. In this case the mixing zone is either the Pit water body (for the upward gradient scenario, or the UEVF for the Downward gradient scenario. The source zone is the Ash compartment. Therefore, using **Figure 5-4** as reference the following equations were used to calculate the DAFs;

4.2.1 Upward Gradient (Movement from UEVF to Pit water body)

$$DAF = (Q1+Q2+Q3+Q4) / Q1$$

Note: As the clay layer present under the pit constrains the flow, the hydraulic properties to determine the flux (Qm3/d) have been based on the hydraulic conductivity of the clay layer.

Therefore, and using Table 5-2 and using the average flows from Salt Creek (5100 m3/d, refer to EHS Support 2017d); the resulting DAF is 76.7 ((135+5094+5,100+21.4) / 135)

4.2.2 Downward Gradient (Movement from Pit water body to UEVF)

$$DAF = (Q1+ Q2+Q3) / Q1$$

Note: As above, the clay layer present under the pit constrains the flow, the hydraulic properties to determine the flux (Qm3/d) have been based on the hydraulic conductivity of the clay layer. In addition, Q2 assumed a 2000m x 25m cross-sectional area for the Upper Sands of the UEVF.

Therefore, and using Table 5-3 the resulting DAF is 35.2 ((40.5+535.5+850) / 40.5).

Compared to the DAF identified above to achieve the screening level criteria, the criteria are sufficient to ensure no potential impacts on groundwater and surface water. However, despite this, more complex Geochemical Modelling (**EHS Support 2017(i)**) was conducted (refer **Section 5**).

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4.3 Numerical Modelling Results

The empirical calculations presented in **Section 4.1** are highly simplistic and conservative. Key conservatism inherent in these calculations is that the calculations only consider the upper portions (25m) of the UEVF and does not consider that only the lower portions of the UEVF (~205m in thickness and deeper than the interbedded coal sequences) was historically pumped for groundwater and that the gradients are transient and declining over time.

Numerical modelling presented in EHS Support 2017(e) was used to assess time frames for recharge of groundwater in the area, verify lake fill times and to assess the potential fate and transport of surface water constituents in groundwater via particle tracking. The results concluded that particles of water associated with recharge from the lake into the UEVF does not leave the immediate vicinity of the former pit. Once established seasonal recharge to groundwater and discharge from groundwater into surface water will results in water particles and associated constituents not leaving the area of the pit. Therefore, the empirical calculations provided above are highly conservative and there is limited potential for recharge and migration of particles of water (with potential constituents) into the UEVF. from potential impacts on water quality in the UEVF is considered limited.

A detailed discussion of the model setup and results is provided in EHS Support 2017(e). In addition, geochemical reactions/attenuation occur when the water passes through the ash and the overlying units. This is further discussed in **Section 5**.

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5.0 STAGE THREE – GEOCHEMICAL TRANSPORT SIMULATION

While the flux of constituents is a key determinant on potential concentrations in surface water and groundwater (as described above) a number of geochemical reactions will occur as waters mix decreasing (and in rare cases) increasing the solubility of metals in solution. The following section evaluates the geochemical speciation of metals and the possible interactions following mixing with supporting information on geochemical speciation also included in **Attachment 2.**

Geochemical modelling simulations have been used to explore the geochemical characteristics of ash pond water and the interactions that occur when ash pond water mixes with other waters such as UEVF groundwater and the pit water body. The USGS geochemical modelling program PHREEQC has been used in the following sections to explore the speciation and controlling mineral phases that may be present within the ash pond water. The soluble species and mineral phase equilibria will provide information on which species may be mobile or have the potential to precipitate if redox/pH conditions change.

The aqueous and leachable analyses were used in TRANSPORT scenarios between the following solutions and solids:

1. UEVF groundwater, ash porewater and ash solids
2. Pit water body, ash porewater and ash solids

A TRANSPORT and EXCHANGE SURFACE simulation was used to estimate the mass transport of a solution through the ash solids in the pit water body. The direction of flow will either be groundwater from the UEVF aquifer into the pit water body or surface water from the pit water body into the UEVF aquifer (refer to **Figure 5-1**). Both scenarios will be explored. The simulated effluent solutions from each transport scenario will be mixed with solutions representative of the pit water body (scenario 1) and UEVF groundwater (scenario 2). The building of the transport model will use hydraulic parameters defined in the hydrogeological model.

The transport flow pathway is simplified as it does not take into account the clay cover overlying the ash layer or the underlying spoil, residual coal or clay which overlie the UEVF aquifer (refer to **Figure 4-4**). This is a conservative assumption as it does not account for the retardation, attenuation and dispersion that would occur if these materials were included in the transport simulation. They have been omitted due to the level of uncertainty associated with the thickness and physical properties (e.g. CEC, permeability) of these lithologies.

5.1 Development of the transport flow pathway

The simulated transport of UEVF groundwater through a saturated ash lithology has been simulated using the TRANSPORT option within PHREEQC. The setup of the input file has incorporated the attributes of the ash material and the characteristics of the porewater and groundwater solutions. As the groundwater solution flow through the ash, many potential reactions can occur which are illustrated in **Figure 5-1**. Not all of these reactions are accounted for within the geochemical model simulation due to the heterogeneity of the chemical system and limited known characteristics of the pathway.

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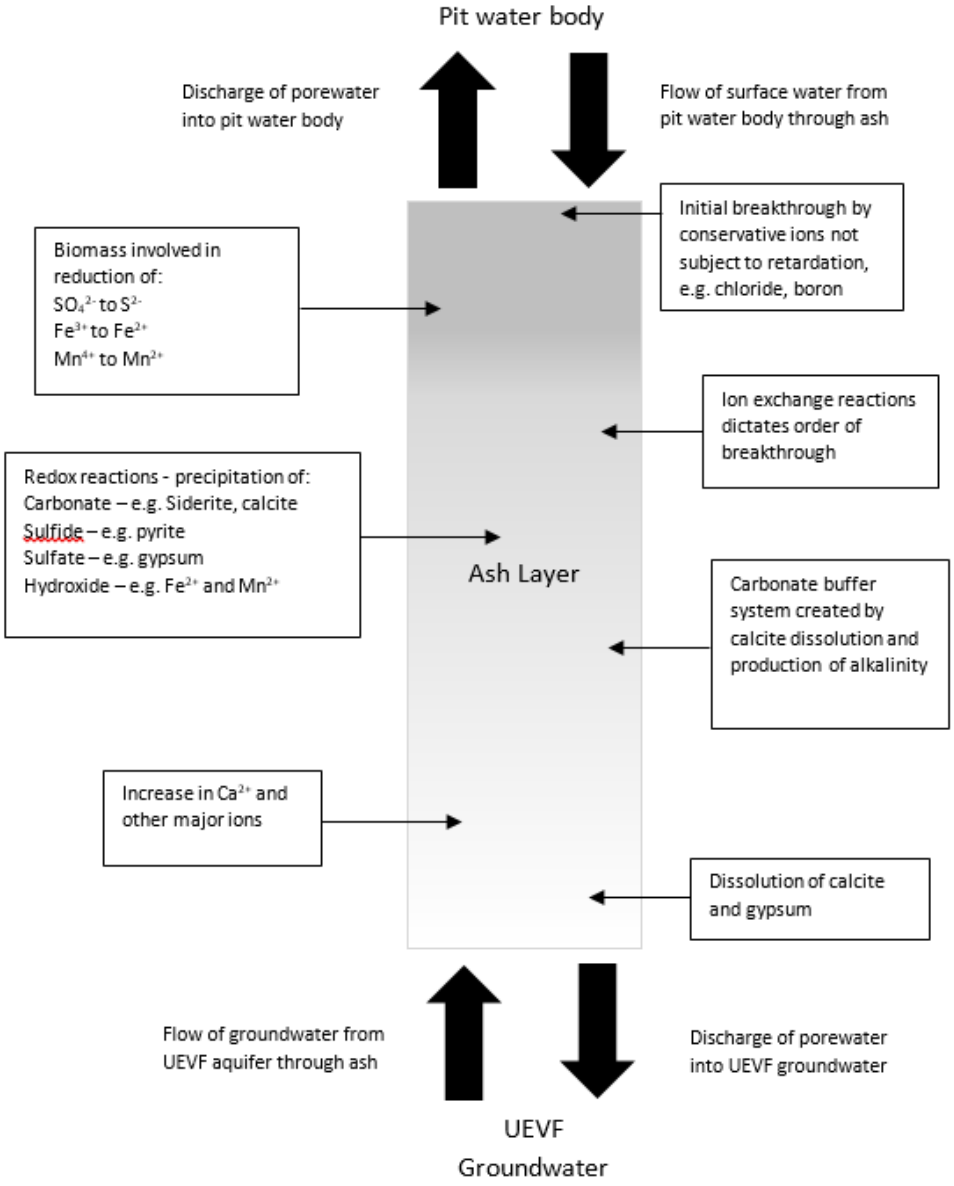

Figure 5-1: Potential reactions occurring along transport flow path

The leachability of compounds within the ash material is dependent on the quantity and acidity of percolating groundwater and on the ion exchange, buffering capacity and redox potential of the ash. For most trace elements leachate concentrations increase with increasing acidity and redox potential. The soluble component of coal ash is dominated by calcium and sulfate and lower concentrations of sodium, potassium and magnesium. Coal ash leachate is alkaline as pH rapidly increases as calcium is leached. Sulfate usually precipitates with calcium as gypsum. If sufficient calcium carbonate is present in the ash, mineral phase precipitation reduces porosity and permeability.

The dry bulk density of the Anglesea power station ash has been reported as 904 kg/m^3 (Beattie, 2003). This is slightly lower than the range of values reported by the EPRI (1993), 1,220±110 kg/m^3 (based on a population of 25). This may be due to the level of compaction which can affect the dry bulk density, in the latter samples. Porosity has not been reported for the ash solids, however, as discussed in **Section 3.2.1.1**, the ash material comprises >70% silt sized particles (2 to 60 µm) and total porosity is anticipated to be elevated. EPRI (1993) report values of total porosity for coal fly ash at 42.3±6.8% (based on a population of 23). Although total porosity is high, effective porosity is expected to be low

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based on the low permeability values. Site specific saturated hydraulic conductivity values are not available, however, EPRI (1993) report 10^{-4} to 10^{-5} m/s. Compacted coal ash typically reports permeabilities within the range 10^{-4} to 10^{-9} m/s dependent on the degree of compaction (EPRI, 1984).

The materials placed in the pit have been hydraulically pumped and allowed to settle and will be subsequently track rolled prior to being covered and on this basis permeabilities are anticipated to be less than 10^{-6} m/s. Effective porosity based on saturated hydraulic conductivity is anticipated to be ≥10% (non-compacted ash) and to decrease over time as mineral precipitation and cementation processes occur within the ash. Compaction of the ash within the pit to achieve a thickness of 2 to 5 m will further reduce the permeability and porosity of the material.

The model input file data blocks discussed below are representative of the final input file structure after a series of development and verification steps which are not presented or discussed.

5.2 UEVF groundwater flow through Ash - Model Input

5.2.1 Transport Solutions

In the transport data block, the flow path has 10 cells, which requires that 10 solutions, 1-10, be defined to infill each cell along the flow path. Solutions 1-10 represent the porewater (or Leachate 1 from the ASLP laboratory analysis). The displacing solution, the UEVF groundwater, is defined as solution 0.

The solution infilling each of the 10 cells of the pathway is defined within SOLUTION 1-10 data block:

```
SOLUTION 1-10 #Leachate 1 ash pond reagent water & ash solids
        Temp            15
        pH              9.8
        pe              0
        redox           pe
        units           mg/l
        density   1
        Alkalinity      116 as Ca.5(CO3).5
        B               29
        Ca              560
        Cl              931
        K               112
        Mg              237
        N(-3)           0.08 as NH4
        Na              1690
        S(6)            4540 as SO4
        -water          1 # kg
```

Figure 5-2: Porewater solution 1-10 data block

As discussed within Attachment 2, the equilibrium phases anticipated to be oversaturated are calcite and gypsum and these are defined as:

```
EQUILIBRIUM_PHASES 1-10
```

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```
    Calcite    0 10
    Gypsum  0 10
equilibrate with solution 1-10
```

Figure 5-3: Equilibrium phases 1-10 data block

The influent solution for the initial simulation is defined as the UEVF groundwater:

```
SOLUTION 0 #UEVF groundwater reducing
    temp      15
    pH        6.58
    pe        0
    redox     pe
    units     mg/l
    density   1
    Al        0.05
    N(-3)     0.15 as NH4
    Ba        0.064
    B         0.37
    Ca        86
    Cl        578
    Fe        23.9
    Mg        39
    Mn        0.958
    K         28
    Na        242
    S(6)      146 as SO4
    Alkalinity 103 as Ca.5(CO3).5
    -water    1 # kg
```

Figure 5-4: Influent UEVF groundwater solution data block

5.2.2 Transport Parameters

The PHREEQC transport option has been used to estimate the geochemical changes in ash porewater concentrations as UEVF groundwater flows through an ash horizon. The transport pathway is simulated using a sequential cell arrangement with each cell defined by the physical and hydraulic characteristics of the ash. A solution representative of the ash porewater is equilibrated with equilibrium phases and an exchange assemblage of exchange species which are derived from the analysis of the ash solids:

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The composition of the exchange assemblage can be defined in the input file, in two ways:

a) Listing the composition of each exchange component in moles;

```
EXCHANGE 1 ion exchange
    CaX2    0.228
    MgX2    1.246
    NaX     0.205
    KX              0.021
    NH4X    1e-005
    MnX2    1e-005
    FeX2    1e-005
```

Figure 5-5: Exchange data input block, individual exchange species

Or,

b) Specifying that each exchanger is in equilibrium with a solution of fixed composition, used in transport and/or advection simulations (Parkhurst and Appelo, 1999).

```
EXCHANGE 1-4 ion exchange
    X               1.700
   -equilibrate with solution 1
```

Figure 5-6: Exchange data input block, total exchange capacity

The exchanger mean (average) total CEC and individual cation exchange capacity values were converted from meq/100g to moles/L as follows:

The individual species exchange capacity derived as moles/L are calculated by dividing the ash bulk density (0.904 g/cm^3) by the ash effective porosity (0.10) and multiplying by the measured exchange capacity in meq/kg to give meq/L. This value is then divided by the species valance and then by 1000 to correct for units.

Table 5-1: Conversion of average exchange capacity from meq/100g to moles/L

Species	Exchange capacity meq/100g	Exchange capacity meq/kg	Exchange capacity meq/l	Exchange capacity moles/l
Calcium CaX_2	5.0	50.3	455	0.228
Magnesium MgX_2	27.6	275.7	2492	1.246
Sodium NaX	2.3	22.7	204.9	0.205
Potassium KX	0.2	2.3	21.1	0.021
Total X	35.1	351	3173	1.700

Either the total cation exchange or individual exchange values can be used depending on the exchange composition within the model. In **Figure 5-5**, small amounts of ammonium, iron and manganese have been added to provide initial sites for ion exchange of these species. In **Figure 5-6**, the ion exchanger is equilibrated with solution 1, which is the porewater solution.

This keyword data block is used to define a half-reaction and relative log *K* for each exchange species. Normally, this data block is included in the database file and only additions and modifications are included in the input file (Parkhurst and Appelo, 1999).

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In the default database file, sodium (NaX) is used as the reference and is the master species, and the reaction X - + Na + = NaX is given a log K of 0.0.

```
EXCHANGE_SPECIES 1-n
    Na+ + X- = NaX
       log_k     0
       -gamma    4 0.075
    K+ + X- = KX
       log_k     0.7
       delta_h   -4.3 kJ
       -gamma    3.5 0.015
    NH4+ + X- = NH4X
       log_k     0.6
       delta_h   -2.4 kJ
       -gamma    2.5 0
    Ca+2 + 2X- = CaX2
       log_k     0.8
       delta_h   7.2 kJ
       -gamma    5 0.165
    Mg+2 + 2X- = MgX2
       log_k     0.6
       delta_h   7.4 kJ
       -gamma    5.5 0.2
    Mn+2 + 2X- = MnX2
       log_k     0.52
       -gamma    6 0
    Fe+2 + 2X- = FeX2
       log_k     0.44
       -gamma    6 0
```

Figure 5-7: Exchange species input data block

The number of pore volumes required for the simulation defines the number of shifts required. One shift moves a solution to the next cell, and the last solution out of the ash. PHREEQC calculates cell-centred concentrations, so that the concentrations in the last cell arrive 0.5 shifts later at the end of the flow path. The number of pore volumes flushed from the ash is equal to the number of shifts (+ 0.5) divided by the number of cells (Parkhurst and Appelo, 1999).

Table 5-2: Initial PHREEQC transport parameters

Parameter	Value
Pathway length	5 m
Pathway saturated hydraulic conductivity	10^{-5}, 10^{-7}, 10^{-9} m/s
Pathway porosity	0.1, 0.05
Number of cells	10
Length of cell	0.5 m
Number of pore volumes	2
Number of cell shifts along pathway	20

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```
TRANSPOR
        -cells                  10
        -shifts                 20
        -time_step              50000 # seconds range 50,000 to 500,000,000
        -flow_direction         forward
        -boundary conditions    flux flux
        -lengths        10*0.5
        -dispersivities         10*0.01035
        -correct_disp           true
        -diffusion_coefficient  0
        -print_cells            10
        -print_frequency  1
        -punch_cells            10
        -warnings               false
```

Figure 5-8: Transport data block

For linear flow, which is assumed in the transport simulation, the time step is equal to the cell size divided by the average linear velocity. Based on the range of ash hydraulic conductivities (10^{-5} to 10^{-9} m/sec) sourced from literature (EPRI, 1993) the average linear velocity ranged from 0.864 to $8.6x10^{-5}$ m/day. Although a time duration or time step is assigned to each cell the transport is defined by the number of pore volumes. Reactions are not defined by kinetics or rates but by thermodynamic equilibrium reactions. Therefore, the time step magnitude is meaningless in the geochemical calculations unless rate constants are applied. An estimate of theoretical flow through time can be calculated using the pathway length and hydraulic conductivity. Based on a 5 m pathway length and hydraulic conductivities between 10^{-5} and 10^{-9} m/sec, a conservative transport particle would take between 5.8 days and 57,870 days (or 159 years).

The flow direction is defined as forward advective flow. The boundary conditions are set to flux at the first cell and flux at the end cell. These are the default options. The length for each cell is 1/10th of the total flow path (5 m) which is equal to 0.5 m.

The dispersivity for each cell is 1/10th of the total dispersivity (0.1035 m), which is equal to 0.01035 m. The dispersivity has been estimated by fitting a column breakthrough curve from clay column experimental data, to an analytical solution of the Ogata-Banks advection-dispersion transport equation (Thornton et al, 1993), which is likely to be representative of flow conditions for this transport simulation. The identifier, -correct_disp, should be set to true when modelling outflow from a column set with flux boundary conditions.

The diffusion coefficient is an optional parameter; the default is $0.3e^{-9}$ m^2/s. Model runs were completed with and without this parameter selected. It appeared that the presence or absence in the input file did not make any difference for this specific model setup. The identifiers -punch_cells and -punch frequency, specify that data will be written to the selected-output file for cell 10 at each shift. The identifiers -print_cells and -print_frequency, indicate that data will be written to the output file for cell 10 (the final cell) for every shift.

5.3 UEVF groundwater flow through Ash - Model Output

Results of the simulated flow of UEVF groundwater through saturated ash have been plotted as **Figure** 5-9 to **Figure 5-11**. The estimated concentrations are reported from the final cell of the transport pathway (ash) and does not account for mixing within the pit water body. The influent solution (UEVF groundwater) and porewater within the transport pathway achieve equilibrium within two pore volumes at the highest saturated hydraulic conductivity of 10^{-5} m/sec.

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Figure 5-9 plots the change in major ion chemistry of the last cell as 2 pore volumes of UEVF groundwater flow through the ash material. The chemistry of the last cell is constant until approximately 0.75 pore volumes, where the leachate front of the UEVF groundwater starts to influence the decrease in pH. The decrease in pH is observed between 0.75 and 1.15 pore volumes, after which equilibrium conditions are attained within the ash material. The resulting solution which is flowing into the pit water body after 1.15 pore volumes has lower concentrations of sodium and chloride and to a lesser extent calcium, magnesium and potassium and a pH 7.2. Sulfate concentrations are elevated in comparison to the ash porewater, increasing from 2,816 mg/L to 3,086 mg/L. The final concentration is still lower than the initial sulfate concentrations within the unequilibrated ash porewater (4,540 mg/L) due to the initial oversaturation of sulfate.

Alkalinity species and pH change as one pore volume passes through the final cell of the model. As the pH decreases bicarbonate concentrations increase as bicarbonate becomes more dominant than carbonate (refer to **Figure 5-10**). The ash porewater after one pore volume is more circum-neutral (approximately pH 7.2) after the more acidic UEVF groundwater has passed through the ash.

Boron concentrations appear to decrease from 29 mg/L to 0.4 mg/L (refer to **Figure 5-11**) and will be as a result of dilution as boron behaves conservatively. Aluminium was below detection levels in the ASLP results, however, due to the presence of aluminium in the UEVF groundwater concentrations are observed to equilibrate within the ash porewater to 0.05 mg/L. Aluminium is expected to precipitate and the diaspore phase could have been used as an equilibrium phase to simulate this within the initial ash porewater, however, this can only be used if it is initially present as an elemental species. Barium concentrations are also observed to increase from non-detectable concentrations, however, it is likely to form barite (due to elevated sulfate) which is highly insoluble.

Precipitation of gypsum has lowered the sulfate concentrations in the initial equilibrated porewater (refer to **Figure 5-12**). As the UEVF groundwater flows through the ash the pH drops and dissolution of gypsum occurs resulting in an increase in sulfate concentrations. Sulfate concentrations are observed to equilibrate after 1.25 pore volumes while gypsum continues to dissolve. This is due to the supersaturation and potential precipitation of pyrite (iron sulfide). The dissolution of calcite and gypsum has a negligible effect on calcium aqueous concentrations as the additional calcium is taken up by the ion exchange surface.

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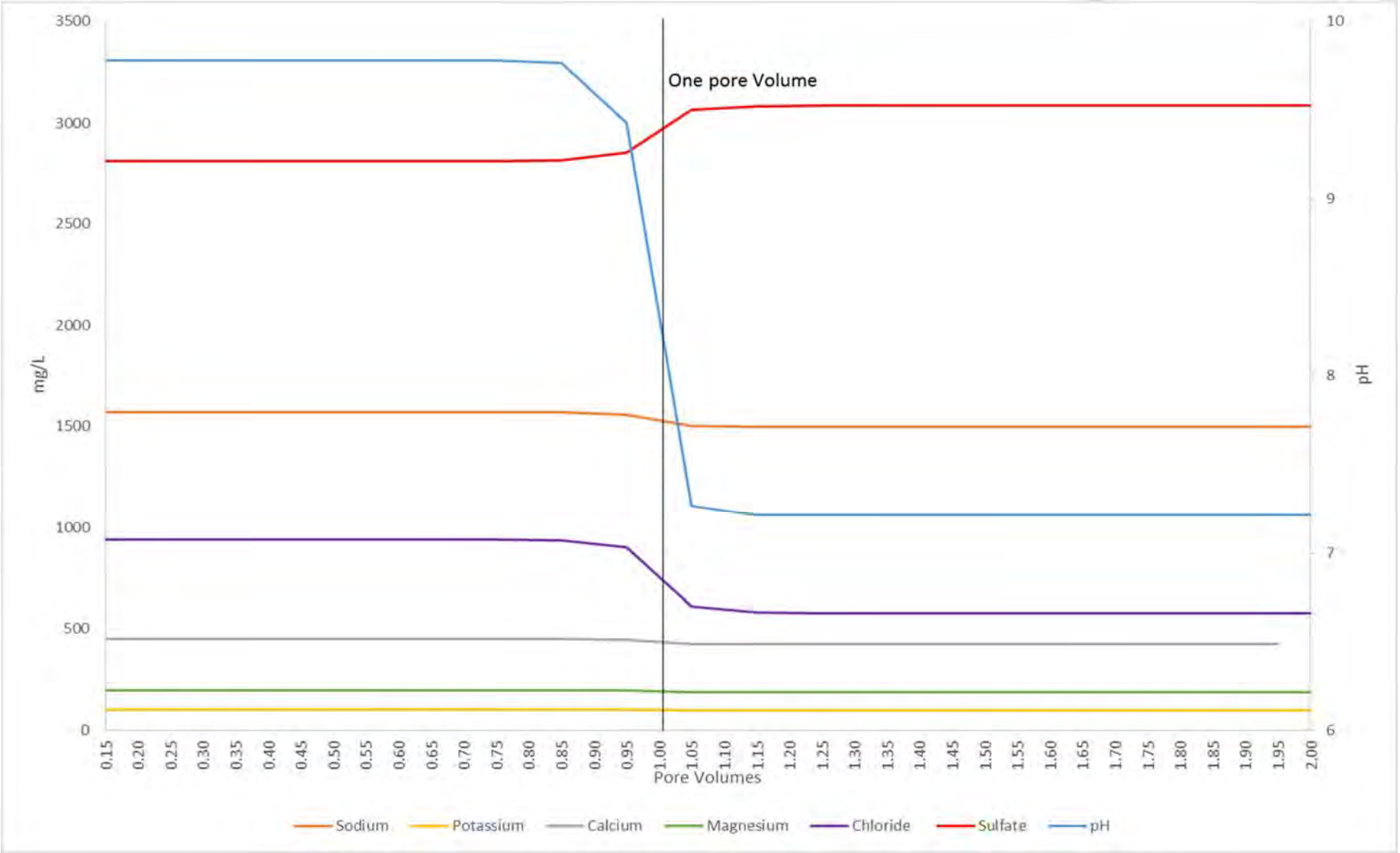

Figure 5-9: Breakthrough major ion chemistry UEVF groundwater and ash solids

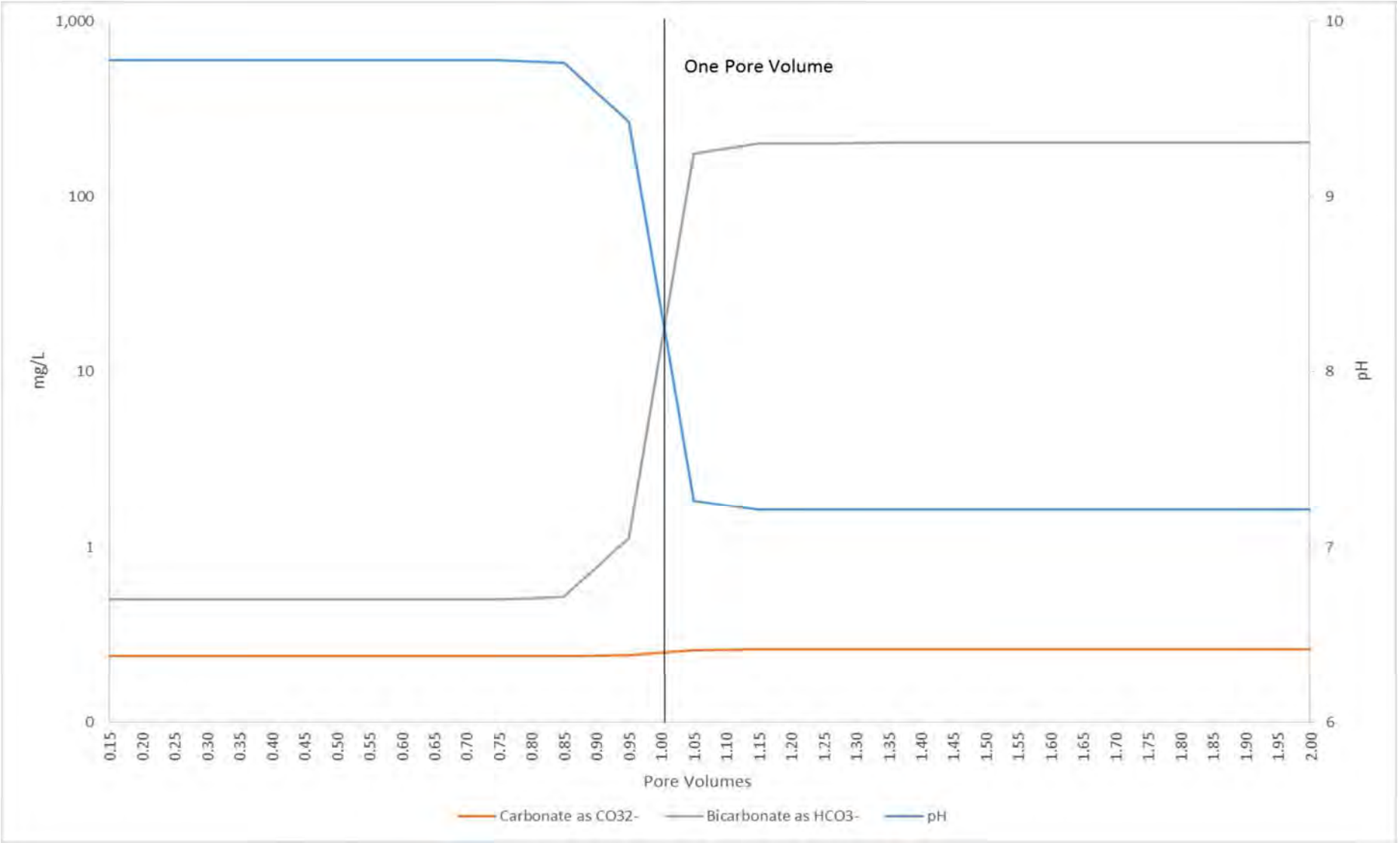

Figure 5-10: Breakthrough pH and alkalinity as carbonate and bicarbonate chemistry UEVF groundwater and ash solids

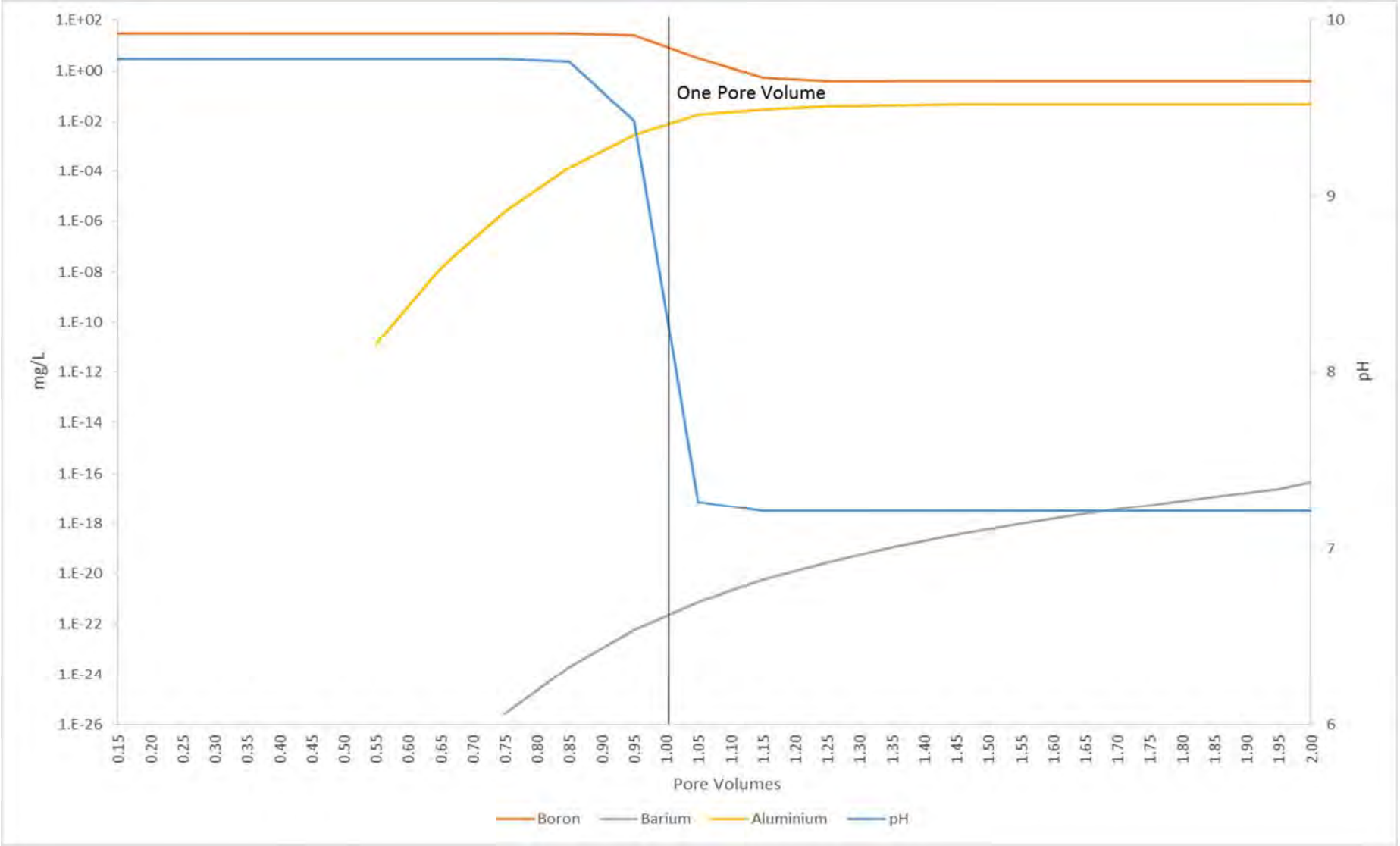

Figure 5-11: Breakthrough pH and trace element chemistry UEVF groundwater and ash solids

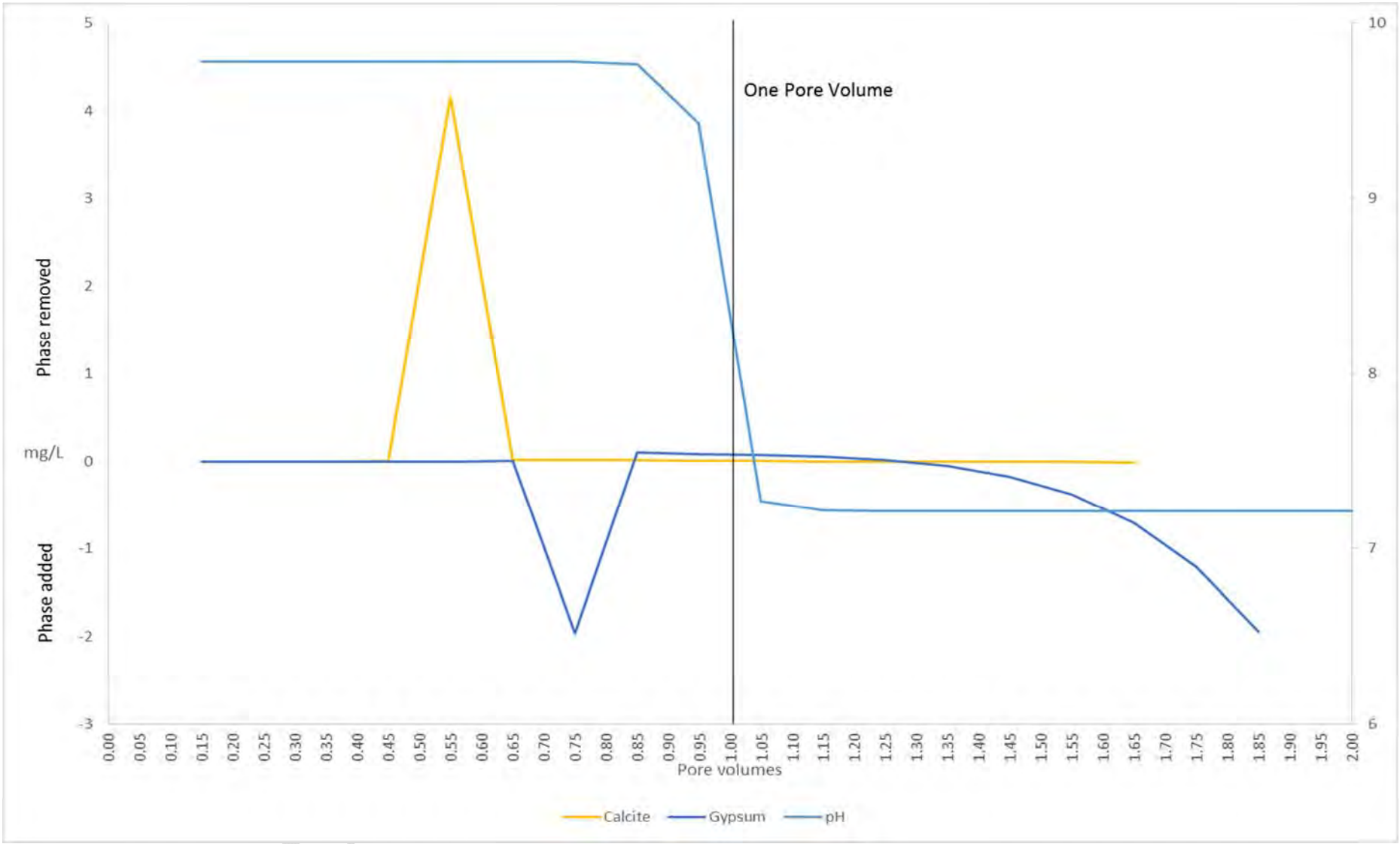

Figure 5-12: Calcite and gypsum dissolution/precipitation equilibrium

5.4 Pit water body flow through Ash - Model Input

To explore the potential geochemical changes to pit water body that flows through the ash layer and discharges into the UEVF groundwater a reverse flow scenario was simulated using the transport option within PHREEQC.

5.4.1 Transport Solutions

For the transport data block conditions are maintained as discussed within **Section 5.2.1** for Solutions 1-10 and Equilibrium Phases within the ash flow pathway.

The influent solution for the initial simulation is defined as the pit water body:

```
SOLUTION 0 #Pit water body 080316
   temp      15
   pH        3.1 #CO2(g) -3.5
   pe        4
   redox     pe
   units     mg/l
   density   1
   Al        1.7
   N(-3)     0.53 as NH4
   Ba        0.078
   B         1.1
   Ca        45
   Cl        530
   Fe        14
   Mg        89
   Mn        0.41
   K         9.7
   Na        220
   S(6)      470 as SO4
   Alkalinity 2 as Ca.5(CO3).5
   -water    1 # kg
```

Figure 5-13: Influent pit water body solution data block

5.4.2 Transport Parameters

The majority of the transport data block has been used as discussed within **Section 5.2.2**. The only change was to increase the number of shifts to 200 so 20 pore volumes would be eluted from the column and equilibrium observed in the species of interest.

5.5 Pit water body flow through Ash - Model Output

Results of the simulated flow of pit water body through saturated ash have been plotted as **Figure 5-14** to **Figure 5-17**. The estimated concentrations are reported from the final cell of the transport pathway (ash) and does not account for mixing within the UEVF groundwater. The influent solution (pit water body) and ash porewater within the transport pathway achieve equilibrium (for the majority of species) within twenty pore volumes at the highest saturated hydraulic conductivity of 10^{-5} m/sec.

Figure 5-14 plots the change in major ion chemistry of the last cell as 20 pore volumes of pit water body flow through the ash material. The chemistry of the last cell is constant until approximately 0.75

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pore volumes, where the leachate front (consisting of calcium, sodium and sulfate) of the pit water body starts to influence the decrease in pH. The decrease in pH is observed between 0.75 and 1.15 pore volumes, after which equilibrium conditions with respect to pH, are attained within the ash material. Other aqueous species such as calcium, sulfate and sodium do not achieve equilibrium until approximately 20 pore volumes have passed through the ash layer. The varying concentrations are due to equilibrium conditions being established on the ion exchange surface and between defined mineral phases (gypsum and calcite). The resulting solution which is flowing into the UEVF groundwater after 20 pore volumes has a lower pH and elevated concentrations of major ions with the exception of sodium. Eluted sulfate concentrations decrease from 2,816 mg/L in the initial ash porewater to 588 mg/L at the end of 20 pore volumes. The final concentration is higher than the 146 mg/L reported in the UEVF groundwater.

Alkalinity species and pH change as one pore volume passes through the final cell of the model. As the pH decreases bicarbonate concentrations increase as bicarbonate becomes more dominant than carbonate (refer to **Figure 5-15**). The ash porewater after one pore volume is more acidic (approximately pH 5). Dissolution of calcite occurs as the acidic pit water body flows through the alkaline ash material and bicarbonate concentrations are reported at approximately 5,730 mg/L after 20 pore volumes. With bicarbonate and calcium concentrations at these levels, calcite is expected to have precipitated which in reality would result in lower aqueous concentrations of calcium and bicarbonate

Boron concentrations appear to decrease from 29 mg/L to 1.1mg/L, mainly due to the decrease in pH (refer to **Figure 5-16**). Aluminium was below detection levels in the ASLP results, however, due to the presence of aluminium in the pit water body, concentrations are observed to equilibrate within the ash porewater at 1.7 mg/L. Aluminium is expected to precipitate. Barium concentrations are also observed to decrease slightly from 0.064 mg/L to 0.05 mg/L.

Gypsum dissolution at the leachate front is responsible for the initial increase in sulfate concentrations at 0.65 pore volumes (refer to **Figure 5-17**). As the pit water flows through the ash the pH drops and dissolution of gypsum and calcite occurs. Sulfate concentrations are observed to decrease around 1 pore volume and equilibrate after 17 pore volumes while gypsum continues to dissolve. This is due to the supersaturation and potential precipitation of pyrite (iron sulfide). The dissolution of calcite and gypsum appears to have delivered more calcium than can be preferentially exchanged and aqueous calcium is observed to increase as calcite and gypsum dissolve. As equilibrium between calcium, calcite and gypsum is achieved the concentrations level out after 17 pore volumes (refer to **Figure 5-14** and **Figure** 5-17).

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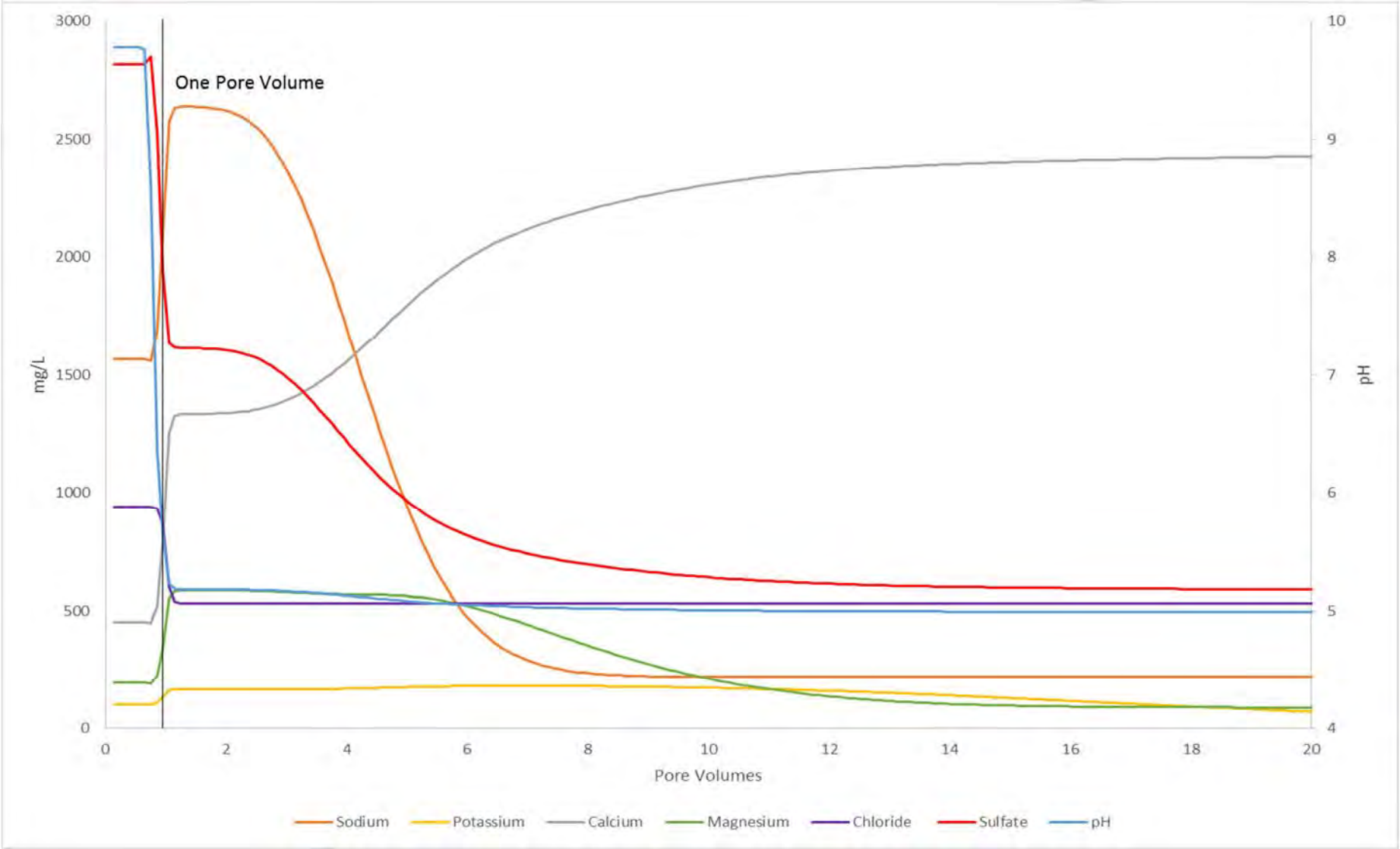

Figure 5-14: Breakthrough major ion chemistry pit water body and ash solids

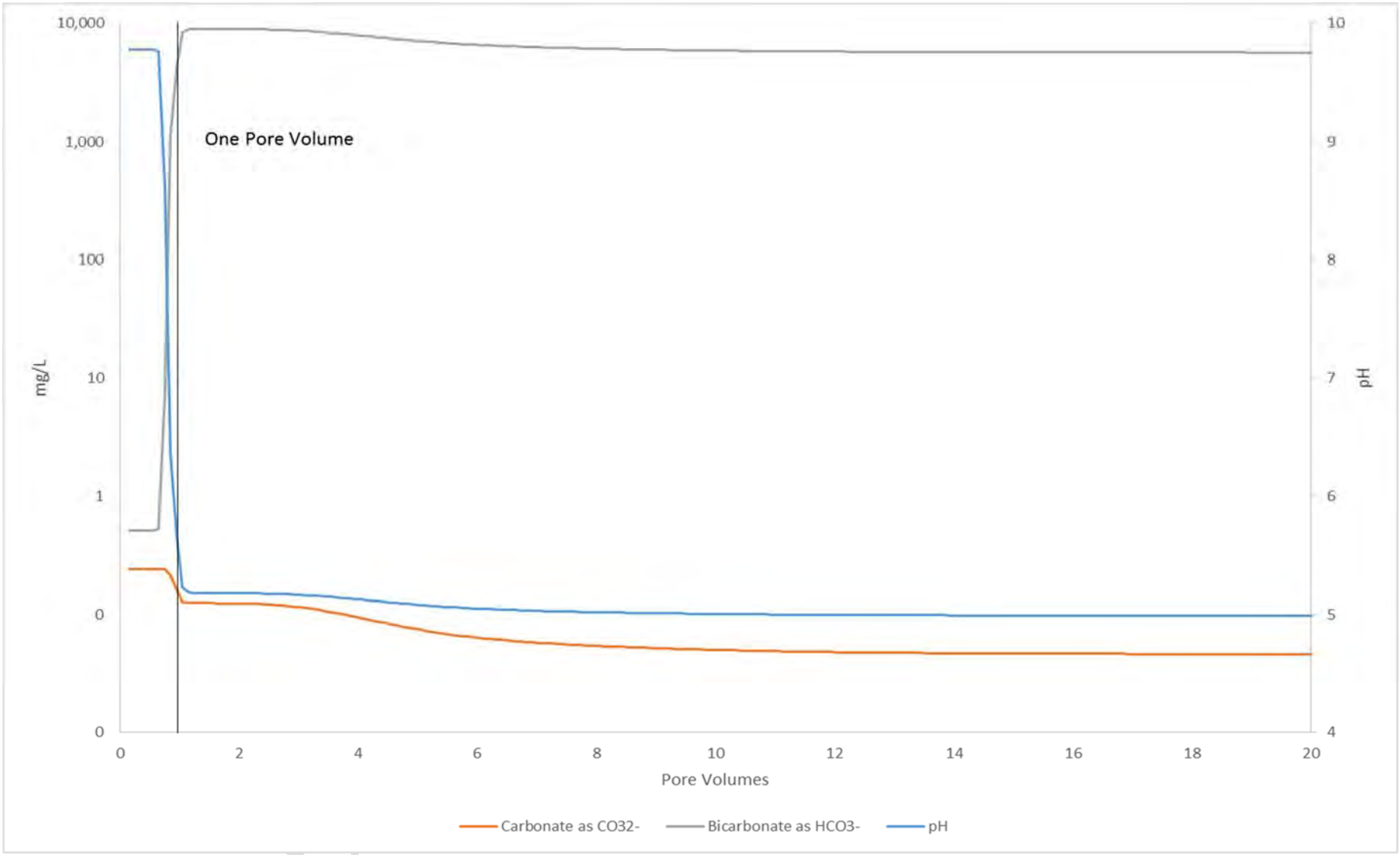

Figure 5-15: Breakthrough pH and alkalinity as carbonate and bicarbonate chemistry pit water body and ash solids

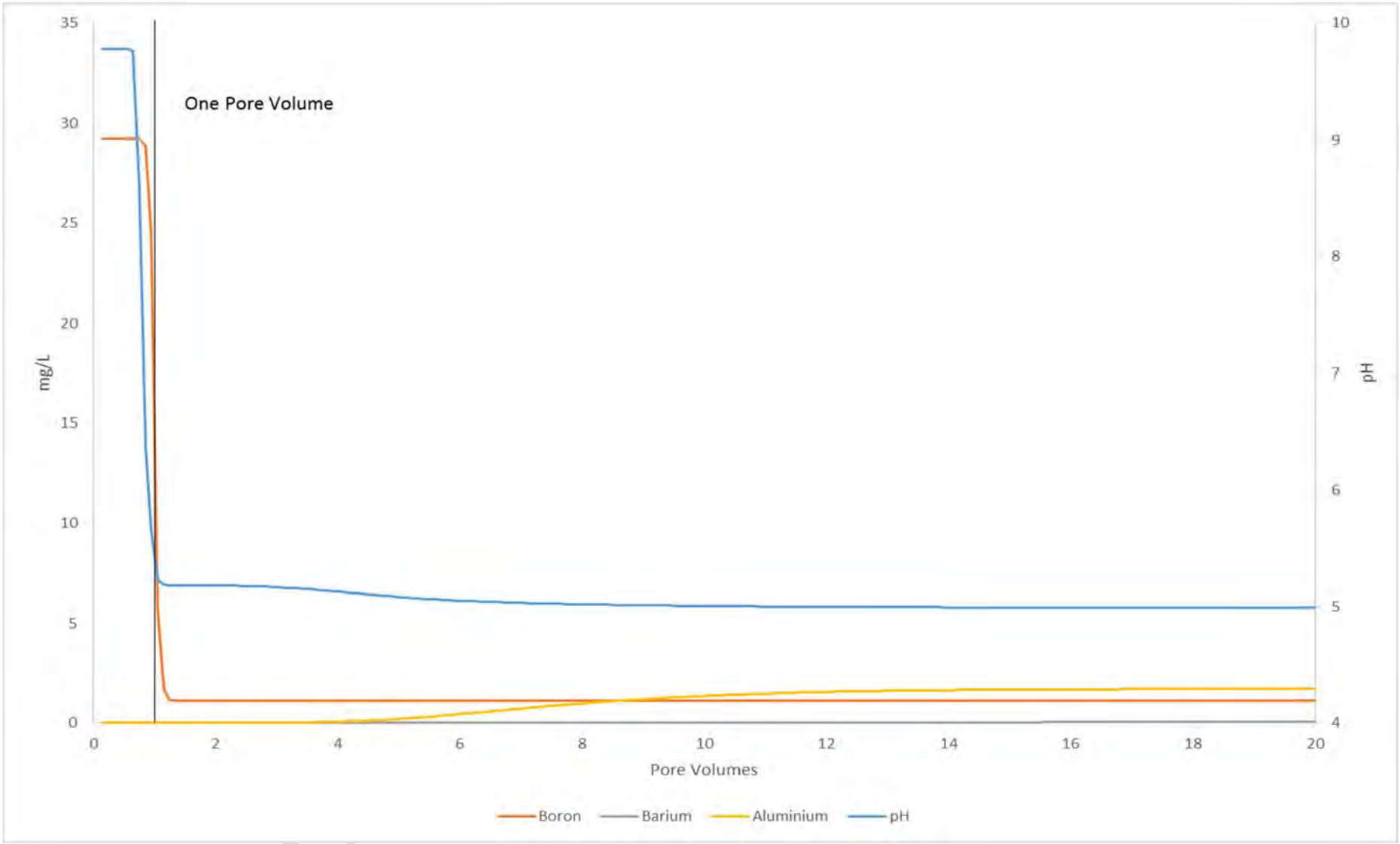

Figure 5-16: Breakthrough pH and trace element chemistry pit water body and ash solids

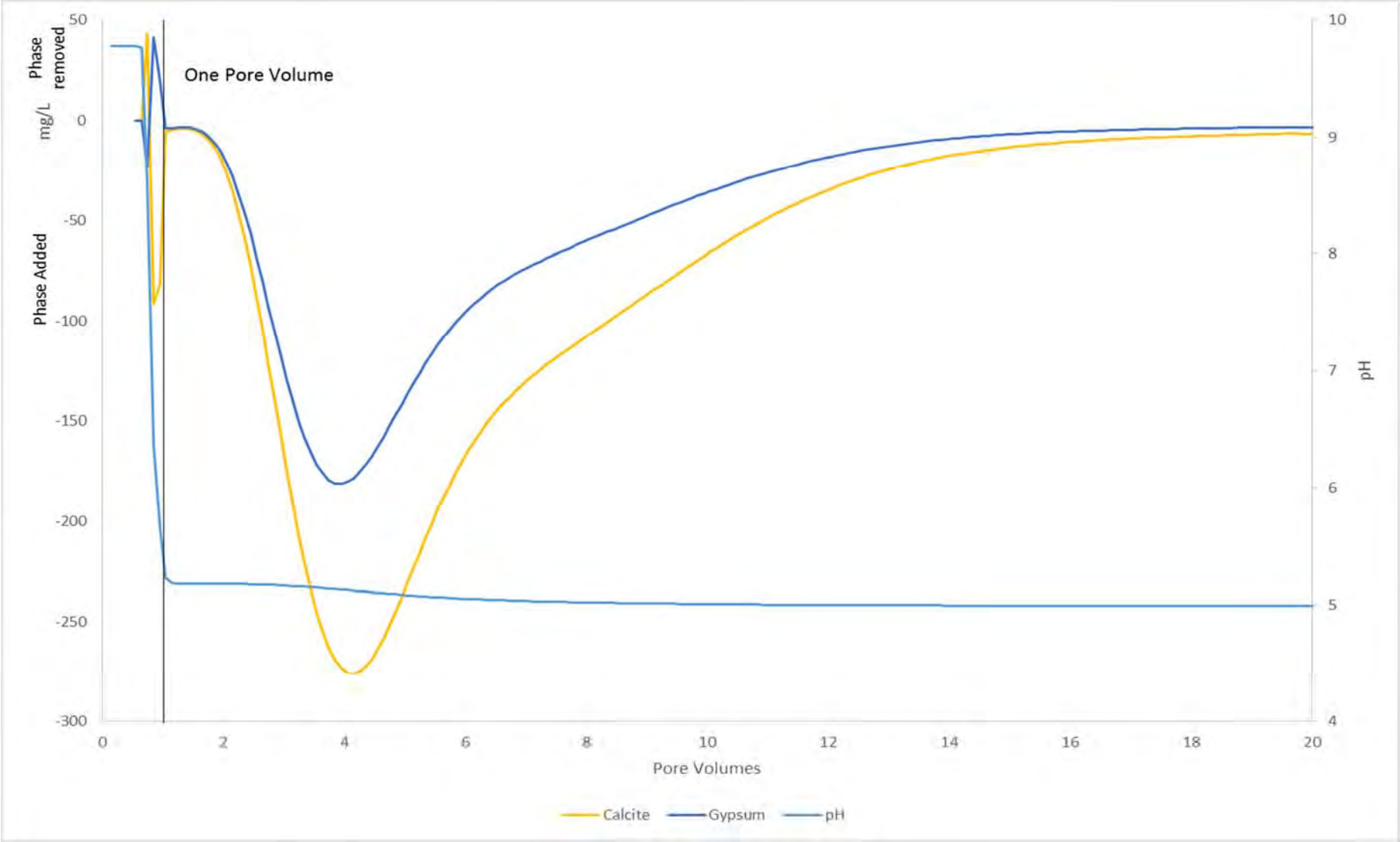

Figure 5-17: Calcite and gypsum dissolution/precipitation equilibrium

5.6 Defining Surface Water and Groundwater Concentrations using Transport Solutions

The chemistry of porewater within the ash material has been predicted using either UEVF groundwater or pit water body as the recharge or discharge solution. The transport simulations do not provide information on chemistry changes once these solutions are discharged into the receiving water. Using the hydrogeologic flux calculations described above, the simple mixing simulations have been revised to incorporate these geochemical processes.

Based on the DAFs calculated above the ash porewater discharge/recharge will be less than 1% to the UEVF and 0.1% to the pit water body during the early time period and once the lake is established the fluxes will be negligible.

5.6.1 Pit water body as a receptor

The simulated chemistry within cell 10 after 2 pore volumes of UEVF groundwater had passed through the ash layer (Section **5.3**) was used to explore the potential changes in chemistry when mixed with the pit water body. This scenario considers upward gradients which result in UEVF moving vertically upward through the ash and into the Pit water body.

At this stage, it is not known precisely what volume to volume ratio of mixing will occur at the interface between discharge of pore water from the ash into the pit water body surface water. Based on the DAFs presented within **Table 4-1** and **Table 6-11**, the ratio of ash pore water moving vertical up into the lake is very small. As noted above, interaction of groundwater with the Ash will not occur until groundwater and levels in the upper portion of the UEVF are at -14 m AHD. Without the diversion of Salt Creek this will not occur for 10 years. Further, the diversion of Salt Creek is planned to occur after completion of toe buttress construction work which will occur in the next year. On this basis, the heads will be downward in the short-term and upward fluxes will only be upward once the lake is full with vertical flux driven solely by evaporation from the lake. As detailed in Section 4 the calculated dilution ratio is 62.80 or a ratio of 0.016 pore water sourced from the ash and 0.984 lake water.

To explore the outcome of larger volumes of ash porewater discharging to the pit water body, a higher magnitude greater than the DAF was used within the mixing ratio (0.05:0.95). Boron and Aluminium are the primary minor ions assessed based on their exceedances of screening criteria. The only significantly measurable change in lake water chemistry is the increase in carbon concentrations (by an order of magnitude). Carbon is not a constituent of concern, does not influence any changes in acidity or alkalinity in the pit water body due to the acidity buffering and is a positive component in supporting various degrees of seasonal mixing (including complete mixing) occurring between the individual layers and establishment of sulfate and metal reduction. For all other constituents, the concentrations are effectively unchanged.

Table 5-3: Results of mixing ratios – Ash Porewater and pit water body

Analyte	Surface Water Background (Salt Creek and Anglesea River)	Ash porewater	Pit water body	0.016:0.984	0.05:0.95
	mg/L	mg/L	mg/L	mg/L	mg/L
pH (unitless)	3.68 – 3.8	7.2	3.1	3.17	3.31
redox (mV)		-177	109	104.42	94.70
Aluminium	9.6 – 52.4	0.05	1.7	1.67	1.62

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Analyte	Surface Water Background (Salt Creek and Anglesea River)	Ash porewater	Pit water body	0.016:0.984	0.05:0.95
	mg/L	mg/L	mg/L	mg/L	mg/L
Boron	< 0.05 – 0.30	0.37	1.10	1.09	1.06
Barium		0	0.08	0.08	0.08
Carbon		48	0	0.77	2.40
Calcium		428	45	51.13	64.15
Chloride		581	531	531.80	533.50
Iron	5 – 30	0	14	13.78	13.30
Potassium		98	10	11.41	14.40
Magnesium		185	89	90.54	93.80
Manganese		0	0.5	0.49	0.48
Nitrogen		0.02	0.4	0.39	0.38
Sodium		1,505	220	240.56	284.25
Sulfur	396 – 1,466 (as sulfate)	1,037	157	171.08	201.00

The simulation results suggest that at the anticipated high dilution factors within the pit water body there will be negligible changes to the pit water body chemistry. While Boron is present within the existing pit water body at concentrations greater than background, the Ash water does not yield concentrations significant above background and the surface water into the pit (as part of the rediversion) will result in a decrease in concentrations. Further the short-term treatment activities and the stratification of the lake (with associated biotic processes) will lead to improvements in water quality in the upper lake surface over those calculated above.

5.6.2 UEVF groundwater as a receptor

The simulated chemistry within cell 10 after 20 pore volumes of pit water body had passed through the ash layer (Section 5.5) was used to explore the potential changes in chemistry when associated with the flux of water from the pit water body through the ash into the UEVF groundwater. This scenario reflects the re-diversion of Salt Creek where the elevation of the lake will be higher than groundwater and the lake will be recharge the UEVF.

Using the hydrogeologic evaluation and calculations described above and the resulting DAFs (refer **Table 4-1** and **6-11**), the DAF for flux to UEVF groundwater is 51.44. As detailed above, the numerical modelling indicates that particles of water (and associated constituents) from the pit water body will be confined to the upper portions of the UEVF (the coal sequences) and will not descend into the deeper water bearing layers. Therefore, the calculations provided are considered highly conservative and no additional sensitivity analysis is conducted.

The simulation results suggest that at the anticipated high dilution factors within the UEVF there will be negligible changes to the groundwater chemistry. The only significantly measurable change above that observed naturally in the UEVF is the increase aluminium concentrations from 0.06 mg/L to 0.09 mg/L. Aluminium precipitates at pH greater than 4.5, so is unlikely to be mobile within UEVF groundwater.

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Table 5-4: Results of mixing ratios – ash transport porewater and median UEVF groundwater concentrations

Analyte	ANZECC Aquatic or Background	Ash porewater transport outpot water quality	Median Concentrations 1989-2016 UEVF groundwater	mixing ratio 0.03:0.98
	mg/L	mg/L	mg/L	mg/L
pH	3.68 – 3.8	5	5.79	5.15
Redox	not available	-36	0	-40
Aluminium	9.6 – 52.4	1.5	0.14	0.002
Boron	0.37	1.1	0.08	0.11
Barium	not available	0.01	long term data not available	0.0003
Calcium	not available	2,342	long term data not available	72
Carbon	not available	23,986	long term data not available	146
Chloride		531	long term data not available	16
Iron	5 – 30	13.91	long term data not available	0.43
Potassium		167	long term data not available	5
Magnesium	not available	165	long term data not available	5
Manganese	0.1 – 1.9	0.41	0.97	0.95
Nitrogen	0.5	0.18	long term data not available	0.12
Sodium		220	long term data not available	6.8
Sulfur	396 – 1,466 (as sulfate)	374	long term data not available	176

Calcium concentrations are predicted to be higher than the receiving water concentrations, however, as discussed within Section 5.5 calcium is anticipated to precipitate as calcium carbonate. The redox potential is also predicted to be reducing which is being controlled by the precipitation of pyrite.

In summary, the discharge of ash porewater into either the UEVF groundwater or the pit water body is likely to have a negligible effect on the receiving water chemistry.

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6.0 CONCLUSIONS

The long-term goal for the rehabilitation of the coal pit void is the creation of a pit water body. Extraction of groundwater in the vicinity of the pit void by Alcoa ceased in early 2016 and the rebound of groundwater levels will gradually flood the pit void. Groundwater and rainfall will contribute to the filling of the pit void which is currently estimated to take between 15-20 years. The slow filling of the pit void increases the risk of acidity generation from materials within the pit void such as overburden and spoil and exposed unworked coal seams within the pit walls. Decommissioning of the former power station facility has included the movement of ash materials from the ash ponds to the eastern area of the pit void.

The surface water catchments and native lithologies surrounding the pit void are characterised by low pH (high acidity) and elevated concentrations of metals such aluminium, iron, manganese and zinc. Depending on the pH, all of these metals have the ability to buffer acidity (through uptake or release of hydrogen ions, H^+). Historically, the pit water body has reported the effects of the dissolution of acidity and metals from the native spoil and overburden within the pit void and the oxidation of elevated iron within the groundwater (which discharges into the pit water body).

During the filling of the pit water body, there is the possibility that recharge of pit water body will occur to the UEVF groundwater. Equally once surface water and groundwater levels have equilibrated UEVF evaporation of water may lead to flux of groundwater through the ash and into the pit water body. Assessment of the potential impacts of the ash on surface water and groundwater quality has been conducted using an assessment of fluxes using hydrogeologic parameters for the site. Simple DAF using the analytical results from ASLP and ash pond water analyses show that there is limited potential for impacts on groundwater quality in the UEVF and the existing pit water body chemistry.

Transport modelling of both pit water body and UEVF groundwater through the ash materials in the pit void has been simulated. Geochemical modelling indicates the porewater and water flowing through the ash solids will attain equilibrium within 2 pore volumes. Using geochemical mixing simulations, the chemical influence of either pit water body or UEVF groundwater on the ash has been evaluated and the resulting changes in receiving water quality. Based on this assessment there was very limited effect on water quality above that observed in the existing pit water body and UEVF. This is mainly due to the dilution effects of the receiving waters but in the case of the pit water body (as a receiving water) acidity buffering limits large increases in pH. In terms of the pit water body chemistry it is recognized that metals are elevated but the lake will be subjected to short-term alkaline additions (which will reduce the solubility of metals) and seasonal stratification, mixing and biological processes.

The simulations provided are considered highly conservative. Based on the referenced hydraulic conductivities of coal combustion ash (10^{-5} and 10^{-9} m/sec), a conservative transport particle would take between 5.8 days and 57,870 days (or 159 years) to travel through the 5m thickness. The geochemical reactions simulated within PHREEQC are based on thermodynamic equilibrium, so it is likely that transport through the ash material would have to be in the order of years or decades for some of the reactions to attain steady-state. Using the equilibrated porewater solutions and receptor waters, the discharge of ash porewater into either the UEVF groundwater or the pit water body is likely to have a negligible effect on the receiving water chemistry.

On the basis of these assessments, the placement and covering of ash with 1 m of silts and clays from the site will provide a solution that will prevent direct interaction of the ash with surface water and is sufficient in combination with the hydraulic properties of the formation to constrain the flux of constituents into groundwater and surface water. Considering these conditions, there will be no long-term adverse impact associated with the placement and management of Ash within the pit.

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ATTACHMENT 1 TABLES

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Table 1: Ash Solid Samples Physical parameters and Exchangeable Ions

Parameter	Unit	Location 1	Location 2	Location 3	Berm
+75µm	%	3	5	25	18
+150µm	%	2	3	19	11
+300µm	%	<1	2	13	8
+425µm	%	<1	2	11	7
+1180µm	%	<1	1	8	6
+2.36mm	%	<1	<1	5	4
+4.75mm	%	<1	<1	2	1
+9.5mm	%	<1	<1	<1	<1
+19.0mm	%	<1	<1	<1	<1
+37.5mm	%	<1	<1	<1	<1
+75.0mm	%	<1	<1	<1	<1
+600µm	%	<1	<1	<1	<1
Clay (<2 µm)	%	<1	2	3	40
Silt (2-60 µm)	%	96	85	72	33
Sand (0.06-2.00 mm)	%	4	13	22	25
Gravel (>2mm)	%	<1	<1	3	2
Cobbles (>6cm)	%	<1	<1	<1	<1
Exchangeable Magnesium	meq/100g	22.5	57	3.2	4.4
Exchangeable Potassium	meq/100g	<0.2	<0.2	0.3	0.7
Exchangeable Sodium	meq/100g	1.8	2.1	2.9	0.8
Exchangeable Calcium	meq/100g	5.2	2.2	7.7	4.6
Cation Exchange Capacity	meq/100g	29.6	61.3	14.1	10.6

Table 2: Acid Sulfate Soil Parameters

Parameter	Unit	Location 1	Location 2	Location 3	Berm
Sulfur - Total as S (LECO)	%	4.74	7.27	4.58	0.13
MPA	kg H2SO4/t	145.04	222.46	140.15	3.98
ANC as CaCO3	% CaCO3	44	45.5	29.6	0.3
ANC as H2SO4	kg H2SO4 eq/t	432	446	290	3.1
Net Acid Production Potential	kg H2SO4/t	-287	-224	-150	0.9
NAG (pH 4.5)	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1
Fizz Rating	Fizz Unit	5	5	4	0
pH Value	pH Unit	11.2	10.8	10.3	6.7
pH (OX)	pH Unit	9.2	9.4	8.4	7.2

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Table 3: Ash Solids Major Ions

Parameter	Unit	Location 1	Location 2	Location 3	Berm
Calcium	mg/kg	8,830	10,800	6,330	50
Magnesium	mg/kg	<10	40	50	80
Sodium	mg/kg	6,490	7,060	4,580	590
Potassium	mg/kg	510	430	350	50
Chloride	mg/kg	6,100	6,490	2,560	150
Sulfate as SO4 2-	mg/kg	25,500	31,000	20,400	1,370
Total Alkalinity as CaCO3	mg/kg	109	65	87	11
Bicarbonate Alkalinity as CaCO3	mg/kg	22	<1	<1	11
Carbonate Alkalinity as CaCO3	mg/kg	87	44	54	<1
Total Organic Carbon	%	2.27	1.47	9.57	0.48
Moisture Content (dried @ 103°C)	%	67.4	73.2	57.6	25.7
Acidity	mg/kg	<1	<1	<1	5
Electrical Conductivity @ 25°C	µS/cm	4,060	3,770	3,420	661

Table 4: Ash Solids Total Minor Ions

Parameter	Unit	Location 1	Location 2	Location 3	Berm
Aluminium	mg/kg	18,500	4,730	28,600	16,600
Arsenic	mg/kg	16	5	18	<5
Barium	mg/kg	1,740	2,140	1,070	50
Beryllium	mg/kg	7	1	10	<1
Boron	mg/kg	2,570	1,150	2,400	60
Cadmium	mg/kg	<1	<1	<1	<1
Chromium	mg/kg	13	5	11	31
Cobalt	mg/kg	13	2	24	<2
Copper	mg/kg	10	8	12	<5
Fluoride	mg/kg	<40	<40	<40	210
Iron	mg/kg	68,100	83,800	82,900	42,500
Lead	mg/kg	5	<5	6	10
Manganese	mg/kg	1,080	1,670	1,030	14
Mercury	mg/kg	0.3	0.3	0.2	<0.1
Molybdenum	mg/kg	<2	<2	<2	<2
Nickel	mg/kg	44	19	66	5
Selenium	mg/kg	<5	<5	<5	<5
Tin	mg/kg	<5	<5	<5	<5
Vanadium	mg/kg	21	<5	13	48
Zinc	mg/kg	81	38	136	<5

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Table 5: Ash Solids ASLP test Reagent Water and Leachate results Major Ions

Analyte	Units	Ashpond 1 location 3 water	Leachate result	UEVF groundwater	Leachate result
Sodium	mg/L	1630	1690	242	346
Potassium	mg/L	102	112	28	38
Calcium	mg/L	450	560	86	641
Magnesium	mg/L	311	237	39	19
Chloride	mg/L	849	931	578	659
Sulfate as SO4 - Turbidimetric	mg/L	4340	4540	146	1500
Bicarbonate Alkalinity as CaCO3	mg/L	63	1	103	14
Carbonate Alkalinity as CaCO3	mg/L	1	87	1	28
Total Alkalinity as CaCO3	mg/L	63	116	103	41
Total Dissolved Solids (Calc.)	mg/L	6080	6140	1380	2710
Total Hardness as CaCO3	mg/L	2400	2370	375	1680

Table 6: Ash Solids ASLP test Reagent Water and Leachate results Minor Ions

Analyte	Units	Ashpond 1 location 3 water	Leachate result	UEVF groundwater	Leachate result
Aluminium	mg/L	0.1	<0.1	0.05	<0.1
Arsenic	mg/L	<0.001	<0.1	<0.001	<0.1
Barium	mg/L	0.017	<0.1	0.064	<0.1
Beryllium	mg/L	<0.001	<0.05	<0.001	<0.05
Boron	mg/L	22.4	29	0.37	7.3
Cadmium	mg/L	<0.0001	<0.05	<0.0001	<0.05
Chromium	mg/L	<0.001	<0.1	<0.001	<0.1
Cobalt	mg/L	<0.001	<0.1	<0.001	<0.1
Copper	mg/L	<0.001	<0.1	<0.001	<0.1
Fluoride	mg/L	0.2	0.1	0.1	<0.1
Iron	mg/L	<0.05	<0.1	23.9	0.1
Iron, Ferrous	mg/L	<0.05	<0.05	13.5	<0.05
Iron, Ferric	mg/L	<0.05	<0.05	10.4	0.1
Lead	mg/L	<0.001	<0.1	<0.001	<0.1
Manganese	mg/L	0.012	<0.1	0.958	<0.1
Selenium	mg/L	<0.01	<0.05	<0.01	<0.05
Vanadium	mg/L	<0.01	<0.01	<0.01	<0.1
Zinc	mg/L	<0.005	<0.1	<0.005	<0.1

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Table 7: Ash Solids ASLP test Reagent Water and Leachate results Nutrients

Analyte	Units	Ashpond 1 location 3 water	Leachate result	UEVF groundwater	Leachate result
Ammonia as N	mg/L	0.02	0.08	0.15	0.31
Dissolved Organic Carbon	mg/L	4	2	1	3
Nitrate as N	mg/L	0.1	0.04	<0.01	<0.01
Nitrite + Nitrate as N	mg/L	0.1	0.16	0.01	0.03
Nitrite as N	mg/L	0.01	0.12	0.01	0.03
Total Kjeldahl Nitrogen as N	mg/L	<0.1	<0.1	<0.5	<0.5
Total Nitrogen as N	mg/L	0.1	0.2	<0.5	<0.5
Total Phosphorus as P	mg/L	<0.01	<0.01	<0.01	<0.01

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Table 8 Ash Pond Water Major Ions and Physico-chemical Analytes

	Unit	Ashpond 1 location 1 water		Ashpond 1 location 2 water		Ashpond 1 location 3 water	
Parameter		LOR	20/06/2016	LOR	20/06/2016	LOR	20/06/2016
Sodium	mg/L		1750		1660		1630
Potassium	mg/L		106		104		102
Calcium	mg/L		438		457		450
Magnesium	mg/L		296		319		311
Chloride	mg/L		897		866		849
Sulfate as SO4 - Turbidimetric	mg/L		4670		4510		4340
Bicarbonate Alkalinity as CaCO3	mg/L		78		65		63
Carbonate Alkalinity as CaCO3	mg/L	<	1	<	1	<	1
Total Alkalinity as CaCO3	mg/L		78		65		63
Total Hardness as CaCO3	mg/L		2310		2450		2400
Electrical Conductivity @ 25°C	µS/cm		9870		9560		9360
pH Value	pH Unit		8.25		8.28		8.22
Redox Potential	mV		255		254		254

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Table 9: Ash Pond Water Minor Ions

		Ashpond 1 location 1 water				Ashpond 1 location 2 water				Ashpond 1 location 3 water			
		20/06/2016				20/06/2016				20/06/2016			
Parameter	Unit	LOR	Total	LOR	Dissolved	LOR	Total	LOR	Dissolved	LOR	Total	LOR	Dissolved
Aluminium	mg/L		0.13		0.11		0.12		0.12		0.12		0.1
Arsenic	mg/L	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001
Barium	mg/L		0.02		0.019		0.022		0.02		0.023		0.017
Beryllium	mg/L	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001
Boron	mg/L		26.8		24		25.9		22.8		26.3		22.4
Cadmium	mg/L		0.0001	<	0.0001	<	0.0001	<	0.0001	<	0.0001	<	0.0001
Chromium	mg/L	<	0.001	<	0.001		0.001	<	0.001	<	0.001	<	0.001
Cobalt	mg/L		0.001		0.001	<	0.001	<	0.001	<	0.001	<	0.001
Copper	mg/L	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001
Fluoride	mg/L		0.2		not applicable		0.2		not applicable		0.2		not applicable
Iron	mg/L		0.05	<	0.05	<	0.05	<	0.05	<	0.05	<	0.05
Iron, Ferrous	mg/L		not applicable	<	0.05		not applicable	<	0.05		not applicable	<	0.05
Iron, Ferric (calculated)	mg/L		not applicable	<	0.05		not applicable	<	0.05		not applicable	<	0.05
Lead	mg/L	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001
Manganese	mg/L		0.016		0.012		0.016		0.011		0.017		0.012
Mercury	mg/L	<	0.0001	<	0.0001	<	0.0001	<	0.0001	<	0.0001	<	0.0001
Molybdenum	mg/L		0.011		0.01		0.012		0.01		0.013		0.01
Nickel	mg/L		0.003		0.003		0.003		0.002		0.003		0.002
Selenium	mg/L	<	0.01	<	0.01	<	0.01	<	0.01	<	0.01	<	0.01
Tin	mg/L	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001	<	0.001
Vanadium	mg/L	<	0.01	<	0.01	<	0.01	<	0.01	<	0.01	<	0.01
Zinc	mg/L		0.012		0.008		0.006	<	0.005		0.006	<	0.005

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Table 10: Ash Pond Water Nutrients

			Ashpond 1 location 1 water		Ashpond 1 location 2 water		Ashpond 1 location 3 water
Parameter	Unit	LOR	20/06/2016	LOR	20/06/2016	LOR	20/06/2016
Ammonia as N	mg/L		0.02		0.03		0.02
Nitrate as N	mg/L	<	0.01		0.05		0.1
Nitrite + Nitrate as N	mg/L	<	0.01		0.05		0.1
Nitrite as N	mg/L	<	0.01	<	0.01	<	0.01
Total Kjeldahl Nitrogen as N	mg/L	<	0.1	<	0.1	<	0.1
Total Nitrogen as N	mg/L	<	0.1	<	0.1		0.1
Total Organic Carbon	mg/L		2		4		3
Dissolved Organic Carbon	mg/L		4		5		4
Total Phosphorus as P	mg/L	<	0.01	<	0.01	<	0.01

Table 11: UEVF groundwater Major Ions and Physico-chemical Analytes

Parameter	Units	Well Bore 15 (WS4)	
		LOR	20/06/2016
Sodium	mg/L		242
Potassium	mg/L		28
Calcium	mg/L		86
Magnesium	mg/L		39
Chloride	mg/L		578
Sulfate as SO4 - Turbidimetric	mg/L		146
Bicarbonate Alkalinity as CaCO3	mg/L		103
Carbonate Alkalinity as CaCO3	mg/L	<	1
Total Alkalinity as CaCO3	mg/L		103
Total Hardness as CaCO3	mg/L		375
Electrical Conductivity @ 25°C	µS/cm		2120
pH Value	pH Unit		6.58
Redox Potential	mV		-46

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Table 12: UEVF groundwater Minor Ions

Parameter	Units	Well Bore 15 (WS4)			
		20/06/2016			
		LOR	Total	LOR	Dissolved
Aluminium	mg/L		0.02		0.05
Arsenic	mg/L	<	0.001	<	0.001
Barium	mg/L		0.067		0.064
Beryllium	mg/L	<	0.001	<	0.001
Boron	mg/L		0.42		0.37
Cadmium	mg/L	<	0.0001	<	0.0001
Chromium	mg/L		0.002	<	0.001
Cobalt	mg/L	<	0.001	<	0.001
Copper	mg/L		0.004	<	0.001
Fluoride	mg/L		0.1		not applicable
Iron	mg/L		28.7		23.9
Iron, Ferrous	mg/L		not applicable		13.5
Iron, Ferric	mg/L		not applicable		10.4
Lead	mg/L	<	0.001	<	0.001
Manganese	mg/L		1.06		0.958
Mercury	mg/L	<	0.0001	<	0.0001
Molybdenum	mg/L	<	0.001	<	0.001
Nickel	mg/L	<	0.001	<	0.001
Selenium	mg/L	<	0.01	<	0.01
Tin	mg/L	<	0.001	<	0.001
Vanadium	mg/L	<	0.01	<	0.01
Zinc	mg/L	<	0.005	<	0.005

Table B-13 UEVF groundwater Nutrients

Parameter	Well Bore 15 (WS4)		
	Units	LOR	20/06/2016
Ammonia as N	mg/L		0.15
Dissolved Organic Carbon	mg/L	<	1
Nitrate as N	mg/L	<	0.01
Nitrite + Nitrate as N	mg/L	<	0.01
Nitrite as N	mg/L	<	0.01
Total Kjeldahl Nitrogen as N	mg/L	<	0.5
Total Nitrogen as N	mg/L	<	0.5
Total Organic Carbon	mg/L	<	1
Total Phosphorus as P	mg/L	<	0.01

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ATTACHMENT 2 GEOCHEMICAL SPECIATION

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GEOCHEMICAL SPECIATION

Geochemical modelling simulations have been used to explore the geochemical characteristics of ash pond water and the interactions that occur when ash pond water mixes with other waters such as UEVF groundwater and pit water body. The USGS geochemical modelling program PHREEQC has been used in the following sections to explore the speciation and controlling mineral phases that may be present within the ash pond water. The soluble species and mineral phase equilibria will provide information on which species may be mobile or have the potential to precipitate if redox/pH conditions change.

Speciation simulations have been undertaken on the following solutions using PHREEQC:

1. Ash pond I water;
2. Leachate from ash solids ALSP;
3. UEVF groundwater; and
4. Pit water body.

Some assumptions were made for the solution input files. Temperature was not collected for this phase of sample collection. A value of 15 °C for the groundwater and surface water is a representative temperature for both systems during the winter months (during which these samples were collected). The temperature is not a sensitive value as the majority of the thermodynamic constants within the database are mostly derived at standard temperature and pressure, i.e. 20 °C and 10^{-5} Pa. Information about potential controlling mineral phases in the UEVF groundwater or ash pond surface water is not available so equilibrium phases were not enabled for speciation. Once the solutions are speciated using PHREEQC, an indication of controlling mineral phases is provided within the output file. These have been used to define the input file for the transport simulations. The PHREEQC or Minteq v4 databases were used for the thermodynamic properties of all input parameters.

Ash pond 1 water speciation

Three water samples were collected for laboratory analysis, the analytical schedule was the same as that used for the UEVF groundwater analysis. The ionic balance of the water samples from locations 1, 2 and 3 was 0.36%, 1.75% and 2.51%. A smaller set of analytes was used for the speciation modelling in PHREEQC which calculated an ionic balance of 0.48%, 2.2% and 3.13% respectively. The analytes used within the PHREEQC input file were compared between the 3 samples. Summary statistics are provided within Table 1.

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Table 1: Comparison of Ash pond samples

Parameter	Location 1	Location 2	Location 3	min	max	average median	stdev	count
Temperature °C	15	15	15	15	15	15	0	3
pH	8.25	8.28	8.22	8.22	8.28	8.25	0.03	3
pe	4	4	4	4	4	4	0	3
Aluminium mg/L	0.11	0.12	0.1	0.10	0.12	0.11	0.01	3
Ammonia as N mg/L	0.02	0.03	0.02	0.02	0.03	0.02	0.01	3
Barium mg/L	0.019	0.02	0.017	0.02	0.02	0.02	0.002	3
Boron mg/L	24	22.8	22.4	22	24	23	0.8	3
Calcium mg/L	438	457	450	438	457	448	10	3
Chloride mg/L	897	866	849	849	897	871	24	3
Magnesium mg/L	296	319	311	296	319	309	12	3
Manganese mg/L	0.012	0.011	0.012	0.011	0.012	0.012	0.001	3
Potassium mg/L	106	104	102	102	106	104	2	3
Sodium mg/L	1750	1660	1630	1630	1750	1680	62	3
Sulfate mg/L	4670	4510	4340	4340	4670	4507	165	3
Alkalinity as $CaCO_3$ mg/L	78	65	63	63	78	69	8	3

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Median values are not presented; however, they are the same or similar to the mean values. As observed the 3 samples are very similar and the majority of analytes have a limited variance between samples (<10%). One sample (Location 3) is discussed in the following section. A replicate of this sample was used as the reagent water for the second ASLP on the ash sample from Ash Pond 1.

The PHREEQC input file for Location 3 is provided as . Atmospheric partial pressure for carbon dioxide is enabled because the ash pond water is open to the atmosphere. There were no convergence issues encountered within the model and PHREEQC made no adjustments to the charge balance. This indicates that there was low uncertainty with the simulations undertaken by PHREEQC. Ferrous iron was non-detectable within all 3 ash pond samples and no other speciated metals were analysed. Redox couples were not specified for the solutions in PHREEQC, although all solutions were reported to be mildly oxidising.

```
SOLUTION Ashpond 1 location 3 water 20/03/2016
    temp      15
    pH        8.2 #CO2 (g) -3.5
    pe        4
    redox     pe
    units     mg/l
    density   1
    Al                  0.12
    Alkalinity          63 #as CaCO3
    B                   26.3
    Ba        0.023
    Ca        450
    Cl                  849
    K                   102
    Mg        311
    Mn        0.017
    N(-3)     0.02 gfw 14.007
    Na        1630
    S(6)      4340
    -water    1 # kg
```

Figure 1: Solution data input block for ash pond 1 location 3 speciation

Within the output file, PHREEQC predicts the concentration of a range of soluble species based on the parameters within the input file.

Table 2 provides the element input and speciated output for Ash pond surface water at sampling location 3. In contrast to the predicted soluble species within the UEVF groundwater, the ash pond water is dominated by sulfate species influenced by the elevated concentration of sulfate.

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Table 2: Ash Pond 1 location 3 - predicted soluble species

Element	Species
Aluminium	$Al(OH)_4^-$
Boron	H_3BO_3
Barium	$BaSO_4$
	Ba^{+2}
Carbon	HCO_3^-
	$MgHCO_3^+$
Calcium	Ca^{+2}
	$CaSO_4$
Chloride	Cl-
Potassium	K^+
Magnesium	Mg^{+2}
	$MgSO_4$
Manganese(II)	Mn^{+2}
	$MnSO_4$
Nitrogen	NH_4^+
Sodium	Na^+
Sulfur	$SO4^{-2}$
	$MgSO_4$

Table 3: Ash pond 1 location 3 predicted oversaturated mineral phases

Mineral phase	Saturation Index (SI)	Mineral Stoichiometry	Primary metal species	Secondary metal species	Primary ligand
Diaspore	2.65	AlOOH	Aluminium		Oxyhydroxide
Gibbsite	1.39	$Al(OH)_3$	Aluminium		Hydroxide
Dolomite	0.8	$CaMg(CO_3)_2$	Calcium	Magnesium	Carbonate
Calcite	0.38	$CaCO_3$	Calcium		Carbonate
Barite	0.35	$BaSO_4$	Barium		Sulfate

A small number of phases are predicted to be oversaturated and with a potential to precipitate. These comprise carbonate, sulfate and hydroxide species which are a function of the pH, oxidising conditions and elevated sulfate concentrations. It is likely that the precipitation is occurring within ash pond 1 and that secondary mineral phases within the ash material include the minerals listed within

. The presence of alkalinity generating mineral phases such as calcite, provide a source of acid neutralisation when the ash is relocated to the Anglesea pit.

Boron is observed to be present as soluble species, with no immobile phases predicted to form. Boron is therefore predicted to be mobile under these geochemical conditions. PHREEQC predicts that there is a potential for aluminium to precipitate as the mineral phase diaspore. To explore the possibility of

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this occurring, equilibrium phases is enabled in the input file with diaspore and calcite as mineral phases and pH fixed to 8.22. In the output, it is estimated that less than 99% of the aluminium is precipitated as diaspore with 0.003% or 0.35 µg/L remaining as a soluble species.

Leachate 1 and 2 speciation

The two (2) ASLP leachate analyses were speciated using PHREEQC and the same parameter template input as presented in Section **3.2.3**. The solutions were not equilibrated with atmospheric carbon dioxide because the ASLP was undertaken in sealed containers. There were no convergence issues encountered within the model and PHREEQC made no adjustments to the charge balance. This indicates that there was low uncertainty with the simulations undertaken by PHREEQC.

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```
SOLUTION Leachate 1 - ash pond reagent water
        temp      15
        pH        9.8
        pe        0
        redox     pe
        units     mg/l
        density   1
        N(-3)     0.08 gfw 14.007
        B                 29
        Ca        560
        Cl                931
        Mg        237
        K                 112
        Na        1690
        S(6)      4540
        Alkalinity        116 #as CaCO3
        -water    1 # kg

SOLUTION Leachate 2 - UEVF reagent water
        temp      15
        pH        9.7
        pe        0
        redox     pe
        units     mg/l
        density   1
        N(-3)     0.31 gfw 14.007
        B                 7.3
        Ca        641
        Cl                659
        Mg        19
        K                 38
        Na        346
        S(6)      1500
        Alkalinity        41 #as CaCO3
        -water    1 # kg
```

Figure 2: Solution data input blocks for Ash Pond water and UEVF ASLP results speciation

Table 4 provides the element input and speciated output for both of the leachate solutions. The range of soluble species is virtually the same for both leachate solutions, however, the distribution is different due to the more elevated concentrations within Leachate 1.

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Table 4: Leachate solutions 1 and 2 - predicted soluble species

Element	Species
Boron	$H_2BO_3^-$
	H_3BO_3
Carbon	$CaCO_3$
	HCO_3^-
Calcium	Ca^{+2}
	$CaSO_4$
Chloride	Cl-
Potassium	K^+
Magnesium	Mg^{+2}
	$MgSO_4$
Nitrogen	NH_3
	NH_4^+
Sodium	Na^+
Sulfur	$SO4^{-2}$
	$CaSO_4$

Mineral saturation is also similar for both leachate solutions. Calcium carbonate phases dominate with the additional potential for gypsum precipitation. It should be noted that the metals, metalloids and major cations are reported as filtered values and some phases may have been filtered out of the solution prior to the analysis. The absence of aluminium, manganese and iron may be related to precipitation of mineral phases or sorption of complexes to mineral surfaces.

Table 5: ASLP leachate solutions 1 and 2 - predicted oversaturated mineral phases

Solution	Mineral phase	Saturation Index (SI)	Mineral Stoichiometry	Primary metal species	Secondary metal species	Primary ligand
Leachate 1 ash pond reagent water	Dolomite	0.81	CaMg(CO3)2	Calcium	Magnesium	Carbonate
	Calcite	0.49	CaCO3	Calcium		Carbonate
	Aragonite	0.34	CaCO3	Calcium		Carbonate
	Gypsum	0.12	CaSO4:2H2O	Calcium		Sulfate
Leachate 1 UEVF reagent water	Calcite	1.15	CaCO3	Calcium		Carbonate
	Aragonite	1	CaCO3	Calcium		Carbonate
	Dolomite	0.97	CaMg(CO3)2	Calcium	Magnesium	Carbonate
	Gypsum	-0.01	CaSO4:2H2O	Calcium		Sulfate

Boron is observed to present as soluble species, with no immobile phases predicted to form. Boron is therefore predicted to be mobile under these geochemical conditions.

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Comparison between Ash Pond water and Leachate 1

As discussed earlier in Section **3.2.2**, the ash pond water has been in contact with the ash solids for an extended period of time and in contact with atmospheric gases such as oxygen and carbon dioxide. The expectation (or hypothesis) is that the chemical composition of the ash pond water is likely to be similar to that of the leachate derived from the ASPL of the ash pond water and the ash solids. To explore this hypothesis, the program AQqa was used to compare the major ion concentrations between the two samples. If the coefficient of variance between the two samples is low (less than 5%), then a good agreement between the samples exists.

Table 6: Comparison of Ash pond location 3 and leachate 1 major ion chemistry

Parameter	Units	Ashpond 1 location 3	Leachate 1 ash pond reagent water	Coefficient ±5%
Calcium	mg/L	450	560	10.89
Magnesium	mg/L	311	237	13.50
Sodium	mg/L	1630	1690	1.81
Potassium	mg/L	102	112	4.67
Bicarbonate	mg/L	63	< 1	NA
Sulfate	mg/L	4340	4540	2.25
Chloride	mg/L	849	931	4.61
Dissolved Solids	mg/L	6080	6140	0.49
Conductivity	µS/cm	9360	9440	0.04
pH	unitless	8.22	9.8	NA

As observed within **Table 6** a reasonable comparison exists between the two solutions, ash pond water (location 3) and leachate 1. Any differences between the two solutions can be attributed to the disequilibrium that potentially exists during the short ASLP test and that the test is not open to atmosphere unlike the ash pond water.

Pit water body speciation

The pit water body has recently been effected by the Ash management activities which have neutralized much of the lake acidity. To facilitate assessment of mixing with pit water body the data from three events including those affected by ash management activities has been utilized to assess the interactions with pit water body that has and has not been amended with alkaline materials. The sample for March 2016 pre-dates the ash management activities that commenced in August 2016 and three samples (one location at three elevations) were collected during ash management activities in October 2016. The October 2016 samples were collected at 0.5 m below surface level (bsl), 4 m bsl and 8 m bsl. As the samples are very similar geochemically only the sample collected from 0.5 m bsl is discussed. The use of pit water body for ash slurrying and re-circulation has altered the water chemistry within the pit water body as detailed within the input files in Table 7. Both sets of samples are discussed below.

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Table 7: Solution data input blocks for pit water body speciation

Parameter	Untreated Pit water body 08/03/2016	Treated Pit water body 11/10/2016 0.5 m bsl
Temp	20	20
pH	3.1	6.8
Redox potential	4	4
Density	1	1
Al	1.7	0.18
B	1.1	4.01
Ba	0.078	0.037
Ca	45	294
Cl	550	480
Cu	0.0005	0.0005
Fe	14	0.5
K	9.7	25
Mg	89	59
Mn	0.52	0.143
Na	220	389
Ni	0.028	0.007
Zn	0.1	0.012
S(6)	470	1180

The acidic pH of the pit water body suggests that equilibrium conditions between jarosite (yellow boy) and ferrihydrite/goethite (equilibrium at pH 3.2) could be present (Miller, 1979). The oxidation of pyrite has multiple intermediate stages with the formation of a variety of ferric/ferrous hydroxysulfates minerals including jarosite. Jarosite is a fully oxidised (ferric) iron hydroxysulfate mineral which is stable at low pH. It also has retained or latent acidity which can be generated under increasing pH. Jarosite weathers to ferrihydrite or goethite which are both ferric oxyhydroxides. The buffer system created between jarosite and ferrihydrite has the capacity to buffer large amounts of added alkalinity which means it is critical that acidity budgets are calculated taking actual and retained acidity into consideration.

As observed within **Table 7**, the pit water body quality is markedly different before and during the ash management activities. In particular, pH increases by three pH units, dissolved metal concentrations decrease (e.g. aluminium, iron, manganese and zinc) and boron and calcium concentrations increase. These changes are mainly due to the increased alkalinity of the ash pond water mixing with the pit water body which increases the pH and decreases the solubility of metals. The March 2016 sample speciation also reports the majority of mineral phases as unsaturated. Only barium sulfate was slightly oversaturated. The October 2016 samples predict iron and aluminium mineral phases as approaching saturation or oversaturated which could account for the decrease in the concentrations of these metals between March and October 2016 (**Table 8**). Other metal decreases (manganese and zinc) could be related to co-precipitation and/or sorption onto precipitating mineral phases.

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Table 8: Comparison of pit water body before and during ash management activities

Location	Date	Depth	Mineral phase	Saturation Index (SI)	Mineral Stoichiometry
Pit water body	08/03/2016	surface	Barite	0.65	BaSO4
			Diaspore	-3.11	AlOOH
			Magnetite	-9.65	Fe3O4
	11/10/2016	0.5 m bsl	Barite	0.49	BaSO4
			Diaspore	3.86	AlOOH
			Magnetite	15.26	Fe3O4
		4 m bsl	Barite	0.5	BaSO4
			Diaspore	4.05	AlOOH
			Magnetite	15.38	Fe3O4
		8 m bsl	Barite	0.45	BaSO4
			Diaspore	3.89	AlOOH
			Magnetite	15.31	Fe3O4

For all following mixing and transport scenarios the pit water body sample dated 08/03/2016 will be used as this is representative of historical water quality and closest to equilibrium conditions.

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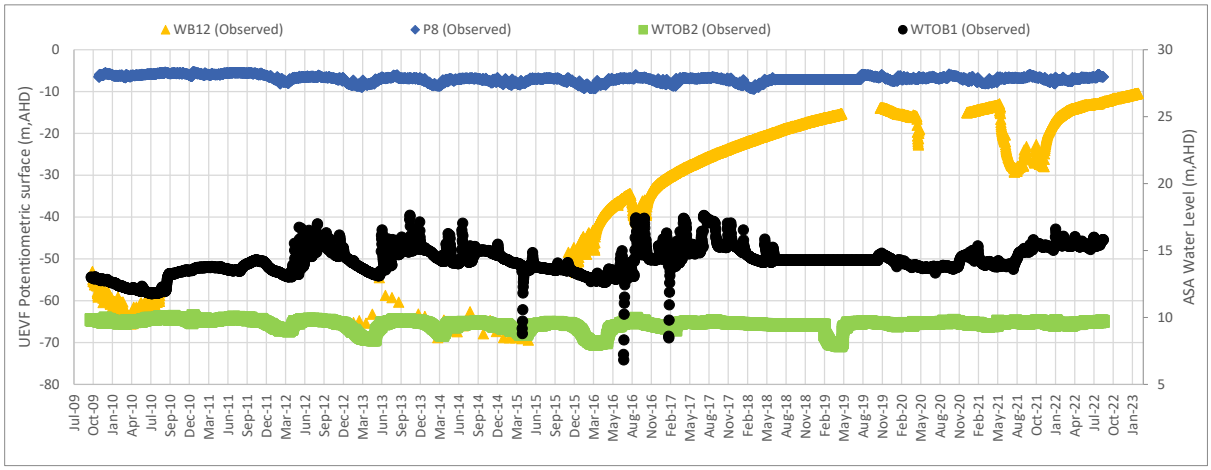
Appendix D Key Hydrographs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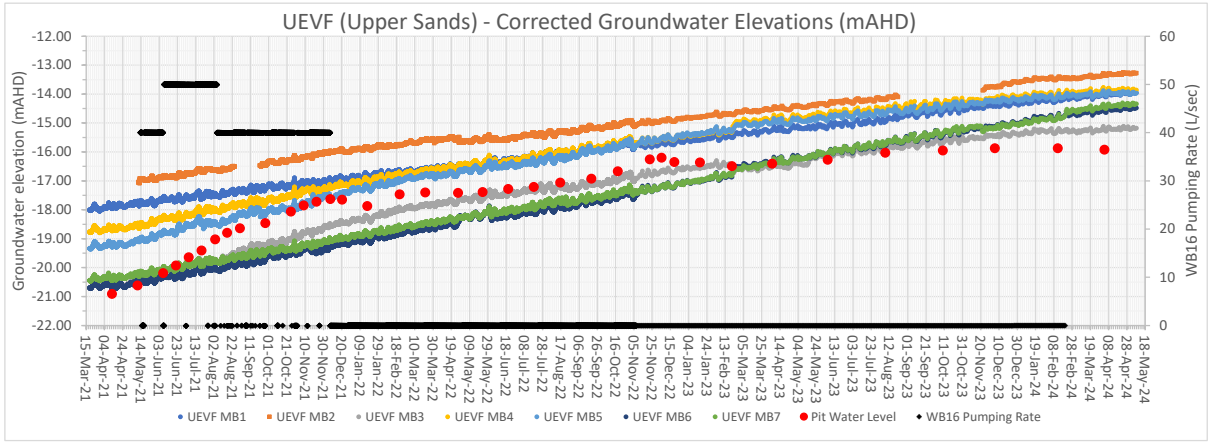
P8 (Observed)
WTOB2 (Observed)
WTOB1 (Observed)
UEVF Potentiometric surface (m,AHD)
ASA Water Level (m,AHD)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Groundwater elevation (mAHD)
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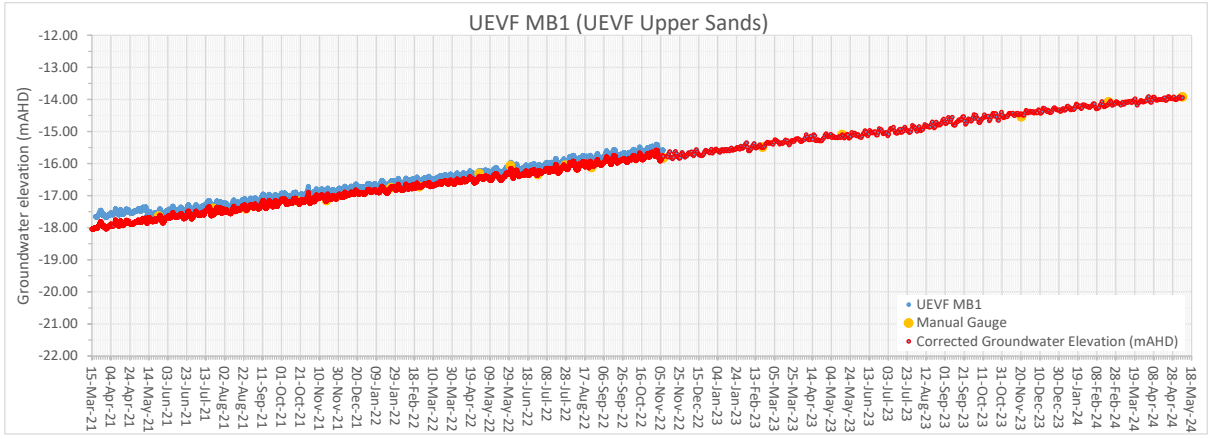
UEVF MB2
UEVF MB3
UEVF MB4
UEVF MB5
UEVF MB6
UEVF MB7
Pit Water Level
WB16 Pumping Rate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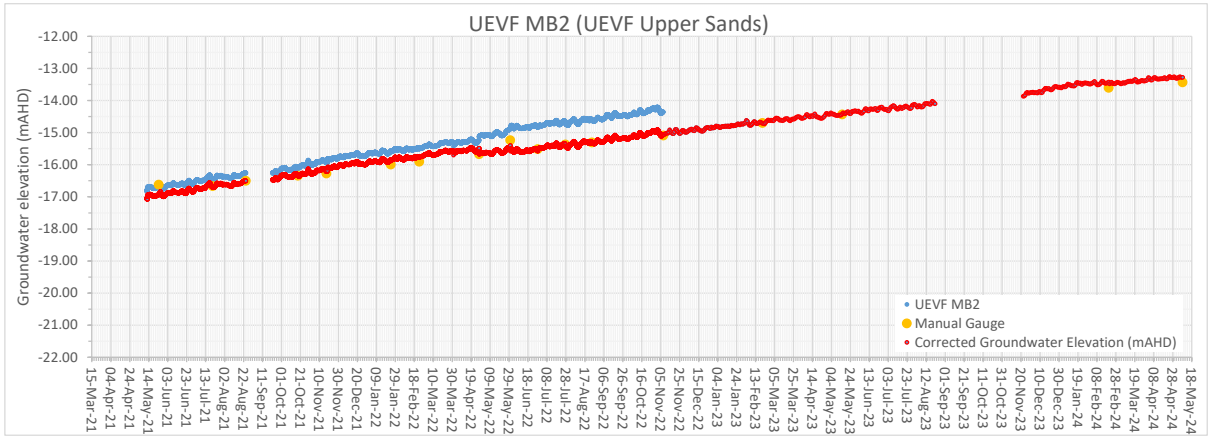
Corrected Groundwater Elevation (mAHD)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-22.00
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Manual Gauge
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24-Apr-21
14-May-21
03-Jun-21
23-Jun-21
13-Jul-21
02-Aug-21
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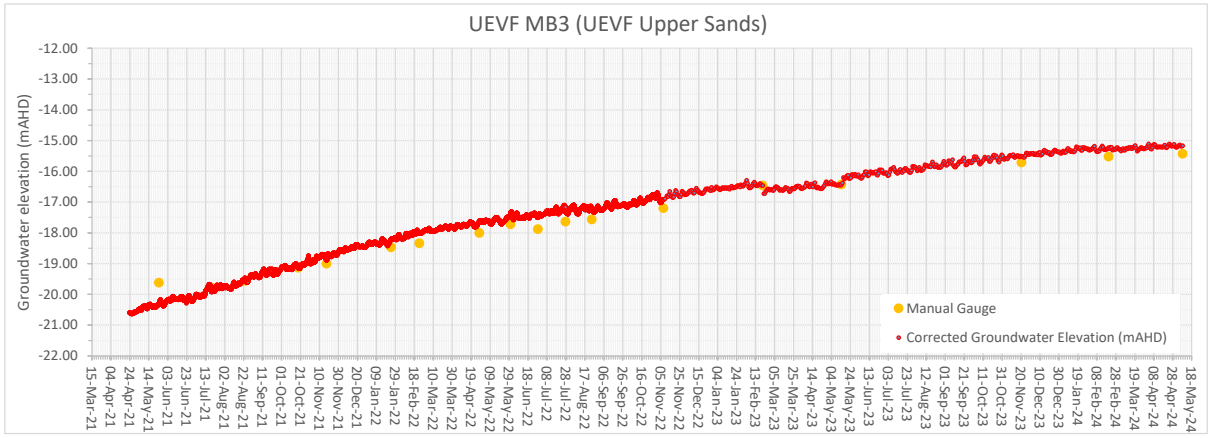
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-22.00
Manual Gauge
Corrected Groundwater Elevation (mAHD)
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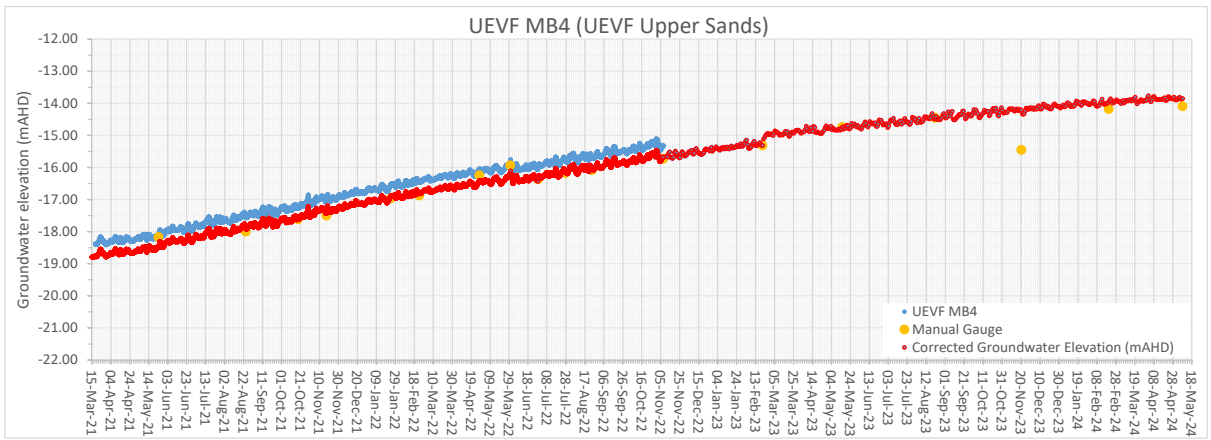
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UEVF MB4
Manual Gauge
Corrected Groundwater Elevation (mAHD)
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04-Apr-21
24-Apr-21
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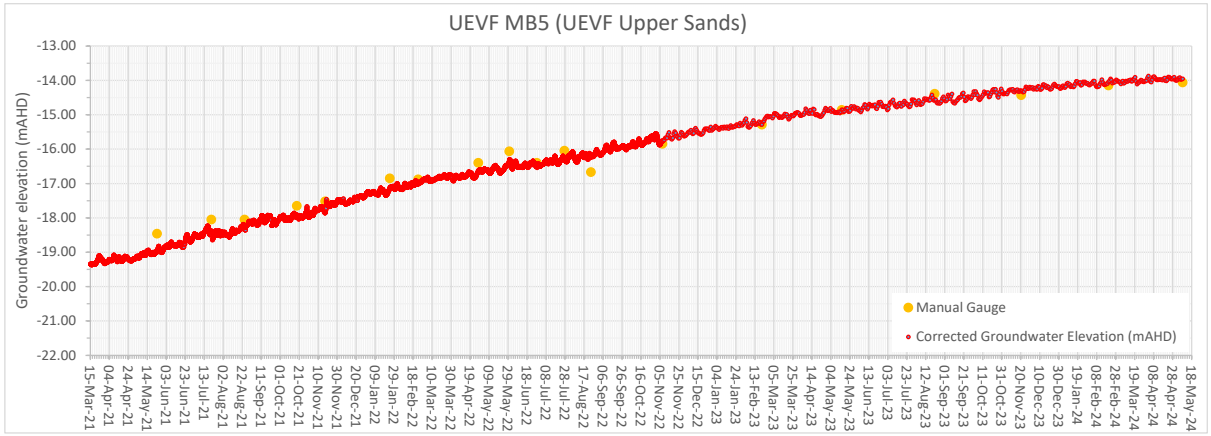
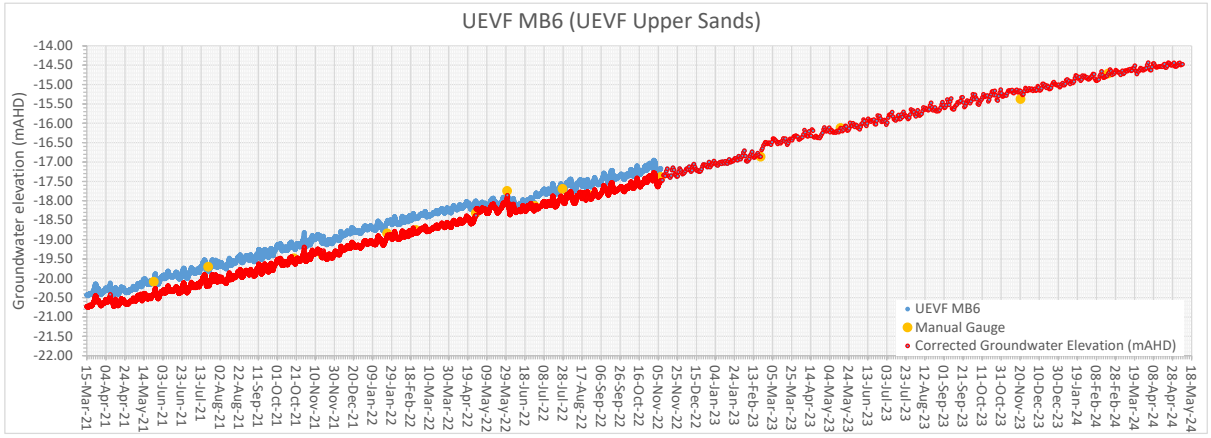
28-Apr-24
18-May-24


UEVF MB5 (UEVF Upper Sands)
Groundwater elevation (mAHD)
Manual Gauge
Corrected Groundwater Elevation (mAHD)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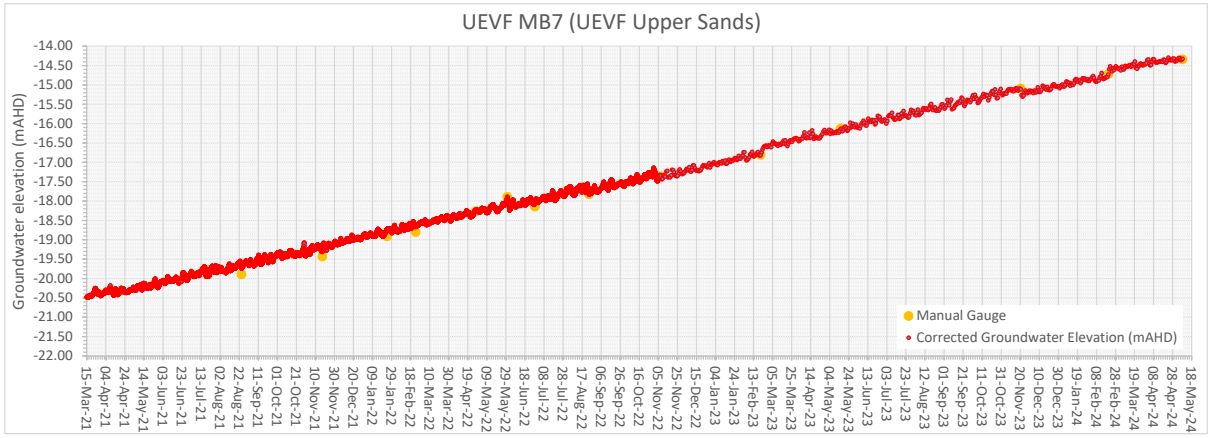
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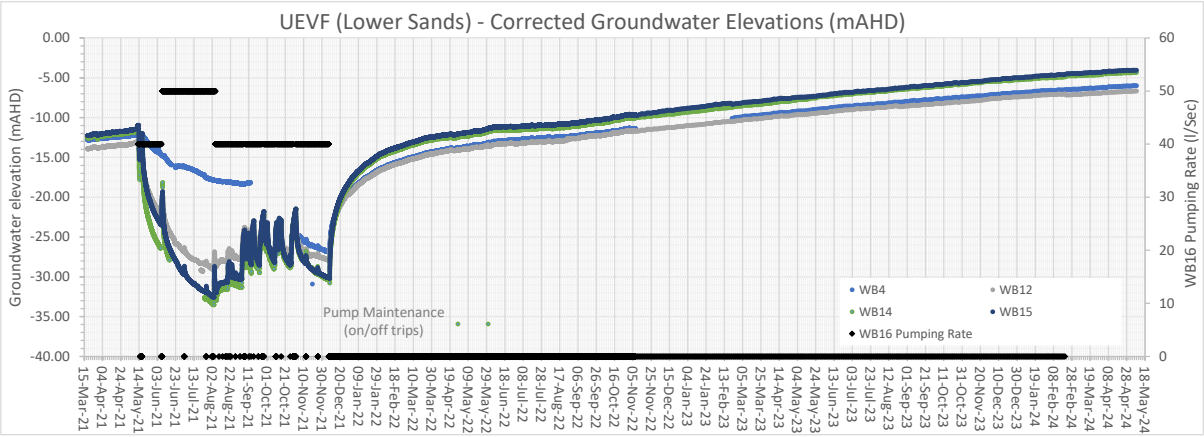
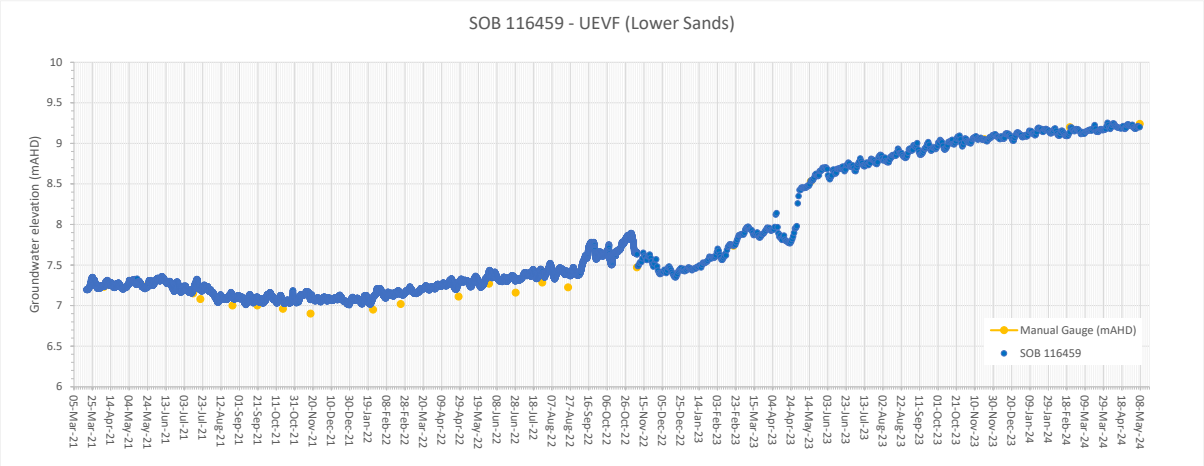
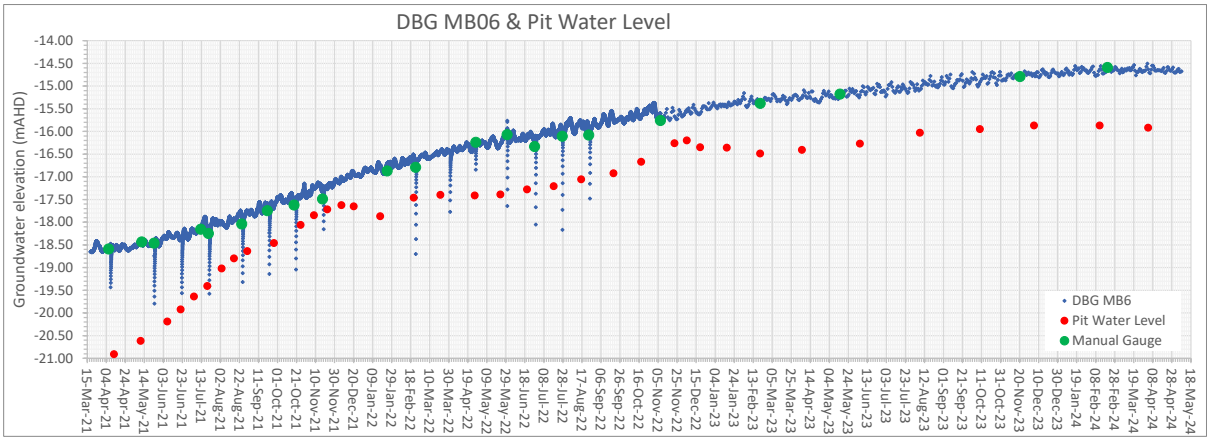
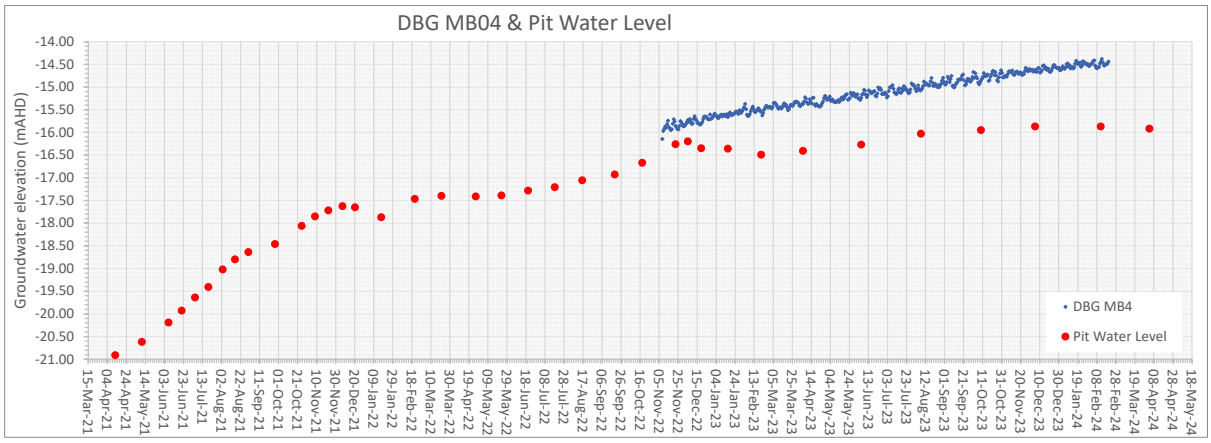
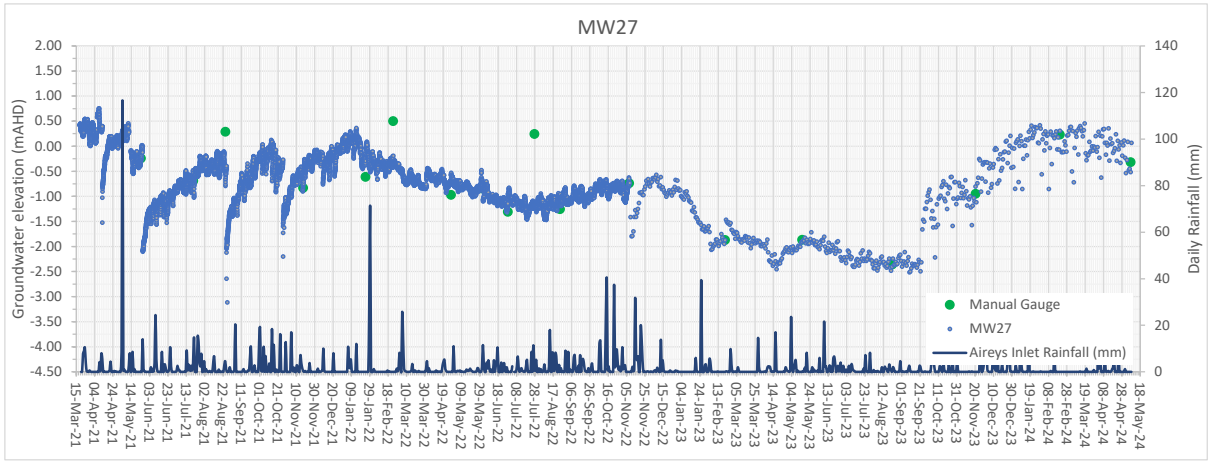
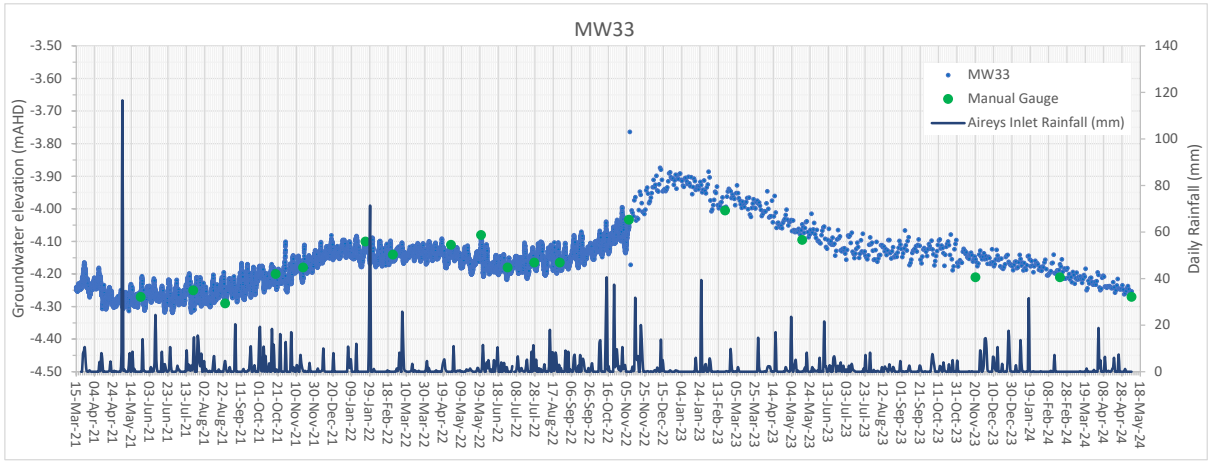

UEVF (Lower Sands) - Corrected Groundwater Elevations (mAHD)
Groundwater elevation (mAHD)
WB16 pumping Rate (l/Sec)
Pump Maintenance
(on/off trips)
WB4
WB12
WB14
WB15
WB16 Pumping Rate

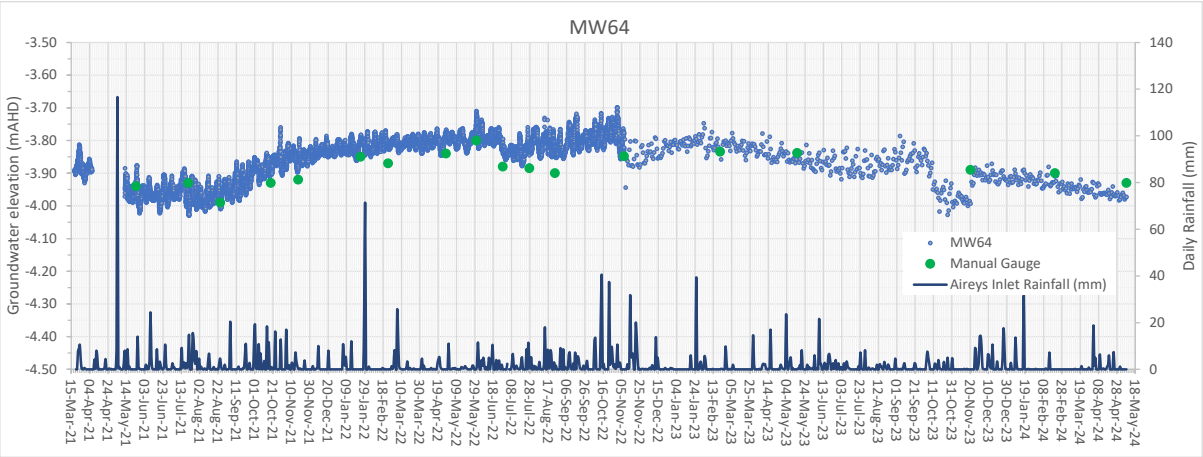

SOB 116459 - UEVF (Lower Sands)
Groundwater elevation (mAHD)
Manual Gauge (mAHD)
SOB 116459


DBG MB06 & Pit Water Level
Groundwater elevation (mAHD)
DBG MB6
Pit Water Level
Manual Gauge


DBG MB04 & Pit Water Level
Groundwater elevation (mAHD)
DBG MB4
Pit Water Level


MW27
Groundwater elevation (mAHD)
Daily Rainfall (mm)
Manual Gauge
MW27
Aireys Inlet Rainfall (mm)


MW33
Groundwater elevation (mAHD)
Daily Rainfall (mm)
MW33
Manual Gauge
Aireys Inlet Rainfall (mm)


MW64
Groundwater elevation (mAHD)
Daily Rainfall (mm)
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-3.60
-3.70
-3.80
-3.90
-4.00
-4.10
-4.20
-4.30
-4.40
-4.50
140
120
100
80
60
40
20
0
MW64
Manual Gauge
Aireys Inlet Rainfall (mm)
15-Mar-21
04-Apr-21
24-Apr-21
14-May-21
03-Jun-21
23-Jun-21
13-Jul-21
02-Aug-21
22-Aug-21
11-Sep-21
01-Oct-21
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10-Nov-21
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28-Feb-24
19-Mar-24
08-Apr-24
28-Apr-24
18-May-24

Appendix E Numerical Model Calibration Report

Anglesea Groundwater Model Update

Numerical Model Development and Calibration Report

Barwon Water

5 February 2024

GHD Pty Ltd | ABN 39 008 488 373

180 Lonsdale Street, Level 9

Melbourne, Victoria 3000, Australia

T +61 3 8687 8000 | **F** +61 3 8732 7046 | **E** melmail@ghd.com | **ghd.com**

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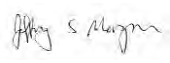
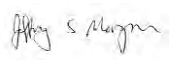
Final	7 (Calibration2)	Chris Nicol, Jeff Morgan	Jeff Morgan		Jeff Morgan		05/02/2024

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Executive summary

This report is subject to, and must be read in conjunction with, the limitations set out in sections 2.3, 2.2.2, and the assumptions and qualifications contained throughout the Report.

Barwon Water investigated and developed the Anglesea borefield, an urban groundwater supply, between 2007 and 2010 in response to severe water shortages at that time. The borefield is one of a number of water sources that can be used by Barwon Water to supplement the existing Greater Geelong water supply system. Barwon Water's diverse water supply mix is part of a balanced approach to managing the region's water resources and providing greater water security. Development of the borefield was supported by a series of field and desktop investigations, including numerical modelling of potential borefield impacts by GHD (the "Anglesea groundwater model"). A Bulk Entitlement (BE) for borefield operation was originally issued by the Victorian Government in June 2009 based on those preliminary investigations and updated in 2014 following a 6-month pumping test and further calibration of the numerical model. Five-yearly review of data and modelling is required under the BE following borefield operation, which occurred in late 2019, and Barwon Water rely on the model for borefield sustainability and impact assessments.

Alcoa of Australia Ltd (Alcoa) developed and operated the Anglesea open cut coal mine and power station from the 1960s through to 2015. This involved abstraction of up to 4 GL/year of groundwater for water supply. Mine operations ceased in August 2015, after which site rehabilitation activities began, including the development of a pit water body. These activities are ongoing.

In 2020, Alcoa applied to Southern Rural Water (SRW) to amend their existing groundwater abstraction licence to enable completion of a 12-month pumping test. This test is designed to assess the sustainability and effects of groundwater abstraction for filling of the pit water body over a period of approximately ten years (EHS, 2020). Hydrogeological data from the test will support further development and calibration of a numerical groundwater model to establish a sustainable abstraction rate. The first 6-month period of the proposed 12-month test commenced on the 13th of May 2021, and ceased in December 2021. A second period of test pumping was conducted by Barwon Water using its Anglesea Borefield, between January and July of 2022.

An agreement was reached between Barwon Water and Alcoa for Alcoa to utilise Barwon Water's Anglesea groundwater model, updated using data from Alcoa and Barwon Water, to support Alcoa's license application to SRW for potential long-term groundwater abstraction. The data collected as part of the Alcoa pumping test has been used to inform the update of this groundwater model.

The intention is to develop a single Anglesea groundwater model that is suitable for both Barwon Water and Alcoa's ongoing water management and planning needs. This will be an updated groundwater flow model based on the earlier model of GHD (2013), but utilising the comprehensive post-Alcoa closure observation data, including the recent test pumping data.

The updated Anglesea groundwater model is the subject of this report.

The broad objectives of the developed groundwater model are two-pronged:

- Support Barwon Water's Anglesea borefield planning, management and approvals works under the BE process.
    - Specifically, Barwon Water are required to periodically update their groundwater flow model that underpins the Anglesea borefield Bulk Entitlement and use it to re-assess aspects of borefield sustainability, details of which are outlined in the main body of this report.
    - It is intended that GHD, with subconsultant Groundwater Logic, will, after the work documented in this report, develop, and apply predictive model scenarios for Barwon Water's purposes, using the developed history-matched models documented in this report.
- Support Alcoa / EHS Support (EHS) for Alcoa's mine closure and rehabilitation planning and management works.

- Specifically, support Alcoa's license application to SRW for potential long-term groundwater abstraction for filling of the pit water body. Specific issues to be addressed using the model are outlined in the main body of this report.
- It is intended that Alcoa/EHS will develop and apply predictive model scenarios for Alcoa's purposes, using history-matched models developed by GHD.

Existing hydrological conditions and conceptualisation of the groundwater and surface water systems that underpin development of the numerical model are summarised in the main body of this report.

The developed model is based in a minor sense on the earlier modelling of GHD (2013) but is a wholly new model using a new numerical code, new layer structure, new parameterisation schemes, and modern methods of history-matching to historical observation data. It was built and operates in a stochastic framework that recognises input observation data and model parameter uncertainties.

The intent of using this approach is that the recognised input uncertainties are carried through to their effects on model forecasts and their uncertainty, and therefore their effects on water management decision-making.

The model simulates flux-conserved groundwater and surface water flow, and interactions between the two systems. It also simulates the post-Alcoa coal mine closure pit water body balance, including its interaction with groundwater and other surface water systems. The model history-matching process therefore uses a range of surface water and groundwater data of wide-ranging types, including pit water body water levels, to inform (constrain) model parameters. It also uses derivative observations such as watertable depth-frequency curves, flow-frequency curves, pumping-induced drawdown trends, and vertical hydraulic gradients.

The intent of employing these wide-ranging observation types is, to the extent possible, minimise related model forecast uncertainties, such as the uncertainty in potential effects from groundwater use on the shallow watertable (in swamps), surface water systems, and acid generation risks.

263 history matched model realisations, each with widely varying parameters, were selected from an ensemble of 500. For predictive scenario modelling purposes, a smaller, more manageable number of model realisations will be selected for application in that case (e.g., the top 150 models of higher history match quality).

History match quality across these models is generally good, for groundwater levels in deeper bores, watertable depths in shallow bores, pit water body levels, and surface water flows. However, there are of course exceptions to this, which are discussed in the main body of this report. Several points for further investigation and analysis - aimed at improving history-match quality at specific sites in specific ways - are also identified and discussed.

The model developed, and framework used, provide a sound basis for ongoing use of the model in the context of rigorous model forecast and uncertainty assessment for both Barwon Water's and Alcoa's unique requirements.

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Appendices

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1. Introduction

Barwon Water investigated and developed the Anglesea borefield, an urban groundwater supply, between 2007 and 2010 in response to severe water shortages at that time. The borefield is one of a number of water sources that can be used by Barwon Water to supplement the existing Greater Geelong water supply system. Barwon Water's diverse water supply mix is part of a balanced approach to managing the region's water resources and providing greater water security. Development of the borefield was supported by a series of field and desktop investigations, including numerical modelling of potential borefield impacts by GHD (the "Anglesea groundwater model"). A Bulk Entitlement (BE) for borefield operation was originally issued by the Victorian Government in June 2009 based on those preliminary investigations and updated in 2014 following a 6-month pumping test and further calibration of the numerical model. A five-yearly review of data and modelling is required under the BE following borefield operation, which occurred in late 2019, and Barwon Water rely on the model for borefield sustainability and impact assessments.

Alcoa of Australia Ltd (Alcoa) developed and operated the Anglesea open cut coal mine and power station from the 1960s through to 2015. This involved abstraction of up to 4 GL/year of groundwater for water supply. Mine operations ceased in August 2015, after which site rehabilitation activities began, including the development of a pit water body. These activities are ongoing.

During 2020, Alcoa applied to Southern Rural Water (SRW) to amend their existing groundwater abstraction licence to enable completion of a 12-month pumping test. This test is designed to assess the sustainability and effects of groundwater abstraction for filling of the pit water body over a period of time (EHS, 2020). The first 6-month period of the 12-month test commenced on the 13th of May 2021. Ultimately the second 6-month period was not completed by Alcoa. Barwon Water also undertook a 6- month pumping trial, starting in January 2022, and utilising all 7 of their production bores in the Anglesea borefield. Hydrogeological data from both the tests will support further development and calibration of a numerical groundwater model to establish a sustainable abstraction rates from the target aquifer systems. An agreement was reached between Barwon Water and Alcoa for Alcoa to utilise Barwon Water's Anglesea groundwater model, updated using data from Alcoa and Barwon Water, to support Alcoa's license application to SRW for potential long-term groundwater abstraction. The data collected as part of both Alcoa's and Barwon Water's pumping tests has been used to inform the update of this groundwater model.

1.1 Purpose of this report

The purpose of this report is to document the design, development, and history-matching of a numerical groundwater flow model of the Anglesea area and surrounds. The purpose of this modelling is two-pronged:

- To support Barwon Water's Anglesea borefield planning, management and approvals works under the BE process.
    - Specifically, Barwon Water are required to periodically update their groundwater flow model that underpins the Anglesea borefield Bulk Entitlement and use it to re-assess aspects of borefield sustainability, details of which are outlined in the main body of this report.
- To support Alcoa / EHS Support (EHS) for Alcoa's mine closure and rehabilitation planning and management works.
    - Specifically, support Alcoa's potential license application to SRW for potential long-term groundwater abstraction for filling of the pit water body. Specific issues to be addressed using the model are outlined in the main body of this report.

The intention is to develop a single Anglesea groundwater model that is suitable for both Barwon Water and Alcoa's ongoing water management and planning needs. This will be an updated groundwater flow model based on the earlier model of GHD (2013). The updated Anglesea groundwater model is the subject of this report. The specific objectives of the updated model are detailed in Section 2.1.

It is intended that Alcoa/EHS will use the GHD-developed groundwater model to apply predictive model scenarios for Alcoa's mine closure and rehabilitation planning and management purposes after the model development documented in this report is complete. Similarly, it is intended that GHD, with subconsultant Groundwater Logic, will, after the work documented in this report, develop, and apply predictive model scenarios for Barwon Water's BE review purposes, using the developed history-matched models documented in this report.

1.2 Scope

The scope of work documented through this report is to re-develop the Anglesea groundwater model to the point of history matching (i.e., excluding scenario forecasting). Scope items include:

- Migrate model software from MODFLOW-SURFACT to MODFLOW-USG-Transport, or possibly MODFLOW 6.
- Develop a new grid or mesh with spatial refinement around key features of interest.
- Capabilities are to remain as per the current model: i.e., detailed semi-integrated simulation of groundwater and creek and river flows, and interaction of both systems with a pit water body.
- Update model layers and structure in consideration of more detailed data and requirements around the Anglesea coal mine pit water body.
- Extend the previously applied PERFECT (Littleboy et al., 1989) recharge/runoff model (or similarly capable tool) in time and integrate its outputs with the revised model code and mesh.
- Rebuild all model boundary conditions (coastal, creeks and rivers, groundwater users' wells, Alcoa's pit water body).
- Undertake model history-matching to all relevant available data, including Alcoa's (2021) and Barwon Water's (2022) pumping tests.
- Include assessment of model uncertainty in the history-matching process.
- Document the project and model objectives, design, build and history-matching outcomes.
- Hand over the groundwater model to Alcoa/EHS for their use in model scenario forecasting to meet Alcoa's specific project objectives.
    - This will include a base forecast model template for Alcoa/EHS to modify and further develop as needed.
- Contribute to the Technical Reference Panel (TRP) review process as needed.

The scope of work excludes the following:

- No scenario modelling or development of results for such modelling to be conducted or reported at this stage.
- Conceptual Hydrogeological Model as relevant to Alcoa and EHS is to be developed and documented by Alcoa/EHS.

1.3 Limitations

This report: has been prepared by GHD for Barwon Water and may only be used and relied on by Barwon Water for the purpose agreed between GHD and Barwon Water as set out in sections 1.1 and 1.2 of this report, and in accordance with the terms and conditions. In addition, it may only be used by Alcoa in accordance with Data Sharing Agreement between Barwon Water and Alcoa (dated 28th October 2021).

GHD otherwise disclaims responsibility to any person other than Barwon Water arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 2.3 and other various sections), and subject to the model limitations as described in this report (refer section 2.2.2 and other various sections of the report) . GHD disclaims liability arising from any of the assumptions being incorrect.

2. Model Objectives & Approach

2.1 Objectives

The broad objectives of the developed groundwater model are two-pronged:

- Support Barwon Water's Anglesea borefield planning, management and approvals works under the BE process.
    - Specifically, Barwon Water are required to periodically update their groundwater flow model that underpins the Anglesea borefield Bulk Entitlement and use it to re-assess aspects of borefield sustainability (Table 2-1).
    - It is intended that GHD, with subconsultant Groundwater Logic, will, after the work documented in this report, develop, and apply predictive model scenarios for Barwon Water's purposes, using the developed history-matched models documented in this report.
- Support Alcoa / EHS for Alcoa's mine closure and rehabilitation planning and management works.
    - Specifically, support Alcoa's potential groundwater licence application for utilising groundwater sourced from the Upper Eastern View Formation (UEVF) aquifer for filling of the pit water body. Specific issues to be addressed using the model are outlined in Table 2-1.
    - It is intended that EHS will develop and apply predictive model scenarios for Alcoa's purposes, using history-matched models developed by GHD.

Since the Anglesea groundwater model last underwent a major update (GHD, 2013), a much more extensive body of groundwater and surface water data has been collected than was available in 2013. Furthermore, major hydrological changes have occurred – specifically Alcoa ceasing operations and groundwater abstraction, paired with the development of a pit water body. This aquifer stress-response data, in conjunction with data from the recent 6-month pumping test, provide a strong basis for constraining model parameters and therefore the uncertainty of forecasts related to those stresses.

It is sometimes said that developing a model aimed at covering many different issues is not a good idea. In this case however, the nature of the groundwater and surface water systems utilised and potentially impacted by the two parties (Alcoa and Barwon Water), and their interconnections, support this broad approach for many objectives. This does not mean however that the model should aim to "do everything"; certain requirements will be better addressed through more targeted tools.

Table 2-1 Anglesea Groundwater Model Objectives of Barwon Water and Alcoa

Party	Item	Requirement	Required model features
Barwon Water	1	Sustainability of the Anglesea borefield in terms of long-term recharge (climate and other) risks, and specifically available production bore pressures.	A method of estimating the nature, timing, and magnitude of groundwater recharge, such as a physically based recharge-runoff model.
	2	Spatial drawdown impacts (in all aquifers) of pumping groundwater from the Anglesea borefield (i.e., from the Lower Eastern View Formation (LEVF))	3D groundwater flow model covering all forecast-relevant aquifers and aquitards.
	3	Impacts of borefield use on Bulk Entitlement "trigger bores" - including in the swamp/alluvial aquifer (ASA)	– Simulation of the alluvial swamp aquifer watertable, and interaction with intermittently through-flowing creeks and rivers. – Simulation of intermittent flows and flow losses and gains to/from the watertable. – Simulation of the frequency and duration of creek flows (and swamp outflows), and periods of shallower versus deeper swamp watertable. I.e., periodic flushing of the swamp watertable. – And as per [1] above.
	4	Impacts of borefield use on creek flows, specifically low flows and flow frequencies along the Anglesea River, Salt Creek, and all tributaries.	
	5	Impacts and risks from borefield use on acid-generating potential from the Swamp/Alluvial Aquifer (ASA), and ultimately creeks and rivers.	
	6	Risks of borefield use from coastal saline intrusion.	Simulation of drawdown along coastal areas, and suitable simulation of the coastal margin in the groundwater model.
	7	Risks of borefield use on pumped LEVF groundwater quality (primarily TDS).	Simulation of Upper, Middle and Lower Eastern View Formation (UEVF, MEVF and LEVF) aquifers/aquitards at a minimum. A simple mixing model based on fluxes between these is used.
	8	Risks of Alcoa's rehabilitation works on groundwater quality and quantity recoverable from the Anglesea borefield, and on sustainability questions asked of Barwon Water's borefield use.	Simulation of the Alcoa pit water body, and its development over time. This includes augmentation options such as creek diversion, and augmentation from groundwater. It must also include interactions with the underlying groundwater system, and inflowing and outflowing surface waters.
	9	Risks of borefield use on land subsidence.	Ability to estimate drawdown across the entire onshore aquifer area. Subsidence will be assessed using these model outputs by suitably qualified geotechnical engineers and using a simple 1-D subsidence model.
	10	Risks of borefield use to third party groundwater users in all aquifers.	
Alcoa	11	The hydraulic impact zone (HIZ) i.e., the cone of depression caused by pumping groundwater at various rates from an existing production bore (likely WB16).	As per [2] above
	12	Groundwater drawdown at various locations due to pumping: – Other groundwater users – Within the in-pit power station waste ash deposit – At the coast and at the base of the Anglesea Estuary (for saline intrusion risk) – In the perched swamp watertable – At BW BE trigger bores – At BW production bores	As per [2,3,5,6,10] above

Party	Item	Requirement	Required model features
	13	The potential water quality impact zone (WQIZ), i.e., pit water migrating into groundwater, both horizontally and vertically under various scenarios including: – Pumping the lower sands of the UEVF to accelerate filling the void. – Using supplemental Salt Creek flows (or other surface water) to fill the void.	As per [8] above
	14	Estimate groundwater recovery times and likely steady state level water level within the mine void and surrounding aquifer, under various scenarios of augmented filling.	As per [8] and [2] above
	15	Maximum extent of pit water body water migration into the groundwater system	Particle tracking (e.g., Mod-Path3DU) or flux source tracing (e.g., FlowSource code (Foley and Black, 2013))
	16	What a particle of water does where Alcoa have covered the power station waste ash deposit (in-pit near MB4) once that becomes submerged beneath the pit water body.	As per [15] above
	17	Impact of pumping on creek and river flows	As per [4] above

In summary, the following features are therefore required of the groundwater model:

- Regional groundwater flow simulation covering the ASA, UEVF, MEVF, LEVF at a minimum.
- Dynamic simulation of groundwater recharge under climate variability.
- Dynamic simulation of creek flows, their variability, and interactions with the groundwater system.
- Dynamic simulation of the Alcoa pit water body water balance and water levels, and pit water body interactions with groundwater and surface water systems.
- Groundwater particle tracking and/or flux source tracing in the vicinity of the pit water body and Alcoa production bore(s).
- Simulation of groundwater pressure changes along the coast, for saline intrusion risk assessment.
- Simulation of dynamic watertable variability in the ASA, for use as a proxy measure of acid generation risk across model scenarios.
- Simulation of groundwater pressure drawdown at third party users' bores.
- Sensitivity assessment of climate change effects on key forecasts of interest. This should focus on potential future sea level rise, changes to groundwater recharge rates, and changes in evaporation, particularly as that relates to the simulated future pit water body.

Given modern industry standards, and the requirements of the Department of Energy, Environment and Climate Action's (DEECA's)[1] Technical Review Panel (TRP), the developed model must be capable of simulating these objectives using methods that recognise and account for model uncertainty, and potentially conceptual uncertainty.

2.2 Approach

The broad approach to the modelling documented in this report is centred around assimilation of as much data of relevance to the required forecasts of interest (Table 2-1) as is possible; see Section 5.2 for details. This is implemented in a framework that recognises model input and process representation uncertainties in such a way that they are carried through to their effects on model forecasts and their uncertainty (see Sections 5 and 6, particularly Sections 5.1, 5.2.1, 5.3 and 6.1.7).

Existing hydrological conditions and conceptualisation of the groundwater systems that underpin development of the numerical model are described in separate reports and are not duplicated herein (see: EHS, 2022a; GHD, 2013; GHD, 2019). Nonetheless, key aspects of the hydrogeological conceptualisation and underlying data are described where relevant for supporting model design and performance.

[1] Formerly known as Department of Environment, Land, Water and Planning (DELWP)

2.2.1 How will acid generation risks be addressed through modelling?

The BE review process, largely centring around review of GHD (2013), noted that little was known about acid generation processes, and hence the assessment of acid generation risks from groundwater development was very uncertain (DELWP, 2013). GHD (2013a and 2013b) identified Salt Creek as the dominant source of acid generation events in the Anglesea catchment, based on previous studies, and analysis of recent creek flow and groundwater level data, as compared with the historical record of acid generation events. GHD (2013a) also developed conceptual models of acid generation but highlight significant knowledge gaps towards which more recent efforts have been directed at addressing (e.g., Monash University (2020)).

GHD (2013a) describe a 2-layer (vadose and saturated zone) acid generation model, the boundary between which varies through time in response to climate and potentially other factors such as vegetation water use, stream flow, and groundwater pumping. This work was supported by a preliminary Acid Sulphate Soil (ASS) assessment undertaken at two locations within the Anglesea swamp by Glover and Webb, 2013. Monash University (2020) subsequently investigated the distribution and characterisation of acid sulphate soils in the Anglesea swamplands for Barwon Water.

The GHD (2013a) model, supported by the more recent work of Monash University (2020), is that sulphide-bearing sediments, peat, and coal are exposed to air and oxidised in the vadose zone. This primarily occurs during dry spells when the watertable falls, exposing sulphidic material in previously oxygen-poor (saturated) conditions to air. In subsequent wet periods, these newly oxidised sediments and coal are rewet, completing the oxidisation process, acidifying infiltrating water and runoff. This leached acid, and potentially metals along with it, is mobilised into runoff, interflow[2], and recharge to the watertable.

Monash University (2020) found that:

- Both Salt Creek and the Marshy Creek (upper Anglesea River) contain substantial volumes of acidity in a form that can be mobilised rapidly.
- Marshy Creek contains higher concentrations of “labile” acidity that can be readily mobilised than Salt Creek, although Salt Creek contains higher concentrations of “retained acidity” that can be slowly released over time.
- Greater evidence of previous sulphide oxidisation (i.e., less labile acidity) identified in Salt Creek Swamplands. The values are high enough to suggest significant historical oxidation in Salt Creek which may be more extensive than what has occurred at Marshy Creek.
- There is 2.4 times higher net acidity in the surface 0-10 cm of soil in the Salt Creek Swamplands than in the Marshy Creek Swamplands.

GHD (2013a) point out many variables that may influence the timing, magnitude, and location of acid generation events. A key driver is the frequency, intensity, and duration of wet versus dry climate spells. Clearly, longer, more intense dry spells incur a lower watertable over a longer duration, and less flushing of sulphidic material from the vadose zone - hence driving a greater potential for oxidisation and therefore acid generation in subsequent wet spells. Acid may also be mobilised (by runoff and interflow) and transported from upper-catchment areas to lower catchment areas, such as the Anglesea swamplands, where they may accumulate and be later flushed out. Other factors such as topographic position and form, and small-scale sediment property variability contribute to where acid generation processes are most likely to occur.

[2] Deep soil drainage diverted laterally to streams by low permeability sedimentary horizons, rather than passing vertically down to the watertable.

In the Anglesea swamplands, GHD (2013a and 2013b) suggest that acidic outflows from the swamp periodically occur during wet climatic events, when the watertable has risen sufficiently high over sufficiently broad an area that stream discharge occurs out of the swamp, ultimately into the Anglesea Estuary. During these events, more potentially acid-containing baseflow and stream flow passes through to the catchment outlet than would be the case during smaller rainfall and flow events. That stream flow reaching the catchment outlet carries with it significant volumes of groundwater baseflow (much of it from the acid generating portions of the swamp sediments), because the watertable is shallower across larger catchment areas, driving higher rates of groundwater baseflow over longer reaches of stream. It will also carry with it large volumes of runoff and interflow which would also carry with it mobilised acid and metals similarly flushed from the vadose zone and shallow surface soils.

Historical observations suggest that the longer the preceding dry spell, the more significant the subsequent acid generation event (GHD, 2013b). Such swamp flushing events, particularly in Salt Creek, are known to have periodically caused “fish kills” in the estuary (see GHD, 2013b Section 3.3). GHD (2013b) concluded that “*fish kill events may potentially occur when Salt Creek has had no significant outflows (i.e., >1 ML/day) for greater than 15 months, and this low-flow period is followed by a first flush event of greater than 4-5 ML/day*”.

A more detailed updated conceptual model of acid generation events is described in EHS (2022a) and Section 3.10.1.2.

Simulation of physico-chemical acid generation processes using the groundwater model is computationally impractical and probably futile given the paucity of supporting data and extremely wide variation in acid generating process throughout the catchment (see GHD, 2013a). As a more practical alternative, it is proposed to use proxy hydraulic measures of scenario-induced change to acid generating processes. As such, the modelling of this report will be designed as follows:

- Simulate seasonal and inter-annual recharge, potential groundwater evapotranspiration, and interflow/runoff dynamics using a soil water balance model (see Section 4.5.5).
- Simulate the intermittent nature of streams using the Stream Flow Routing (SFR) package (see Section 4.5.8). This includes the ability to simulate:
    - Complete loss of stream flow routed from catchment headwaters before it reaches the catchment outlet during dry spells.
    - The enhanced passage of stream flow from headwaters to the catchment outlet during wetter climatic spells.
    - Variable baseflow-gaining / stream flow-losing conditions along streams through time.
- Simulate the watertable within swamp sediments using a single model layer, which enables simulation of variable saturated/vadose zone depths over time. The aim is to simulate watertable dynamics and its interaction with overlying streams.
- Watertable and stream flow dynamics, and how they change under simulated groundwater development scenarios, are the adopted proxy measures for acid generation risk. This risk will be assessed in response to groundwater development scenarios in the following ways:
    - Watertable depth-duration/frequency curves.
    - Maps of watertable variability, and scenario-induced change in that variability.
    - Stream flow duration/frequency curves.
    - No flow period statistics.

That is, scenario-induced change to the processes driving the risk of acid generation in the catchment will be assessed using the above proxy indicators. For example, should a groundwater development scenario result in significant increases in the frequency and duration of zero stream flow and/or deeper watertable events, this would imply an increased risk of acid generation events. This information could potentially be used in a more detailed assessment of acid generation in the catchments. For example, in the event of an inferred high risk, a specific acid generation / geochemical model could be developed.

Uncertainty in these measures and the implied risks will be assessed using the stochastic modelling framework described in Section 5.1. This will be supported by the inclusion of observations of direct relevance to the acid generating processes described above in the history-matching process (Section 5) – specifically spatio-temporal variability in swamp watertable depths and stream flows.

2.2.2 Toward addressing previously identified model limitations

GHD (2019) outlined fourteen limitations of the model upon which this report's model will be based. Not all of these can be addressed because they relate to inherent limitations of groundwater modelling and simplified representation of geological variability. However, some of those limitations can be addressed or at least further investigated through the work of this report. These are outlined in Table 2-2.

Table 2-2 Previously Identified Model Limitations and Proposed Redress

Issue	Description (GHD (2019))	Propose to address in updated model
1	Outcrop area of the LEVF in the northwest area and outcrop of MEVF to the south. The best interpretations have been made on the available data. Significant uncertainties remain, despite further sampling and palynological analysis having been undertaken to improve the definition of this outcrop region;	The proposed modelling approach will employ spatial parameter variability using pilot points, with allowable upper and lower bounds reflective of the uncertainty in the properties of each unit, so that they can play proxy hydrogeological roles in different areas as driven by the observation data. See Section 5.3. Actual layer extents / outcrops cannot be allowed to vary in the model history matching process as designed, and so some limitations in this regard remain unresolved.
2	Thickness and extent of all geological units. This has been based upon point borehole information, which is sparse for many of the geological units across many areas of the model domain. The point data have been interpolated using geological judgement and is therefore likely be incorrect in places. The geological model used in this report was updated from earlier models, but the model recalibration suggests that there remain significant shortcomings, primarily related to the role of geological structure in aquifer boundary effects;	As per [1]. In addition, model layering is enhanced locally to the Alcoa mine through the mapping of EHS (2022a), which is carried through to the updated model layering (Section 4.3). Uncertainties in the role of geological structure, although not having been investigated further since the work of GHD (2013), can also be addressed to some degree using finer resolution spatial parameter variability in the model than was employed by GHD (2013), and definition of suitably wide allowable parameter bounds (Section 5.3). This will enable (for example) the barrier role of a fault zone to be mimicked through lower hydraulic conductivity interpolation where the observation data suggests such features may exist. Where the data do not imply such a feature's existence, yet it exists, the model uncertainty analysis would allow parameters to take on any value within the allowable bounds, thereby incorporating these potential effects in an indirect manner. However, given historical stresses (at least in the UEVF) are greater than those proposed in future, this issue is unlikely to be of significance to model forecasts.
3	Simulation of Geological Heterogeneity. Geological and hydrogeological structure has been simplified down to only 7 layers. These aquifers comprise many sub-units with different pressures and behaviours. The numerical model is unable to simulate such detail, nor are the data available to support such a simulation. This has the potential to prove a shortcoming of model forecasts;	As per [1] and [2]. However, it must be noted that the true hydrostratigraphic complexity is infinite and cannot ever be modelled. Simplifying assumptions are an inherent feature of modelling, and so limitation remain in this regard.
4	Lateral facies changes in the UEVF main coal deposit. The model simulates the extent of this geological unit based upon mapping of the coal. The modelled extent of the UEVF main coal deposit aquitard may be significantly smaller than the aquitard really is. This in turn will result in the model over-predicting drawdown and baseflow impacts on surface water features, particularly the impacts predicted for Anglesea Swamp.	As per [1]; model layers within the Alcoa area of interest have been updated with far greater detail than in the model of GHD (2013). In addition, pilot point parameterisation and suitably wide allowable bounds will allow the model history-matching and uncertainty analysis process to mimic facies changes. See Section 4.3 and 5.3.

Issue	Description (GHD (2019))	Propose to address in updated model
5	Thickness of the UEVF and LEVF at the coastal end of the Jan Juc Syncline. Thickness maps suggest the UEVF and LEVF thin out on the eastern end of the Jan Juc Syncline. There are no bore data to the south of Torquay to establish if the syncline containing thick EVF sediments continues across the coast and offshore. An additional deep monitoring bore on the coast near Jan Juc is required to confirm the thickness and extent of the EVF sediments in the coastal region. This would also provide additional information on groundwater flow in this area;	No additional drilling has occurred in this region. However, as per [1], spatial parameter variability and uncertainty analysis will compensate for such unknowns.
6	Hydraulic conductivity of the MEVF aquitard. The hydraulic conductivity of this unit has not been tested and the values used are based on a suitable calibration of the numerical model, and literature estimates. Geological data and the model calibration suggest that the hydraulic conductivity may be variable between the Anglesea Syncline and Jan Juc Syncline;	As per [1], spatial parameter variability and uncertainty analysis will compensate for such unknowns.
7	Hydraulic properties of other hydrogeological units. Whilst a significant body of pumping stress response data has been collected for the LEVF, UEVF and other aquifers, this testing was relatively short-term, and the development of aquifer boundary effects have been noted in the late-time groundwater level responses. This was made particularly clear during the model recalibration of GHD (2013b). However, long-term behaviour of this boundary effect remains uncertain due to the limited temporal extent of the borefield-stressed data.	The updated modelling includes a 6-month pumping trial. Furthermore, there was further use of the Barwon Water (LEVF) borefield in late 2019 for approximately 6 months. There is also several years of post-Alcoa mining UEVF recovery. Hence there will ultimately be more stress data available than was previously the case. However, it must be noted that there has not been a longer period of LEVF pumping than was available for the history-matching of GHD (2013). Stress-response data will be included in the model history matching process as drawdowns from starting conditions and relatively high weight will be placed on these observations. See Section 5.2. Finer spatial parameter variability than was employed by GHD (2013) will allow for simulation of potential boundary effects.
8	Offshore discharge mechanism and location of saline groundwater. These features have been assumed based on limited information.	The updated model parameterisation and boundary condition design for the offshore area, in conjunction with the proposed uncertainty analysis approach, aims to address this uncertainty. See Sections 4.5.2 and 5.
9	Pre-Alcoa coalmine groundwater levels. These are generally lacking. This means that the impact of the coal mine on the aquifers cannot be confidently assessed;	This issue remains a limitation and cannot be resolved. However, its potential impact on model forecast uncertainty will be addressed through flexible parameterisation of the initial (pre-mining) steady state model stress period. This will be implemented by including uncertainty in steady state recharge rates, as distinct from recharge rates to the subsequent steady state stress periods. See sections 4.4 and 4.5.5.
10	Alcoa mine development history. Mining history is not well known (i.e., pit geometries and elevations). Model calibration suggests that this imposes limitations on the quality of model calibration, particularly to water levels in the UEVF. This may have implications for model forecasts;	Effort has been put in to accurately defining Alcoa's mine pit development history in the updated model. See EHS (2022a) and Section 4.5.10.

Issue	Description (GHD (2019))	Propose to address in updated model
11	Alcoa Pit Lake recovery. As noted by GHD (2019), there was an apparent model overestimation of groundwater inflows in the November 2017-May 2018 period. This issue may be related to model error, or to unknown and un-modelled pit water use activities; it was recommended that the model be re-validated and re-calibrated within the next 2 years, once more pit water level recovery data become available from Alcoa.	This will be addressed through the updated modelling of this report. Significantly more pit water body development data are now available than was the case for GHD (2019). See Sections 4.5.9 and 5.2.
12	Forecast impacts on Anglesea borefield Bulk Entitlement trigger levels: As noted in the introduction to Section 6, whilst the Barwon Water borefield was simulated at 5.7 GL/year constant rate in all climate and pit fill scenarios, it is important to note that Barwon Water's relatively recent sustainable borefield yield work (GHD & Groundwater Logic, 2015) showed that in certain drier climate change cases, borefield yield would probably need to be reduced by varying amounts to avoid exceeding trigger bore drawdown limits. This assumption affects the modelled sustainable UEVF yield assessed in this project, particularly in the natural pit fill cases, in which there is less water in the system; the assessment of this report for these natural fill cases are probably conservative, because Barwon Water will likely be pumping at lower rates than those modelled here.	Not relevant to this report.
13	Anglesea Swamp impacts. A relatively poor calibration to flows in Anglesea Swamp was achieved. Reasons are provided by GHD (2013b). This introduces greater uncertainty to forecast impacts on Anglesea Swamp.	Significantly more stream flow data are available now than was the case for GHD (2013). This should enable resolution of this issue. Flow data will be included in model history matching as described in section 5.2.
14	Groundwater levels. Whilst an extensive monitoring network and program is in place, the available period of record for most bores is relatively short, compared with forecast time periods. The SOBN monitoring of the LEVF (and UEVF) aquifer only began recording water levels in the 1990s, and several bores are now of questionable integrity. No groundwater level information for the LEVF is available prior to this period. These issues pose potential implications for the reliability of the model calibration and forecasts.	A paucity of pre-1990 groundwater level data remain a limitation. However, significantly more groundwater level data are available now than was the case for GHD (2013). These data cover periods of significant hydrologic stress in the UEVF, particularly with the cessation of Alcoa groundwater pumping and pit water body development. There are also more stress-response data available for the LEVF, and even more are available from this year's 6-month pumping test. Not only are there longer periods of groundwater level monitoring than was previously available, but there is also more coverage of more aquifers, particularly the ASA. These changes should enable resolution of much of this issue. Groundwater level data will be included in model history-matching as described in section 5.2. Uncertainty analysis will enable quantification of the implications of data shortcomings on key model forecasts.

2.3 Assumptions at the model planning stage

Underpinning assumptions at the model planning stage include the following:

- Relative changes in groundwater and surface water systems arising from Barwon Water and Alcoa's groundwater abstraction and pit water body development activities are the primary focus of the modelling. Model design is specifically targeted at these objectives, and nothing more.
- Simulation of detailed historical Alcoa coal mining activities such as diversion of overland flow around the pit and the water balance of the historical pit sump is not a model objective. Instead, the focus is on groundwater-related impacts of historical mining activities, which are dominated by Alcoa's groundwater abstraction, maintaining a largely water-free working pit via sump pumping, and open cut mine pit development in different areas over time and their effect on groundwater discharge via shallow groundwater evapotranspiration from a lowered groundwater surface.
- The focus of impact assessment relates to groundwater and surface water flux quantities. Water quality is not explicitly modelled or assessed, although broad inferences may be made regarding potential water quality changes due to Barwon Water and Alcoa's activities using water flux information from the model.
- The complex structure and stratigraphy of the groundwater system is necessarily simplified and idealised in the numerical model, because our geological understanding is based on bore hole data collected at a scale coarser than that of geological variability. Therefore, much about its hydraulic properties and behaviour can only be inferred from the available groundwater and surface data, their limitations, and the limitations of the applied modelling methods. As a result, potentially large uncertainties in some hydrologic behaviours are likely to be encountered. This is not to devalue the utility of modelling; to the contrary, recognition of and accounting for these uncertainties ensures that their potential or actual existence is carried through to their potential implications for model end use - i.e., forecasts of potential aquifer behaviour, and how widely that might range based on what we do and do not know. The approach taken to the modelling *must* therefore account for these uncertainties.
- Little is known of groundwater conditions in the offshore area – i.e., where the coastal saline wedge is located. This may have ramifications for the estimation of onshore groundwater system behaviour. The approach taken to the modelling must also account for these uncertainties.

In recognition of the last two limitations identified above, the modelling approach documented in this report seeks to estimate and account for those limitations and their resulting model uncertainties in a highly flexible manner, in keeping with modern modelling approaches. This assessment of uncertainty will be critical when using model outputs to inform risk-based decision making. It is a positive thing that they have been identified at an early stage, so that they can be recognised and accounted for - uncertainties that have not been identified cannot be accounted for, which may pose problems for model-dependent decision-making.

3. Hydrogeological and Hydrology Characterisation

3.1 Catchment Hydrology

3.1.1 Overview

The catchment hydrogeology is described in detail in EHS (2022a) and GHD (2013, 2019), and therefore a summary has been provided in this document to support the conceptual hydrogeological model (CHM) and numerical model development. EHS (2022a) report also includes a summary of the key hydrogeological findings from Alcoa's recent pumping test trial and should be reviewed in conjunction with this summary.

The key surface water features in the vicinity of the mine pit and Barwon Water's borefield are shown in Figure 3-1 and consist of:

- **Anglesea River, Salt Creek Catchments, and associated Swamplands:**

Anglesea River and Salt Creek are generally ephemeral features that also drain the eastern flanks of the Otway Ranges, and much of the outcropping Eastern View Formation (EVF). Major swamplands are present in the lower reaches of both the catchments.

The swamplands at the lower reaches of each catchment are supported by a water table aquifer formed in the permeable alluvial sediments deposited along the creek valley. The water table rises and falls over the year as rainfall recharge and evapotranspiration occurs. Surface flows into the swampland are attenuated by storage in the alluvial water table aquifer (referred to as the Alluvial Swamp aquifer), and surface water outflow only occurs from the swamps when the aquifer system is at full capacity, generally following significant rainfall events. This is discussed further in Section 3.10 (Groundwater Dependent Ecosystems). It is also noted that a section of Breakfast Creek, a tributary to Salt Creek, is a near-perennial surface water feature which supports a pygmy perch population. This is also discussed further in Section 3.10.

Surface water from both rivers run into the Anglesea Estuary, downstream of Coal Mine Road. The Anglesea River estuary is classified as a wave-dominated intermittently open/closed estuary (GHD, 2021).

- **Spring Creek and Thompson Creek:**

These creeks are located to the east and north of the Anglesea River and Salt Creek, respectively. They largely drain the geological formations which overlie the EVF (i.e. the Demons Bluff Formation).

- **Painkalac Creek:**

This is a perennial creek that drains the Otway Ranges. It is known to have a relatively consistent annual flow, suggesting groundwater baseflow derived from the Otway Group. Distillery Creek, a tributary of Painkalac Creek that drains both the UEVF and LEVF, joins Painkalac Creek immediately north of Aireys Inlet.

Barwon Water's surface water monitoring network has focused on the Anglesea River and Salt Creek Catchments based on the assessment of potential impact risk associated with long term groundwater extraction (GHD, 2013 & 2008).

3.1.2 Flow Duration and Catchment Statistics

Barwon Water has installed seven flow gauging sites and additional pool monitoring sites in the two main catchments (refer Figure 3-1) and currently undertake flow, level, and water quality sampling in adherence with the Monitoring and Assessment Program (MAP) required under their BE.

A summary of the surface water flow statistics from these sites (2009-2018) is presented in Table 3-1 (GHD, 2021), including for the historical flow from site SV2 which was in operation from 1967 to 1982.

Table 3-1 Flow summary statistics over historical record to December 2019

Sub-catchment	Gauge ID	Catchment area (km^2)	Average daily flow (ML/day)	Average yearly flow (ML/year)	Median zero flow days per year
Salt Creek	SV3	4.7	0.3	83	8
	SV1	3.2	1.2	343	98.0
	SV4	24.7	1.2	362	116
	SV2	48.2	1.2	343	250
	SV2 (Historical)[3]		11.5	3,175	16.5
Anglesea River[4]	AV1	16.6	0.4	121	242
	AV2	65.2	1.7	553	183

In the Salt Creek catchment, the surface water flow data shows that the catchment is ephemeral and that generally the daily and annual flow volumes increase further downstream. The exception being between flow gauge SV4 and SV2, located at the upstream end and downstream end respectively of the Swamplands, which recorded similar rates. The number of zero flow days increases down catchment, being due to lower rainfall and the attenuation of the flows in the swamplands and subsequent evapotranspiration processes. At the lower end of Salt Creek, gauge SV2 records no flow approximately 68% of the time. Site SV3 in the Breakfast Creek tributary is the only site which records near perennial flows (across both catchments).

The Anglesea River catchment flow data shows this catchment is also ephemeral, with flow volumes increasing downstream. Flow occurs more regularly, and on average at a higher annual volume from the lower end of the Anglesea Swamplands/catchment than the Salt Creek Swamplands/catchment for the 2010 to 2018 period. However, it is noted that during several peak flow periods, Salt Creek Catchment produces significantly higher peak flows; however, on a yearly average basis higher flow volumes normally occur from the Anglesea Catchment (i.e., 7 out of 9 years the higher volumes came from the Anglesea Catchment). At the lower end of Anglesea River Creek, gauge AV2 records no flow approximately 50% of the time.

3.1.3 Surface water acidity

Acidic surface water flows have been recorded from the Anglesea River catchment. At the lower end of the Anglesea catchment gauge AV2 usually record a pH of <3, while at the lower end of the Salt Creek catchment the pH is slightly higher ranging between 3.5 and 4 (EHS, 2022a). Longer term pH data at or near location at AV2 also shows pH generally ranging between 3 and 4 since 1969 (EHS, 2022a). The source of the acidity is discussed further in Section 3.10.1.2.

[3] Historical flow data from 1967-1982, except yearly flow from 1968-1981; Other flow data from approximately 2009 to December 2019.
[4] AV3 on the mid Anglesea catchment does not have enough data to establish a flow rating curve

WENSLEYDALE

ANGLESEA

JAN JUC GROUNDWATER MANAGEMENT AREA

ANGLESEA RIVER

SPRING CREEK

UPPER SWAMP

LOWER SWAMP

BFC TRIBUTARY

BREAKFAST CREEK

SALT CREEK

SALT CREEK SWAMP

ANGLESEA RIVER ESTUARY

MELALEUCA SWAMP

Great Ocean Road

113004
AGP1B
P18
P13
AV1
P13B
P3
WTOB3
AV3
116458
GW7
115873
119347
119348
NB1
NB2
GW6
P7B
P7
ASP7
P12
P8
P19
115869
121768
P9
P10
WTOB5
113470
P16
SV3
SGP 1a
SV1
WTOB4
AGP2
WTOB2
WB4
235222
AV2
WB5
WB12
WB9
WB16
SV2
SB1
SV4
P17
SGP2-B
P6
P1
115867
116459
122149
WTOB1
GW4
SB2
GW1
GW3
GW5
119349
P14
P21
115868
P15
GW2
116460

Legend

- DSE - Flow gauge
- BW - Flow gauge
- BW - Pool level site
- ASA
- UEVF
- LEVF
- UEVF_LEVF
- Alcoa test production bore
- Southern Borefield
- Northern Borefield
- Jan Juc GMA
- Alcoa Mine
- Arterial
- Collector
- Proposed
- Watercourse
- Lake
- Swamp
- River
- Stream
- Channel
- Drain/ Channel/ Other
- National Parks
- Other Parks

Paper Size ISO A3

0 0.5 1 1.5 2

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Barwon Water
Anglesea Groundwater Model Update

Surface water and groundwater monitoring locations

Project No. 12542999
Revision No. 0
Date 09/01/2023

FIGURE 3.1

G:\31\12542999\GIS\Maps\Working\31_12542999_05_SWmonitoring_A3L_Rev0.mxd
Print date: 09 Jan 2023 - 11:04

Data source: : DELWP, VicMap, 2022; BW, bore locations, 2013; DELWP, Jan Juc GMA, 2017; EHS, Alcoa AOI, 2022; GHD, interpreted outcrop geology, 2012; GHD, syncline and anticline structures, 2007; BW, surface water sites, 2013; DSE, flow gauge, 2013; GHD, groundwater monitoring locations, 2011; . Created by: bsmyth

3.2 Regional Geological and Hydrogeological Setting

Alcoa and Barwon Water production bores are located within the Jan Juc Groundwater Management Area (GMA) (refer Figure 3-2). The numerical model domain covers most of the GMA, as well as an area offshore (refer Section 4). The geology and hydrogeology of this region has been described in detail previously by GHD (2013 and 2019), and more recently by EHS (2022a) with a focus of the Alcoa area of interest (AOI). Therefore, a summary has been provided in this document to support the CHM and numerical model development.

The Jan Juc GMA incorporates the north-western onshore section of the Torquay Basin, a structurally controlled depression in the Lower Cretaceous-aged Otway Group bedrock. In this section of the basin, it has been predominately infilled with Tertiary-aged non-marine sediments.

Within this portion of the Torquay Basin there is two distinct synclines; the Anglesea (or southern) Syncline and the Jan Juc (or northern) Syncline (refer Figure 3-3) where the sedimentary sequences are up to approximately 500 m and 350 m thick respectively. Separating the two synclines is bedrock high referred to as the Bells Beach Anticline, and along the northern edge of the Jan Juc Syncline and the GMA, is the Torquay Anticline (refer Figure 3-3).

A summary of the main geological units in the region, from youngest to oldest, in the region, is shown in Table 3-2 and interpreted outcrop areas of these main units are shown in Figure 3-3. Detailed geological review within the Alcoa AOI completed by EHS, 2022a provided further breakdown of the UEVF into several key lithological units (refer Table 3-3), which are relevant to the hydrogeological assessment.

Table 3-2 Regional Geological Units

Period	Geological unit	Description	Approximate Thickness and Location
Quaternary	Swamp and Alluvial Sediments	Alluvium consisting of sand, silt, clay and gravel deposited along the local river valleys and swamp deposits such as peat in the main swamplands.	Generally 10 -30m thick. Present along the creek lines (i.e., Painkalac Creek, Salt Creek, Spring Creek, and Anglesea River), and thickest in the Salt Creek Swamp and Anglesea Swamp.
	Colluvium	Sand, silts and clays	Also present along some creek lines.
Tertiary	Moorabool Viaduct Sands	Sand, ferruginous sand, limestone and gravel, and was deposited in a marine environment	Isolated pod to the north of Torquay Township and north of the Bambra Fault
	Torquay Group (including Jan Juc and Puebla Formation):	limestone, marl, calcareous and clayey silt, deposited in a marine environment	This unit is mainly present to the northeast of the Torquay Basin and overlies the Demons Bluff Formation.
	Demons Bluff Formation (DBF), including Anglesea Formation & Salt Creek Formation	Marine deposit of fine-grained micaceous and carbonaceous silts and silty clays. The basal member of the formation is a sandstone unit referred to as the Boonah Formation, which overlies the coal seams of the underlying EVF	Along the coastal stretch between Aireys Inlet and Anglesea and stretches inland on the eastern side of the Anglesea River.
	Boonah Formation	The Formation consists of 1-3 m thick- coarse-grained sand channel units with interbedded minor clay, shale and carbonaceous siltstone.	In the Anglesea coal mine, the Boonah Sands Formation is up to 32 m thick with the permeable sections extending laterally up to 50 m (e.g., representative of disconnected “shoe-string sands”)
	Eastern View Formation (EVF)	Deposited in a non-marine lacustrine or deltaic environment and sub-divided into three distinct units (below)	

Period	Geological unit	Description	Approximate Thickness and Location
	Upper Eastern View Formation (UEVF)	Clay, silty clay, silt and fine to medium grained sand sequences with minor fine gravel lenses. Brown coal seams are common in the top of the sequence.	Unit up to 230m thick in Anglesea Syncline. Coals (i.e. A Group coals) from this unit were formerly mined by Alcoa (generally <50m thick).
	Middle Eastern View Formation (MEVF)	Shale and mudstone., minor sand and gravel lenses present	In the order of 50-60m deep in the Anglesea Syncline and 25-50m thick in the Jan Juc syncline
	Lower Eastern View Formation (LEVF)	Micaceous silts, carbonaceous clays, silty clays, thin brown coal and fine to coarse grained sands and gravels.	The average thickness of the unit is almost 200 m along the Anglesea Syncline and 100 m along the Jan Juc Syncline. The unit is thought to be absent over parts of the Bells Beach Anticline[5].
Lower Cretaceous	Otway Group	Inter-bedded sandstones and laminated grey siltstone and mudstone	The bedrock outcrops on the western side of the GMA, and along the Breakfast Creek Tributary gully.

Table 3-3 Upper Eastern View Formation (UEVF): Geological Sub-units

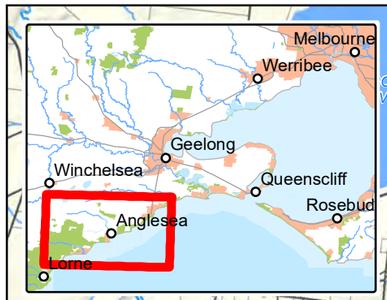
Period	Geological unit	Sub-unit	Description	Approximate Thickness and Location
Tertiary	*Upper Eastern View Formation (UEVF)*	A Group Coals	The main brown coal mined by Alcoa, and in the upper portion of the UEVF	Up to 36m around the coal mine. The coal is interpreted to extend north of the coal mine (around 1 km north of Salt Creek) and south beyond the coast
		Basal Clay	Grey to pale brown clay layer	Located immediately below the main coal seam. The thickness of this clay varies from 1 to 4m
		UEVF upper sands	Shoestring sands	Primarily found underneath the basal clay & main coal seam in the vicinity of the former mine, and potentially extend towards the coast. Varies from 0.5 m to 25 m with a typical thickness being less than 5m
		UEVF Intermediate	Series of peaty coal and clay. Occasional thin (<0.2m) coarse sand and gravel lenses	Beneath the UEVF (upper) sands, between 60-150m thick with individual coal/clay layers between 2 and 30m in thickness
		UEVF lower sand	Coarse sands with minor claystone and coal intervals.	The total thickness is up to 180m. Alcoa extraction bores were screened across these sands

[5] In recognition of the uncertainty in connectivity over the anticline, the LEVF model layer is continued at 1 m (minimum) thickness over the anticline, and the model history matching process will be used to simulate varying degrees and locations of potential connectivity between the two synclines via the LEVF. Initial hydraulic conductivity values over the anticline in the LEVF are low, but are allowed to increase during model history matching if observation data suggests a degree of connection in places.

3.2.1 Interpreted Geological Surfaces

Based on the work completed by GHD, 2013 and EHS, 2022a, geological unit thickness (isopach) and extent maps were constructed for the numerical model and are shown in Section 4.3, for the follow units:

- Swamp and Alluvial Sediments (Figure 4-3),
- Demons Bluff Formation (DBF), including Anglesea Formation & Salt Creek Formation (Figure 4-4)
- Boonah Formation (Figure 4-5, within the Alcoa AOI)
- A Group coals, including the basal clay (Figure 4-5, within the Alcoa AOI)
- UEVF upper sands (Figure 4-5, within the Alcoa AOI)
- UEVF intermediate (Figure 4-5, within the Alcoa AOI, and Figure 4-4 regionally)
- UEVF lower sands (Figure 4-4)
- MEVF (Figure 4-6)
- LEVF (Figure 4-7)
- Otway Group (Figure 4-7)



MERRIGIG CREEK

OLUG VOIR

Hendy Main Road

Anglesea Road

Anglesea Road

THOMPSON CREEK

TORQUAY

SPRING CREEK

JAN JUC

Bones Road

Bells Beach Road

Great Ocean Road

GW7

GW6

WENSLEYDALE

JAN JUC GROUNDWATER MANAGEMENT AREA

MARSHALL CREEK

WB16

SALT CREEK

GW5

GW1

GW4

GW3

ANGLESEA

GW2

ANGLESEA RIVER

DISTILLERY CREEK

MELALEUCA SWAMP

PAINKALAC DAM

MOGGS CREEK

PAINKALAC CREEK

AIREYS INLET

FAIRHAVEN

Legend

- Alcoa test production bore
- Southern Borefield
- Northern Borefield
- Alcoa AOI boundary
- Jan Juc GMA
- Alcoa Mine
- Highway
- Arterial
- Collector
- Proposed
- Watercourse
- Lake
- Swamp
- River
- Stream
- Channel
- Drain/ Channel/ Other
- National Parks
- Other Parks
- Township boundary

Paper Size ISO A3

0 1 2 3 4 Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

GHD

Barwon Water
Anglesea Groundwater Model Update

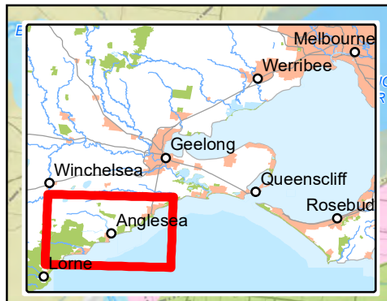
Jan Juc Groundwater Management Area and Key Production Bores

Project No. 12542999
Revision No. 0
Date 9/01/2023

FIGURE 3.2

G:\31\12542999\GIS\Maps\Working\31_12542999_01_SiteLocation_A3L_Rev0.mxd
Print date: 09 Jan 2023 - 10:48

Data source: : DELWP, VicMap, 2022; BW, bore locations, 2013; DELWP, Jan Juc GMA, 2017; EHS, Alcoa AOI, 2022 . Created by: bsmyth



MERRIGIG CREEK
THOMPSON CREEK
Hendy Main Road
Anglesea Road
Torquay Anticline
TORQUAY
SPRING CREEK
JAN JUC
Jan Juc Syncline
GW7
GW6
WORMBETE CREEK
WENSLEYDALE
JAN JUC GROUNDWATER MANAGEMENT AREA
Bones Road
Bells Beach Road
Bells Beach Anticline
Great Ocean Road
MARSHALL CREEK
Anglesea Syncline
WB16
SALT CREEK
GW5
GW1
GW4
GW3
ANGLESEA
GW2
ANGLESEA RIVER
DISTILLERY CREEK
MELALEUCA SWAMP
PAINKALAC DAM
MOGGS CREEK
PAINKALAC CREEK
AIREYS INLET
FAIRHAVEN

Legend

- Alcoa test production bore
- Southern Borefield
- Northern Borefield
- Geophysics - basement structure
- Anticline
- Syncline
- Alcoa AOI boundary
- Jan Juc GMA
- Alcoa Mine
- Highway
- Arterial
- Collector
- Proposed
- Watercourse
- Lake
- Swamp
- River
- Stream
- Channel
- Drain/ Channel/ Other
- Alluvials
- Bedrock
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View

Paper Size ISO A3

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Barwon Water
Anglesea Groundwater Model Update

Interpreted outcrop geology

Project No. 12542999
Revision No. 0
Date 09/01/2023

FIGURE 3.3

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Print date: 09 Jan 2023 - 10:53

Data source: : DELWP, VicMap, 2022; BW, bore locations, 2013; DELWP, Jan Juc GMA, 2017; EHS, Alcoa AOI, 2022; GHD, interpreted outcrop geology, 2012; GHD, syncline and anticline structures, 2007; -

Created by: bsmyth

3.3 Hydrogeology

The hydrogeology of the region has been described in detail in previous reports (i.e., GHD, 2013a, 2019), while the hydrogeology of the Alcoa AOI is detailed in EHS, 2022a.

In summary, there are three main aquifer systems, the regionally extensive UEVF and LEVF aquifers and the Alluvial / Swamp Aquifer (ASA), formerly referred to as the "Perched Watertable (PWT)"[6], which is present along the main creek lines. The hydrostratigraphy of the region is summarised in Table 3-4.

Table 3-4 Regional Hydrostratigraphy

Period	Geological unit	Sub-unit	Aquifer/Aquitard Name	Lithology	Aquifer/ Aquitard Type
Quaternary	Swamp and Alluvial Sediment	-	Alluvial Swamp aquifer (ASA)	Silt, clay and gravel.	Aquifer, unconfined / semi- confined
Tertiary	Moorabool Viaduct Sands	-	Moorabool Viaduct Sands	Sand, ferruginous sand, limestone and gravel	Aquitard/ minor aquifer to the north of Torquay
	Demons Bluff Formation (DBF)	-	Demons Bluff Formation (DBF)	Fine-grained micaceous and carbonaceous silts and silty clays.	Aquitard generally, but can form a perched water table aquifer in places around the mine
	Boonah Formation	-	Boonah Formation (BF) aquifer	Coarse-grained sand with interbedded minor clay, shale and carbonaceous siltstone.	Aquifer, unconfined to confined
Tertiary	UEVF	A Group Coals	A Group Coals	Brown coal	Aquitard
		Basal Clay	Basal Clay	Grey to pale brown clay layer	Aquitard
		UEVF upper sands	UEVF Upper Sand aquifer	Shoestring sands	Aquifer, unconfined to confined
		UEVF Intermediate	UEVF Intermediate	Series of peaty coal and clay. Occasional thin coarse sand and gravel lenses	Aquitard
		UEVF lower sand	UEVF Lower Sands aquifer	Coarse sands with minor claystone and coal intervals.	Aquifer, unconfined to confined
	MEVF	-	MEVF	Shale and mudstone., minor sand and gravel lenses present	Aquitard
	LEVF	-	LEVF aquifer	Micaceous silts, carbonaceous clays, silty clays, thin brown coal and fine to coarse grained sands & gravels.	Aquifer, unconfined to confined
Lower Cretaceous	Otway Group	-	Bedrock	Inter-bedded sandstones and laminated grey siltstone and mudstone	Aquitard / minor fractured rock aquifer

[6] The PWT was renamed to the ASA based on DEECA Technical Review Panel (TRP) comments that "Perched Watertable" was a misleading term given that this aquifer is not perched in all areas.

3.3.1 UEVF and LEVF Aquifers

In the vicinity of Anglesea, the UEVF is around 200 to 250 m in thickness, and the LEVF is around 200 m in thickness (refer Figure 4-4 and Figure 4-7). The UEVF aquifer consists of brown coal, in the upper portion of the UEVF sequence, and interbedded clay, silty clay, silt and fine to medium grained sand sequences with minor fine gravel lenses. As noted in Section 3.2 above, the UEVF has been subdivided into several sub-units with different hydraulic properties in the vicinity of the coal mine, where intensive drilling data made this possible.

The LEVF consists of unconsolidated micaceous silts, carbonaceous clays, silty clays, thin brown coal seams and fine to coarse-grained sands and gravels.

These aquifers systems are separated by the MEVF aquitard, which is generally 40 to 60 m in thickness. The MEVF generally consists of mudstone and siltstone but also has minor sand and gravel lenses as well as thin brown coal layers. The aquifer systems are thickest in two main synclines, the Anglesea Syncline, and the Jan Juc Syncline (refer Figure 3-3). Underlying the main sedimentary aquifer systems is the basement rocks of the Otway Group.

Groundwater recharge to the LEVF and UEVF aquifers occurs via direct rainfall recharge where both aquifer systems outcrop, and the aquifer systems are unconfined. Groundwater migrates towards the coast, where the aquifer systems become confined, and eventually discharges offshore (refer Section 3.12).

Bore yields from the UEVF aquifer (lower sub-unit specifically) have been recorded more than 50 L/sec (GHD, 2008), while yield from the LEVF aquifer are generally in the order of 30 -40 L/sec.

Representative aquifer parameters from the UEVF Lower aquifer are a transmissivity of 110 m^2/day, average hydraulic conductivity of 0.5m /day, while over the sand layers the hydraulic conductivity was in the order of 4.5 m/day. A representative aquifer storativity was in the order of 9.4 $x10^{-4}$ (GHD, 2008). The derived aquifer parameters from the recent pumping test completed on WB16 were largely consistent with these previous parameters, with an average transmissivity of 91 m^2/day, and hydraulic conductivity of 1.2 m/day (based on a 72m aquifer thickness) and an aquifer storativity of 2 x 10^{-4} (EHS, 2022a).

Pumping tests completed in 2008 and 2009 by Barwon Water in the LEVF indicated aquifer transmissivities between 40 and 330 m^2/day and hydraulic conductivity varying from 0.5 to 40 m/day depending on the sequences tested (GHD, 2013a). LEVF aquifer storativity was recorded between 0.002 and 9 x 10^{-5}. Additional information on aquifer properties is included in Section 4.6.

To the east of Anglesea and along the coast, the Demons Bluff Formation (DBF), consisting of silts and silty clays, acts as an aquitard and overlies the UEVF aquifer. Around the mine and power station the DBF is largely unsaturated likely due to the presence of the mine void, however it forms the watertable aquifer in places, where a discontinuous artificial perched groundwater system has formed related to past impacts from the mine infrastructure (i.e., the cooling tower or ash ponds; EHS, 2022a).

3.3.2 Alluvial Swamp Aquifer (ASA)

In the Anglesea River and Salt Creek valleys younger permeable alluvial deposits overlie the regional aquifer systems. The thickness of the alluvial sediments is generally in the order of 10-20 m but thins towards up-catchment areas and the alluvial body margins (refer Figure 4-3). A water table aquifer system, which supports the large swamplands in the Anglesea River and Salt Creek catchments, has formed within the confines of the alluvial deposits and is referred to as the Alluvial Swamp Aquifer (ASA). In previous reports, (i.e. GHD, 2013) this shallow aquifer had been referred to as the Perched Watertable (PWT) aquifer; reasons for the renaming of this unit are discussed in the introduction to this report section.

As noted in Section 3.1.1, this ASA system is primarily recharged by rainfall and runoff, and to a lesser degree by baseflow from underlying aquifer systems (such as UEVF aquifer), where upwards vertical hydraulic gradients exist. When surface water flow occurs in the upper reaches of these catchments, it is often attenuated by the available storage in the ASA system. Subsequently, surface water flow from the lower end of the catchments and into the Anglesea Estuary only occurs following significant or continuous rainfall events where the ASA system becomes filled and there is no further storage capacity. During drier months, the groundwater within the ASA is

lost through evapotranspiration from the swamp vegetation, and groundwater levels subsequently decline. Discharge from the ASA will also potentially occur as leakage to underlying aquifer systems, where there is a downwards vertical hydraulic gradient. This conceptualisation is shown in Figure 3-23.

It is critical for readers to note and keep in mind that the magnitude of the baseflow component into or out of the ASA is dependent on the direction and level of connection with the underlying aquifers, which is dependent on the following factors, all of which can vary spatially, and some of which can vary over time:

- Vertical hydraulic gradients. This relationship can change spatially and temporally depending on climatic conditions, and groundwater abstraction and mining activities in different areas in question (such as Alcoa's and Barwon Water's abstraction). For instance:
    - In the immediate vicinity of the Alcoa mine, the lower sand units of the UEVF aquifers indirectly underlying the ASA and other shallower aquifer systems, have been historically extracted to supply cooling water for the power station and presumably for pit stability, and pressures have been recovering since cessation of Alcoa mine operations).
    - In other places further away from the mine and groundwater pumping, UEVF aquifers have historically exhibited both upward and downward hydraulic gradient into the ASA. In the headwaters of the catchment, such as the Upper Anglesea Pools and Breakfast Creek tributary area, the gradient between the aquifer(s) underlying the ASA and the ASA itself will mainly vary depending on climatic conditions and local geology (and hydraulic properties).
- Thickness and conductivity of intervening aquitards (i.e., coals and clays). These factors will vary across the Salt Creek and Anglesea River catchments, and therefore the ASA will be gaining in some areas and losing in other areas to greater or lesser degrees. The local hydraulic properties of the geology underlying the ASA in different areas will affect the hydraulic response of the groundwater system to groundwater pumping and/or mining (in terms of vertical gradients) differently in different areas.
- Basin architecture also plays a role in spatially variable directions and magnitudes of hydraulic connection between the ASA and underlying aquifers at different times. Figure 3-4 provides a geological cross-section aligned from northwest to southeast through the Jan Juc GMA and along the axis of the Anglesea Syncline. The section indicates the layered sedimentary sequence and the down-dip transition in the UEVF and LEVF from outcropping unconfined conditions, to deeply buried confined conditions. The interpreted outcrop areas of all the geological units in the study area are also shown in Figure 3-3. The geological layers are also shown in the block diagram summarising the conceptual hydrogeological model (Figure 3-21). These factors will affect connection to and from the ASA in different areas.

Readers should therefore recognise that some of the discussion later in this section may appear contradictory; this is not the case however – it is just that the "gaining" and/or "losing" nature of the ASA (and streams) has always varied spatially and temporally (and always will) due to a wide range of influences.

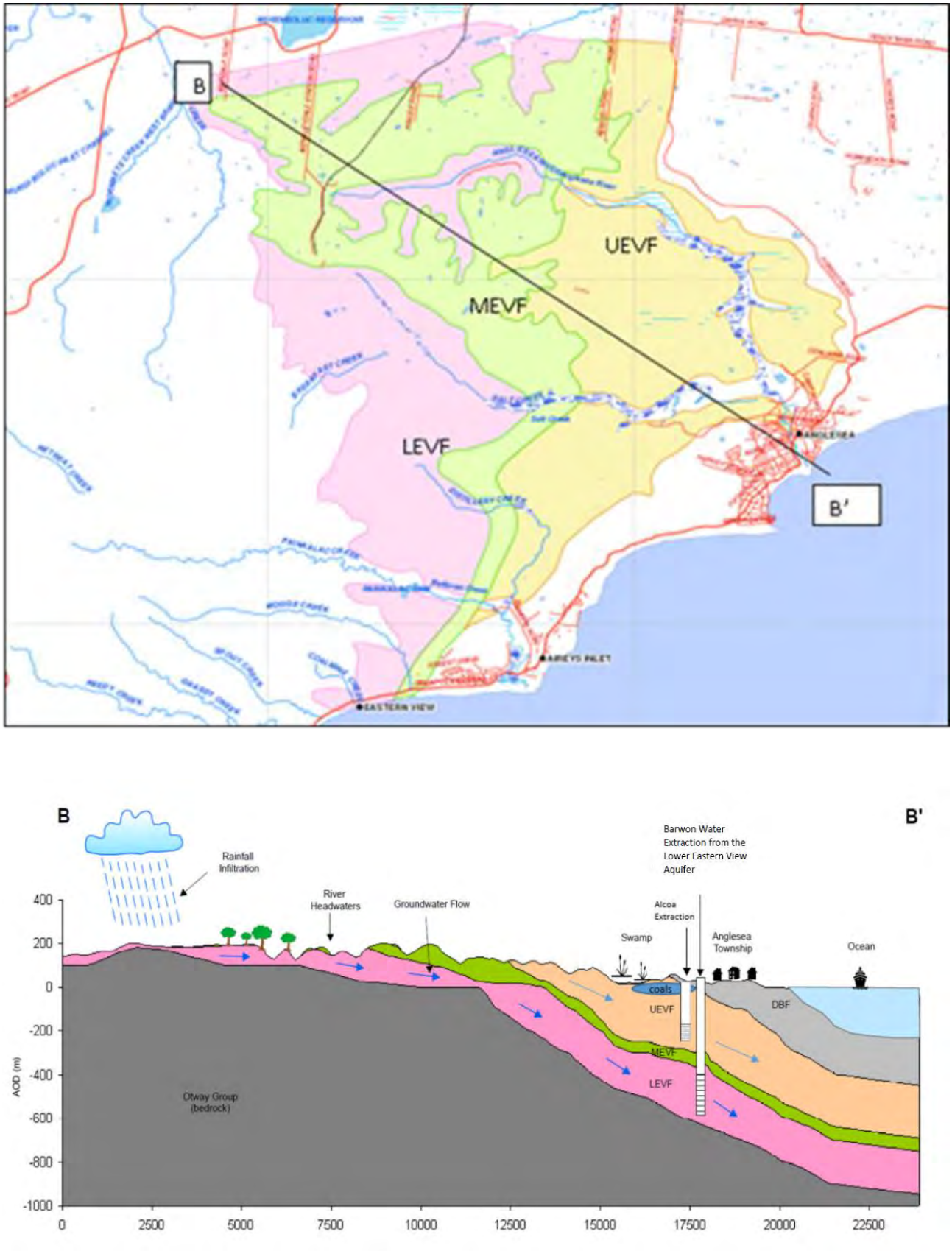

Figure 3-4 *Jan Juc GMA: Cross Section and Interpreted Auifer Outcrop (GHD, 2013)*

3.4 Groundwater Quality

3.4.1 UEVF and LEVF

Groundwater salinity in the UEVF Lower Sands aquifer system has been measured between approximately 800 - 1,200 mg/L Total Dissolved Solids (TDS), whilst the groundwater salinity in the LEVF aquifer system is approximately 500 - 900 mg/L TDS in the Anglesea Syncline and around 600 - 800 mg/L TDS in the Jan Juc Syncline (GHD, 2013).

The groundwater pH from the UEVF Lower Sands aquifer is approximately 5.8 (based on monitoring of 2 observation bores by Barwon Water). Similarly, the average pH from the LEVF aquifer is approximately 5.9 (based on monitoring from 3 observation bores).

Groundwater temperature in the UEVF is generally between 28-33^{0}C in the Anglesea Syncline, while groundwater temperature in the LEVF is marginally hotter and varies from around 34-38^{0}C in the Anglesea Syncline to around 25^{0}C in the shallower Jan Juc Syncline (GHD, 2013).

3.4.2 ASA

Groundwater salinity and pH in the ASA is variable depending on the location in the catchment, seasonal variations, and surface water conditions (i.e., when surface flows occur). ASA groundwater monitoring undertaken by Barwon Water recorded the following salinity and pH trends from April 2015 to Feb 2017 (GHD, 2019):

- In the Anglesea Catchment, groundwater salinity in the ASA generally increased downstream, with ASA aquifer upstream average salinity ~ 1,000 to 1,500 mg/L TDS and the downstream average salinity ~ 2,020 mg/L.
- In the Salt Creek Catchment, the groundwater salinity in the ASA, was similar at the upstream and downstream extents, with upstream average salinity ~ 890 mg/L TDS and downstream average salinity ~ 570 mg/L TDS.
- The greatest salinity variability in the ASA system was recorded in bore WTOB2 at the lower end of the Anglesea Catchment and bore P17 at the upper end of the Salt Creek Swampland (i.e., both bores recorded a standard deviation >200 mg/L TDS).
- Groundwater pH varied between 3.5 and 6.1 in the ASA aquifer system in the Anglesea catchment. The lowest pH was recorded in bore P7B during February 2016.
- Groundwater pH varied between 5.13 and 6.95 in the ASA aquifer system in the Salt Creek Catchment. The lowest pH was recorded in bore P1, at the upstream end of the Salt Creek Swampland in July 2016.

3.4.3 Demons Bluff Formation / Boonah Sands Aquifer

TDS in the Boonah Sands and DBF perched aquifer from the recent groundwater monitoring event in 2020 ranges between 578 mg/L and 6,660 mg/L with an average of 2,519 mg/L (EHS, 2022a).

3.5 Groundwater Monitoring Network

In the Jan Juc GMA there is an extensive groundwater monitoring network, consisting of State Observation Bore Network (SOBN) bores, Alcoa bores and Barwon Water bores (Figure 5-3). The network is summarised below, and a full list of observation bores, and bore location figure, is included in Appendix C. There are several key nested bore sites which are summarised in Table 3-6.

Table 3-5 Groundwater Monitoring Network Summary

Aquifer Monitored	Number of Monitoring Bores	Comment
ASA	9	Barwon Water bores installed for their Monitoring and Assessment Program (MAP)
DBF	21	Alcoa bores on mine site
Boonah Formation	40	Alcoa bores on mine site
Mine Overburden	3	Alcoa bores on mine site
UEVF Upper	7	Alcoa bores on mine site- around the pit
UEVF intermediate	1	Alcoa bores on mine site
UEVF Lower	13	Alcoa, DELWP and Barwon Water bores
LEVF	20	Barwon Water and DELWP bore
Total	137	

Table 3-6 Key Nested Bore Sites

Bores	Aquifer	Location/Justification
Southern Syncline		
116459/115867 / WT0B1	UEVF/ LEVF/ ASA	Nested site at salt creek. SOBN bores may have failed
115868/P15	UEVF/LEVF	West of Barwon Water borefield and the former mine
SB1/SB2	UEVF/LEVF	Vicinity of Barwon Water borefield and the Alcoa extraction bores
P14/P21	UEVF/ LEVF	On the coast. P21 has just been installed (Dec 2021)
P1/P6	LEVF/ASA	Salt Creek, and a nearby a surface water gauge
UEVF MB1 / DBG MB1	UEVF Upper and Boonah sand	Monitoring shallow aquifer systems around the pit lake
UEVF MB2 / DBG MB2	UEVF Upper and Boonah sand	Monitoring shallow aquifer systems around the pit lake
UEVF MB3 / DBG MB3	UEVF Upper and Boonah sand	Monitoring shallow aquifer systems around the pit lake
UEVF MB4 / DBG MB4	UEVF Upper and Mine overburden	Monitoring shallow aquifer systems around the pit lake
UEVF MB5 / DBG MB5	UEVF Upper and Mine overburden	Monitoring shallow aquifer systems around the pit lake
UEVF MB6 / DBG MB6	UEVF Upper and Mine overburden	Monitoring shallow aquifer systems around the pit lake

Bores	Aquifer	Location/Justification
UEVF MB7 / DBG MB7	UEVF Upper and Boonah sand	Monitoring shallow aquifer systems around the pit lake
UEVF MB8 / DBG MB8	UEVF(Intermediate) and Boonah sand	Monitoring shallow aquifer systems around the pit lake
Northern Syncline		
NB2/NB1	UEVF / LEVF	Monitoring in the vicinity of Barwon Water's northern borefield
P8/P19/P12	ASA/UEVF/LEVF	Monitoring head differences in the vicinity of the upper Anglesea River swamplands
P13B/P13	ASA/LEVF	Upper Anglesea River

3.6 Jan Juc GMA: Permissible Consumptive Volume (PCV) and Licenced Groundwater Use

3.6.1 PCV

Both the UEVF and LEVF aquifer systems are managed under the Jan Juc Groundwater Management Area (GMA) (refer Figure 3-3).

The Permissible Consumptive Volume (PCV) for the Jan Juc GMA is currently set by DELWP, 2009 at:

- Zone 1: All Formations: 250 ML/year.
- Zone 2: UEVF: 4,000 ML/year.
- Zone 2: LEVF 35,000 ML total in any 5-year period (i.e. 7,000 ML/year average).
- Zone 2: All formations other than LEVF and UEVF: 0 ML.

3.6.2 Licenced Groundwater Volume and Use

Within the GMA the current licenced groundwater volume is 11,250 ML/year, consisting of the following licences:

- Alcoa: 4,000 ML/year from the UEVF aquifer (historical licence subject to amendment by SRW based on current investigations).
- Barwon Water: 7,000 ML/year from the LEVF aquifer
- Moriac Quarry: 250 ML/year from the LEVF aquifer

Timeseries charts of groundwater usage for Alcoa and Barwon Water bores are presented in Appendix B.

Alcoa ceased extraction from the UEVF aquifer for the mine dewatering and cooling tower supply in March 2016. Following this there was some short-term testing at bore WB16 in mid-2020, and then a 6-month test at WB16 from May 2021 to December 2021 at a rate of approximately 3.5 ML/day.

Barwon water ceased extraction following a 6-month pumping test in early June 2012. Barwon Water then recommenced extraction in late 2019 to July 2020 from several of their southern borefield bores only. A pumping trial from both the northern and southern borefields was then commenced in late January 2022 and ceased in late July 2022. The Barwon Water pumping trial design and objectives were documented in GHD, 2020.

3.7 Groundwater Potentiometric Contours and Flow direction

3.7.1 UEVF Aquifer

The interpreted groundwater elevation contours (or potentiometric surface) in the UEVF aquifer in February 2022 is shown in Figure 3-5. Note that near the Alcoa mine this is based on bores screened in the UEVF Lower Sands aquifer.

The groundwater contours indicate that groundwater flow direction in the UEVF aquifer is generally towards the south and south-east in the Anglesea syncline, from the outcrop recharge area and towards the drawdown cone developed due to Alcoa groundwater extraction from bore WB16, and remnant drawdown from pumping pre-2016.

In the north, there is a component of groundwater flow towards the north-east along the Jan Juc Syncline.

Groundwater contours from the Boonah sands and UEVF upper sands are included in EHS, 2022a, with groundwater flow generally towards the mine void.

3.7.2 LEVF Aquifer

The interpreted groundwater elevation contours (or potentiometric surface) in the LEVF aquifer in February 2022 is shown in Figure 3-6.

The contours indicate that groundwater flow in the LEVF aquifer is towards the south-east in the Anglesea Syncline, and towards the drawdown cone developed around Barwon Water's extraction bores (which have been pumping discontinuously since late January 2022).

The groundwater contours are separated in the north-east due to the absence of the LEVF aquifer system over the Bells Beach anticline. In the Jan Juc Syncline groundwater flow is generally to the east when extraction is not occurring, however currently groundwater flow is largely towards Barwon Water's extraction bores GW7 and GW6, which again have been pumping intermittently since January 2022.

116458 (36.7)

NB2 (35.6)

P19 (31)

121768

115869 (16)

WB4 (-16)

WB14 (-13.6)

WB16 (-14.9)

WB12 (-16)

WB15 (-14)

116459 (7)

SB2 (-15.1)

P21

115868 (-18.3)

ANGLESEA

MARSHALL CREEK

ANGLESEA RIVER

SPRING CREEK

SALT CREEK

SALT CREEK

ANGLESEA RIVER

Great Ocean Rd

Hurst Dr

35

30

20

10

0

-10

-10

Legend

- UEVF Monitoring Bore
- Alcoa Production Bore (UEVF)
- UEVF interpreted groundwater contour (mAHD)
- Groundwater flow direction
- Alcoa Mine
- Arterial
- Collector
- Tracks
- Watercourse
- Swamp
- River
- Stream
- Channel
- Drain/ Channel/ Other

Geology

- Alluvials
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View

Paper Size ISO A3

0 0.25 0.5 0.75 1

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Barwon Water
Anglesea Groundwater Model Update

UEVF Aquifer - 13 February 2022
Interpreted Groundwater Contour

Project No. 12532099
Revision No. 0
Date 09/01/2023

FIGURE 3.5

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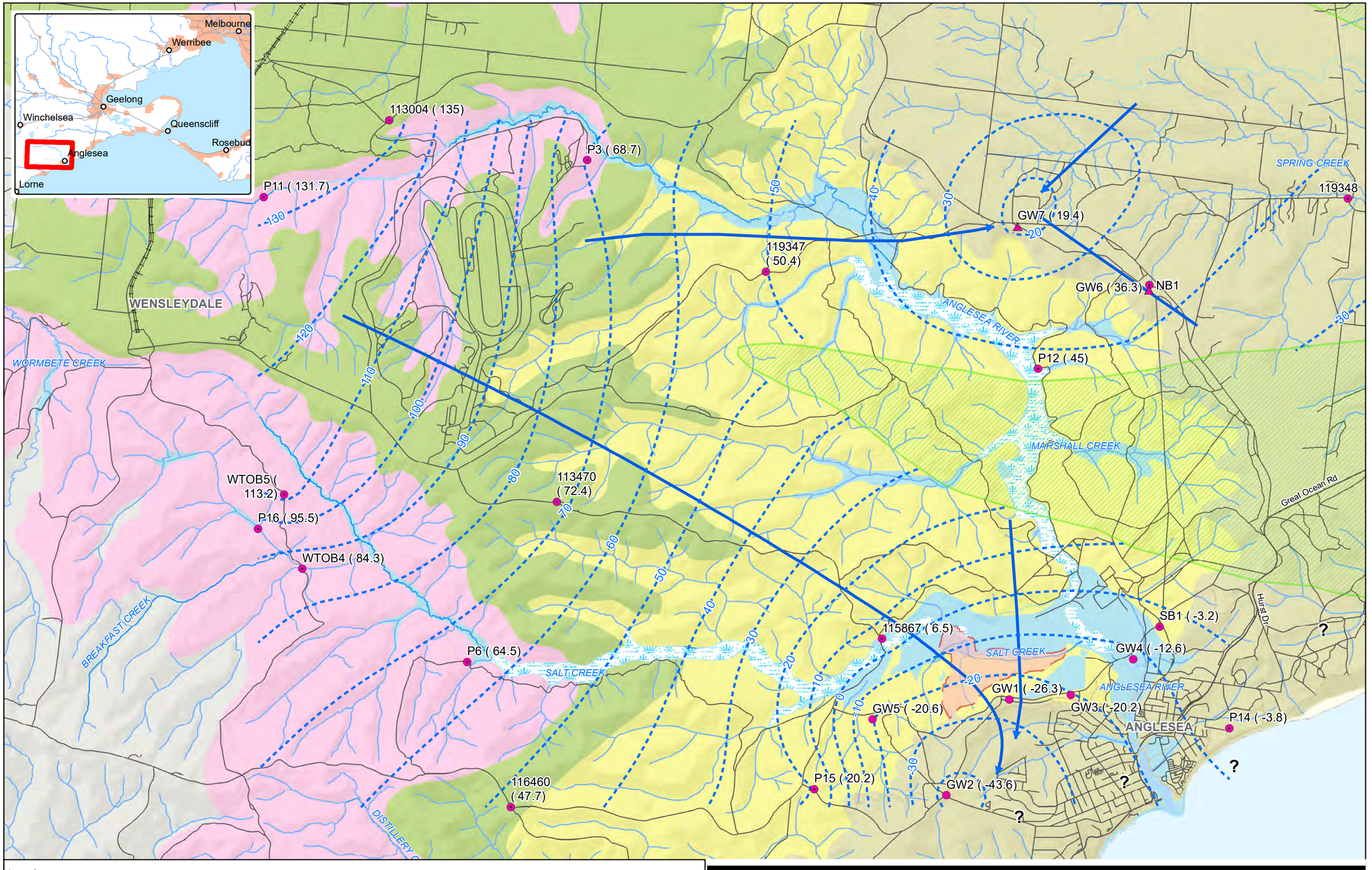
Print date: 09 Jan 2023 - 10:59

Data source: DELWP, VicMap, 2020; GHD, groundwater contour, 2022; Alcoa, GW level data, 2021; BW, groundwater level data, 2022; GHD, Alcoa Pit extent from BW LiDAR, 2012; GHD, interpreted outcrop geology, 2012; . Created by: bsmyth



Legend

- LEVF Monitoring Bore
- Southern borefield
- Northern borefield
- LEVF interpreted groundwater contour (mAHD)
- Groundwater flow direction
- LEVF absent
- Alcoa Mine
- Geology
- Alluvials
- Bedrock
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View
- Arterial
- Collector
- Tracks
- Watercourse
- Lake
- Swamp
- River
- Stream
- Channel
- Drain/ Channel/ Other

Paper Size ISO A3

0 0.5 1 1.5 2 Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Barwon Water
Anglesea Groundwater Model Update

LEVF Aquifer - 13 February 2022
Interpreted Groundwater Contour

Project No. 12532099
Revision No. 0
Date 09/01/2023

FIGURE 3.6

G:\31\12542999\GIS\Maps\Working\31_12542999_04_LEVF_GWcontourFeb22_A3L_Rev0.mxd
Print date: 09 Jan 2023 - 11:01

Data source: DELWP, VicMap, 2020; GHD, groundwater contour, 2021; Alcoa, GW level data, 2021; BW, groundwater level data, 2021; GHD, interpreted outcrop geology, 2012; GHD, LEVF absent region, 2016; .
Created by: bsmyth

3.8 Vertical Hydraulic Gradients

In general, there is an upwards gradient from the LEVF to the UEVF aquifer system. In the Anglesea Syncline the upwards gradient had historically been enhanced by the drawdown in the UEVF caused by Alcoa's long-term extraction. Although Alcoa has ceased full scale extraction and UEVF levels have recovered significantly, there is still an upwards gradient in the lower end of the syncline (refer Figure 3-7).

Figure 3-8 shows post January 2020 data, when Barwon Water started extraction. This shows the vertical gradient was reversed to downwards for a short period of around 6 months. Subsequently, when Barwon Water ceased extraction the vertical hydraulic gradient returned to an upward gradient, which increased in magnitude once Alcoa started the 2021 pumping test from GW16. Ongoing monitoring in 2022 showed the vertical gradient reversed again to downwards near the end of Barwon Water's pumping trial.

In the Jan Juc Syncline, there is also generally an upwards gradient from the LEVF aquifer to the UEVF aquifer (refer Figure 3-9), with the LEVF aquifer being artesian in the Anglesea River valley (refer Figure 3-10, which includes P18 in the ASA). It is noted that when Barwon Water undertook extraction from the LEVF over the 6-month trial in 2012 the LEVF head was drawn below the UEVF head, reversing the vertical hydraulic gradient.

The head difference and the interaction between the LEVF and the UEVF with the ASA aquifer (and GDEs) is described further in Section 3.10.

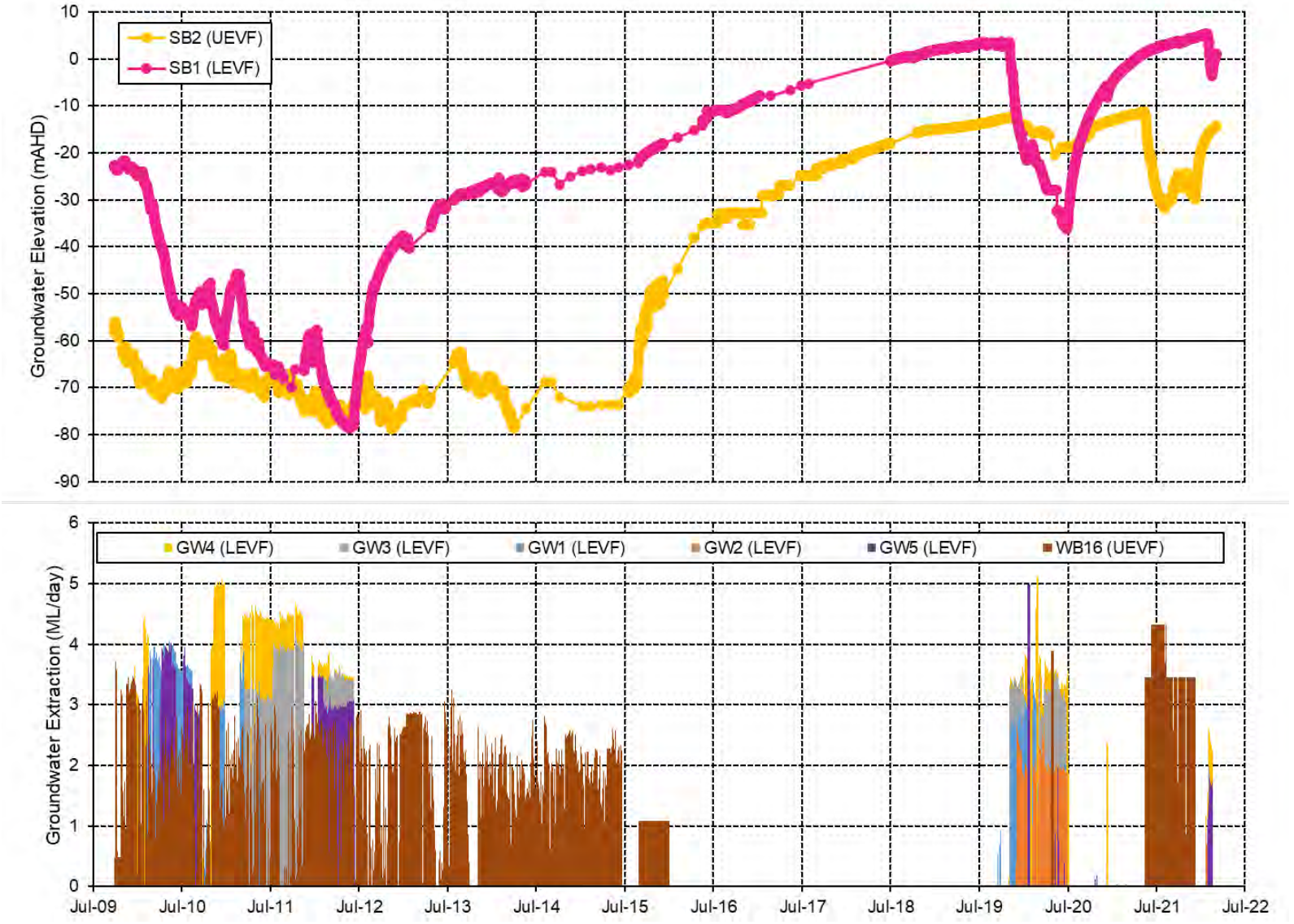


Figure 3-7 ***Southern Syncline: Nested Bores SB1 (LEVF) and SB2 (UEVF) (2010-2022)***

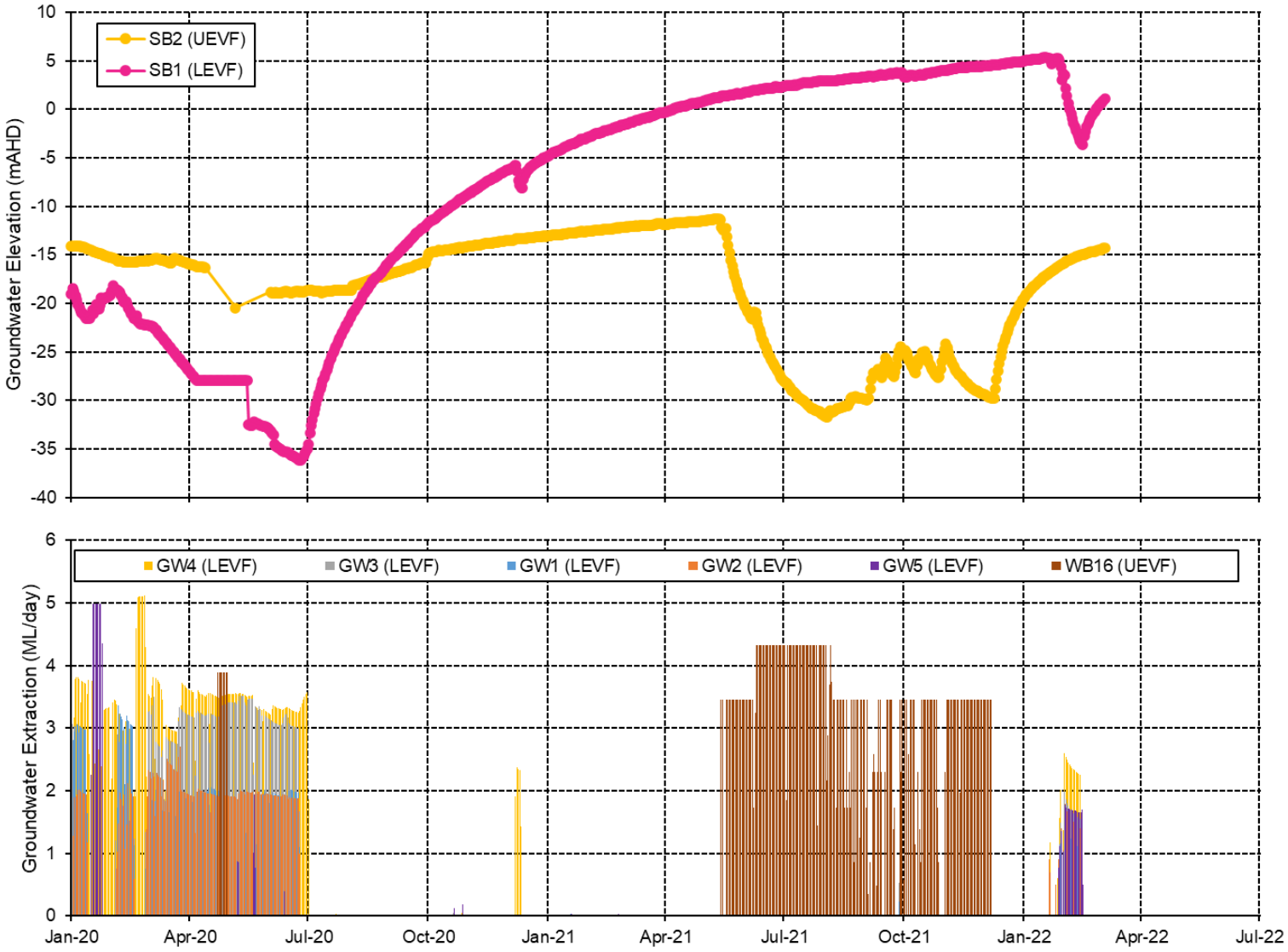


Figure 3-8 ***Southern Syncline: Nested Bores SB1 (LEVF) and SB2 (UEVF) (2020-2022)***

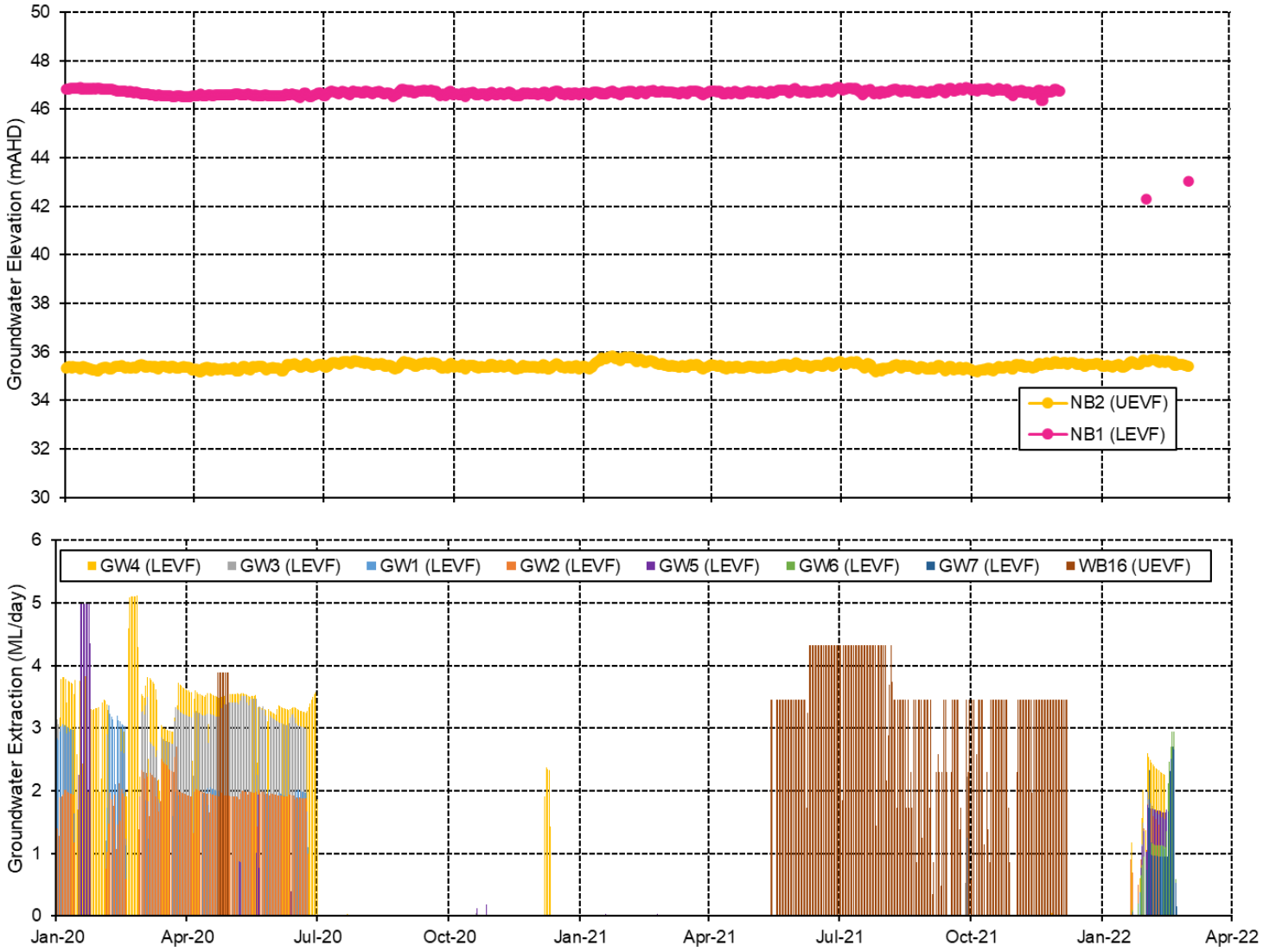


Figure 3-9 ***Northern Syncline: Nested Bores NB1 (LEVF) and NB2 (UEVF) (2020-2022)***

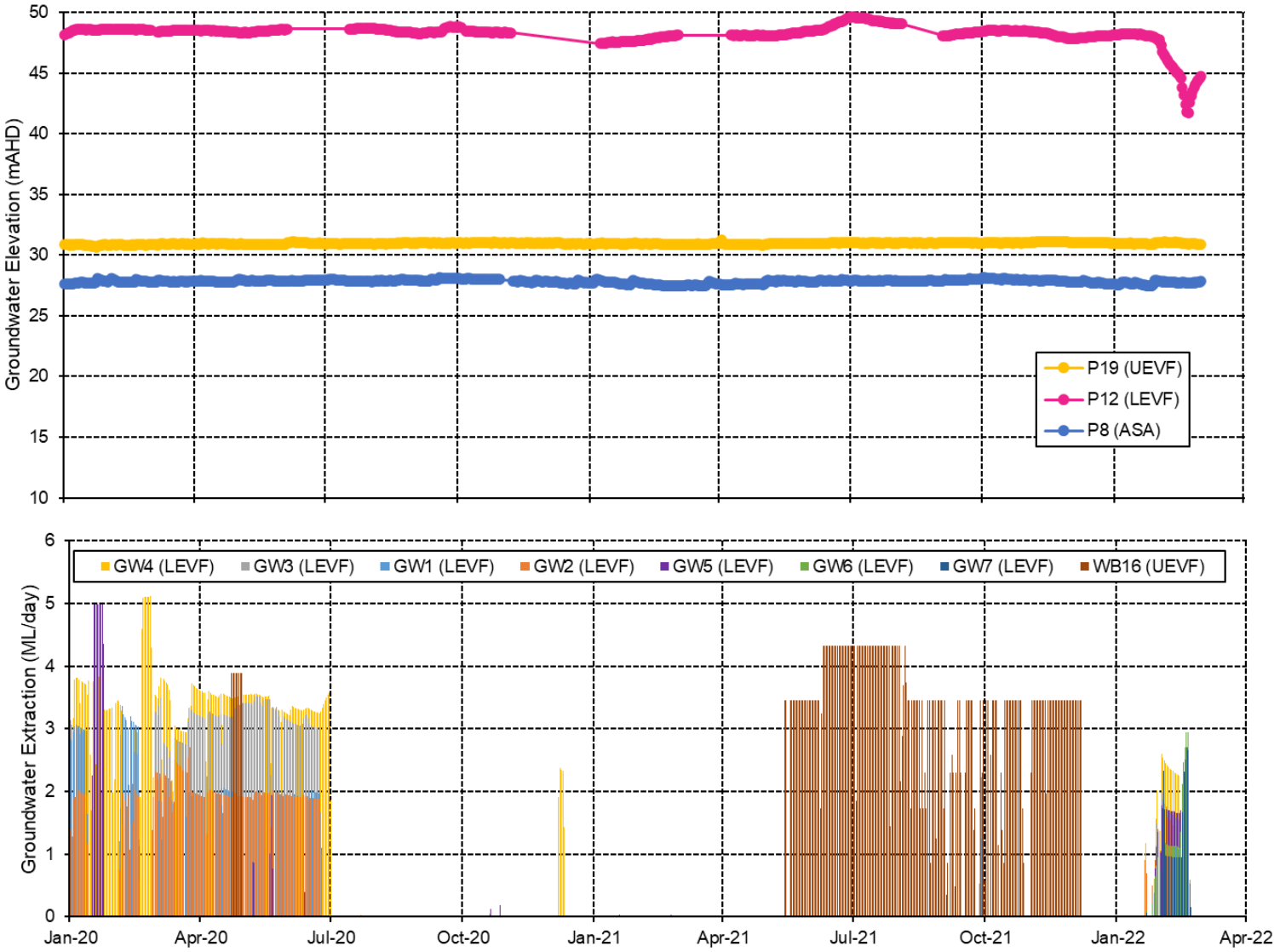


Figure 3-10 Nouthern Syncline: Nested Bores P8 (ASA), P19 (UEVF) and P12 (LEVF)

3.9 Inter-aquifer connection

The degree of interaction between the UEVF and LEVF will be driven by the groundwater gradient and the hydraulic conductivity and thickness of the MEVF aquitard separating the aquifer systems. Similarly, movement between individual aquifer layers (i.e., UEVF Upper sands and UEVF Lower sands) within the same main aquifer system will depend on vertical head gradients, aquitard permeability and thickness.

It is noted that the long- term average calibrated model water balance (1969-2012) for the LEVF aquifer completed in 2013 (GHD, 2013a), indicates that the inter-aquifer flow into the LEVF and out of the LEVF aquifer was broadly equal.

Previous groundwater modelling (GHD, 2013a) indicated that under the scenario of Barwon Water abstraction from the LEVF (i.e., 7,000 ML/year over a 43 year period), additional groundwater is predicted to be drawn into the LEVF from the UEVF aquifer though the MEVF aquitard, and ultimately from the overlying ASA aquifer in certain areas. For context, predicted drawdown cones from the 2013 model, under the median climate scenario, associated with abstraction from the LEVF are shown in Figure 3-11. This figure shows the greatest drawdown in the ASA, associated with Barwon Water extraction of 7,000 ML/year continuously after 5 years, is in the area of the upper Anglesea Swampland, where subsequently trigger levels were established to ensure any drawdown impact was identified and appropriate measures taken to prevent impacts of GDE's (refer Section 3.10.2.1 for further detail).

It is also noted that prior to July 2020, a number of Alcoa UEVF monitoring bores (WB4, WB5, WB12, WB14 and WB15) show a minor but distinct response to Barwon Water extraction from the LEVF aquifer. This response was reviewed and discussed with Alcoa and inter-aquifer connection was concluded to likely be related to a number of Alcoa bores which intersected the MEVF aquitard and potentially the LEVF aquifer (i.e. WB9, WB10). A number of these Alcoa bores have since been decommissioned (WB5, WB9, WB10, WB13, WB17) to further minimise interaction. At the time of writing, no response has been observed in the groundwater levels at the remaining Alcoa observation bores associated with Barwon Water's LEVF extraction, which commenced in January 2022, indicating the decommissioning works have reduced the degree of interaction between these aquifers at this location.

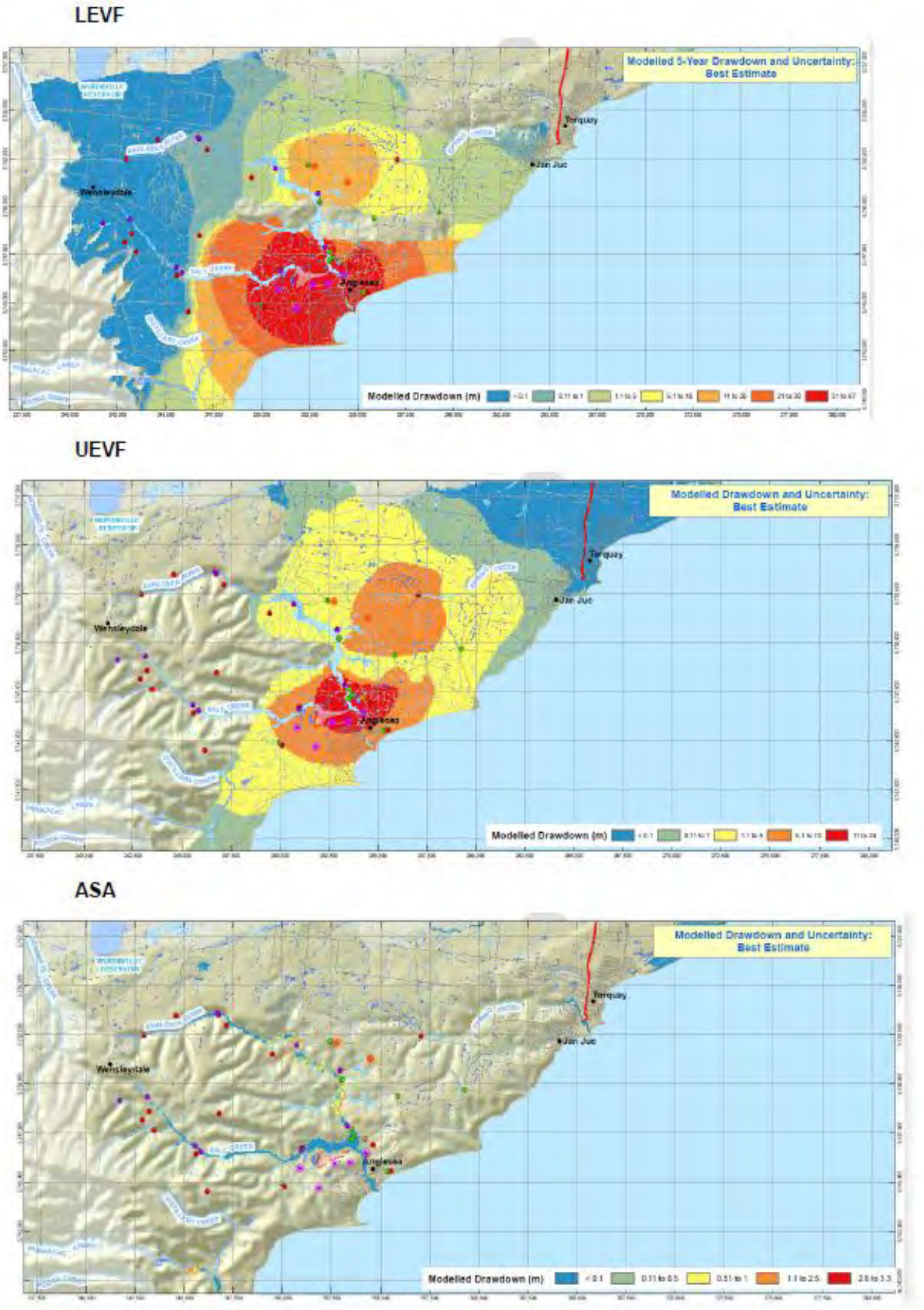


Figure 3-11 Modelled 5 -year drawdown in ASA, UEVF and LEVF associated with Barwon Waters LEVF Extraction (7,000 ML/year)

3.10 Groundwater-Surface Water Interaction and Groundwater Dependent Ecosystems

In general, discharge from some aquifer systems can provide baseflow to surface water features such as swamps, lakes and rivers and support Groundwater Dependent Ecosystems (GDE's) such as terrestrial flora and fauna (for example riverside vegetation and frogs), and aquatic ecosystems (for example, macro-invertebrates).

In the Anglesea region, groundwater and surface water level and flow data was reviewed and incorporated into the BE Review Numerical Model (GHD, 2013a) and groundwater-surface water interaction was modelled (refer Figure 3-12). This generally shows that the lower end of the Salt Creek and Anglesea River catchments are potentially losing in average climate conditions over the 1969-2012 model calibration period, while in the upper reaches the catchments are potentially gaining, however this relationship is a snap shot in time and dependent on interaction of the shallow ASA with underlying aquifers, and will vary spatially and temporally depending on climatic conditions and groundwater extraction in the region (as noted in Section 3.3.2).

In the Salt Creek and Anglesea River catchments, there are three key natural features which are supported by local groundwater discharge to the ASA aquifer, being:

- Anglesea Swampland
- Salt Creek Swampland.
- Breakfast Creek Tributary.

Drawdown in the aquifers supporting these features may impact the GDE heath and therefore need to be monitored and managed. Barwon Water has installed an extensive network of groundwater monitoring bores and surface flow and level gauges to improve the understanding of groundwater-surface water interaction at these GDE's and our current conceptualisation of these features (GHD, 2013a, and EHS, 2022a) is discussed below.

In addition, the mine void is an area that is gaining groundwater due to seepage from the UEVF aquifer and the Boonah and DBF aquifers; this is discussed later in this section.

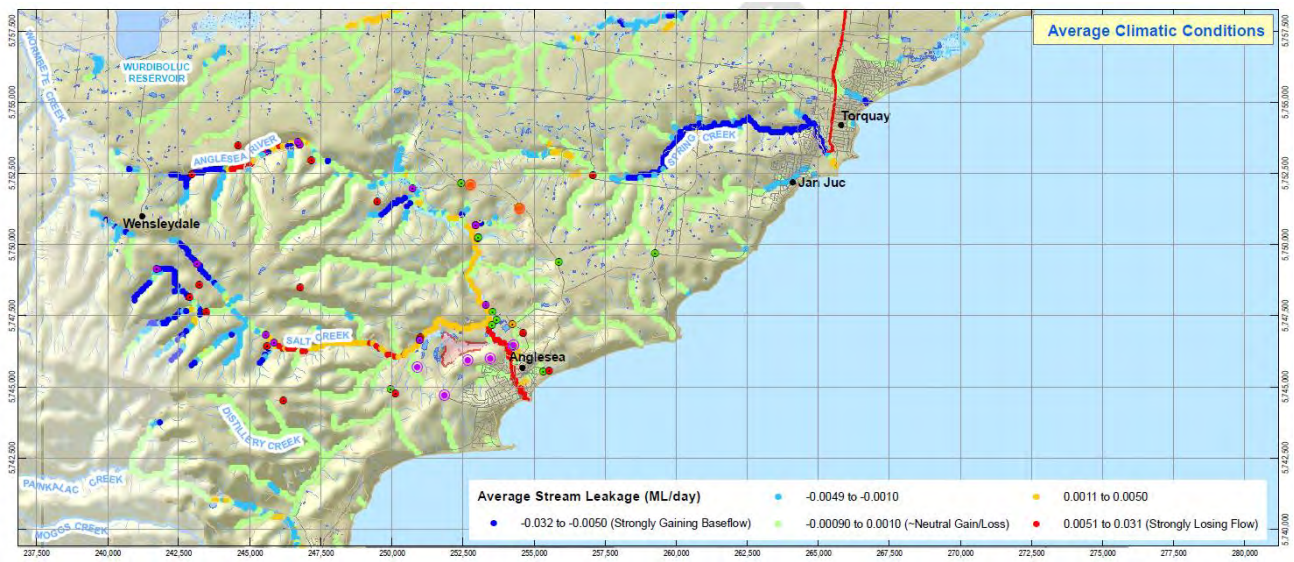


Figure 3-12 Modelled Stream –Aquifer Interaction (GHD, 2013a)

3.10.1 Anglesea and Salt Creek Swamplands

3.10.1.1 General

As noted previously, the swamplands at the lower reaches of each catchment are supported by the shallow water table aquifer formed in the permeable alluvial sediments deposited along the creek valley. The water table aquifer acts like a sponge which is predominately refilled by rainfall and runoff and, to a lesser degree, baseflow from the underlying aquifer system (i.e., the UEVF). The magnitude of the baseflow component (or discharge losses) is dependent on the level of connection with the underlying aquifers, which is dependent on vertical hydraulic gradient and the thickness and conductivity of intervening aquitards (i.e., coals and clays; refer Figure 3-23). The water table rises and falls over the year as recharge and evapotranspiration occurs.

Surface flows into the swampland are attenuated by storage in the ASA, and surface water outflow only occurs from the lower end of the swamplands when the aquifer system is at full capacity. In the Anglesea River Swamp, although flow is ephemeral, there are several wetlands that appear to be near perennial.

The Anglesea River Swamp overlies both the Anglesea Syncline and Jan Juc Syncline geological structures (refer Figure 3-1). In this report the northern section of the swamp overlying the Jan Juc Syncline has been described as the *upper Anglesea River Swampland*, and the southern section overlying the Anglesea Syncline has been described as the l*ower Anglesea River Swampland* (refer Figure 3-1).

The Salt Creek Swamp overlies the Anglesea Syncline. There is a smaller swamp located in the upper reaches of the Salt Creek catchment, above the confluence of Breakfast Creek, and this has been referred to as the Upper Salt Creek Swamp.

As noted in Section 3.1.2 the Anglesea River and Salt Creek are ephemeral and no surface water flows occur on average 50% and 68% of the time at the downstream gauges of the catchments, which also reflects the flow attenuating capacity of the swamps.

3.10.1.2 Acid Generation

As detailed in Section 3.4.2, groundwater salinity in the ASA varies across the catchments being around 2,000 mg/L TDS at the lower end of the Anglesea Swampland and around 600 mg/L TDS at the lower end of the Salt Creek Catchment and the groundwater pH is as low as 3.5 in the Anglesea catchment.

During large first flush events of the swamps (i.e., after a period of no flow, wet periods fill the ASA storages and flow is seen at the lower ends of the swamp), significant volumes of acidic water can be flushed into the estuary which may cause low pH, metals precipitation and, in some cases, fish kills (GHD, 2013a). As noted in Section 3.1.3, the surface water acidity at the lower end of the catchments commonly has a pH <4, since monitoring began in 1969.

The conceptualisation of acid generation in the catchments (GHD, 2013a) is that the source of acidity in the catchments is naturally occurring sulphides (pyrites) present within the main swamps and possibly coal and other pyritic sediments in the upstream catchments. It is conceptualised that as the water table rises and falls over the year, the pyritic sediments and coals are subjected to wetting and drying cycles, which oxidise the sediments and causes acid generation within the swamplands. The acid is released from the swamp when there is a major rainfall event or consistent rainfall, which fills the water table aquifer in the swamp and flushes the stored acid (and dissolved metals and salts) from the downstream end of the swamp and into the Estuary, which may result in fish kill events. The low pH water may also mobilise additional metals from the catchment (i.e., aluminium) which also may contribute to the fish kills (refer Pope, 2010). GHD (2013a) also reviewed historical fish kill events, and concluded that there were two key processes required to result in a fish kill event associated with an acid flush event:

- The duration between flushing events in the Salt Creek Swamp needs to have been long enough to generate significant acid and metals storage in the ASA.
- The first flush of Salt Creek Swamps needs to be of sufficient volume to affect the estuary (i.e., a small flush volume would be diluted within the estuary).

It was concluded that fish kill events may potentially occur when Salt Creek has had no significant outflow (i.e., >1 ML/day) for longer than 15 months, which is then followed by a first flush event of greater than 4-5 ML/day (GHD,2013a).

This acid generation conceptualisation in GHD (2013a) was based on limited data however has subsequently been confirmed by studies completed by Monash University (2020), which completed an investigation of the acid sulphate soils throughout the Salt Creek and Anglesea catchments and found both Salt Creek and Marshy Creek (i.e., Anglesea River) contain substantial volumes of acidity in a form that can be mobilised rapidly. Marshy Creek contains higher concentrations of labile acidity which can be transported readily in surface water and groundwater, whereas Salt Creek contains higher concentrations of retained acidity which can be slowly released over time. Both catchments were assessed as significant acidification, metal mobilisation and monosulfide formation hazards.

Further updated detail on the conceptual model of acid generation is included in EHS (2022a), and this latest data review suggests that significant low pH conditions from the catchments occur when the no flow period approximately exceeds 180 days and the magnitude of first flush flows is >5 ML/day (AV2 gauge).

With respect to assessment of potential acid generation impacts within the swamplands, two key hydrologic responses that have the potential to increase the rate and extent of acid generation and export are thought to exist:

- The lowering (drawdown) of groundwater levels (and frequency) in the swampland that may increase the exposure of PASS sediments, to oxygen, where present.
- Longer cease-to to-flow periods, where there will be a longer period with no export or dilution of any acid stored in the system and potentially more acid could also be generated by dryer conditions and greater groundwater level fluctuations promoting further oxidation of PASS, where present.

The numerical modelling of hydrologic impacts as outlined in Section 2.2.1 is proposed for initial assessment of impacts on acid generation. Based on these results, and considering the risk of significant impacts, then further geochemical assessment may be required, using sperate geochemical models.

It is also noted that another source of water inflow to the Estuary up until 2016 was treated process water from Alcoa. The cessation of this continual process water flow (around 2.9ML/day at pH ~8) has resulted in lower surface water levels in the estuary, a lower pH and changing ecosystem communities. These changes are detailed further in Section 3.11.

3.10.2 Anglesea Swamplands Hydrogeological Conceptualisation: Interaction with Underlying Aquifers

As noted previously, the Anglesea Swampland hydrogeological conceptualisation (GHD, 2013a) has been split into two main areas; the upper Anglesea Swampland overlying the Jan Juc Syncline and the lower Anglesea River Swampland overlying the Anglesea Syncline (refer Figure 3-1). These conceptualisations focus on specific catchment areas where data is available (i.e., nested bore sites). As described in greater detail in Section 3.3.2, the magnitude and direction of interaction between the ASA and underlying aquifers across the catchments will be dependent on:

- The level of connection with the underlying aquifers, which is dependent on vertical hydraulic gradient and the thickness and conductivity of intervening aquitards. These factors will vary across the Salt Creek and Anglesea River catchments, and therefore the ASA will be potentially gaining in some areas and potentially losing in others.
- Climatic conditions, and mining and groundwater abstraction activities (such as Alcoa's and Barwon waters abstraction) in different catchment areas. This will variably affect the nature of interaction between the ASA and underlying aquifers not only in a spatial sense, but also (perhaps primarily) in a temporal sense.

Readers should therefore try to avoid the temptation to compartmentalise the behaviour of the ASA; its behaviour is complex and varies widely across different areas at different times. The next five sub-sections aim to provide a summary overview of the current understanding of the *typical* behaviour of the ASA in five specific areas (Upper and Lower Anglesea River, Lower Salt Creek, Upper salt Creek/ Breakfast Creek Tributary and around the Alcoa mine), from the available observation data.

3.10.2.1 Upper Anglesea River Swamplands

In the Jan Juc Syncline there is a significant upwards vertical hydraulic gradient from the LEVF towards the UEVF and the ASA (refer Figure 3-13, Figure 3-14 and the Figure 3-10 hydrograph). The MEVF aquitard will limit the connectivity between the UEVF and LEVF (its effectiveness reflected in the LEVF artesian head), and similarly clays at the base of the ASA will limit the connectivity between the UEVF and the ASA. However, the upward groundwater gradient suggests that there is potential for some baseflow from the UEVF to the ASA in this region.

As shown in Figure 3-11 previous modelling (under a proposed LEVF abstraction scenario) showed that over a 5-year period of continuous pumping at 7,000 ML/year, drawdown impacts in this area of the ASA aquifer may occur. Drawdown in the ASA aquifer may then potentially impact on the stream flows from the swamp, which may subsequently influence acid generation. Recognising this risk, a trigger level was developed in this area (Bore P19 and P8) as part of Barwon Water's BE. The trigger level is designed to minimise any drawdown in the ASA aquifer system, and therefore prevent potential impacts on the swampland GDE and potential subsequent downstream impacts. The trigger level response will be predicted under different modelled extraction scenarios using the updated model described in this report.

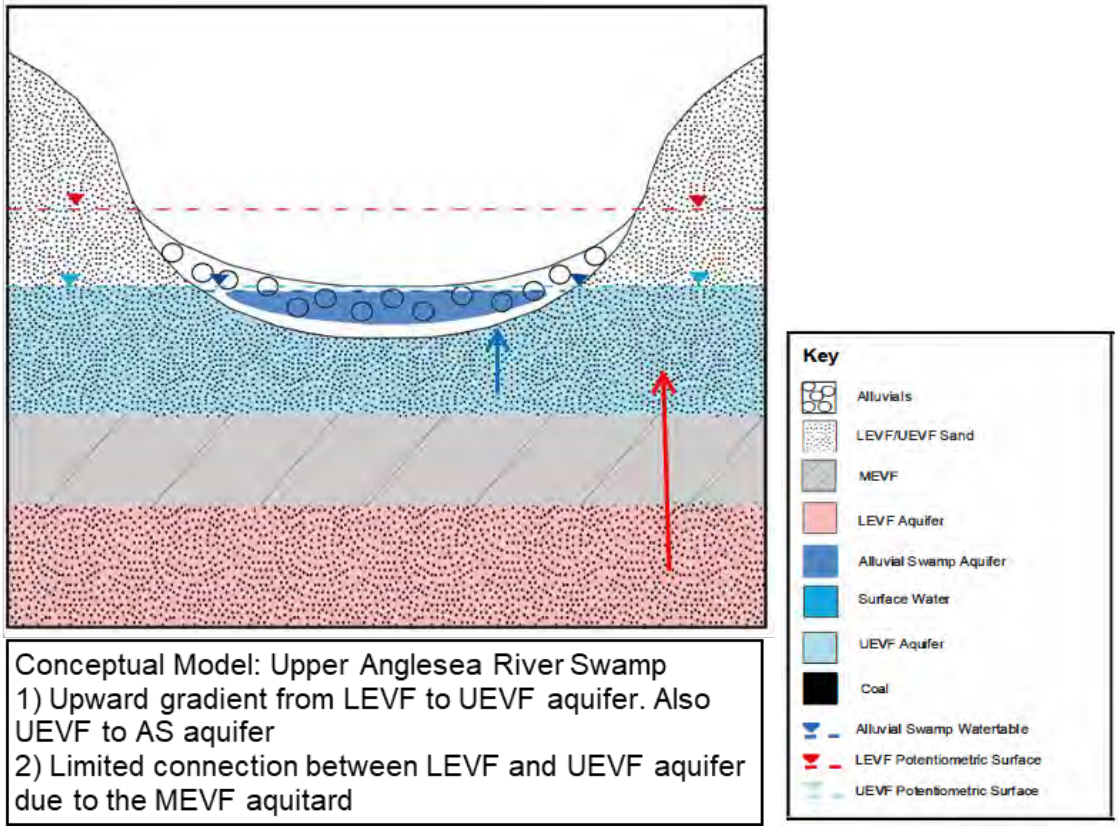


Figure 3-13 Conceptual Model: Upper Anglesea River Swamp (Jan Juc Syncline) (GHD, 2013a)

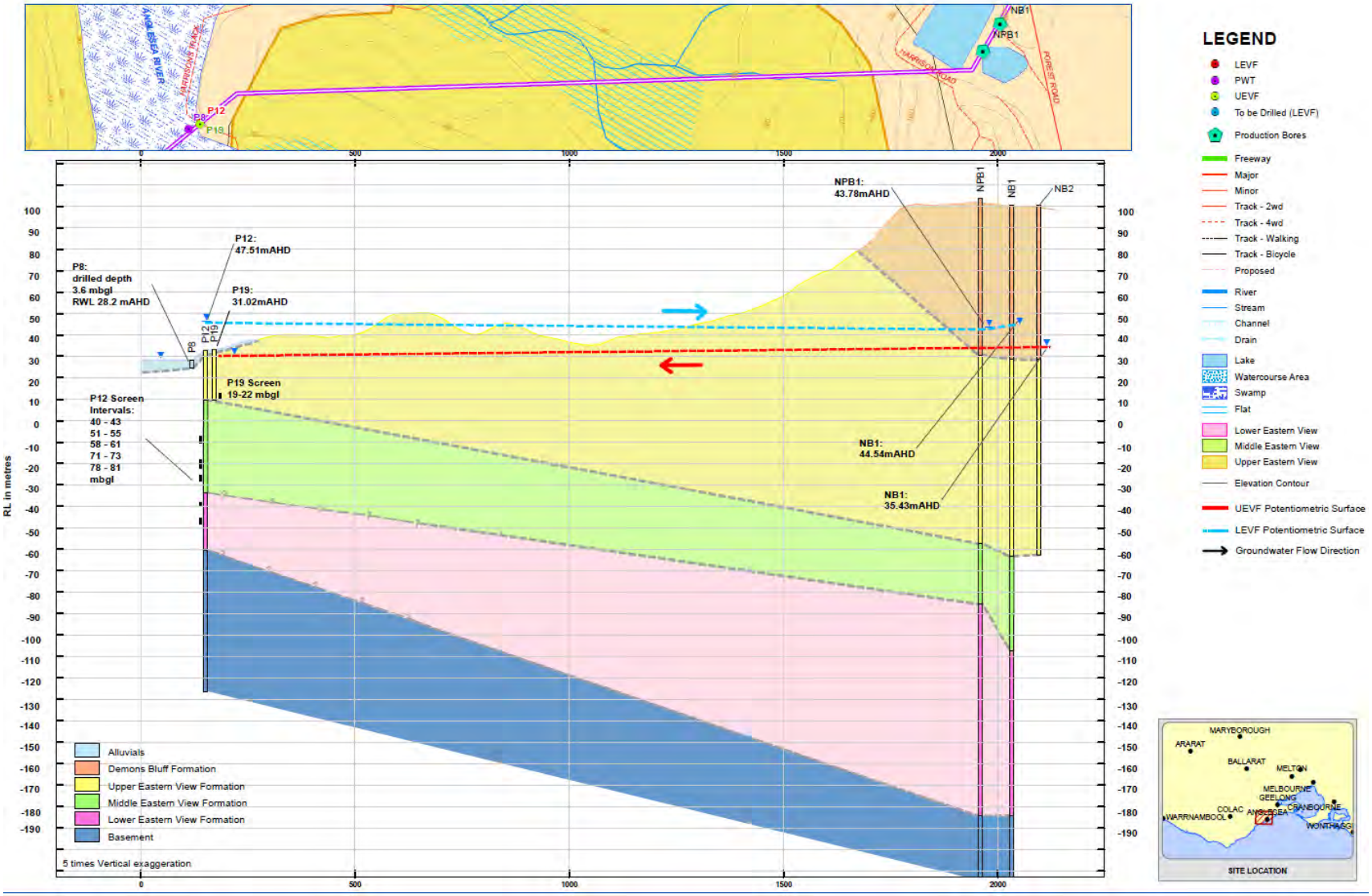


Figure 3-14 Cross Section: Trigger Bores to Barwon Water Northern Pump Bore (GHD, 2013a)

3.10.2.2 Lower Anglesea River Swamplands

The conceptualisation of groundwater interaction with the lower Anglesea River Swamp is shown in Figure 3-15. In this section of the swamp, the LEVF aquifer again commonly has higher heads than the UEVF aquifer and therefore there is an upwards gradient from LEVF to UEVF (although as noted in 3.8, this vertical gradient may reverse depending on whether Alcoa and/or Barwon Water are extracting).

The UEVF lower aquifer, has been drawn down due to the historical pumping from the former Power Station supply bores, and there is also a downward hydraulic gradient from the ASA to the UEVF. The head difference between WTOB2 (ASA) and WB4 (UEVF lower) was approximately 20m as shown in Figure 3-16 prior to the WB16 pumping test and was in the order of 60m while Alcoa was pumping (pre-2016). This downwards gradient is also noted from the ASA to the Boonah Formation aquifer, where saturated around the former power station (EHS, 2022a).

Therefore, as shown by the relative groundwater levels in Figure 3-16 over the last 13 years at least, the ASA aquifer, which supports the swamplands, is generally hydraulically separated from the underlying UEVF lower sands aquifer in the lower reaches adjacent the pit. (i.e. >20m head difference between 2009 and 2022). With the data available (2009-2022), there is no obvious evidence of desaturation of the ASA near the mine pit (in both Anglesea River and Salt Creek catchments), associated with pit dewatering and UEVF extraction, with groundwater levels in the ASA in bores WTOB1 and WTOB2 generally fluctuating between 0.5m and 6m below ground level. In addition, the swamp vegetation and associated ecology has persisted, indicating that the ASA has remained sufficiently saturated to support the vegetation over the long term (i.e. 40 years +) Alcoa operations, and that rainfall/rainfall runoff are the main recharge mechanism for the ASA. This cannot rule out the potential for a subtle influence on the frequency of wetting and drying of the swamplands and the water table depth associated with Alcoa operation. This is also discussed further in Section 4.5.8 and shown in Figure 4-13.

The downward vertical gradient suggests the potential for some diffuse leakage from the ASA towards underlying aquifers over time, however the low permeability coals and clays in the Anglesea Syncline provide an aquitard between the UEVF sands and the ASA in the lower reaches. There is also a degree of hydraulic separation between the ASA and the underlying Boonah Formation aquifer (which is saturated on the eastern side of the mine void) due to the DBF aquitard (refer EHS, 2022a). The interaction between these aquifer systems will vary over time, as potentiometric heads recovery in the UEVF aquifer, and other pumping scenarios occur.

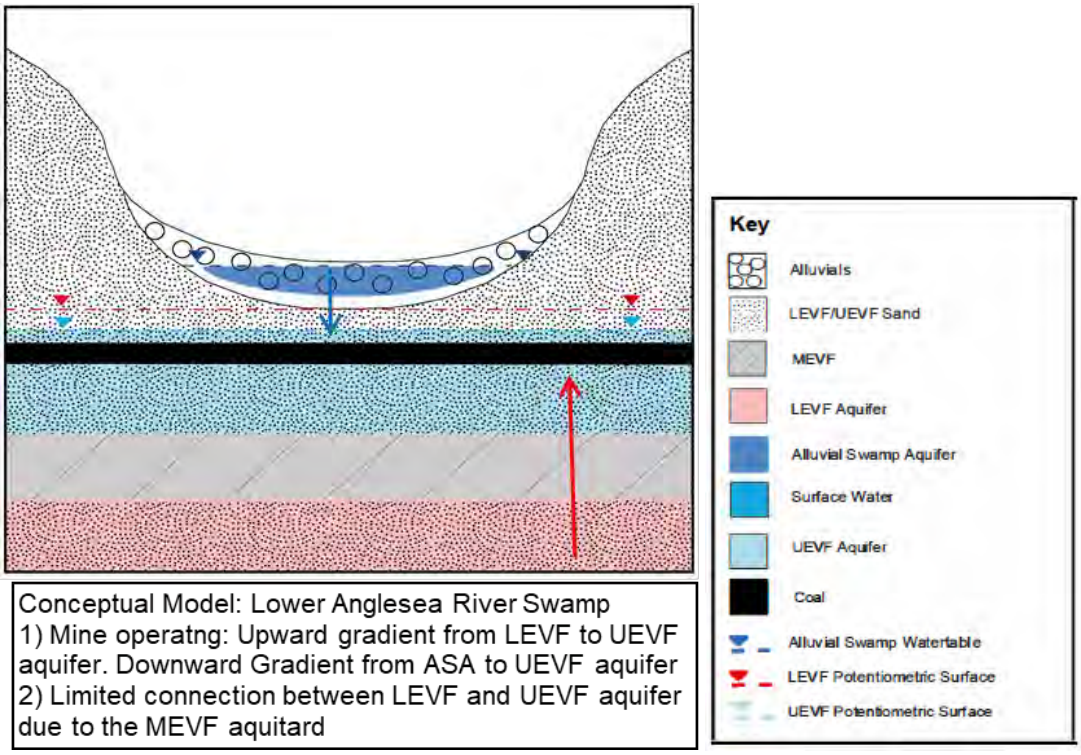


Figure 3-15 Conceptual Model: Lower Anglesea River Swamp (Anglesea Syncline) (GHD, 2013a)

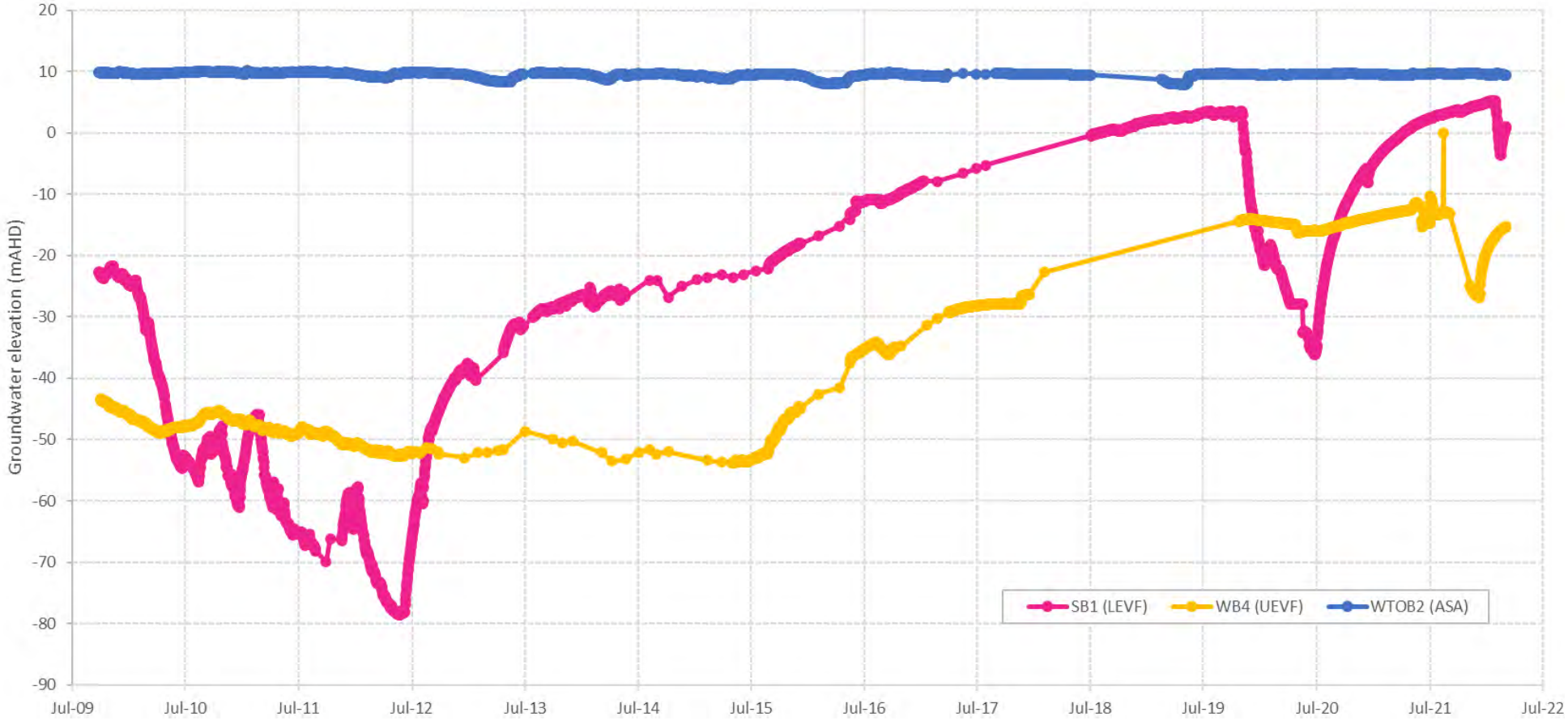


Figure 3-16 Lower Anglesea Swampland: WTOB2 (ASA,)WB4 (UEVF) & SB1 (LEVF) Nested Hydrograph

3.10.3 Salt Creek Swamp (Anglesea Syncline): Interaction with Underlying Aquifers

The Salt Creek Swamp has a similar conceptualisation to the lower Anglesea Swamp (Figure 3-15), with the ASA in the lower section near the mine being generally hydraulically separated from the UEVF lower sands due to long-term drawdown in the UEVF aquifer by the Power Station supply bores and numerous aquitard layers. Like the Anglesea River Swamplands, there is no obvious evidence of desaturation of the ASA in Salt Creek near the mine pit (i.e., bore WTOB1), and the swamp vegetation and associated ecology has persisted throughout the long-term Alcoa operations.

Further upstream where the UEVF drawdown cone is less, there is still an upwards gradient from the UEVF lower sands to the ASA. However, the low permeability coals and clays of the UEVF intermediate unit provide a sequence of aquitards separating the UEVF aquifer from the ASA aquifer in the lower swamp area. The numerical model will be used to provide a further assessment of potential long-term impacts on the ASA, as the drawdown cone and the groundwater gradients stabilise between aquifers over the various long-term pumping scenarios and in combination with on-going recovery in the UEVF aquifer.

3.10.4 Breakfast Creek Tributary

The hydrogeological conceptualisation of interaction in the Breakfast Creek Tributary is shown in Figure 3-17. This tributary overlies the LEVF outcrop area and has near perennial flow. Monitoring site SV3 shows gaining and losing conditions during different periods throughout the year. During the drier summer periods, the tributary at this site generally becomes losing (GHD, 2013a).

The extent of the gaining and losing stretch of the tributary will vary over the year, depending on climatic conditions. Upstream of this monitoring location it can generally be concluded that the tributary continues to receive groundwater baseflow over longer periods during the dry months, which is reflected in the near-perennial flows recorded at the SV3 site. As recorded in March 2010, in occasional dry conditions the tributary ceases to flow at this point as the gaining sections of the creek either retract much further upstream and/or baseflow to the creek ceases altogether.

This tributary supports a pygmy perch population in the Salt Creek catchment, which is an important GDE which requires protection. Modelling of Barwon Water's abstraction from the LEVF (GHD, 2013a) forecast that the drawdown cone would not extend to this location under long-term abstraction and therefore the risk of impacting the GDE was assessed as being moderate.

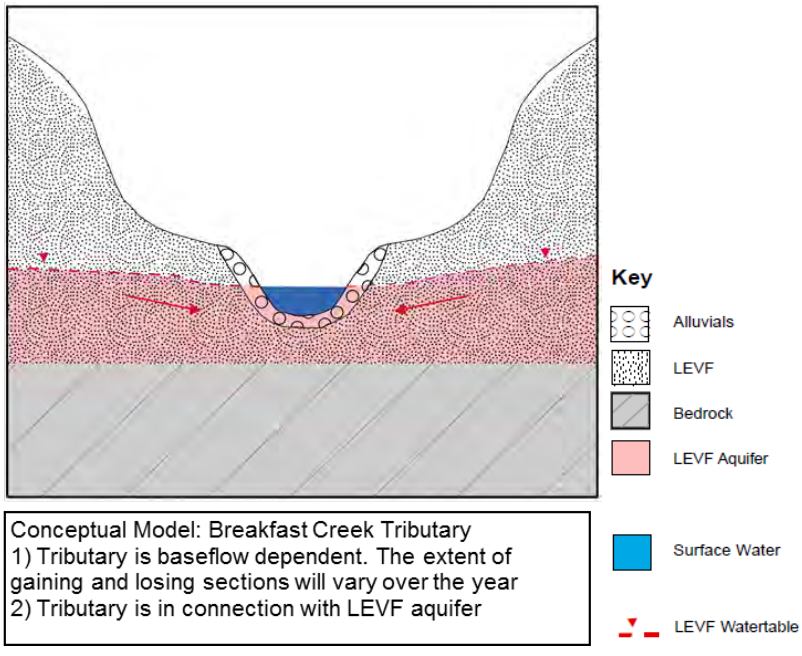


Figure 3-17 Conceptual Model at Breakfast Creek Tributary

3.10.5 Mine Void

In 2020/21, Alcoa installed 16 bores at 8 nested bore sites around the mine void to gather additional information regarding the geology around the pit and groundwater levels in the DBF aquitard, Boonah Sands aquifer and the UEVF Upper sands aquifer. The mine void conceptualisation is shown in Figure 3-19 (EHS, 2022a), including the local lithological units and groundwater levels in the shallow aquifer systems. The information shown in this figure, and the current conceptual understanding of surface water and groundwater interaction around the mine void is summarised below:

- The mine void acts as a groundwater sink to the unconfined Boonah Formation aquifer (EHS, 2022a). Figure 3-18 shows the Boonah Formation aquifer is still saturated on the eastern side of the mine void around the former power station with a groundwater gradient towards the mine. On the western side of the mine the Boonah Formation is unsaturated.
- A discontinous artificial perched water table exists in the DBF sediment underlying the former Power Station (EHS, 2022a).
- The groundwater level in bore UEVF MB07 screened in the UEVF Upper Sands aquifer is slightly lower than the surface water level in the void. This indicates currently there is a downwards vertical gradient towards this bore, although there is expected to be a degree of hydraulic separation from the mine void due to the presence of the basal clay at the base of the pit. The low salinity in this bore ~100 mg/L TDS) suggests the bore is not influenced by the pit surface water level (EHS, 2022a). It is noted that other bores in the UEVF Upper Sands aquifer (i.e., UEVF MB2, MB3 and MB4) have potentiometric heads higher than the surface water in the mine void. Groundwater levels in the UEVF Upper Sands aquifer are likely to be impacted currently by several processes including local recharge, recovery of heads in the UEVF Lower Sands aquifer and the intermediate aquitard following Alcoa ceasing operation, as well as potential leakage to or from the mine void. EHS (2022a) noted that groundwater levels in the UEVF Upper Sands aquifer are generally rising at a similar rate of 0.02 m/month and were not impact by pumping from WB16.
- The potentiometric head in the UEVF intermediate coal (bore UEVF MB8) was approximately 20-25m higher than the UEVF Upper Sands aquifer and the pit surface water level indicating there is an upwards hydraulic gradient from these deeper units towards the shallower aquifer systems and the pit void.
- The development of catchment drains diverts local surface water into the mine void. At times the amount of water these drains can add to the void is significant (EHS, 2022a)
- A water balance for the mine void has been estimated by EHS (2022a). The groundwater baseflow component entering the mine void was estimated at approximately 0.46 to 1.4 ML/day (170-520 ML/year).

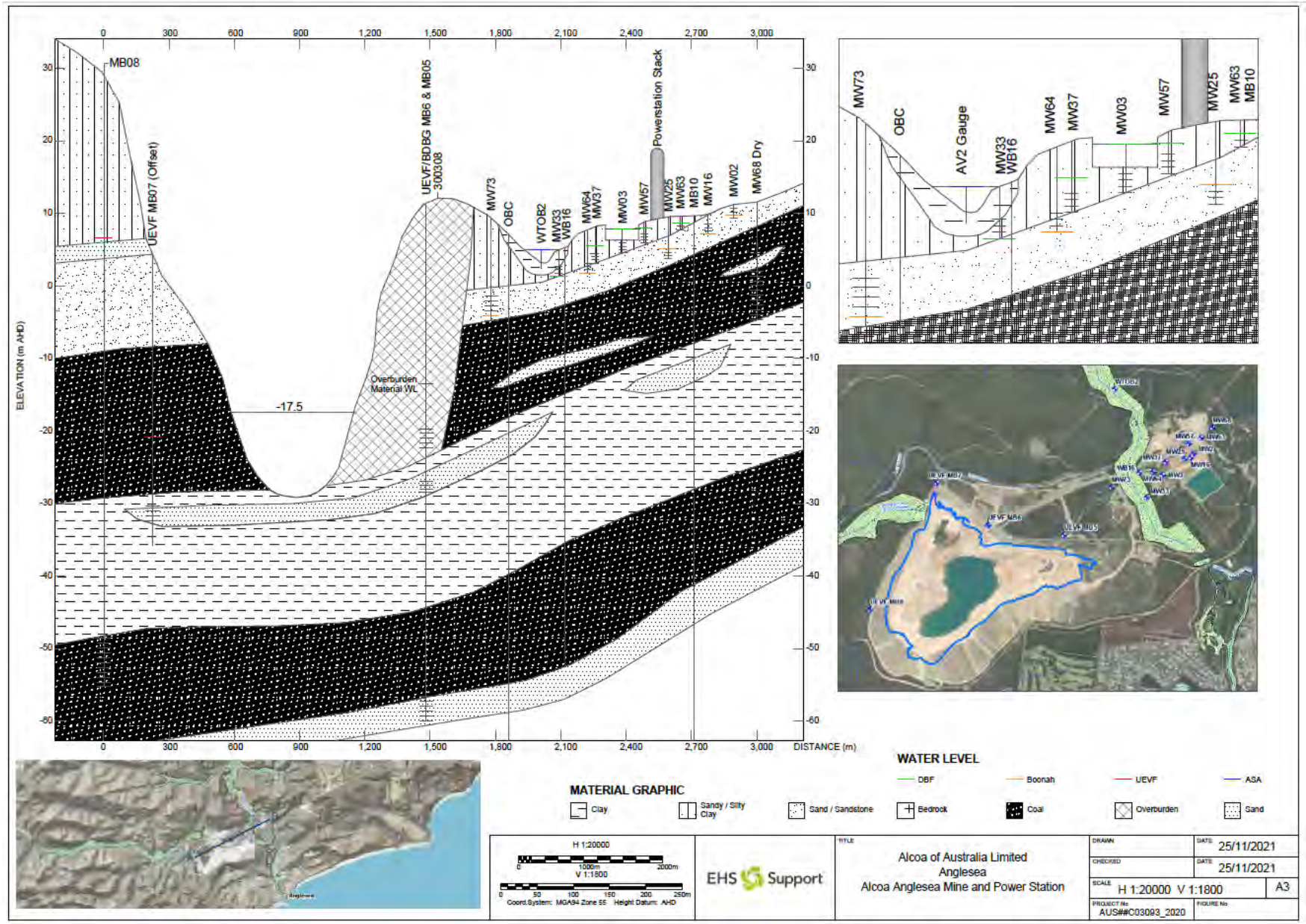


Figure 3-18 Mine Void Conceptualisation (Source EHS, 2022a)

3.11 Estuary Inflow

Historically, groundwater extracted from the UEVF production bores by Alcoa was used for process water and cooling water for the power station. The surplus (treated) process water was discharged to the lower Anglesea River and estuary under an EPA licence.

The estuary conditions have changed since 2016, primarily due to Alcoa ceasing to provide this consistent surface water flow into the estuary, in the order of 4 ML/day, from the power station.

Natural flows from the Anglesea Catchment are intermittent, and generally less than 50% of the time, and when flows occur the average is in the order of 2.9 ML/day (refer Table 3-1). During winter, when the estuary is relatively high, surface water is extracted from the estuary by Barwon Water, on behalf of DELWP, and stored in the former ash ponds adjacent the former power station. Barwon Water has an extraction licence for 126 ML/year. Stored water is then discharged back to the head of the estuary over the dry period to maintain water levels as directed by DELWP. GHD, 2021 recommended a base flow of 0.75−1 ML/day was required from December to June to maintain water levels in the estuary to reduce the potential for activation of acid sulfate soils in the artificial channels of Coogoorah Park. This minimal flow was aimed at compensating for the loss of freshwater inputs from the now-ceased mine discharge and to mitigate acidification impacts within the estuary.

It is noted that the influence of ASS in Coogoorah Park wetlands and channels is significantly less than the contribution from Salt Creek and Anglesea River (GHD, 2021). However, water level management reduces the risk of activation of ASS from Coogoorah Park in the estuary.

A conceptual model of changes in the ecological condition of the Anglesea River estuary is shown in Figure 3-19 (GHD ,2021). The model defines the changes from timing of the mine and power station discharge and the changes occurring to the estuary from:

- A reduction in freshwater flows from the catchment reducing water levels and over topping of the berm. This results in an increase in the height and width of the berm by wave action and coastal currents pushing sand further into the estuary.
- Reduced outflows from the estuary resulting in an increase in the height and width of the beach berm because of wave action and coastal currents pushing sand further into the estuary.
- Reduced buffering of moderate (5.5-7) pH catchment flows from mine and power station inflows.
- Estuary ecosystems communities transitioning to a freshwater dominated system.

The impact of the cessation of the Alcoa discharge, and the alkaline buffering capacity of the discharge, can be seen in Figure 3-20 (EHS, 2022a), the general decrease in the estuary pH since 2016 and particularly over the last 3 years.

It is noted that the estuary, like the lower portion of the Anglesea River, is hydraulically separated from the underlying main aquifers in the UEVF and LEVF. There may be the potential for some diffuse leakage from the water table aquifer towards underlying aquifers over time, however the DBF aquitard becomes thicker towards the coast providing an aquitard between the upper sand units of the UEVF and low permeability coals and the intermediate unit provide a further aquitard between the UEVF Lower Sand aquifer. Historical records of artesian conditions in the UEVF around the former power station provided further confirmation that the clay units overlying the UEVF aquifer were low permeability and confining (EHS, 2022a).

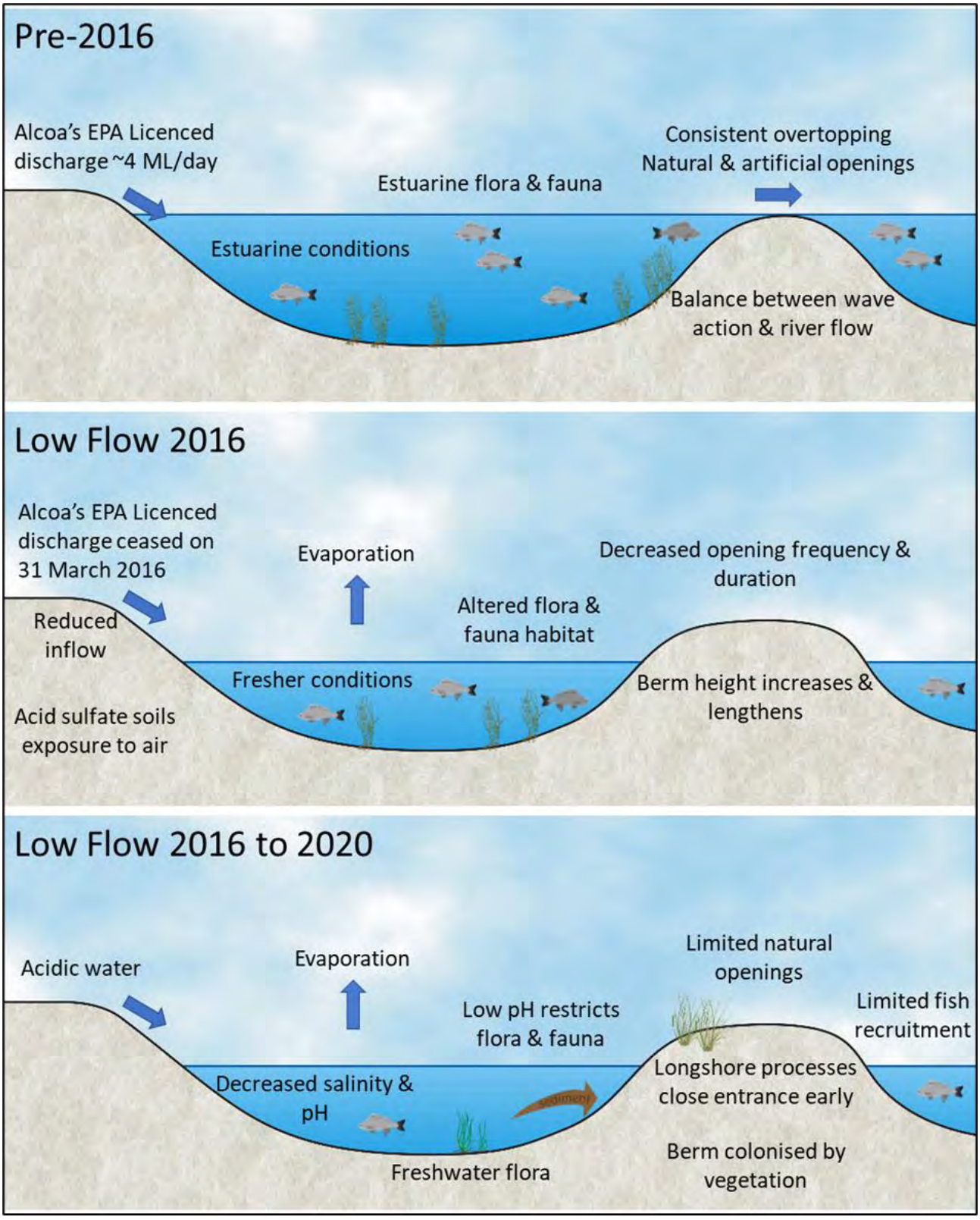


Figure 3-19 Conceptual model of changes in the Anglesea River estuary

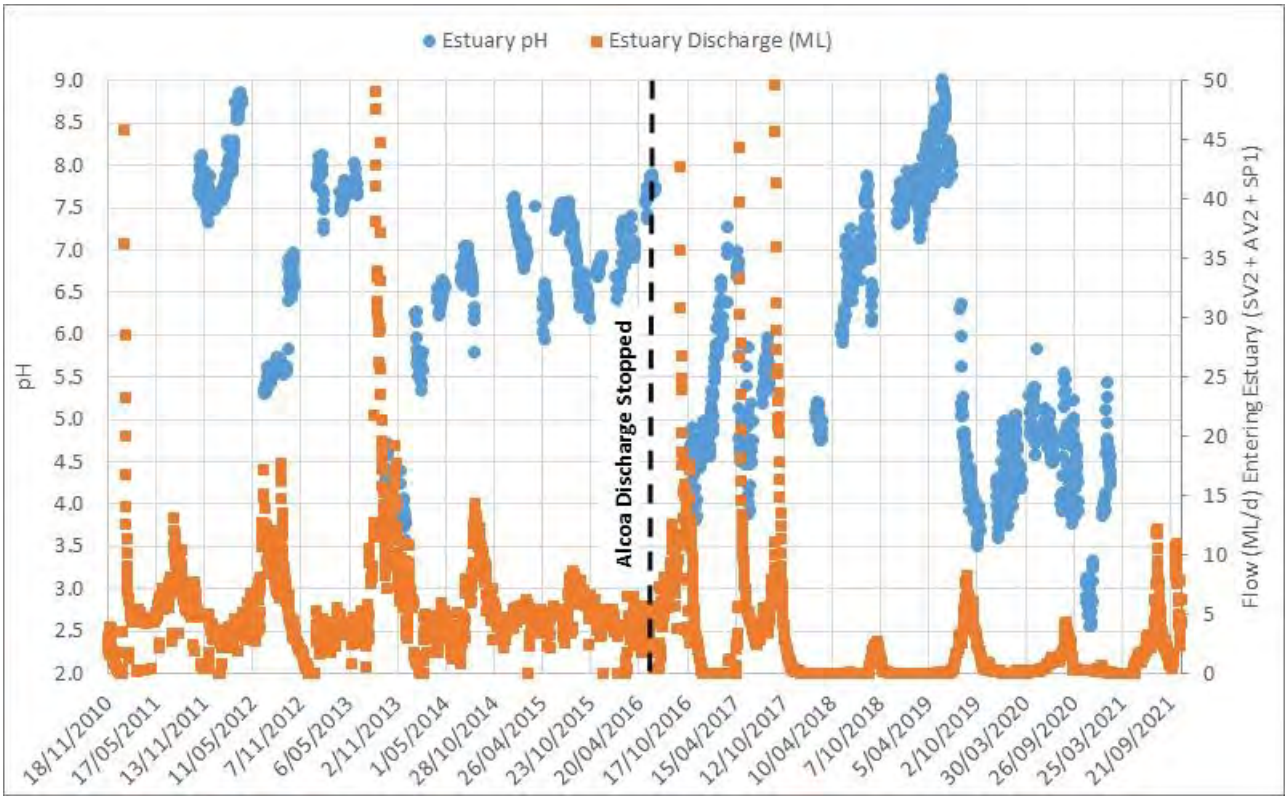


Figure 3-20 **Historical Surface Water Flows into the Anglesea River Estuary (Source EHS, 2022a)**

3.12 Regional Conceptual Hydrogeological Model

Consistent with GHD,2013a, and with reference to EHS, 2022a, the conceptual hydrogeological model for the region is presented in Figure 3-21 and the recharge and discharge processes are summarised in Table 3-7. In addition, the CHM is shown along a north-south cross section down the Anglesea River catchment, crossing from the Jan Juc Syncline to the Anglesea Syncline (Figure 3-22). Figure 3-23 graphically presents the conceptual model for the Alluvial Swamp aquifer.

Each process has been discussed in the previous sections and the numerical model will be used to quantify each of these parameters in the water balances.

Table 3-7 ***Summary of Aquifer Recharge and Discharge Processes***

Aquifer System	Recharge Process	Discharge Process
Alluvial Swamp aquifer	Direct rainfall infiltration	Evapotranspiration
	Runoff & Interflow recharge	Leakage to underlying formations
	Direct leakage from UEVF/LEVF aquifers	Swamp/Creek surface water outflow
	Baseflow (as stream inflow) from up-catchment	
Upper Eastern View	Direct rainfall infiltration	Offshore
	Runoff recharge (stream Infiltration)	Abstraction
	Upwards leakage from LEVF/ Downward leakage from overlying formations	Baseflow to Streams
	Leakage from mine void	Evapotranspiration
		Downward Leakage to the LEVF

Aquifer System	Recharge Process	Discharge Process
		During mining: Sump discharge/evaporation/storage in sediments removed Post mining: discharge to the pit waterbody /evapotranspiration
Lower Eastern View	Direct rainfall infiltration	Offshore
	Runoff recharge (stream infiltration)	Abstraction
	Downward Leakage from UEVF/MEVF	Upward leakage to UEVF
		Baseflow to Streams
		Evapotranspiration

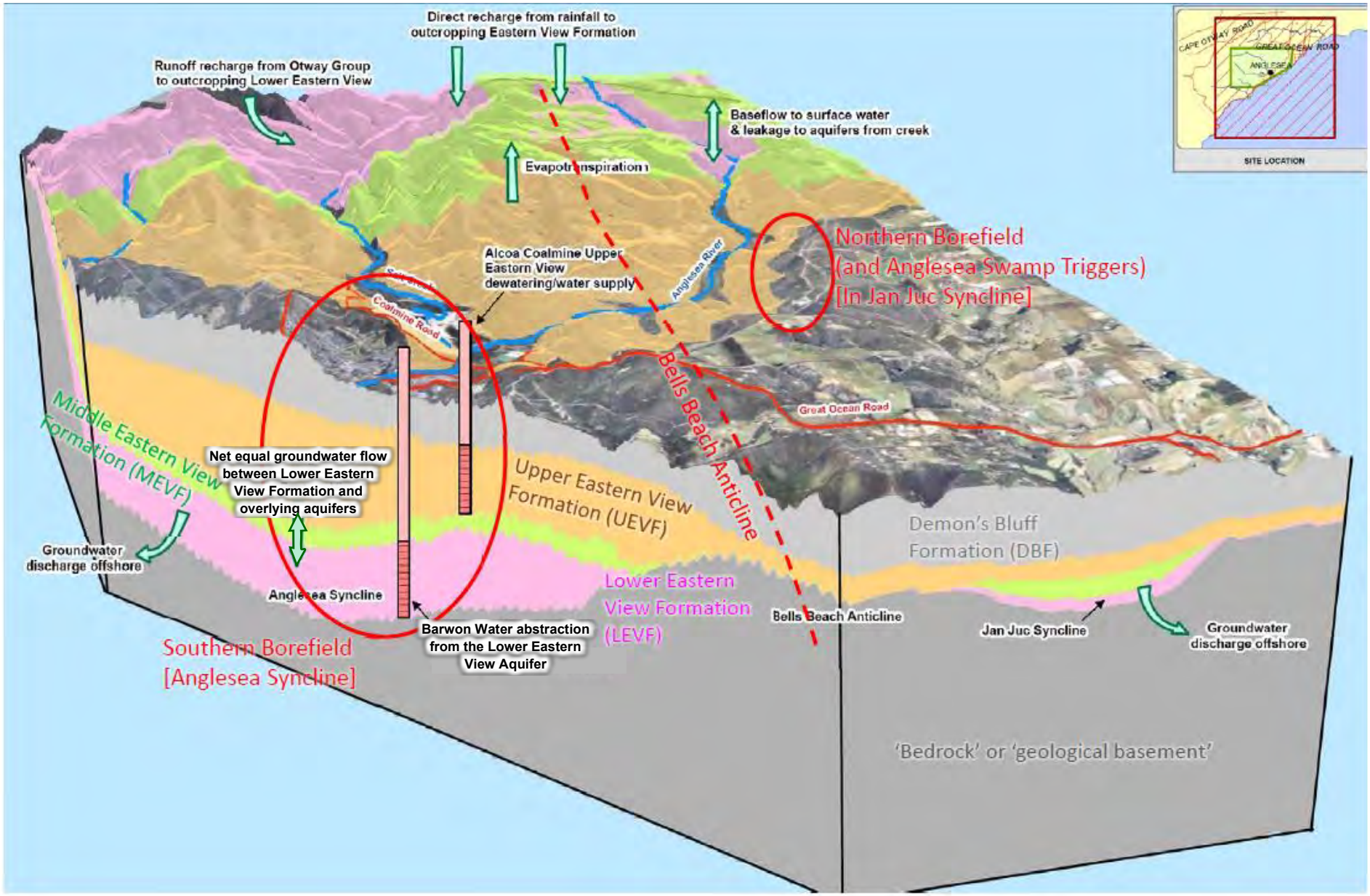
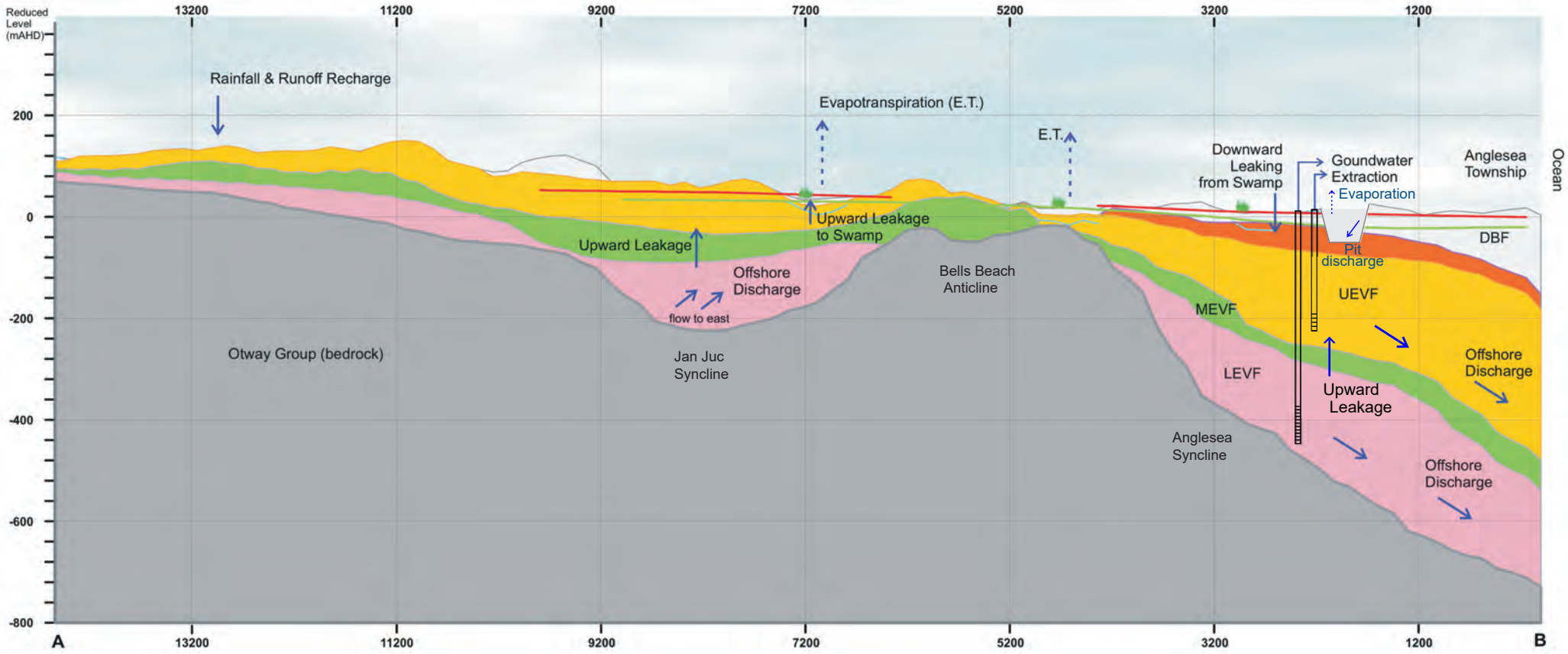
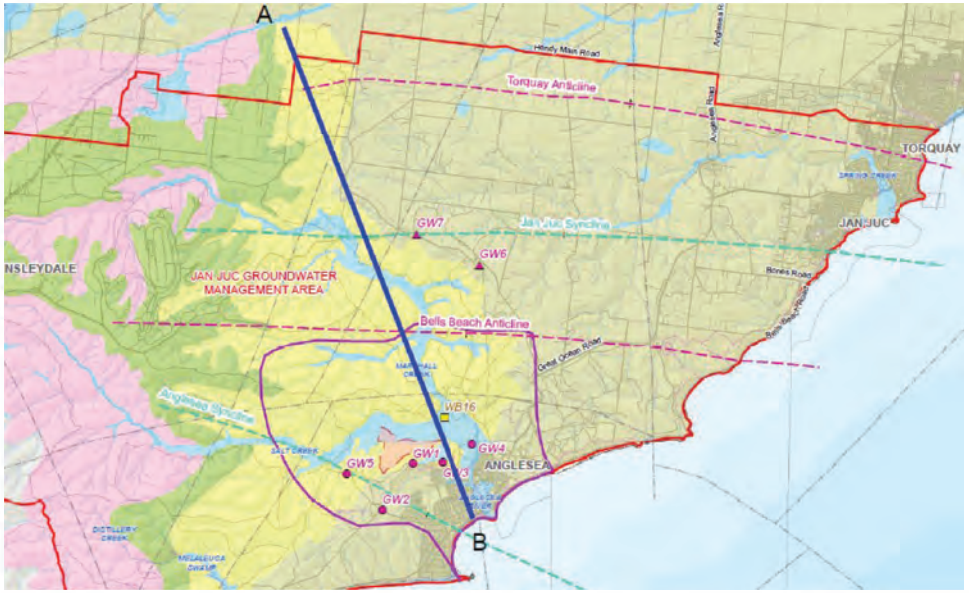


Figure 3-21 Conceptual Hydrogeological Model (Source GHD, 2013a-modified)





- Demons Bluff Formation (DBF)
- Upper Eastern View - Coal (Coal)
- Upper Eastern View - Sand (UEVF)
- Middle Eastern View (MEVF)
- Lower Eastern View (LEVF)
- Otway Group (bedrock)
- Groundwater - Head - UEVF
- Groundwater - Head - LEVF
- Alluvial floor

Paper Size ISO A3

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Barwon Water
Anglesea Groundwater Model Update

Hydrogeological Model:
Anglesea River (North-South)

Project No. 12542999
Revision No. A
Date 22/03/2022

FIGURE 3.22

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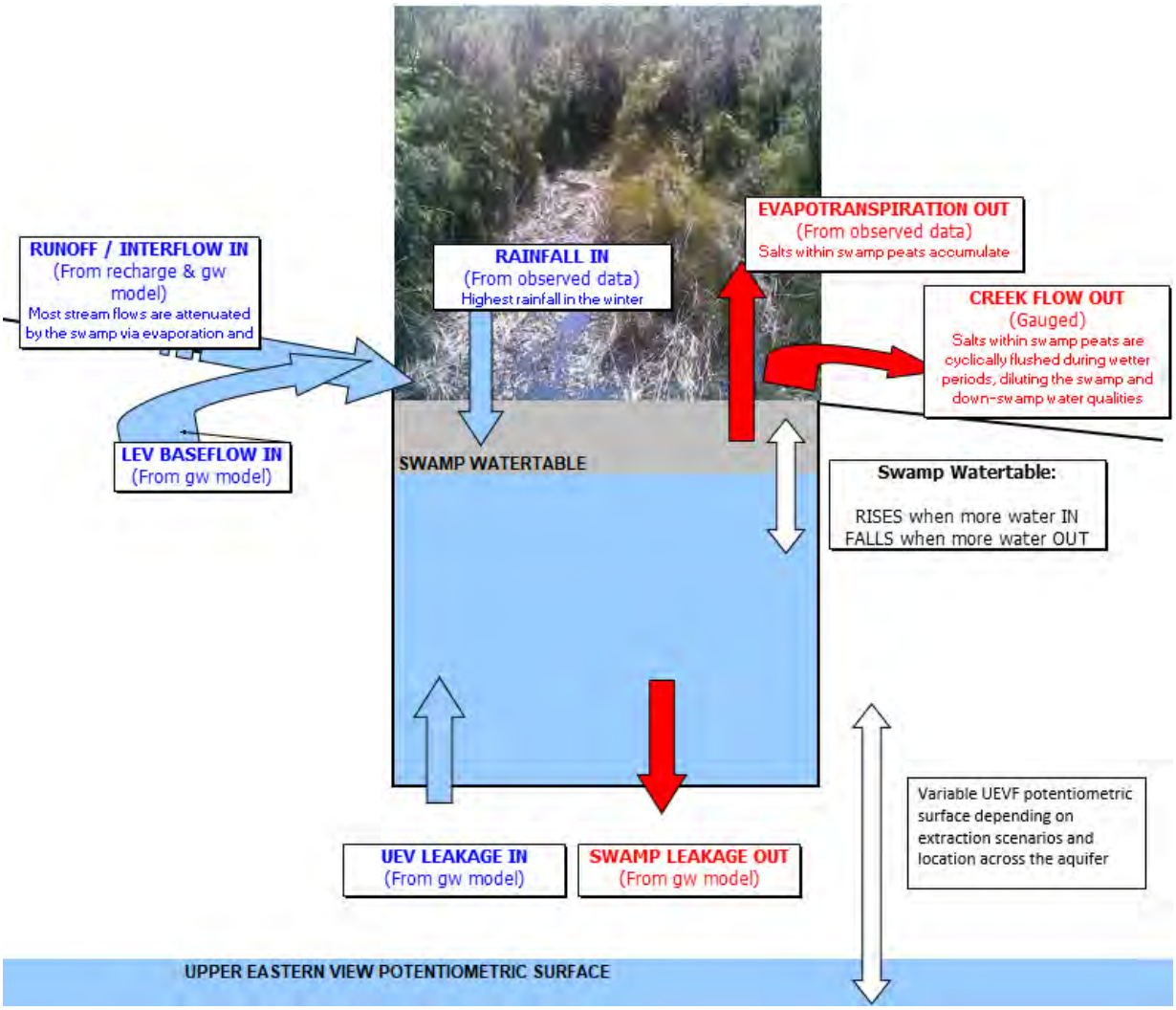

Figure 3-23 Alluvial Swamp Aquifer: Conceptual Hydrogeological Model (Source GHD, 2013a- modified)

4. Model Design and Construction

4.1 Software

The numerical groundwater flow model described in this report utilises MODFLOW-USG-Transport (version 2.1.0; Panday and others (2013) and Panday (2023)). This is a MODFLOW version that uses the Control Volume Finite Difference method, which allows for an unstructured model grid, as opposed to structured regular or irregular grids.

Features of MODFLOW-USG that are particularly suited to addressing the modelling needs and objectives of this study include:

- Robust handling of dry cells, via MODFLOW-USG's upstream weighting option, which operates in a similar way to other MODFLOW codes including MODFLOW 6 and MODFLOW-NWT.
- This is important in this case for several reasons. First, outcropping or near-surface model cells are expected to become desaturated in places in response to variable climate and historical mining operations. Second, some deeper model cells may become desaturated, with shallower cells remaining saturated, such as those in the Anglesea and Salt Creek swamplands around Alcoa's historical mining operations. It is important that the model be capable of passing vertical leakage from the base of the alluvial/swamp aquifer down through any desaturated layers, and ultimately to the next (fully- or partially-) saturated deeper layer. MODFLOW-USG with its upstream weighting option is capable of this.
- Flexible meshing (as a means of model domain discretisation), utilising a range of cell shapes and levels of refinement. This allows model cells to closely follow the geometry of features of interest, e.g., stream channels, swamps, mine pits and the coast.
- Efficient local mesh refinement around features of interest within the large regional model domain required of this study, whilst retaining larger cells elsewhere. The ability to simulate local mesh refinement within a large regional domain provides smaller, faster models, without compromising resolution in areas of interest. This has flow-on benefits in terms of more robust and efficient history-matching and uncertainty analyses.

Model boundary conditions capable of simulating the following features to a level of detail adequate for the objectives outlined in Section 2.1:

- Stream flow routing and its interaction with groundwater (the Stream Flow Routing (SFR2) package; see Niswonger and Prudic (2005), and Panday and others (2013)); and
- The Alcoa mine pit water body and its interaction with groundwater and creeks (the Lake (LAK3) package; see Merritt and Konikow (2000) and Panday and others (2013)).
- Highly efficient numerical methods, which contribute to more robust and efficient history-matching and uncertainty analyses.
- An expansive, regularly updated, regularly expanded family of open-source support tools for pre- and post-processing, and for providing linkages with the uncertainty analysis and optimisation codes used in this report.
- A mature and stable open-source (i.e., transparent and reproduceable) code base[7].
- The code is free – there are no expensive licences required, nor the associated licensing issues with running many models across many computers, as is required in a modelling workflow such as that outlined in this report.

Furthermore, the requirement for using the model to estimate the maximum extent of pit water body water migration into the groundwater system (Section 2.1), particle tracking can be undertaken on unstructured MODFLOW-USG models using the code mod-PATH3DU (Muffels and others (2020)).

Details on how MODFLOW-USG is applied are provided in the following sub-sections.

[7] https://www.gsienv.com/product/modflow-usg/

4.2 Modelling units and spatial projection

The groundwater flow model uses units of metres and days. The geographic coordinate system used is the Geographic Datum of Australia 1994 (GDA94), and the projection used is the Map Grid of Australia (MGA) zone 55 (EPSG WKID 28355).

4.3 Domain and Spatial Discretisation

The model domain and mesh discretisation are presented in Figure 4-1. The domain extends approximately 38 km by 26 km in the southwest-northeast and northwest-southeast directions respectively (Figure 4-1). It covers a 570 km^2 area, broad enough to allow simulation of potential groundwater and surface water effects from future Barwon Water and Alcoa groundwater use and mine rehabilitation activities without undue interference from model boundaries. Therefore, the domain extends some distance offshore – to avoid near-shore pumping interactions with a coastal model (head) boundary located along the shoreline. It also covers the geological extent of the key units in onshore areas for the same reason.

The domain has been laterally subdivided into a maximum of 48,525 variably sized Voronoi-shaped model cells in any one layer (Figure 4-1), and vertically subdivided into 12 layers, which are detailed in Table 4-1. These are shown in cross section view in Figure 4-2, and as thickness maps in Figure 4-4 through Figure 4-7. All layers extend over the entire domain (i.e., a 12-layer stacked mesh of 48,525 cells is used) resulting in a total number of model cells of 582,300. This is on the large side for the computing demands of modern history-matching and uncertainty analysis methods, however, many of these cells have been inactivated in the numerical solution because geologically all layers do not exist across the entire domain (they pinch out); this leaves only 261,559 active cells, which is a more practicable number given computing demands.

The reason for using a stacked mesh across all layers is that this is a requirement of MODFLOW-USG's LAK package (see Section 4.5.9); if this package were not used, the pinched-out model cells could be removed entirely from the model files. Given the inclusion of pinched out cells in the model files, the MODFLOW-USG Discretisation (DISU) package file is modified such that each active cell that is underlain by an inactive (pinched-out) cell is vertically connected down to the next active underlying cell. In addition, nodal connection lengths are adjusted accordingly, reciprocal (upward) connections are made, and connections to inactive cells are removed.

The model top (land) surface is defined using the Victorian Government's Vicmap Elevation DEM 10m (a hydrologically enforced 10 m resolution Digital Elevation Model with respective horizontal and vertical accuracy of 12.5 m and 5 m or better (DELWP, 2020a)). This is averaged across each variably sized model cell (based on the intersection of raster cell centres with model cell polygons), and hence this accuracy is variably maintained in the numerical model, with lower accuracy in large cells away from areas of interest, and higher accuracy in finer resolution cells in areas of interest.

The model mesh is refined as follows:

- Within the historical mining activity area, aligned with different pit development activities over time. This also results in a high level of refinement (20-50 m cell sizes) around the existing and future pit water body.
- Alcoa and Barwon Water groundwater abstraction bores, and ASA observation bores (approximately 5 m at the bore).
- Along creeks and rivers. Compared with other creeks, greater refinement (50 m long by 25 m wide) is implemented along the Anglesea River, Salt Creek, and their tributaries, because these are the key potential impact receptors of Alcoa and Barwon Water activities.
- Within swamps and alluvial deposits, model cells are sub-100 m resolution, and often much finer.

The mesh is also broadly aligned with other selected feature boundaries, such as the coastline and MEVF outcrop locations, which also mark the outcrop boundaries of the two important UEVF and LEVF aquifers.

Around the Alcoa Area of Interest (AOI), which is local to the Alcoa coal mine, more detailed mapping of hydrogeological units is available based on mine borehole data. These detailed AOI sub-layers are extrapolated out from the AOI as follows:

- The Boonah Formation (model layer 3) is extended to the coast, with the coastward thickening evident in the AOI mapping and as described by Holdgate and others (2002) extrapolated, broadly following the morphology of the directly underlying and closely related UEVF coal sequence in the Anglesea Syncline, as mapped by Holdgate and others (2002).
- The UEVF main coal (model layer 4) and UEVF upper sands (model layer 5) are relatively thin and pinched out around the margins of the AOI mapping.
- The UEVF (intermediate coal; model layer 5) is extended regionally across the entire UEVF extent. Within the AOI, Alcoa's detailed mapping is used to define this surface. Beyond the AOI, this unit is extrapolated using its proportion of total UEVF (intermediate) plus UEVF (lower sands) thickness mapped within the AOI. That is, this proportion is used to subdivide the total UEVF thickness in areas beyond Alcoa's AOI. A smooth (interpolated) transition between the AOI and surrounding areas is implemented, rather than a sharp boundary.

Including greater vertical discretisation through sub-layering in this area is advantageous over the simpler (more lumped) layering system of GHD (2013) for several reasons, including:

- Groundwater monitoring and pumping bores screen specific sub-layers within the broader ("bulk") UEVF and overlying formations in this area, for example the Boonah Sands, the UEVF upper sand, and the UEVF lower sand. There is important information in these sub-layer-specific groundwater data with respect to interactions between groundwater, the historical open cut coal mine, and the rehabilitated pit water body. The model can only be trained to that important information if the model is discretised to an appropriate level of detail.
- The ability to simulate vertical gradients within the bulk UEVF beneath the historical coal mine and rehabilitated pit water body.
- The ability to simulate the effects of sub-layers of differing hydraulic properties, and potentially differing water qualities, on groundwater interactions with the pit water body as its levels rise and fall.

Table 4-1 Groundwater Model layer summary

Group	Formation	Member	Model HGU code	Model Layer	Layer name	Other details
	Qa Alluvials / swamp peats		1	1	Swamp / Alluvial (ASA) Aquifer	
Demons Bluff Group	Anglesea Formation		2	2	Demons Bluff Formation (DBF)	
	Salt Creek Formation					
	Boonah Formation		20	3	Boonah Formation	These are sub-layers that are extrapolated out to varying degrees from the Alcoa AOI. See report text for details.
Eastern View Group	Upper Eastern View Formation	A Group coals	31	4	A Group coals & basal clay	Layer 4's basal clay is thin (1-4 m thick), not found everywhere, and not consistently mapped (see EHS, 2022a). Where it is recorded in logs it is included with the A group coals layer. The A Group coals are up to 45 m thick (EHS, 2022a). Spatially variable vertical hydraulic conductivity of layer 4 is used to allow for the presence of the basal clay, as inferred through observation data and the model history-matching process. A discrete basal clay layer is considered unnecessary complexity, given that: 1. There are no groundwater monitoring data on either the basal clay or the A Group coals. 2. The basal clay will act as the flow-retarding stratigraphic unit within this layer, dominating the vertical conductance term in this layer (i.e., the coal is likely to be of higher permeability). 3. Its small thickness relative to that of the A Group coals means that it would contribute very little reduction in transmissivity of this layer.
		Basal clay				
		UEVF upper sand	32	5	UEVF Upper	
		UEVF intermediate sand, coal, clay	33	6	UEVF Intermediate	
		UEVF lower sand	34	7	UEVF Lower	
	Middle Eastern View Formation		4	8, 9, 10	MEVFa, MEVFb, MEVFc	Split across three layers in subcrop for simulation of vertical gradients LEVF→UEVF. One layer in outcrop.
	Lower Eastern View Formation		5	11	LEVF	

Group	Formation	Member	Model HGU code	Model Layer	Layer name	Other details
Otway Group	Otway Group		6	12	Bedrock	Limited extent on western margin, approximately 50 m at its thickest (western) wedge, thinning to nil approximately 5 km to the east of the western model boundary.

PARAPARAP
WURDIBOLUC
GHERANG
ANGLESEA RIVER
WENSLEYDALE
BREAKFAST CREEK
SALT CREEK
SOKEL
DISTILLERY CREEK
PAINKALAC CREEK
AIREYS INLET
MOGGS CREEK
FAIRHAVEN
EASTERN VIEW
MEMORIAL ARCH
BIG HILL
(LORNE)
ANGLESEA
BELLS BEACH
JAN JUC
BELLBRAE
SPRING CREEK
DEEP CREEK
TORQUAY
THOMPSON CREEK
BREAMLEA

WB10
WB14
WB16
WB17
WB15
WB13
GW4
GW3
GW1
GW5
SALT CREEK

Legend

Township

Aquifer Monitored

- Swamp/Alluvial Aquifer (SAA)
- Demons Bluff Formation
- Boonah Formation
- UEVF (Upper Sands)
- UEVF; UEVF (Basal Sands)
- UEVF/LEVF
- LEVF

Groundwater Production Bore

Owner

- Alcoa Production Bore
- BW Production Bore
- Stream
- Historic Mining Area
- Groundwater Model Mesh

Outcrop

- Alluvials
- Bedrock
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View

Paper Size ISO A3

0 1 2 3 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Groundwater Model Domain and Mesh

Project No. 31-12542999
Revision No. 1
Date 11/12/2021

FIGURE 4-1

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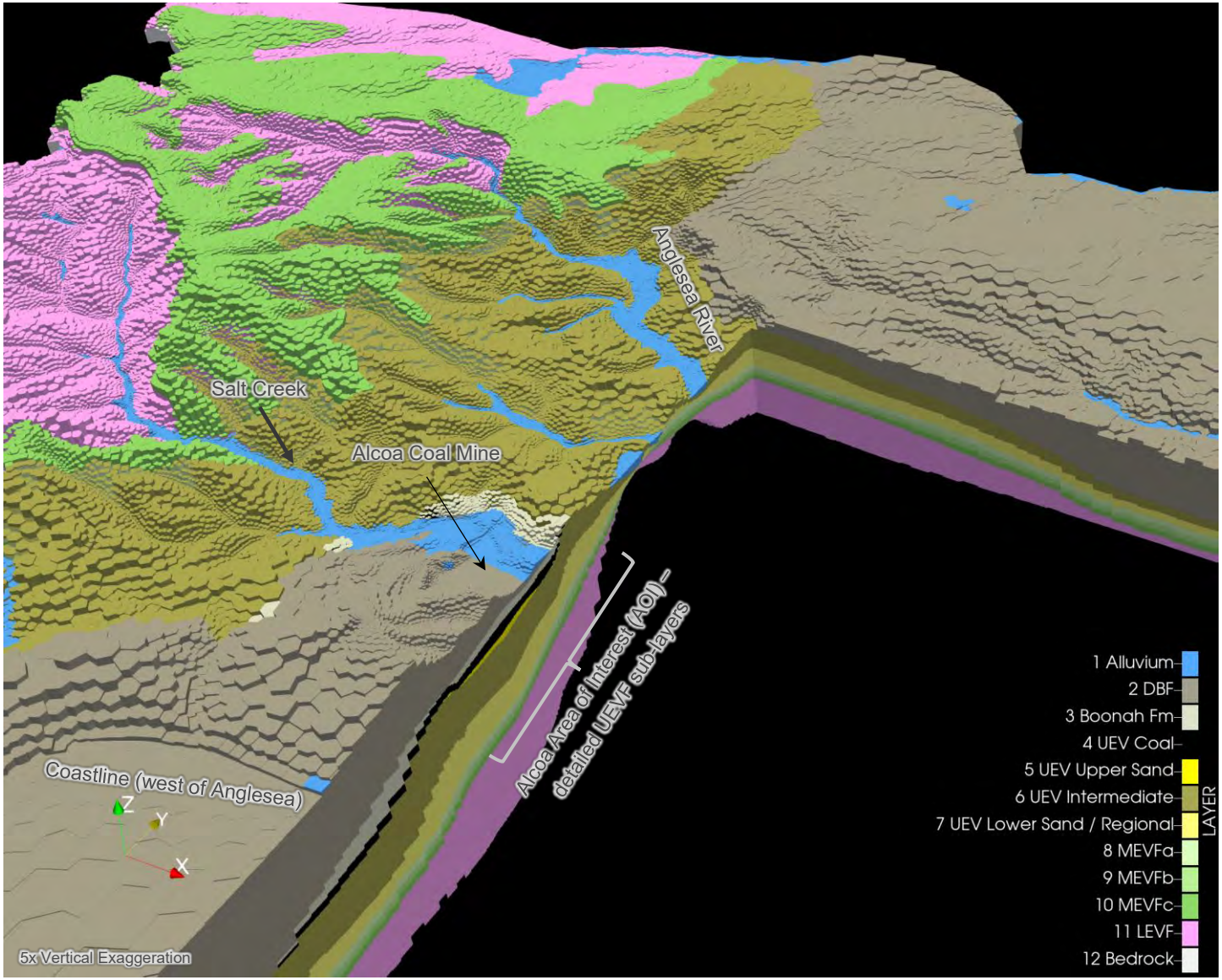


Figure 4-2 Groundwater Model Layering and Sub-layering: box cut view through Alcoa coal mine from southeast

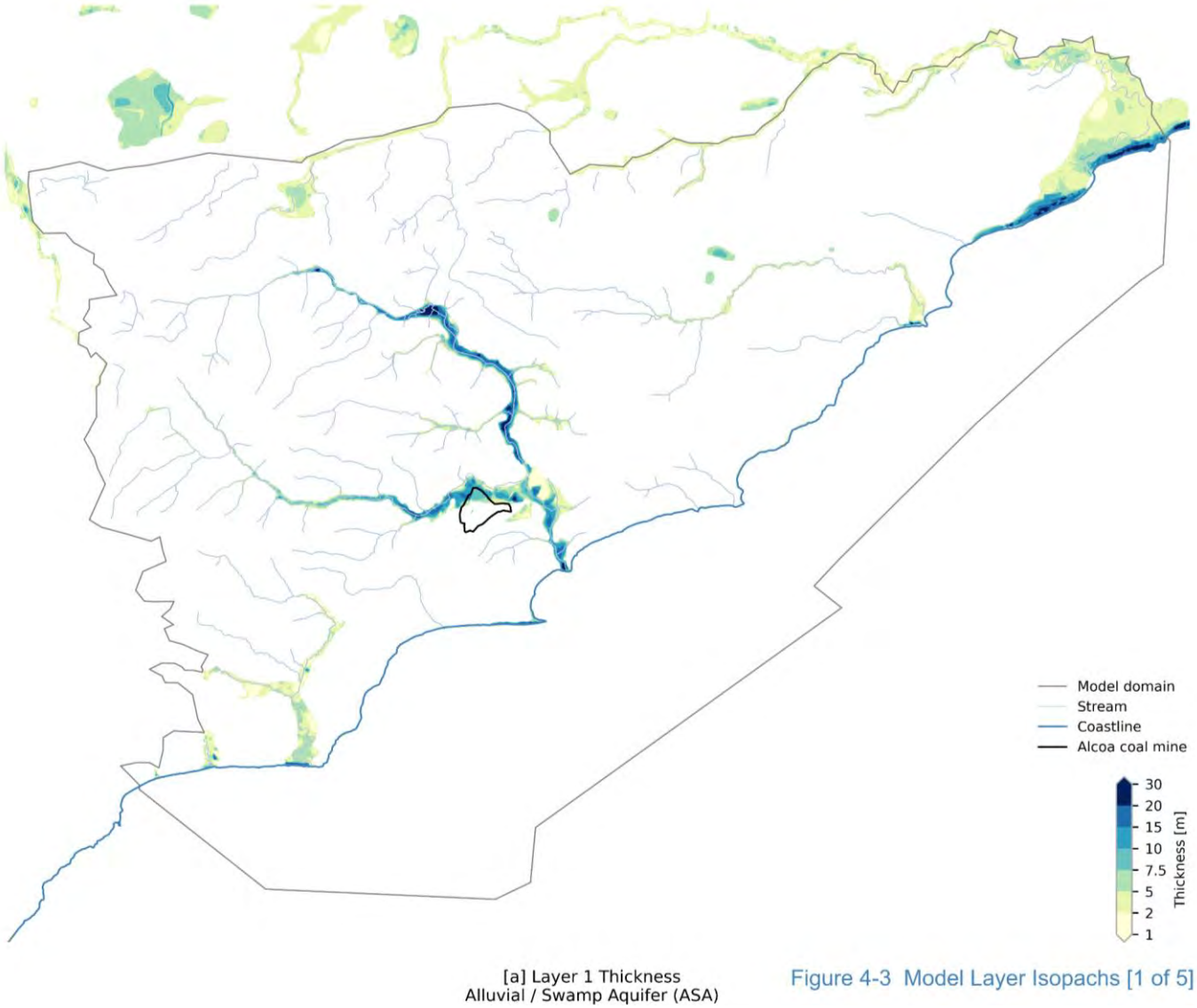


Figure 4-3 Groundwater Model Layer Isopachs [1 of 5] – Alluvial / Swamp Aquifer (ASA)

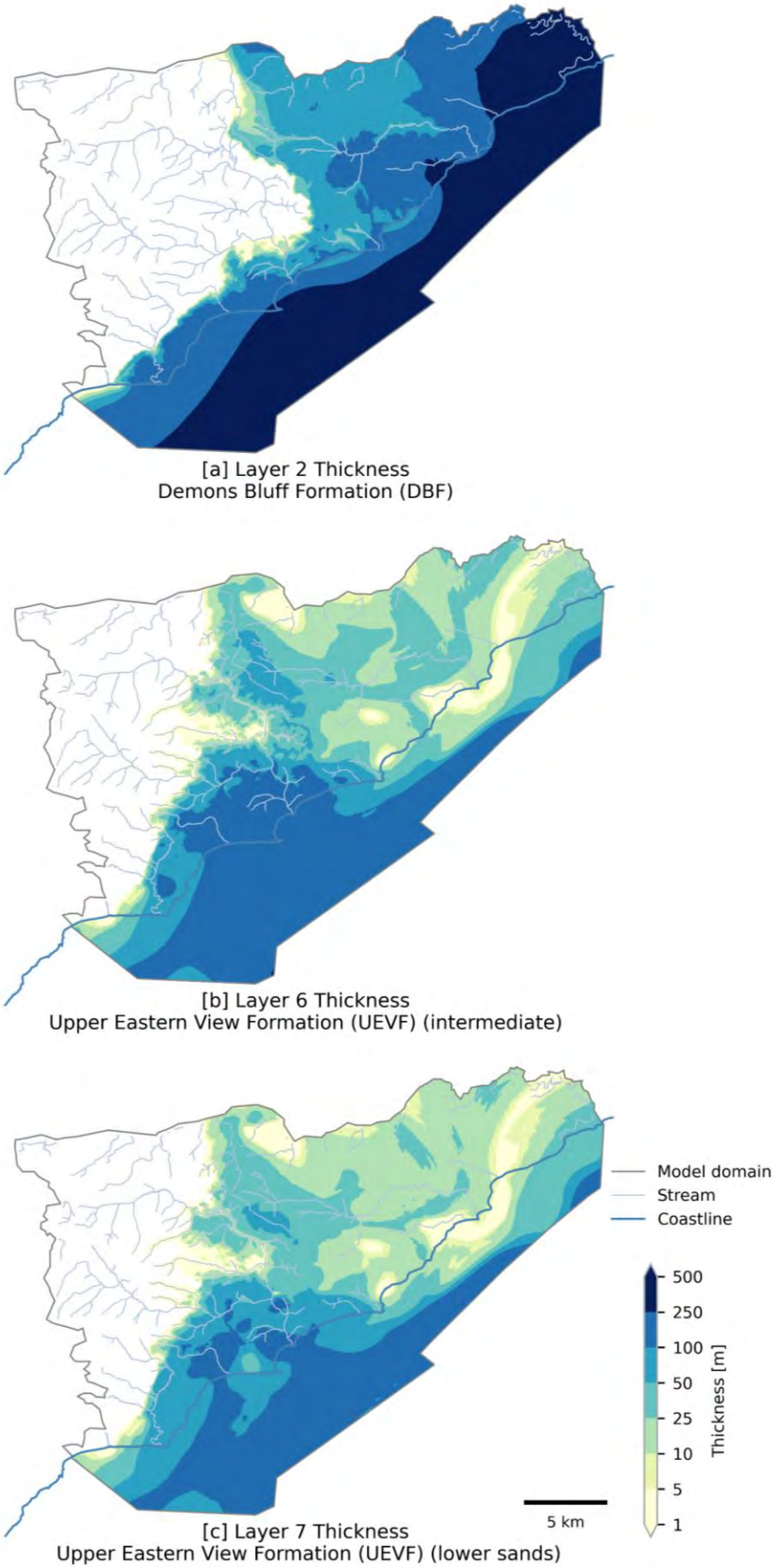


Figure 4-4 ***Groundwater Model Layer Isopachs [2 of 5] –Demons Bluff Formation (DBF), Upper Eastern view Formation (UEVF Intermediate and UEVF lower sands)***

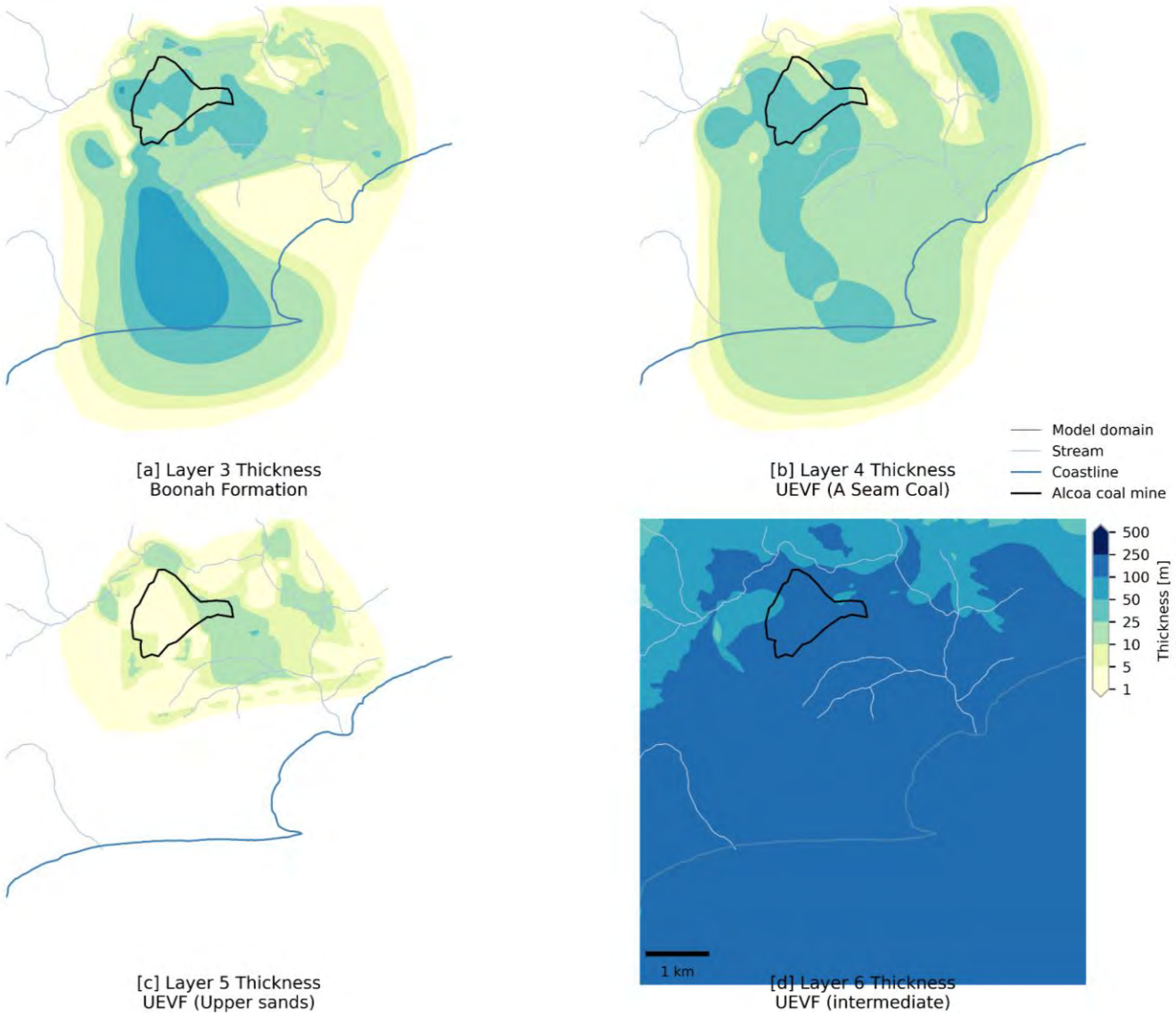


Figure 4-5 ***Groundwater Model Layer Isopachs [3 of 5] – UEVF Sub-layers in Alcoa's Area of Interest***

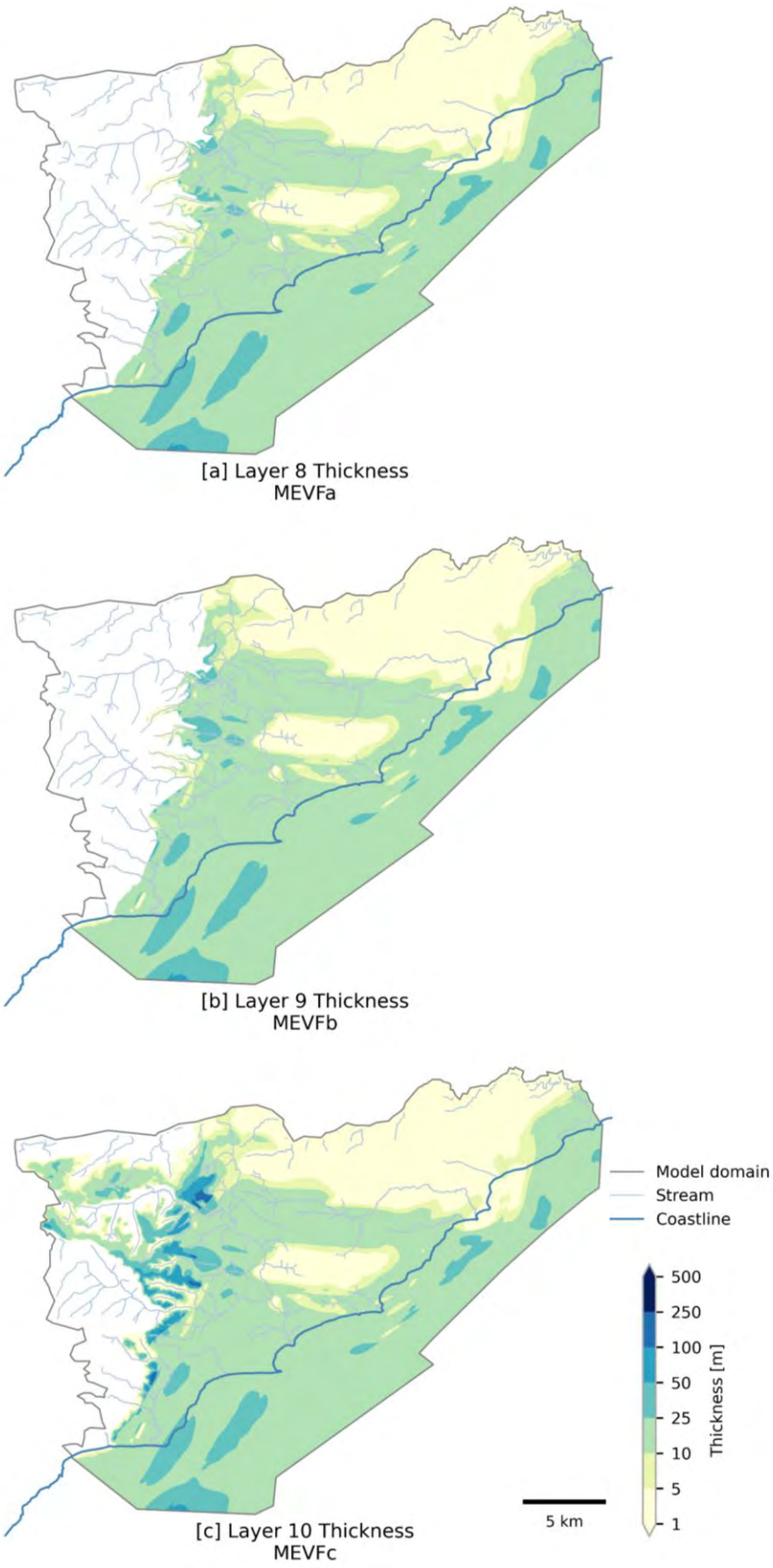


Figure 4-6 *Groundwater Model Layer Isopachs [4 of 5] – Middle Eastern View Formation (MEVF)*

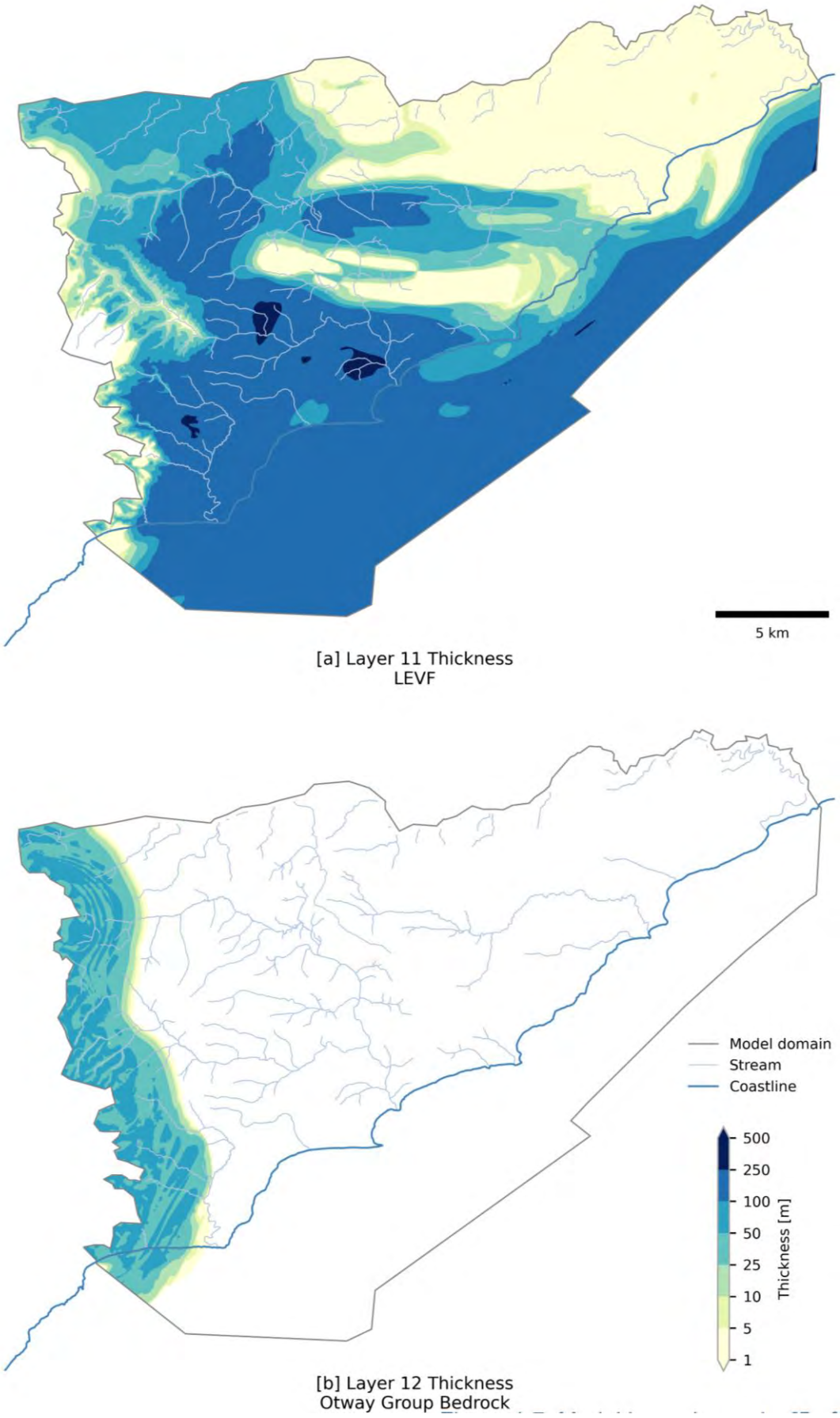


Figure 4-7 *Groundwater Model Layer Isopachs [5 of 5] – Lower Eastern View Formation (LEVF) and Bedrock*

4.4 Temporal Discretisation and Numerical Solver

Temporal model discretisation for the history-matching model is as follows:

- A single initial steady state stress period to provide initial conditions for the subsequent transient stress periods. Prior to development of the Alcoa coal mine in 1969, groundwater abstraction from the Jan Juc GMA is understood to have been minimal and hence starting conditions for the transient run were created from a steady-state simulation using long-term average recharge and assuming zero groundwater abstraction.
- 323 transient stress periods of variable duration, depending on observation data density and hydrologic stresses and change during different time periods. These cover the period from January 1969 through to the end of March 2023. Details of and rationale for stress period durations are shown in Figure 4-8. When flow gauges record peak stream flow (and recharge) events, stress periods are refined to monthly to half-monthly scale. During drier periods when there is little hydrological variability, and/or when there are limited temporally detailed observation data or hydrological change (e.g., change in borefield pumping rates), stress period durations are increased up to quarterly, or even annual further back in time towards the start of the simulation when data are very sparse. This approach provides faster-running models, which aids in history-matching and uncertainty analysis workflows, whilst not compromising the ability of the process to extract as much information as possible from the observation data, with respect to model parameters and their uncertainty.

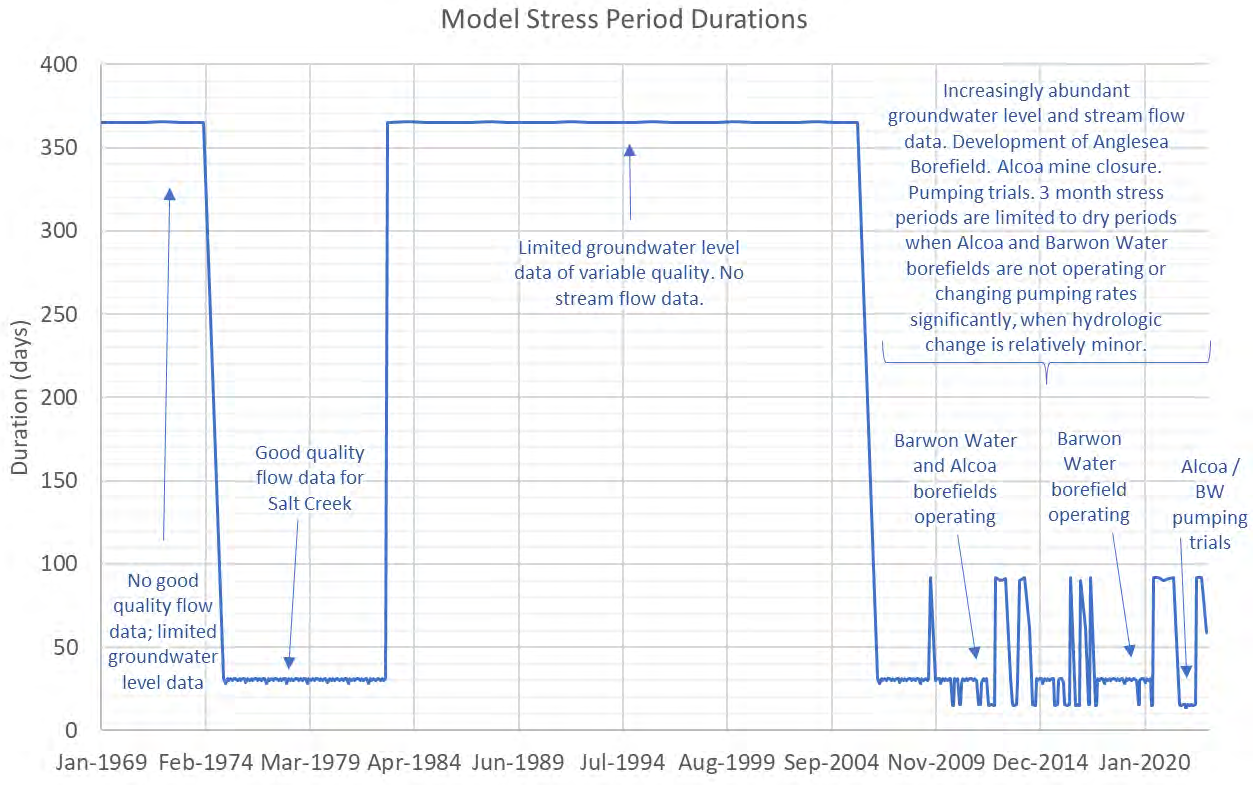


Figure 4-8 Model temporal discretisation details

Predictive models use initial conditions from the end of the transient historical model. Temporal discretisation will be confirmed in predictive model reporting that will be provided when that work is undertaken, after model history matching is completed.

Each stress period is subdivided into two time-steps, except for annual stress periods which are subdivided in three. Adaptive time stepping is however applied where numerically required to provide convergence. Outer iteration head closure tolerance is set to 0.001 m for the steady state model, and 0.01 m for the transient model. These were increased for the purposes of PESTPP-IES to 0.01 and 0.1 respectively, with no resultant increase in water balance closure error, yet appreciable gains in simulation run times; they could be reduced if desired for subsequent modelling if this is considered important. MODFLOW-USG's Sparse Matrix Solver (SMS) package is applied, with the unstructured Preconditioned Conjugate Gradient (PCGu) linear solver. Newton iterations and backtracking are activated.

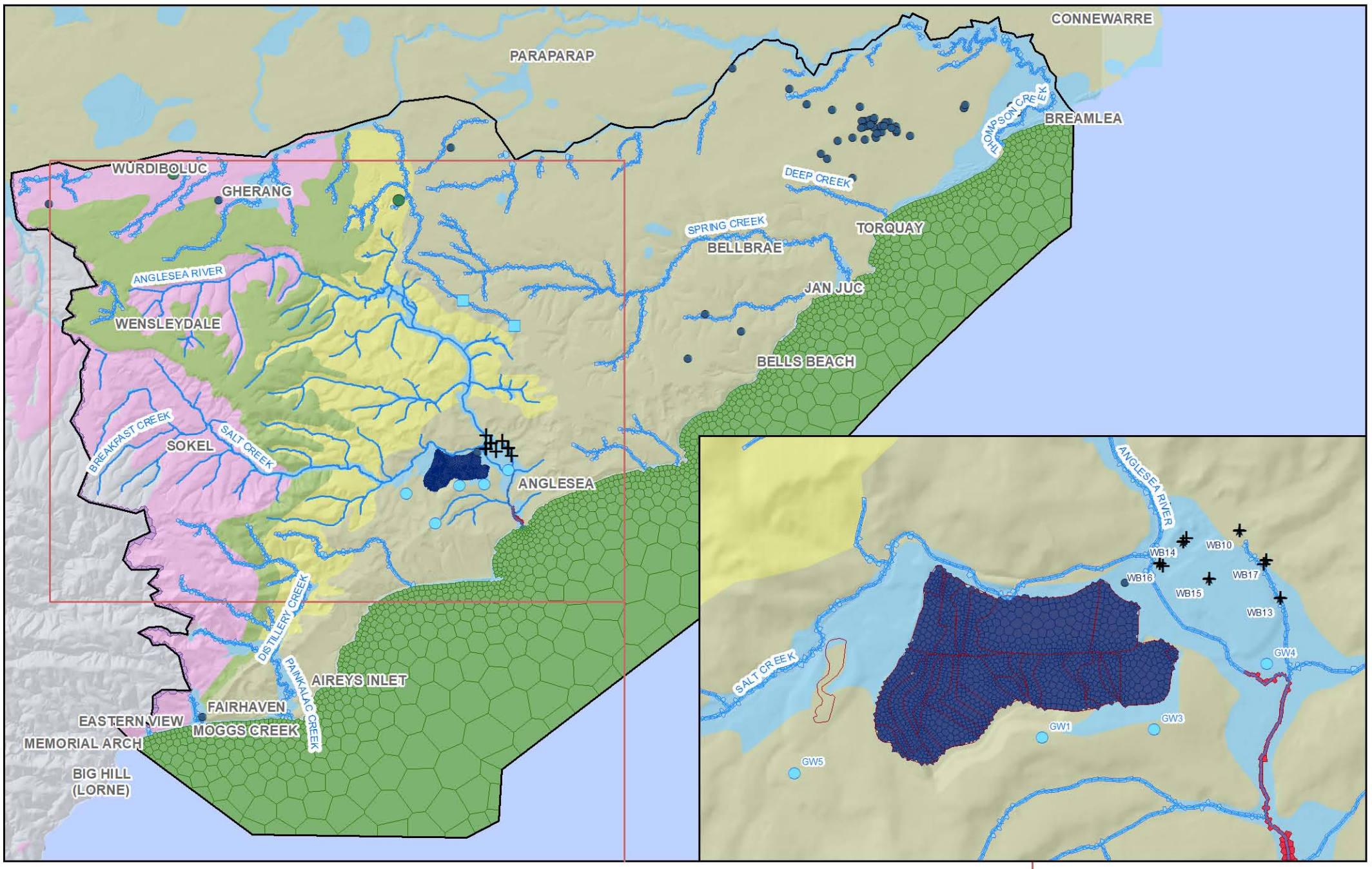
4.5 Boundary Conditions and Applied Fluxes

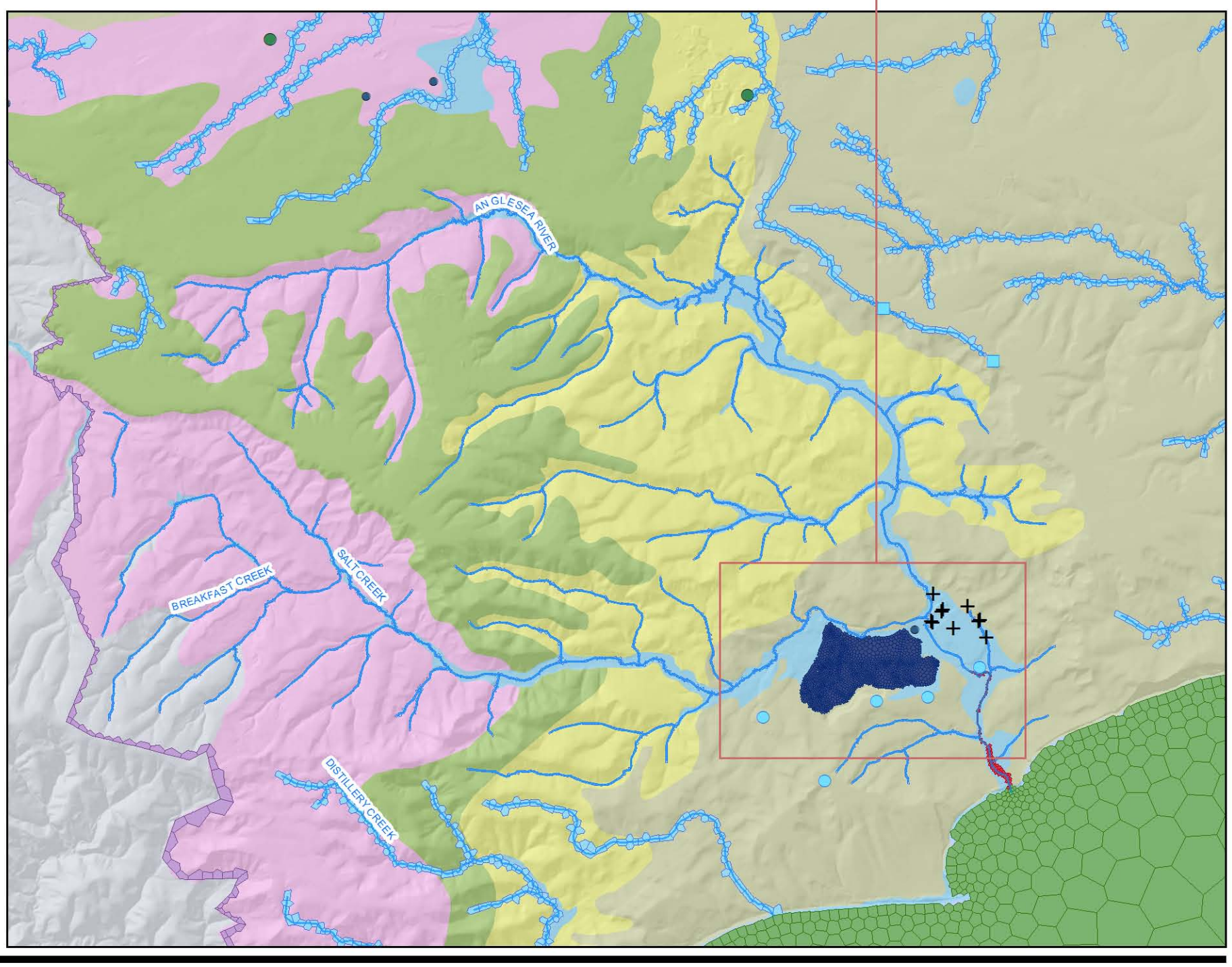
4.5.1 Anglesea Estuary

The Anglesea Estuary is simulated using MODFLOW-USG's River (RIV) package (Figure 4-9). This is a head- and conductance-dependent flux boundary:

- When groundwater levels rise above the defined stage elevation, groundwater discharges into the RIV boundary, as a linear function of groundwater level-stage difference and boundary conductance.
- When the groundwater level is above the defined boundary bottom elevation (estuarine bathymetry) but below its stage, the flux to the boundary from groundwater is a linear function of the head difference between the boundary and groundwater levels, and boundary conductance. Bathymetry was defined through topographic interpolation from the project DEM surrounding the estuary.
- Although unlikely to occur in this model, a constant maximum loss term is applied when the groundwater level in the model cell to which the RIV boundary is applied falls below the specified base (bathymetry) of the river. At these times, the loss term is a function of the boundary stage, bottom elevation, and conductance.

The hydraulic conductivity term of RIV conductance was initially set to 0.01 m/day, and a 1 m thick bed material was assumed. This is adjusted during history-matching. Cell areas (which vary) were used to define the remainder of the conductance terms. RIV stage is defined using the observed mean freshwater head sea level of 0.1 mAHD, assuming 1 m depth; see Section 4.5.2. This stage height will be varied during predictive modelling, using the forecasts of potential future sea level rise described in Section 4.5.2.





Legend

Township

Groundwater Pumping Bore (WEL)

- Alcoa
- Barwon Water (Northern Borefield)
- Barwon Water (Southern Borefield)
- Licensed
- Stock & domestic
- Stream

Model Boundary Condition

- General Head Boundary (GHB) (offshore)
- General Head Boundary (GHB) western bedrock margin
- Lake (LAK) (Alcoa Pit Lake)
- River (RIV) (Anglesea Estuary)
- Stream Flow Routing (SFR)
- Historic Mining
- Model Domain

Outcrop

- Alluvials
- Bedrock
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View

Paper Size ISO A3

0 1 2 3 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Groundwater Model Boundary Conditions

Project No. 31-12542999
Revision No. 1
Date 12/12/2021

FIGURE 4-9

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4.5.2 Coastal Boundary

The location of the fresh-saline groundwater interface within the aquifers and aquitards along the coast and offshore is unknown. Based on the projection of groundwater contours, Hancock (1967) estimated this to be at 3,500 m from the coast in the UEVF, which is in the vicinity of the Torquay Fault.

In the Gippsland Basin's offshore area, a very similar related geological sequence, within the equivalent aquifers of the Eastern View Group (the Latrobe Group), the fresh-saline interface has been mapped as being located up to 70 km offshore, with a broad mixing zone on the landward side between 30- and 70 km offshore (Lawrence, 1992; Post and others, 2013).

Freij-Ayoub and others (2007) mapped the freshwater equivalent potentiometric surface for the pre-offshore development period of the offshore Gippsland Basin's Upper Latrobe Group; this indicates that the freshwater flow system would result in upward diffuse discharge of fresh water to the ocean from deep confined aquifers in the central parts of the offshore basin up to as far as 25-50 km offshore. In hydrostratigraphic units at shallower depths, the fresh-saline interface would be located progressively closer to the coastline (Post and others, 2013). Similar offshore groundwater system behaviour may be reasonably expected in the Anglesea area, albeit possibly closer to shore, at least in the UEVF, as suggested by Hancock (1967).

The offshore area in the Anglesea groundwater model is simulated using MODFLOW USG's General Head Boundary (GHB) package (Figure 4-9). This operates in a very similar way to the RIV package described in Section 4.5.1, except that the maximum loss term is not applied; gain and loss from and to groundwater is a constant linear function of the head difference between boundary stage, groundwater levels, and boundary conductance.

GHBs are applied to all outcropping (surficial) layer cells in the offshore area – in this case, these are all in model layer 2 (DBF). GHB stage varies from 0.080 to 1.46 mAHD – approximately reflective of mean sea level[8], as corrected for the density of seawater over the mapped offshore bathymetric depth, which varies from 0-50 m. These boundaries extend 5-7 km offshore. The sensitivity of selected forecast model outputs to likely future sea level rise will be assessed using the very high greenhouse gas scenario (RCP8.5) projections for the Surf Coast (median estimate of 0.24 m rise at 2050 relative to the 1986-2005 average)[9].

Beneath these GHB cells in other layers, no boundary conditions are applied, but groundwater flow is simulated through them. At the furthest offshore (south-eastern) edge of the model, a no flow boundary is applied in all layers. This forces groundwater flow within the model domain in the offshore area up into the surficial GHB cells representing the overlying ocean, as controlled by the vertical hydraulic conductivity of the layers underlying the offshore area, and the GHB conductance and stage. These parameters are adjusted during history-matching, given the largely unknown nature of the fresh-saline interface. This design reflects the observations from the Gippsland Basin and Hancock (1967) noted above, whilst acknowledging and accommodating the fact that the behaviour of groundwater in the offshore area is uncertain.

The hydraulic conductivity term of GHB conductance was initially set to 0.01 m/day, and a 1 m thick bed material was assumed. Hydraulic conductivity is adjusted during history-matching. Cell areas (which vary) were used to define the remainder of the conductance terms.

4.5.3 Western Boundary Otway Group Bedrock

The western margin of the Otway Group bedrock (model layer 12) is also assigned GHB boundaries (Figure 4-9). GHB head is defined as 5 m below ground surface and is not adjusted during history matching. GHB conductance is only implicitly made adjustable during history-matching, through the explicitly adjustable hydraulic conductivity of layer 12 being used to calculate conductance, along with an assumed length term of 1 m, and lateral cell face areas.

[8] 0.077 mAHD given a gauge zero elevation of -1.423 mAHD and mean gauged level of 1.5 m. See: http://www.bom.gov.au/ntc/IDO71056/IDO71056SLD.shtml and http://www.bom.gov.au/ntc/IDO50000/IDO50000_60790.pdf
[9] https://coastadapt.com.au/sea-level-rise-information-all-australian-coastal-councils#VIC_SURF_COAST

4.5.4 Northern Boundary

Much of the northern model boundary is defined by a major river valley filled with alluvium, is generally a topographic low point, and is hence considered a net discharge area. Model layers in this area are generally thin, often close to or at minimum thickness (see figures discussed in Section 4.3). The geology in this area is not well explored and therefore not as deeply understood as in areas to the south. It was found during earlier model runs that groundwater was artificially building up against this boundary, particularly in deeper layers, because of the low permeability MEVF and DBF layers; this seemed to cause numerical difficulties and slow model run times, and it adversely affected history match quality to the BW ASR bores to the south.

On this basis, the northern model margin is assigned Specified Gradient Boundaries (SGBs) in all layers (Figure 4-9). SGBs are useful in that groundwater head along the boundary condition is naturally computed on a transient basis by the model given aquifer properties and recharge (and other input forcing) dynamics, which continually change during history matching. That is, groundwater levels do not need to be defined as they do for head-based boundary conditions. This is considered an appropriate approach along this boundary given the relative lack of geological and groundwater level data in the area.

SGB gradients are initially defined as -5e-4 (m/m; negative values meaning out of the model) and are adjusted during history matching using spatially varying pilot points, with an allowable range of -1e-5 to -5e-3 m/m. The area component of the SGB input term is computed as cell thickness multiplied by the square root of the cell surface area; this does not change during history matching.

4.5.5 Groundwater Recharge

For the purposes of estimating groundwater recharge for input to the groundwater model, in addition to runoff and interflow (“quickflow”) to modelled streams, the one-dimensional soil moisture model PERFECT (Littleboy and others, 1989) is applied. Although PERFECT has typically been used for agricultural applications, and occasionally land use change (reforestation or clearing) studies, in this case it is used in its simplest form – the “crop factor model”.

This simple approach is used to provide an assessment of recharge and quickflow variability given climatic variability and its effect on soil moisture deficits, for a groundwater-focussed model of temporal discretisation that is relatively coarse compared with surface water-focussed models. For the purposes of this study, whatever approach is taken to estimate these hydrologic components should preferably be fast-running, adjustable through history matching, and sufficiently flexible to facilitate observed groundwater level and stream flow variability simulation to a level of temporal and spatial detail commensurate with the model’s intended purposes (Section 2.1).

PERFECT simulates near-surface water balance components. It partitions effective rainfall into components including surface runoff, movement through soil moisture stores, soil water uptake by vegetation, and deep drainage from the soil profile. A schematic overview of PERFECT and its linkages to the groundwater model of this study is presented in Figure 4-10.

In this case, the simplest vegetation water use model offered by PERFECT was used, the “crop factor model”. The crop factor model estimates transpiration using a user-defined annual (monthly) distribution of green cover, pan evaporation, and a crop factor. Transpiration is then removed from individual layers of the soil profile using a generic root penetration and density equation. See Littleboy and others (1989) for further details.

PERFECT estimates runoff using a modified form of the US Soil Conservation Service’s (SCS) runoff curve number method; to summarise, this applies a higher curve number when vegetation cover is lower (see Littleboy et al, 1989 for details).

As is shown in Figure 4-10, a proportion of deep drainage from PERFECT is diverted laterally to streams as interflow. This is estimated external to PERFECT using the method of Rassam and Littleboy (2003), and the remaining deep drainage is applied to the groundwater model as watertable recharge. The Rassam and Littleboy (2003) method uses topographic slope and the ratio of upper to lower soil horizon permeability to estimate the fraction of deep drainage that is diverted laterally within the unsaturated zone as interflow; the steeper the slope, and the higher the upper soil horizon permeability relative to that of the lower soil horizon, the greater the proportion of deep drainage from PERFECT that is diverted laterally to streams as interflow, along with the runoff, which are together defined as "quickflow" here; this is also described further in Section 4.5.8.

Sources of input data for the PERFECT models are outlined as follows:

- Rainfall and pan evaporation data are from the SILO patched point data service[10], which provides temporally infilled and extrapolated climatic data at all available gauges across the model domain. This is augmented by two Barwon Water-owned rainfall gauges (235805 at AARC and the 235806 at Breakfast Creek). Rainfall records at these gauges were interpolated to the full period of other SILO data (1950 to current) using the highest quality monthly total rainfall linear regression with all SILO gauges, which is the closest SILO gauge (87119) in both cases (Appendix A). The regression-derived estimates of total monthly rainfall were disaggregated to daily scale according to the distribution of daily rainfall across each month at gauge 87119. Pan evaporation data for the two Barwon Water's gauges, also required by PERFECT, was taken directly from gauge 87119 because no pan evaporation records are available for the Barwon Water's gauges.
- Soil hydraulic properties and estimates of allowable upper and lower bounds for the purpose of model history-matching are from the Soil Hydrologic Properties of Australia data set (Western and Mackenzie, 2004).
- An additional bottom soil horizon was added to these soil profile data where aquitards and poorly permeable aquifers (DBF, MEVF, bedrock) are modelled to occur at outcrop; this bottom horizon is given the same properties of that of the SHPA data set, except for vertical permeability, which is adjustable during history matching and uncertainty analysis. The reason for doing this is to avoid excessively high recharge rates being applied to groundwater model aquitard layers, which is both unrealistic and numerically challenging.
- Initial runoff curve number values and allowable ranges for use in history-matching were obtained from USSCS (1989), for grassed and forested land.
- Monthly average LAIs are taken from the CSIRO data set described in Lu and others, 2001.

One PERFECT model is built and run for the combination of soil types (including outcrop aquitard layers), land covers, and climate gauges[11] mapped across the model domain (Figure 4-11). This equates to a total of 237 PERFECT models. Each model uses the three nearest climatic time series from the SILO / Barwon Water data. Data from the three nearest gauges are linearly interpolated to the centroid of each PERFECT model polygon, with weights initially set using linear distance between each gauge and the centroid; these weights are however adjustable during history matching, to account for the potential local dominance of one more distal gauge over the closest. The interpolated time series is then scaled by the Bureau of Meteorology's (BoM's) long-term average rainfall distribution map for 1980-2010 resampled to 10 m resolution[12]. For each mapped polygon, this scaling is implemented using the ratio of the BoM's mapped average rainfall with the corresponding period average rainfall interpolated from the three relevant climate gauges. This introduces greater accounting for local-scale topographic effects on spatial climate (and runoff/recharge) variability.

[10] https://www.longpaddock.qld.gov.au/silo/

[11] Climate gauge zones are mapped as theissen polygons around each gauge across the model domain. Linear spatial interpolation is conducted, using the three nearest climate gauges, for each PERFECT model polygon within each theissen climate polygon. The linear interpolation (weighting) factors between these three gauges are adjusted during history-matching, in recognition of uncertainty in which gauge is most representative of climatic conditions within each PERFECT model polygon.

[12] http://www.bom.gov.au/jsp/ncc/climate_averages/rainfall/index.jsp?period=an&area=vc#maps. The BoM data are provided on an approximate 4.5 by 5 km resolution grid. Given that this is quite coarse compared to the scale of significant topographic (and by implication climatic) variability across the model domain, ArcGIS's Empirical Bayesian Kriging (EBK) Regression tool was used to resample the BoM grid to the 10 m resolution of the project DEM. This tool uses the project DEM as a secondary (regression) variable that is known to influence spatial rainfall variability. Inspection of the BoM rainfall map confirms this.

Each PERFECT model simulates the near-surface water balance on a daily time step from 1960 through to January 2022 for different sets of climatic sequences, land cover, soil type and topographic slope. Once each PERFECT model is run, interflow is estimated based on topographic slope and vertical soil hydraulic conductivity contrast as per Rassam and Littleboy (2003). Example output recharge and quickflow timeseries are shown in Figure 4-12 to illustrate their variability.

Recharge and quickflow data from these models, which represent initial estimated recharge and quickflow within each soil type, land use, and climate gauge combination, are then spatially aggregated and applied to groundwater model cells (RCH package) and stream or water body boundary conditions (SFR2 package reaches and LAK3 package lakes; see Sections 4.5.8 and 0).

Spatial scaling of applied recharge is implemented at the groundwater model cell scale, accounting for the finer cell resolution (and therefore topographic and climatic variability) relative to that represented by the PERFECT models (i.e., soil and land cover combination polygons). This is done as follows:

1. Using annual deep drainage (recharge plus interflow)[13] versus rainfall linear regression statistics from the initial PERFECT models. The regressions suggest an approximate 64% change in annual deep drainage relative to changes in annual rainfall (this is mean of the linear regression slopes presented in Appendix A, limited to those with correlation coefficients of at least 0.75); for example, a mapped 100 mm/year rainfall difference between one area and another is estimated to result in a 64 mm/year deep drainage reduction. A similar regression approach was investigated for runoff, but this was abandoned due to comparatively poor correlation between rainfall and runoff changes (see Appendix A and Section 4.5.8 for details).
2. Scaling via interpolated pilot point multipliers, with initial values of 1. These allow for the model history matching and uncertainty analysis processes to adjust the initially estimated spatial recharge (and interflow) variability, as informed (or not) by the available observation data.

In historically mined areas, land cover is modelled to change from vegetated to cleared condition from the onset of mining, and back to vegetated condition at the onset of pit backfilling. Spatial mapping and dates of mining and backfilling operations were provided by Alcoa. During mining, recharge is directly applied to the model layer containing the mined seam (typically model layer 4); at other times (and in all other areas), it is applied to the upper most active layer.

For the purposes of defining recharge rates to the initial steady state model stress period described in Section 4.4, PERFECT's estimates from 1960 through 2023 are applied (excluding mined land cover models). A single model-wide scaling factor of these recharge rates is then applied and made adjustable during calibration. This is in recognition of the initial stress period's potentially important but unknown abstract role in defining initial conditions for the subsequent transient stress periods. In effect, the steady-state stress period is an abstract representation of past climate that has led to the initial transient groundwater conditions in 1960, setting the transient period up for its pre-conditioned response to subsequent climatic variability.

4.5.6 Climate Change Sensitivity Scenarios

The adopted approach to runoff and recharge estimation for this project provides a suitable basis from which forthcoming predictive modelling can be undertaken whilst considering potential future climate change effects. DELWP (2020b) provides guidance around approaches to such scenarios for both stream flow and groundwater recharge. This is summarised as follows:

Use two historical climate reference periods as a basis for future rainfall, runoff, and recharge projections:

- The post-1975 reference period; and
- The post-1997 reference period.

[13] Recharge plus interflow (deep drainage) is used because recharge and interflow are both derived from the same PERFECT output (deep drainage). Therefore, the same scaling factors (per change in rainfall) apply equally to recharge and interflow.

- The post-1997 reference period is directly applied to the recharge/runoff models, without any ongoing or future climate changes, i.e., Global Climate Model (GCM) projections are not used, and this scenario represents a step change that started in 1997. If longer simulation periods are required, longer historical data sets can be adjusted to match the statistical properties of the post-1997 period using percentile-based scaling.
- The post-1975 reference period is scaled according to the RCP8.5 (conservative) GCM-projected changes between 1995 and the year of interest, assuming a linear progression over time between the GCM time slice projections for the Otway Coast as presented by DELWP (2020b). For example, to model the medium-term climate (over the next 25 years), the 1975-2000 climate (rainfall and potential evapotranspiration) sequence used as input to the PERFECT models is scaled by the GCM-projected changes between 1995 and 2047 (i.e., 25 years beyond 2022), using a linear interpolation between the GCMs' 2040 and 2065 projections. For evapotranspiration under the medium climate change projection, this would be a 4.5% increase (3.7% in 2040 to 6.4% in 2065); for rainfall, this would be a -3.9% change (-3.6% in 2040 to -5.8% in 2065). These factors would be applied directly to the 1975 to 2000 climate sequence before application to the PERFECT models.

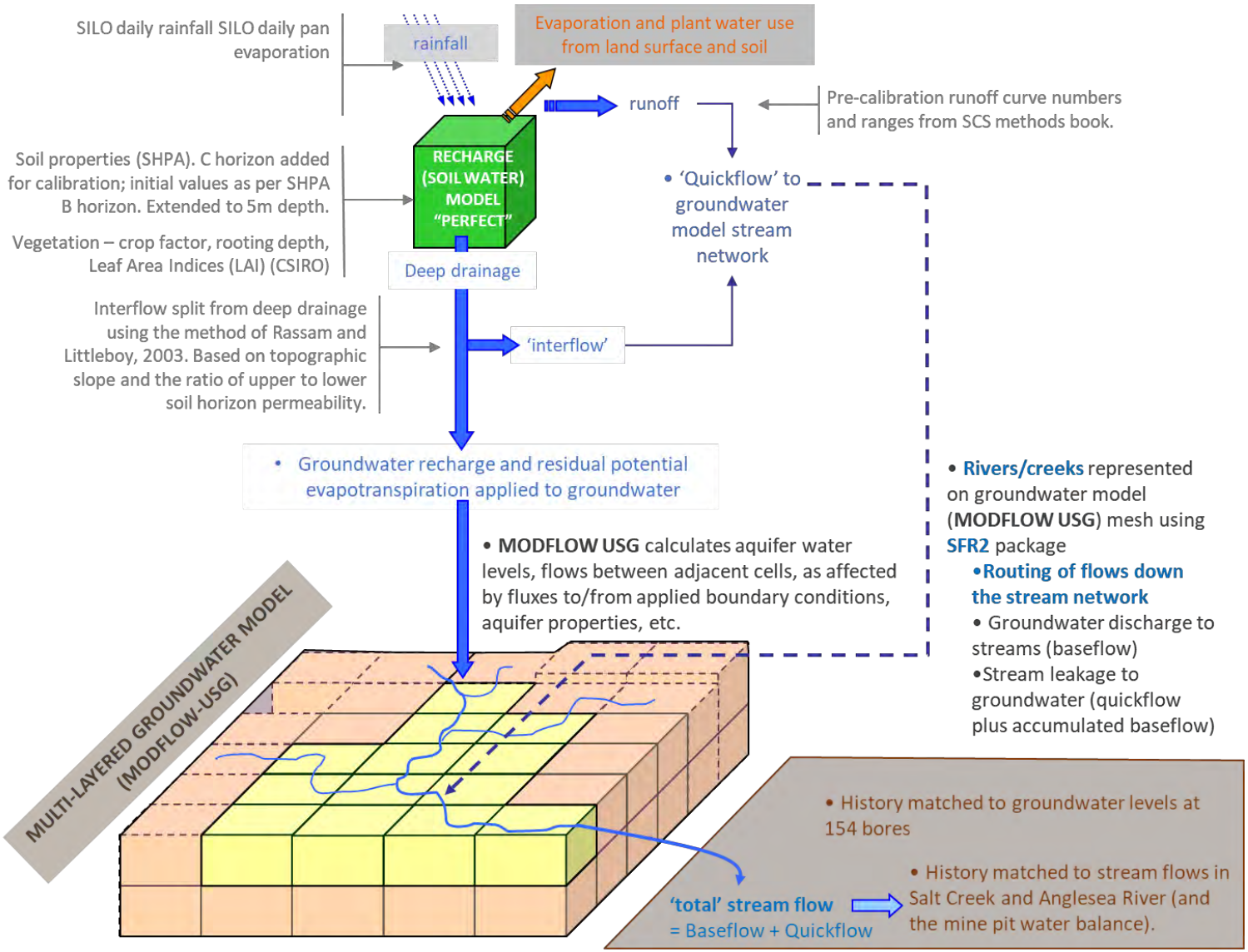
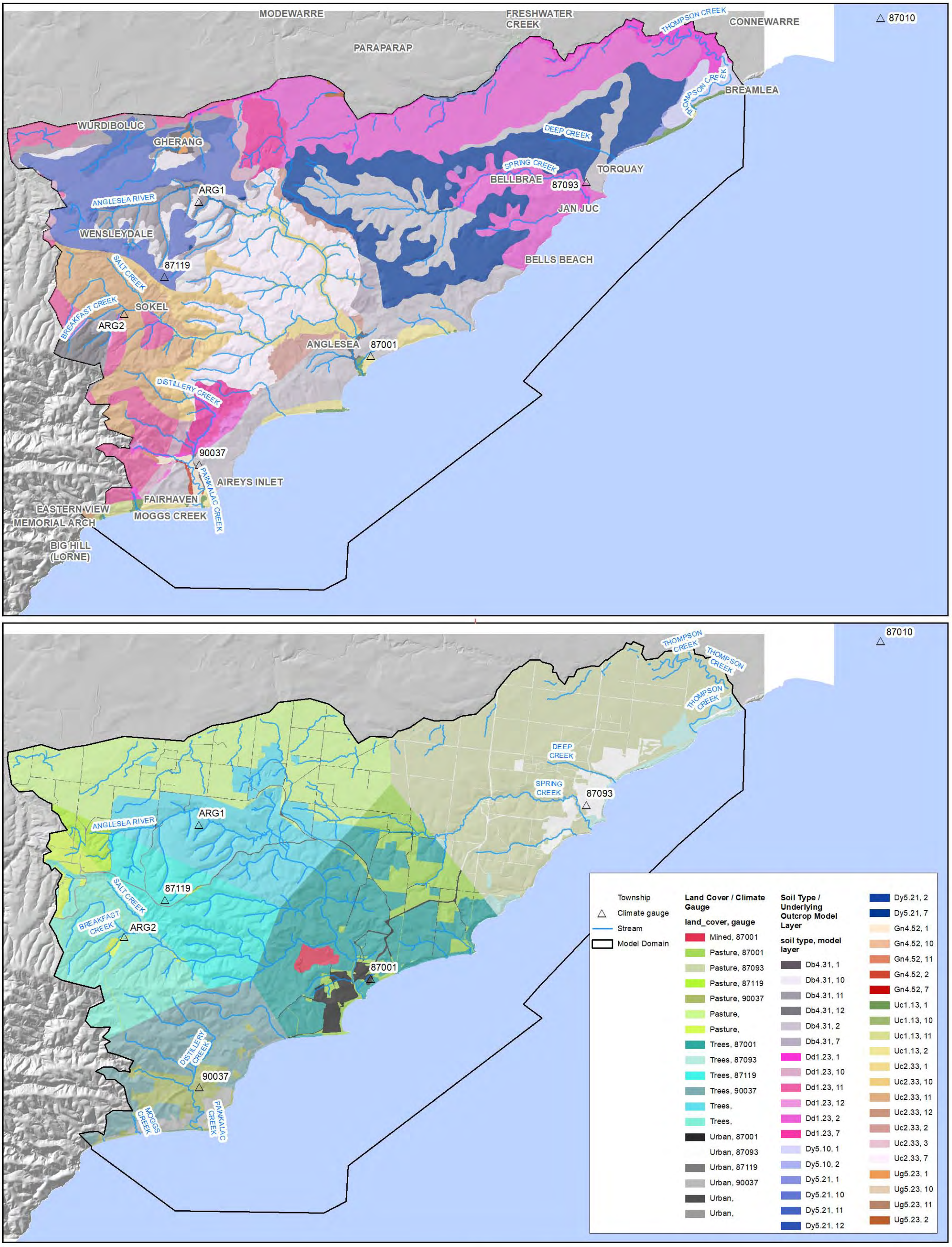


Figure 4-10 ***Recharge-runoff model process schematic and its links to the groundwater model***



Paper Size ISO A3

0 1 2 3 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Groundwater Model History-Matching Observation Locations

Project No. 31-12542999
Revision No. 2
Date 20/01/2022

FIGURE 4-11

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Print date: 29 Jan 2024 - 17:31

Data source: . Created by: Chris Nicol

Figure 4-12 Example preliminary PERFECT mode outputs for selected soil types and land covers

4.5.7 Evapotranspiration from Groundwater

Evapotranspiration from groundwater is modelled using MODFLOW-USG's EVT package. This simulates uptake of groundwater through evaporation and transpiration, from within a defined "extinction depth" below the defined "evapotranspiration surface" (normally defined as the land surface, or top of the model). A simple linear function of the extinction depth is used to take evapotranspiration from groundwater at a linearly declining rate with depth. The user-defined maximum rate is applied when groundwater levels are at or above the defined evapotranspiration surface, and this rate is linearly reduced to zero as groundwater levels fall to or below the extinction depth.

The applied maximum rate was defined as pan evaporation ***minus*** the near-surface actual evapotranspiration modelled by PERFECT ("PE-AE"). Spatial aggregation from PERFECT to groundwater model cells is as described for recharge in Section 4.5.5. However, further spatially variable adjustment of the estimated maximum EVT rates is implemented using pilot points and kriging (via PLPROC's calc_kriging_factors_auto_2d function; see Doherty, 2016c and Doherty, 2003). These EVT adjustment factors are initially set to a value of one but can vary from 0.5 to 1.2 during history matching; this range remains consistent in the post-history matching (optimised) parameter realisations (see Section 6.1.7 and Figure 6-32).

Applied extinction depths are initially set to values of 5 m for natural areas outside of the swamps (a mix of heath, eucalypt, and many other species), 2.5 m for swamp and alluvial areas (mixed species but largely melaleuca scrub), and 1 m for areas of pasture. Allowable extinction depth ranges for history-matching are set wide however, in recognition of the wide variety of landscapes and vegetation within the domain, and the inherent variability and uncertainty of this parameter. These ranges are loosely based on the global data of Canadell and others (1996) and Fan and others (2017) and are outlined in Table 4-2, recognising that:

- There are no known Anglesea-specific species rooting depth or water use data.
- The strong sensitivity of rooting system depth to local topographic, soil, climatic and hydrologic conditions (see Fan and others, 2017).
- The heavily simplified representation of saturated zone evapotranspiration in MODFLOW-USG.
- The same set of pilot points as is used to scale the maximum EVT rate are also used to spatially scale extinction depths across the domain during history-matching.

Table 4-2 Maximum Evapotranspiration Extinction Depths

Land Cover Type	Initial Value [m]	Minimum Value [m]	Maximum Value [m]
Natural (uncleared) areas	5	1	20
Swamp and alluvial	2	0.5	5
Pasture / grassland	1	0.5	2
Bare ground (open mine pit)	1	0.5	2

Within the historical Alcoa coal mine void, the evapotranspiration surface is changed over time according to the area of open cut mine developed at any given time. It is assumed in these areas that the evapotranspiration surface is the same as the Drain boundary elevations, which can change during history matching (see Section 4.5.9). When (if) these open cut areas are subsequently backfilled, the evapotranspiration surface is set at the pit floor elevation as recorded in the 2021 project DEM, which reflects rehabilitated mine pit conditions.

An attempt was made to make the EVT surface adjustable during history matching; however, this was found to instil too much instability in the models, and therefore adversely affected the model history matching and uncertainty analysis processes. It was therefore abandoned.

The sensitivity of groundwater evapotranspiration rates to projected future climate changes will be assessed using the PERFECT model climate scenarios described in Section 4.5.6. To be clear, PE-AE from versions of the PERFECT models with altered rates of potential evaporation will be used to define maximum evapotranspiration rates in MODFLOW-USG's EVT package in each climate scenario, just as they are for the history-matching models.

4.5.8 Creeks and Rivers

MODFLOW-USG's Streamflow Routing (SFR2) package is used to simulate stream flows through the modelled catchment (Figure 4-9), and stream interaction with groundwater. This package accumulates and routes applied quickflow (Section 4.5.5) and baseflows from headwaters down the length of each stream. With MODFLOW-USG's upstream weighting option invoked, this package can pass leakage from the stream down to underlying partially- or fully saturated layers via completely unsaturated ("dry") layers; this may be important for the Anglesea model but was not available in most older versions of MODFLOW. This functionality holds true for any applied flux and/or boundary condition in MODFLOW-USG when the upstream weighting option is used.

The package as applied here uses Manning's equation to simulate time-varying stream stage in response to variable flow routing volumes; Manning's n is set to a value of 0.1, which is not adjusted during history-matching. A simple rectangular channel cross section is applied, with widths as defined in Table 4-3. The location of all SFR nodes in the model is presented in Figure 4-9.

Streambed hydraulic conductivity, which controls the degree of channel leakage to and/or from the groundwater system, is made adjustable for model history-matching. This is implemented using pilot points and kriging (via PLPROC's calc_kriging_factors_auto_2d function; see Doherty, 2016c and Doherty, 2003). This is initially set to 0.1 m/day, based on initial manual history-matching. The optimised base realisation of optimised bed hydraulic conductivity and the range of optimised uncertainty is discussed and shown later in this report, in Section 6.1.7 and Figure 6-34.

Table 4-3 Modelled Initial Stream Properties

Strahler Stream Order	Stream Base Width (m)	Stream Bed Thickness (m)	Manning's n (/m)
1	0.5	1	0.1
2	0.5	1	0.1
3	2.5	1	0.1
4	5	1	0.1

Some of the outputs from PERFECT are used to define inputs to the MODFLOW-USG groundwater model. Quickflow (runoff plus interflow) estimated by PERFECT (see Section 4.5.5) is directly passed, with adjustable time lag factors (see below), to the downslope receiving Streamflow Routing (SFR2) package reach of the MODFLOW-USG groundwater model. This depends on the proportional area of soil type and land use (i.e., PERFECT model polygons; see Section 4.5.5) within the contributing watershed area for each SFR2 reach and is implemented using a Python script. Note that SFR2 reaches are shown as model cells in Figure 4-9 – so there are many small watersheds within which PERFECT's quickflow estimates are accumulated for.

Daily runoff and interflow estimated by the PERFECT models is delayed using simple linear decay stores with daily release factors that are made adjustable during model history matching. These stores work by releasing only a defined fraction of the runoff and interflow from PERFECT to the SFR2 network per day; the residual is accumulated over into the next day, when the same fraction of the residual, plus additional runoff, and interflow from that day, is released to the SFR2 network. Initial runoff decay is 0.95, and that for interflow is 0.9, for all PERFECT models, however these can differ from one another during history matching.

Spatial scaling of applied interflow is implemented at the groundwater model cell scale as is described for recharge in Section 4.5.5, but this is not applied to runoff given the poor regression quality between rainfall and runoff variability (see the second figure in Appendix A). Cell-scale spatial variability[14] in applied runoff and interflow from PERFECT is implemented using pilot points as was described for recharge in Section 4.5.5; these are scaling parameters with an initial value of 1, and are adjusted during history matching and uncertainty analyses, as informed (or not) by the observation data.

For the initial steady state model, PERFECT's estimate of average inflows to the stream network over the same period as that used to define steady state recharge is applied (1960 through 2021; Section 4.5.5).

[14] I.e., beyond the variability represented by the 237 land cover / soil type / climate gauge (PERFECT model) polygons.

MODFLOW USG's GAGE package is used to record modelled flow timeseries at the SFR2 reach locations of flow gauges for history-matching (see Section 5).

During model design, consideration was given to the need to simulate drying and rewetting of model cells beneath modelled streams; in earlier versions of MODFLOW, if a cell beneath a stream became desaturated (because of low rainfall and/or other factors), then the modelled stream flowing over the top of the cell would (unrealistically) stop interacting with the underlying groundwater. The software used for this model, USG-Transport, caters for such situations if upstream-weighting and Newton-Raphson iterations are activated - which they are - by never removing dry model cells from the groundwater flow equations. That is, in this model, streams can always lose water to underlying desaturated aquifers, which is potentially an important requirement in the modelled Anglesea catchments.

Related to this question, consideration was also given to model capability in simulating delayed leakage from streams to the watertable via the vadose zone, given the potential for very deep watertable levels around the Alcoa mine void and lower Anglesea and Salt Creek swamplands. Whilst MODFLOW-USG can simulate such vadose zone processes beneath losing streams, it is considered an unnecessary complexity, and best practice modelling suggests that complexity should be avoided unless that complexity is of direct relevance to required model forecasts (Doherty and Moore, 2021).

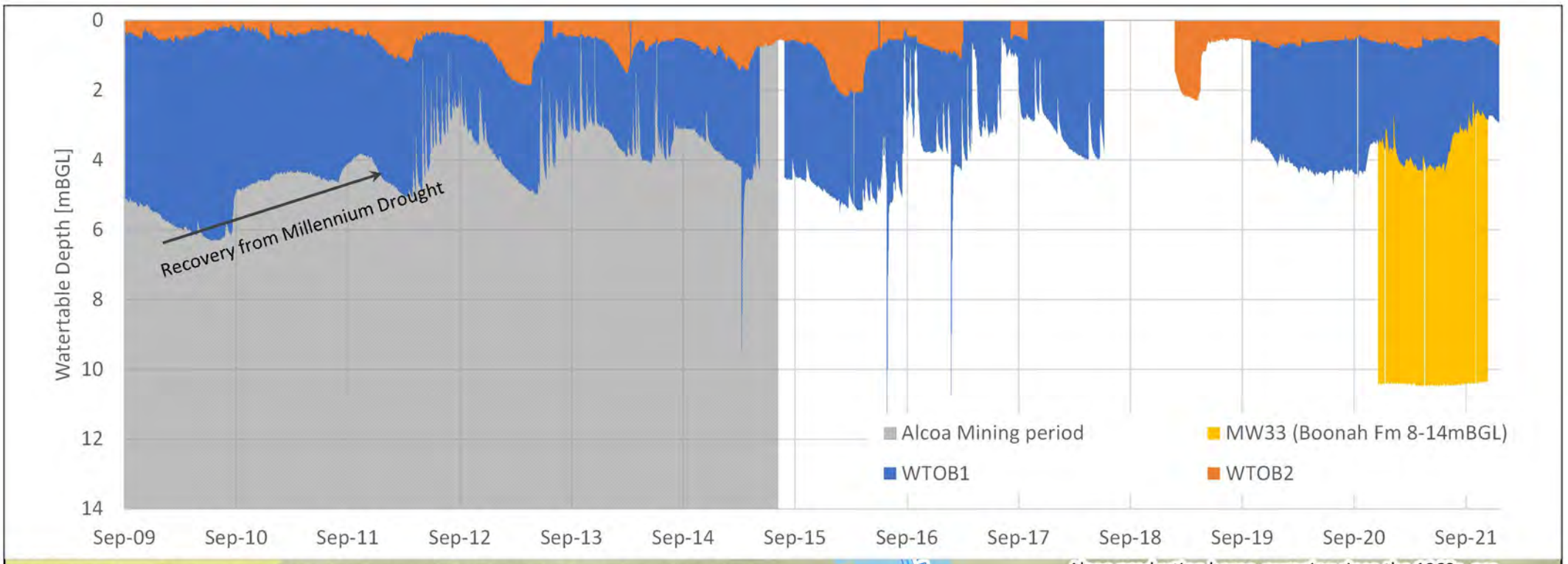
Figure 4-13 presents a series of observations relating to the issue. In summary, there is no evidence of a very deep watertable in the swamps and/or other sediments underlying the lower Anglesea River and/or Salt Creek. To the contrary, the watertable is observed to be consistently shallow (typically less than 5-10 m) throughout this area, with no evidence that historical mine pit dewatering and/or UEVF groundwater pumping has desaturated the shallow watertable around the Alcoa mine; of course, immediately adjacent the pit, this is unlikely to hold true, but from the evidence presented, it appears that any desaturation must only exist within very close proximity to the pit. This is consistent with the conceptualisation of the swamp groundwater system as presented by GHD (2013) and is the reason why the swamp/alluvial watertable aquifer was originally named the "Perched Watertable" (PWT) by GHD (2013)[15]. This is also consistent with the clear long-term evidence of the extensive swamplands remaining swamplands, with periodically groundwater-dependent vegetation, despite Alcoa mine void development since the 1970s, and despite the Millennium Drought.

However, it is important to understand that this is not to say that deeper sediments (e.g., UEVF sub-units) *underlying shallow saturated sediments* (i.e., the ASA) in the lower catchment area are not or have not ever become desaturated in response to mine void development and/or groundwater abstraction. To the contrary, the observation data suggests that this is a near certainty in some places, *must* be true in the immediate vicinity of the (dewatered) pit, and may also have occurred naturally in places in the pre-mining period. This is also consistent with the conceptualisation of GHD (2013).

Based on the available evidence, there is no need to introduce the added unnecessary complexity to the model to simulate delayed and attenuated leakage from streams to the watertable around the Alcoa mine void in the lower catchment, because the watertable in this area beneath streams is typically within 5-10 m of land surface, if not shallower. MODFLOW-USG's SFR2 package in its basic form as used here operates under the same assumption as similar head-dependent boundary conditions such as the River package; that is, "*that flow across the streambed sediments is translated directly to the water table without delay, and that the leakage rate does not exceed the saturated hydraulic conductivity of the deposits or rocks that occupy the interval between the bottom of the streambed sediments and water table*" (see Langevin and others, 2021). Given the observed shallow watertable beneath streams and the relatively coarse temporal model discretisation, this is considered a reasonable simplifying assumption for the Anglesea groundwater model.

The sensitivity of groundwater runoff and interflow rates to projected future climate changes will be assessed using the PERFECT model climate scenarios described in Section 4.5.6.

[15] Since renamed to the Alluvial / Swamp Aquifer (ASA)



Historical observed swamp watertable depths around the Alcoa mine have always been shallow (typically less than 5 m below ground). Bores WTOB1 and WTOB2, located 400 and 600m from the mine void, provide evidence of this (above). This holds true over the relatively dry period from 2009 until August 2016 when Alcoa ceased groundwater pumping and pit sump dewatering. The early part of the active mine operations period shown above was also recovering from the extremely dry period of the Millennium Drought.

On this basis, there is no need to simulate delayed leakage from streams to the watertable via the vadose zone in these areas, because the watertable is and always has been consistently shallow in the available historical record.

Further evidence of this is the fact that the Anglesea and Salt Creek swamps remain and have always been swamps - i.e., areas of shallow watertable with periodically groundwater-dependent vegetation.

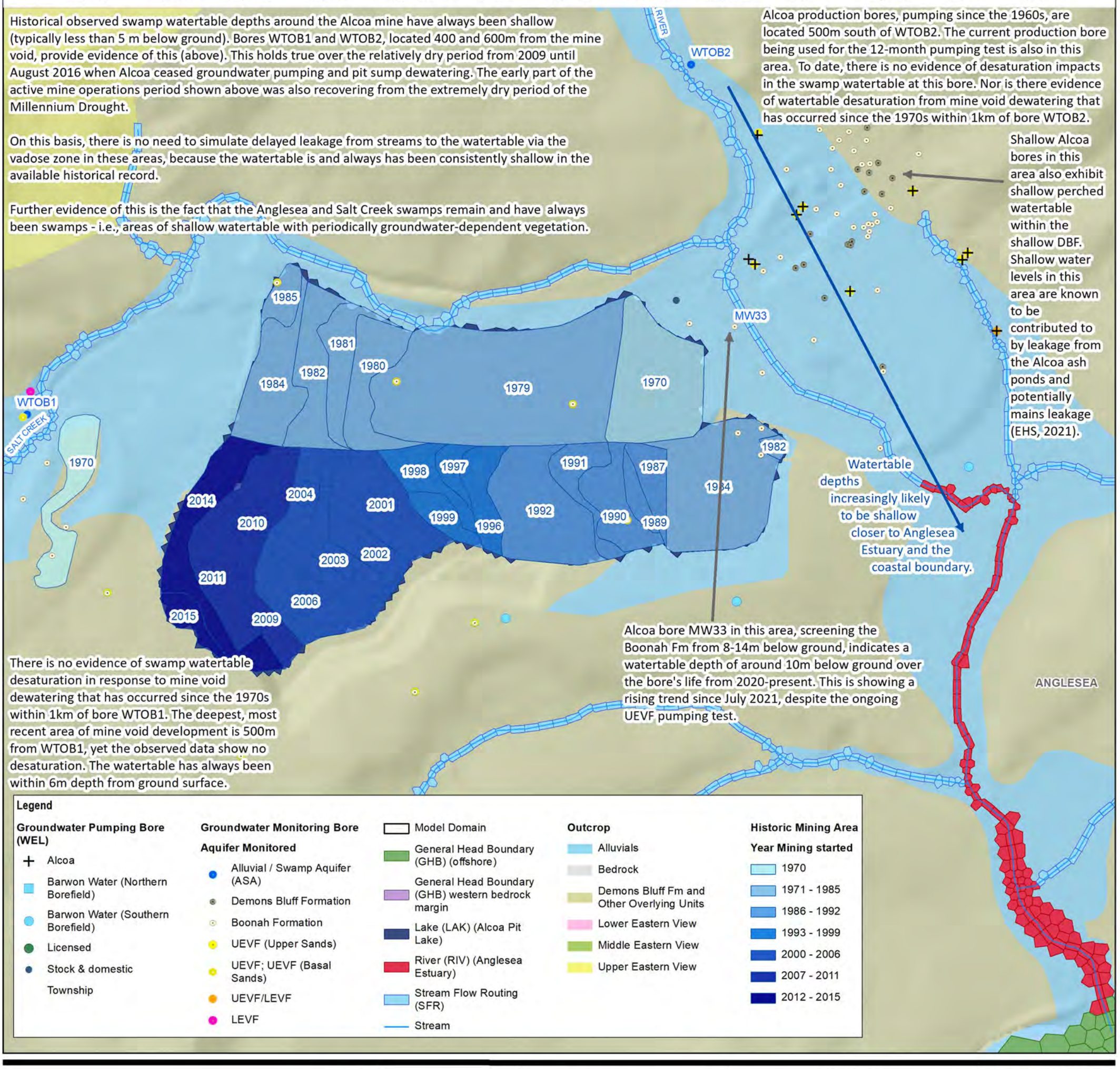
There is no evidence of swamp watertable desaturation in response to mine void dewatering that has occurred since the 1970s within 1km of bore WTOB1. The deepest, most recent area of mine void development is 500m from WTOB1, yet the observed data show no desaturation. The watertable has always been within 6m depth from ground surface.

Alcoa production bores, pumping since the 1960s, are located 500m south of WTOB2. The current production bore being used for the 12-month pumping test is also in this area. To date, there is no evidence of desaturation impacts in the swamp watertable at this bore. Nor is there evidence of watertable desaturation from mine void dewatering that has occurred since the 1970s within 1km of bore WTOB2.

Shallow Alcoa bores in this area also exhibit shallow perched watertable within the shallow DBF. Shallow water levels in this area are known to be contributed to by leakage from the Alcoa ash ponds and potentially mains leakage (EHS, 2021).

Watertable depths increasingly likely to be shallow closer to Anglesea Estuary and the coastal boundary.

Alcoa bore MW33 in this area, screening the Boonah Fm from 8-14m below ground, indicates a watertable depth of around 10m below ground over the bore's life from 2020-present. This is showing a rising trend since July 2021, despite the ongoing UEVF pumping test.



Paper Size ISO A3

0 1.5 3 4.5 6

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Swamp Watertable Depths Around the Alcoa Mine

Project No. 31-12542999
Revision No. 2
Date 05/05/2022

FIGURE 4-13

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4.5.9 Alcoa Coal Mine, Sump, and Rehabilitated Pit Water Body

The Mining Period

Historical mine drainage from groundwater into the mine sump is simulated using MODFLOW USG's Drain (DRN) boundary[16]. Drains are located across the actively mined pit floor locations, which vary over time according to information provided by Alcoa. Drain elevation is initially assigned using a single mine floor elevation estimate for each major mining block within the mined area, as provided by Alcoa. However, the elevations and therefore layers intersected by the Drain boundaries are allowed to vary at a finer spatial scale than the mining block during model history-matching - by +/-10 m from Alcoa's block-based estimates. This is achieved using pilot points scattered throughout the historically mined area.

Drain conductance is initially defined using:

- The vertical permeability of the model layer that each Drain boundary cell intersects (as defined by its elevation),
- Intersected cell areas, and
- An assumed clogging layer thickness of 1 m.

Conductance is however adjusted during history-matching as a factor of the initial estimate, as informed by recorded mine sump pumping rates, noting that sump pumping includes runoff into the mine void, and Alcoa has historically estimated the proportion of runoff versus groundwater at certain times; uncertainty arising from this is accounted for through the inclusion of significant error (noise) on these observations as described in Section 5.2, and relatively little weight should be placed on them in the history-matching process. Optimised Drain conductance values for the base model realisation are presented in Figure 4-14.

Evapotranspiration of shallow groundwater from the historical mine pit floor is simulated using the EVT package as is described in Section 4.5.7.

Drain boundaries are also applied to layers overlying the mined seam; DRN elevations for these are set to the cell floor elevation, and conductance is calculated in the same way as the mined layer but using the respective layers' hydraulic conductivity. In practice, these overlying DRN cells represent removal of water from storage as overburden is removed from the excavated pit. As time progresses, flux into these layers will comprise lateral and vertical inflow to the pit sides and floor (seepage), much of which is likely to evaporate on the pit walls and floor before reaching the sump; over the entire historically mined area (1.68 km^2), evaporation could range from approximately 3.5 to 4.8 ML/day, for an average annual evaporation rate of 1050 mm/year.

At the times and locations of mining initiation, aquifer properties are altered to reflect their (subsequently) backfilled and/or mining-modified hydraulic properties (vertical and horizontal hydraulic conductivity, specific yield, and specific storage). This is achieved using USG-Transport's Time-Varying Materials (TVM2) package (Panday, 2023). Note that the Drain conductance calculations described above are however made using "host" (pre-TVM application, or pre-mining) properties. Initial TVM properties for each layer are provided in Table 4-4; in practice during history matching, these values are variably changed at a fine spatial scale using pilot points. Some areas of the pit were never backfilled, and they remain open void; these areas are still assigned the TVM properties outlined in Table 4-4, however, they generally do not ultimately affect the simulation, because the Lake (LAK) package inactivates these model cells in the post-mining period in terms of groundwater flow, instead simulating the pit water body here as a time-varying head boundary based on the pit water balance (see discussion below) [17]. Maps showing the optimised base model realisation hydraulic properties for the mined area are presented in Figure 4-15 through Figure 4-18.

[16] Although it would be possible to simulate the historical mine pit using the LAK3 package, this was considered unnecessarily complicated and prone to significant data limitations. We instead chose to focus history matching of water body behaviour and LAK3 package parameters on the post-mining (rehabilitation) period, given that this relates to many key model forecasts of interest (see Section 2.1), and is the period over which we have more robust data with which to constrain water body hydrology.

[17] In places, they may affect LAK-groundwater conductance values in the post-mining period.

Table 4-4 Simulated Alcoa Mine Excavation and Backfill Properties

Model Layer	Kh [m/day]	Kv [factor of Kh; -]	Ss [/m]	Sy [-]
1	10 [0.001 - 30]	1 [0.001 - 1]	0.0001 [0.000001 - 0.001]	0.2 [0.01 - 0.5]
2	10 [0.001 - 30]	1 [0.001 - 1]	0.0001 [0.000001 - 0.001]	0.2 [0.01 - 0.5]
3	10 [0.001 - 30]	1 [0.001 - 1]	0.0001 [0.000001 - 0.001]	0.2 [0.01 - 0.5]
4	10 [0.001 - 30]	1 [0.001 - 1]	0.0001 [0.000001 - 0.001]	0.2 [0.01 - 0.5]
5	10 [0.001 - 30]	1 [0.001 - 1]	0.0001 [0.000001 - 0.001]	0.2 [0.01 - 0.5]
6	10 [0.001 - 30]	1 [0.001 - 1]	0.0001 [0.000001 - 0.001]	0.2 [0.01 - 0.5]

Note: Values show are the initial value used in history matching, with the allowable range shown in brackets.

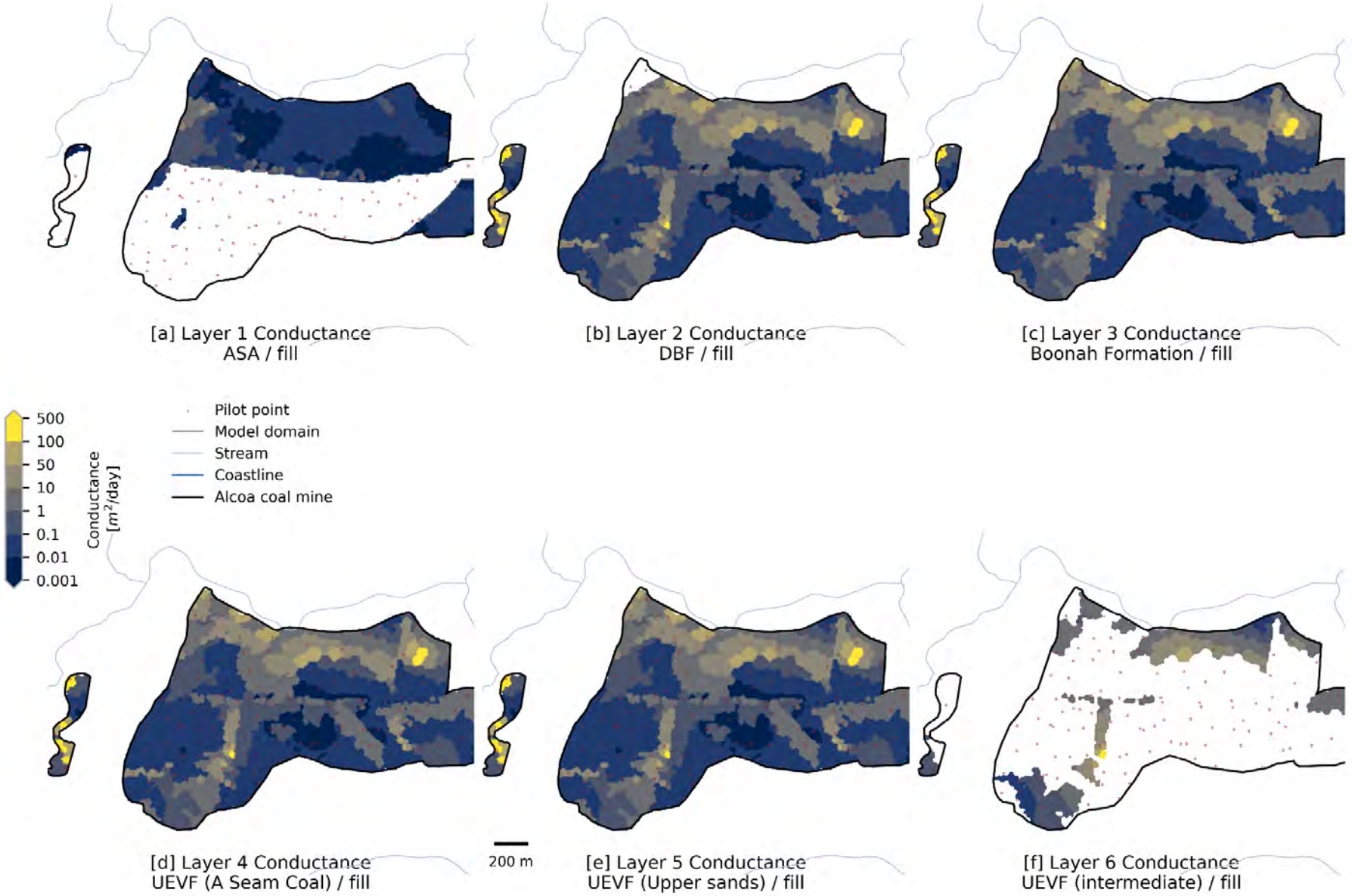


Figure 4-14 Alcoa Mine – Modelled Drain Conductance [optimised base realisation]

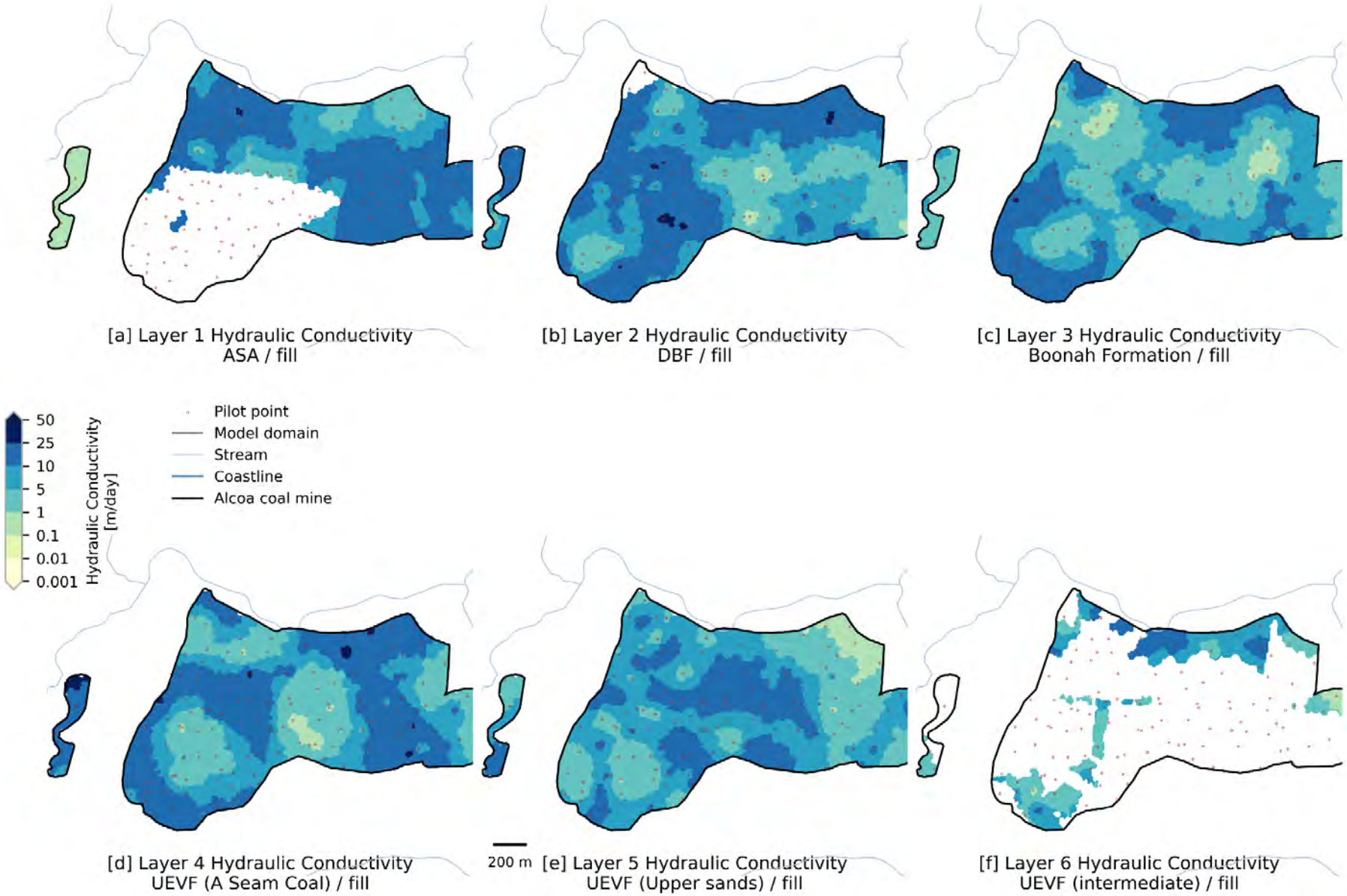


Figure 4-15 Modelled Post-Alcoa Mining Backfill / Altered Properties – Horizontal Hydraulic Conductivity [optimised base realisation]

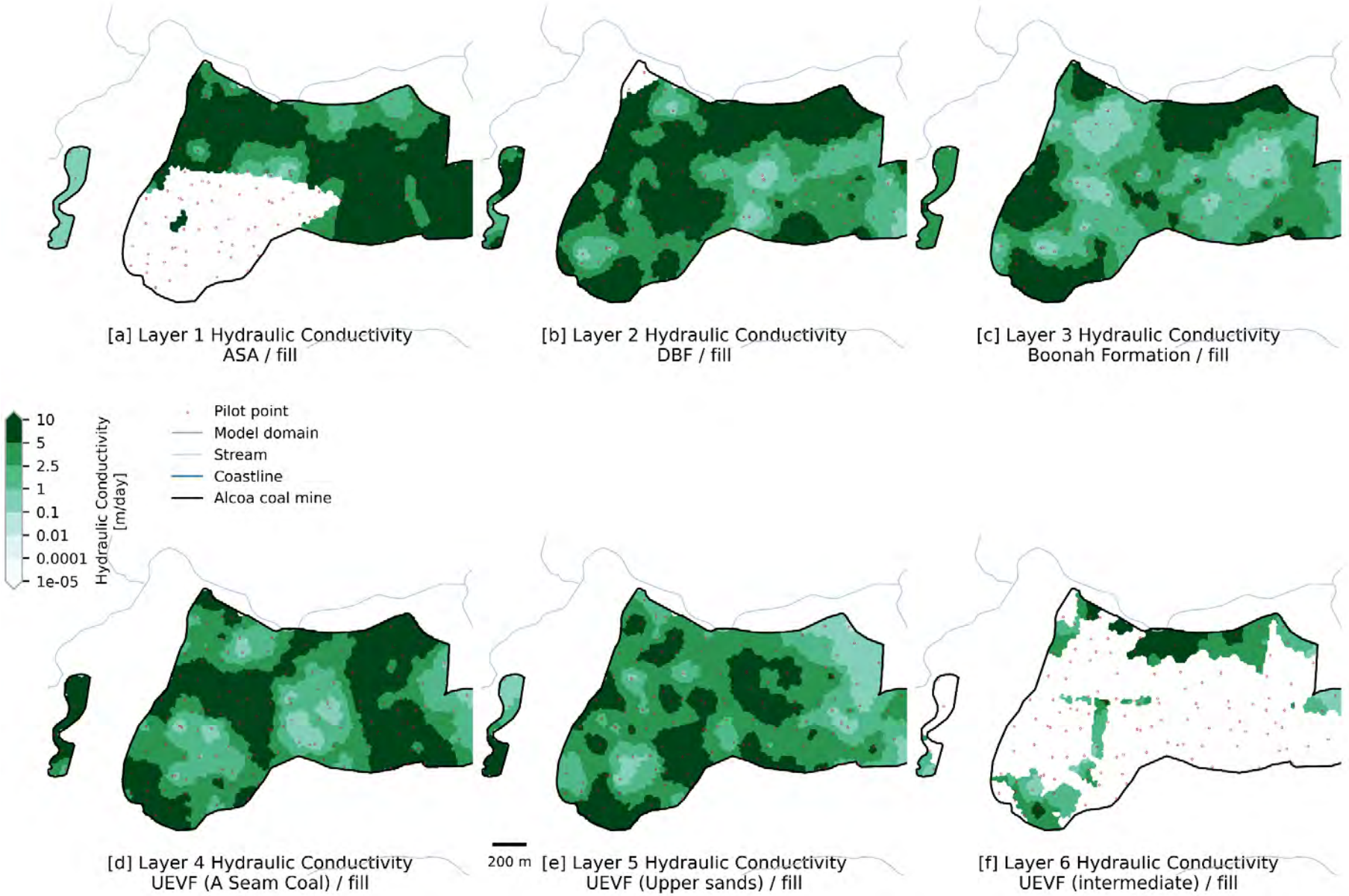


Figure 4-16 Modelled Post-Alcoa Mining Backfill / Altered Properties – Vertical Hydraulic Conductivity [optimised base realisation]

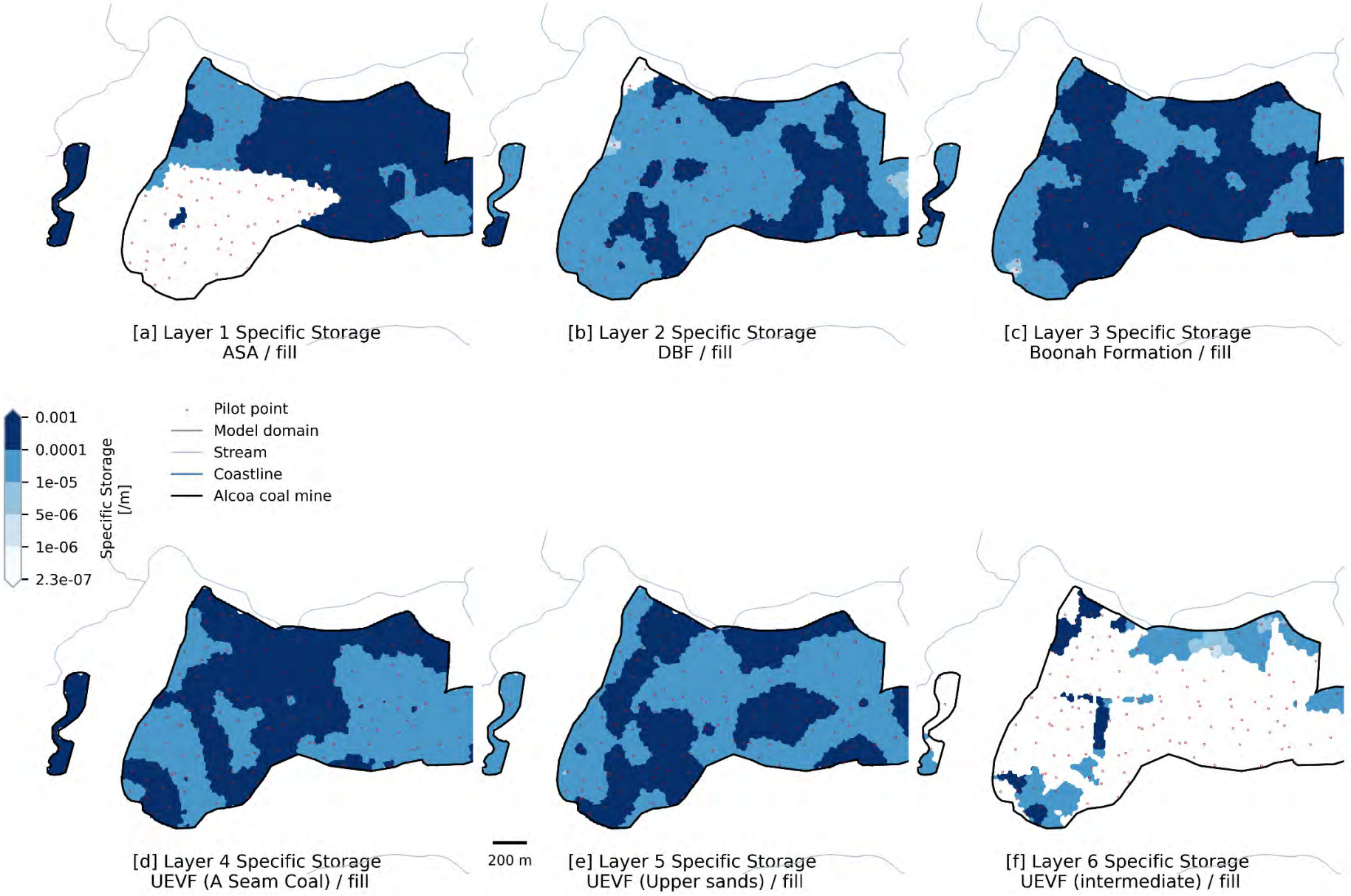


Figure 4-17 ***Modelled Post-Alcoa Mining Backfill / Altered Properties – Specific Storage [optimised base realisation]***

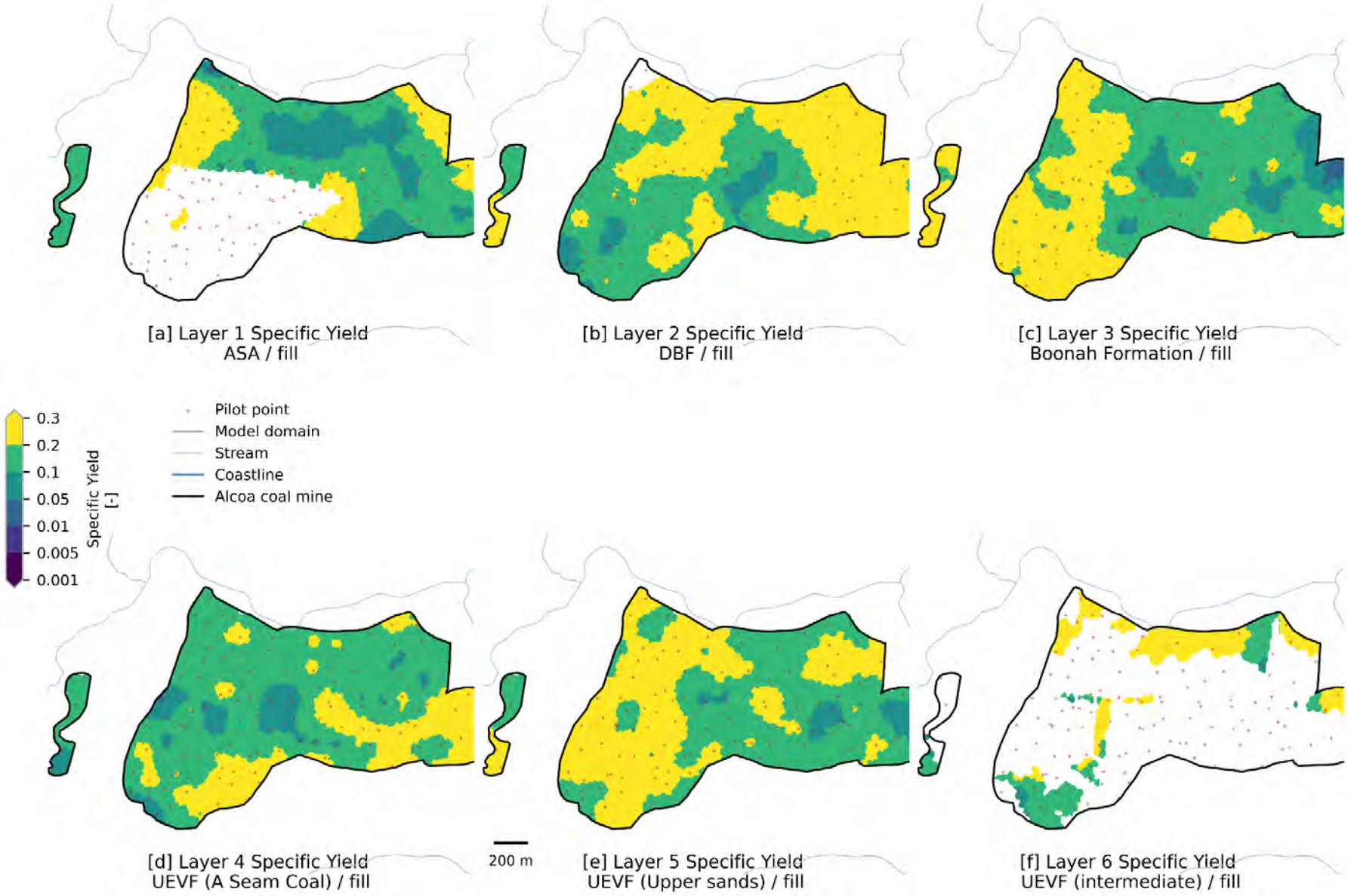


Figure 4-18 ***Modelled Post-Alcoa Mining Backfill / Altered Properties – Specific Yield [optimised base realisation]***

The Post-Mining Period

MODFLOW USG's Lake package (LAK3; Merritt and Konikow (2000); Panday and others (2013)) is used to dynamically simulate Alcoa's rehabilitated pit water body water balance and hydraulics, in response to underlying and surrounding groundwater pressures and aquifer properties. It is shown in Figure 4-9.

In the simulated post-mining period, the LAK3 package is assigned to model layers 2, 3, 4 and 5 (DBF through to the UEVF Upper Sands), as dictated by pit floor geometry (bathymetry) and history matching. The top of layer 2 within the water body is set to 7 mAHD – the maximum achievable final pit water body level given current spill levels. The Lake package as applied here uses specified water body (pit) bathymetry within mined areas; this defines modelled water body level- volume and area curves. Bathymetry is defined using a combination of the 2021 and 2017[18] project DEM elevation data sets.

For wetted water body areas, groundwater flow is internally deactivated by MODFLOW-USG, as is the EVT package (evapotranspiration from shallow groundwater) and recharge (RCH) package. When these areas of water body bed dry out, applied recharge and groundwater evapotranspiration are reactivated and applied to the cell underlying the water body bed. The maximum extent of the modelled water body boundary is shown in Figure 4-9.

- Modelled water inflows to the pit water body boundary condition include the following:
    - Upward seepage from groundwater through the water body bed.
    - Runoff and interflow from the local pit catchment, as estimated using the project Digital Elevation Model (DEM) and recently installed surface drain information (EHS, 2022a).
    - Direct rainfall.
    - Artificial augmentation, for example as occurred during Alcoa's 6-month UEVF pumping trial in 2021.
- Pit water body outflows include:
    - Evaporation from the water body water surface. This will increase with increasing pit water body surface area (I.e., as the pit water body level rises).
    - Potential leakage to groundwater at times.
    - (Potentially) water body spill outflow to the Anglesea River.

Runoff and interflow components are defined using the outputs of the recharge-runoff model as is described for SFR2 reaches in Section 4.5.8. Potential water body evaporation rates are derived from the evaporation gauge closest to the mine (Anglesea). An initial pit water body pan evaporation factor of 0.75 was applied based on EHS (2022a) but is made adjustable during history matching. Allowable ranges for history matching consider alternative estimates including those using Morton's water body evaporation, which is included with SILO.

The sensitivity of groundwater runoff and interflow rates to projected future climate changes will be assessed using the PERFECT model climate scenarios described in Section 4.5.6.

Initial water body bed leakance values were defined using the vertical hydraulic conductivity values of the underlying groundwater model cell for both horizontal and vertical connections, because in practice modelled horizontal connections from the lake to surrounding groundwater are sub-vertical. This is adjusted during history matching, as the properties of the water body bed material can only be inferred through the observed groundwater and water body level data.

The sensitivity of groundwater runoff and interflow rates to projected future climate changes will be assessed using the PERFECT model climate scenarios described in Section 4.5.6. Potential pit water body evaporation rates will be scaled accordingly.

[18] The 2017 DEM is used where the 2021 DEM represents the submerged pit water body area.

4.5.10 Groundwater Abstraction

All groundwater users' bores were simulated using MODFLOW USG's Well (WEL) package (Panday and others, 2013). These bores are presented in Figure 4-9. For all Alcoa and Barwon Water production bores, these WEL boundaries are simulated within MODFLOW-USG Connected Linear Networks (CLNs). The CLN package allows a bore to pump from more than one screened aquifer, which was historically the case in at least one Alcoa production bore. It also simulates head and storage within the bore itself, as affected by well losses and the conductance between the bore and the aquifer.

Bore construction details are used to define the radius and length terms CLN package where available, and the Thiem equation with no skin is used to estimate CLN to groundwater cell conductance.

Actual groundwater abstraction data are available for the Alcoa power station extraction boreholes for the period April 1970 to 2022 and these data are used to calculate average monthly rates for each of the bores. All recorded historical groundwater abstraction data are presented in Appendix B. It is worth noting that the Alcoa bores were often historically used on a sub-daily (on/off) basis, and that recorded production bore groundwater levels comprise a mix of static (no pumping) and pumped levels. This means that when fine temporal scale historical pumping data are aggregated up to coarser model stress periods (often monthly or longer), there is often a conflict between model temporal resolution, the resolution at which observed production bore groundwater levels are recorded, depending on whether those bores were actively pumped at the time of each groundwater level record. This conflict is considered in design of the model history matching process in terms of groundwater level data from intermittently pumped production bores (see Section 5.2.1).

Also of note for the Alcoa production bores is that the construction details of some are not well known. At least one is known to have screened both the LEVF and UEVF aquifers (WB9), whilst others are thought to *possibly* screen both aquifers (WB10 and WB4). Other factors that are known to affect a bore's connection to the screened sub-strata are screen and bore integrity. In recognition of these uncertainties, adjustable model parameters are introduced to the history matching process that allow a fraction of the initial (best guess) screened LEVF length to be reassigned to the bore's (CLN) connection to the UEVF aquifer. Initial LEVF screen length factors for these three bores are 0.9, based on initial manual history matching efforts and available data along with the geological model; allowable ranges are 0.001 to 0.98. Optimised LEVF screen length factors for WB10, WB9 and WB4 are 0.69, 0.34 and 0.16, respectively.

Furthermore, several of the Alcoa production bores that may intersect multiple aquifers have been decommissioned in recent years; this cessation of potential inter-aquifer connection via the bore is simulated in the model using USG-Transport's Transient Ibound (TIB) package (Panday, 2023). Using the same package, these bores' time of construction is used to define the stress period in which each bore (and the associated potential aquifer inter-connectivity) is activated in the model.

No actual abstraction data are available for the Moriac Quarry or the other agricultural and domestic groundwater users and hence steady extraction at licensed quantities or 2 ML/year for stock and domestic bores are assumed.

Current licensed extraction from the LEVF is limited to around 0.7 ML/day in total from the Moriac Quarry and one minor agricultural abstractor. Total licensed abstraction from the UEVF totals approximately 11.9 ML/day pre-Alcoa mine closure. Modelled abstraction locations are shown in Figure 4-9, and summarised in Table 4-5. There are estimated to be approximately 53 stock and domestic bore users within the model domain, most of which are (or were) located near Jan Juc and Torquay in the east. These bores largely extract from the Torquay Group (model layer 2).

Table 4-5 Modelled Long-Term Average Groundwater Abstraction Rates during Historical Operational Periods

Bore	Modelled Layer
Barwon Water ASR	Upper Eastern View (Layer 7)
Barwon Water GW1	Lower Eastern View (Layer 11)
Barwon Water GW2	Lower Eastern View (Layer 11)
Barwon Water GW3	Lower Eastern View (Layer 11)
Barwon Water GW4	Lower Eastern View (Layer 11)
Barwon Water GW5	Lower Eastern View (Layer 11)
Barwon Water GW6	Lower Eastern View (Layer 11)
Barwon Water GW7	Lower Eastern View (Layer 11)
Alcoa WB10	Upper & Lower Eastern View (Layer 7, 11)
Alcoa WB12	Upper Eastern View (Layer 7)
Alcoa WB13	Upper Eastern View (Layer 7)
Alcoa WB14	Upper Eastern View (Layer 7)
Alcoa WB15	Upper Eastern View (Layer 7)
Alcoa WB16	Upper Eastern View (Layer 7)
Alcoa WB17	Upper & Lower Eastern View (Layer 7, 11)
Alcoa WB4	Upper & Lower Eastern View (Layer 7, 11)
Alcoa WB5	Upper Eastern View (Layer 7)
Alcoa WB9	Upper / Lower Eastern View (Layer 7 / 11)
Moriac Quarry	Lower Eastern View (Layer 11)
Buchanan Irrigation Bore	Lower Eastern View (Layer 11)
Stock and domestic users	Primarily Torquay Group (Layer 2) and other shallow formations

4.6 Hydraulic Properties

MODFLOW-USG's Layer Property Flow (LPF) package is used with upstream weighting (layer type 4) for calculating groundwater flow components in the model. This requires definition of aquifer hydraulic properties, parameterisation of which is now outlined.

Table 4-6 presents initial (pre-history-matching, or "prior") horizontal and vertical hydraulic conductivity parameters, and their allowable upper and lower bounds for history-matching. Table 4-7 presents the same information, but for aquifer storage parameters.

These are presented for each model layer (which are described in Table 4-1) and are based on field data from Alcoa and Barwon Water where available, and/or the available literature (primarily Rau and others (2018), and Chowdhury and others (2020)), along with the application of conceptual judgement and experience. It is important to note that these parameters are for input to the numerical model's history-matching process; there are therefore several points of important note regarding their definition and use in the modelling context:

- Initial values and allowable ranges need to reflect what each model layer represents in reality - i.e., highly variable lithologic units - versus its simplified, discretised form (a single model layer, with each model cell representing variable-sized portions of that highly variable geological material).
- Allowable ranges need to be wider than field test data might indicate. This is because of the variable materials that each model cell represents, and because field test data is subject to bias. Both observation and production bores tend to be screened in the most permeable (highest yielding) portions of aquifer material. Furthermore, several bores screened within the same model layer will often likely screen different sub-units within that layer; this is likely to be a major contributor to model structural noise in this model. Bores are also only sparsely located across the model domain, relative to the scale of true geological variability.

Figure 4-19 through Figure 4-23 present maps of modelled horizontal hydraulic conductivity, for the history-matched "base" realisation[19]. The prior realisation is not presented here because there is little spatial variability, so little of interest to display; local prior variability is only present at the Barwon Water and Alcoa production bores, primarily within the UEVF and LEVF aquifers.

Figure 4-19 through Figure 4-23 show the "pilot point" parameters (red dots; see Doherty (2003)) that are used to introduce spatial aquifer parameter variability to model parameters for each layer. Interpolation from these pilot point parameter locations to the model mesh is undertaken for each layer and parameter type using kriging, via PLPROC's calc_kriging_factors_auto_2d function (see Doherty, 2016c). Kriging ranges are defined using MKPPSTAT (Doherty, 2016d), with ranges defined as twice the average distance from each pilot point to its closest eight neighbouring pilot points, in the same layer. Kriging sills are defined as one; all parameters are log-transformed, so this equates to one order of magnitude sill variability at and beyond the (spatially-variable) range distance. No kriging anisotropy is implemented.

Horizontal and vertical hydraulic conductivity (its ratio to hk), specific storage, and specific yield were all parameterised in this way. Specific yield parameters in areas that never become unconfined (offshore) are not adjusted during history matching. Maps of optimised base realisation parameter sets for vertical hydraulic conductivity are presented in Figure 4-24 through Figure 4-28. Corresponding maps for specific storage are presented in Figure 4-29 through Figure 4-32, and for specific yield in Figure 4-33 through Figure 4-37. Parameter range reductions from the prior (pre-history matching) realisations to those of the posterior are discussed and presented in Section 6.1.7.

The same set of pilot points are used for all layers but are limited to the spatial extent of each active model layer area, as shown in Figure 4-19 through Figure 4-37. Pilot point locations were defined using a combination of the following:

- A selection of regularly spaced SFR package nodes, and the ASA extent polygon, to ensure spatial parameter flexibility in the important stream valley floors.
- A custom Python script to build regularly spaced and aligned point data sets along and within the Jan Juc anticline, to allow flexibility in hydraulic connectivity (or lack thereof) across the anticline within the LEVF (see the area of low hydraulic conductivity across the anticline in Figure 4-23, which is not present in the other layers, because those layers are known to be thick and continuous over the anticline).
- Production and observation bore locations – to encourage a variable density of pilot points (and spatial variability) depending on observation and production bore density in different areas of the model.
- The historical Alcoa coal mine polygon – to ensure sufficient pilot points in and around this important feature.
- Triangulation within the domain using Algomesh (HydroAlgorithmics, 2020), using the input points and polygons defined above. It can be seen in Figure 4-19 through Figure 4-23 that there is reduced pilot point density further from areas of interest, aquifer stress, and monitoring; for example offshore and to the east.

[19] The "base" realisation in PESTPP parlance is the model parameter realisation (one of many) that is either the history-matched (posterior) parameter set derived from the initial (prior, expert knowledge-based) parameter set, or the prior itself. In this case, all other model realisations are centred around the base realisation, for both prior (un-optimised), and posterior (optimised / history-matched) realisations.

Table 4-6 Initial modelled aquifer hydraulic conductivity parameter values and allowable ranges per model layer

Parameter	Layer	Initial Value	Min Value	Max Value	Initial Value Basis
Horizontal Hydraulic Conductivity (hk) [m/day]	1	1.08E+00	8.64E-05	3.00E+01	Chowdhury et al (2021) sandy material, limited maximum to 30m/day. Min reduced to account for stratigraphic variability.
	2	4.06E-03	1.73E-05	3.02E+00	Chowdhury et al (2021) clayey material. Min reduced to account for stratigraphic variability.
	3	4.32E+00	8.64E-05	5.00E+01	Chowdhury et al (2021) sandy material. Min reduced to account for stratigraphic variability.
	4	1.00E-01	8.29E-04	1.21E+01	No coal data, so author experience from pumping and drill stem tests in coals in the Surat Basin, which range from 1e-4 to 1E+1, median ~1E-1 (noting they are probably more competent, more deeply buried coals than those at Anglesea)
	5	1.47E+00	8.64E-05	5.00E+01	Average of pumping test mean and min for initial value - to account for pumping bores targeting most productive strata. Max loosely based on UEVF test data. Min from Chowdhury et al (2021), but reduced to allow for stratigraphic variability.
	6	4.92E-01	8.29E-04	3.00E+01	Chowdhury et al (2021) silty material (no tests on this less permeable UEVF unit). Min reduced to account for stratigraphic variability. Max based loosely on UEVF test data. Min reduced to account for stratigraphic variability.
	7	1.47E+00	8.64E-05	7.50E+01	Average of pumping test mean and min for initial value - to account for pumping bores targeting most productive strata. Max based on UEVF test data. Min reduced to account for stratigraphic variability.2
	8	4.06E-03	1.73E-05	3.02E-02	Chowdhury et al (2021) clayey material. Min reduced to account for stratigraphic variability.
	9				
	10				
	11	8.90E-01	8.64E-05	5.00E+01	Average of pumping test mean and min for initial value - to account for pumping bores targeting most productive strata. Min from Chowdhury et al (2021), but reduced to account for stratigraphic variability. Max also from Chowdhury but limited based on LEVF and UEVF test data.
	12	7.17E-02	1.04E-05	3.00E+01	Chowdhury et al (2021) sandstone. Min increased by two orders of magnitude, based on shallow fractured aquifer at Anglesea. Max limited based on conceptual understanding.
Vertical Hydraulic Conductivity Factor of hk (kzf) [-]	1	1.00E-03	1.00E-04	1.00E+00	Assumed; no data. But given this is a thin discrete alluvial/swamp peat unit, this seems conceptually reasonable.
	2	2.45E-03	2.50E-05	1.00E+00	Ratio of test data geomean kv to mean hk for initial value. Min value 50% of UEVF test min. Max assumed.
	3	1.00E-03	1.00E-05	1.00E+00	Assumed; no data. But given this is a thin discrete sand unit, this seems conceptually reasonable.
	4	9.27E-04	1.00E-05	1.00E+00	Assume cleats are sub-vertical so not a lot of h-->v contrast
	5	9.27E-03	1.00E-05	1.00E+00	Average of UEVF tests. Min value 20% of UEVF test min. Max assumed.
	6	9.27E-03	1.00E-05	1.00E+00	Average of UEVF tests. Min value 20% of UEVF test min. Max assumed.
	7	9.27E-02	1.00E-05	1.00E+00	Average of UEVF tests. Min value 20% of UEVF test min. Max assumed.
	8	1.00E-01	2.50E-05	2.00E+00	Assumed, no tests, but 1E-1 gives slightly lower than UEVF kv, which seems reasonable conceptually for this

Parameter	Layer	Initial Value	Min Value	Max Value	Initial Value Basis
	9				primary regional aquitard unit. Min value 50% of UEVF test min. Max assumed; allowed higher than kh to allow for potential cracks, discontinuous clay sub-units and exploration drillhole pathways.
	10				
	11	9.27E-04	1.00E-05	1.00E+00	Average of UEVF tests. Min value 20% of UEVF test min. Max assumed.
	12	1.00E-01	1.00E-05	1.00E+00	Assumed, no data

Table 4-7 Initial modelled aquifer storage parameter values and allowable ranges per model layer

Parameter	Layer	Initial Value	Min Value	Max Value	Basis
Specific Storage [/m]	1	1.20E-05	2.30E-07	2.00E-03	N/A - unconfined aquifer
	2	1.73E-06	2.30E-07	8.00E-04	DBF - assume Rau et al (2018) geomean and range from Chowdhury et al (2021).
	3	4.74E-06	2.30E-07	2.00E-03	Boonah Fm - assume similar to UEVF (so Rau et al (2018) geomean of mid-upper, and range from Chowdhury et al (2021))
	4	1.00E-05	2.30E-07	1.00E-03	Largely coal - assume higher storage
	5	4.74E-06	2.30E-07	2.00E-03	UEVF Rau et al (2018) geomean of mid-upper, and range from Chowdhury et al (2021).
	6	4.74E-06	2.30E-07	1.00E-03	UEVF Rau et al (2018) geomean of mid-upper, and range from Chowdhury et al (2021).
	7	4.74E-06	2.30E-07	2.00E-03	UEVF Rau et al (2018) geomean of mid-upper, and range from Chowdhury et al (2021).
	8	1.73E-06	2.30E-07	8.00E-04	MEVF - assume Rau at al (2018) geomean, and range from Chowdhury et al (2021).
	9				
	10				
	11	3.02E-06	2.30E-07	2.00E-03	LEVF - geomean test data mean and min --> assume that the pumping test derived values are overestimates for models (which do not need an implicit leaky term). Chowdhury et al (2021) for range.
	12	3.70E-06	2.30E-07	4.00E-04	Chowdhury et al (2021) sandstone mean and range.
Specific Yield [-]	1	1.00E-01	5.00E-03	3.50E-01	No data; Johnson (1967); calibratable
	2	1.00E-02	1.00E-03	5.00E-02	No data; Johnson (1967); calibratable
	3	1.00E-01	5.00E-03	3.50E-01	No data; Johnson (1967); calibratable
	4	1.00E-02	1.00E-03	1.00E-01	No data; assumed based on the QLD UWIR model; calibratable
	5	5.00E-02	5.00E-03	3.50E-01	No data; Johnson (1967); calibratable
	6	5.00E-02	5.00E-03	3.50E-01	No data; Johnson (1967); calibratable
	7	5.00E-02	5.00E-03	3.50E-01	No data; Johnson (1967); calibratable
	8	1.00E-02	1.00E-04	5.00E-02	No data; Johnson (1967); calibratable
	9				
	10				
	11	5.00E-02	5.00E-03	3.50E-01	No data; Johnson (1967); calibratable
	12	1.00E-02	1.00E-03	1.00E-01	No data; assumed, calibratable

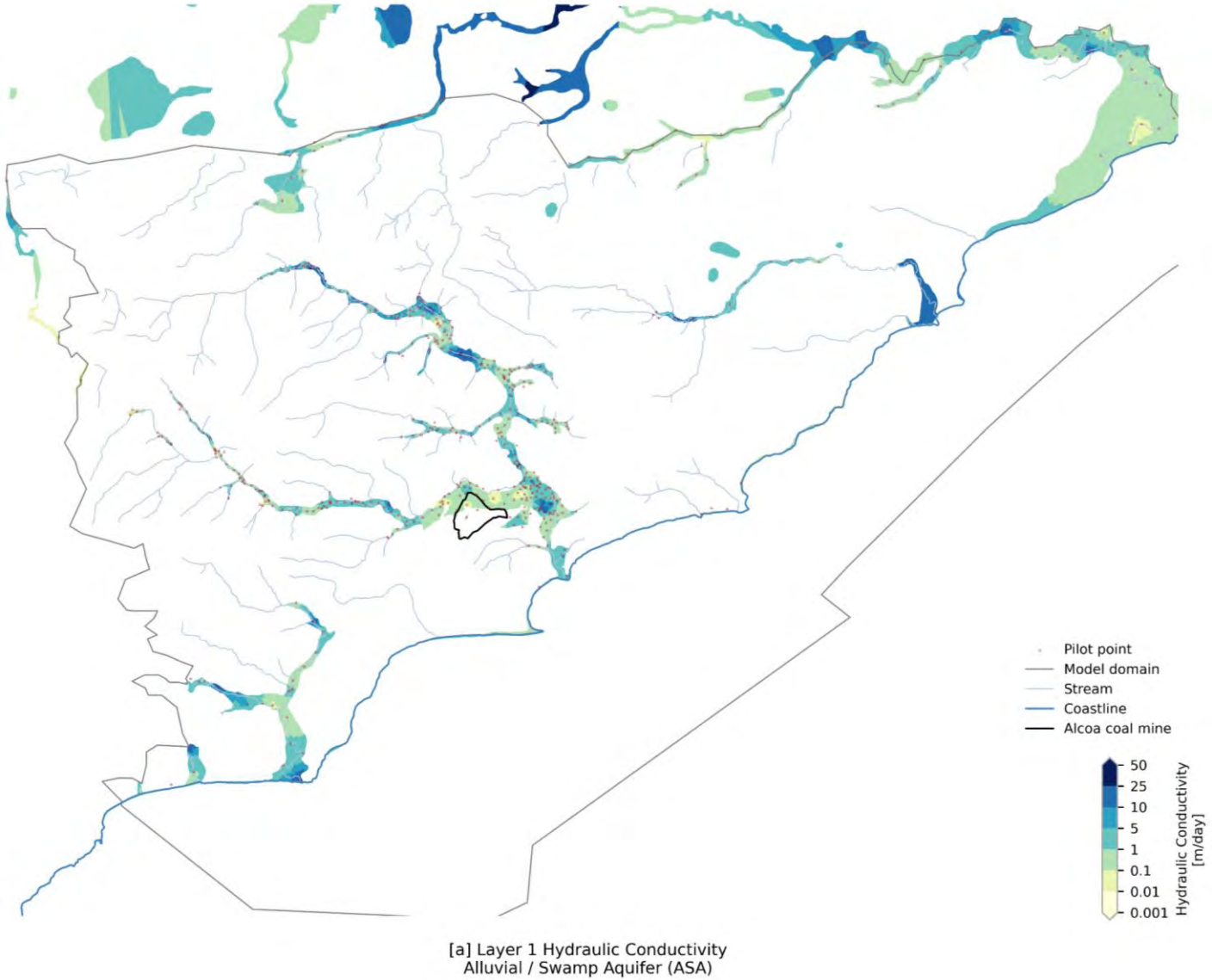


Figure 4-19 Modelled Horizontal Hydraulic Conductivity – Optimised base realisation [1 of 5] – Alluvial / Swamp Aquifer (ASA)

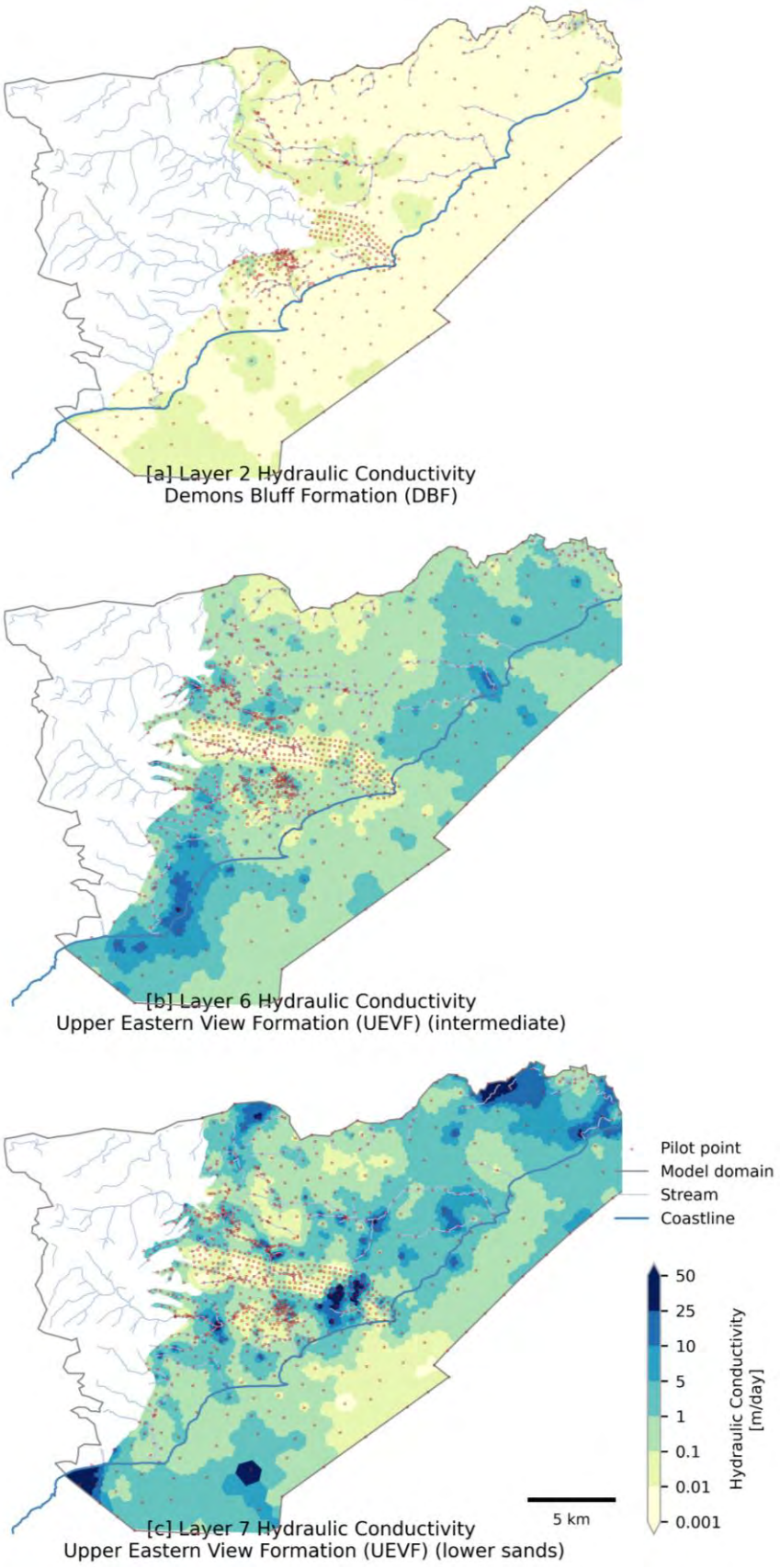


Figure 4-20 ***Modelled Horizontal Hydraulic Conductivity – Optimised base realisation [2 of 5] –Demons Bluff Formation (DBF), Upper Eastern view Formation (UEVF Intermediate and UEVF lower sands)***

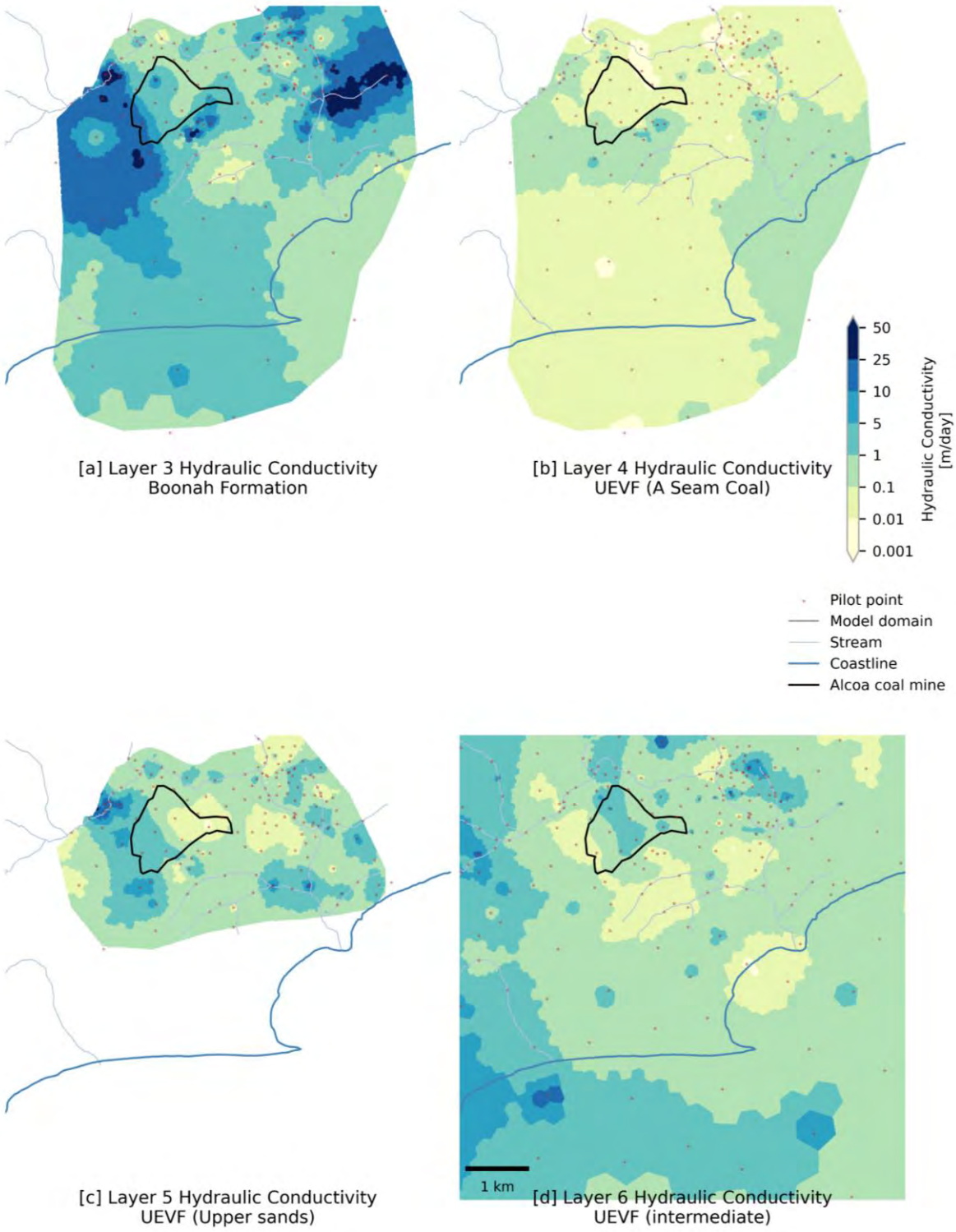


Figure 4-21 ***Modelled Horizontal Hydraulic Conductivity – Optimised base realisation [3 of 5] – UEVF Sub-layers in Alcoa's Area of Interest***

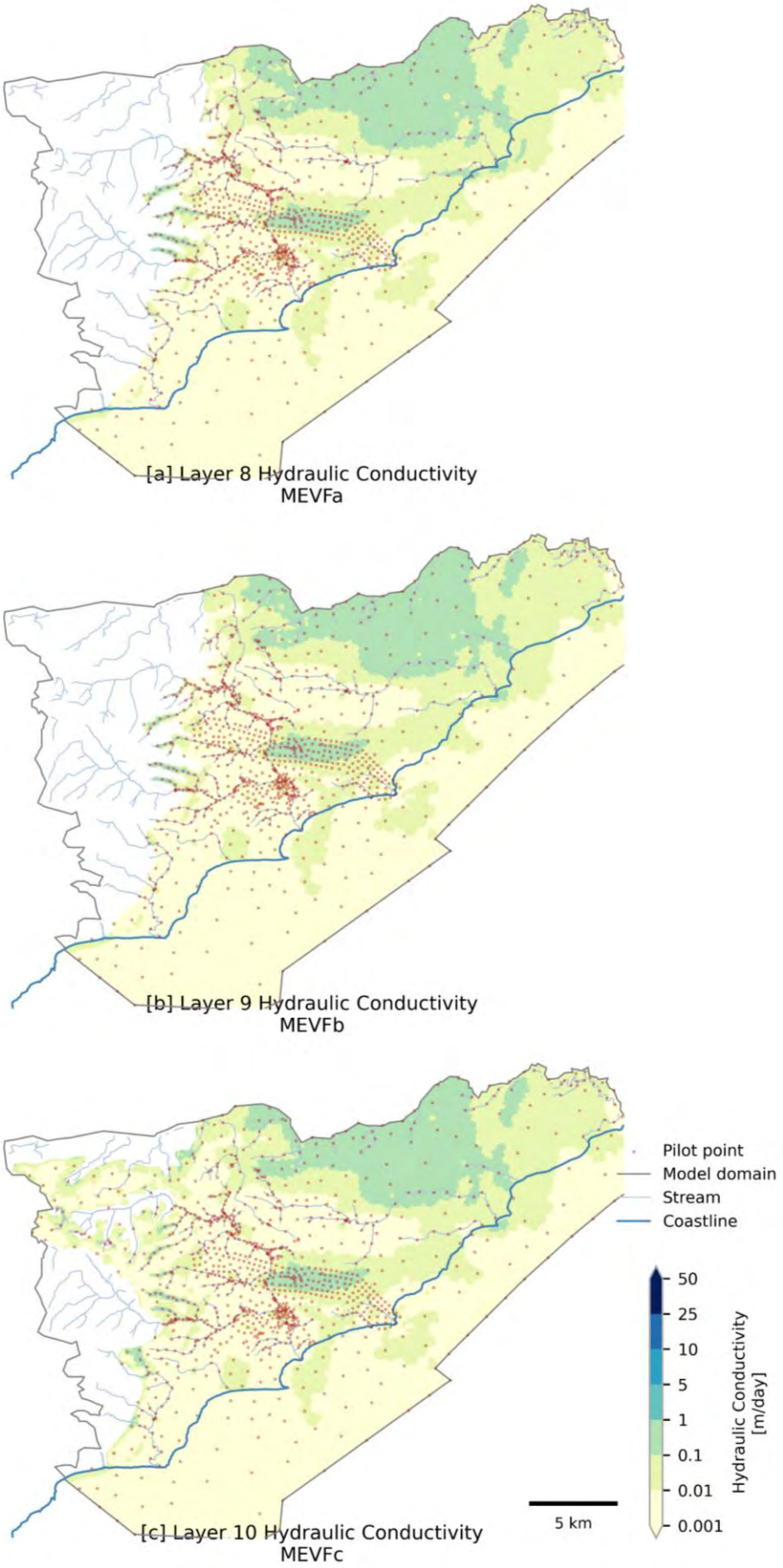


Figure 4-22 Modelled Horizontal Hydraulic Conductivity – [4 of 5] – Middle Eastern View Formation (MEVF)

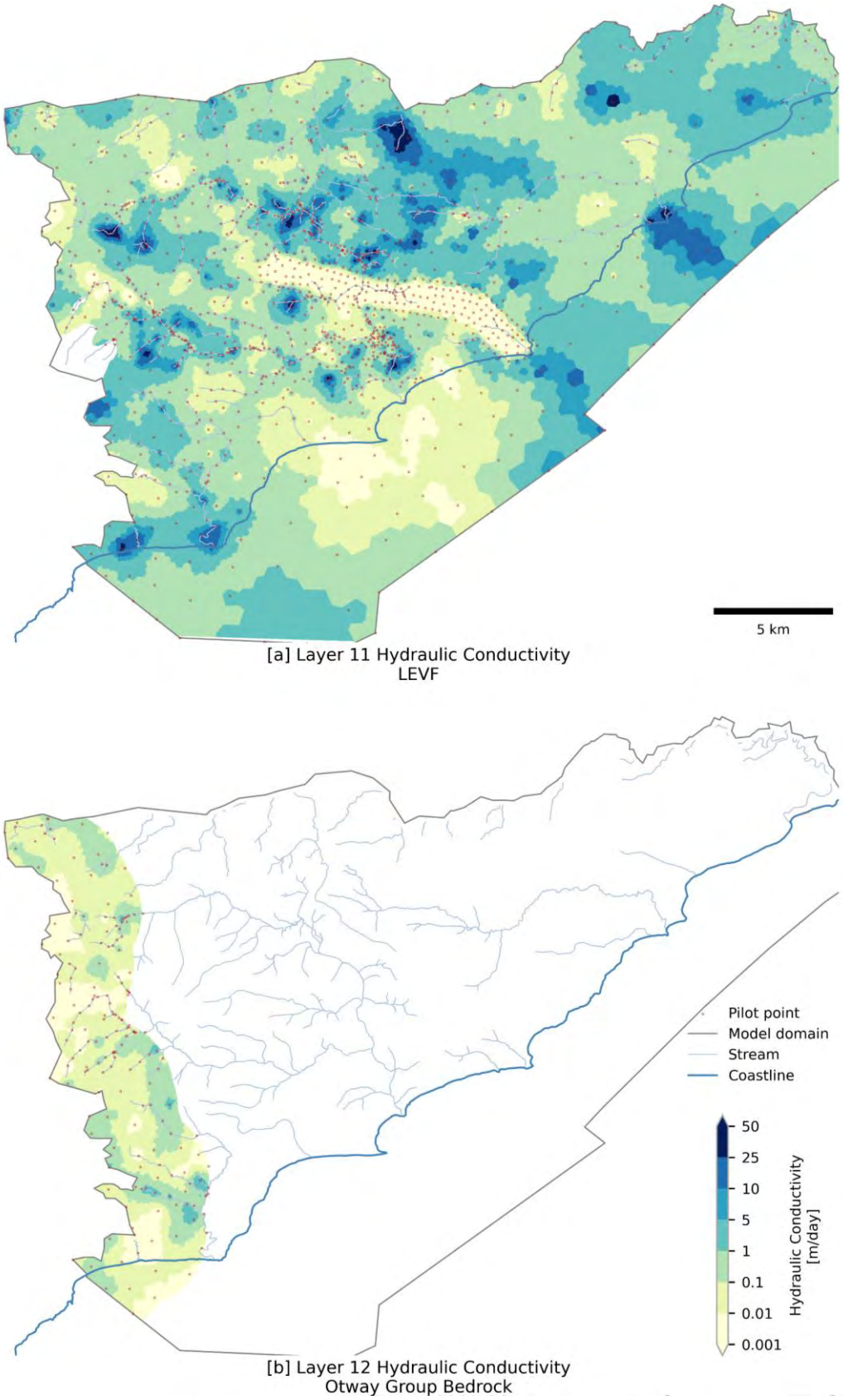


Figure 4-23 ***Modelled Horizontal Hydraulic Conductivity – Optimised base realisation [5 of 5] – Lower Eastern View Formation (LEVF) and Bedrock***

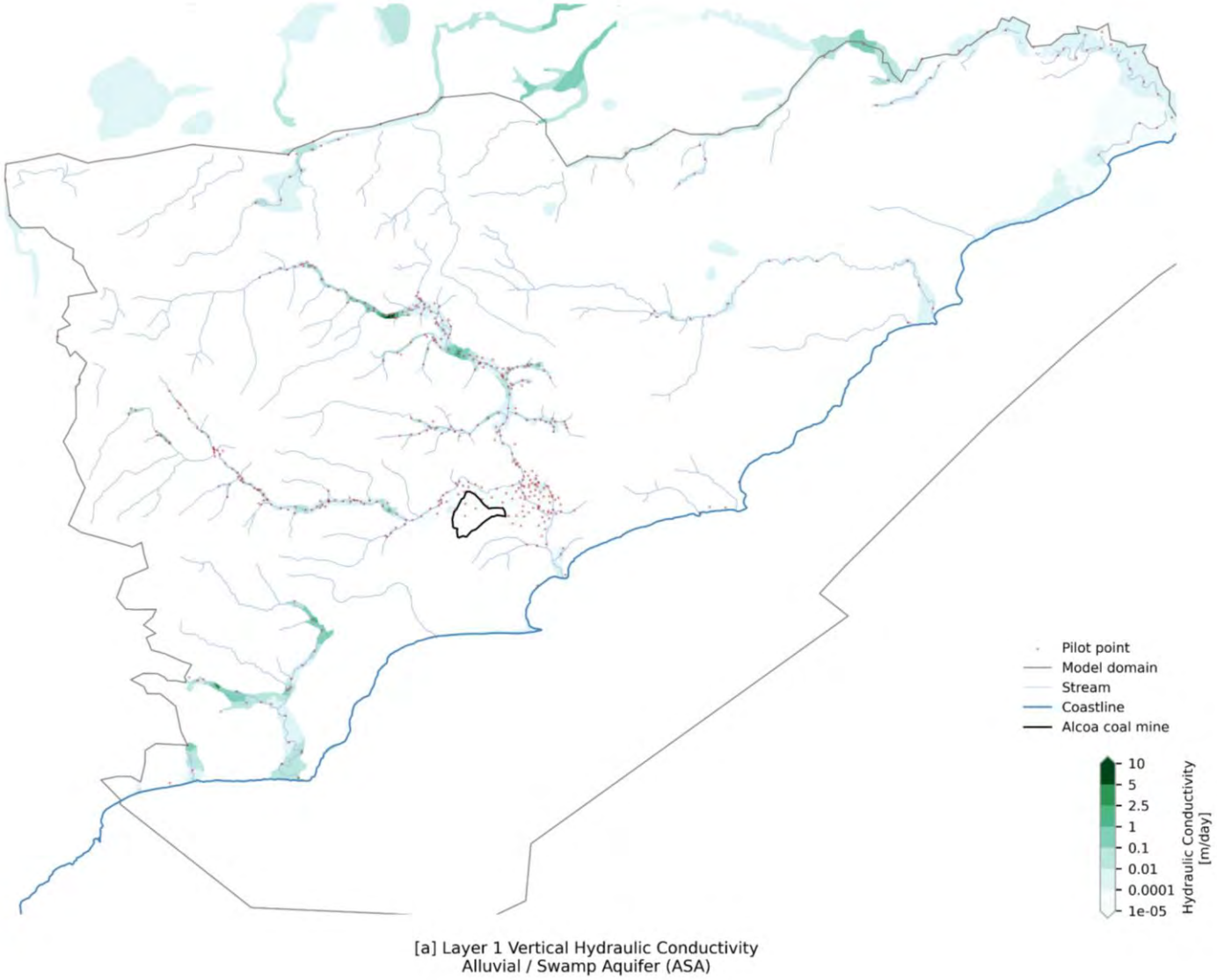


Figure 4-24 Modelled Vertical Hydraulic Conductivity – Optimised base realisation [1 of 5] – Alluvial / Swamp Aquifer (ASA)

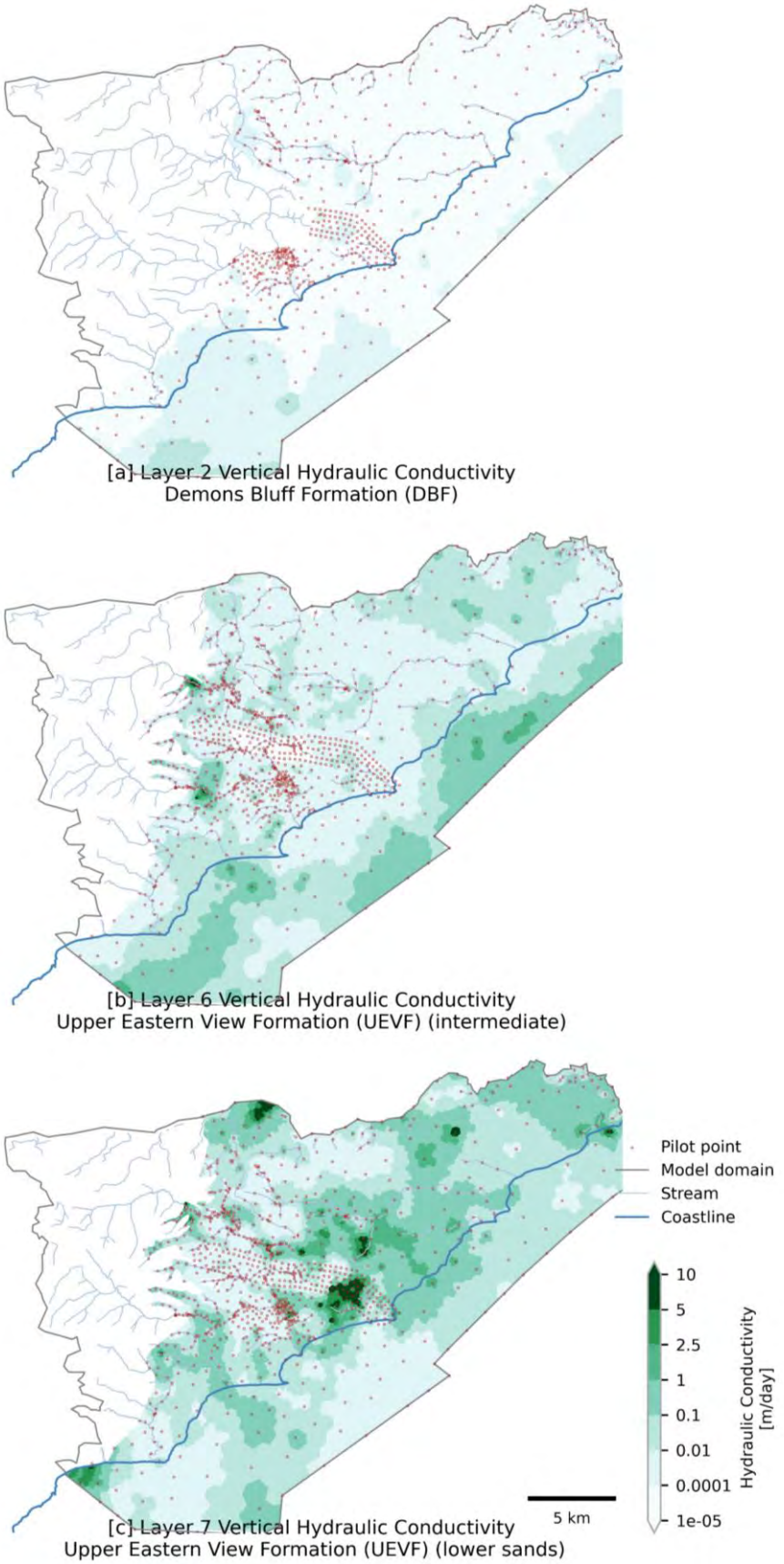


Figure 4-25 ***Modelled Vertical Hydraulic Conductivity – Optimised base realisation [2 of 5] –Demons Bluff Formation (DBF), Upper Eastern view Formation (UEVF Intermediate and UEVF lower sands)***

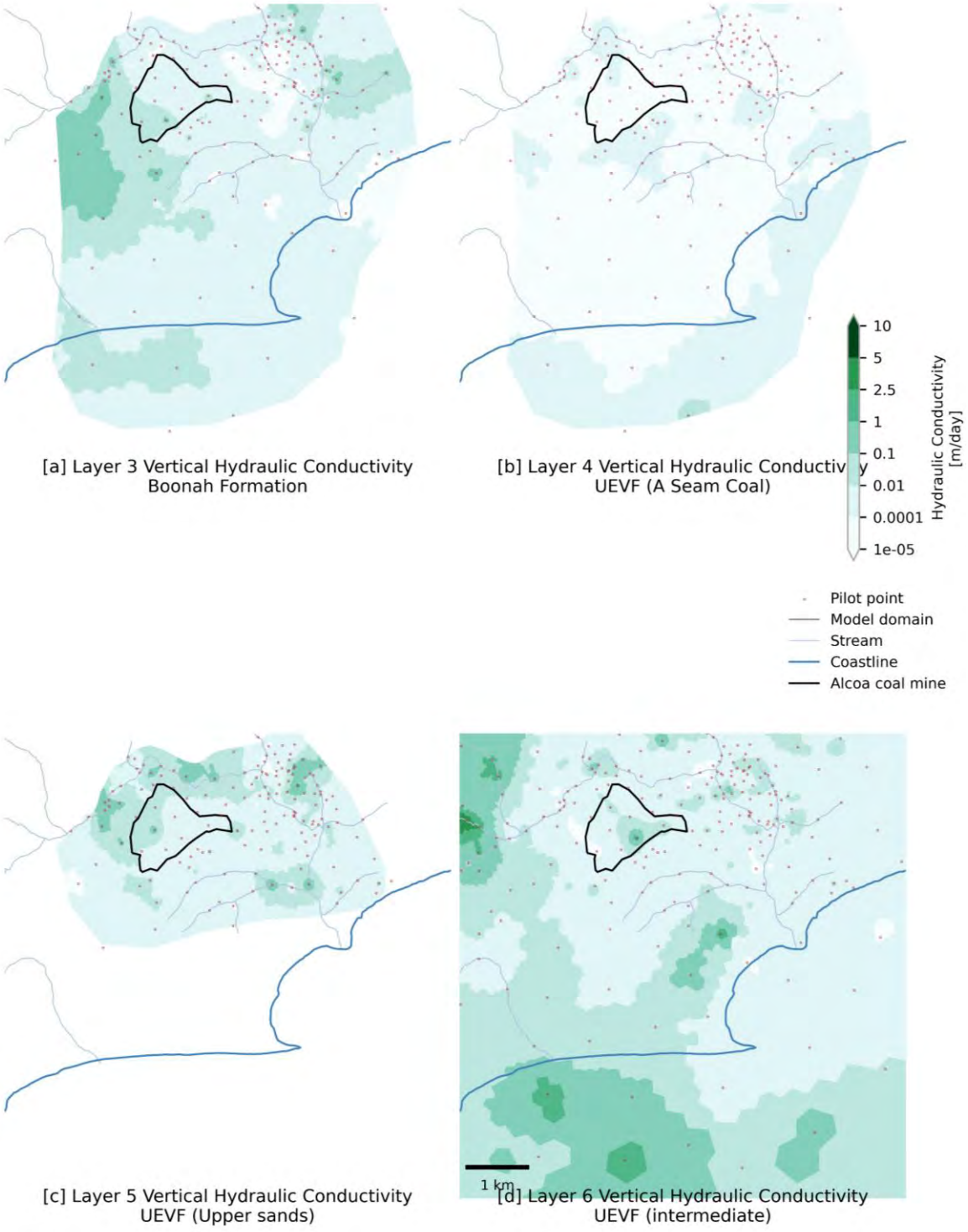


Figure 4-26 ***Modelled Vertical Hydraulic Conductivity – Optimised base realisation [3 of 5] – UEVF Sub-layers in Alcoa's Area of Interest***

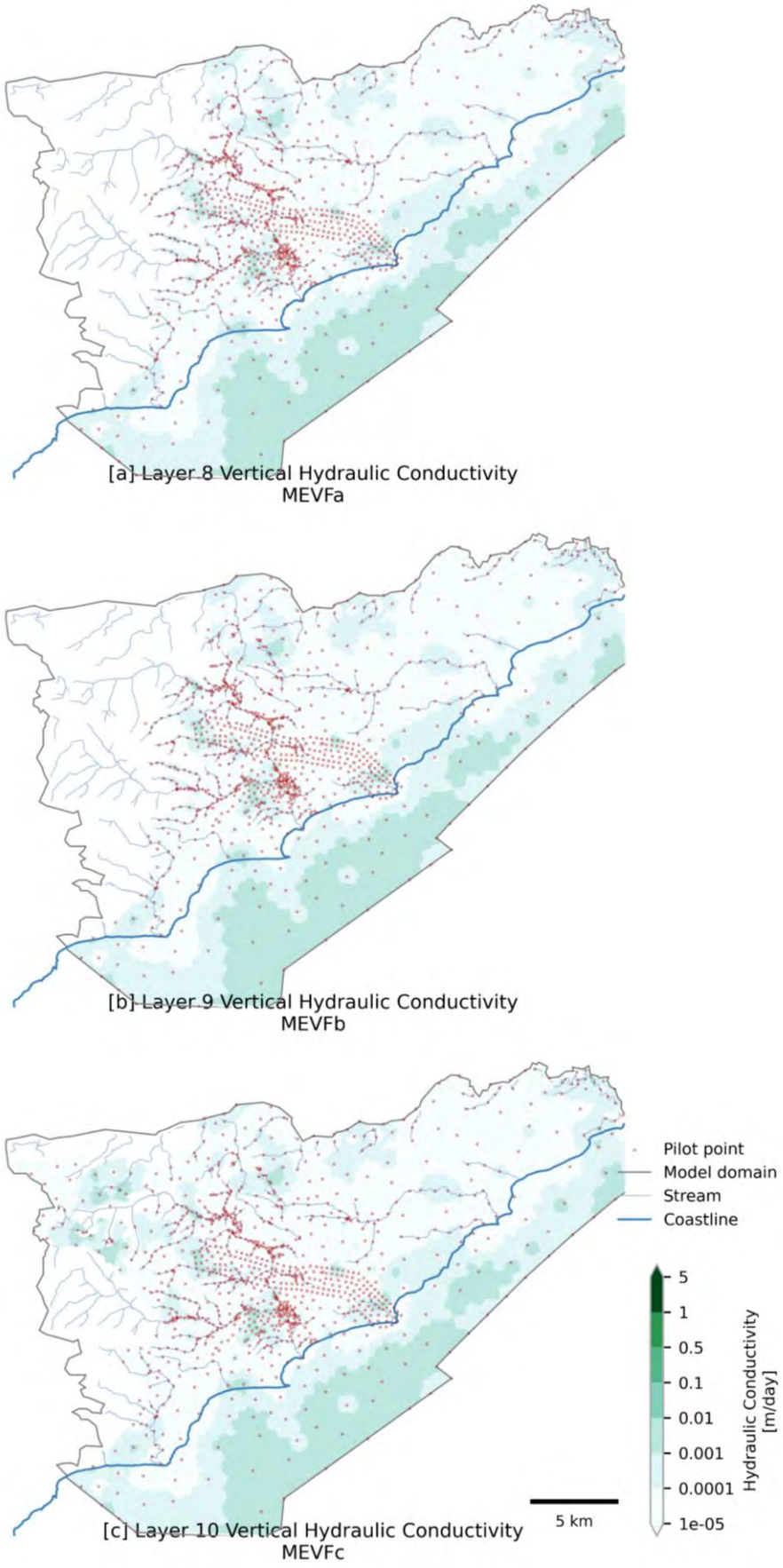


Figure 4-27 Modelled Vertical Hydraulic Conductivity – [4 of 5] – Middle Eastern View Formation (MEVF)

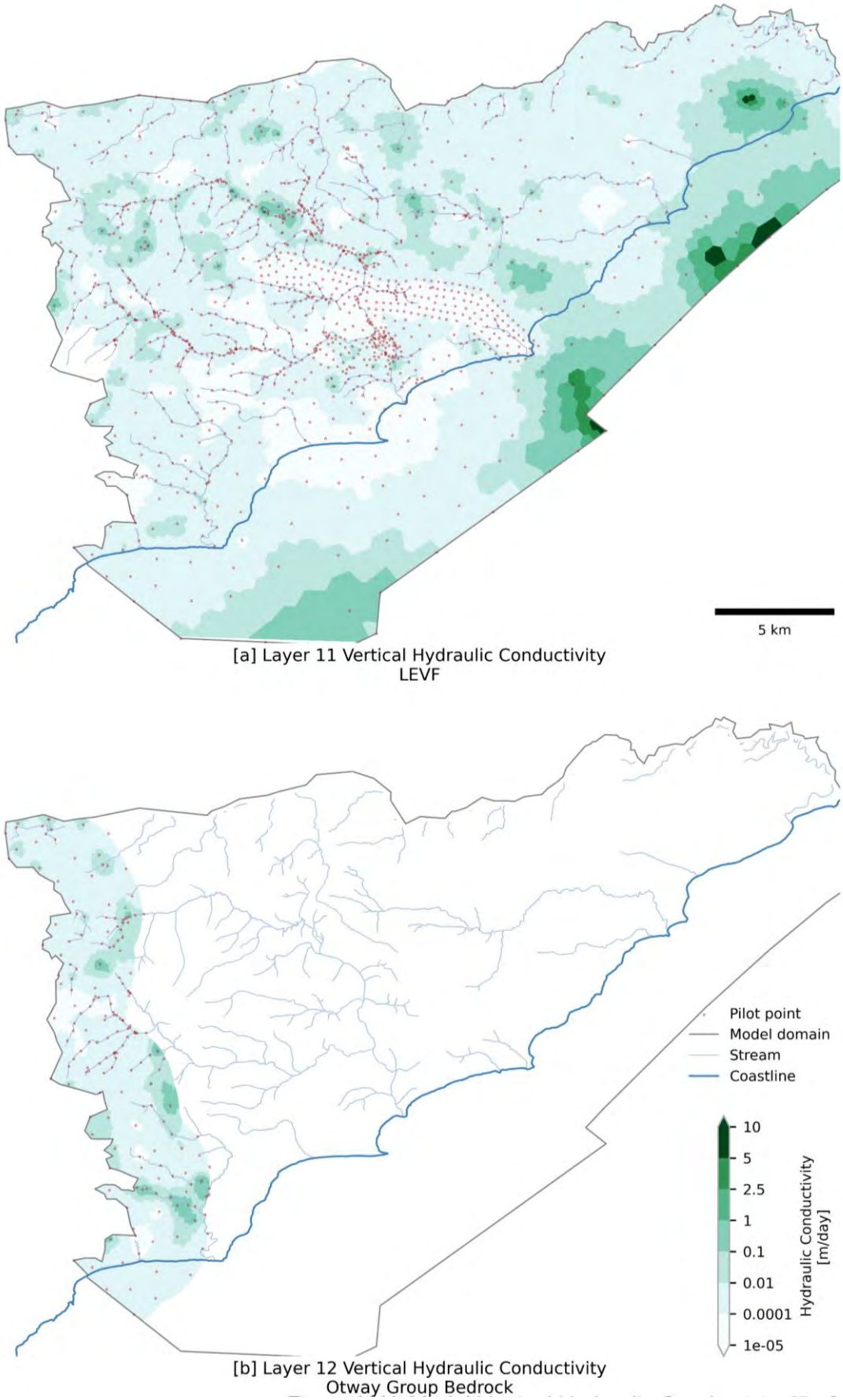


Figure 4-28 ***Modelled Vertical Hydraulic Conductivity – Optimised base realisation [5 of 5] – Lower Eastern View Formation (LEVF) and Bedrock***

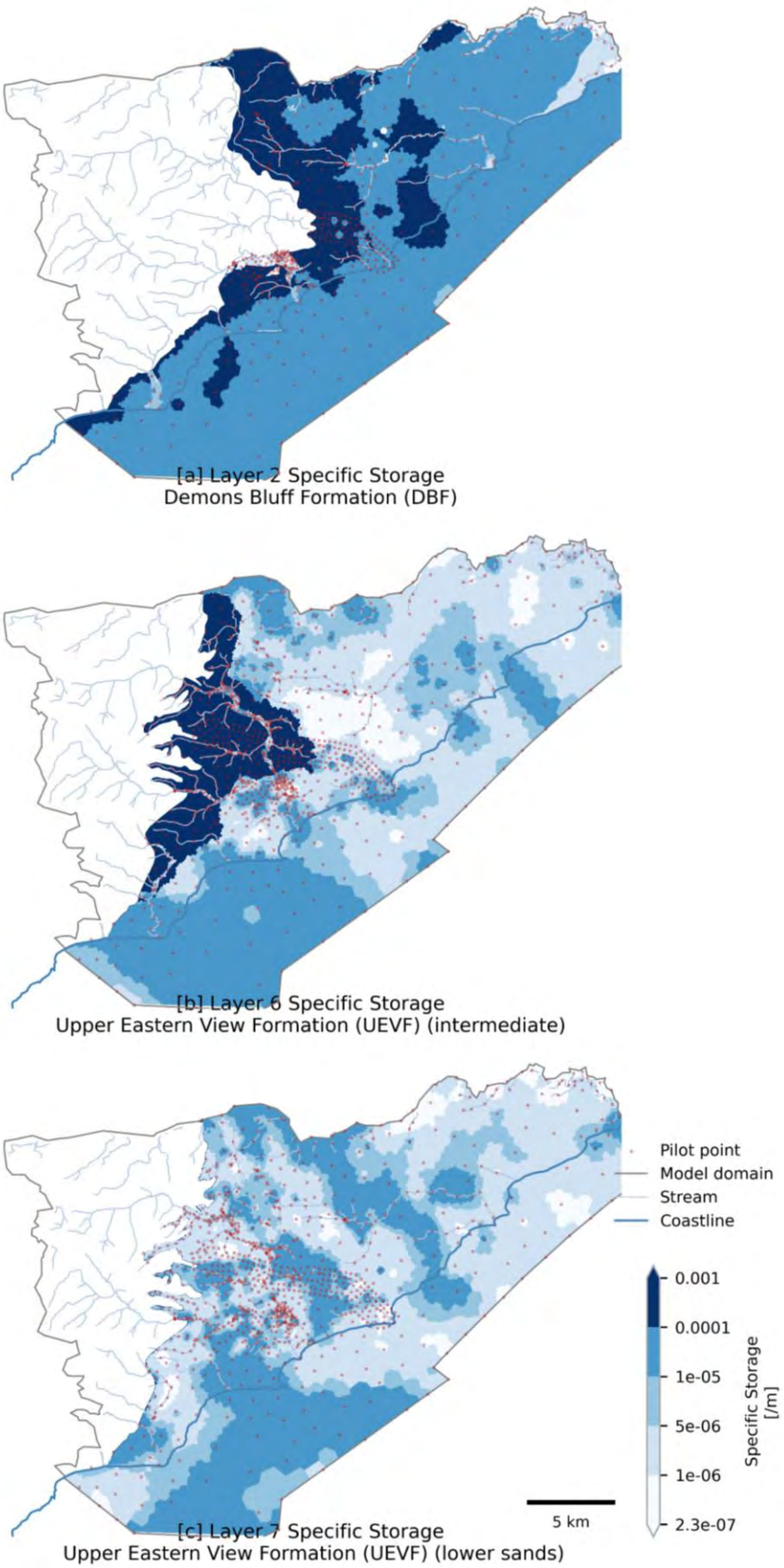


Figure 4-29 ***Modelled Specific Storage – Optimised base realisation [1 of 4] –Demons Bluff Formation (DBF), Upper Eastern view Formation (UEVF Intermediate and UEVF lower sands)***

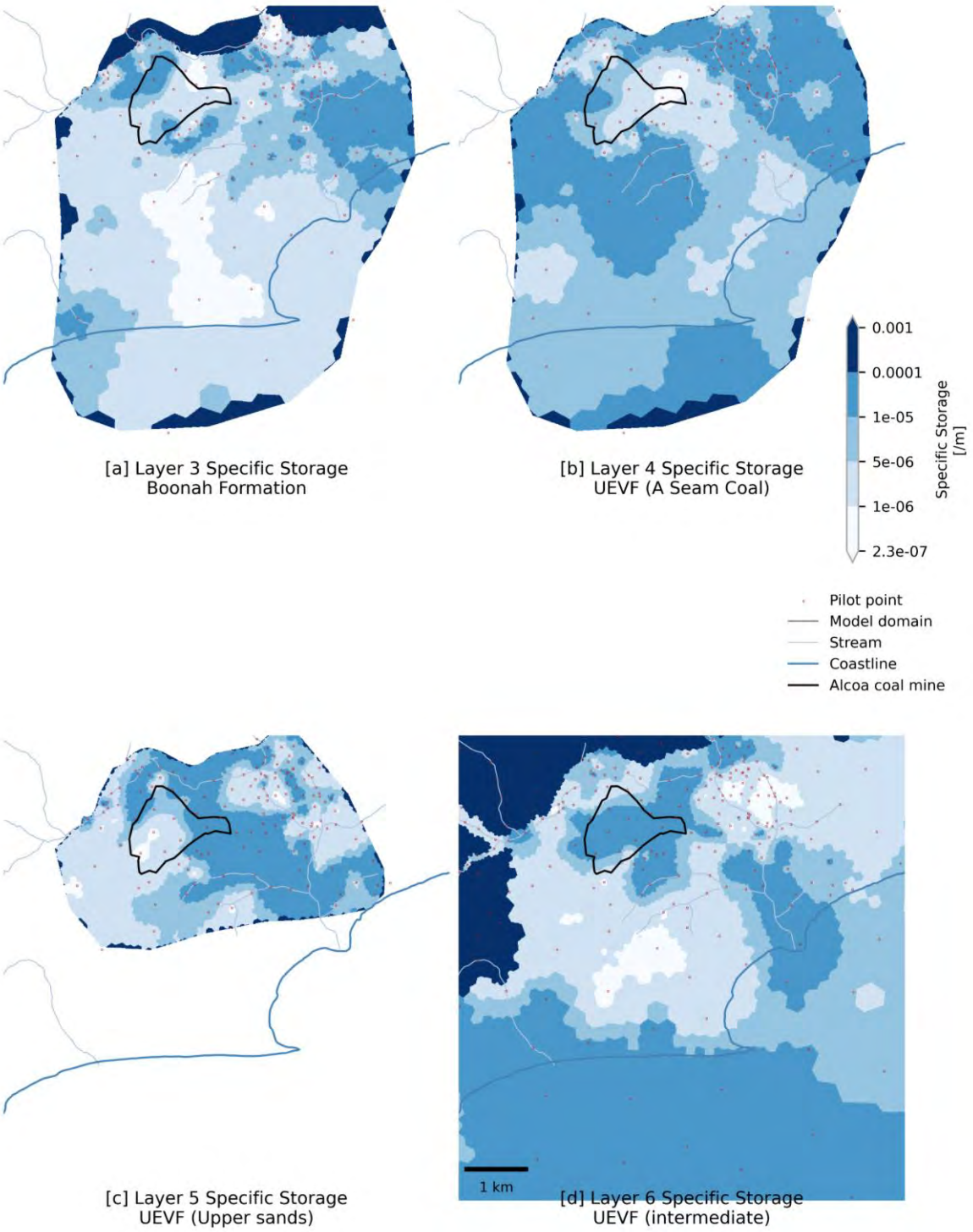


Figure 4-30 ***Modelled Specific Storage – Optimised base realisation [2 of 4] – UEVF Sub-layers in Alcoa's Area of Interest***

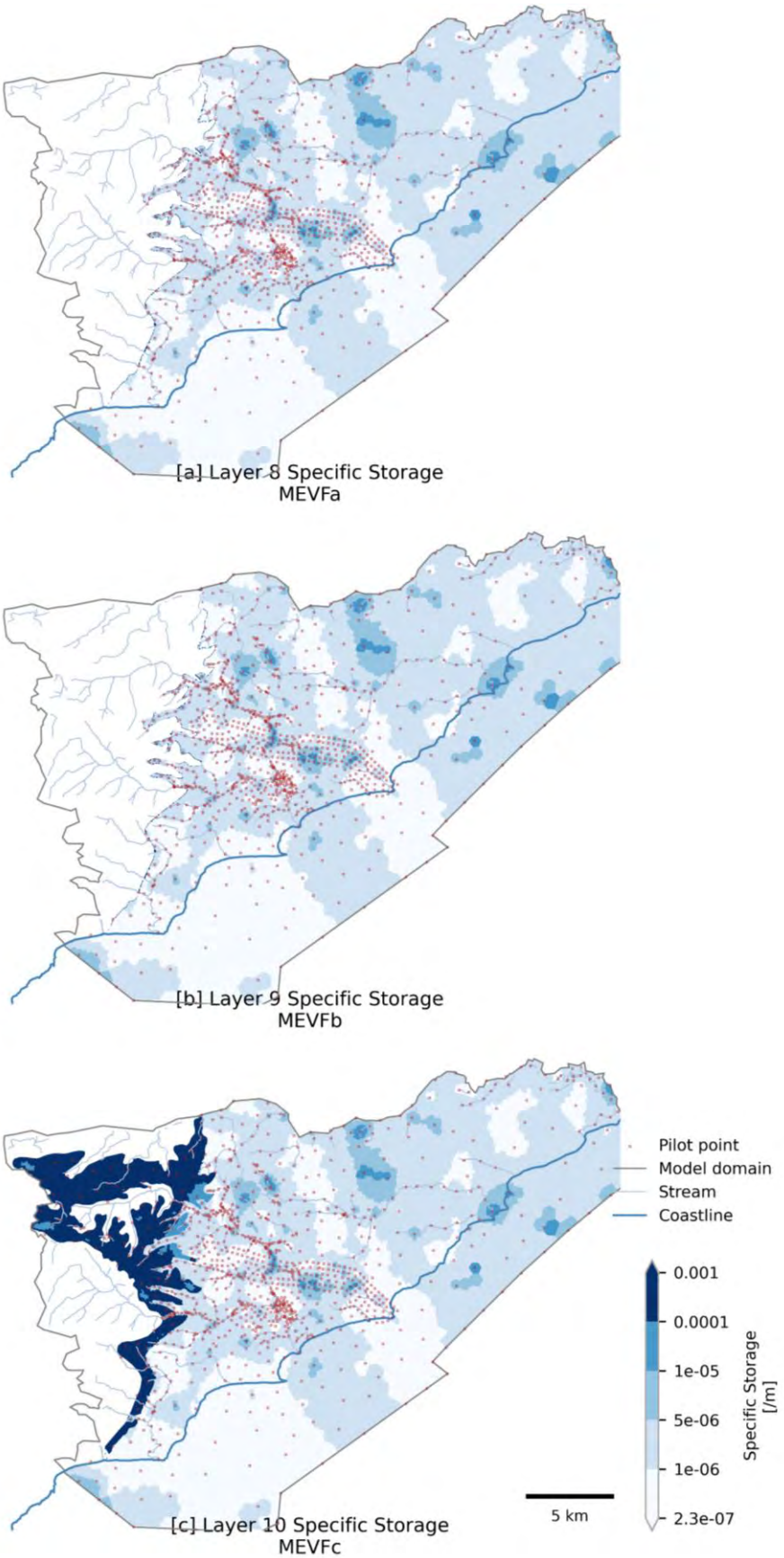


Figure 4-31 ***Modelled Specific Storage – Optimised base realisation [3 of 4] – Middle Eastern View Formation (MEVF)***

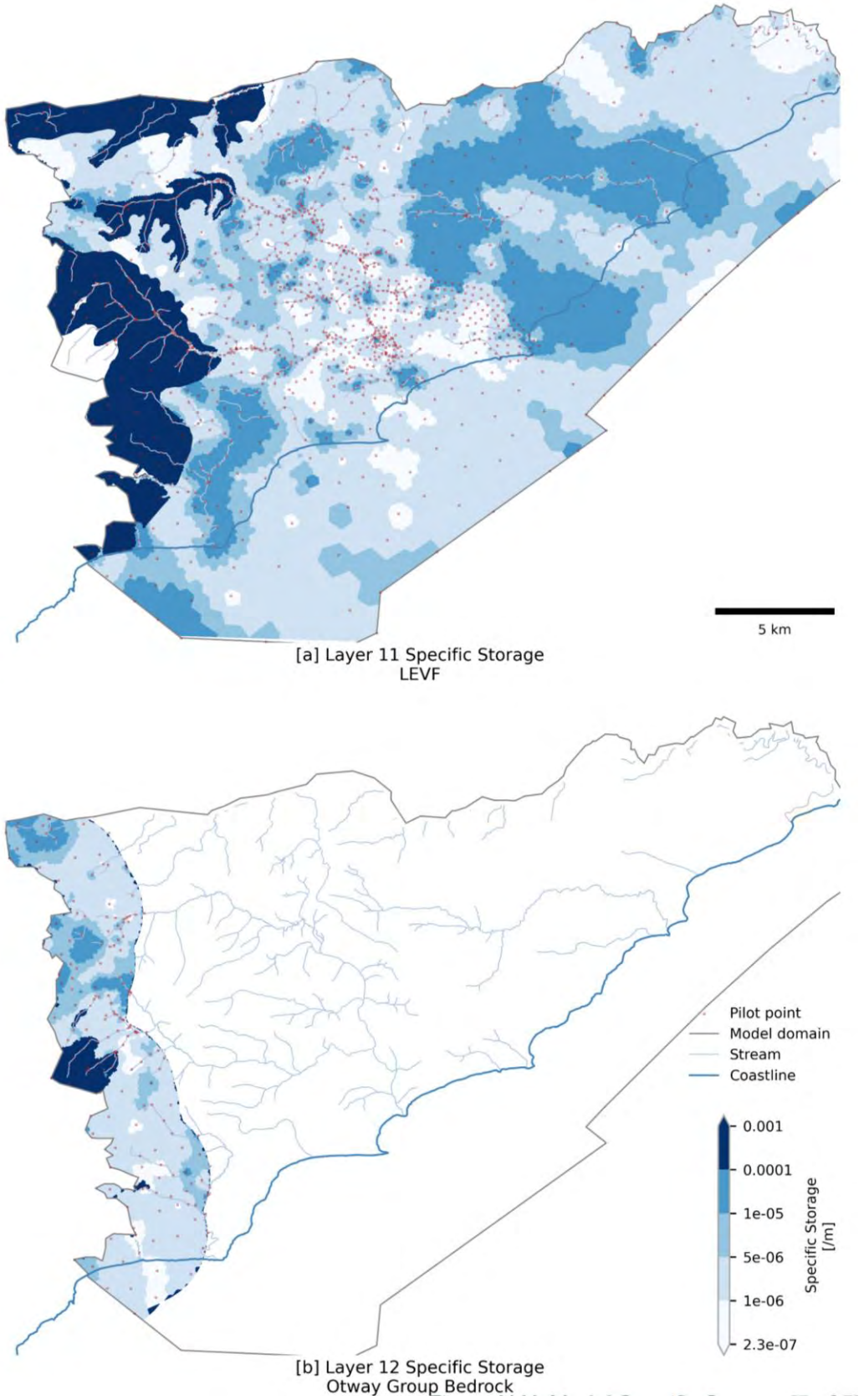


Figure 4-32 ***Modelled Specific Storage – Optimised base realisation [4 of 4] – Lower Eastern View Formation LEVF) and Bedrock***

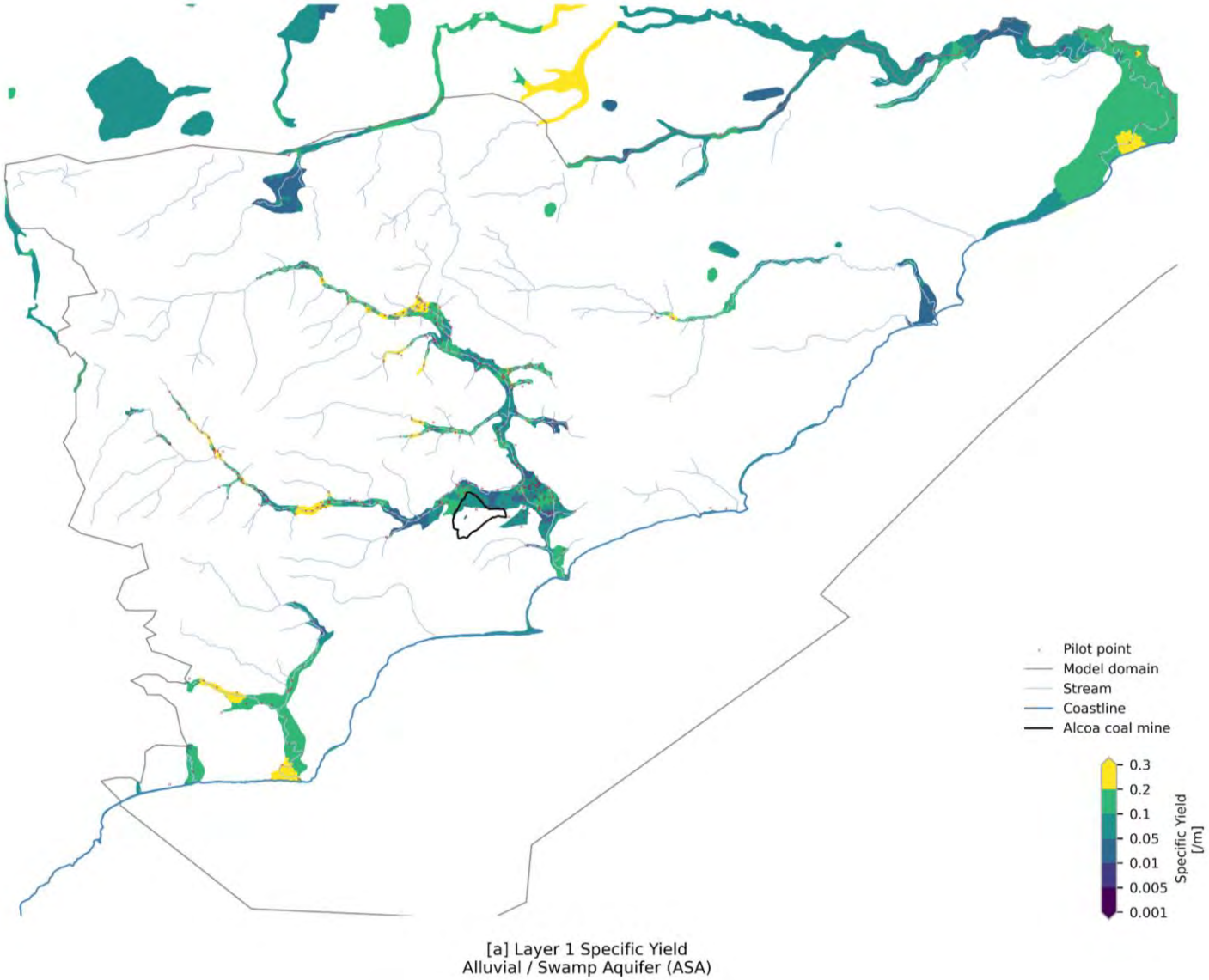


Figure 4-33 Modelled Specific Yield – Optimised base realisation [1 of 5] – Alluvial / Swamp Aquifer (ASA)

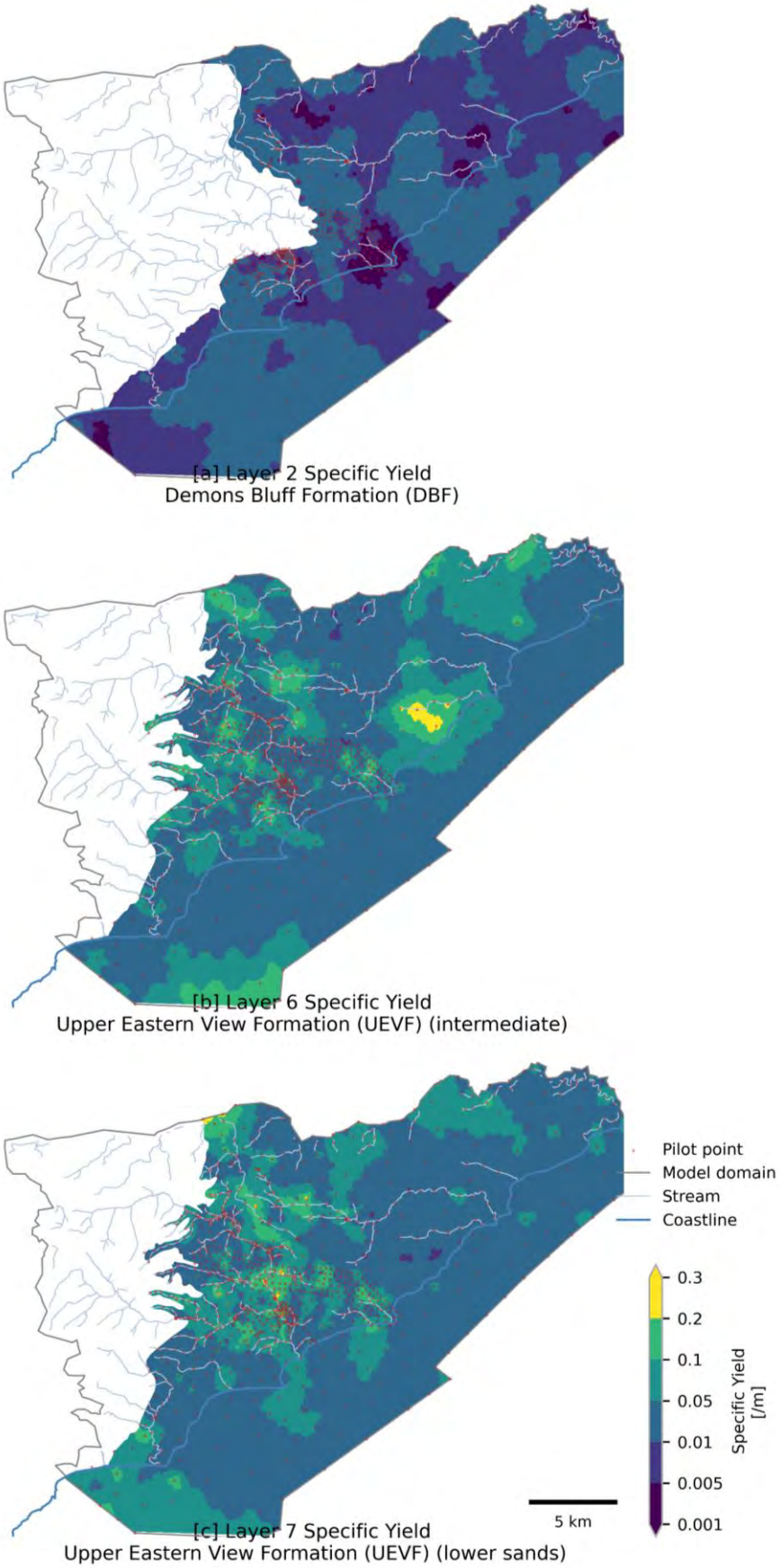


Figure 4-34 ***Modelled Specific Yield – Optimised base realisation [2 of 5] – Demons Bluff Formation (DBF), Upper Eastern view Formation (UEVF Intermediate and UEVF lower sands)***

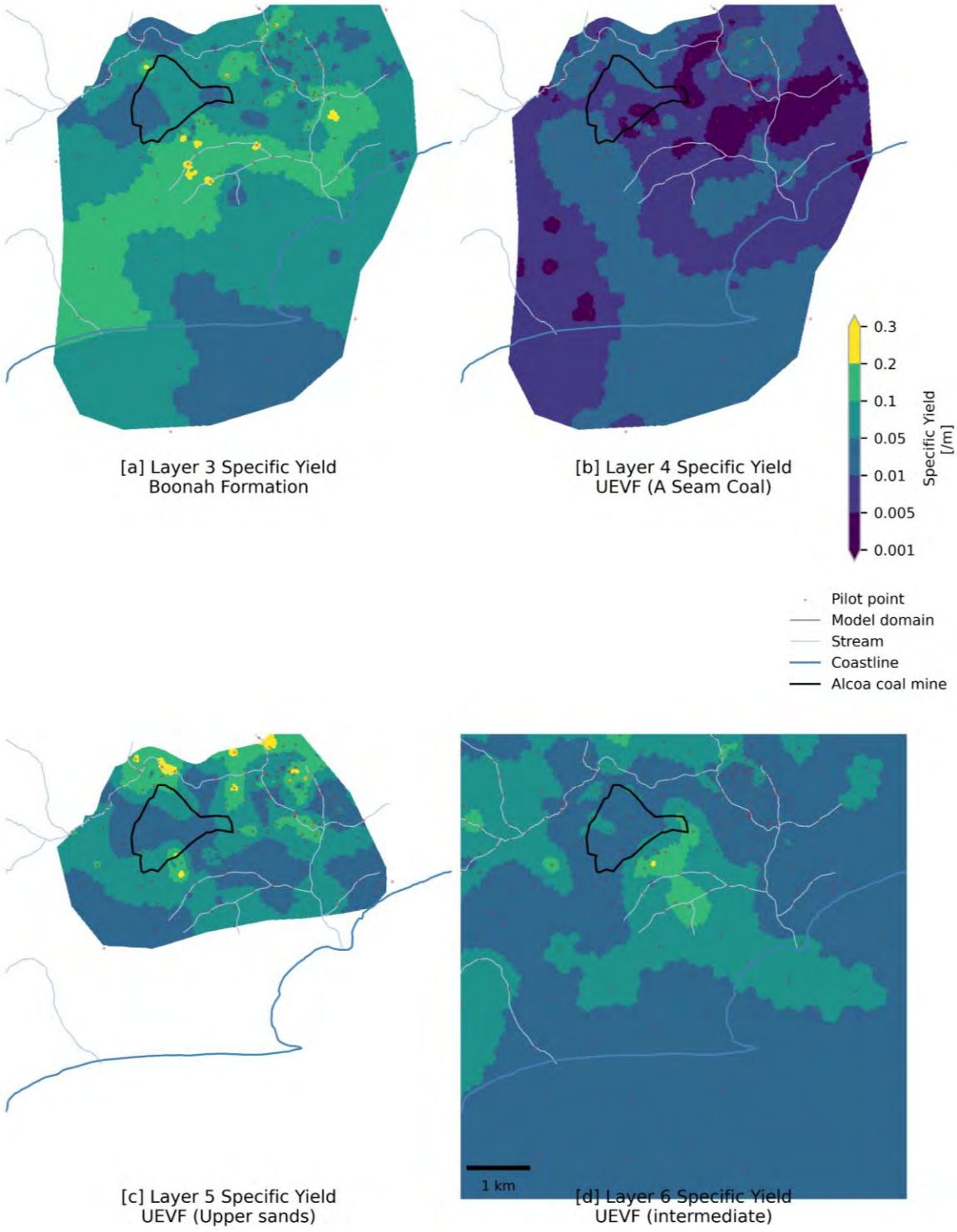


Figure 4-35 Modelled Specific Yield – Optimised base realisation [3 of 5] – UEVF Sub-layers in Alcoa's Area of Interest

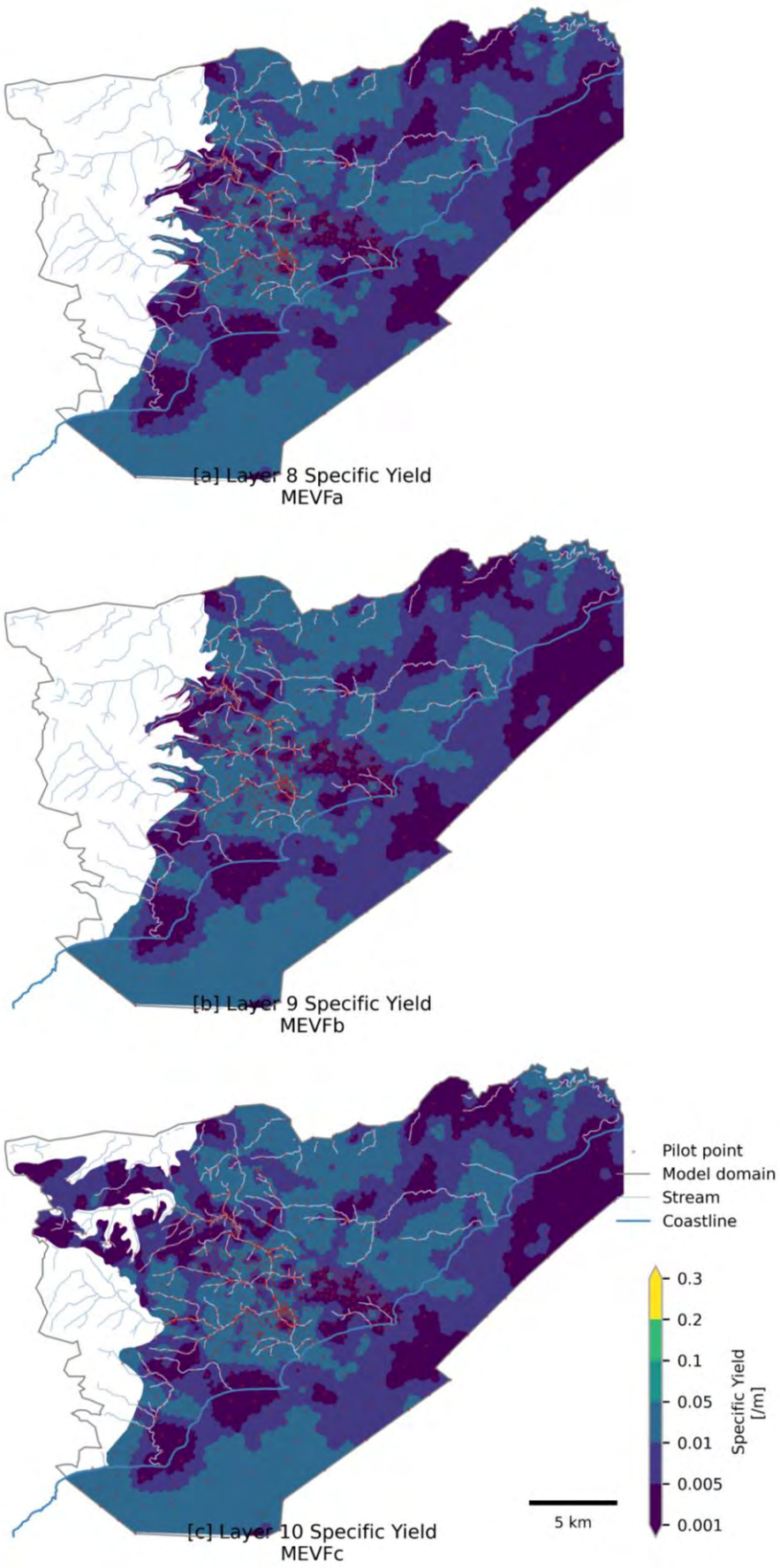


Figure 4-36 Modelled Specific Yield – Optimised base realisation [4 of 5] – Middle Eastern View Formation (MEVF)

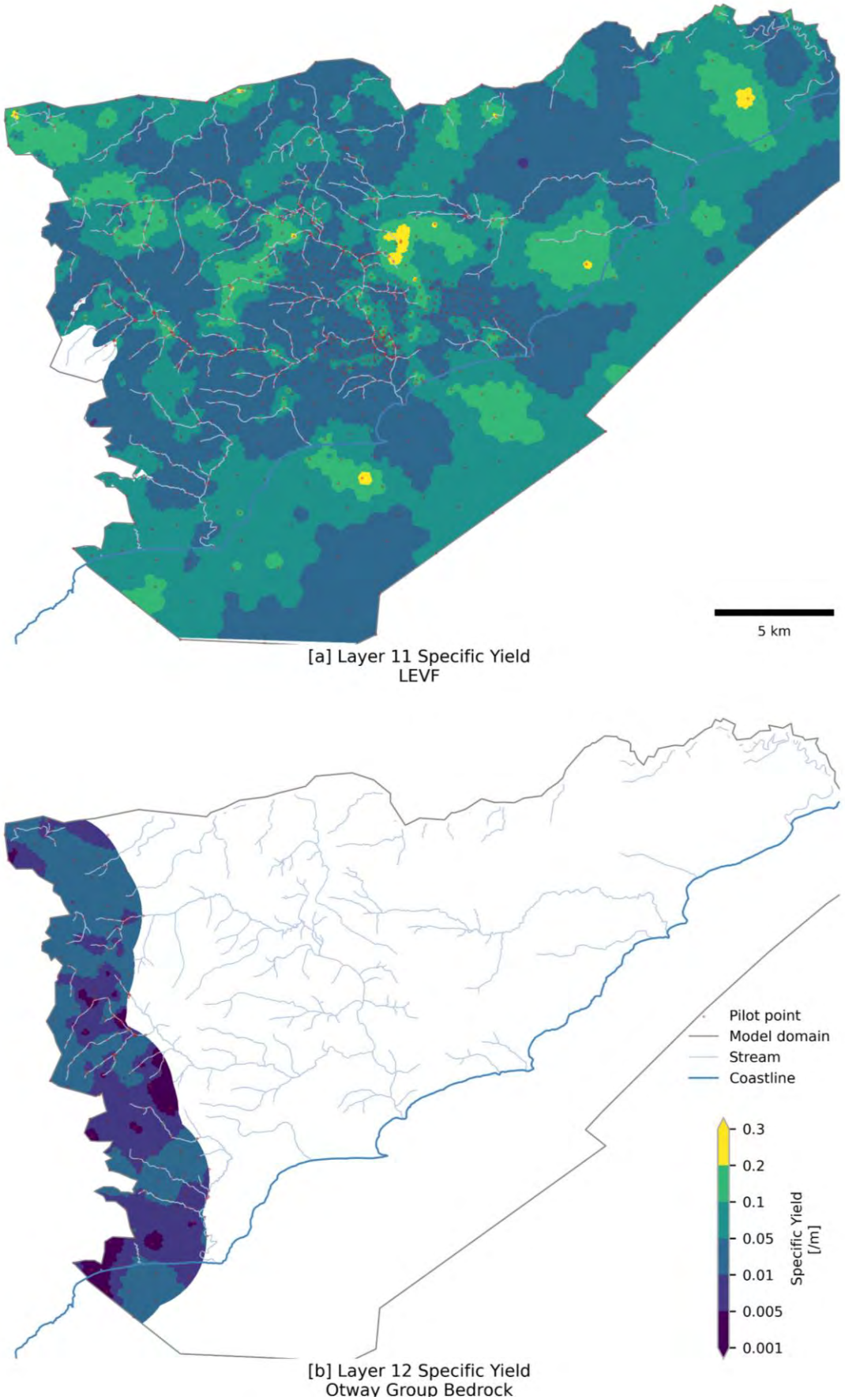


Figure 4-37 Modelled Specific Yield – Optimised base realisation [5 of 5] – Lower Eastern View Formation (LEVF) and Bedrock

5. Model History Matching - Design

5.1 Approach

This section details the philosophy behind the model history-matching (previously referred to as “calibration”) and uncertainty analysis approaches applied with the numerical groundwater flow model described in earlier sections of this report, aimed at meeting the model objectives and assessing the potential effects outlined in Section 2.1. This assessment of potential effects will subsequently be used to inform potential risks, water management-related decision-making, and regulatory processes relating to both Barwon Water and Alcoa operations.

In this study, “history-matching” refers to the process of assimilating observed groundwater and surface water systems’ data into the models. The purpose of history-matching in this context is to constrain model parameters and allowable ranges, based on what is known from field testing, conceptual ideas and observed system behaviour - ideally that of direct relevance to the model forecasts of interest.

This in turn constrains the suite of parameter sets that are used to make model forecasts and to assess their uncertainty (Figure 5-1 and Figure 5-2). Such an approach provides a good basis for enhanced use and understanding of model outputs, including their limitations, in model-dependent decision-making. It should be noted that the term “calibration”, as described in the Australian Groundwater Modelling Guidelines, is intentionally avoided in this report. The traditional approach of developing a single calibrated model can give a false expectation that there is a single deterministic set of best parameters. The approach adopted and described in this report derives a suite of plausible parameters that reflects the uncertain nature of the history-matching process, which can be extended to predictive uncertainty analysis in an efficient manner. This probabilistic approach has become more widely applied in groundwater modelling since the publication of the guidelines in 2012.

Mechanisms by which observation data are used in history-matching are outlined in Section 5.2. Parameterisation schemes and strategies are outlined in the Sections 4.6, 5.3, and 6.

PEST (Doherty, 2015 and 2016a), the software platform related to much of the work presented in this report, represents a family of code and workflows for highly parameterised environmental model optimisation (inversion), uncertainty analysis and associated tasks. In addition, a large set of support utilities have been developed, primarily by John Doherty of Watermark Numerical Computing.

A code that is derived from PEST is applied in the history-matching and uncertainty analysis processes applied in this study: PESTPP-IES, an Iterative Ensemble Smoother (IES; White, 2018). This code optimises an ensemble of random model parameter realisations on an iterative basis. It makes an estimate of the Jacobian (observation-to-parameter sensitivity) matrix, which is used by the traditional PEST code. It does this using the ensemble of parameters and observations, and the modelled equivalents thereof, for each parameter upgrade iteration.

These concepts comprise the applied workflows used in this study and are shown schematically in Figure 5-1. Along with the corresponding implementation detail in Figure 5-2; these figures cross-reference one another. Note that the history-matching process shown in the left side of Figure 5-2 is undertaken iteratively, with the “posterior parameter ensemble” arising from one iteration feeding back into the start of the next; the process is repeated until the level of history-match quality and the posterior parameter uncertainty range that is obtained is satisfactory (typically only a few iterations).

Key implementation details of PESTPP-IES’ application in this case are outlined in subsequent sections of this chapter. For further information, the reader is referred to the following key texts for a full description of the applied methods and theory underpinning this report:

- PEST – The Book (Doherty, 2015; particularly Section 4), and Chen and Oliver (2013) for the theory underpinning much of the inversion and uncertainty analysis of this report. Doherty (2015) and White, (2018) extend that theory to practical application in the environmental modelling and decision support context.
- The PEST, PEST++ and PESTPP-IES manuals and associated literature (Doherty, 2016a, 2016b; White., 2018, and PEST++ Development Team, 2023) for detailed information on practical application of the PEST and PESTPP-IES software, in addition to a range of analysis concepts, workflows and processes.

In terms of PESTPP-IES usage details, PESTPP-IES was instructed to centre its Jacobian estimates on the base (prior) parameter set, and automatic localisation was activated. Interested readers are referred to the PESTPP-IES manual (PEST++ Development Team, 2023).

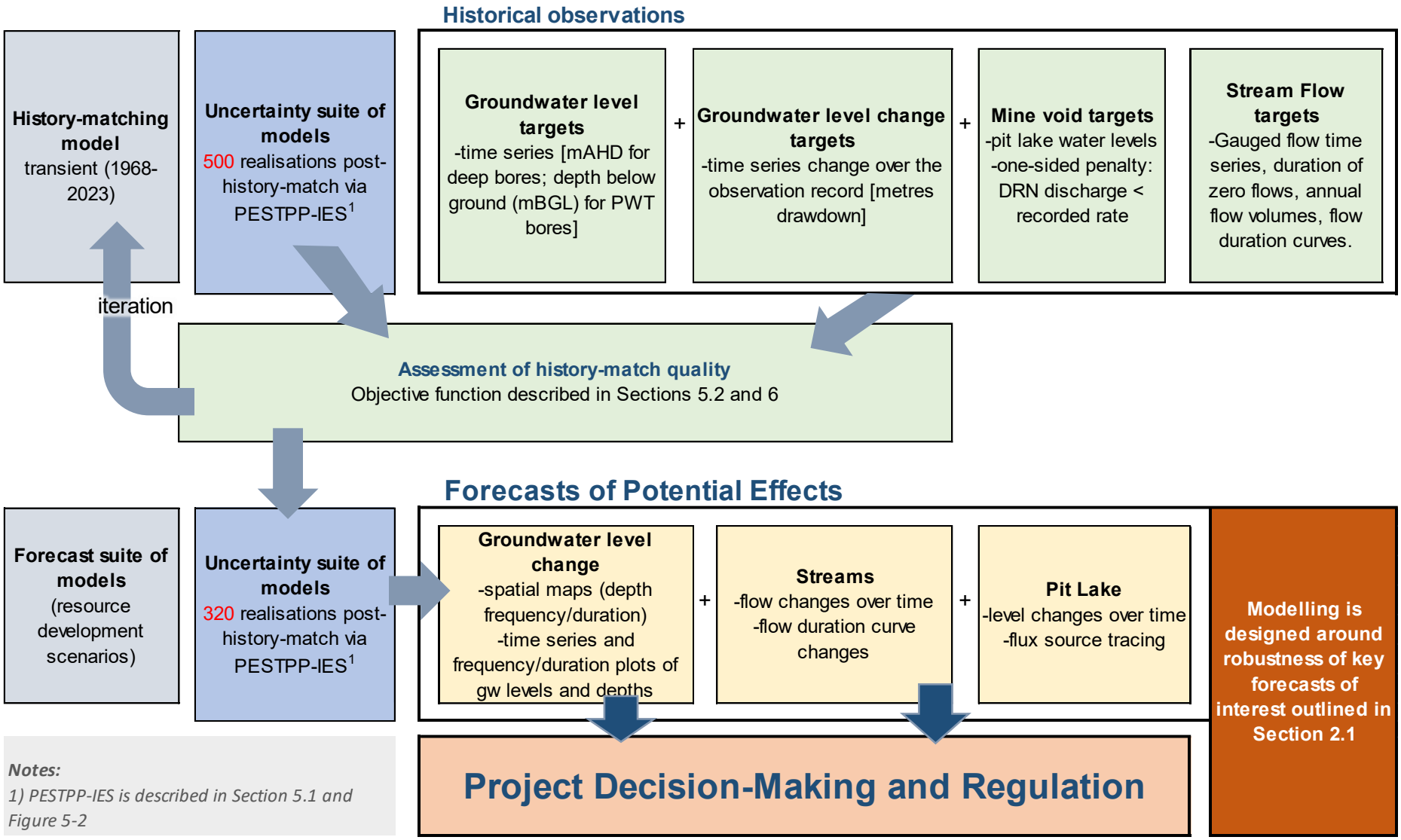


Figure 5-1 Schematic overview of the model history-match and uncertainty analysis workflows applied in this study.

PESTPP-IES estimates model parameter (and forecast) uncertainty using the principles of Bayes equation:
$P(k|h) = P(h|k)P(k)$

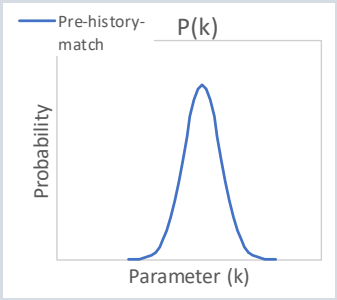
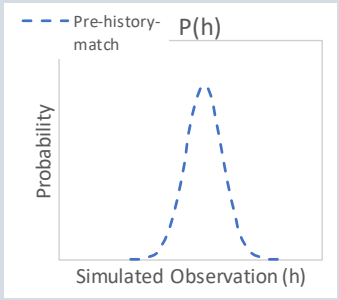
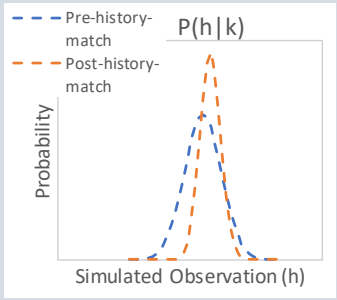
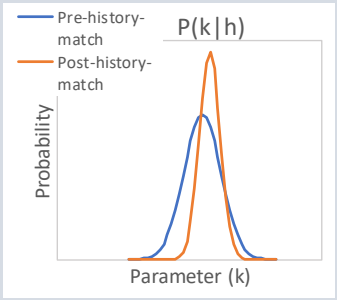
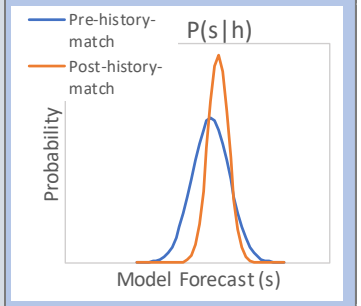
[A]	[B]	[C]	[D]	[E]
P(k) - Prior (pre-history-matching) probability distribution of model parameters ("prior parameter ensemble"). This is explained in Sections 4, 4.6, 5.1 and 5.3.	**P(h) - Prior (pre-history-matching) probability distribution of modelled equivalents to available observation data ("prior simulated observation ensemble"). In this case, noise is added to obs. based on estimated reliability.**	**P(h|k) - The likelihood of P(k) parameters, given the acceptability of the history-match between observation data and their modelled equivalents [P(h)], for each sample of P(k). This is explained in detail in 5 and 6.**	**P(k|h) - Posterior (post-history-matching) probability distribution of model parameters ("posterior parameter ensemble"). This is explained in detail in Sections 6.1.2 and 6.1.6.**	**P(s|h) - Posterior (post-history-matching) probability distribution of model forecasts given the posterior parameter probability distribution [P(k|h); see to left].**
				
* PESTPP-IES takes semi-random samples of this, based on user-specified relevant parameter ranges, and any spatial or other parameter correlation (i.e. covariance). See Sections 4.6 and 5.3. * This collection of parameter samples is called the "prior parameter ensemble". The number of (user-specified) samples is called the "ensemble size". Each sample ("ensemble member") comprises one semi-random value for every model parameter, which are together used to parameterise a single model run.	* PESTPP-IES takes samples of this by running the user-specified number of samples of P(k) (i.e. the "prior parameter ensemble") parameters through the model. * Paired with this "simulated observation ensemble" is the equivalent "observation data ensemble" (i.e. what is used to assess the model history-match quality; see next column). * Uncertainty in the observation data ("noise") is added to each member of the observation ensemble, based on user-specified uncertainty ranges for each observation.	* Comparison of the observation data (plus noise) with their modelled equivalents [P(h)] is used to "filter out" parameters from P(k) for which the match between observations and their modelled equivalents (i.e., the "history-match") is of acceptable quality.	* This is the "filtered out" members of the prior parameter distribution [P(k)], which, when each member is run through the model, provides an acceptable level of history-match quality. * The posterior parameter distrbution from one PESTPP-IES iteration is fed back into the beginning of the next (as the prior parameter distribution).	* This is the "filtered out" members of the prior forecast distribution [P(s)] as derived by running each member of the posterior parameter ensemble [P(k|h); see to left] through the model. * As Doherty (2015) states: "*The extent to which the posterior predictive uncertainty of* ***s*** *is smaller than its prior predictive uncertainty is dependent on the information content of the data, the model parameters to which this information is pertinent, and the parameters to which* ***s*** *is most sensitive.* "
HISTORY-MATCHING (ITERATIVE)				**FORECASTING**

Figure 5-2 ***Schematic overview of implementation details for the model history-match and uncertainty analysis process applied in this study.***

5.2 Observation Data

PEST's role in model inversion is to minimise its objective function (phi) by adjusting model parameters in an iterative fashion (Doherty, 2015 and 2016a). Phi is calculated internally by PEST as the sum of squared weighted residuals between observations and their modelled counterparts. Observations used in this case are outlined in Table 5-1 and Table 5-2, and their locations are shown in Figure 5-3. PEST allows the user to group different observation data types and weight these groups (and individual observations within each group) differently. This allows the modeller to strategically (and subjectively) weight different observation types and locations according to the objectives of the modelling.

There are a whole host of reasons for weighting different data points differently, which will not be discussed in detail here; the interested reader is referred to the PEST documentation referred to earlier. To provide an example, strategic weighting may be used to account for the fact that some bores or flow gauges can have far more data than others; those with fewer observation data may be less "visible" to PEST during inversion, unless their weighting is increased relative to those sites with more data. Other reasons for different weightings may include less reliable versus more reliable data. Or maybe that bores in a particular area are more important to the project objectives than those in other areas.

In this case where PESTPP-IES is used, noise (an estimate of observation data error, including structural model error), can also be optionally added to the observation data realisations. This is implemented with the estimates of error outlined in Table 5-3. These noise estimates define the accuracy to which the model can be reasonably expected to simulate each measurement used in the history-matching, given all its assumptions and limitations. The applied noise is not just a reflection of survey error - it is in large part driven by structural model limitations and assumptions. The application of noise in this way minimises undue model parameter bias incurred through history matching, which can and often does have ramifications for model predictive bias. See White (2018) and PEST++ Development Team (2023) for further detail.

5.2.1 Implementation details

Details of the workflow and underlying utilities used to implement each observation type are presented in Figure 5-4.

All groundwater level, pit water body level, sump discharge, and flow observation data are resampled (averaged) to a single observation per model stress period; this process was used to iteratively refine model stress period discretisation, ultimately leading to the stress period definition outlined in Section 4.3. Secondary data sets such as stream flow frequency-duration curves, groundwater depth-frequency-duration curves, and annual flow volumes, were derived from these resampled data sets to ensure that observations and their modelled counterparts are directly comparable for history-matching.

Groundwater level data from bores that were and/or are used as production bores are simulated using MODFLOW-USG's Connected Linear Network (CLN) package (see Section 4.5.10). Modelled groundwater levels at these bores therefore represent groundwater levels computed within bore casing at the sub-mesh (bore-) scale. Modelled groundwater levels at all other bores are simulated by MODFLOW's groundwater flow routines (within groundwater flow model or "GWF" cells) and are extracted from the model using PEST utility USGMOD2OBS (Doherty, 2016e), using distance-weighted averaging from the bore location to each of the neighbouring groundwater model cell centres.

Two other PEST utilities (described in Doherty, 2016d and 2016e) are also used for processing different observation data counterparts from the model: SMPDIFF, and USGBUD2SMP which are used to calculate changes in computed values and extract flow budget, respectively (customised for a slightly modified form of output).

All other observation processing tasks are carried out using custom Python[20] scripts, largely relying on the Flopy[21], Numpy[22], and Pandas[23] packages.

[20] https://www.python.org/
[21] https://github.com/modflowpy/flopy
[22] https://numpy.org/
[23] https://pandas.pydata.org/

Table 5-1 Model History-Matching - Observation Data Summary

Type	Observation Groups	Count of Sites	Count of Observations	Description
Groundwater levels	-Bores <=30m depth -Bores >30m depth -Trigger bores (shallow and deep)	147	10,675 PEST observations (resampled from many more sub-stress period scale observations)	Groundwater levels as mAHD for deeper bores or mBGL for bores shallower than 30 m depth. Modelled depth below ground is calculated as the depth below the top surface of the model, whereas that at the bore is from the surveyed ground elevation at the bore. This aims to sidestep structural model error derived from discrepancies between topographic elevation at the model cell scale versus that at the bore scale.
Groundwater levels (dry bores)		7	196	Dry bores included as one-sided penalty functions in PEST; where modelled head is below the bore bottom elevation, the modelled value is set to that bottom elevation (which is also the observed value). In this way, the history match is only penalised when those bores are simulated as being at least partially saturated. These observations are defined from December 2021 onward, when these bores were installed.
Groundwater level differences	-Trigger bores -All other bores	48	1944	Vertical (inter-aquifer) head differences at nested sites (including VWPs). A 30 m distance (cluster) limit was applied to define nested sites. Also includes head differences between the pit water body and selected nearby bores.
Groundwater level change (drawdown)	-Trigger bores (shallow and deep) -All other bores (shallow and deep)	147	9362	Change in level since first recorded (and modelled) observation.
Stream flows	-Average rate within stress period -Annual flow volume	6	1073 (resampled to model stress periods), 97 annual volume observations.	
Interstation stream flow differences	Salt Creek (SV2/SV3), Anglesea River (AV1/AV2)	4	266	Downstream flow gain/loss between gauges.
Stream flow exceedance	No sub-groups	6	102	Flow duration curve statistics.
Zero stream flow	No sub-groups	6	300	

Type	Observation Groups	Count of Sites	Count of Observations	Description
Pit water body levels	No sub-groups	1	68	Pit water body water levels
Mine pit sump pumping	No sub-groups	1	108	Highly uncertain data due to (required) historical estimation of relative components of runoff, direct rainfall, and groundwater discharge into the sump.
WEL flow reduction penalties	No sub-groups	44	21,641	One-sided penalty observation for cases in which applied WEL boundary fluxes in any model are reduced due to (stochastic) parameters.
Mass balance error penalties	No sub-groups	1 (model-wide)	676	One-sided penalty observations of mass balance error per time step. Values exceeding 1% error incur penalties to PEST's objective function. This is implemented to enable forced convergence during automated history matching.

Table 5-2 Model History-Matching – Groundwater Level Observation Data Summary by Monitoring Unit

Monitoring Unit	Count of Bores	Count of Observations (pre-resampling to model stress periods)	Minimum Date	Maximum Date
(UEVF Intermediate Coal)	1	11456	22/07/2021	20/02/2023
ASA	12	54814	24/09/2009	03/03/2023
Boonah Formation	14	59990	01/11/2006	20/02/2023
DBF	17	496	01/06/1999	19/10/2020
DBF/BF	10	2253	01/11/2006	18/03/2021
LEVF	30	212043	31/12/1968	07/03/2023
Mine Overburden	1	16641	10/12/2020	20/02/2023
DBF/Boonah Fm (perched)	13	16620	01/11/2006	07/11/2022
UEVF	35	289789	31/12/1968	03/03/2023
UEVF (Upper Sands)	7	110266	10/12/2020	20/02/2023
UEVF_LEVF	2	2586	18/03/1969	21/05/2018

Table 5-3 Applied Observation Data Noise

Observation Data Type	Observation Noise	Rationale
Groundwater level [mAHD / mBGL]	For deep bores: 1 m (mAHD) post-mining; 2m during mining, except for Alcoa production bores (10m); trigger bores: 0.25 m. For bores less than 30 m deep: 0.1 mBGL, except	Considering model cell resolution, elevation survey error, bore water level recording error.

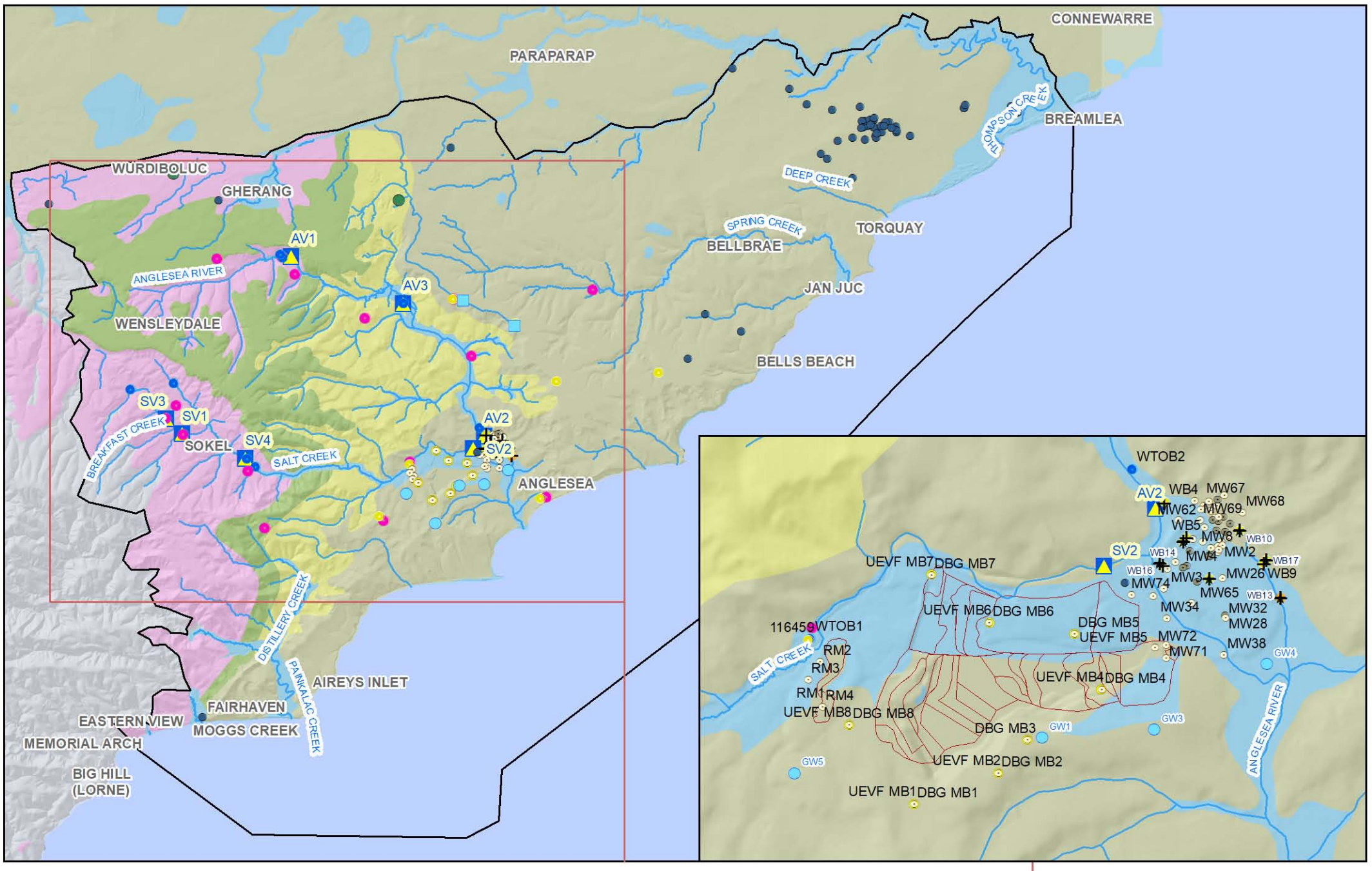
Observation Data Type	Observation Noise	Rationale
	for Alcoa MW* bores (0.25 m).	
Groundwater level change [m]	Deep bores: 0.5m (during mining in southern syncline); 0.25m (post-mining and in northern syncline), 0.1m (trigger bores), 0.05 (shallow bores).	Change from one reading to the next should theoretically be more accurate than a single absolute reading. Cell resolution should be sufficient to overcome issues with bores being too close to one another.
Inter-aquifer (vertical) groundwater level differences [m]	0.1m (between bores); 0.05m (between pit water body and groundwater).	Assumed; any greater could negate these observations' value in some cases.
Pit water body water level [mAHD]	0.1 m (mAHD)	Assume survey and recording error is minimal, but account for relatively coarse temporal resolution of observations, and of water body bathymetry.
Mine pit sump pumping [ML/day]	+/-10%	Account for poor early records, potential metering and recording error, and that this is a "loose" constraint given it is used as an absolute upper limit of groundwater discharge to the pit (i.e., it includes in-pit runoff).
Stream Flow and flow differences [ML/day]	+/-10% (5% for annual flow volumes; 0% for zero flow)	Error would vary with flow volume. Flows from v-notch weirs possibly affected by gauge underflow. Some gauges are known to have been affected by debris after major events. Upstream and downstream channel morphology may affect gauged flow reliability.

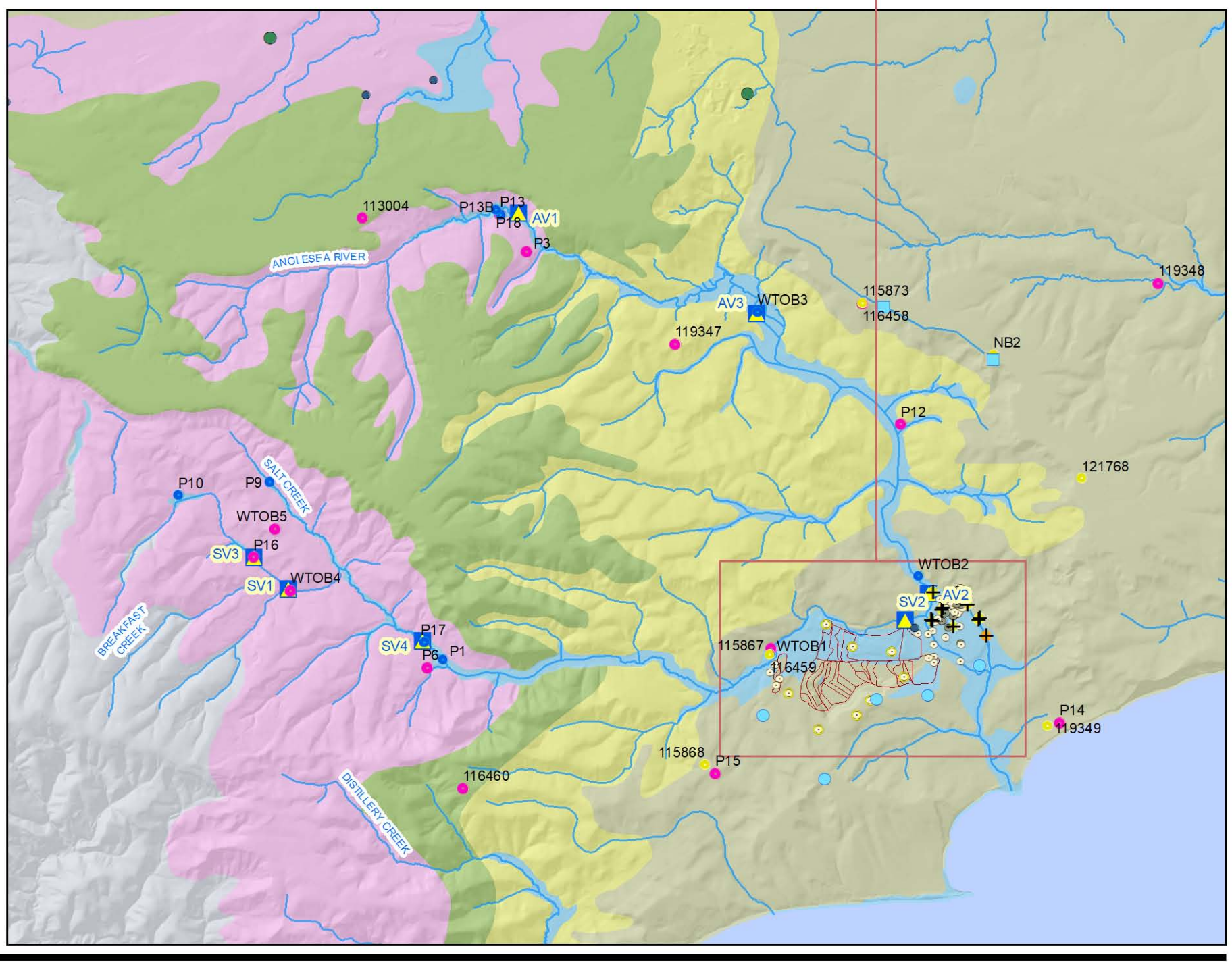
5.2.2 PEST's Objective Function

Groundwater level and difference (trend), drawdown and surface flow and related data were assigned to a range of observation sub-groups as outlined in Section 5.2 and Table 5-1. This was undertaken to ensure adequate weight was placed on important observation data, and that contributions to history-matching error and optimisation progress, or lack thereof, could be easily identified and rectified during optimisation.

The effect of differing relative weighting within each observation group on PEST's objective function is presented in Figure 5-5, for the pre- and post-history matching cases (top and bottom charts respectively). It should be noted that:

- Several additional sub-groups were defined during history-matching, and hence there are additional groups present in the lower pie chart. These include surface water flows greater than 1 ML/day, to better direct PEST's attention to those components of the hydrograph.
- Relative weights were increased by a factor of ten on stream flow records post-2009 for gauge SV2, the record for which comprises two main periods – 1975-1982, and 2009-current. PEST was largely focussing on the observations from the earlier period while somewhat neglecting those from the latter period in early iterations; it was however considered more important to direct history-matching efforts to more recent records given their relevance to a drier catchment in which Alcoa's (and Barwon Water's) operations have changed substantially.
- Relative weights were increased on the groundwater level depth observations (for bores <30 m deep) to increase PEST's focus on these data, as they were being somewhat neglected in earlier iterations. Therefore, their apparent relative contribution to the objective function is larger in the bottom (posterior) pie chart than it is in the upper (prior) chart.





Legend

- Township
- Flow Gauge

Groundwater Pumping Bore (WEL)

- Alcoa
- Barwon Water (Northern Borefield)
- Barwon Water (Southern Borefield)
- Licensed
- Stock & domestic
- Stream
- Historic Mining Area
- Model Domain

Outcrop

- Alluvials
- Bedrock
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View

Groundwater Monitoring Bore

Aquifer Monitored

- Alluvial/SwampA... (ASA)
- Demons Bluff Formation
- Boonah Formation
- UEVF (Upper Sands)
- UEVF; UEVF (Basal Sands)
- UEVF/LEVF
- LEVF

Paper Size ISO A3

0 1 2 3 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Groundwater Model History-Matching Observation Locations

Project No. 31-12542999
Revision No. 2
Date 20/01/2022

FIGURE 5-3

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Data source: . Created by: Chris Nicol

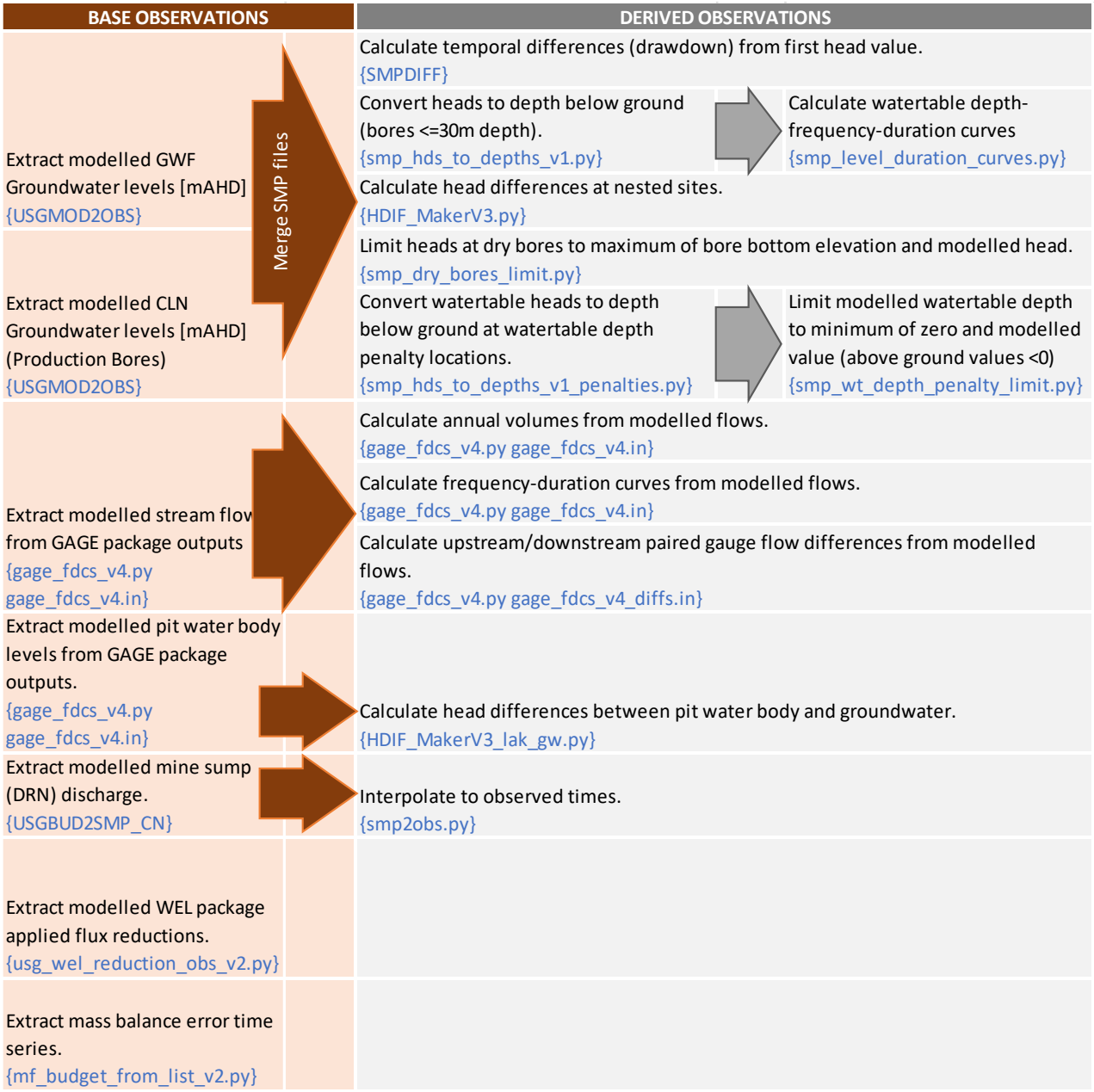

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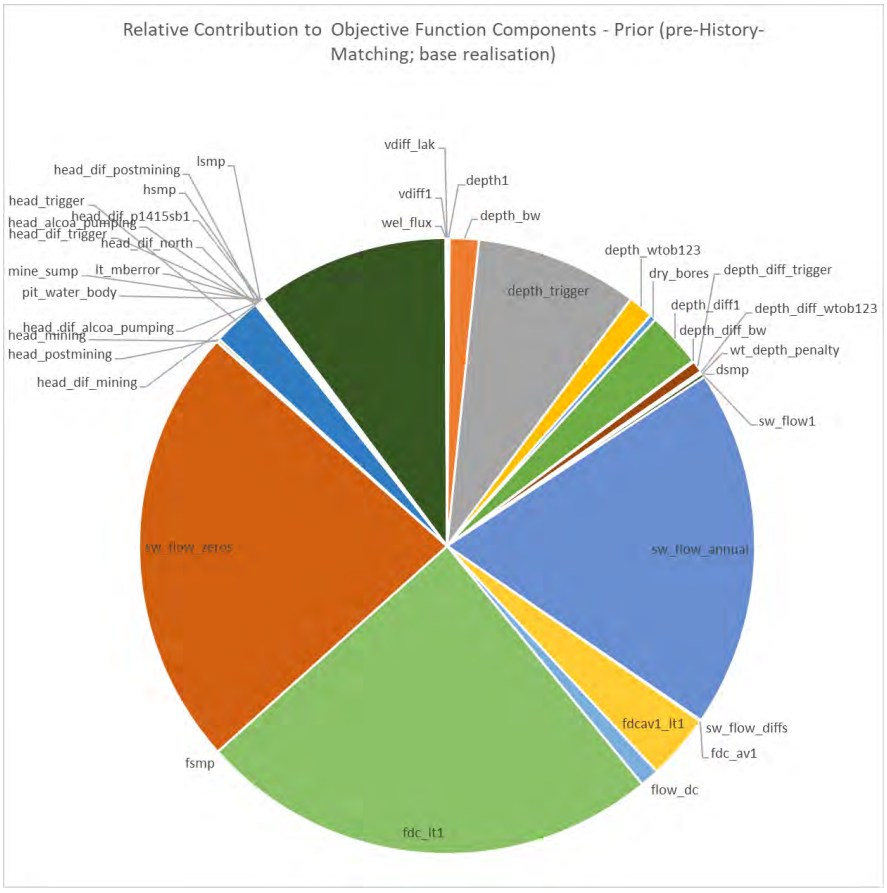
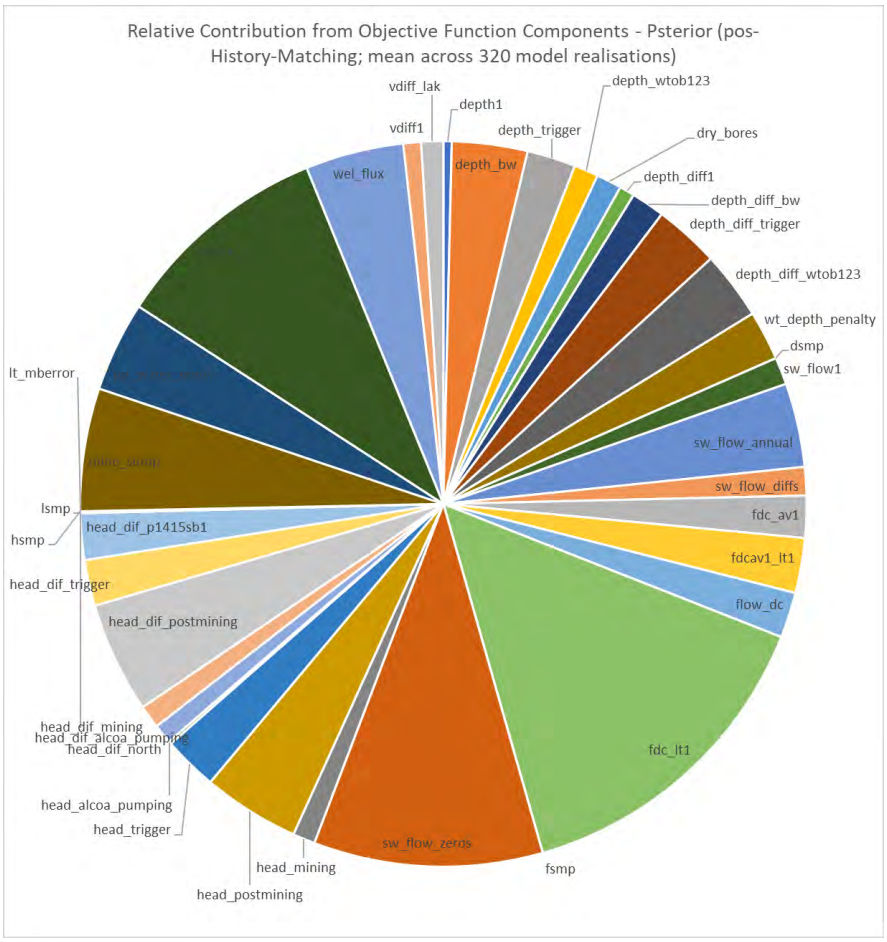
Figure 5-4 Model History Matching Workflow: Observation Data





Notes on acronyms:
wt – watertable (depth above ground penalty observations)
dif / diffs - difference (head; over time. Or Inter-station flow differences).
vdif - vertical (head) difference.
dc - duration curve (flow and watertable depth frequencies)
lt1 - less than 1 (ML/day flow)
sw - surface water

Other Notes:
1. Observation groups were refined during history matching; some groups were subdivided to focus PEST on specific observation types that were being "lost" among the broader groups. Hence the two charts' series are not identical.
2. The relative weight on depth observations (watertable; for bores <30m deep) was purposefully increased during history matching. Therefore, these group's relative size has increased between the prior (upper) and posterior (lower) charts.

Figure 5-5 Relative contribution of each observation group to PESTPP-IES' objective function

5.3 Parameterisation

Parameterisation schemes and allowable parameter ranges applied to the PESTPP-IES history matching process are outlined throughout Section 4, for boundary conditions and applied fluxes (Sections 4.5.1 through 0), and strata hydraulic properties (Section 4.6). However, some additional details with respect to PESTPP-IES in terms of model parameterisation are discussed below.

All pilot point (spatially interpolated) parameters described in earlier sections are assigned spatial covariance structures to encourage the history matching process to honour the initial ("prior", or pre-history matching) parameters and their spatial differences as closely as possibly, unless departures from this are necessary to significantly improve the simulation of historical system behaviour, as measured by PESTPP-IES against the strategically-weighted observation data outlined in the previous section.

These covariances are defined using PEST utilities MKPPSTAT and PPCOV_SVA (Doherty, 2016d). Variances are defined on the assumption that one quarter of the allowable parameter range represents on standard deviation, thereby implying a 95% confidence interval[24]. Covariances were defined using a variogram with range defined based on the mean distance from each pilot point its eight nearest neighbours. No nugget is applied.

For parameters that are not spatially correlated, standard deviations were defined in the same way (one quarter of the allowable parameter range). These standard deviations and covariance matrices were provided to PESTPP-IES via a PEST parameter uncertainty file (see Doherty, 2016b).

PESTPP-IES was instructed to optimise a total of 52,600 adjustable parameters, most of them comprising spatially variable pilot points representing a range of parameter types within each model layer.

5.3.1 The model parameterisation workflow

Figure 5-6 presents a summary schematic of the model parameterisation workflow developed and applied in the history matching process. Detailed discussion of each model package and how the conceptual model and supporting data is used to inform its' design and parameterisation is provided in Section 4 of this report (refer to each of the main sub sections).

PESTPP-IES, at the initiation of each optimisation iteration, first implements the parameterisation workflow shown in Figure 5-6 to update each model parameter of every model realisation in the model input files, and ultimately run MODFLOW-USG with those updated parameters (see the bottom of the figure).

Following parameterisation and running of the model in each optimisation iteration, the observation processing workflow discussion in Section 5.2 and shown in Figure 5-4 is executed by PESTPP-IES on each model realisation. PESTPP-IES then has the information that it needs to develop and test parameter upgrades for the next iteration.

[24] I.e., assuming a normal parameter distribution, given the 68-95-99.7% rule, these percentages of the sampled parameter set lie within 1/2/3 standard deviations of the mean. If we divide the allowable parameter range by 4, this represents two standard deviations around the mean - i.e., PEST's allowable range describes the 95th percentile interval. This is not really of great importance; the range could instead have been divided by six (implying a 99.7% confidence interval), and the sampled parameter distribution would have been narrower around the mean; but this is probably not reflective of true parameter and model uncertainty.

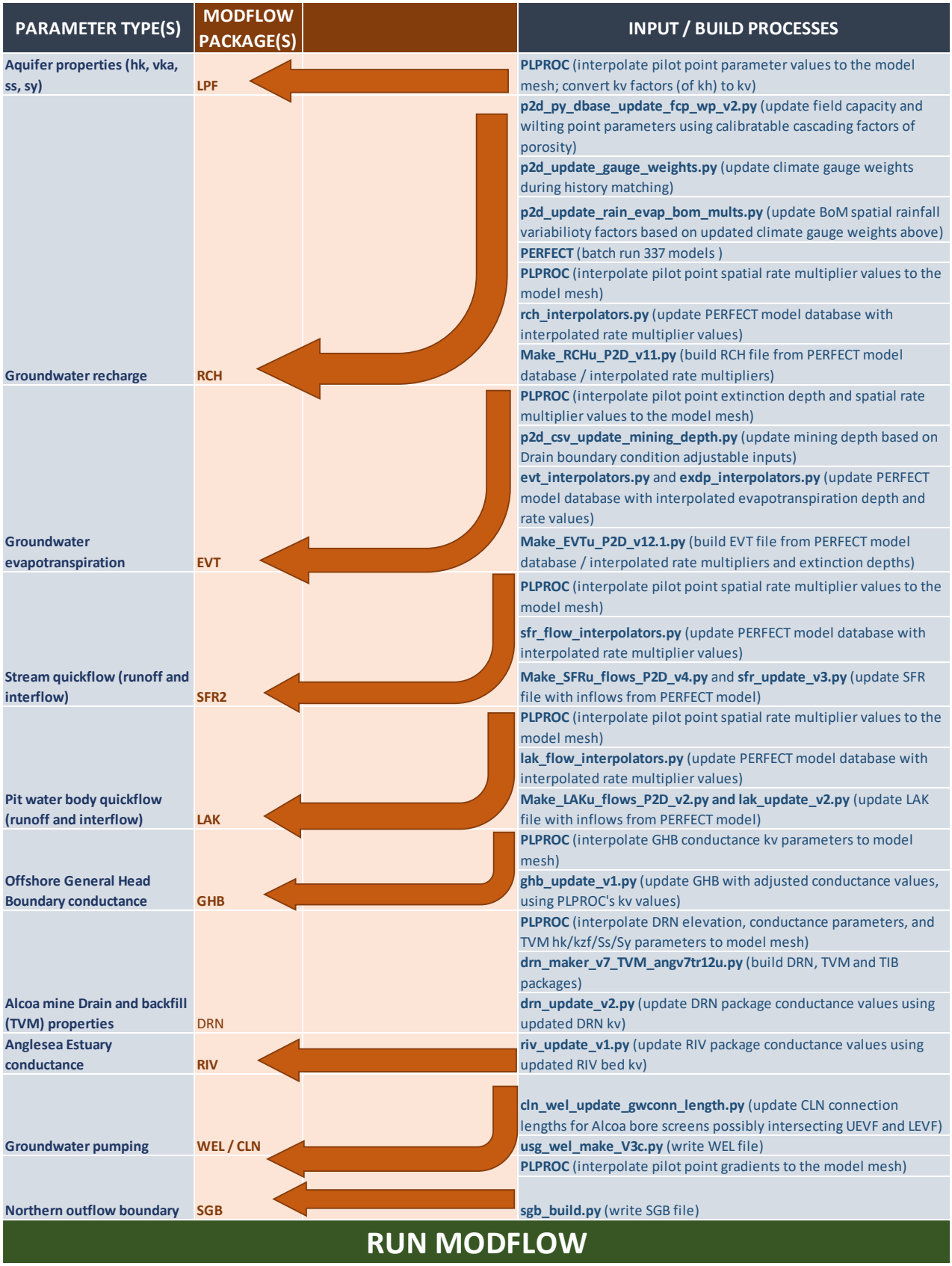


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Figure 5-6 Model Parameterisation Workflow

6. Model History-Matching – Results

The following three subsections present and discuss history-match quality in terms of model performance, groundwater levels and stream flows. Subsequent sections present optimised parameters and their uncertainty.

6.1.1 Model performance

The model used for history matching (323 stress periods) takes anywhere from 1 to 8 hours to build, solve and post-process, depending on the model parameter realisation employed, computer hardware, and how many models are run at once per computer (many during the PESTPP-IES process, which slows the model down). The upper end of this run time is longer than ideal, and could be investigated and potentially reduced, given time and budget, to make the modelling process more efficient (and cost-effective) in future. The base model realisation however only takes only one hour to run, which is reasonable for a model of this size; gainable efficiencies may therefore be minimal.

During and at the end of the history-matching process, convergence and mass balance error details were checked, indicating generally very low mass balance errors in the combined steady-state / transient model. The mass balance errors are for the most part below the maximum 1 % error recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012), generally at less than 0.05% and always less than 0.3%.

PESTPP-IES semi-randomly explores the limits of parameters. On occasion this leads to numerical instability and/or failure to achieve convergence, and hardware/networking issues can also cause issues; of the 500 initial model realisations passed to PESTPP-IES, 237 were lost over the optimisation iterations (totalling thousands of model runs); this leaves a pool of 263 optimised models from which to select a subset for ongoing application in scenario modelling. From a practical point of view, this is a positive outcome considering the tens of thousands of randomly varied parameters, thousands of simulations, the application of two strongly non-linear boundary conditions (in places within the same model cell (SFR2 and EVT)), and other significant non-linear stresses associated with historical mining and groundwater pumping effects.

6.1.2 Optimised Model Realisation Sub-Setting

For the purposes of history matching, no realisation sub-setting is implemented in this case, beyond that described above for mass balance reasons. For predictive purposes however, it is expected that a smaller, more manageable number of model realisations will be selected for application in that case (e.g., the top 150 models of higher history match quality).

6.1.3 Groundwater levels

Summary history-match statistics for heads in bores deeper than 30 m are presented in Figure 6-1, and those for watertable depths in bores less than 30 m are presented in Figure 6-2. These include uncertainty across the 263 history-matched model realisations as both statistics and repeated grey chart series; statistics and series for the base realisation are also presented in these figures.

Figure 6-1 shows root mean square and absolute mean errors are reasonable for absolute levels (3.5-5.8% and 7.1-12.5 m respectively), considering the effect of recognised levels of observation noise (including recognition of aged observation bores), uncertainty in historical pumping rates and mining depths, in conjunction with model spatial resolution and its topographic errors. Also contributing to these model errors is the low weighting that was placed on Alcoa production bores' head data for periods over which they were historically pumped on a sub-daily basis, which the model cannot replicate given its temporal resolution. The full unweighted data set is presented in Figure 6-1, and are included in the statistics and plots presented throughout this report section. The cumulative residual plot on the left side of Figure 6-1 shows that approximately 75% of absolute head observations (for deeper bores) are within 10 m error, and approximately 90% are within 20 m (against observation data spanning more than 250 m range), across all 263 model realisations.

Figure 6-2 shows absolute mean error for watertable depths is small for a regional scale model (0.8-1.4 m), and the root mean square error is reasonable (7.2-13.5%) given the narrow range of observation data for groundwater depths. The cumulative residual plot on the left side of Figure 6-2 shows that 70-80% of watertable depth observations are within 1 m error, and more than 85-95% are within 5 m error, across all 263 model realisations.

The largest watertable depth outliers in Figure 6-2 tend to be for sparse (or even single) readings in the many very shallow (often sub-5 m) Alcoa observation bores around the old power station site, which may monitor shallow perched systems, and some of which are known to have been historically affected by local leakage from site infrastructure – the effect of which is not explicitly modelled, because it is not material to the model objectives. Model layering around these shallow bores, as provided by Alcoa, may also require further investigation and refinement if this is deemed an important issue. In any case, it is clear from the scatter plot on the right side of Figure 6-2 that observation bores with longer timeseries (evident as larger clumps of many points, most often with a diagonal trend) are better simulated by the model than those with far fewer sparse readings.

Maps showing the spatial distribution of mean residual (the difference between modelled and observed values) are presented in Figure 6-3 and Figure 6-4. These maps show:

- Minimal error and no evident bias in the spatial distribution of residuals for the ASA (upper map in Figure 6-3).
- Larger but still minimal error in the shallow (DBF, Boonah Formation) bores around the Alcoa site, which are known to be affected by historical leakage from site infrastructure (lower map in Figure 6-3). There is no clear pattern in their spatial distribution, and therefore no evident spatial bias. It is worth noting the very short period of record for these bores, and the relatively low weighting placed on them in the history matching process.
- A generally good groundwater level history match quality in the UEVF upper sands aquifer within and around the historical Alcoa mine pit (top left map in Figure 6-4). This is significantly improved over earlier model history matching efforts, which was enabled through more flexibility in the simulation of historical mining operations (see Section 4.5.9). Head in bore UEVF_MB8 (monitoring a UEVF intermediate coal sub-unit) to the west of the mine is however underestimated by more than 10 m; this is probably due to the discrete nature of the coal seam interval monitored within the broader and much thicker intermediate aquifer.
- A highly mixed picture of model over- and under-estimation of groundwater levels in the UEVF lower sands aquifer around the Alcoa coal mine (top right map in Figure 6-4). Whilst recognising that drawdown (stress responses, not absolute heads) is the focus of the history matching (see further discussion on this below), this possibly reflects:
    - the highly variable nature of this aquifer,
    - the various sub-units that may be screened by each of these bores,
    - the low history-match weighting placed on the Alcoa production bores during periods of historical sub-daily pumping, which the model cannot replicate due to its temporal resolution; and
    - their age, which tends to lead to poor bore condition.
- To the north of the Alcoa mine, in the northern syncline, the top right map of Figure 6-4 shows minor model residual error for most bores (e.g., NB2, 116458, P19, 121768). However, for Barwon Water's ASR bores which have very short periods of record (typically possessing only one observation each), there is a tendency for increasing model over-estimation of heads in the northerly direction; this appears to be a highly localised issue and is of no consequence to model utility.
- In the LEVF aquifer, the bottom map in Figure 6-4 shows generally negligible mean residual error in the upper catchment areas, and moderate to high levels of residual error in the deeper parts of the basin around the Alcoa coal mine; the largest outliers are generally Barwon Water production bores, with most head error occurring in some model realisations (but not all) under peak pumping stress for short periods; this is not uncommon when trying to simulate production bore heads, given model cell scale and the complexities of well efficiency losses. There is a general pattern of head over-estimation to the southeast of the Alcoa mine, and very slight under-estimation to the west. Broadly speaking, magnitudes of drawdown (i.e., pumping stress response) away from production bores are the focus of the history-matching and are generally well simulated (see Figure 6-6 and Appendix D, the further discussion on this below).

Absolute head and watertable depth hydrographs for all observation bores used in history matching are presented in Appendix D and Appendix E respectively. These include uncertainty across the 263 history-matched model realisations, shown as grey lines. *An important point to note in all model groundwater level and stream flow hydrograph figures presented in this report, is that there are periods of apparently greater variability in the late 1970's to early 1980's, and again in the late 2000's, than there is in intervening periods; readers should recall that this is driven by coarser temporal model discretisation (up to annual stress period durations) in the intervening periods, as is described in Section 4.4 and Figure 4-8.*

Modelled head hydrographs generally show a reasonable to good match to their observed counterparts, although there are exceptions where a poorer match is evident. The following general observations are made with respect to the history match quality to absolute heads (for deeper bores):

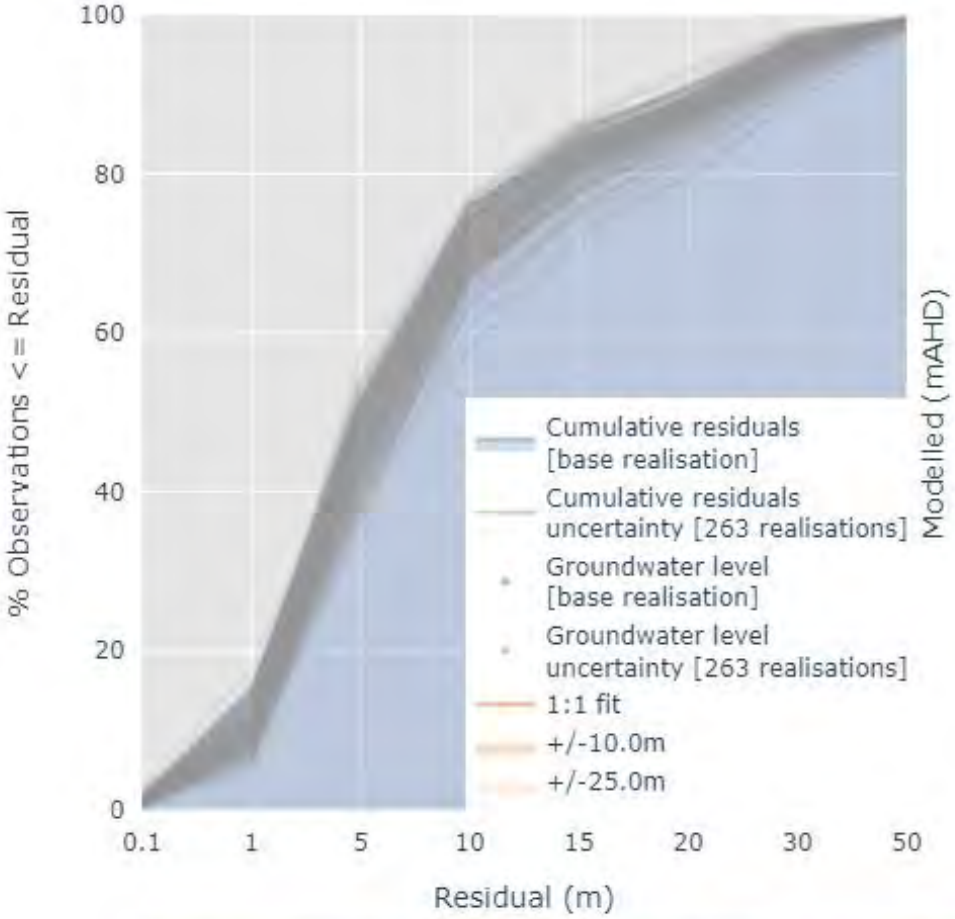
- Appendix D shows that absolute heads and more importantly drawdown trends over time (in response to groundwater pumping, primarily by Alcoa from 1968 through to 2022 and Barwon Water from 2007 to 2022), are well simulated. For example, the Alcoa WB* bores and Barwon Water bore SB2, screening the lower UEVF aquifer (see examples in Figure 6-5); and Barwon Water's GW* bores, SB1 and P* bores screening the LEVF aquifer (see examples in Figure 6-6). The broad UEVF aquifer trends in response to long-term, large-scale hydraulic stresses from Alcoa mine development and groundwater pumping for the power station and mine depressurisation are generally well simulated (Figure 6-5 and Appendix D). Similarly, the LEVF aquifer responses to historical Barwon Water borefield use are well simulated (Figure 6-6 and Appendix D). These are positive outcomes from the point of view of model performance, given that potential effects arising from these two major stressors are the primary reason for model development. As with any model, there are exceptions to the above general statement. These include:
    - Absolute heads in many model realisations for LEVF bores in the shallower western parts of the northern syncline (119347 (Figure 6-6; not all realisations), P13, 113004 and P3 (Appendix D)) tend to be over-estimated by 5 m. To the east however, in deeper parts of the syncline, head and drawdown trends are generally well simulated.
    - There is a lack of modelled drawdown at UEVF bore 115868 as compared with observed data (Appendix D): The sharp decline in 2010 coincides with LEVF Barwon Water's pumping (see nearby LEVF bore P15 in Appendix D), and the head it declines to (-25mAHD) also coincides with LEVF heads around that time. But the subsequent recovery post-Barwon Water's pumping is not observed. It is likely that this bore is of poor integrity, possibly with some connection to the LEVF (e.g., a temporary unblocking under LEVF pumping stress in 2010). *It is important to stress that DELWP have categorised this bore as having failed, and it is no longer monitored by DELWP.* It is noted that UEVF bore 116459 (located at the Alcoa pit west wall) does not draw down to anywhere near -25mAHD at this time, despite being immediately adjacent the pit; neither do those immediately around Alcoa's production bores (WB16 etc). This suggests that bore 115868 is certainly connected to the LEVF in some way but is clearly of poor integrity. The old government bores were not constructed to standard and therefore their reliability is low.
        - Similar, related issues affect other government bores: for example, 115867 (LEVF), and 116459 (UEVF); (refer Appendix F).
- Alcoa's UEVF lower sand bores (WB*) often exhibit a mix of over-and under-estimation during the active mining period (Figure 6-6 and Appendix D); at these times, the Alcoa production bores were intermittently pumped on a sub-daily basis, which the model cannot replicate given its temporal resolution. There is also uncertainty regarding historical Alcoa mining depths. A low weight was placed on these observations during history-matching (primarily because of the intermittent sub-daily pumping schedules), and a higher weight was placed on post-mining heads and recovery trends, which are better simulated.

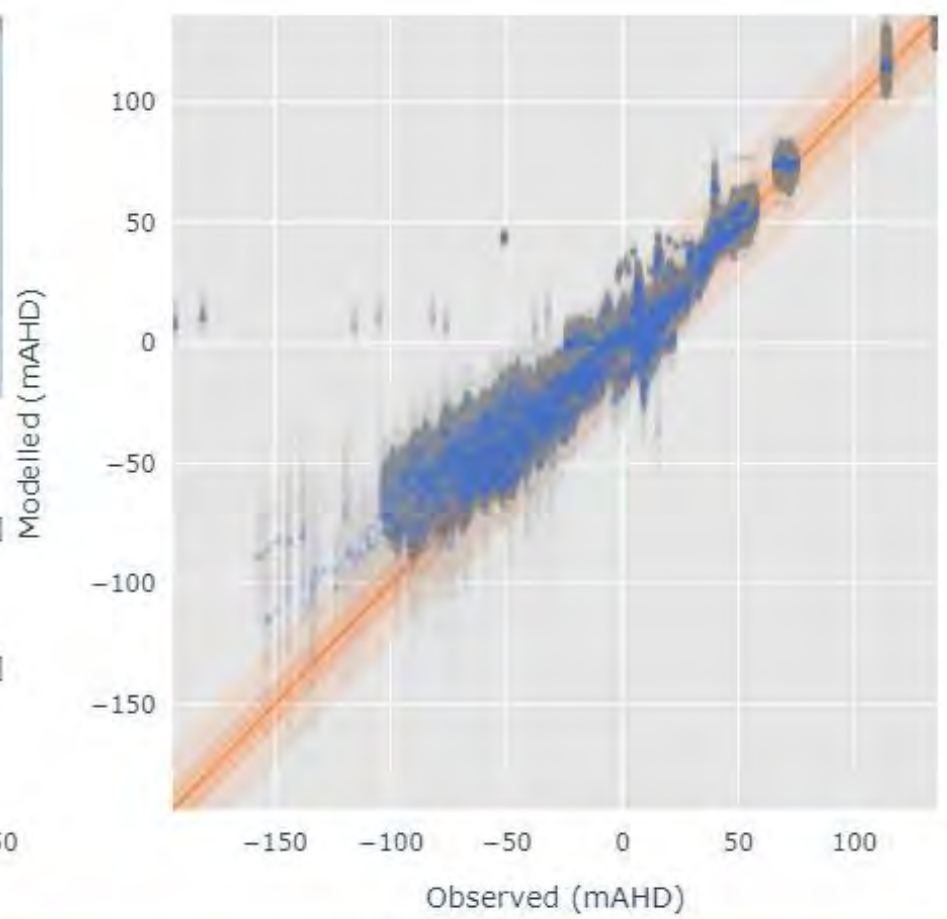
The following general observations are made with respect to history match quality to watertable depths (for bores shallower than 30 m):

- Appendix E and Figure 6-7 show that watertable depths in ASA bores are generally well simulated across all 263 model realisations, in terms of the average depth below (or above) ground, and in terms of seasonal and longer-term trends and variability. For example, see bores P10, P13B, P17, WTOB1 and WTOB2 (Figure 6-7), WTOB3, P7, P7B, P18, and P1. This is also a positive outcome because these observations are of importance to groundwater system behaviour directly related to some of the key modelling objectives (see Section 2.1). Points of note follow:

    - The large differences in watertable depth between P13B (19-20 m) and P18 (1-3 m), despite these bores being located closely together, are due to large local topographic changes. P13B is located on top of a scarp, above the valley floor where P18 is located.
    - Exceptions of poorer ASA history match quality include P9 and P8, with many realisations tending to exhibit shallower watertable depths than is observed by 0.5-1 m (Appendix E). In the case of P9, seasonal fluctuations are also over-estimated by the model, with the observed data showing little to no fluctuation; given the rarity of this behaviour in the observation data set, this could indicate that bore P9 screens a discrete, relatively impermeable lens of sedimentary material, because it's behaviour is not representative of the general behaviour of the watertable throughout the rest of the catchment (Figure 6-7 and Appendix E).
- Appendix E also shows that watertable depths in Alcoa's shallow Boonah Formation bores are reasonably well simulated, although are often under-estimated by the model by 2-5 m. Similar can be said of the history-match to the sparse data from many of Alcoa's shallow DBF bores.
- Also of note is that many shallow Alcoa MW* bores display sill-like (at times flat-lining) hydraulic behaviour. This is due to the very thin DBF layer in much of the Alcoa site being extremely thin and shallow, and therefore this model layer dries out at times in various places.
- Shallow LEVF bores (P11, P16, P6, WTOB4) and UEVF bores (P19) are all very well simulated in terms of seasonal and longer-term trends in watertable depth (Appendix E).

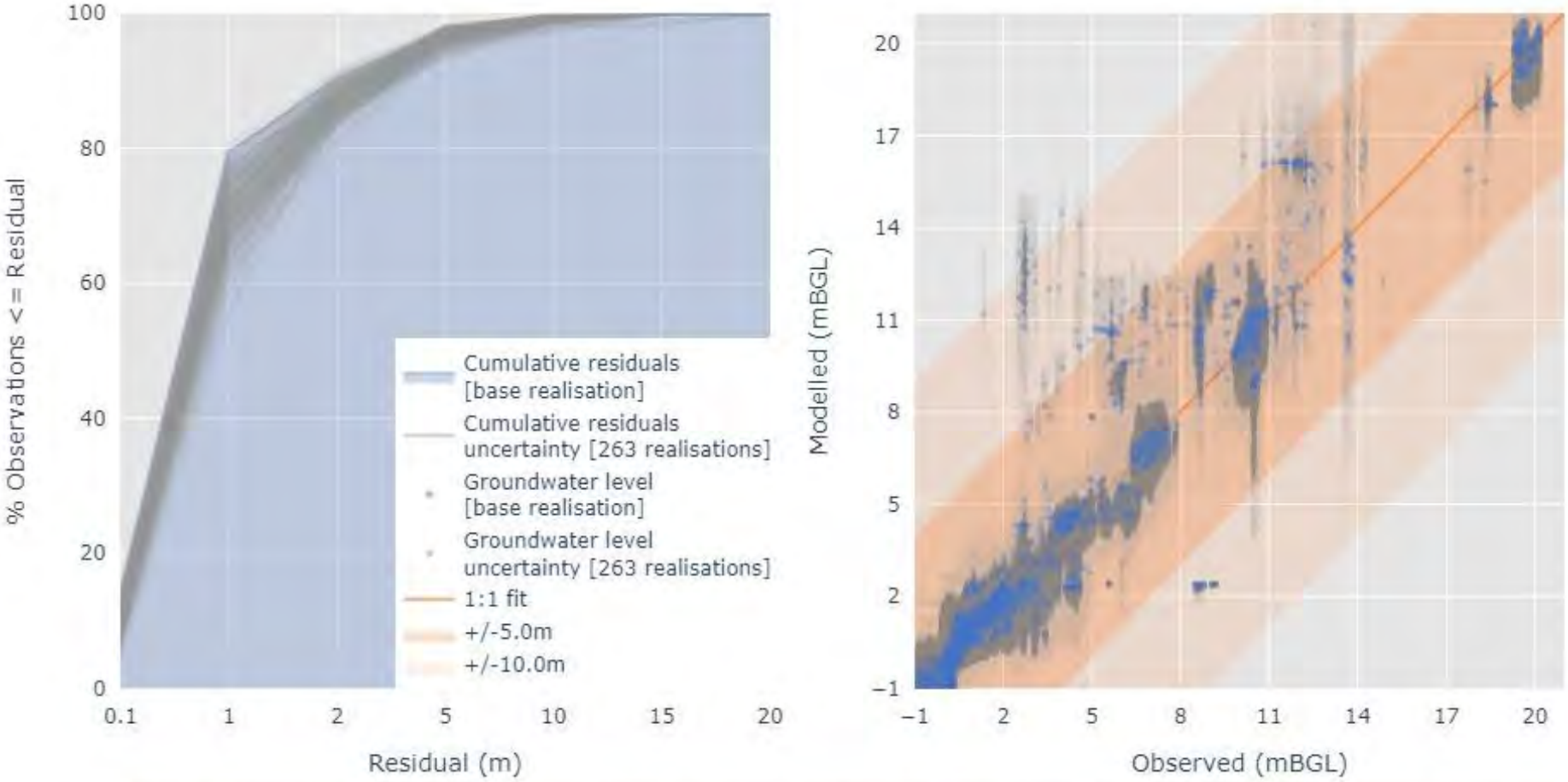
Figure 6-8 presents watertable depth-frequency history matching curves for all Barwon Water bores less than 30 m deep. These generally show good agreement with the observed data in terms of frequency trends and absolute depths; the main exceptions being P9 and P8, as is described above. This is an excellent outcome given the importance of these curves, and the watertable behaviours that they represent, to acid generation risks.





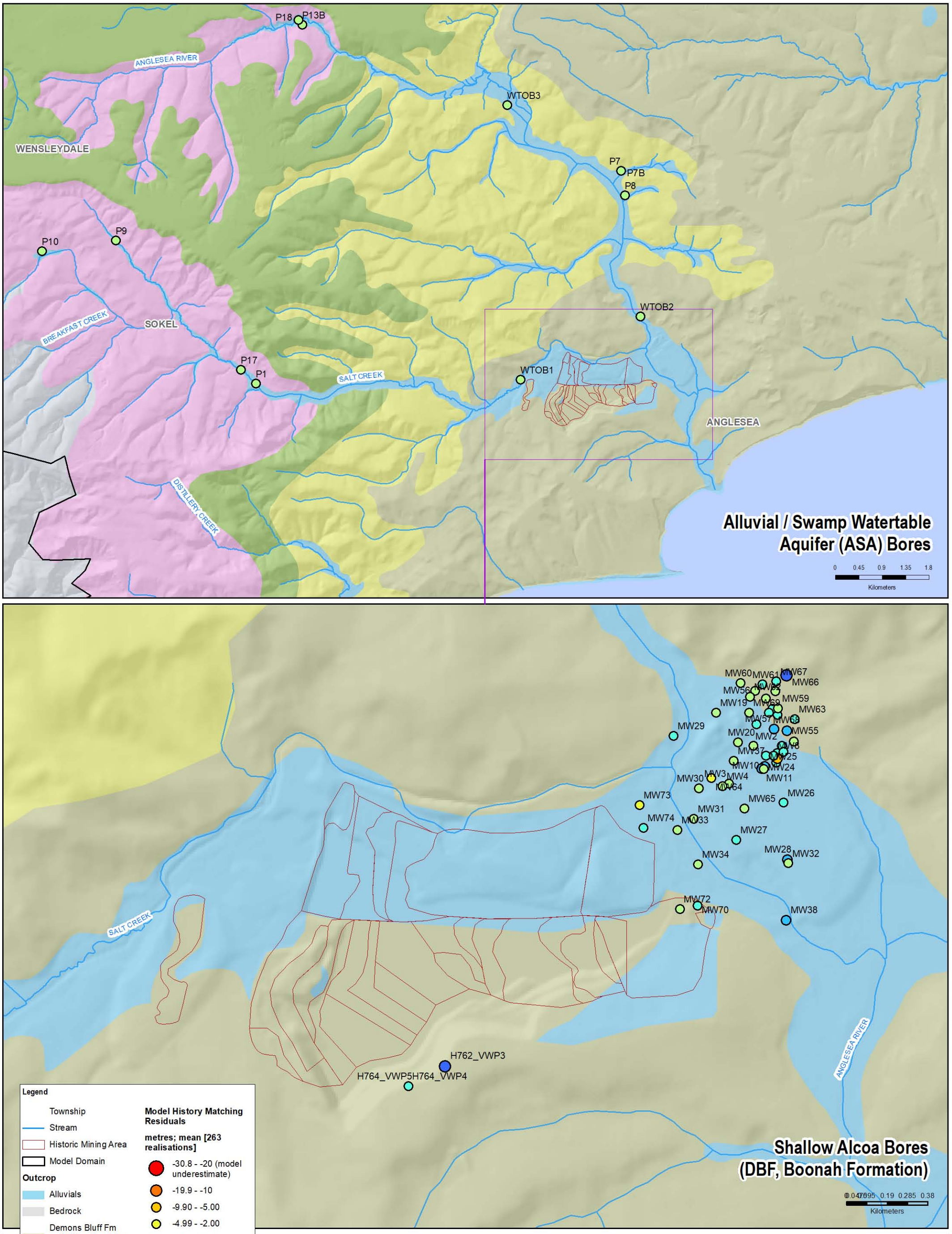
Model / Statistic of 263 realisations:	Number of Observations:	Sum of Squared Residuals:	Root Mean Square (RMS) Residual (m):	Normalised RMS (nRMS) residual:	Mean Absolute Residual (m):
Base realisation:	6594	1096898	12.90	3.9%	7.83
Minimum:	6594	891188	11.63	3.5%	7.07
Mean:	6594	1372587	14.36	4.4%	9.10
Maximum:	6594	2383683	19.01	5.8%	12.50

Figure 6-1 Summary model history matching statistics (groundwater levels for bores deeper than 30 m)



Model / Statistic of 263 realisations:	Number of Observations:	Sum of Squared Residuals:	Root Mean Square (RMS) Residual (m):	Normalised RMS (nRMS) residual:	Mean Absolute Residual (m):
Base realisation:	2908	9305	1.79	8.5%	0.87
Minimum:	2908	6658	1.51	7.2%	0.79
Mean:	2908	11176	1.95	9.2%	1.08
Maximum:	2908	23686	2.85	13.5%	1.36

Figure 6-2 ***Summary model history matching statistics (groundwater depth below ground, for bores shallower than 30 m)***



Paper Size ISO A3

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Spatial distribution of mean groundwater level history-match residuals [1 of 2]

Project No. 31-12542999
Revision No. 3
Date 25/01/2024

FIGURE 6-3

Data source: . Created by: Chris Nicol

ANGLESEA RIVER

Upper Eastern View Formation (UEVF) Aquifer - Intermediate and Upper Sands Bores

0 0.1 0.2 0.4 0.6 0.8
Kilometers

ANGLESEA RIVER

SPRING CREEK

SALT CREEK

ANGLESEA

Upper Eastern View Formation (UEVF) Aquifer - Lower Sands Bores

0 0.55 1.1 1.65 2.2
Kilometers

ANGLESEA RIVER

BREAKFAST CREEK

SALT CREEK

Lower Eastern View Formation (LEVF) Aquifer Bores

0 0.175 0.35 0.7 1.05 1.4
Kilometers

Legend

- Township
- Stream
- Historic Mining Area
- Model Domain

Outcrop

- Alluvials
- Bedrock
- Demons Bluff Fm and Other Overlying Units
- Lower Eastern View
- Middle Eastern View
- Upper Eastern View

Model History Matching Residuals

metres; mean [263 realisations]

- -30.8 - -20 (model underestimate)
- -19.9 - -10
- -9.90 - -5.00
- -4.99 - -2.00
- -1.99 - 2.00
- 2.01 - 5.00
- 5.01 - 10.0
- 10.1 - 20.0
- 20.1 - 36.6 (model overestimate)

Paper Size ISO A3

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GW/L GROUNDWATER LOGIC

GHD

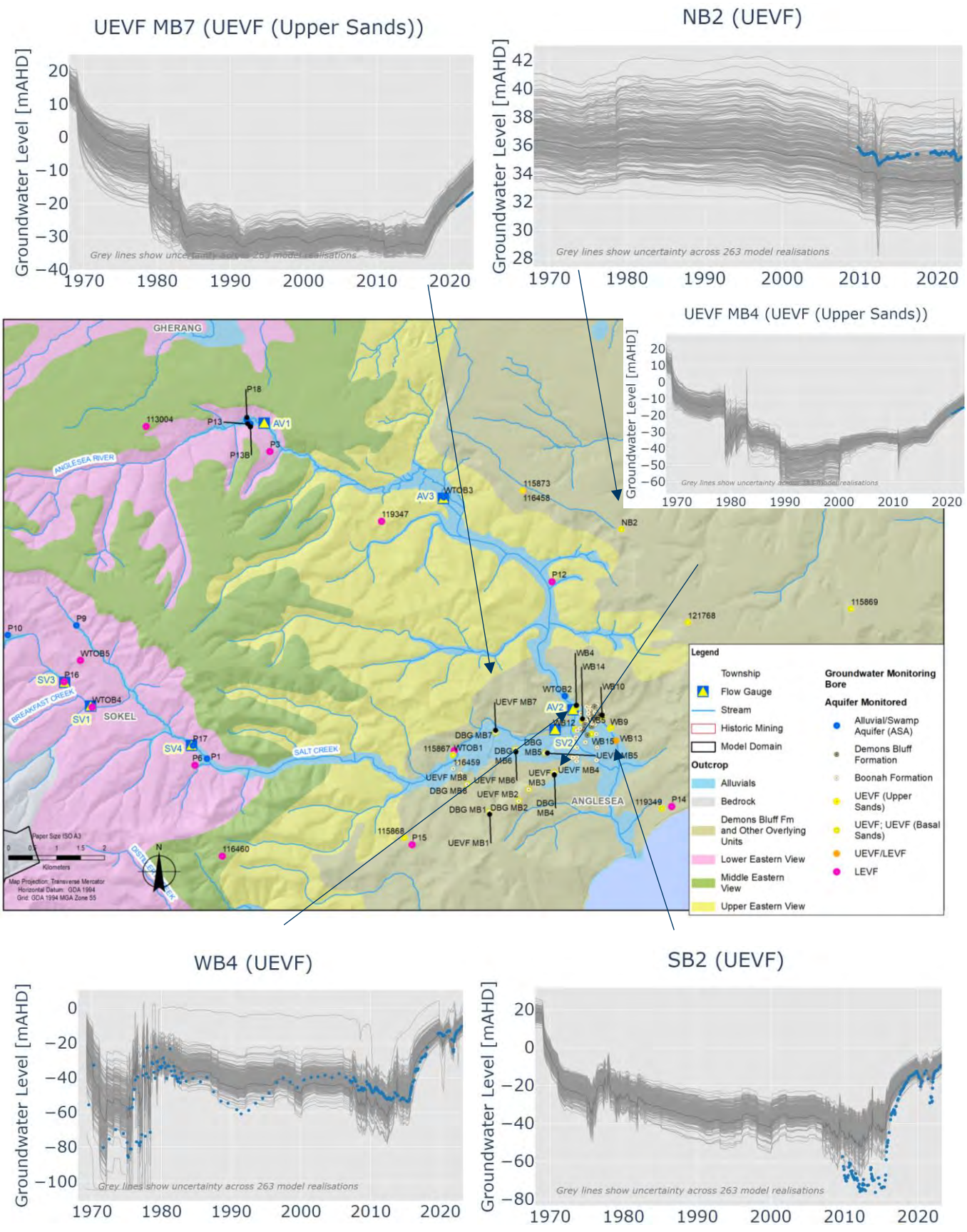
Barwon Water
Anglesea Groundwater Model Updates

Spatial distribution of mean groundwater level history-match residuals [2 of 2]

Project No. 31-12542999
Revision No. 3
Date 25/01/2024

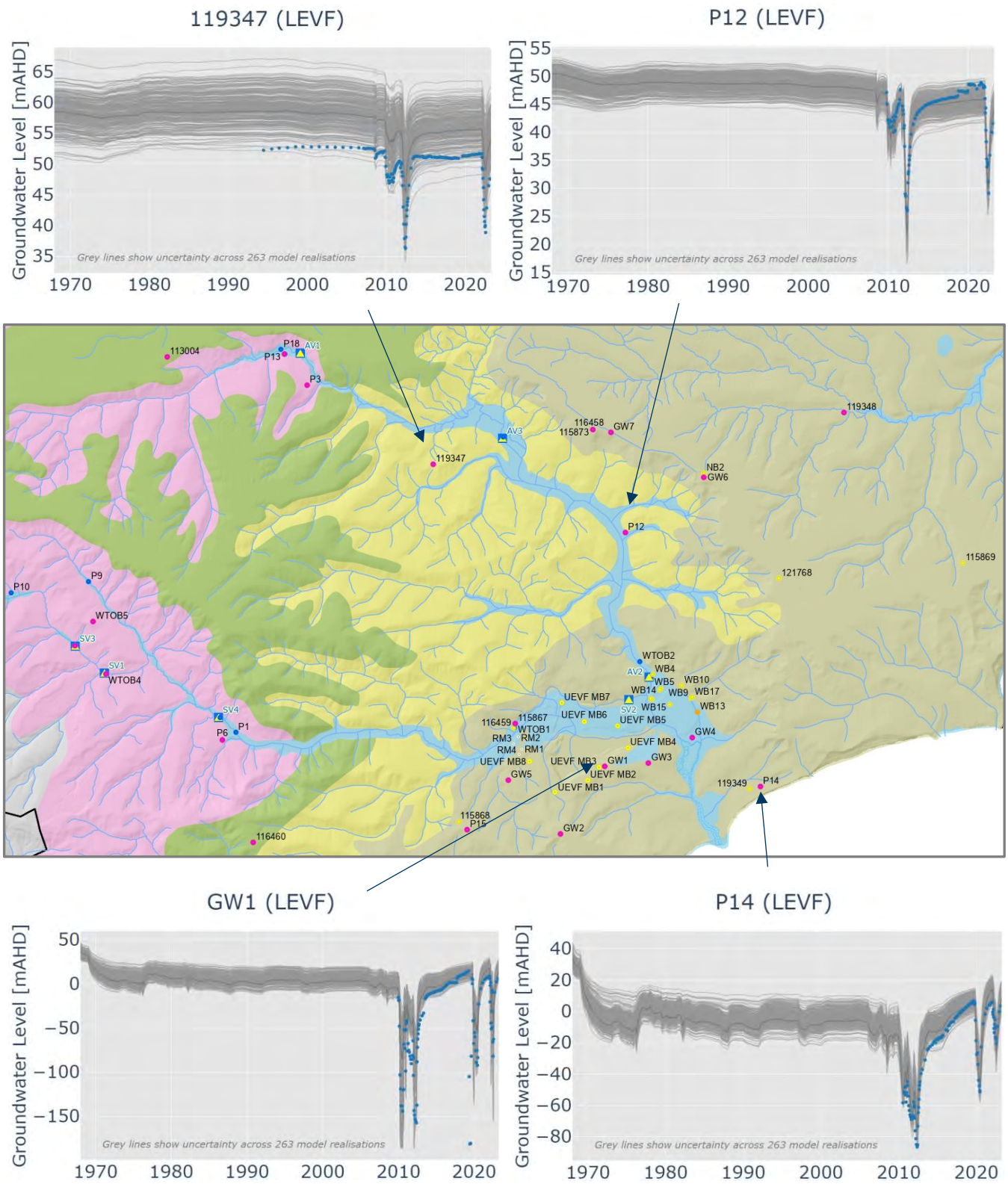
FIGURE 6-4

Data source: . Created by: Chris Nicol



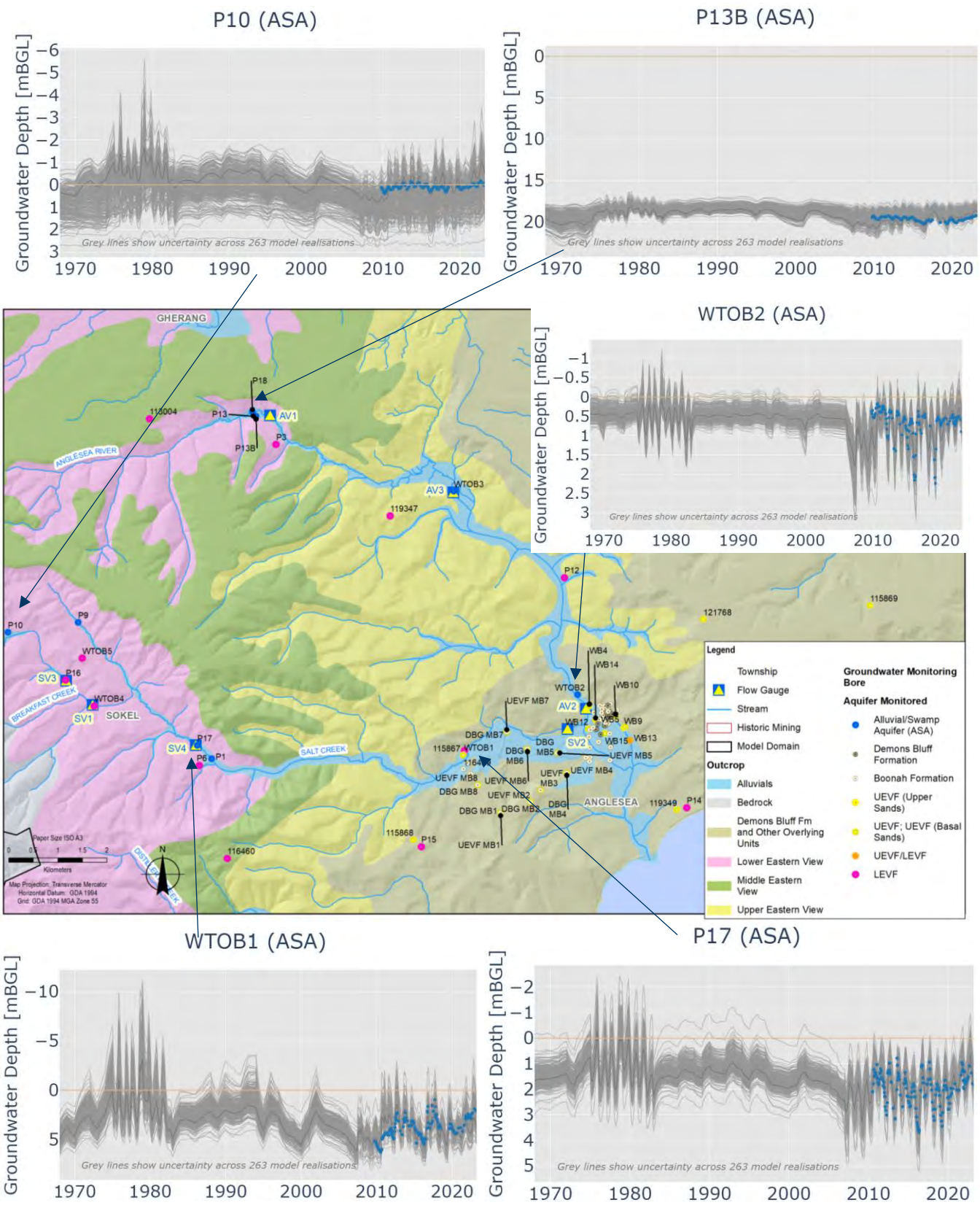
Observed values shown as blue dots; modelled values shown as grey lines (for all model realisations)

Figure 6-5 Selected history matching hydrographs [UEVF; 1 of 3]



Observed values shown as blue dots; modelled values shown as grey lines (for all model realisations)

Figure 6-6 Selected history matching hydrographs [LEVF east; 2 of 3]



Observed values shown as blue dots; modelled values shown as grey lines (for all model realisations)

Figure 6-7 Selected history matching hydrographs [ASA; 3 of 3]

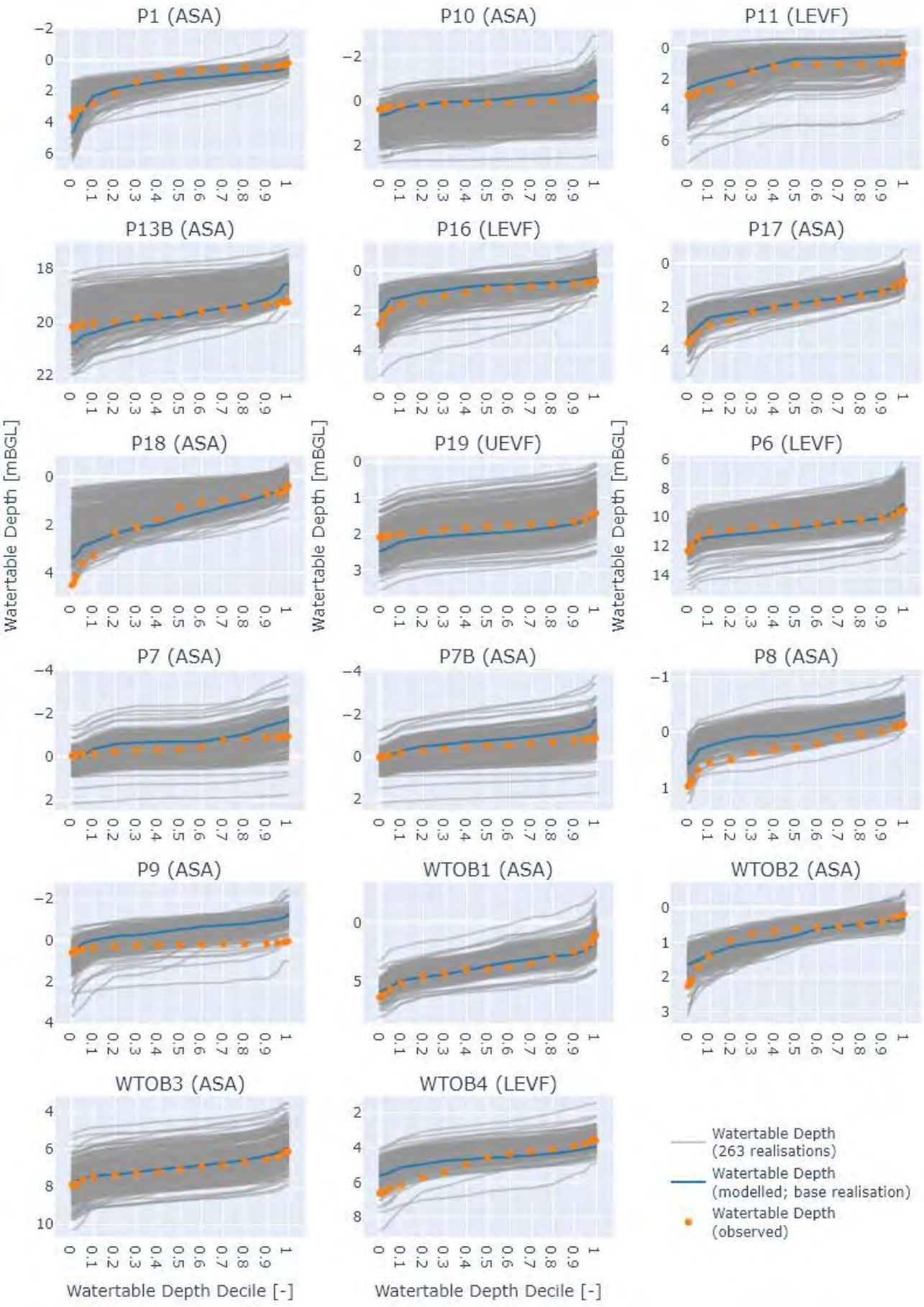
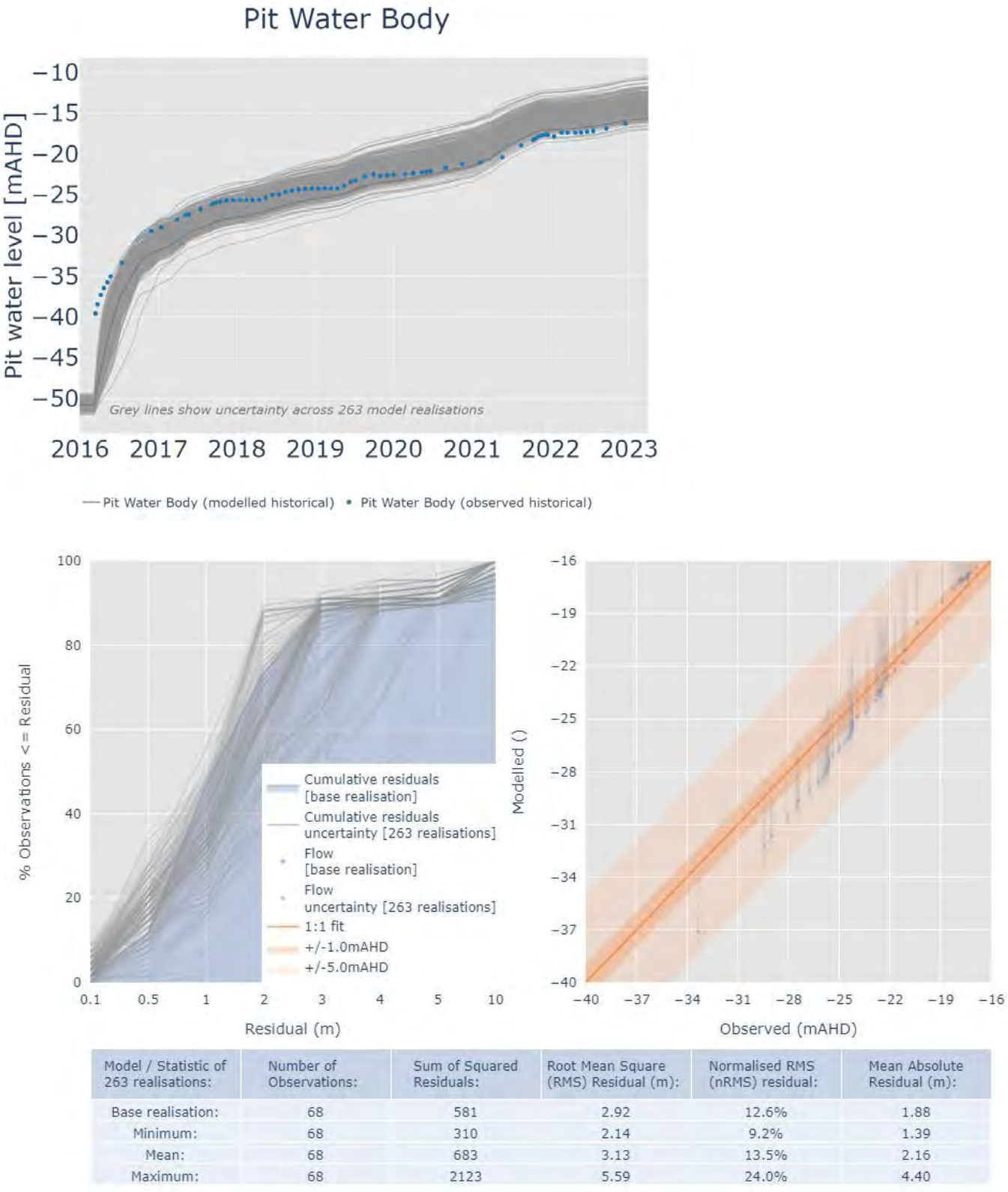


Figure 6-8 ***Watertable depth-frequency history matching curves***

6.1.4 Pit Water Body Levels

Figure 6-9 presents the modelled versus observed pit water body levels for the Alcoa mine void, post-mine closure. Absolute water levels and temporal trends are very well simulated by all 263 model realisations. For many realisations in later time (2019 onward), errors are generally within 2.0 m and temporal trends are well simulated.



Model / Statistic of 263 realisations:	Number of Observations:	Sum of Squared Residuals:	Root Mean Square (RMS) Residual (m):	Normalised RMS (nRMS) residual:	Mean Absolute Residual (m):
Base realisation:	68	581	2.92	12.6%	1.88
Minimum:	68	310	2.14	9.2%	1.39
Mean:	68	683	3.13	13.5%	2.16
Maximum:	68	2123	5.59	24.0%	4.40

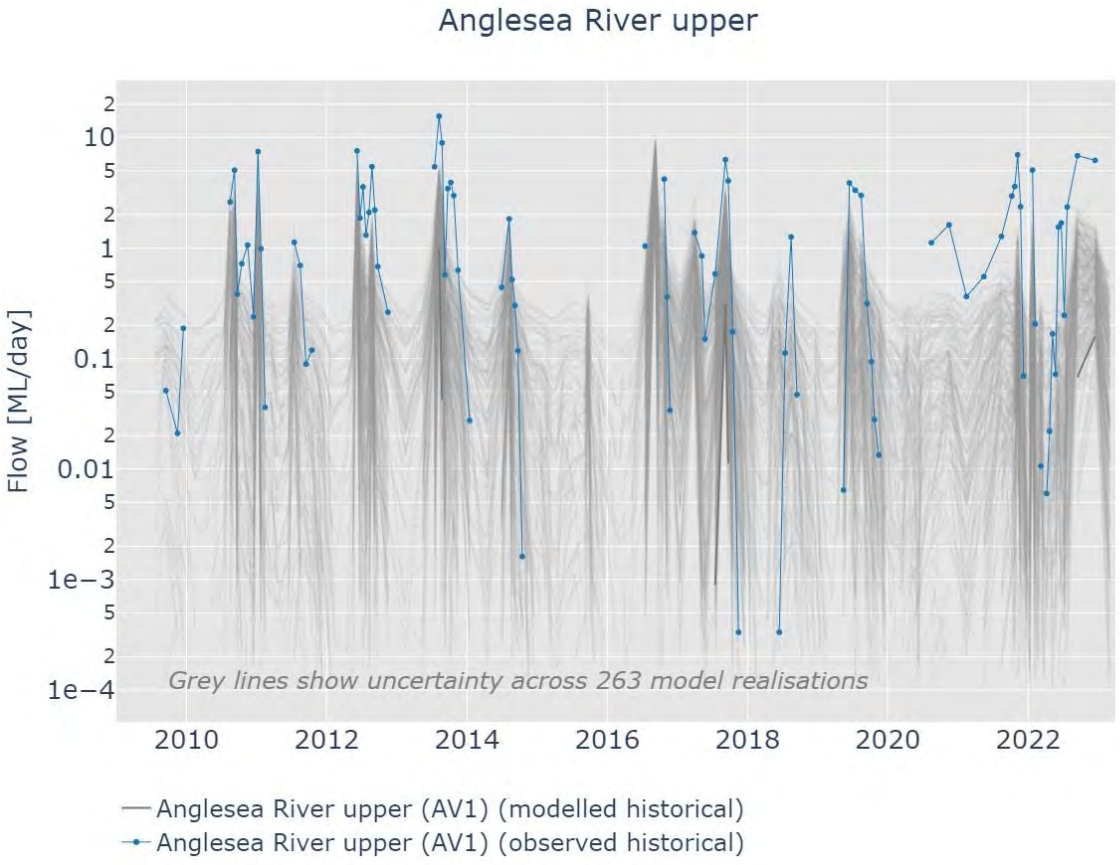
Figure 6-9 Model history matching to pit water body levels

6.1.5 Stream flows

Figure 6-10, Figure 6-11, and Figure 6-12 present stream flow history matching hydrographs for the upper and lower Anglesea River, Breakfast Creek, Breakfast Creek tributary, and for Salt Creek, respectively. Corresponding flow duration curves are presented in Figure 6-13. *Readers are reminded that all model groundwater level and stream flow hydrograph figures presented in this report exhibit periods of apparently greater variability in the late 1970's to early 1980's, and again in the late 2000's, than there is in intervening periods; readers should recall that this is driven by coarser temporal model discretisation (up to annual stress period durations) in the intervening periods, as is described in Section 4.4 and Figure 4-8.*

Figure 6-10 shows that flow magnitudes and their intermittency at the lower Anglesea River gauge is well simulated across all 263 model realisations; in the upper catchment however (AV1), the model tends to underestimate the frequency and magnitude of flow events; this may be a consequence of placing too great a relative weight on the history match to nearby shallow observation bores.

In the upper tributary areas of Salt Creek, Figure 6-11 shows that flow frequencies and magnitudes at both gauges SV1 and SV3 are generally well simulated, if not slightly overestimated at the lowest of flows at SV1 (around 2E-2 ML/day or less). Figure 6-12 shows the history-match quality to gauged flows in Salt Creek (at Denham Track, SV4) and in the lower Salt Creek near the Alcoa mine (SV2). Simulated gauged flows at SV2 match the observed flows closely, both in terms of the magnitude and frequency - the typically very sporadic flows at SV2 are well simulated. At SV4 low flow magnitudes and durations also tend to be well simulated.



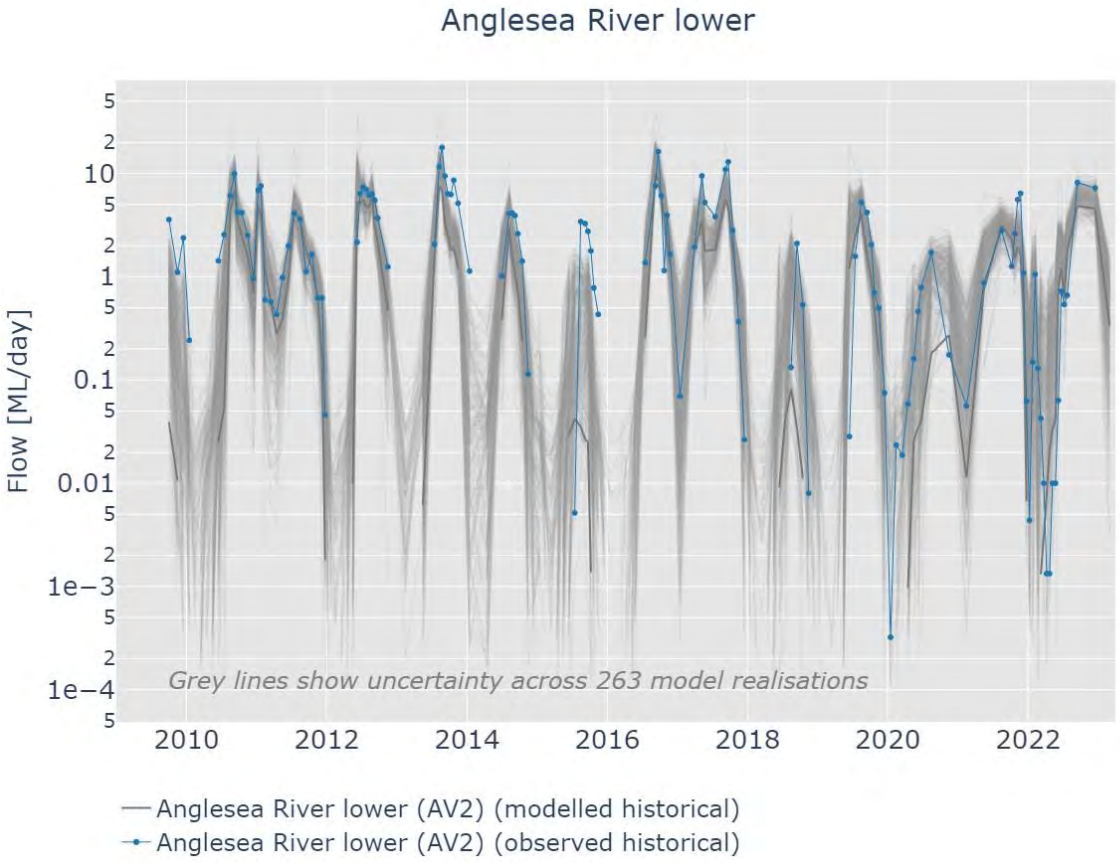


Figure 6-10 Model history matching to Stream Flows – Anglesea River

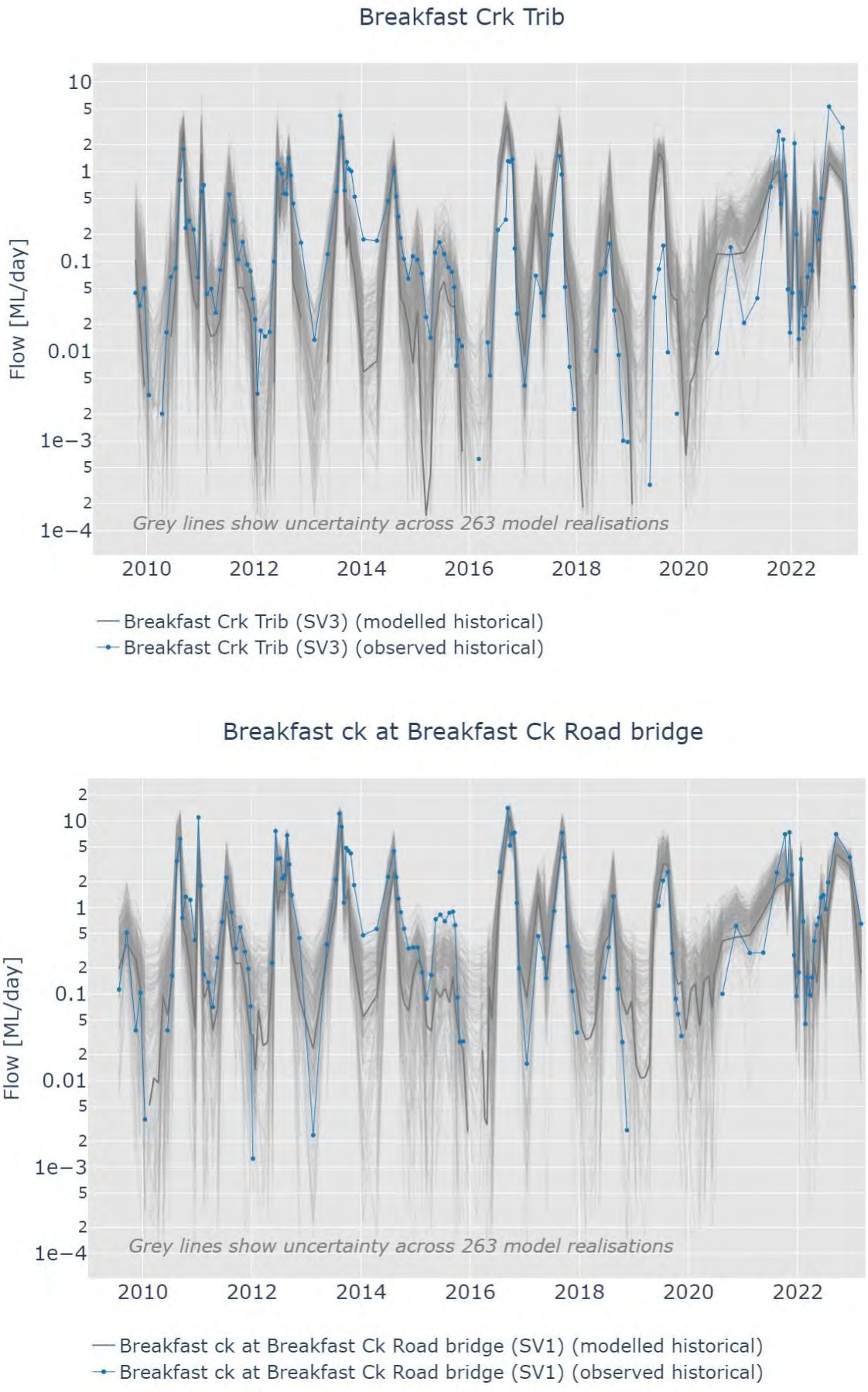
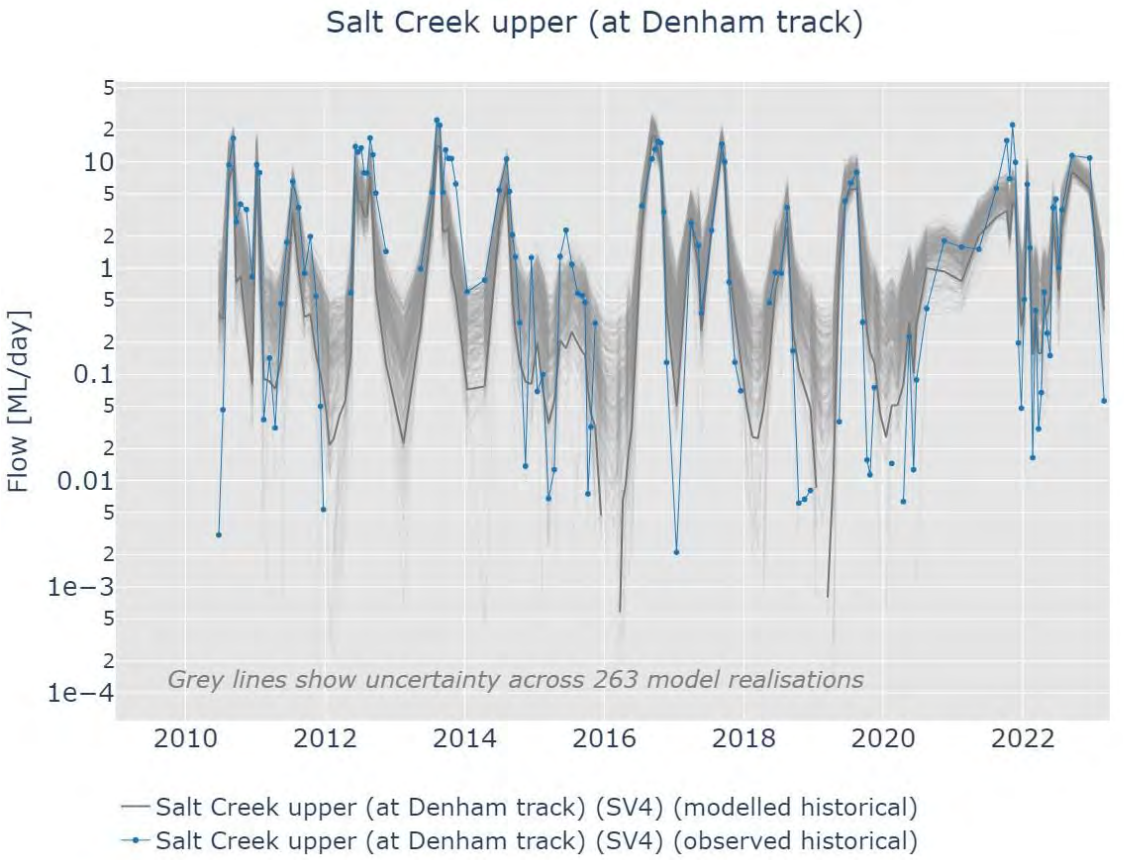


Figure 6-11 Model history matching to Stream Flows – Salt Creek Tributaries



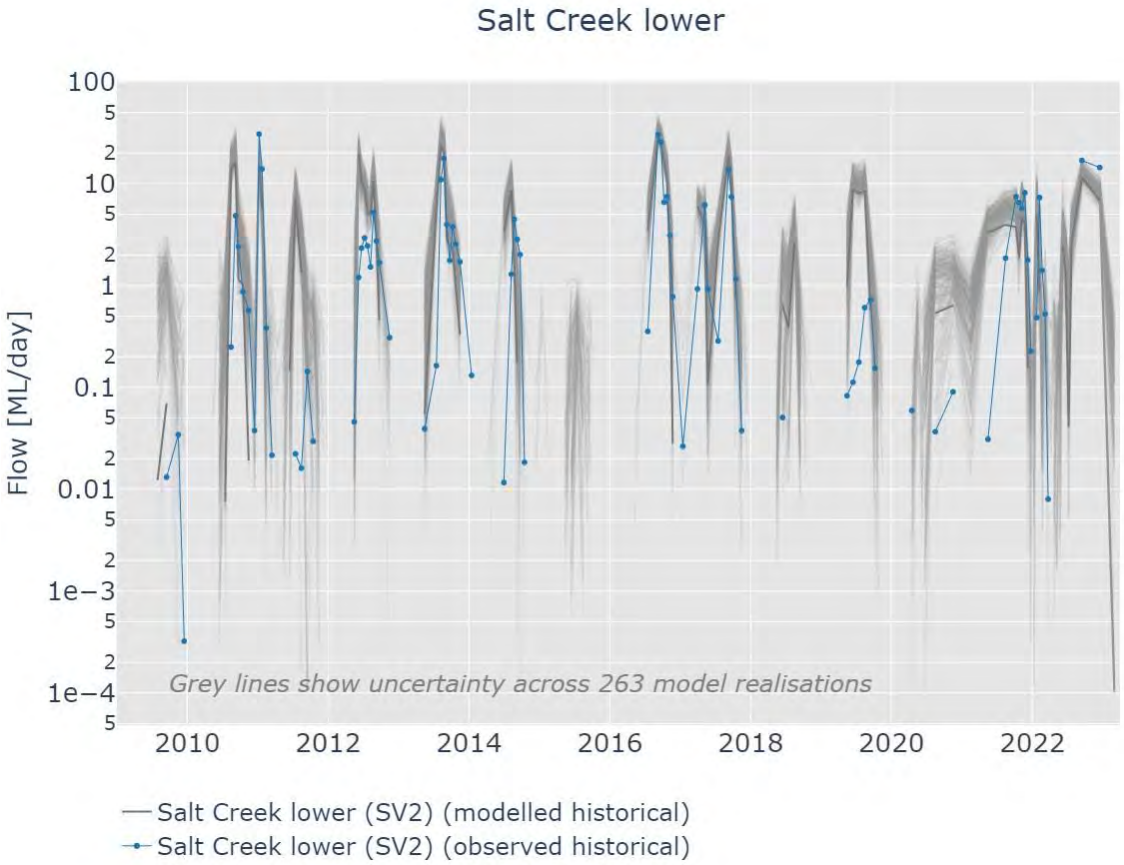


Figure 6-12 Model history matching to Stream Flows – Salt Creek

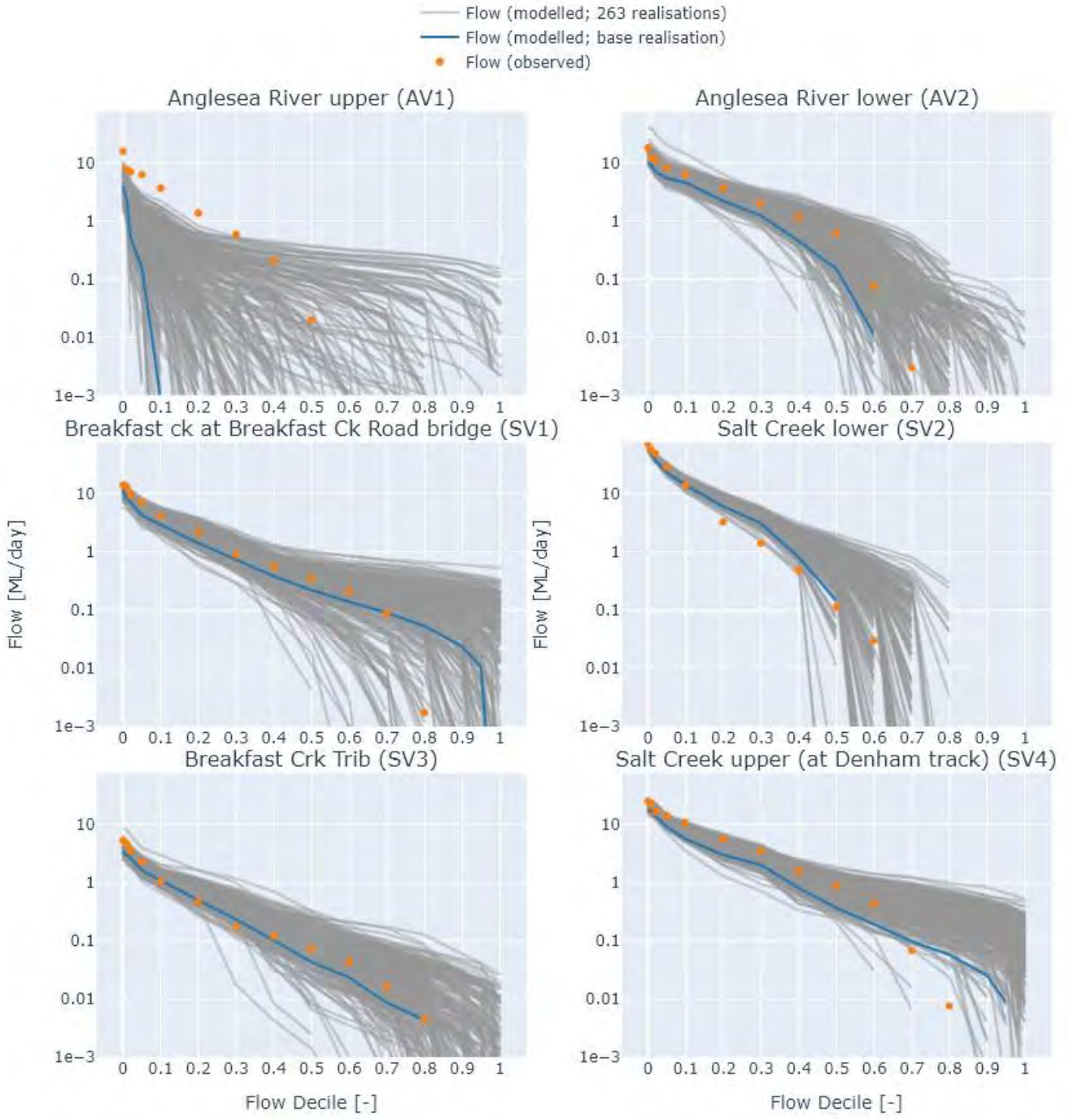


Figure 6-13 Model history matching to Stream Flow Duration Curves

6.1.6 Modelled cause-and-effect behaviour

Putting the above history-matching types together, Figure 6-14 and Figure 6-15 show modelled cause-and-effect responses to various aquifer stressors (pumping, climate) over the last decade; these are presented for lower Salt Creek and lower Anglesea River, respectively. These figures show that the model does a good job of simulating the observed dominance of historical rainfall trends (grey line in the upper-most charts) over groundwater pumping (middle charts) and mining on shallow watertable levels in the ASA around the Alcoa mine and Barwon Water's Anglesea borefield (upper charts). Observed and modelled surface water flows (lower charts) generally follow the same rainfall-dominant trends as does ASA watertable depth (upper charts).

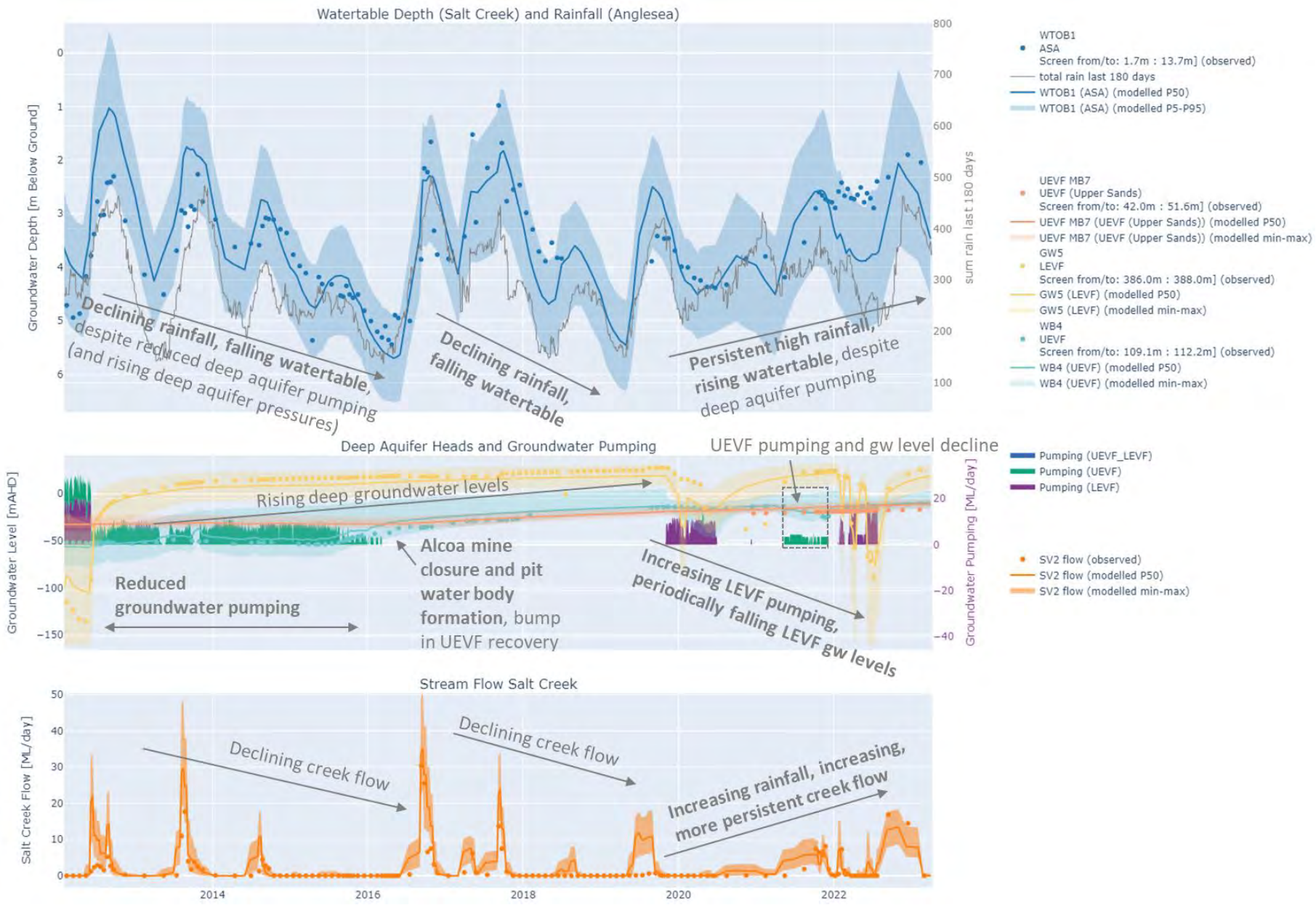


Figure 6-14 Model history matching: stress response cause-and-effect processes [lower Salt Creek]

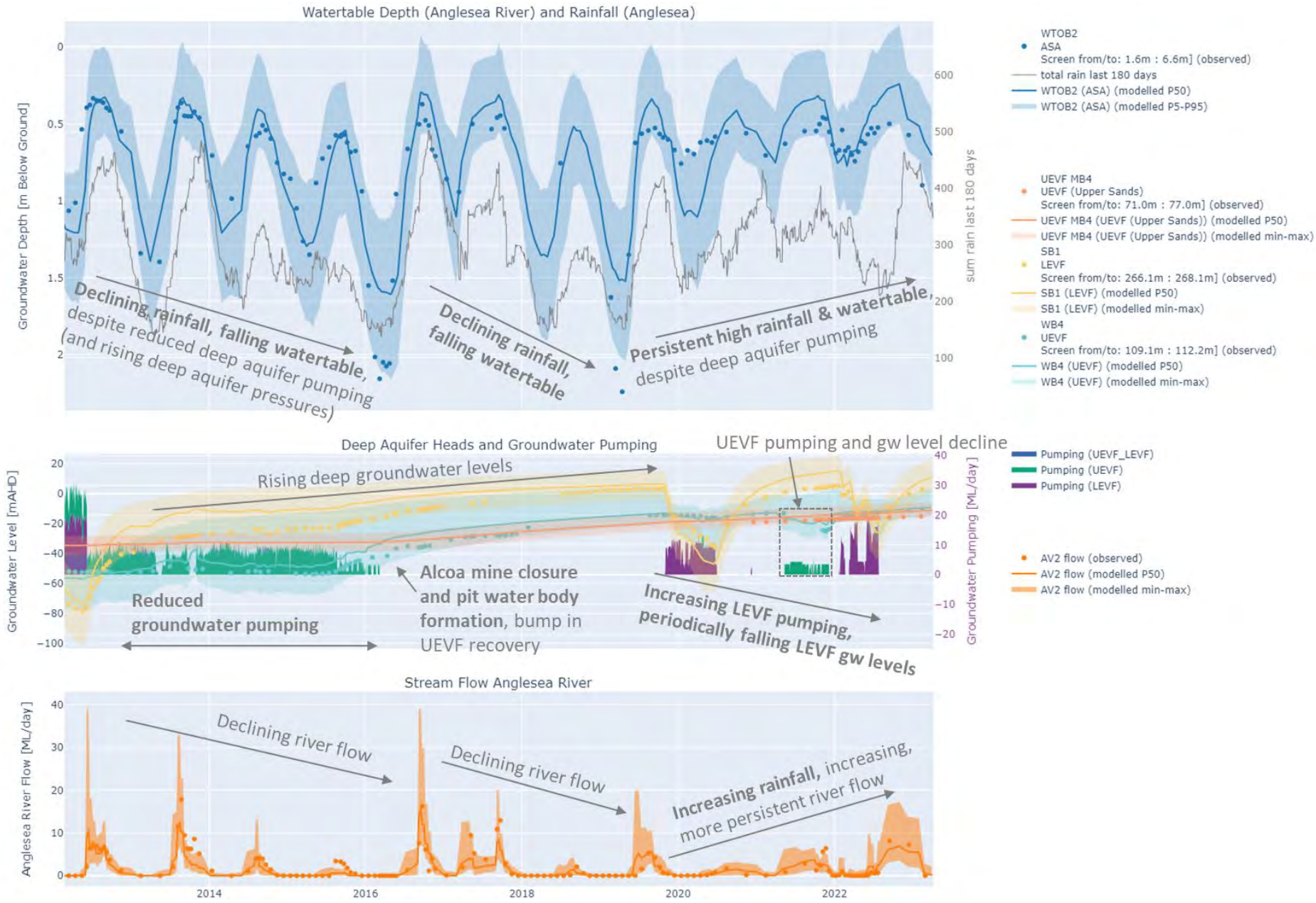


Figure 6-15 Model history matching: stress response cause-and-effect processes [lower Anglesea River]

6.1.7 Optimised parameters and their uncertainty

Horizontal Hydraulic Conductivity

Optimised base realisation horizontal hydraulic conductivity parameters are presented in Section 4.6 and Figure 4-19 through Figure 4-23. Figure 6-16 through Figure 6-20 present corresponding model parameter uncertainties around that base realisation, across the 263 history-matched models. These are presented as the ratio of maximum to minimum values in each model cell on the left side of the plots. On the right side of each plot are maps showing the reduction in uncertainty from the prior (pre-history matching) to the posterior (post-history matching) throughout the model domain; the measure used to show this is the normalised reduction in parameter variance across the 263 parameter set realisations.

The parameter range plots on the left side of Figure 6-16 through Figure 6-20 (top for Figure 6-16) indicate generally significant posterior horizontal hydraulic conductivity uncertainty, typically in the order of 1-3 or more orders of magnitude. The most notable exception to this is the MEVF (Figure 6-19), which exhibits a lower uncertainty range (5-50); on face value this may suggest that the permeability of this regional aquitard is of strong importance to history-match quality, but it is important to note the allowable range for this unit is lower relative to that of other model layers (Table 4-6).

The parameter uncertainty reduction plots on the right side of Figure 6-16 through Figure 6-20 (bottom for Figure 6-16) indicate 75-95% reduction in horizontal hydraulic conductivity uncertainty, from pre- to post-history matching. These relatively large reductions are partly a symptom of the very wide allowable ranges specified at the outset of the process; see Section 4.6, particularly Table 4-6, which shows 5-6 orders of magnitude allowable range for most model layers, the exception being the MEVF (3 orders of magnitude). Perhaps of greater interest is the spatial variability in uncertainty reduction in these maps. For example, the largest uncertainty reductions in LEVF hydraulic conductivity (right side of Figure 6-20) are around the Barwon Water borefields of the northern and southern synclines; this is a direct outcome of the fact that these are the dominant historical aquifer stress locations in this unit.

The key point from these maps is that there is a significant range of residual horizontal hydraulic conductivity represented in the 263 history-matched models, in all layers and in most areas of the model domain; this will carry through to a degree of uncertainty in scenario model forecasts of effects from Barwon Water and Alcoa water development operations. Similar can be said for other model parameters, which are now discussed.

Vertical Hydraulic Conductivity

Optimised base realisation vertical hydraulic conductivity maps are presented in Figure 4-24 through Figure 4-28.

Figure 6-21 Through Figure 6-25 present similar maps as discussed above for horizontal hydraulic conductivity, but for *vertical* hydraulic conductivity. On the left side of these figures, the ratio of maximum to minimum vertical hydraulic conductivity is shown to be consistently wide across the 263 history matched model realisations (typically 100-1000). Some layers exhibit a narrower range than others, but as was the case for horizontal hydraulic conductivity, this is in part a reflection the initial allowable ranges within each layer. One of the more interesting features in these plots is the marked comparatively wider vertical hydraulic conductivity range in headwater valley floors (i.e., beneath stream boundaries) on LEVF outcrop, compared with the narrower range on the interfluves (see top left map in Figure 6-25); this is also apparent with regard to horizontal LEVF hydraulic conductivity, but to a far less stark degree (Figure 6-20).

The maps on the right side of Figure 6-21 through Figure 6-25 show the relative reduction in parameter variance within each layer, as achieved through the history matching process (i.e., from the prior to the posterior). History matching has typically reduced parameter uncertainty by 50-95%, with lesser reductions tending to occur away from historical stress locations such as the Alcoa mine and power station, and the Barwon Water borefields (for example in the offshore areas (Figure 6-22 and Figure 6-24)), and the two Barwon Water borefields.

Aquifer Storage

Optimised base realisation parameters for specific storage are presented in Section 4.6 and Figure 4-29 through Figure 4-32; corresponding figures for specific yield are shown in Figure 4-33 through Figure 4-37.

The post-history matching ranges of specific storage and specific yield values across the 263 model realisations are presented in Figure 6-26 through Figure 6-30, for all model layers. The reduction from prior to posterior uncertainty is not presented for these parameters, for sake of brevity, given that these parameters are typically of lesser significance to history matching and model forecasts. These maps show typical ranges of a factor of 5 to 50 for both specific storage and specific yield; this relatively narrow range is primarily a reflection of the narrow allowable ranges defined in Table 4-7. But again, there is significant posterior parameter uncertainty for aquifer storage parameters, which will carry through to scenario model outputs.

Groundwater Recharge

The maps on the left side of Figure 6-31 presents the modelled median average annual recharge rates across the 263 history matched model realisations, for two different time periods: 1968-2000, and 2001-2023. These show that optimised recharge rates are higher in the 1968-2000 period (pre-Millennium Drought) than they are in the latter period. Estimated recharge rates are highest in the higher rainfall areas of the northwest and west (typically 20-100 mm/year), where the LEVF aquifer outcrops, and diminish towards the Alcoa coal mine and Anglesea, and somewhat to the east too, where the DBF is at outcrop (typically 1-20 mm/year).

The maps to the right side of Figure 6-31 show the post-history matching uncertainty range in recharge to groundwater, as measured across the 263 model realisations. There is significant recharge rate uncertainty across the model domain (typically 30-200 mm/year). There is relatively low uncertainty on the MEVF outcrop where recharge rates are consistently low, and in the mid reaches of the Anglesea River on ASA outcrop; this latter point is largely driven by model history matching to WTOB3 (which exhibits a deep watertable) and to the intermittent stream flows at gauge AV2.

Evapotranspiration from Groundwater

Figure 6-32 presents similar maps to those described above for recharge but pertaining to the post-history matching maximum *potential* evapotranspiration rates from groundwater, and their uncertainty. The maps on the left show the highest potential evapotranspiration rates in the east and coastal southeast of the model (including around the Alcoa coal mine and Anglesea), and lower rates to the west and northwest. The maps to the right side of Figure 6-32 show the wide posterior uncertainty range for maximum groundwater evapotranspiration rates; the narrowest range of uncertainty is on MEVF outcrop, because recharge variability is low and hence so is PE-AE (see Section 4.5.7).

Figure 6-33 Presents the corresponding maps for evapotranspiration extinction depth and its uncertainty. There is little evident spatial trend in these data, although there are localised areas of relatively higher extinction depth around some Baron Water observation bores, particularly in the upper Salt Creek catchment. Also evident is the relatively consistent shallow extinction depths in the east of the model; this corresponds with a gradual easterly change from forested land cover in the west (Otway range flanks) toward the eastern largely pastural areas. The extinction depth uncertainty range maps on the right side of Figure 6-33 tend to show the largest uncertainties in the areas of deepest optimised extinction depth.

As is noted for other parameters above, the evapotranspiration parameter and uncertainty maps presented show significant residual post-history matching uncertainty in these parameters, which will carry through to uncertainty in scenario model forecasts of water development effects.

Pit Water Body (LAK) Parameters

Table 6-1 summarise pit water body model parameters and their uncertainty across the 263 history matched model realisations. These show significant residual range around the means, which will carry through to uncertainty in model forecasts related to pit water body behaviour and its effects on and interaction with the surrounding groundwater systems.

Table 6-1 Pit Water Body – Optimised parameters and their uncertainty across 263 model realisations

Parameter	Description	Units	Average (geomean for LAK bed kv)	Minimum	Maximum
lak_hkfactor1	Pit water body wall horizontal leakance as a factor of aquifer hk (layer 1)	-	3.02E-02	1.31E-04	1.00E+00
lak_hkfactor2	Pit water body wall horizontal leakance as a factor of aquifer hk (layer 2)	-	1.40E-02	8.39E-05	3.40E-01
lak_hkfactor3	Pit water body wall horizontal leakance as a factor of aquifer hk (layer 3)	-	7.29E-04	6.46E-06	6.61E-02
lak_hkfactor4	Pit water body wall horizontal leakance as a factor of aquifer hk (layer 4)	-	5.64E-03	9.78E-05	3.66E-01
lak_hkfactor5	Pit water body wall horizontal leakance as a factor of aquifer hk (layer 5)	-	7.59E-02	2.14E-03	6.03E-01
lak_k1	Pit water body bed leakance (layer 1)	m/day/m	1.24E-02	3.00E-05	5.66E+00
lak_k2	Pit water body bed leakance (layer 2)	m/day/m	4.16E-05	1.00E-06	4.50E-02
lak_k3	Pit water body bed leakance (layer 3)	m/day/m	6.31E-04	2.52E-06	4.15E-02
lak_k4	Pit water body bed leakance (layer 4)	m/day/m	1.39E-02	4.07E-05	7.68E+00
lak_k5	Pit water body bed leakance (layer 5)	m/day/m	2.40E-02	3.72E-05	8.63E+00
lak_pan	Pit water body pan evaporation factor	-	8.24E-01	6.70E-01	9.62E-01

Stream (SFR2) Boundary Bed Hydraulic Conductivity

Figure 6-34 presents stream (SFR2) boundary bed hydraulic conductivity parameters and their uncertainty across the 263 history matched model realisations. The upper map shows bed hydraulic conductivity values for the optimised base realisation. This shows significant spatial variability (facilitated through pilot points, as described in Section 4.5.8). A reasonably clear pattern that has emerged is comparatively high bed hydraulic conductivity (darker browns in Figure 6-34) in streams flowing over outcropping ASA, UEVF and LEVF. In contrast, in areas on and around MEVF outcrop, there is a pattern of relatively lower bed conductivity.

The lower map shows the uncertainty range, measured as a ratio of the maximum to minimum bed conductivity across the 263 model realisations. As is evident from all other parameters, these show significant residual range, typically from 2 to 5 orders of magnitude; but it is also clear that there is comparatively low uncertainty in bed conductivity (1-50) in those higher conductivity areas on outcropping UEVF, LEVF, and to some degree ASA, as described above.

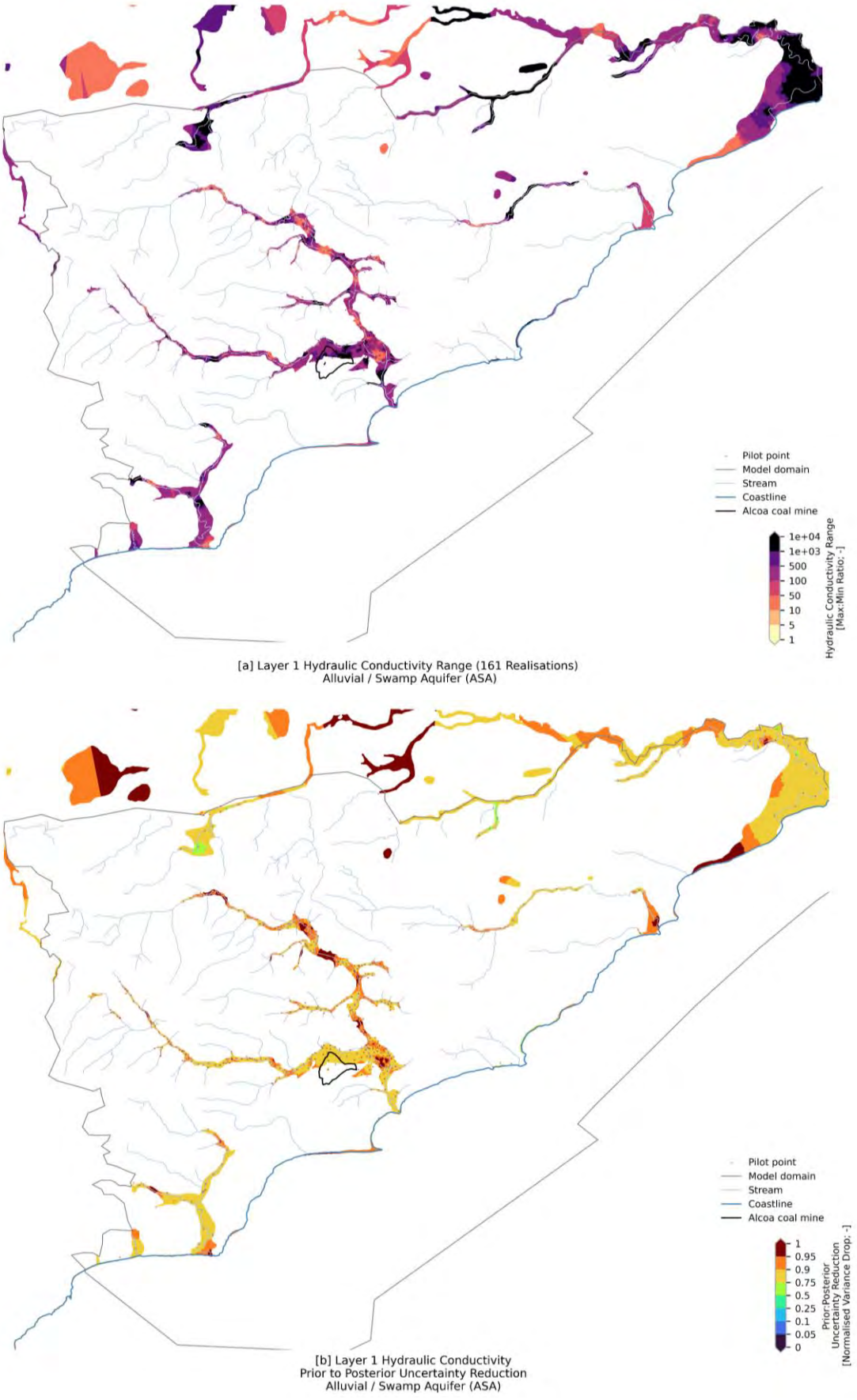


Figure 6-16 *Layer 1 hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction*

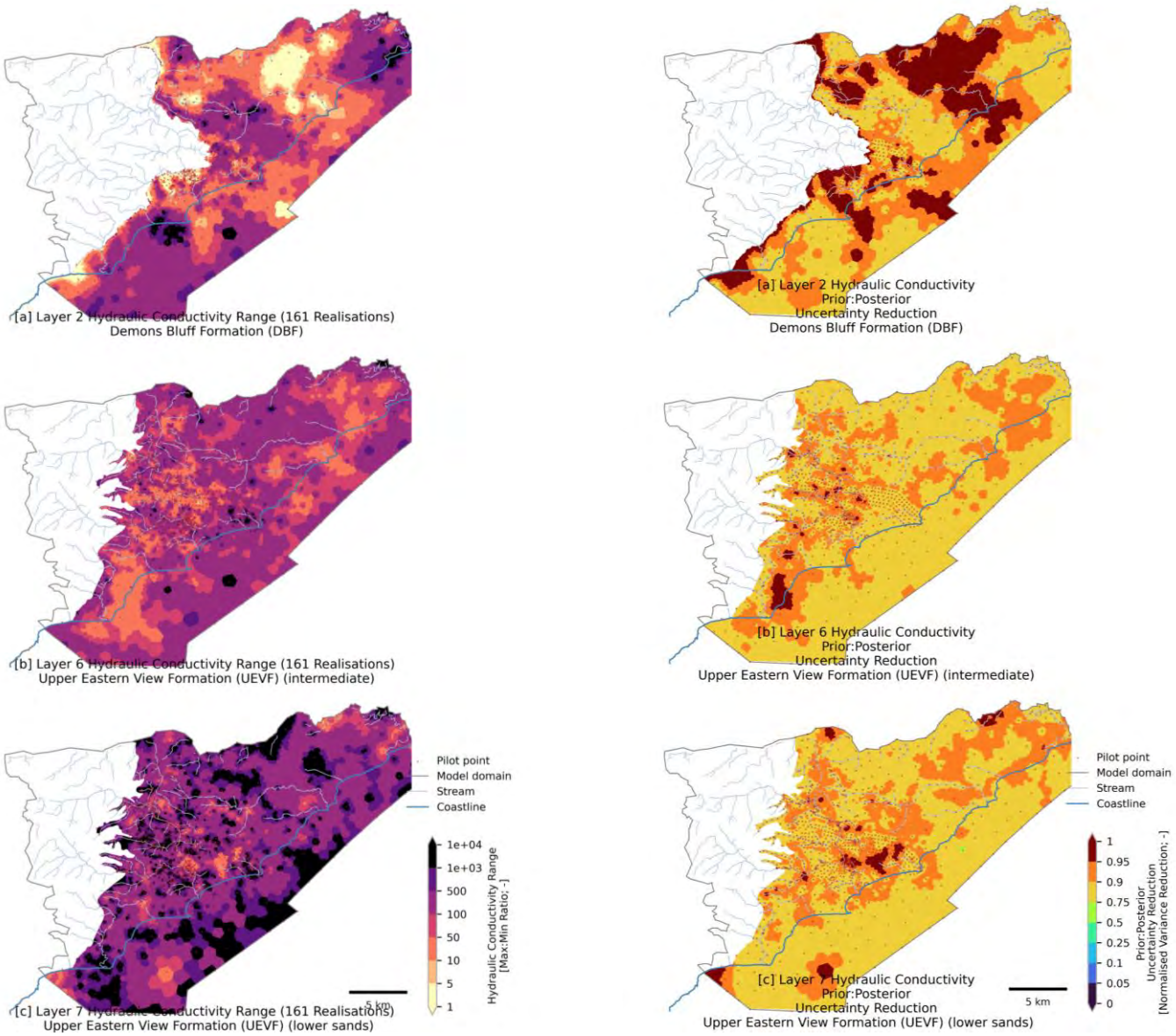


Figure 6-17 Layers 2, 6 and 7 hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

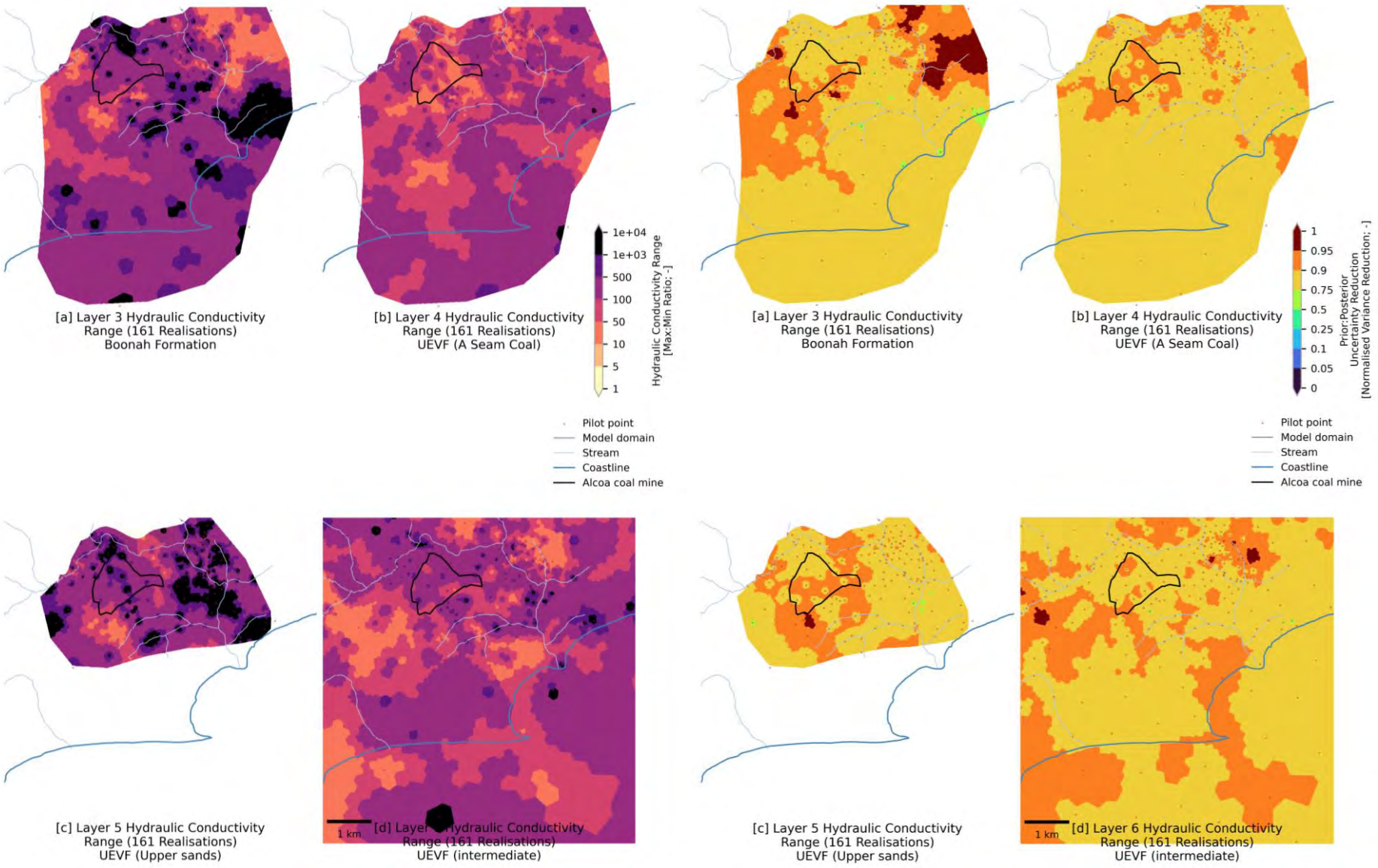


Figure 6-18 Layers 3, 4, 5 and 6 hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

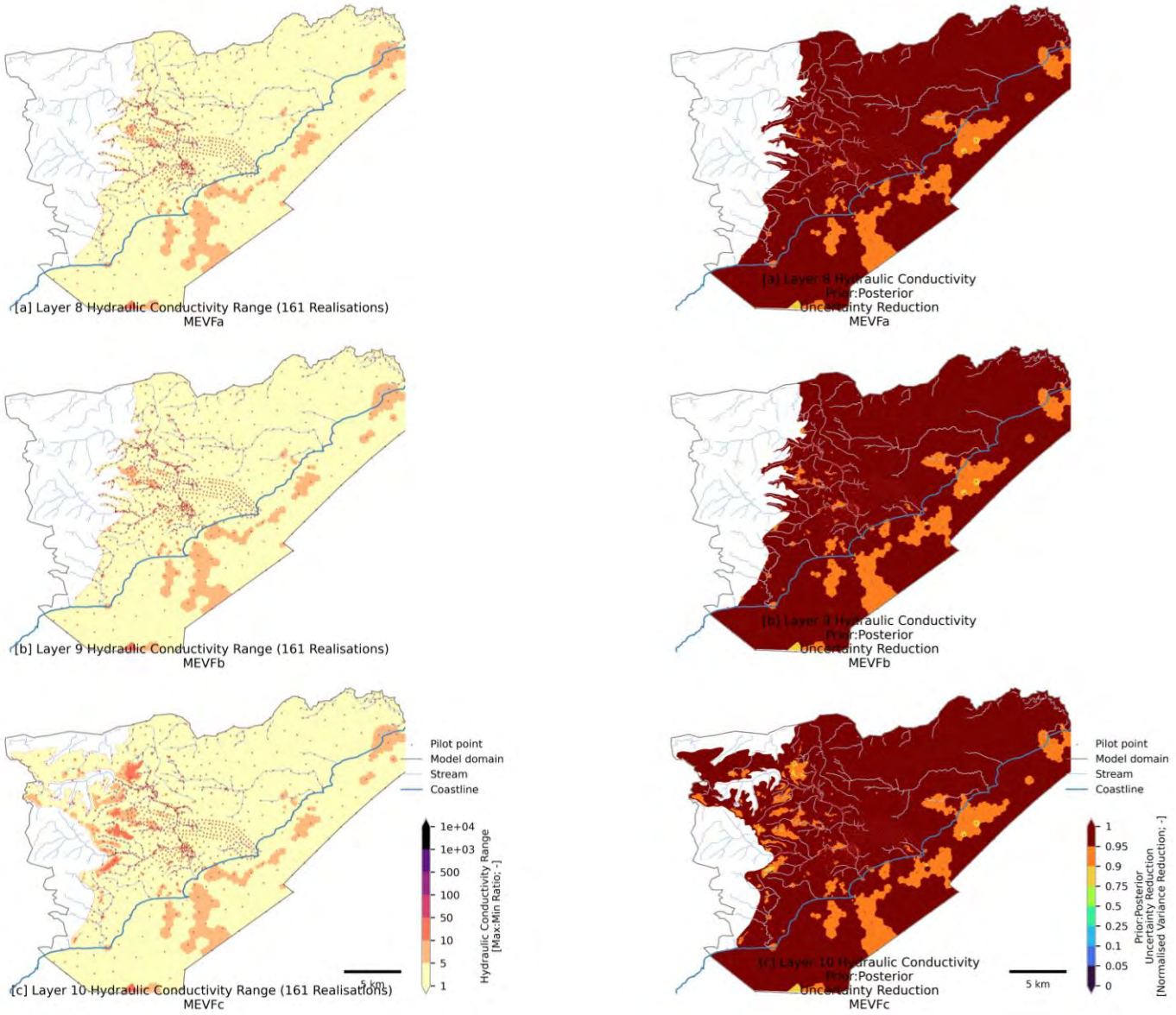


Figure 6-19 Layer 8, 9 and 10 hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

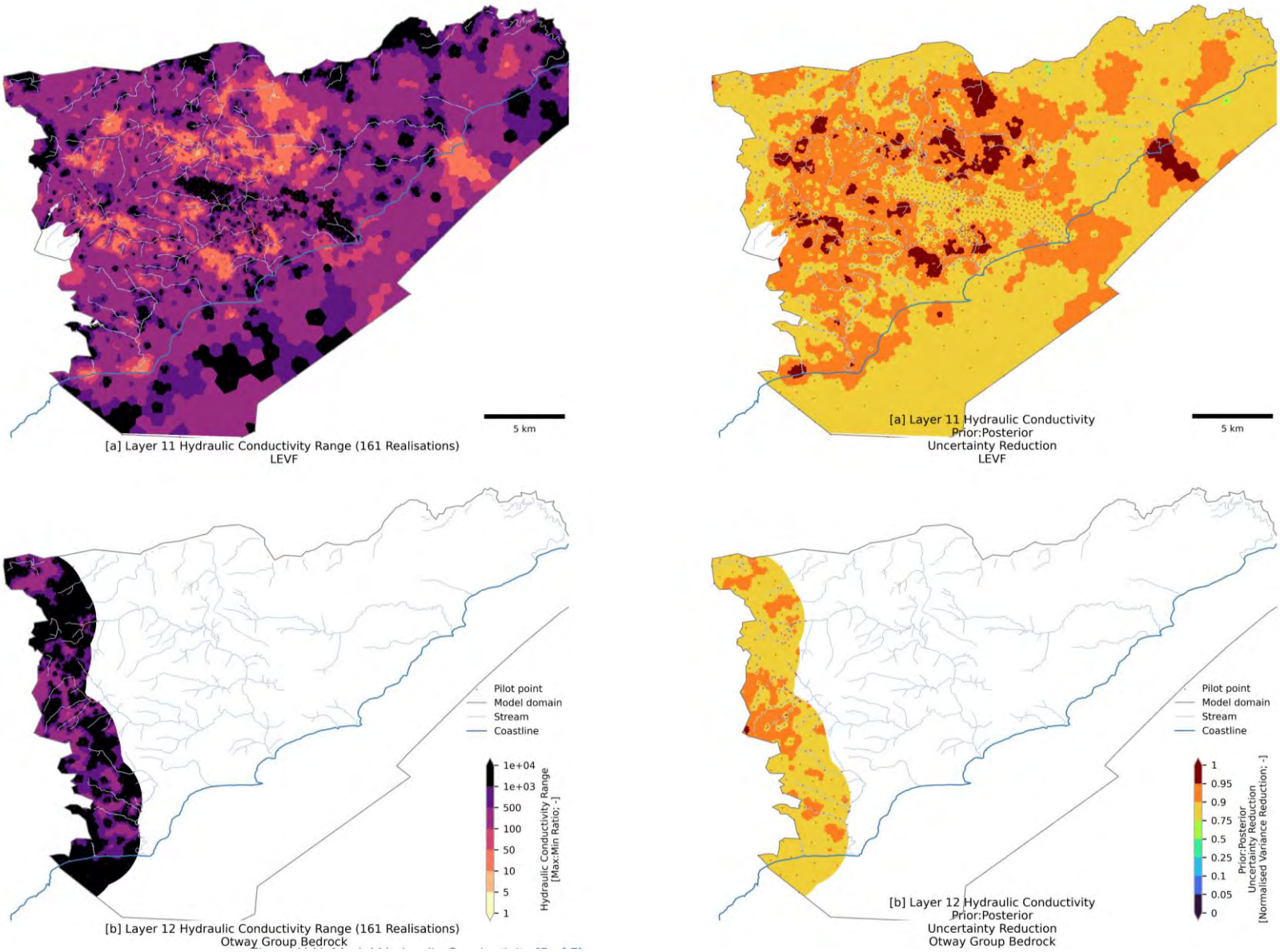


Figure 6-20 Layer 11 and 12 hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

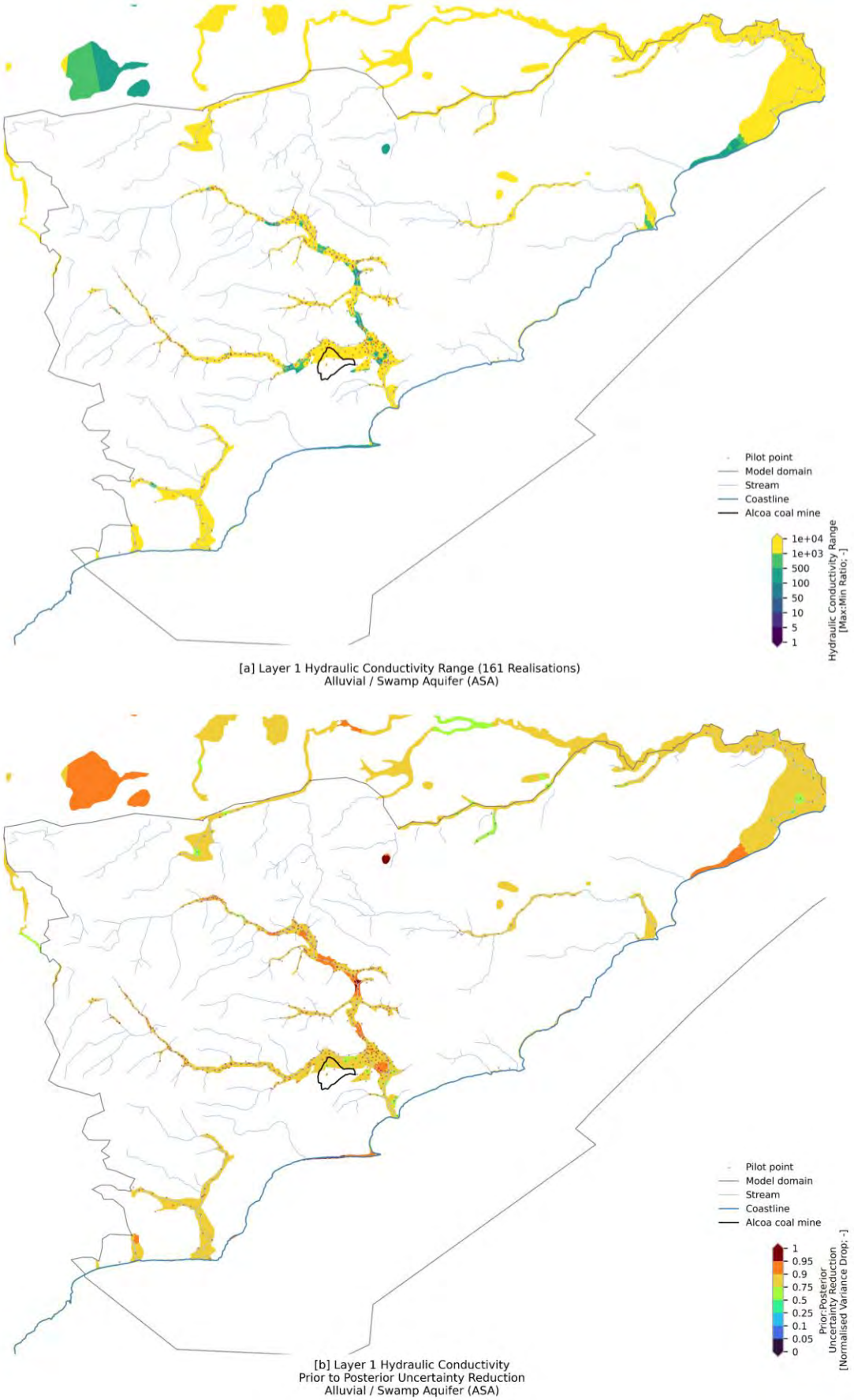


Figure 6-21 ***Layer 1 vertical hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction***

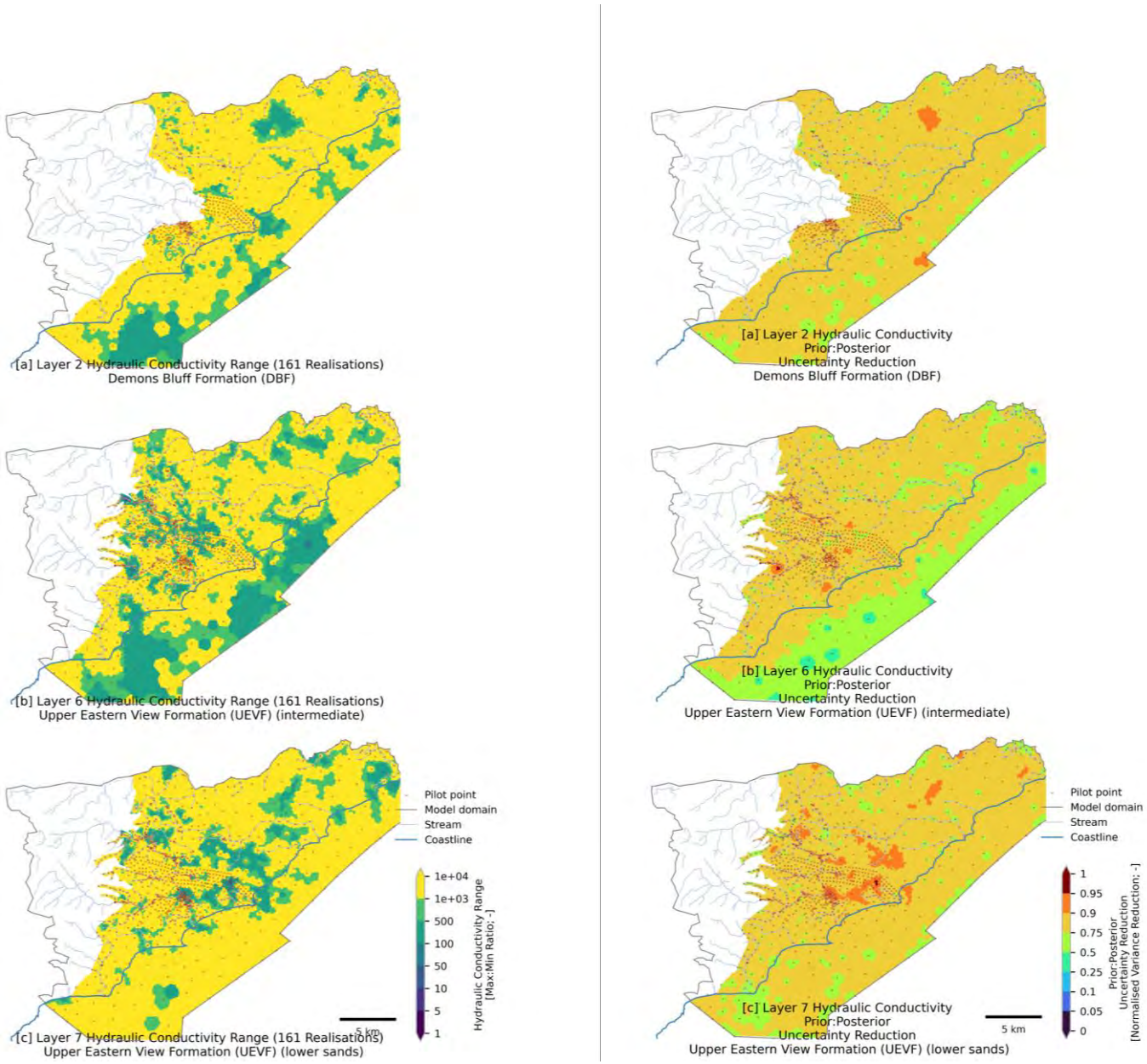


Figure 6-22 Layers 2, 6 and 7 vertical hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

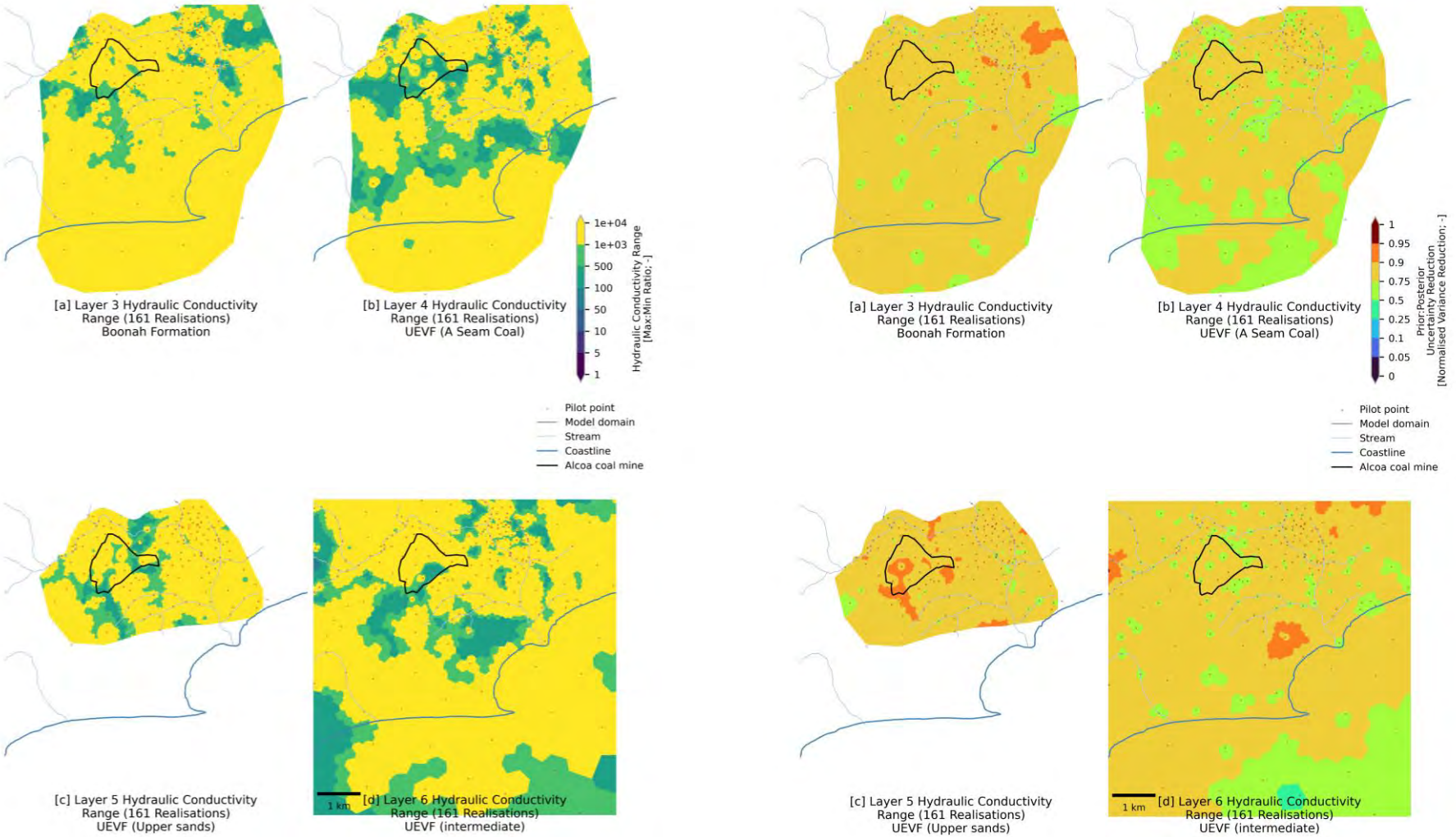


Figure 6-23 Layers 3, 4, 5 and 6 vertical hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

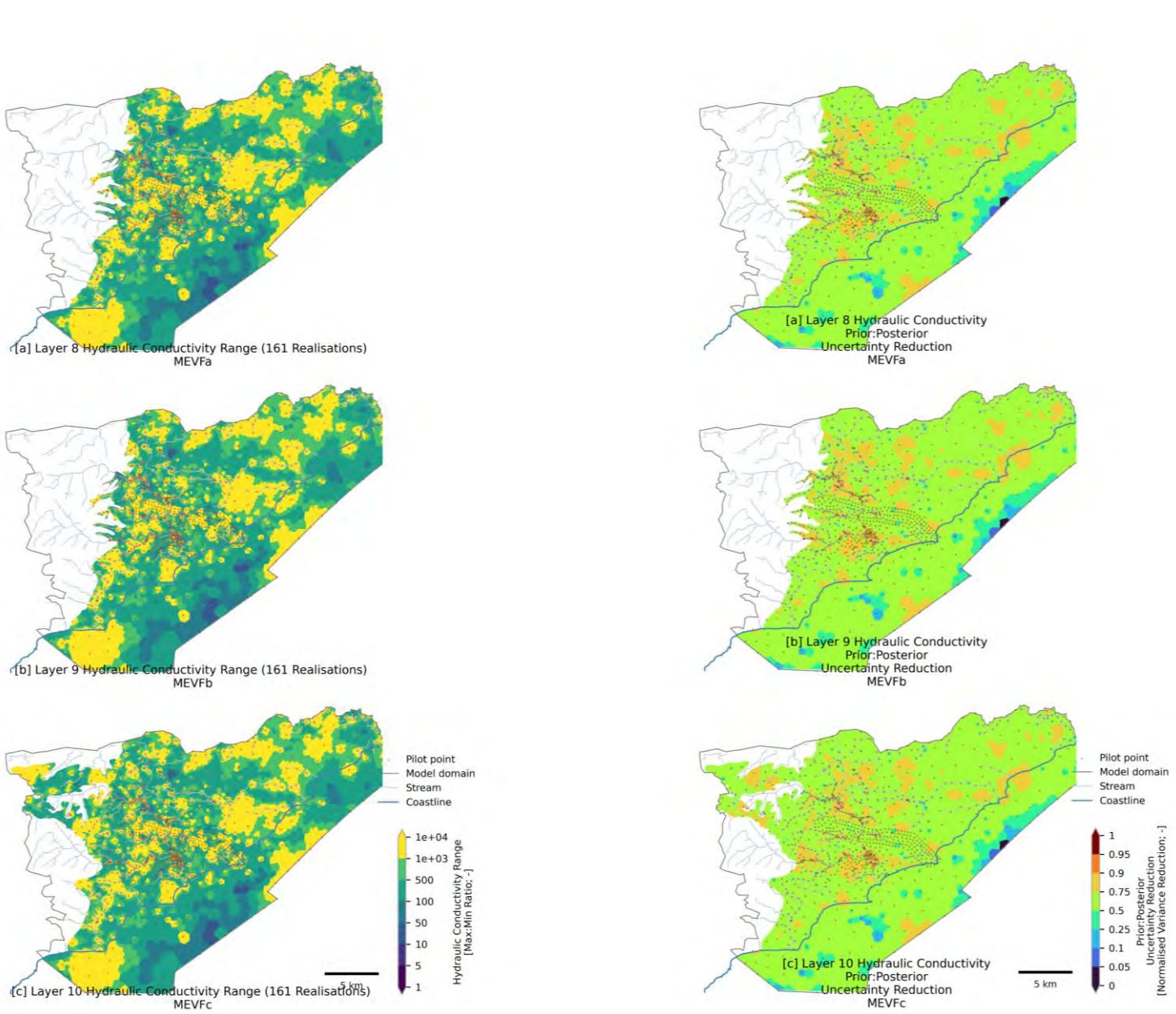


Figure 6-24 Layer 8, 9 and 10 vertical hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

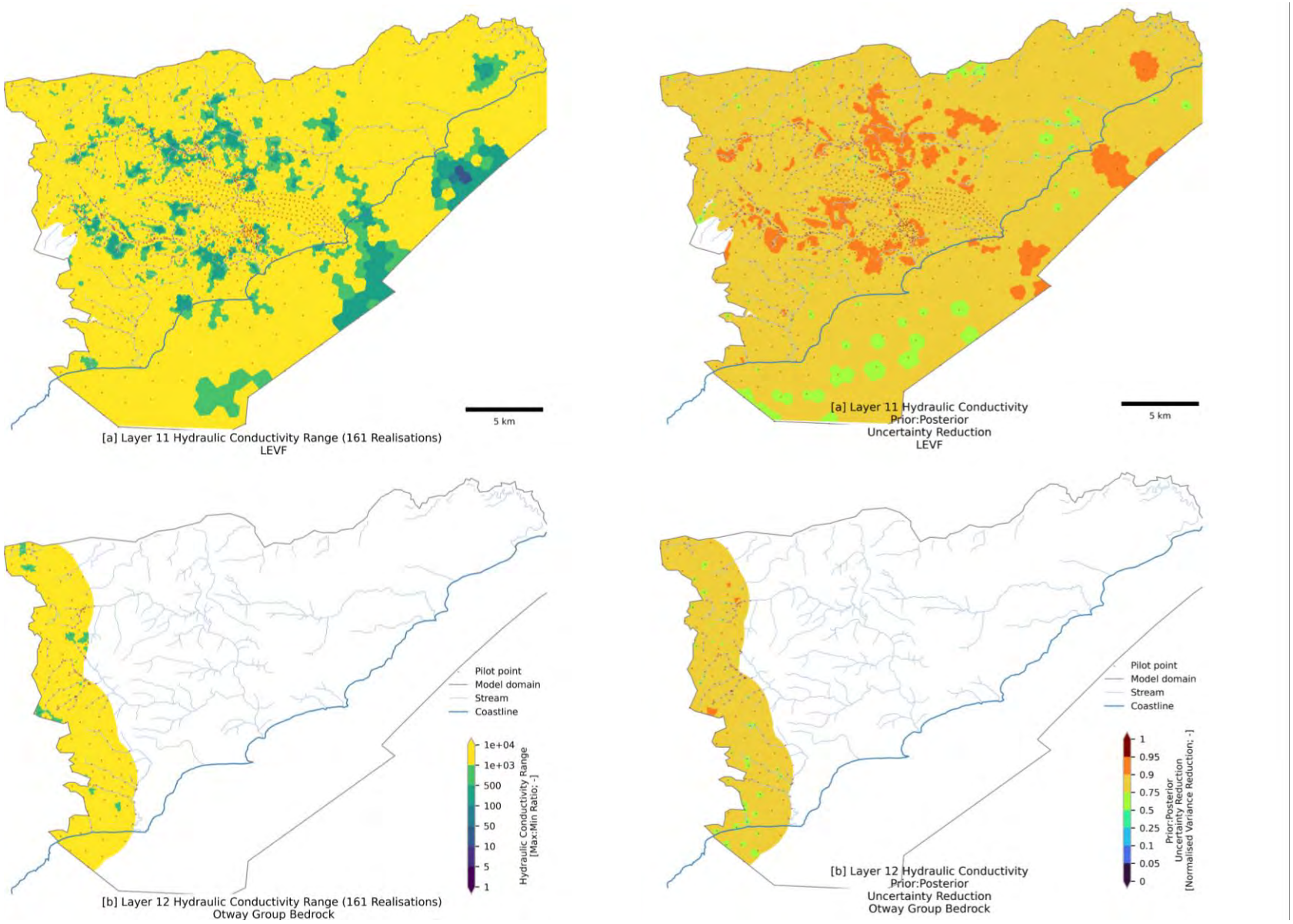


Figure 6-25 Layer 11 and 12 vertical hydraulic conductivity uncertainty range, and prior to posterior uncertainty reduction

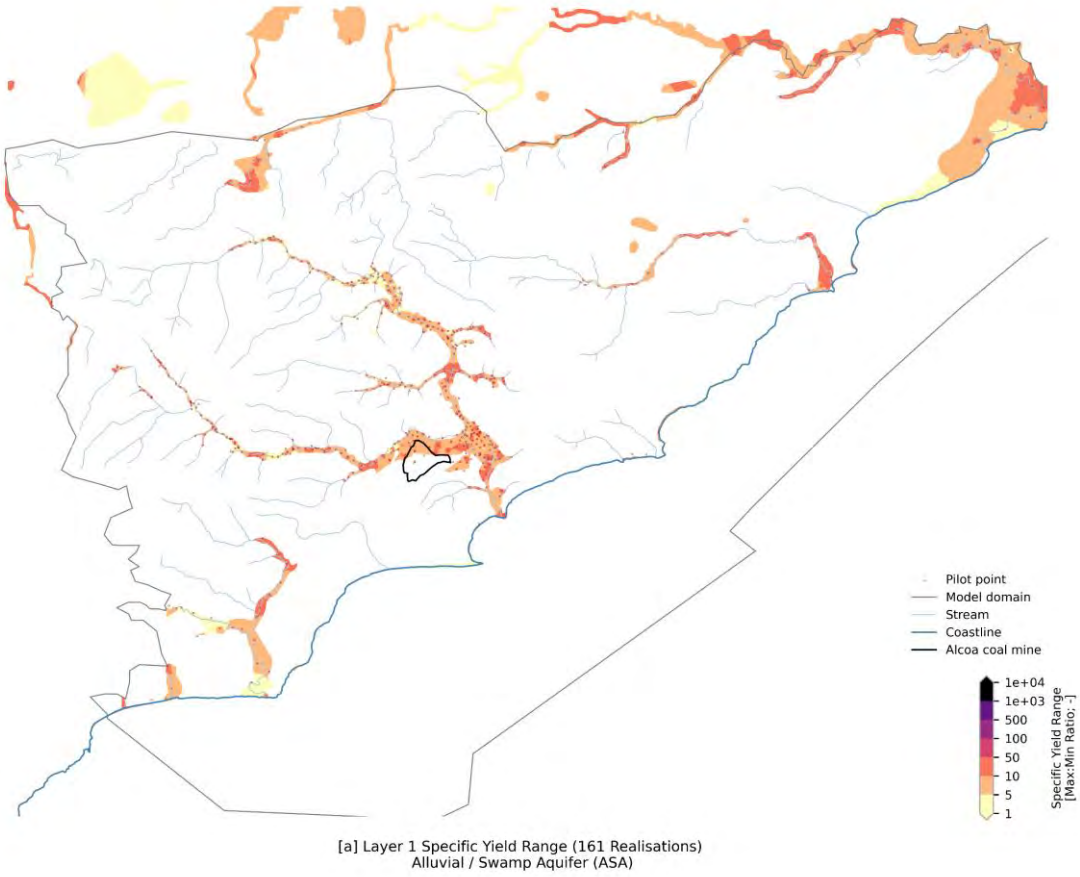


Figure 6-26 Layer 1 specific yield uncertainty range

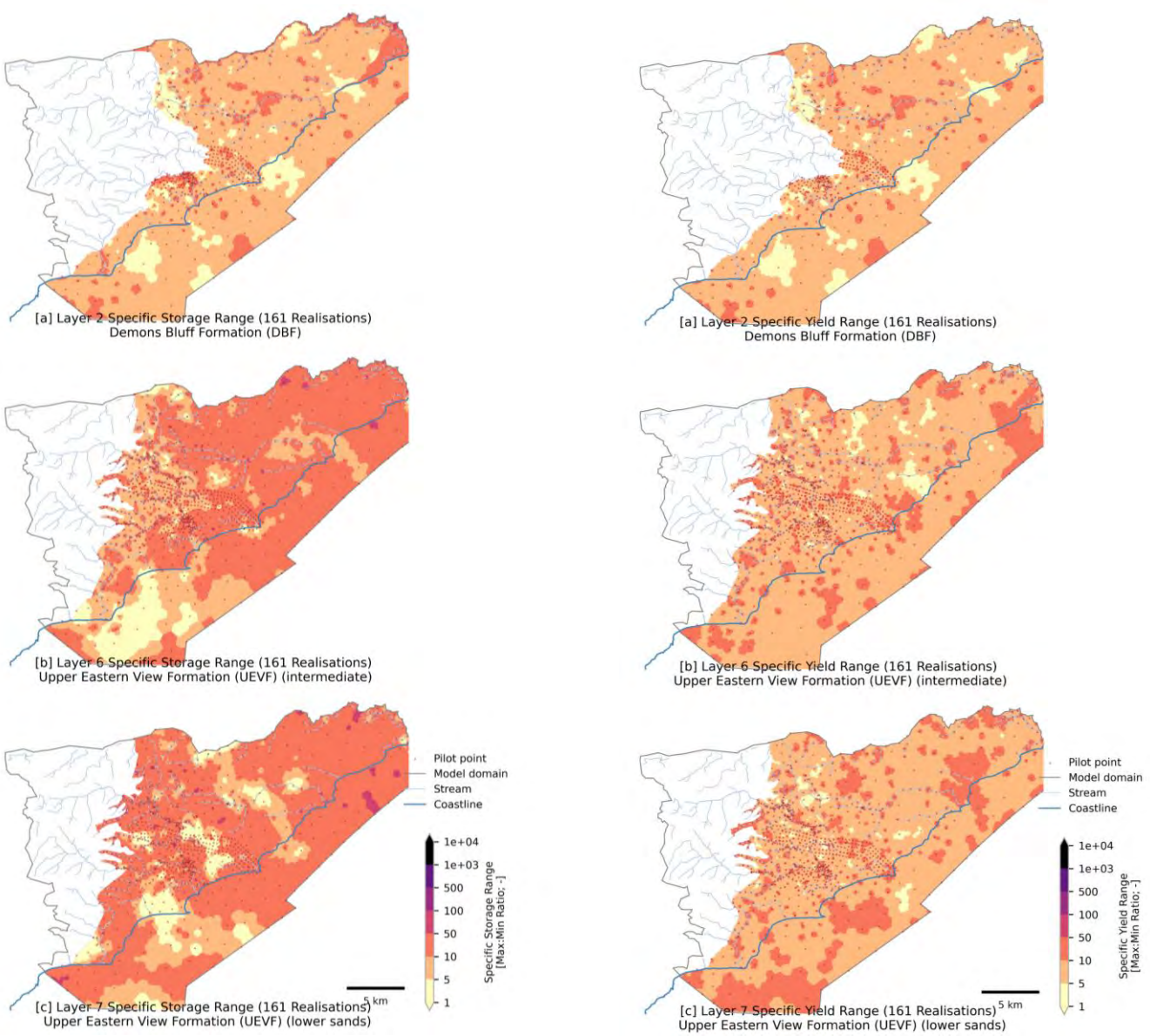


Figure 6-27 Layers 2, 6 and 7 specific storage and specific yield uncertainty range

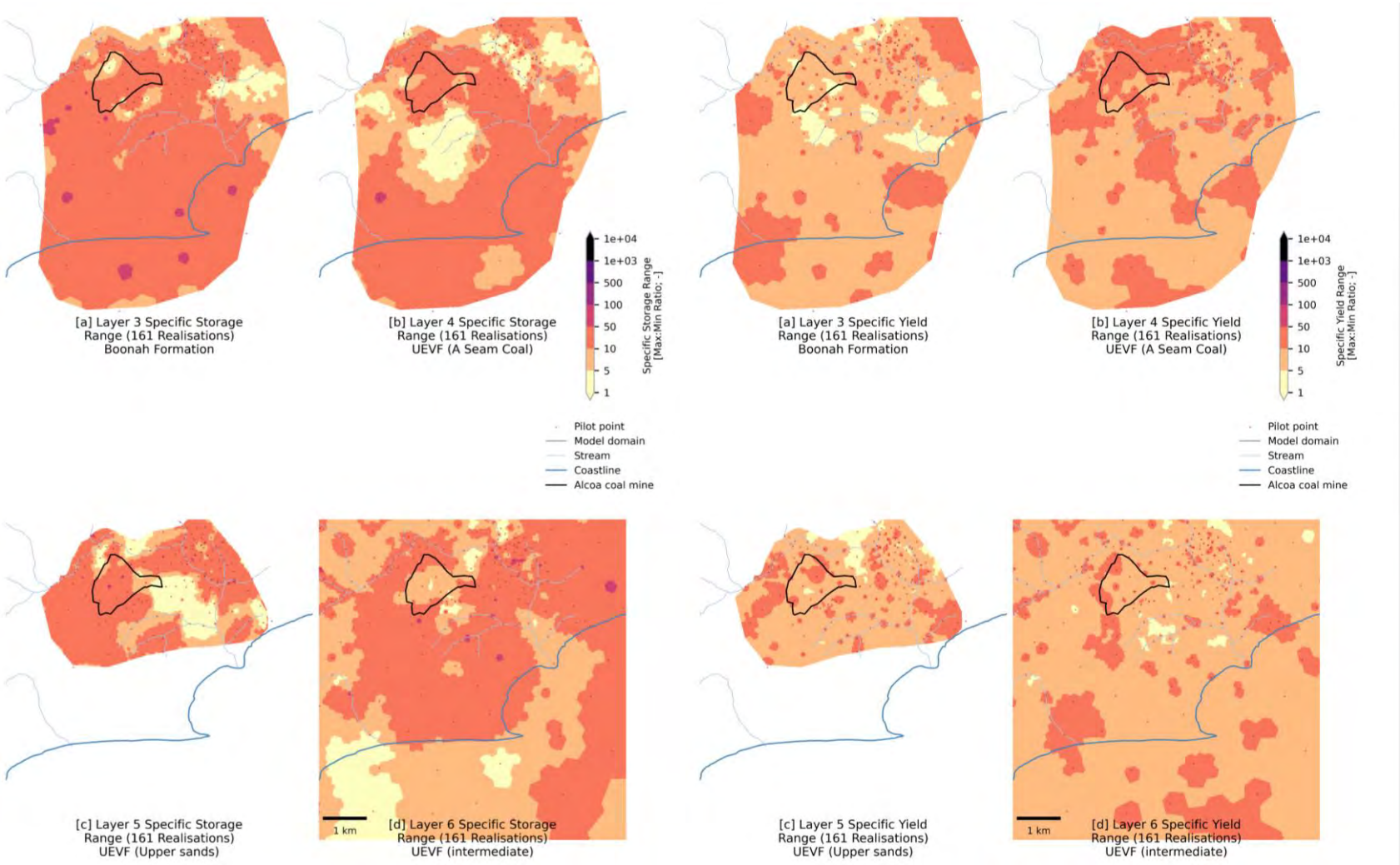


Figure 6-28 Layers 3, 4, 5 and 6 specific storage and specific yield uncertainty range

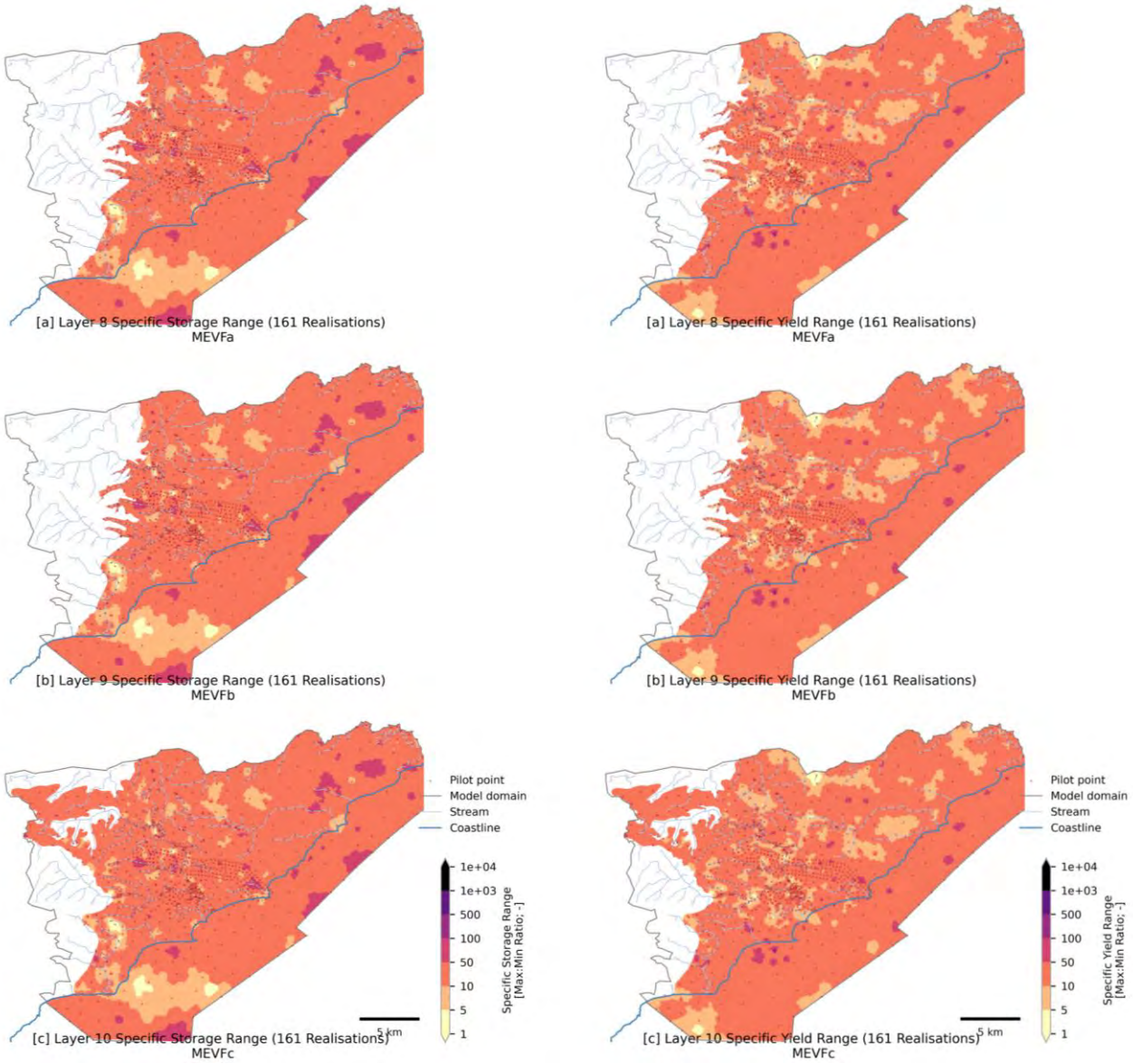


Figure 6-29 Layer 8, 9 and 10 specific storage and specific yield uncertainty range

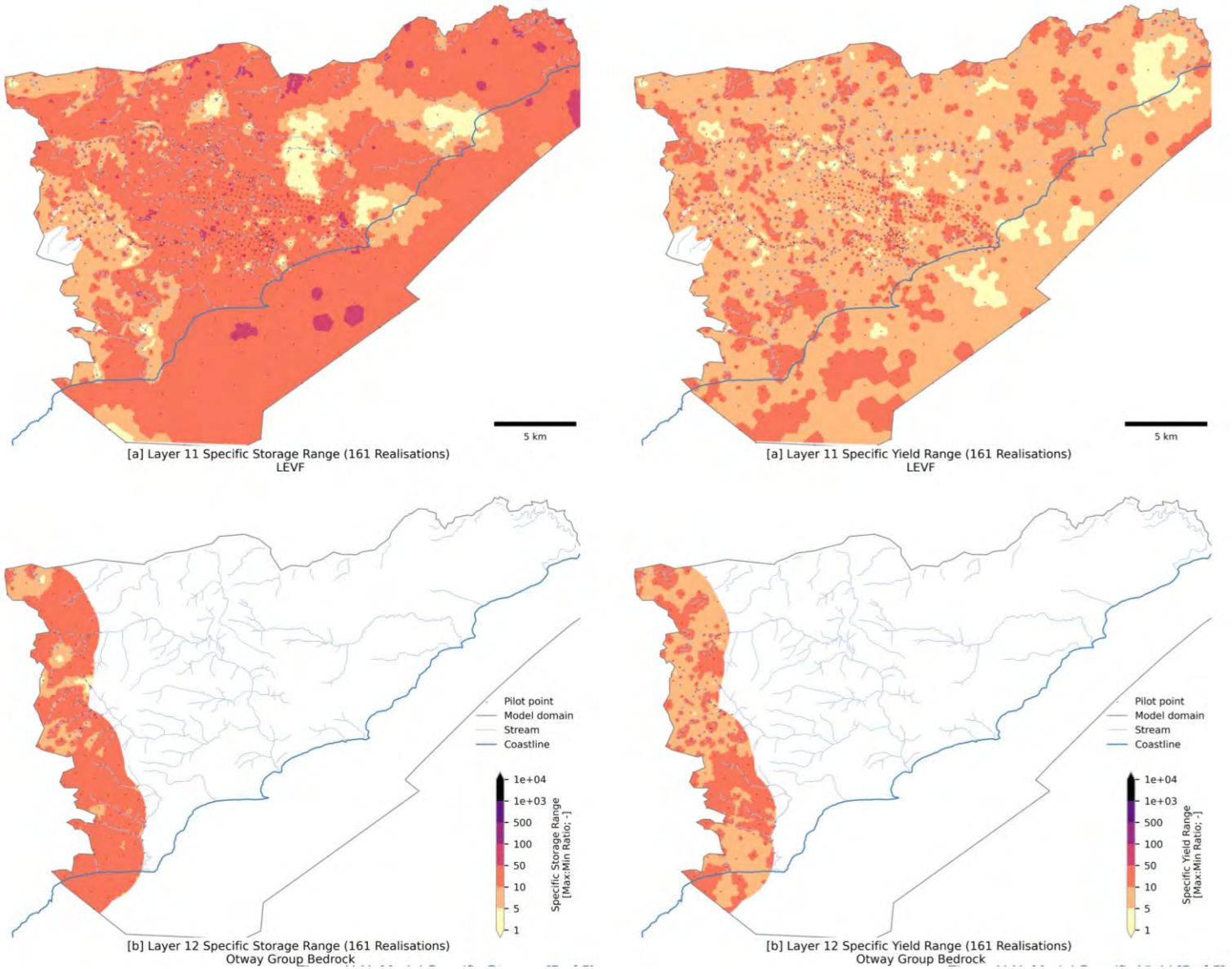
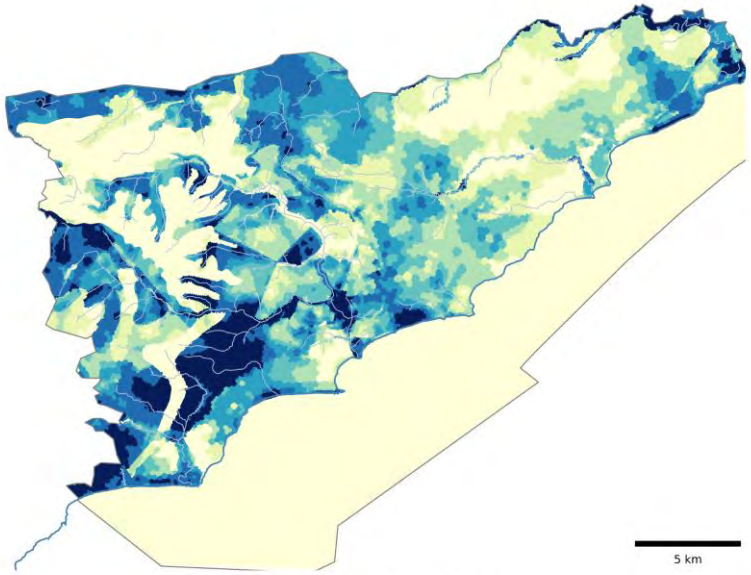
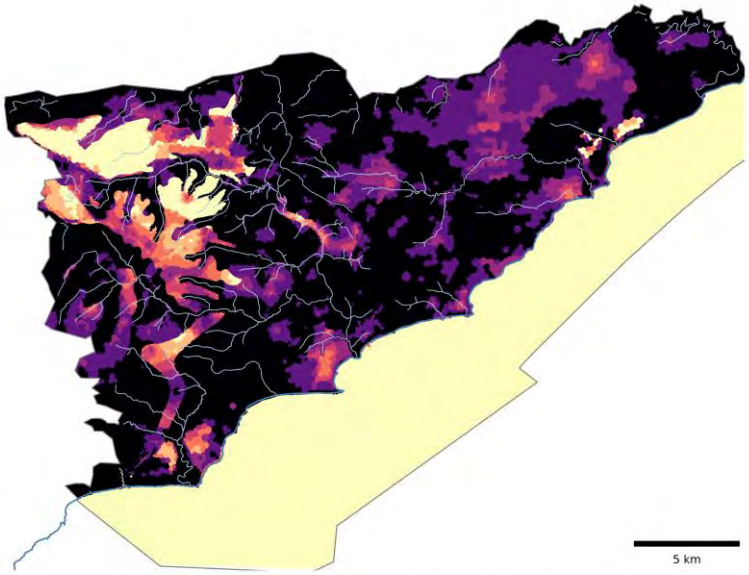


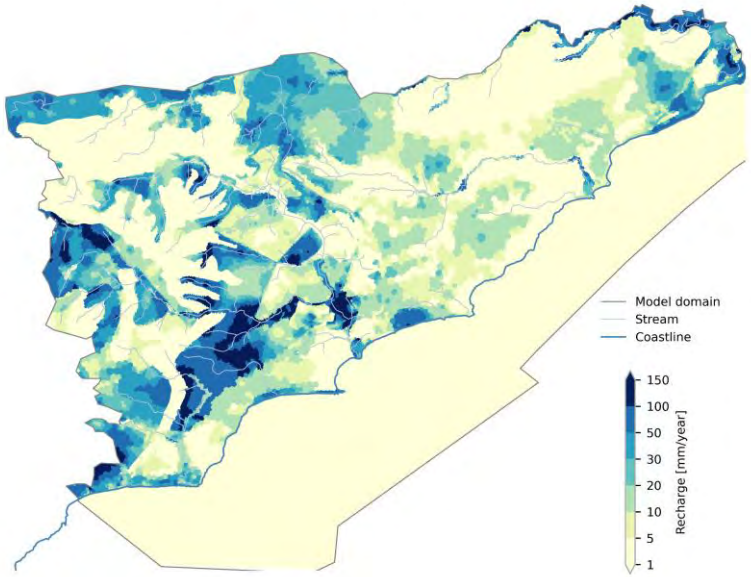
Figure 6-30 Layer 11 and 12 specific storage and specific yield uncertainty range



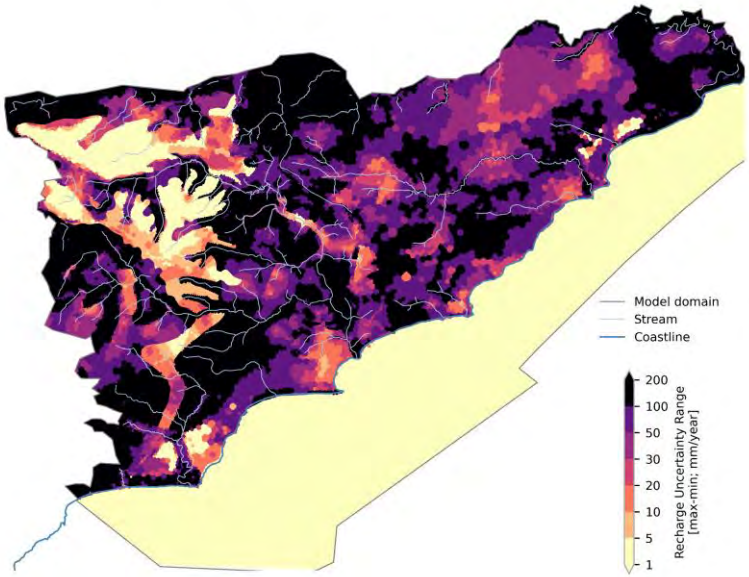
[a] Recharge 1968-2000 Mean (320 realisations)



[a] Recharge 1968-2000 Uncertainty Range (320 realisations)

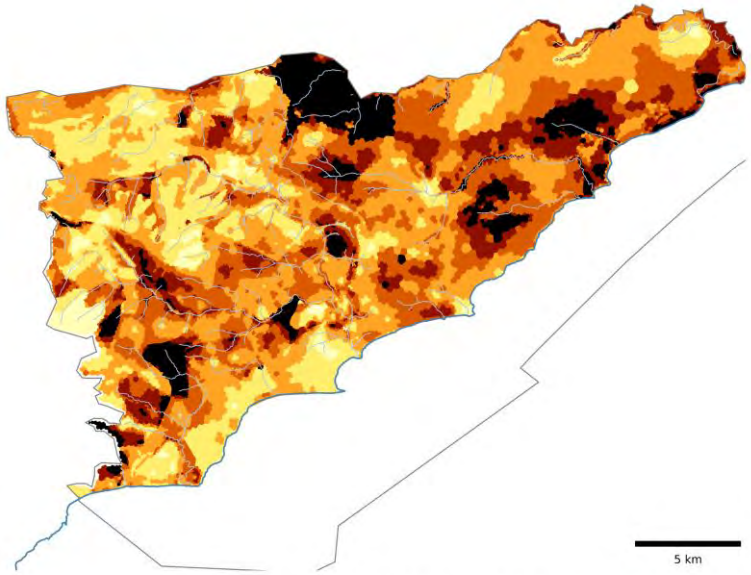


[b] Recharge 2001-2022 Mean (320 realisations)

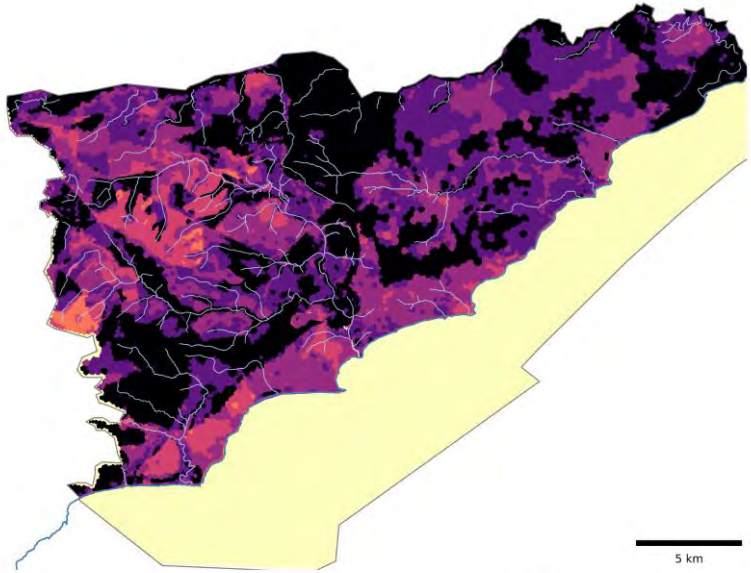


[b] Recharge 2001-2022 Uncertainty Range (320 realisations)

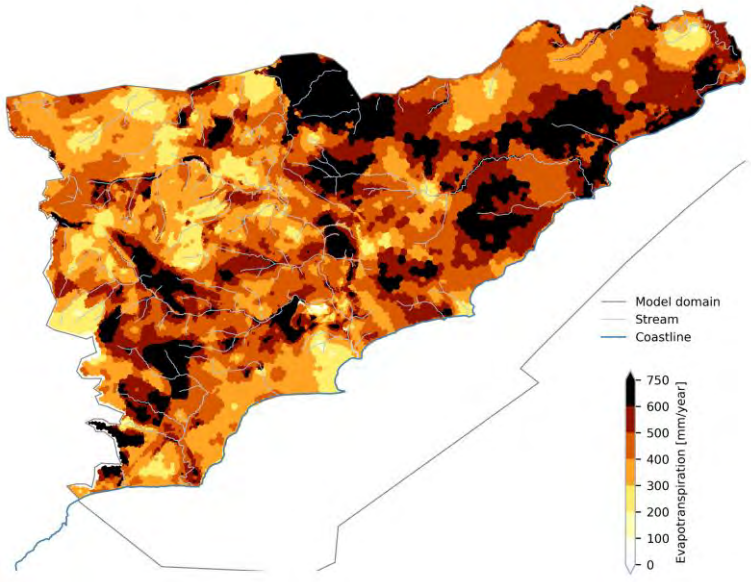
Figure 6-31 Historical recharge parameterisation summary



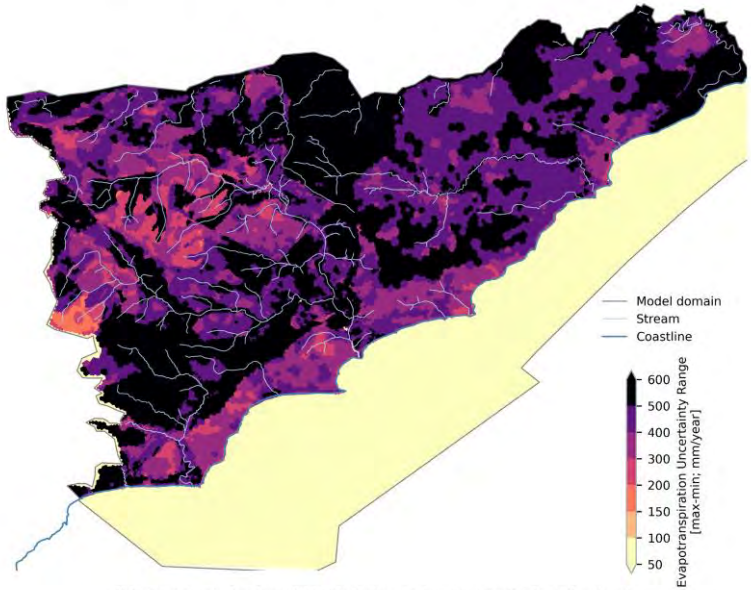
[a] Evapotranspiration 1968-2000 Median (320 realisations)



[a] Evapotranspiration 1968-2000 Uncertainty Range (320 realisations)

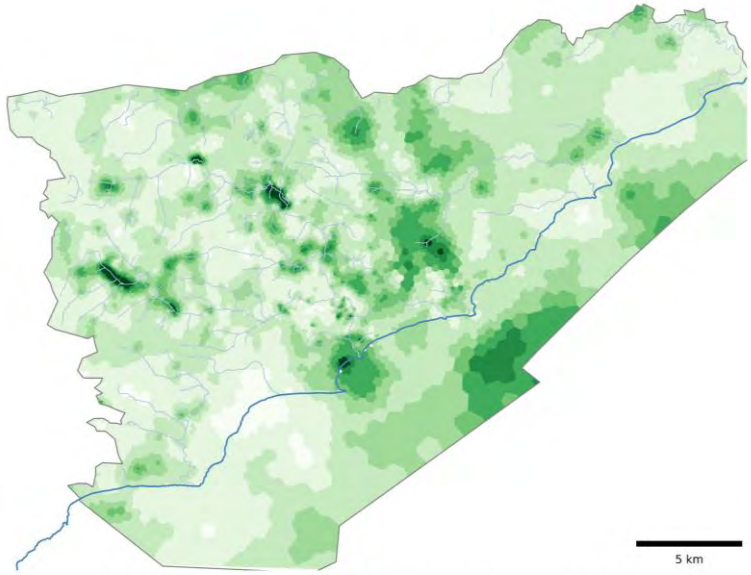


[b] Evapotranspiration 2001-2023 Median (320 realisations)

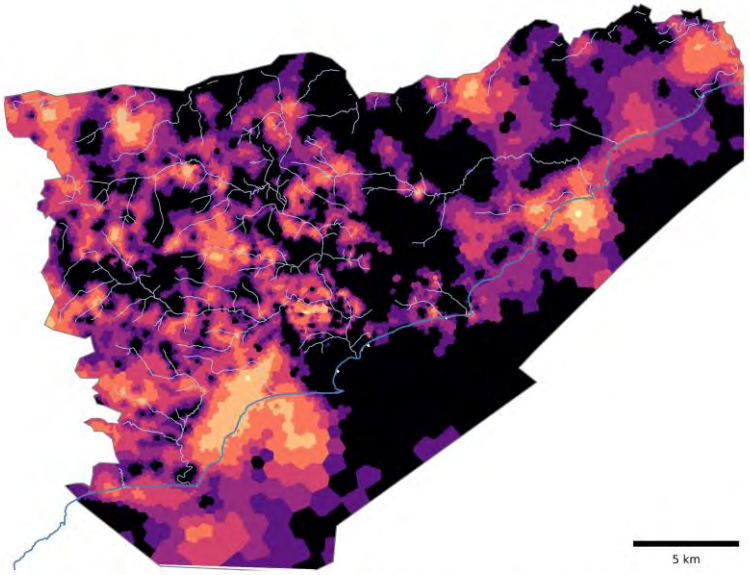


[b] Evapotranspiration 2001-2023 Uncertainty Range (320 realisations)

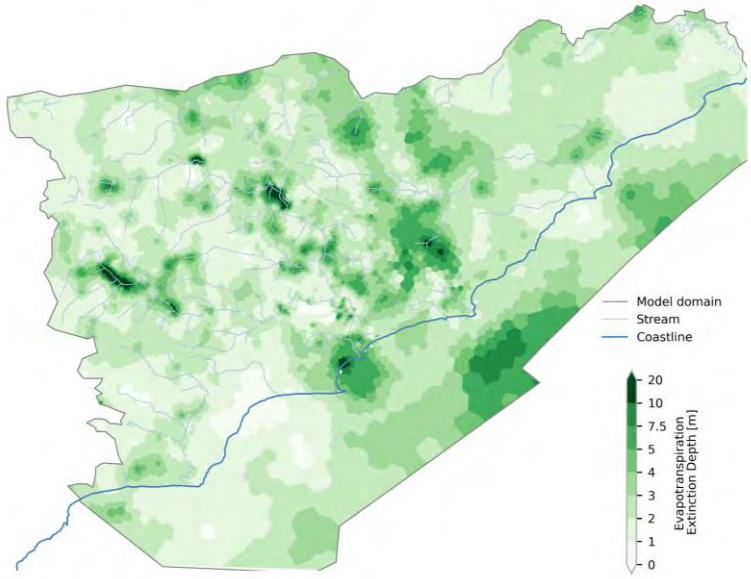
Figure 6-32 Historical maximum groundwater evapotranspiration rate parameterisation summary



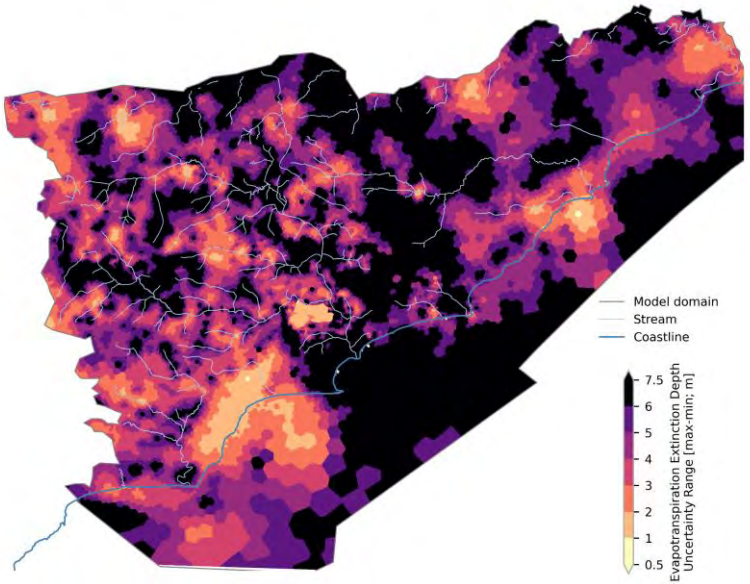
[a] Evapotranspiration Extinction Depth 1968-2000 Median (320 realisations)



[a] Evapotranspiration Extinction Depth 1968-2000 Uncertainty Range (320 realisations)

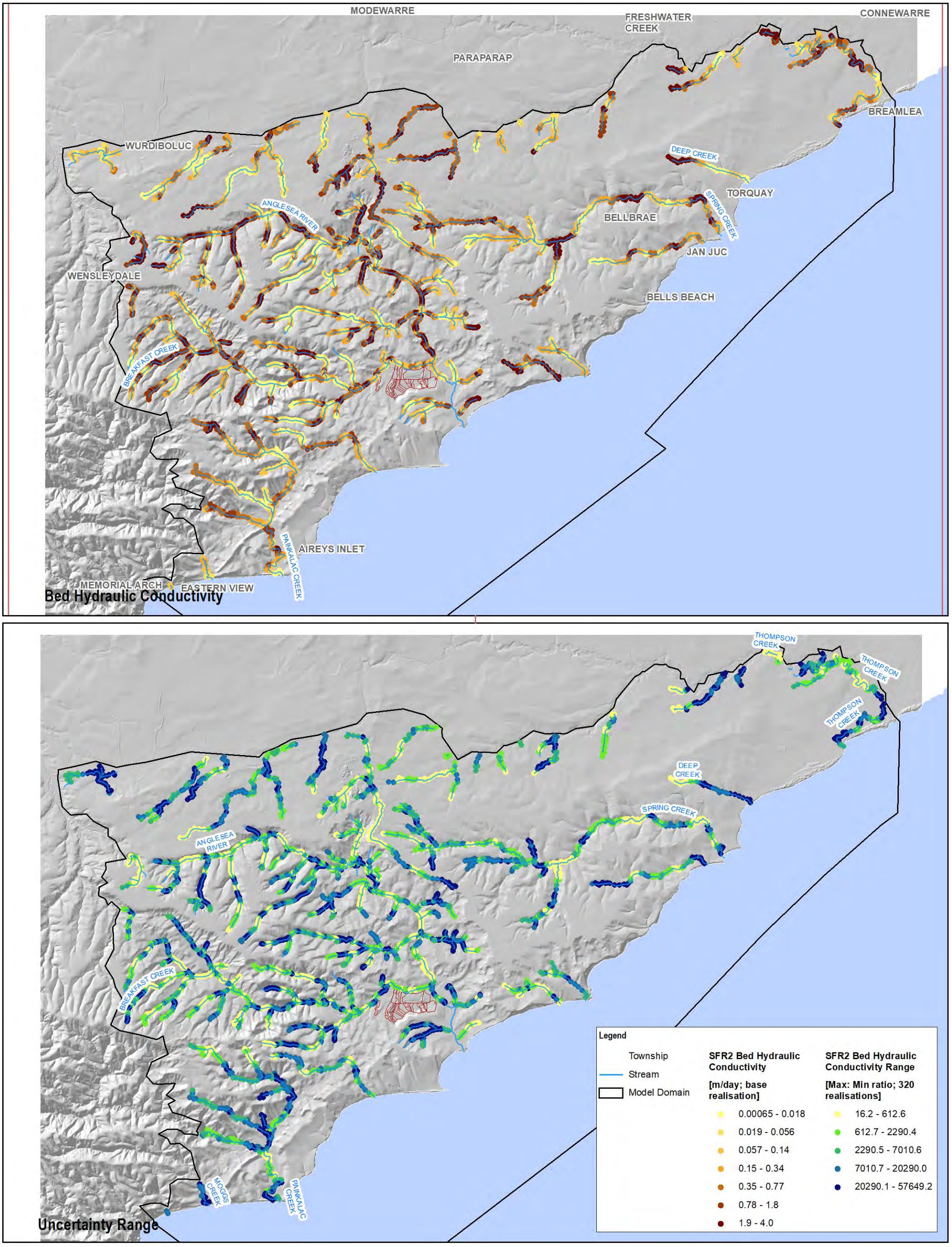


[b] Evapotranspiration Extinction 2001-2023 Median (320 realisations)



[b] Evapotranspiration Extinction Depth 2001-2022 Uncertainty Range (320 realisations)

Figure 6-33 Modelled evapotranspiration extinction depth summary



Paper Size ISO A3

0 1 2 3 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GW/L GROUNDWATER LOGIC

GHD

Barwon Water
Anglesea Groundwater Model Updates

Groundwater Model History-Matching Stream Boundary Parameters and their Uncertainty

Project No. 31-12542999
Revision No. 1
Date 29/01/2024

FIGURE 6-34

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Data source: . Created by: Chris Nicol

6.1.8 Model Water Balance

It is important for readers to note that results presented in this section are from a single model ("base") realisation - one of 263 history-matched realisations developed; that is, this is one of 263 estimates, and there is uncertainty around the estimates presented.

Modelled historical water balance summaries from the optimised base realisation are presented in Figure 6-35 and Figure 6-36 for the Anglesea (southern) and Jan Juc (northern) synclines, respectively. These show period averages over the 1968 to 2000 wetter climatic period, and the drier period from 2001 to 2022. In both basins in both time periods, the dominant model inflow component is recharge. The dominant outflow components are evapotranspiration from shallow groundwater, and offshore discharge.

Recharge is estimated to have fallen sharply between the two periods – by 43% in the Anglesea (southern) syncline, and by 47% in the Jan Juc (northern) syncline. This results in an increase in groundwater entering the model from storage (as groundwater levels fall), and less evapotranspiration, offshore discharge and baseflow to streams. Stream leakage into the modelled groundwater system is also reduced in the drier 2001-2022 period compared with the earlier period (by 20% in the Anglesea syncline and 24% in the Jan Juc syncline); baseflow to streams has fallen by larger proportions (40% and 38% respectively).

Transient variability in model water balance components (from which the averages discussed above are derived) are presented in Figure 6-37 and Figure 6-38, for the southern and northern synclines respectively. *An important point to note in these figures, and in all model groundwater level and stream flow hydrograph figures, is that there are periods of apparently greater variability in the late 1970's to early 1980's, and again in the late 2000's, than there is in intervening periods; readers are reminded that this is driven by coarser temporal model discretisation (as coarse as annual stress period durations) in the intervening periods, as is described in Section 4.4 and Figure 4-8.*

Figure 6-37 and Figure 6-38 show significant transient water balance variability within and across years, primarily depending on prevailing rainfall (recharge) conditions, but also, at least in the case of the Anglesea (southern) syncline, groundwater pumping and Alcoa mine void development. In contrast, in the Jan Juc (northern) syncline (Figure 6-38), there is very little anthropogenic influence on groundwater flux dynamics, aside from Barwon Water pumping from the LEVF for a brief period around 2012.

The Anglesea (Southern) Syncline

Focussing on the Anglesea (southern) syncline, Figure 6-39 presents modelled groundwater flux rates between the ASA and underlying UEVF, and Figure 6-40 presents that between the UEVF and underlying MEVF (hence also the underlying LEVF). Figure 6-44 and Figure 6-45 present corresponding data for the Jan Juc (northern) syncline.

Figure 6-39 shows that modelled groundwater flux between the ASA and UEVF is dominated by downward fluxes (from ASA to UEVF); this is true even in the initial steady state stress period, in which Alcoa operations did not exist, suggesting the root cause to be basin architecture and hydrogeology rather than Alcoa's historical activities[26]. Over the 50-year modelled period, upward leakage from the UEVF to the ASA has declined; similarly, rates of downward leakage from the ASA to the UEVF have declined, albeit less consistently or significantly than upward leakage has. Rates of downward leakage tend to increase markedly during wet (recharge and stream flow) events, as shown by the brief spikes in Figure 6-39; this is confirmed through Figure 6-41, particularly in the 2001-2022 period (bottom chart), which shows brief spikes in leakage from streams to groundwater (the ASA) corresponding with times when there are also spikes in downward leakage from the ASA to the underlying UEVF. In other words, recharge and stream leakage to the ASA during wet events raises watertable heads relative to the underlying UEVF, resulting in spikes in downward leakage from the ASA to the UEVF. Further confirmation of this is provided through the upper chart in Figure 6-42, which shows that for recharge events above 0.01 ML/day (to the ASA in the Anglesea syncline), there is increasing leakage down to the underlying UEVF; a similar albeit weaker correlation is also observed in Figure 6-42 with regard to stream flow versus ASA to UEVF leakage.

[26] Although this is not to say that Alcoa operations may not have altered this (what appears to be natural) process to some degree.

In terms of groundwater flux between the UEVF and LEVF (via the MEVF) in the southern (Anglesea syncline), Figure 6-40 shows generally upward leakage from the LEVF to the UEVF. At times of Barwon Water pumping from the LEVF (2010-2012, and again in 2020; periods of highest LEVF pumping in Figure 6-43), decreased upward leakage in conjunction with increased downward leakage are observed, as gradients are reduced and even locally reversed under pumping stress. One other subtle process is evident in Figure 6-40:

- A mild gradual increase in upward leakage from the LEVF to the UEVF from the late 1960s (pre-Alcoa mine) until the early 1990s (Figure 6-40); this may be a response to mine development and increasing UEVF depressurisation by Alcoa operations over this period, as shown in Figure 6-43. This is followed by a mild decrease in upward leakage as mine development slowed (Figure 6-40) and the UEVF had largely been depressurised in earlier times (Figure 6-43), in addition to a long-term trend of a drying climate post-1996.

The Jan Juc (Northern) Syncline

Focussing on the Jan Juc (northern) syncline, Figure 6-44 presents modelled groundwater flux rates between the ASA and underlying UEVF, and Figure 6-45 presents that between the UEVF and underlying MEVF (hence also the underlying LEVF).

Figure 6-44 shows that modelled groundwater flux between the ASA and UEVF is dominated by upward discharge into the ASA. There is generally very minor downward leakage to the UEVF, although there may be subtle evidence in Figure 6-44 of a slight increase over the Millennium Drought period (from the late 1990's), concomitant with declining upward leakage to the ASA. The converse is observed in the wet period of the mid-late 1970s, in which downward leakage suddenly decreased, and upward leakage increased. It is believed that this must be due to recharge to the ASA and UEVF in the northern syncline (or lack of it, as was the case in the Millennium Drought), rather than groundwater pumping, because:

- There was no groundwater pumping from the UEVF or LEVF in the northern syncline in the 1970's.
- The decline in upward leakage from the UEVF to the ASA during the Millennium Drought began and was occurring at the fastest rate before LEVF pumping by Barwon Water began (compare Figure 6-44 with Figure 6-46). Furthermore, there was no observed decline in rates of upward leakage to the ASA during the most intense period of Barwon Water LEVF abstraction in 2012.
- There is a seasonality in modelled rates of leakage between the ASA and UEVF aquifers (see the annual oscillations in the 1975-1982 and post-2007 periods in Figure 6-44; peaks are in late summer-autumn, whilst troughs are in late spring-early summer).

However, there is no strong correlation between ASA recharge with ASA to UEVF leakage, as shown in Figure 6-47 (top figure; measured across the entire Jan Juc syncline area). There is however strong evidence of this effect from UEVF recharge (both rainfall recharge, and recharge via stream leakage; Figure 6-47 bottom figure). This suggests that recharge to the UEVF plays a role in gradients that control flux rates from the UEVF up into the ASA aquifer.

Figure 6-45 shows that modelled groundwater flux between the UEVF and LEVF (via the MEVF) is generally upward, with brief periods of greater downward leakage when Barwon Water has historically operated its Northern borefield (primarily in the 2010-2012 period; see Figure 6-46). Trends in upward leakage from the LEVF to the UEVF weakly mirror those described above for ASA / UEVF leakage, and those for UEVF/LEVF leakage in the Anglesea (southern) syncline too. That is, a mild rise in upward leakage in the wet mid-late 1970s, followed by a mild to moderate decline over the Millennium Drought period (from the late 1990s onward), with a strong decline from the late 2000's. Rates of downward leakage from the UEVF to the LEVF have not changed markedly over the simulated period. The similarities in long-term temporal trends in upward leakage between aquifers and between synclines suggests that the primary driver is climatic (recharge).

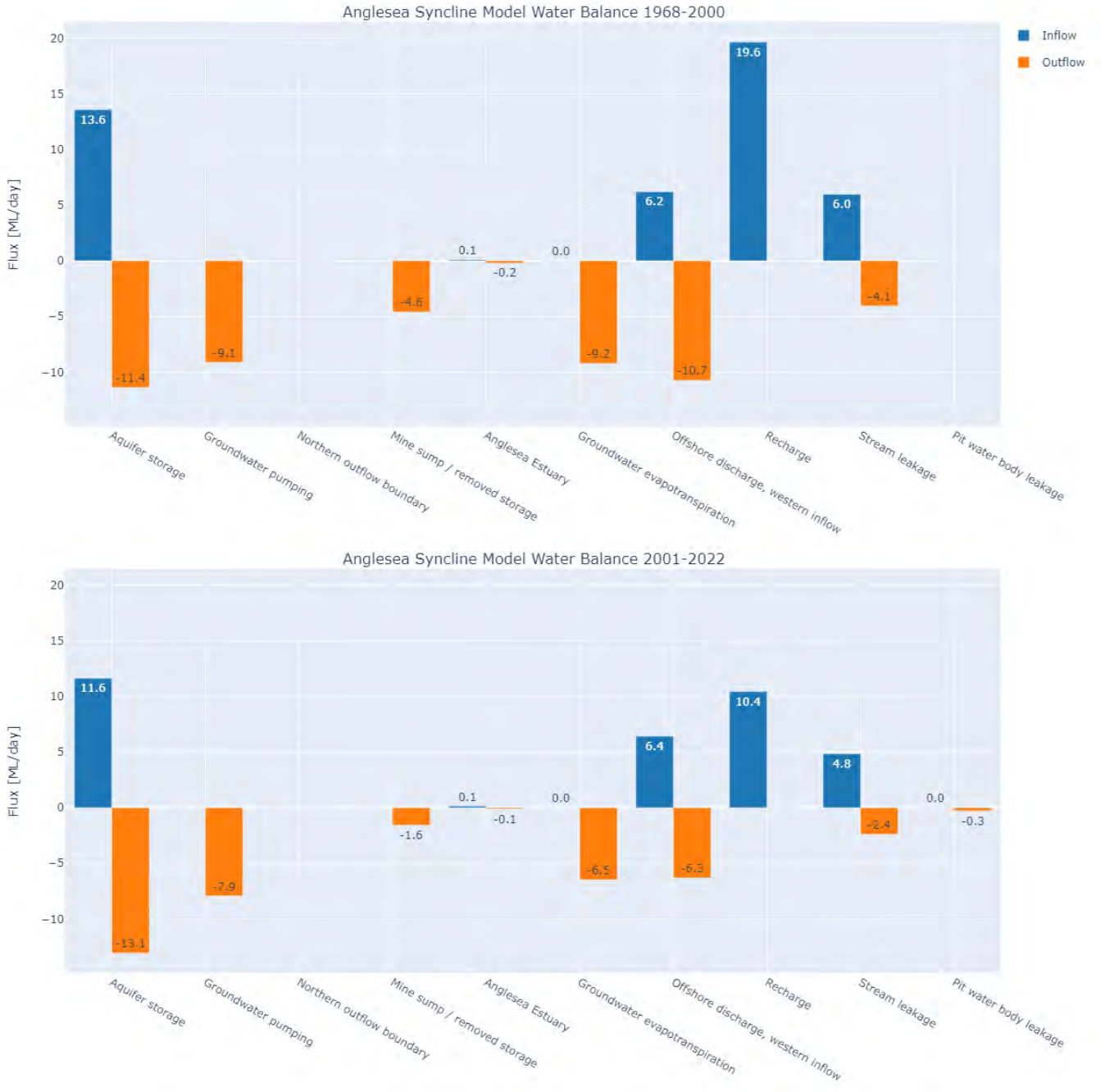


Figure 6-35 Average model water balance summary – Anglesea (Southern) Syncline

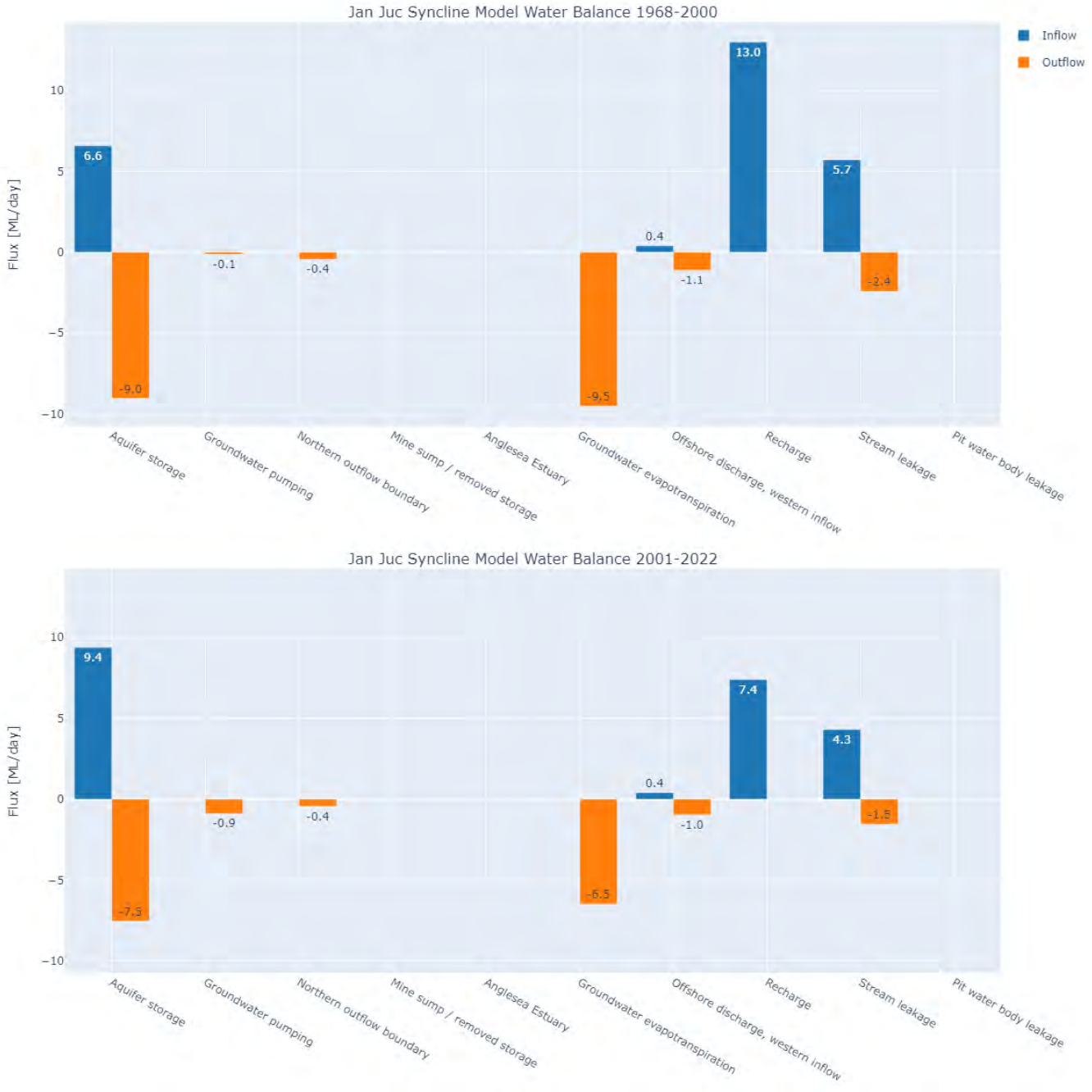
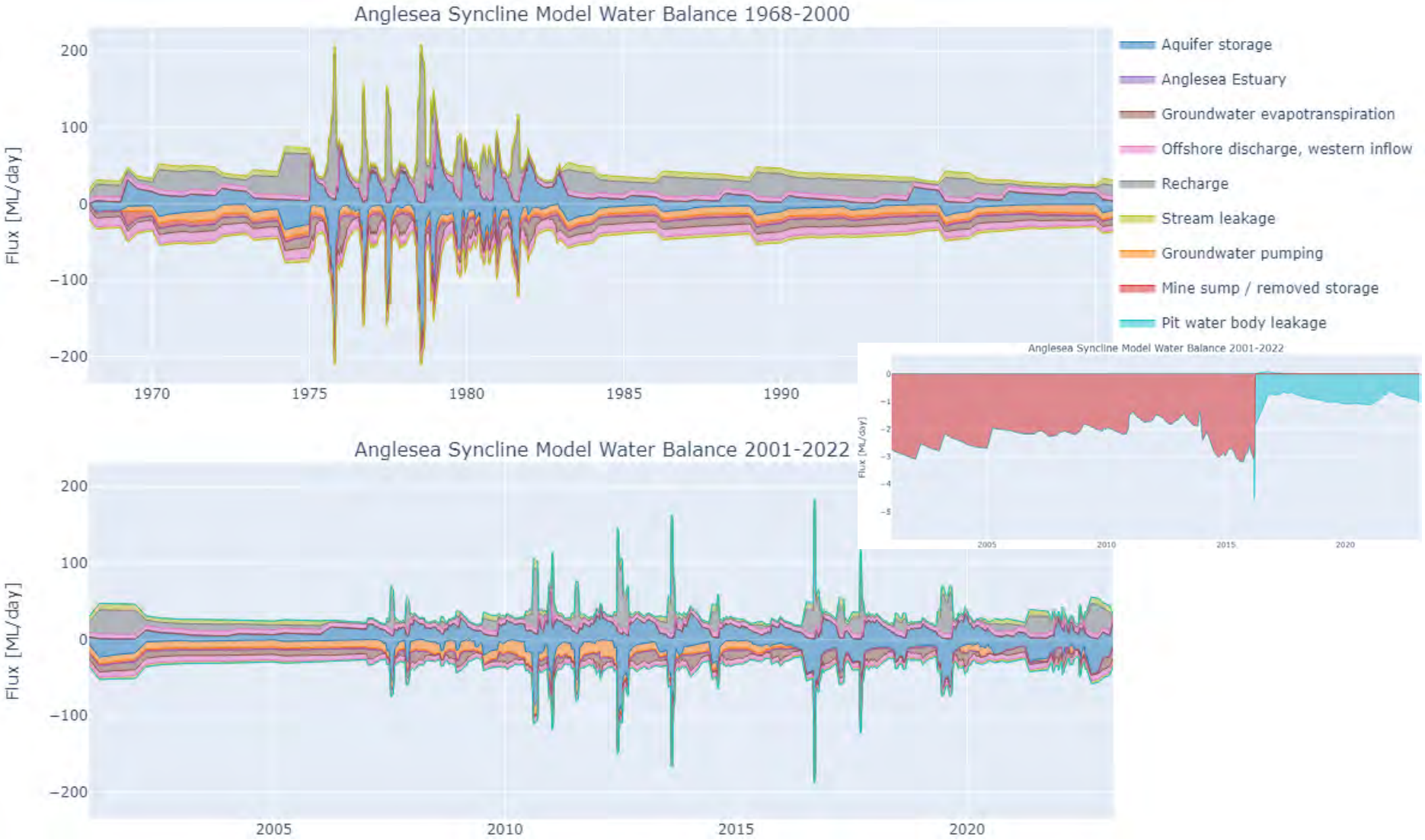
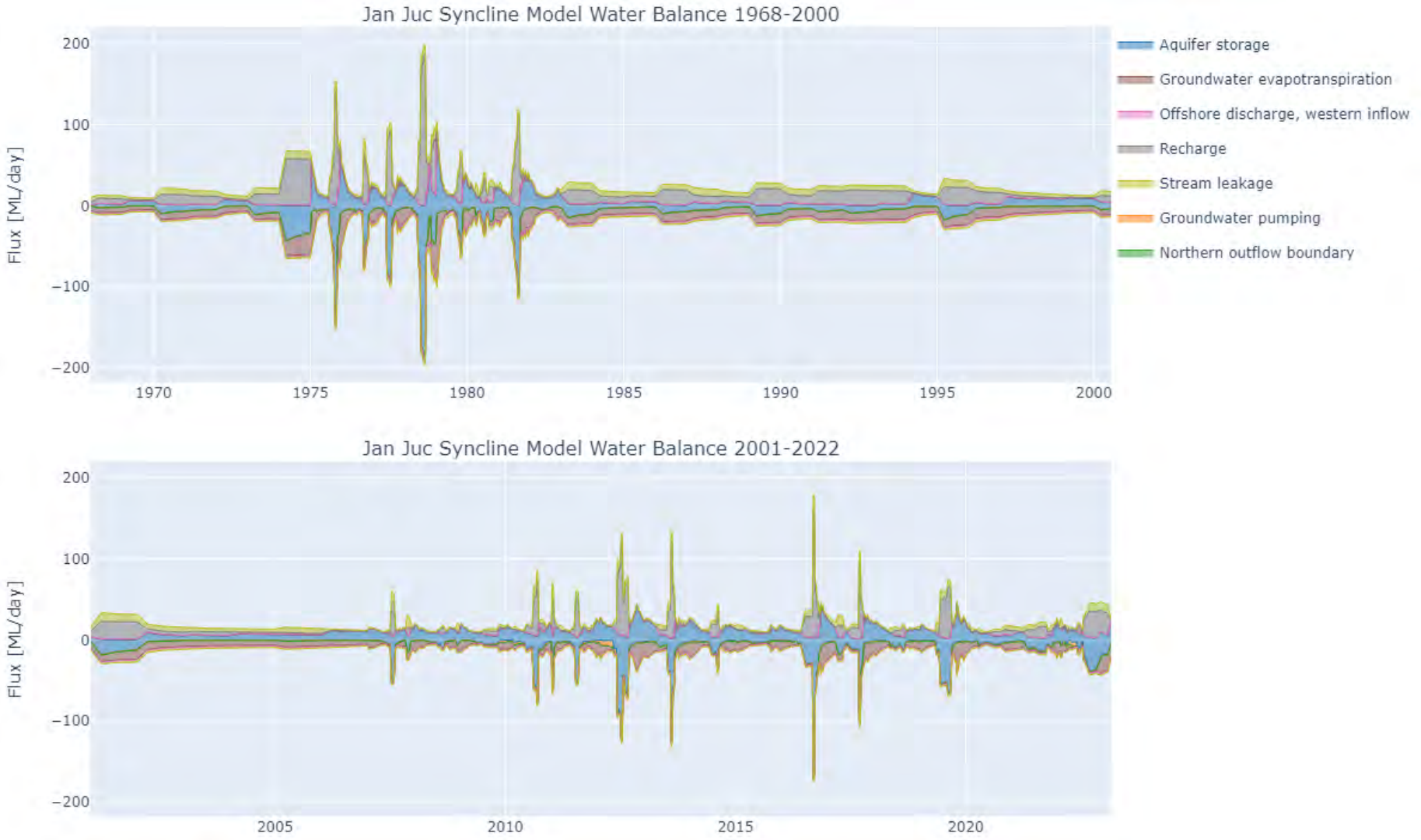


Figure 6-36 Average model water balance summary – Jan Juc (Northern) Syncline



Notes: 1] negative flux is out of model; positive flux is into model. 2] Alcoa mine detail shown as inset to right.

Figure 6-37 Transient model water balance – Anglesea (Southern) Syncline



Note: negative flux is out of model; positive flux is into model.

Figure 6-38 Transient model water balance – Jan Juc (Northern) Syncline

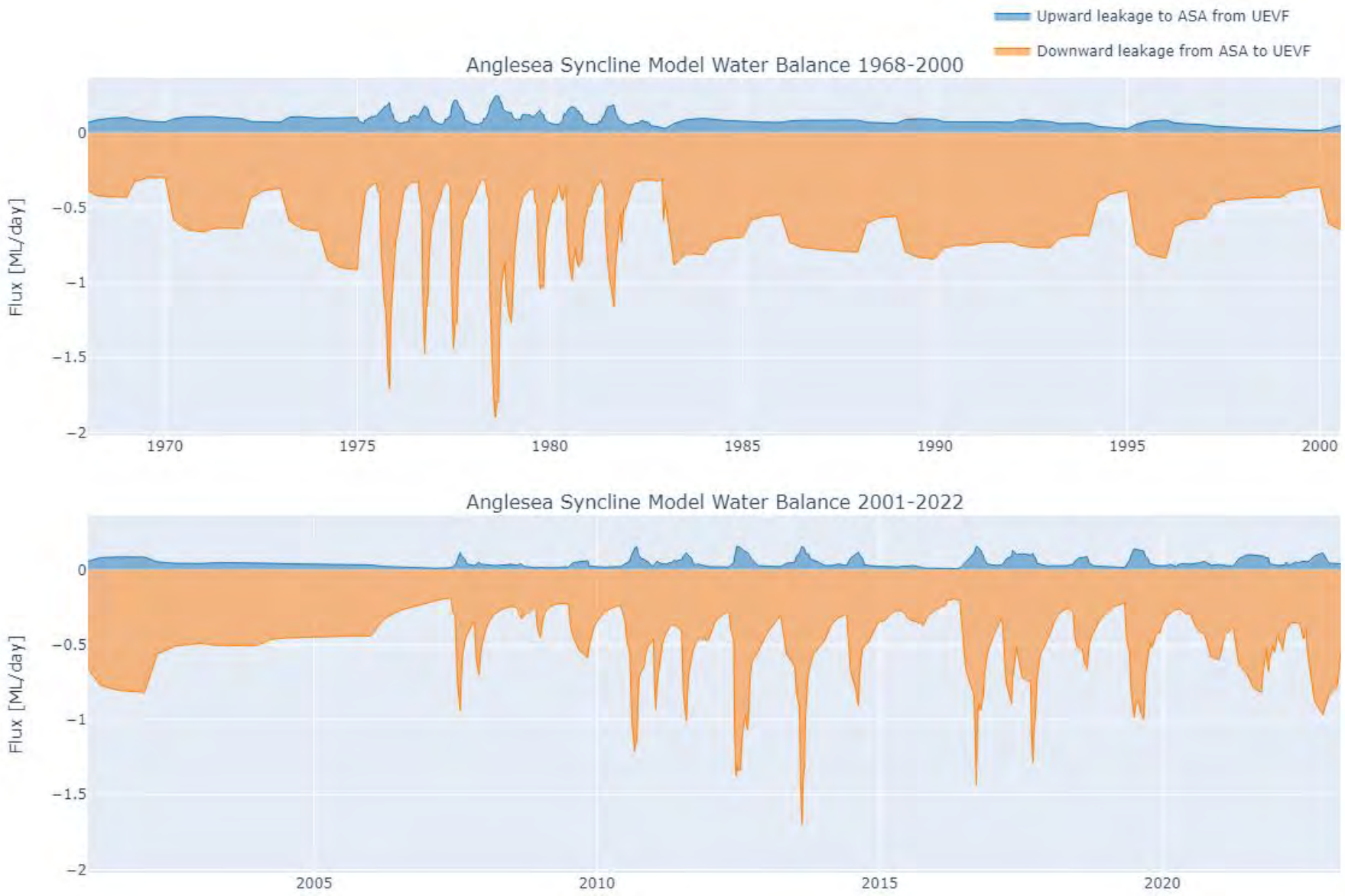


Figure 6-39 Transient ASA / UEVF groundwater flow – Anglesea (Southern) Syncline

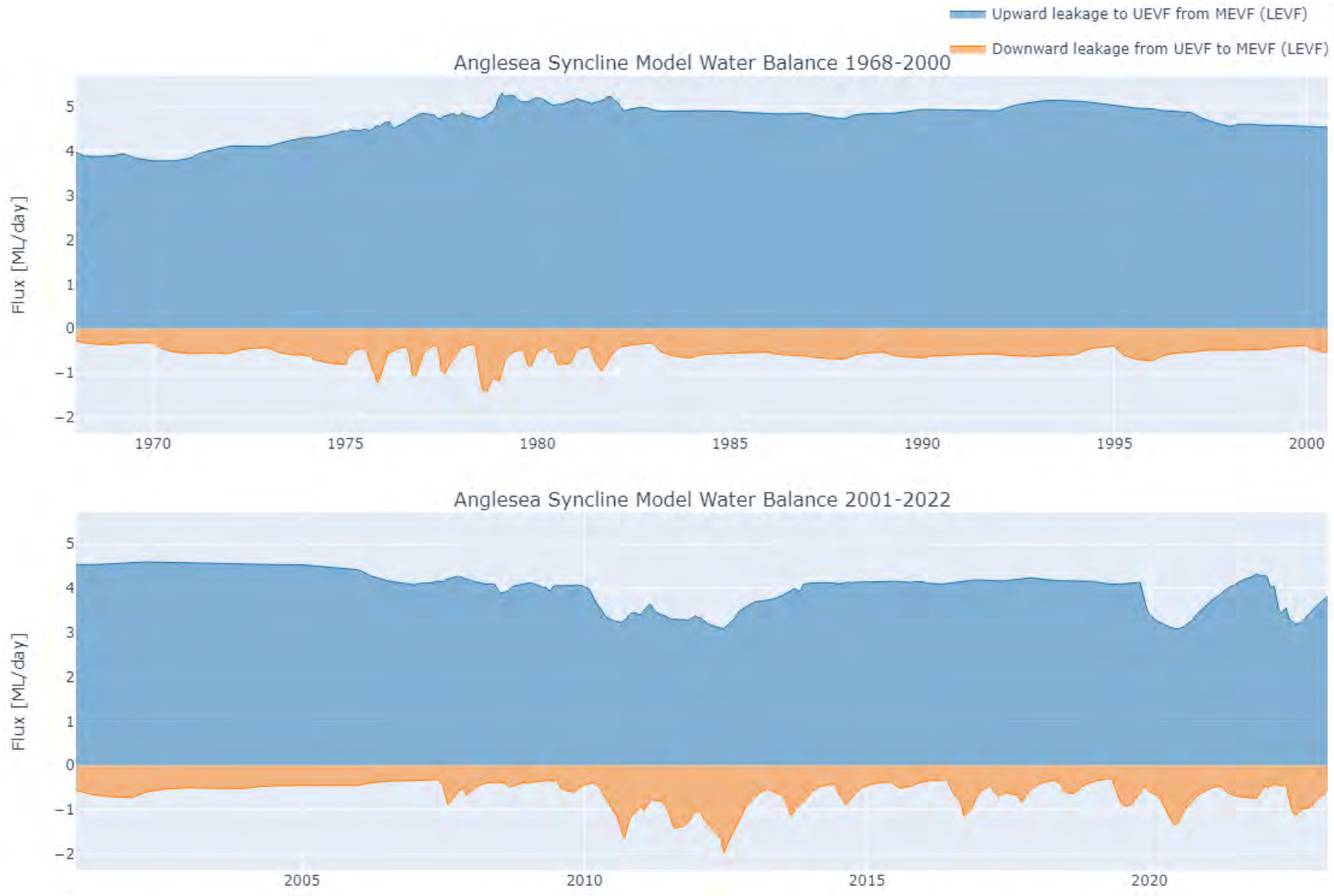


Figure 6-40 Transient UEVF / MEVF (LEVF) groundwater flow – Anglesea (Southern) Syncline

Note: negative flux is out of model (baseflow to streams); positive flux is into model (leakage from streams to groundwater).

Figure 6-41 Modelled transient baseflow and stream leakage to groundwater – Anglesea (Southern) Syncline

Figure 6-42 Modelled relationships between ASA recharge and: stream leakage to groundwater and ASA to UEVF leakage [comparison of both synclines]

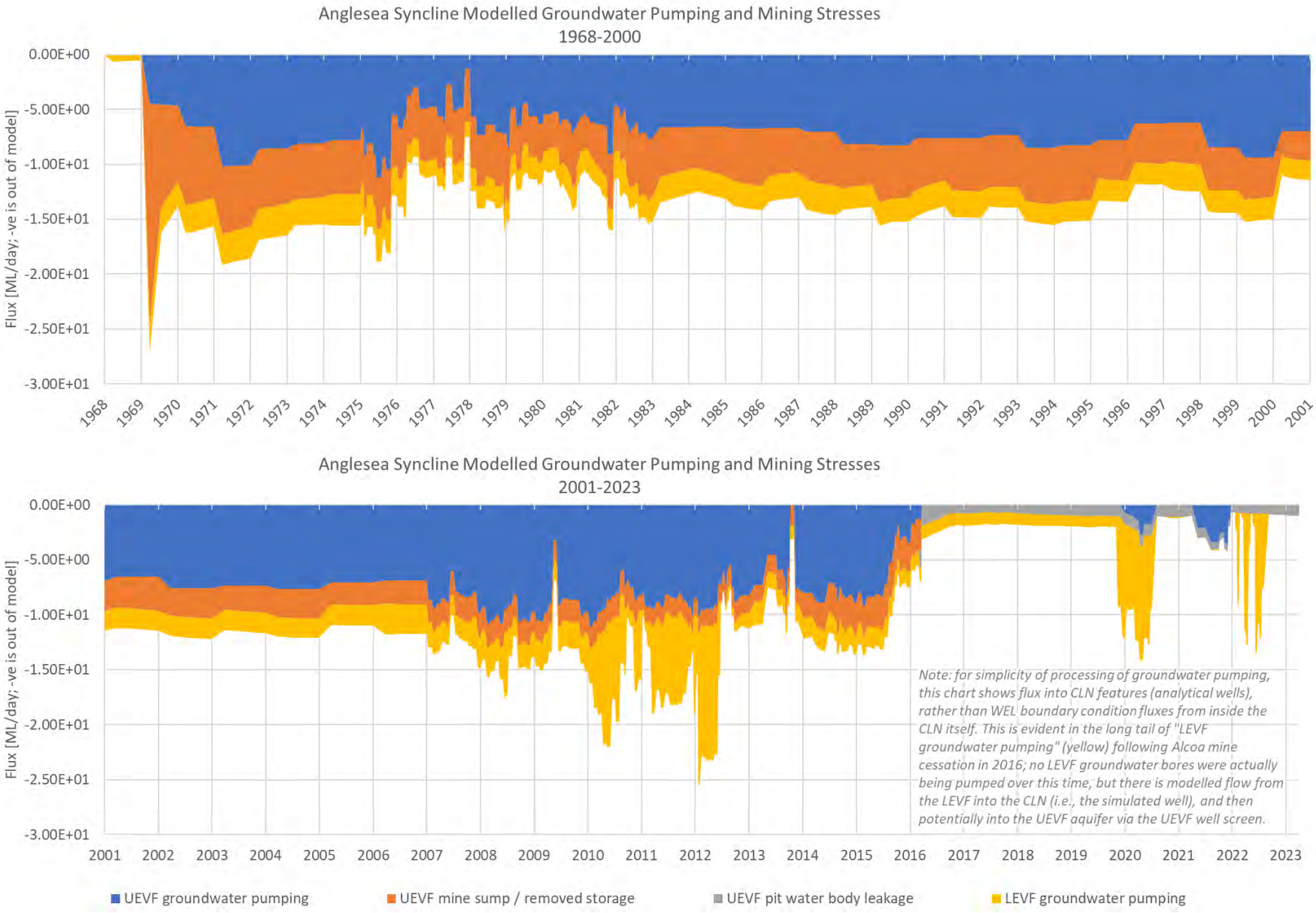
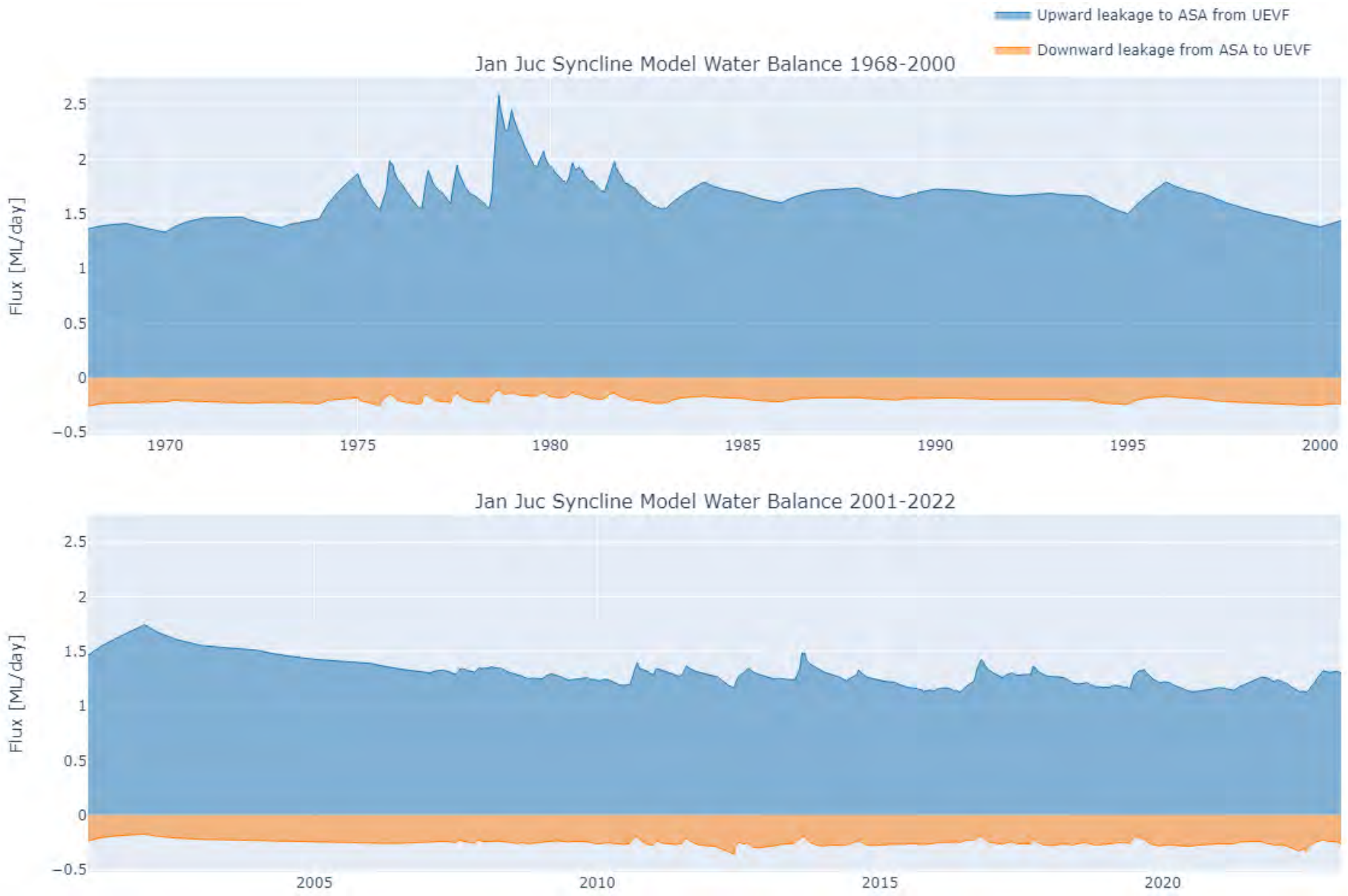


Figure 6-43 Transient pumping and mining stresses on groundwater – Anglesea (southern) syncline



Inset shows modelled hydrograph for bores P19 (UEVF) and P8 (ASA) in the mid-reaches of the Anglesea River swamp. Note the relatively greater groundwater level rises and falls in the UEVF than in the ASA, driving the plotted trends in upward leakage to the ASA from the UEVF. Note that P19 is located uphill from P8, and y axis scales differ.

Figure 6-44 Transient ASA / UEVF groundwater flow – Jan Juc (Northern) Syncline

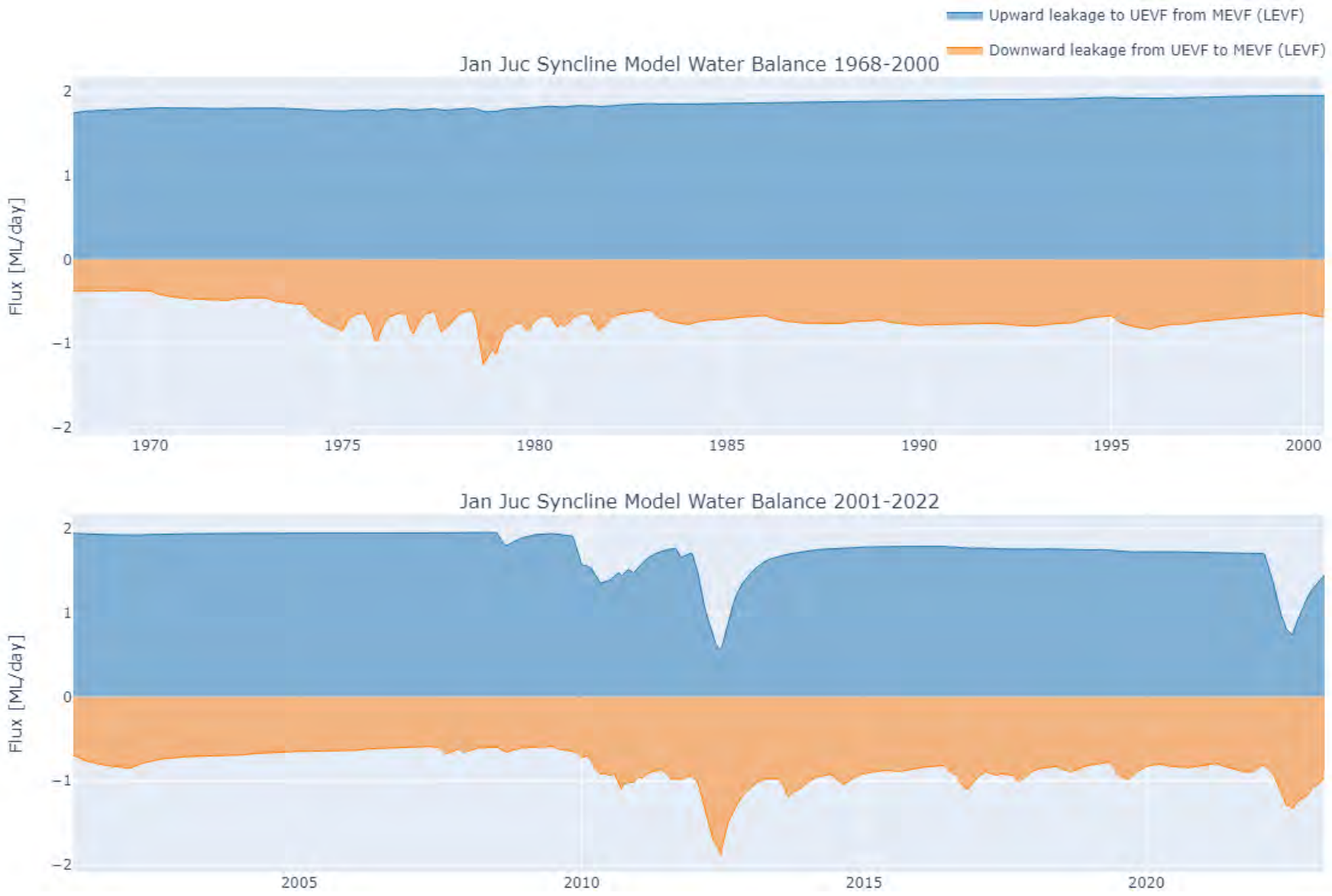


Figure 6-45 Transient UEVF / MEVF (LEVF) groundwater flow – Jan Juc (Northern) Syncline

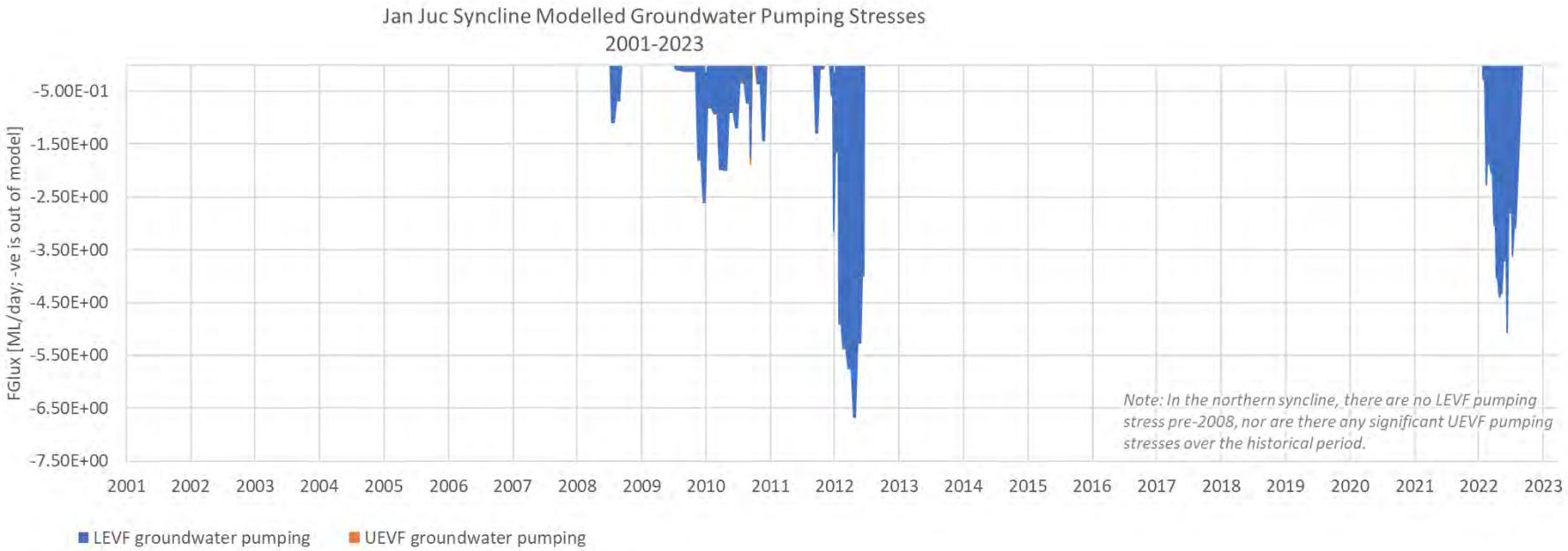
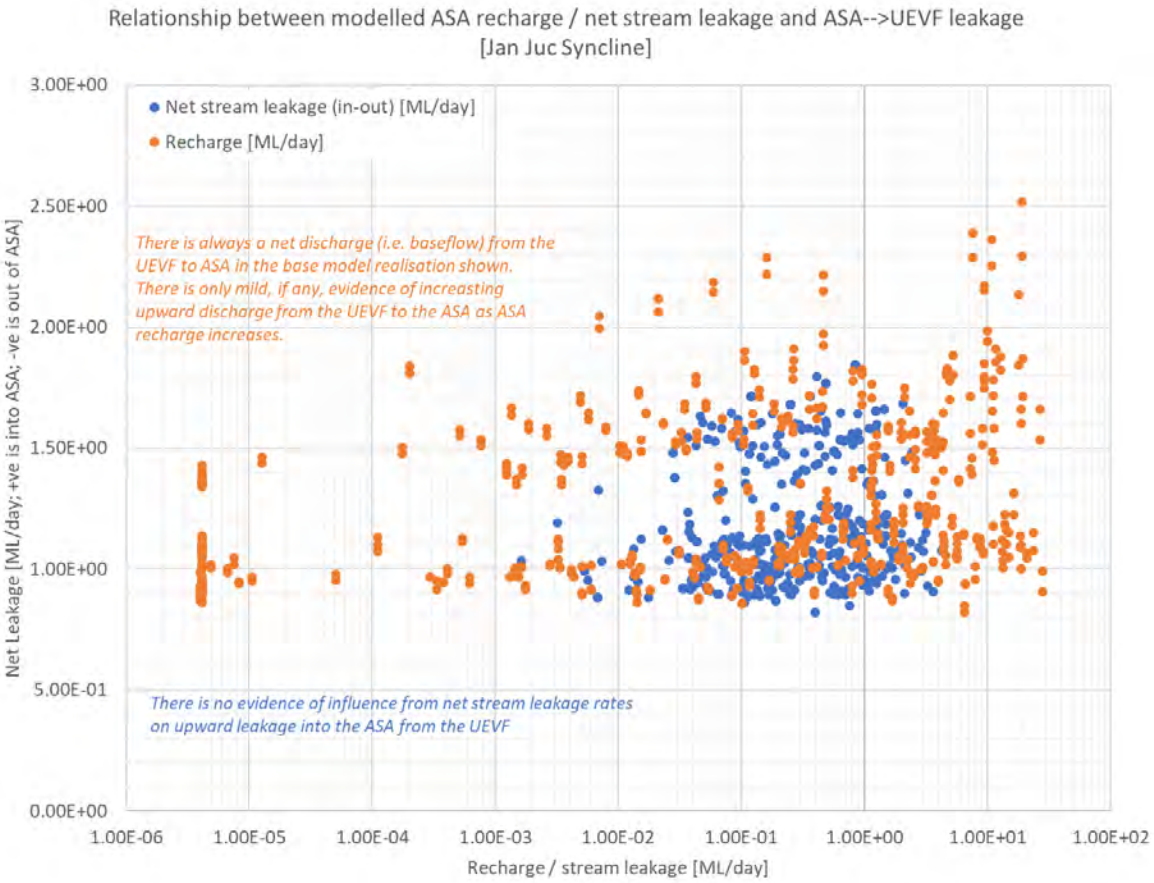


Figure 6-46 Modelled transient groundwater pumping stresses – Jan Juc (Northern) Syncline



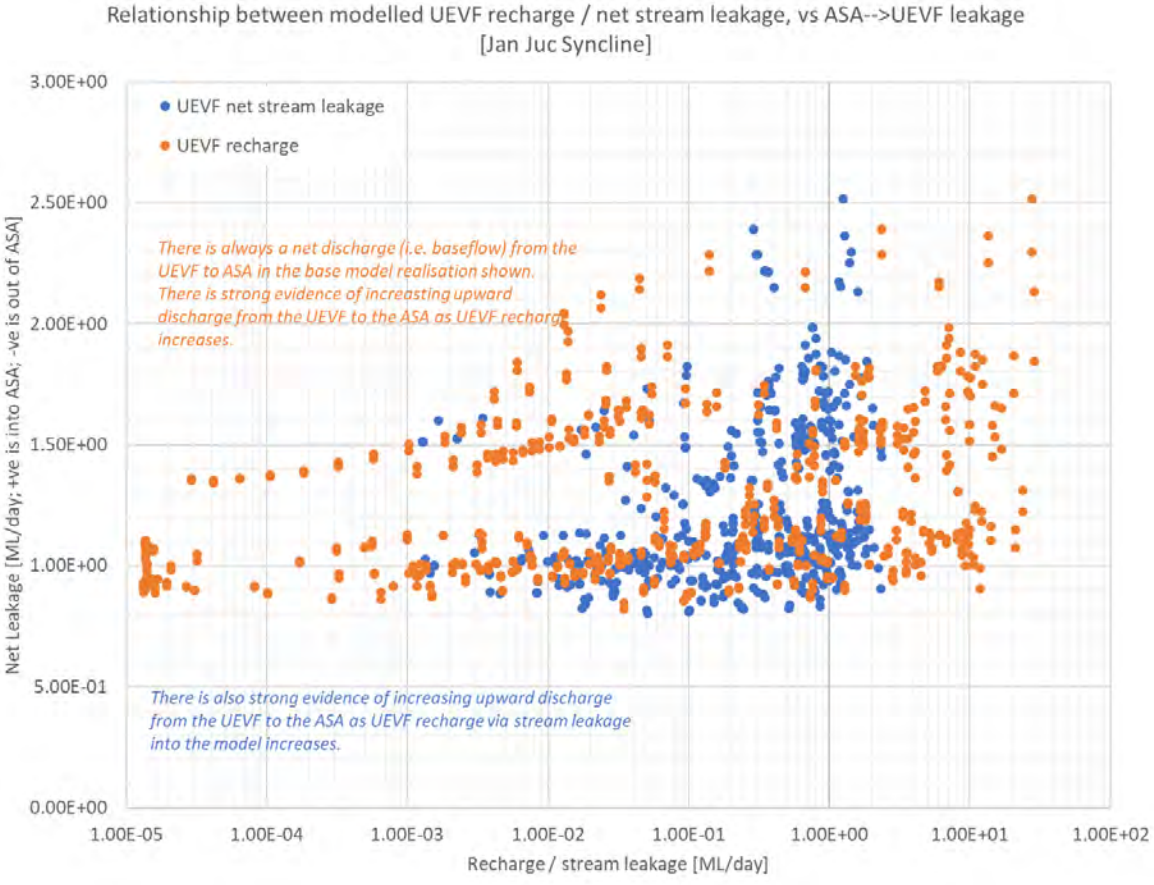


Figure 6-47 ***Modelled relationships between groundwater recharge and: stream leakage to groundwater and UEVF to ASA leakage [Jan Juc (northern) syncline]***

6.1.9 Areas for Further Investigation

As is usual in the modelling process, several areas for further investigation and potential model improvement have been identified. None of these are considered critical to model reliability for impact assessment, particularly given that most model impact assessment is conducted in relative terms (i.e., as differences between scenarios).

Furthermore, given that this is a model of a very complex reality, as was outlined in the introduction to this report, some of these issues will likely never be fully resolved, because models are just that – imperfect, simplified representations of an infinitely complex reality, based on the understanding of the hydrologic system at the current point in time. It is for this reason that the developed modelling workflow documented in this report operates in a framework that recognises and accommodates these uncertainties and simplifications, and carries them through to forecast model outputs, and ultimately to reliant decision-making processes.

Most areas for further investigation that were identified in earlier modelling studies have been addressed and the model has been improved upon in many ways.

Whilst acknowledging the above points, identified areas for further investigation are outlined as follows:

- History matching to watertable depth variability in bore P9 appears hampered by model structure in some way; it may be that this bore screens a discrete relatively impermeable sub-unit of the ASA, because its behaviour differs quite markedly from all other watertable bores.
- If an improved model history matching is desired around the shallow (typically <10m bgl) Alcoa bores (located near the former Power Station), request EHS to revisit the model layers in this area (noting that heads in these bores are influenced by the largely poorly understood processes of historical water leakage from Alcoa site infrastructure). It is understood that modelling of groundwater behaviour in these bores were not of interest to EHS or Alcoa at the outset of the modelling process, and so this is unlikely to be required.
- Increase the history matching objective function weight of Alcoa pit water body levels, and potentially of AV1 gauged flows. Whilst the 263 model realisations cover the observed data, the base model realisation could potentially be improved in these regards.

7. Conclusion

An updated numerical groundwater flow model of the area around Barwon Water's Anglesea borefield and Alcoa's historical coal mine has been developed. The model is based in a minor sense on earlier modelling of GHD (2013) but is a wholly new model using a new numerical code, new layer structure, new parameterisation schemes, and modern methods of history-matching to historical observation data. It was built and operates in a stochastic framework that recognises input observation data and model parameter uncertainties.

The intent of using this approach is that the recognised input uncertainties are carried through to their effects on model forecasts and their uncertainty, and therefore their effects on water management decision-making.

The model simulates flux-conserved groundwater and surface water flow, and interactions between the two systems. It also simulates the post-Alcoa coal mine closure pit water body balance, including its interaction with groundwater and other surface water systems. The model history-matching process therefore uses a range of surface water and groundwater data of wide-ranging types, including pit water body water levels, to inform (constrain) model parameters. It also uses derivative observations such as watertable depth-frequency curves, flow-frequency curves, pumping-induced drawdown trends, and vertical hydraulic gradients.

The intent of employing these wide-ranging observation types is, to the extent possible, minimise related model forecast uncertainties, such as the uncertainty in potential effects from groundwater use on the shallow watertable (in swamps), surface water systems, and acid generation risks.

263 history matched model realisations, each with widely varying parameters, were derived from an initial (prior) ensemble of 500. For predictive scenario modelling purposes, a smaller, more manageable number of model realisations will be selected for application in that case (e.g., the top 150 models of higher history match quality).

History match quality across these models is generally very good, for groundwater levels in deeper bores, watertable depths in shallow bores, pit water body levels, and surface water flows. However, there are of course exceptions to this, which are discussed in Section 6. Selected points for further investigation and analysis - aimed at improving history-match quality at specific sites in specific ways - are identified and discussed in Section 6.1.9.

The model developed, and framework used, provide a sound basis for ongoing use of the model in the context of rigorous model forecast and uncertainty assessment for both Barwon Water's and Alcoa's unique requirements.

7.1 A note on intended model end use

Following Technical Review Panel (TRP) review of a draft of this report, questions were asked regarding further detail around how the history-matched models and modelling workflow developed are proposed to be used for risk assessment purposes by Alcoa and Barwon Water. Clarification of this is provided below.

The modelling workflow developed provides an ensemble of 263 history matched stochastic models (parameter sets) with which to conduct scenario simulations for risk assessment purposes. Those 263 stochastic parameter sets will be applied to each future potential development scenario that is simulated. As a precursor to this, for each of the key risk items outlined in Section 2, Quantities of Interest (QoIs) will be developed, which are model output metrics that can be used to assess the simulated level of risk. Barwon Water's risk assessment process has not yet been developed, because this is to be conducted under the BE process, which was not yet underway at the time of writing. For Alcoa's purposes however, draft QoIs have been developed and distributed to the TRP; see EHS, 2022b.

The modelling and uncertainty analysis workflow outlined in this report can be used to support a risk assessment for each of the specified QoIs. This will be conducted by posing the question: Is it considered likely, based on the 263 developed stochastic models (i.e., as assessed at the 95th percentile uncertainty estimate), that the QoI may be breached under a simulated potential future development scenario? That is, is there less than a 5% likelihood that the QoI may be breached? If so, then the risk of QoI breach, and in turn the unwanted outcome that the QoI is designed to be a proxy measure of, is considered low. If on the other hand there is a greater than 5% likelihood of this occurrence, then the modelling suggests that there is a material risk. Subject area specialists for each risk item will then translate that assessment of metrics into an assessment of risk in terms of acid generation and

ecological risk, for example. This approach forms an efficient means by which potential risk occurrence hypotheses can be tested. Whilst there are more rigorous forms of hypothesis testing available, these are computationally expensive[27], particularly given the range and number of QoIs that need to be assessed by Alcoa and Barwon Water – for each of which a computationally expensive pareto-type model assessment would need to be undertaken. If such an assessment were sought, then very simple, small, and computationally efficient models (note the plural) would need to be developed specific to each QoI; it is unclear how this could work in practice, given the spatial scale and wide breadth of risk types to be assessed in this case.

The TRP also specifically questioned "*whether the <PESTPP->IES methodology can or cannot rule out localised causal pathways between the <Alcoa mine> pit waterbody and ASA*". Clarification with the TRP revealed that "localised causal pathways" refers to pathways and/or mechanisms for connection between various aquifer/aquitard layers, and the potential to impact the ASA due to groundwater extraction from underlying layers. The spatially variable model parameterisation schemes used for almost all hydraulic properties and boundary conditions (via quite dense pilot points / 52,600 stochastically varying model parameters across each of the 263 stochastic models) is considered sufficiently detailed for assessment of these risks. Furthermore, the residual range of parameter uncertainty across the history-matched models is significant (see Section 6.1.7). It is also of note that there are as many as 11 model layers / sub-layers within and around the simulated Alcoa mine void; each of these is parameterised using the spatially dense pilot points, and hence there is not only significant simulated flexibility (uncertainty) in horizontal spatial variability, but also vertically, across those 11 layers. This is considered more detailed than most models, particularly when most of that vertical detail is in the shallow parts of the basin, within and directly below the simulated mine void elevation.

[27] to an impractical degree given model run times.

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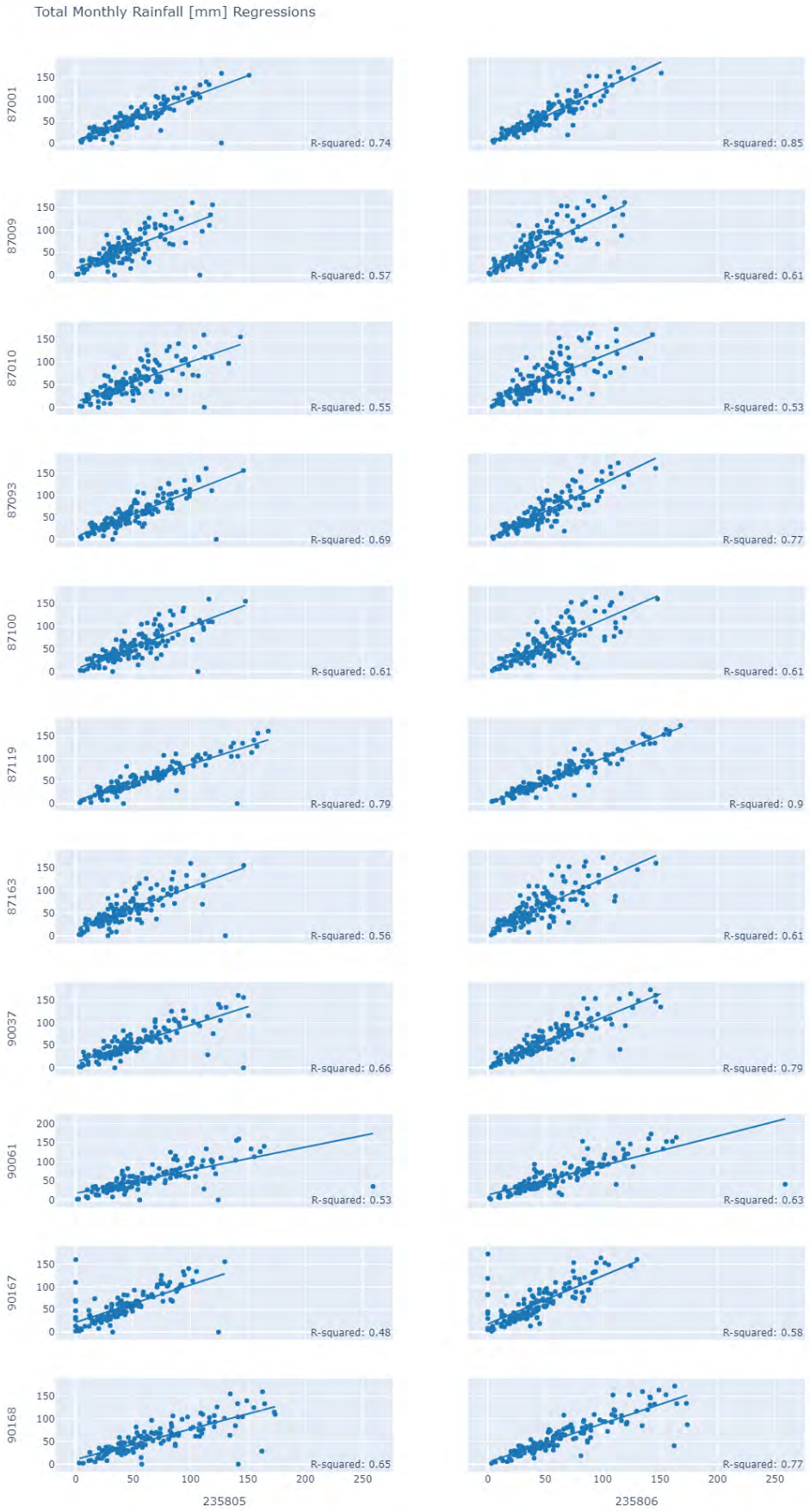
Appendices

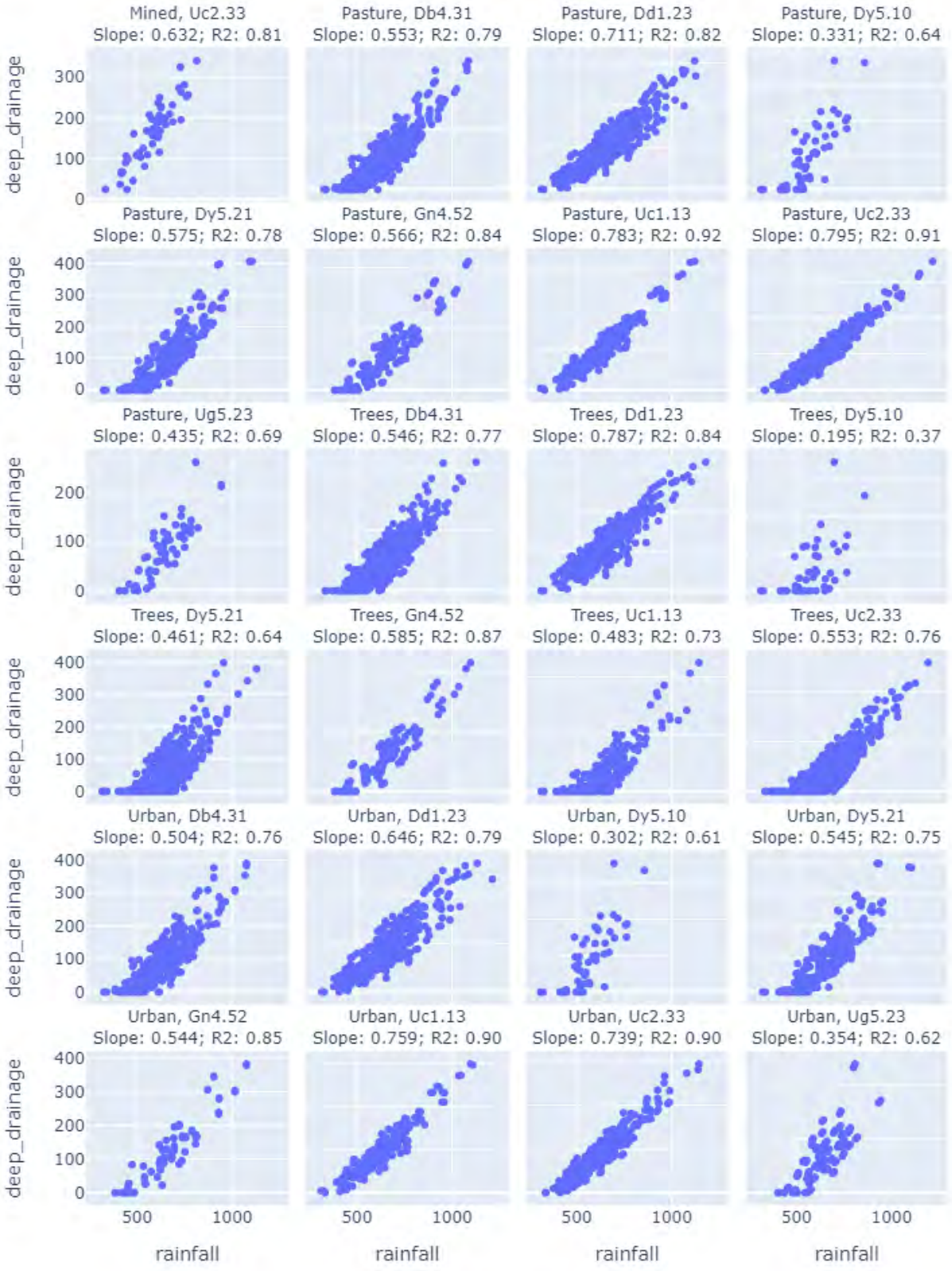
Appendix A

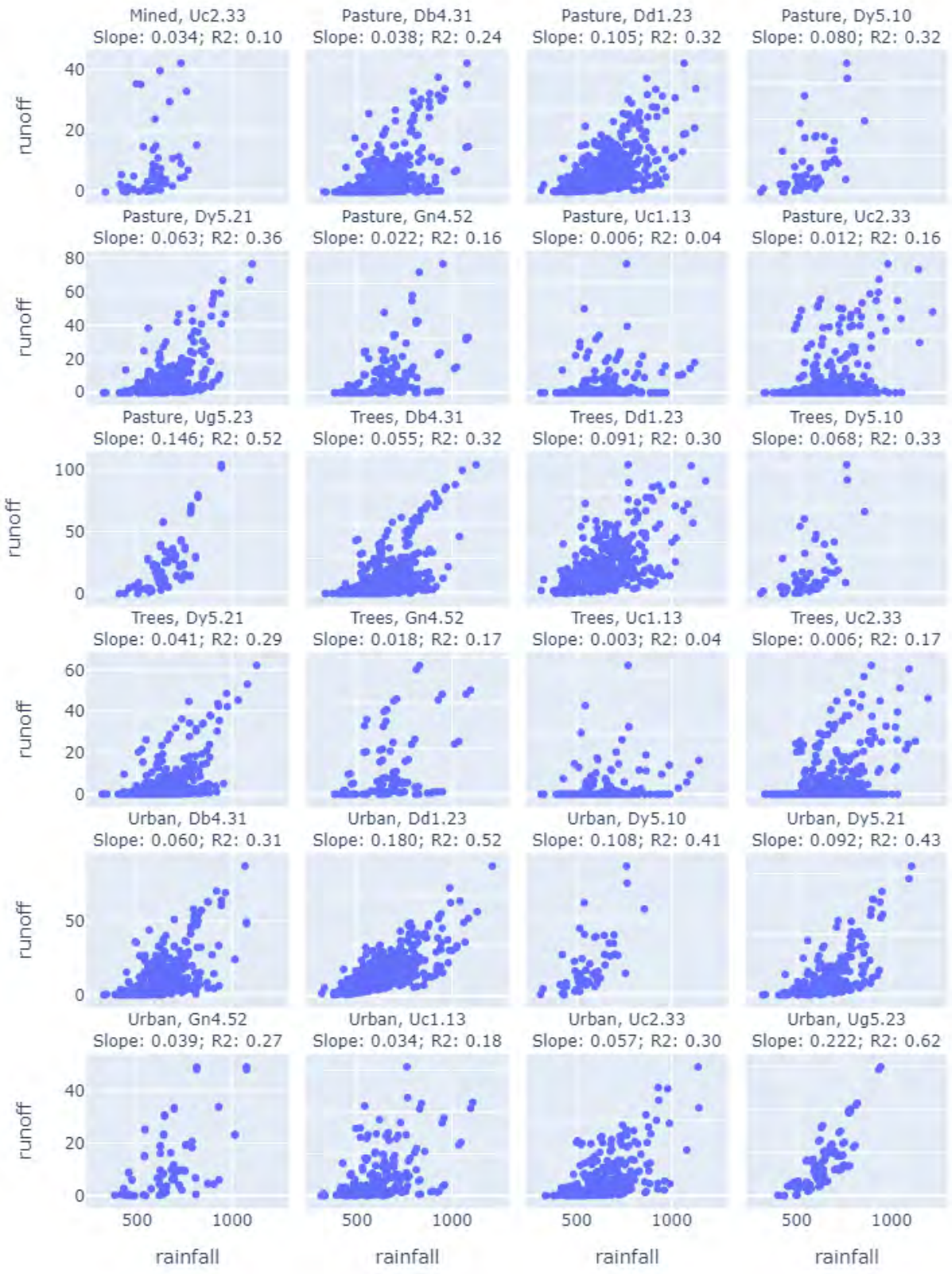
PERFECT Model Preparations

A-1 Rainfall Data Regressions



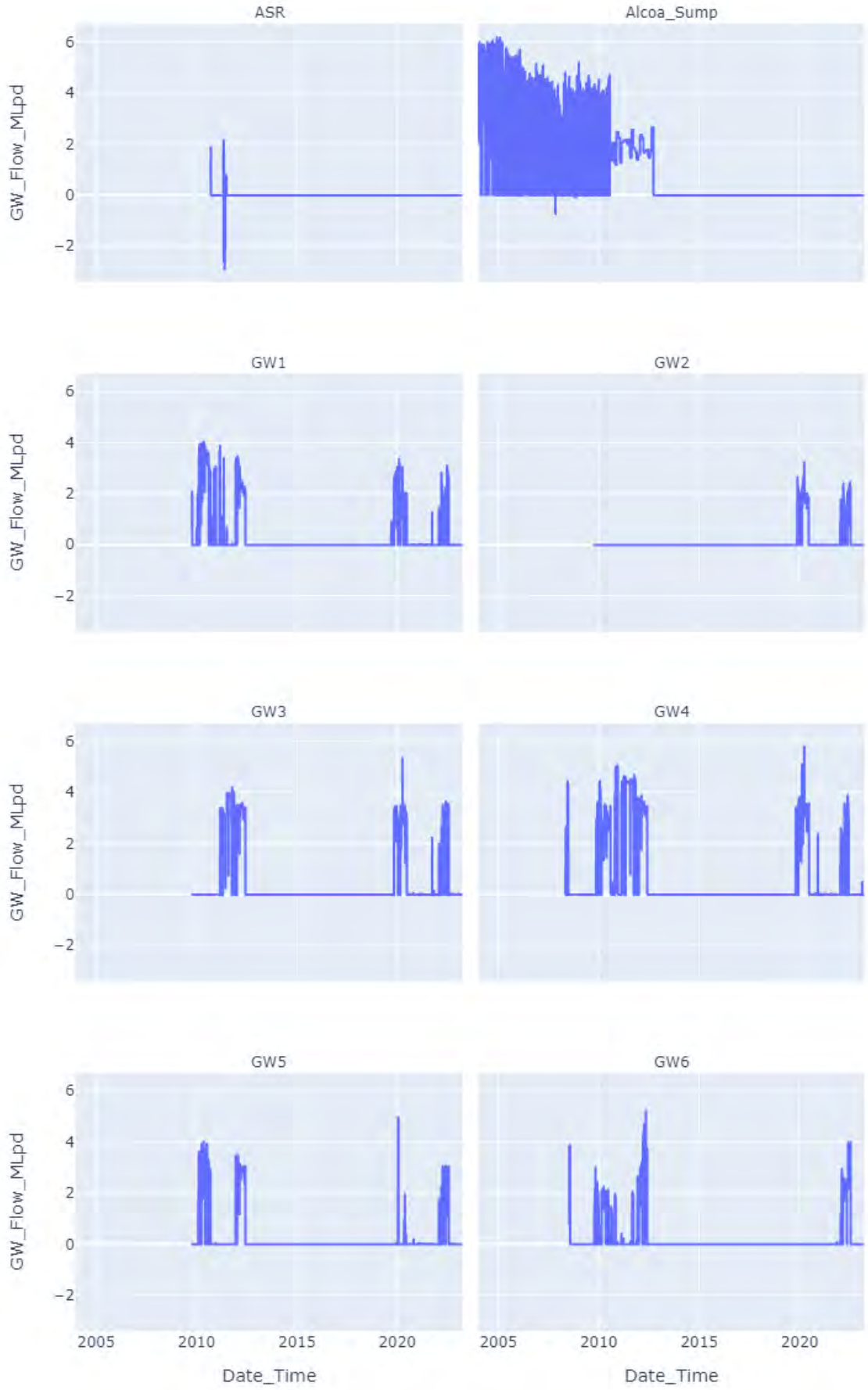
A-2 Modelled Rainfall vs Deep Drainage and Runoff Regressions

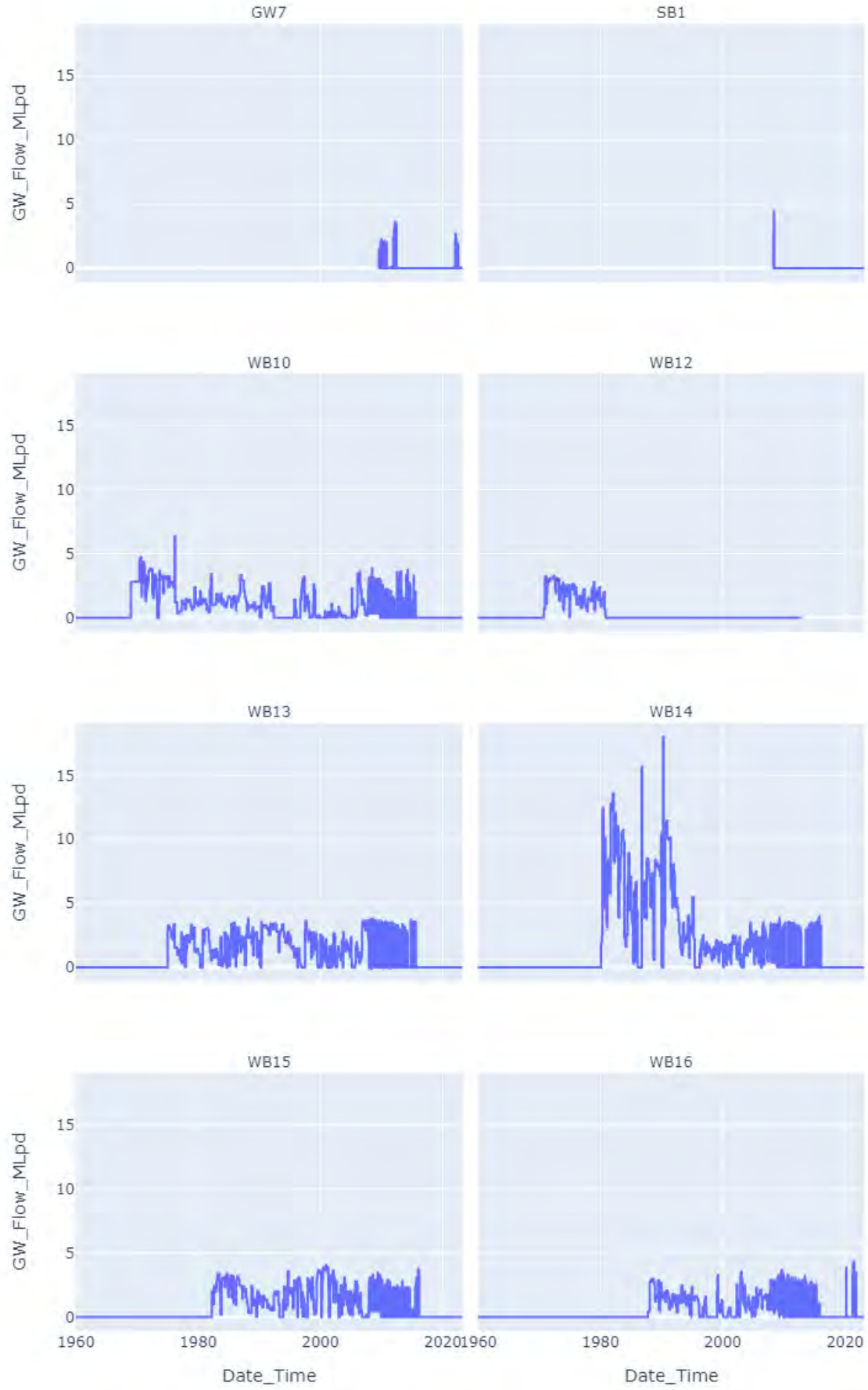


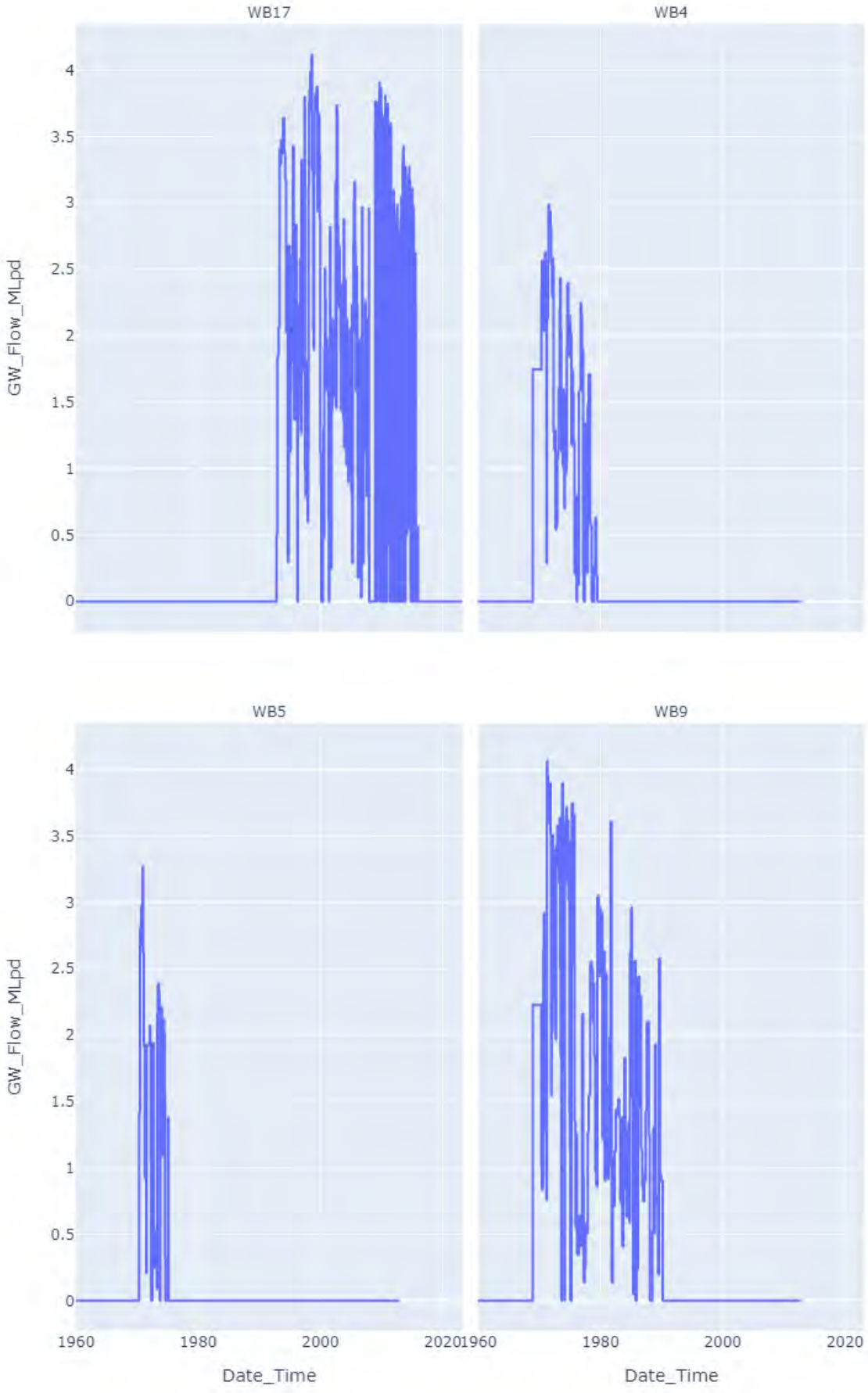

Mined, Uc2.33
Slope: 0.034; R2: 0.10
Pasture, Db4.31
Slope: 0.038; R2: 0.24
Pasture, Dd1.23
Slope: 0.105; R2: 0.32
Pasture, Dy5.10
Slope: 0.080; R2: 0.32
Pasture, Dy5.21
Slope: 0.063; R2: 0.36
Pasture, Gn4.52
Slope: 0.022; R2: 0.16
Pasture, Uc1.13
Slope: 0.006; R2: 0.04
Pasture, Uc2.33
Slope: 0.012; R2: 0.16
Pasture, Ug5.23
Slope: 0.146; R2: 0.52
Trees, Db4.31
Slope: 0.055; R2: 0.32
Trees, Dd1.23
Slope: 0.091; R2: 0.30
Trees, Dy5.10
Slope: 0.068; R2: 0.33
Trees, Dy5.21
Slope: 0.041; R2: 0.29
Trees, Gn4.52
Slope: 0.018; R2: 0.17
Trees, Uc1.13
Slope: 0.003; R2: 0.04
Trees, Uc2.33
Slope: 0.006; R2: 0.17
Urban, Db4.31
Slope: 0.060; R2: 0.31
Urban, Dd1.23
Slope: 0.180; R2: 0.52
Urban, Dy5.10
Slope: 0.108; R2: 0.41
Urban, Dy5.21
Slope: 0.092; R2: 0.43
Urban, Gn4.52
Slope: 0.039; R2: 0.27
Urban, Uc1.13
Slope: 0.034; R2: 0.18
Urban, Uc2.33
Slope: 0.057; R2: 0.30
Urban, Ug5.23
Slope: 0.222; R2: 0.62
runoff
rainfall
0
20
40
50
60
80
100
500
1000

Appendix B

Historical Groundwater Use Data


ASR
Alcoa_Sump
GW1
GW2
GW3
GW4
GW5
GW6
GW_Flow_MLpd
6
4
2
0
−2
2005
2010
2015
2020
Date_Time


GW7
SB1
WB10
WB12
WB13
WB14
WB15
WB16
GW_Flow_MLpd
0
5
10
15
1960
1980
2000
2020
Date_Time


WB17
WB4
WB5
WB9
GW_Flow_MLpd
Date_Time
0
0.5
1
1.5
2
2.5
3
3.5
4
1960
1980
2000
2020

Appendix C

Groundwater Monitoring Network Details

ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
113002	30-Aug-93	06-May-08	2	LEVF					43	64	105.8		
113003	06-May-08	06-May-08	1	LEVF					60	85	95.9		
113004	30-Aug-93	02-Mar-22	5464	LEVF	244592.08	5753480.12	180.267	179.487	51	57	100.6		
113470	30-Aug-93	02-Mar-22	3018	LEVF	246772.37	5748506.84	202.879	201.923	192	195	206.6		
115867	17-May-93	02-Mar-22	6894	LEVF	251007.73	5746727.58	22.697	21.632	359	362	495.7		
115868	30-Aug-93	02-Mar-22	4847	UEVF	249963.71	5744912.46	83.165	82.229	178	184	245.4		
115869	01-Jul-93	03-Mar-22	3309	UEVF	259256.45	5749686.27	105.374	104.539	127	130	167.2		
115873	30-Aug-93	22-Jun-09	148	LEVF	252434.45	5752146.74	113.565	112.468	330.3	333.4	360		
116458	04-Oct-93	03-Mar-22	5028	UEVF	252433.32	5752147.19	113.372	112.546	100	112	116		
116459	26-Nov-93	02-Mar-22	4802	UEVF	250981.91	5746636.91	18.913	17.938	243	246	253		
116460	01-Mar-94	02-Mar-22	3295	LEVF	246175.72	5744537.26	218.129	217.531	174	180	304		
119347	10-Jan-94	03-Mar-22	5278	LEVF	249491.4	5751498.64	84.804	83.999	197	200	226		
119348	01-Mar-94	02-Dec-21	4838	LEVF	257074.03	5752452.24	50.982	50.097	277	280	322		
119349	01-Mar-94	24-Sep-18	4859	UEVF	255327.75	5745520.79	22.288	21.503	183	186	343		
121768	23-Jun-94	02-Dec-21	4718	UEVF	255864.24	5749398.15	113.72	112.9	100.7	108	120		
122149	13-Oct-09	10-Apr-16	4568	LEVF	250970.45	5746639.2	19.356	18.24	349	352	400		
ASR_OB1	05-May-11	07-Jul-11	1509	UEVF	251120.67	5754052.27	116.03	115.12					
ASR_OB2	05-May-11	05-Jul-11	21398	UEVF	252146.56	5755080.46	107.27	106.47					
ASR_OB3	05-May-11	07-Jul-11	1510	UEVF	253001.27	5753792.64	81.13	80.25					
ASR_OB4	05-May-11	07-Jul-11	9059	UEVF	254950.02	5754512.36	103.73	102.84					
ASR_OB5	05-May-11	07-Jul-11	9057	UEVF	254898.75	5753535.45	96.4	95.49					
ASR_OB6	05-May-11	07-Jul-11	23118	UEVF	253424.72	5755250.48	98.61	97.67					
ASR_OB7	05-May-11	01-Jul-11	46224	UEVF	252127.56	5755155.36	106.93	105.81					
ASR_OB8	05-May-11	05-Jul-11	23531	UEVF	251940.06	5755176.95	110.64	109.82					
ASR_OB9	05-May-11	05-Jul-11	34712	UEVF	252476.45	5754769.3	104.17	103.41					
DBG MB6	10-Dec-20	23-Feb-22	10361	Mine Overburden	252277.41	5746760.96	11.92	11.29	34	37		38	
GW1	23-Dec-09	28-Feb-22	13931	LEVF	252658.62	5745937.96	53.42	52.07	510.5	513.5	667	666	
GW2	03-Jul-13	28-Feb-22	3163	LEVF	251840.48	5744690.68	121.37	119.75	538	544.5	707	671.82	
GW3	04-Mar-11	28-Feb-22	4012	LEVF	253462.46	5745995.848	42.045	40.7	426	427.5	667	596.1	

ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
GW4	29-Oct-09	28-Feb-22	14838	LEVF	254271.041	5746465.439	4.81	3.57	288	289.5	498	468.1	
GW5	05-Feb-10	28-Feb-22	18389	LEVF	250880.042	5745680.549	46.477	45.187	386	388	645	589.1	
GW6	10-Oct-09	28-Feb-22	15752	LEVF	254480.35	5751261.402	104.181	102.874	192.5	194	322.5	264.39	
GW7	12-Jan-10	28-Feb-22	13513	LEVF	252767.77	5752088.78	111.263	109.96	237.5	243	328.5	317.4	
H756 (VWP1)	01-Oct-96	01-Feb-11	155										VWP
H756 (VWP2)	01-Oct-96	01-Feb-11	155										VWP
H762 (VWP3)	01-Jul-99	01-Sep-14	126	DBF	252369.206	5745847.176	62.29		47	47	117		VWP
H764 (VWP4)	01-Jun-99	01-Sep-14	127	DBF	252197.677	5745755.514	60.5		29	29	108		VWP
H764 (VWP5)	01-Jun-99	01-Sep-14	127	DBF	252197.677	5745755.514	60.5		34	34	108		VWP
M274	31-Dec-68	31-Dec-68	1	UEVF	254508.7806	5746857.722							
MW10	01-Nov-06	19-Oct-20	13	DBF	253862.939	5747249.269	10.729	10.71	1.8	5.5		5.6	Power station monitoring bore
MW11	01-Nov-06	19-Oct-20	14	DBF	253849.133	5747239.297	11.102	10.96	1.5	4.5		5.47	Power station monitoring bore
MW14	01-Nov-06	19-Oct-20	13	DBF	253824.891	5747445.387	11.034	11.12	5	8		8	Power station monitoring bore
MW15	01-Nov-06	19-Oct-20	13	DBF	253933.052	5747307.539	10.889	11.06	7	10		9.66	Power station monitoring bore
MW16	01-Nov-06	04-Nov-19	12	DBF	253921.075	5747310.938	10.987	11.03	7	10		9.56	Power station monitoring bore
MW18	01-Nov-06	19-Oct-20	14	DBF	253809.989	5747345.33	11.704	10.93	6.3	10.8		10.9	Power station monitoring bore
MW19	01-Nov-12	01-Nov-18	4	Boonah Formation	253635.849	5747500.753	11.021	11.11	5.5	11.5		10.45	Power station monitoring bore
MW2	01-Nov-06	19-Oct-20	13	DBF	253942.795	5747344.458	10.688	10.77	2.5	7		7.4	Power station monitoring bore
MW20	01-Nov-06	19-Oct-20	14	Boonah Formation	253738.93	5747361.67	10.895	10.99	8	12		11.8	Power station monitoring bore
MW21	01-Nov-06	19-Oct-20	14	DBF	253918	5747266.91	11.305	11.36	8	12		11.8	Power station monitoring bore
MW22	01-Nov-06	19-Oct-20	13	DBF	253951.48	5747317.84	11.97	12.05	8	12		11.8	Power station monitoring bore

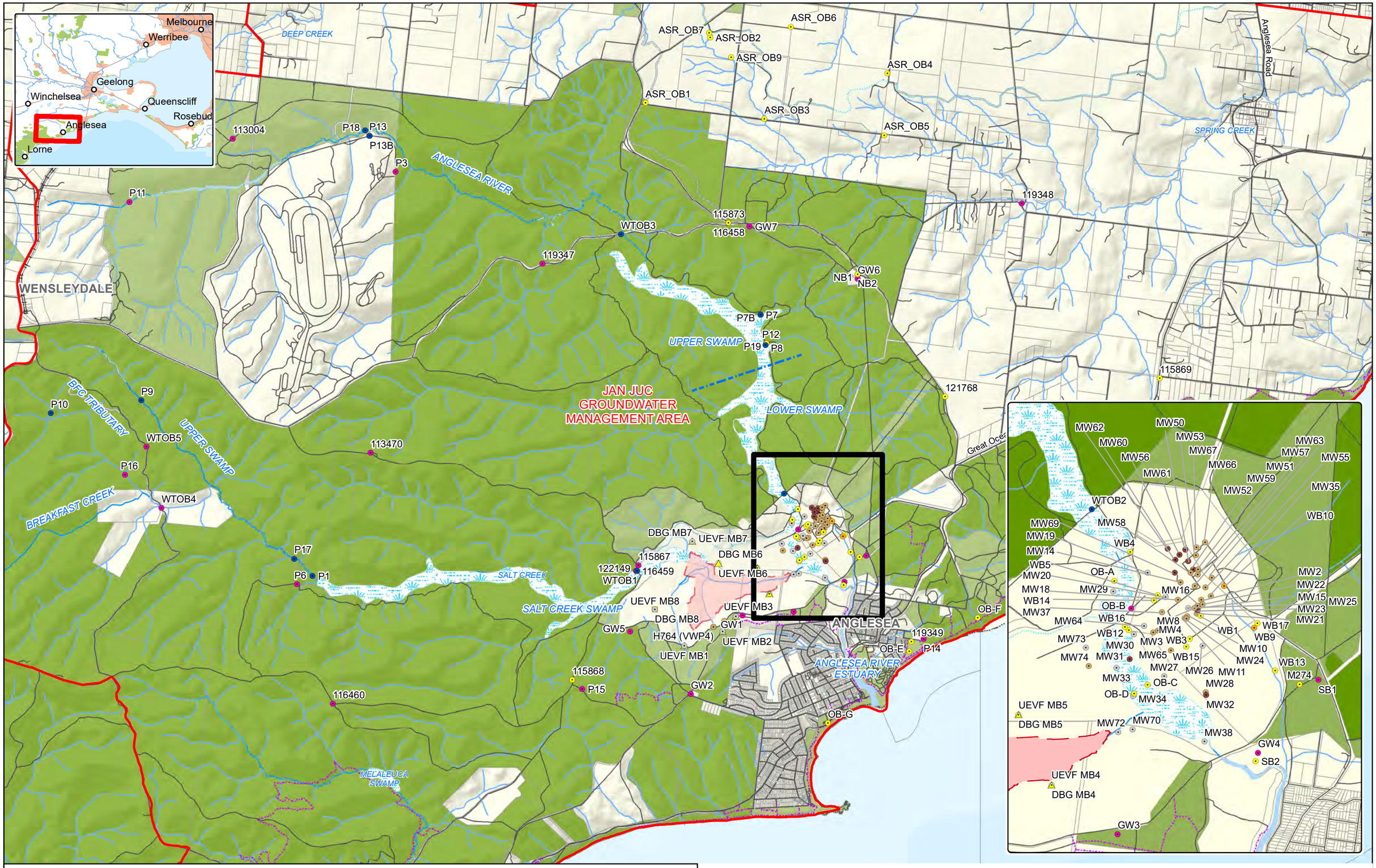
ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
MW23	01-Nov-06	19-Oct-20	14	DBF/BF	253924	5747284.5	11.057	11.11	8	12		11.43	Power station monitoring bore
MW24	01-Nov-06	01-Nov-18	12	DBF	253859	5747237.1	11.077	11	8	12		4.4	Power station monitoring bore
MW25	01-Nov-06	19-Oct-20	14	Boonah Formation	253869.7	5747298.8	11.151	11.26	8	11		10.93	Power station monitoring bore
MW26	01-Nov-06	19-Oct-20	13	Boonah Formation	253952	5747079.7	10.616	10.65	8.5	14.5		14	Power station monitoring bore
MW27	01-Nov-06	23-Feb-22	8123	Boonah Formation	253730.2	5746905.4	11.165	11.22	10	15		14.92	Power station monitoring bore
MW28	01-Nov-06	19-Oct-20	3	DBF	253969.7	5746813.4	10.912	11.05	1.2	7.2			Power station monitoring bore
MW29	01-Nov-06	23-Feb-22	7345	Boonah Formation	253437.8	5747391.8	8.99	9.13	6	12		11.9	Power station monitoring bore
MW3	01-Nov-06	19-Oct-20	14	DBF	253695.206	5747168.502	7.2	7.29	1.5	4		4.18	Power station monitoring bore
MW30	01-Nov-06	19-Oct-20	14	Boonah Formation	253555	5747146.4	9.021	9.08	7.4	13.4		12.72	Power station monitoring bore
MW31	01-Nov-06	19-Oct-20	14	DBF/BF	253531.4	5747003.9	6.367	6.37	6.7	9.7		9.66	Power station monitoring bore
MW32	01-Nov-06	18-Mar-21	2212	DBF/BF	253972.8	5746796.6	10.828	11.06	11	18		18.5	Power station monitoring bore
MW33	01-Nov-08	23-Feb-22	10395	Boonah Formation	253455.5	5746952.2	6.71	6.19	8	14		14.05	Power station monitoring bore
MW34	01-Nov-08	19-Oct-20	12	Boonah Formation	253551.7	5746791.7	12.799	12.21	14	20		20.41	Power station monitoring bore
MW35	24-Oct-16	01-Nov-18	2	DBF	253998.6	5747365.8	12.585	11.86	7	13		12.8	Power station monitoring bore
MW37	01-Nov-11	23-Feb-22	10366	DBF	253717.9	5747275.4	7.826	7.06	3	6		6.6	Power station monitoring bore
MW38	01-Nov-11	19-Oct-20	9	Boonah Formation	253962.4	5746530.2	6.759	5.95	7	15		15.68	Power station monitoring bore
MW4	01-Nov-06	19-Oct-20	12	DBF	253666.987	5747157.282	7.209	7.28	1	4		3.5	Power station monitoring bore
MW50	04-Nov-19	19-Oct-20	2	DBF/BF	253869.78	5747565.35	11.818	11.08	6.5	11.5		11.5	Power station monitoring bore
MW51	04-Nov-19	19-Oct-20	2	DBF	253923.06	5747489.25	11.472	10.78	2	5		5	Power station monitoring bore

ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
MW52	04-Nov-19	19-Oct-20	2	DBF/BF	253898.33	5747517.94	11.674	10.9	9.3	12.3		12.3	Power station monitoring bore
MW53	04-Nov-19	19-Oct-20	2	DBF	253913.63	5747601.38	11.608	10.92	3	7		7	Power station monitoring bore
MW55	04-Nov-19	19-Oct-20	2	DBF	253967.86	5747414.74	11.656	10.89	2	6		6	Power station monitoring bore
MW56	04-Nov-19	19-Oct-20	2	DBF/BF	253818.55	5747602.9	11.888	11.13	2	5		5	Power station monitoring bore
MW57	04-Nov-19	19-Oct-20	2	DBF	253906.46	5747423.24	10.244	10.34	2	4.5		4.5	Power station monitoring bore
MW58	04-Nov-19	19-Oct-20	2	DBF	253882.79	5747500.62	11.431	10.76	2	5		5	Power station monitoring bore
MW59	04-Nov-19	19-Oct-20	2	DBF	253925.15	5747520.49	11.639	10.84	2	8		8	Power station monitoring bore
MW60	04-Nov-19	19-Oct-20	2	DBF/BF	253750.8	5747638.9	11.265	11.52	8.2	12.2		12.2	Power station monitoring bore
MW61	19-Oct-20	19-Oct-20	1	DBF/BF	253852.88	5747631.75	11.811	11.89	8	12		12	Power station monitoring bore
MW62	04-Nov-19	19-Oct-20	2	DBF/BF	253795.3	5747574.29	9.619	8.85	6.1	10.1		10.1	Power station monitoring bore
MW63	04-Nov-19	19-Oct-20	2	DBF	254004.19	5747470.51	11.955	11.24	4	8		8	Power station monitoring bore
MW64	04-Nov-19	23-Feb-22	8924	Boonah Formation	253614.43	5747194.65	6.553	6.66	7	13		13	Power station monitoring bore
MW65	04-Nov-19	19-Oct-20	2	DBF	253768.57	5747052.39	12.377	11.57	4.2	7.2		7.2	Power station monitoring bore
MW66	04-Nov-19	19-Oct-20	2	DBF	253965.57	5747675.04	11.878	11.17	4	10		10	Power station monitoring bore
MW67	04-Nov-19	04-Nov-19	1	DBF	253916.63	5747646.06	11.57	10.87	2.3	7.3		7.3	Power station monitoring bore
MW69	04-Nov-19	19-Oct-20	2	DBF/BF	253790.76	5747500.15	9.736	9.02	8	10		10	Power station monitoring bore
MW70	19-Oct-20	19-Oct-20	1	Boonah Formation	253549.28	5746598.95	9.429	8.67	3	12		12	Power station monitoring bore
MW72	19-Oct-20	19-Oct-20	1	Boonah Formation	253466.45	5746583.32	10.431	9.69	8	20		20	Power station monitoring bore

ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
MW73	19-Oct-20	19-Oct-20	1	Boonah Formation	253279.346	5747068.928	7.696	7.03	10	16		16	Power station monitoring bore
MW74	19-Oct-20	19-Oct-20	1	DBF	253297.226	5746962.754	8.021	7.25	2.5	5.5		5.5	Power station monitoring bore
MW8	01-Nov-06	19-Oct-20	13	DBF	253904.842	5747298.923	11.595	11.67	7	10		10.57	Power station monitoring bore
NB1	24-Sep-09	03-Mar-22	2924	LEVF	254482.86	5751333.95	101.76	100.72	213.28	216.26	300	284	
NB2	24-Sep-09	03-Mar-22	3656	UEVF	254480.58	5751333.94	101.82	100.95	159	162	165	165	
OB-A	31-Dec-68	17-Mar-82	76	UEVF	253444	5747454	9.127				221		
OB-B	31-Dec-68	17-Mar-82	118	LEVF	253540	5747295	8.157				211.5		
OB-C	31-Dec-68	31-Dec-68	1	UEVF	253635	5746855	5.207				243.8		
OB-D	31-Dec-68	17-Mar-82	118	UEVF	253558	5746806	8.027				245.4		
OB-E	31-Dec-68	31-Dec-68	1	UEVF	255294	5745365	27.1				278.9		
OB-F	07-Jan-69	27-Apr-77	22	UEVF	256378	5745894	44.6				283.8		
OB-G	07-Jan-69	23-Nov-71	27	UEVF	254007	5744234	29.4				435.9		
P1	08-Oct-09	02-Mar-22	4958	ASA	245854.965	5746562.438	58.964	58.386	0.5	5.89	5.9	5.89	
P10	08-Oct-09	03-Mar-22	4743	ASA	241711.448	5749134.704	142.145	141.51	0.41	4.69	4.7	4.69	
P11	10-Oct-09	02-Mar-22	3172	LEVF	242958.25	5752478.91	133.44	133.19	0.3	2.77	2.77	2.77	
P12	23-Oct-09	02-Mar-22	5067	LEVF	253035.808	5750242.295	33.53	32.765	40	43	87	87	
P13	17-Oct-09	03-Mar-22	4673	LEVF	246753.243	5753527.553	95.326	94.841	36	39	128	128	
P13B	16-Oct-09	03-Mar-22	4630	ASA	246756.902	5753526.019	95.855	95.282	15	21	27	27	
P14	14-Jul-10	04-Mar-22	2985	LEVF	255524.01	5745565.61	26.765	26.253	394.1	396.1	570.3	504.3	
P15	19-Aug-10	02-Mar-22	2645	LEVF	250122.05	5744773.64	95.462	94.868	362.9	363.9	530	466.6	
P16	01-Jul-10	03-Mar-22	4232	LEVF	242887.549	5748160.578	97.385	96.695	0.3	2.86	3.5	2.86	
P17	01-Jul-10	02-Mar-22	4227	ASA	245564.57	5746833.99	61.61	60.96	0.3	5.37	5.4	5.37	
P18	04-Nov-09	03-Mar-22	4161	ASA	246686.751	5753613.629	79.469	78.854	0.25	5.35	5.35	5.35	
P19	23-Feb-11	02-Mar-22	4737	UEVF	253035.934	5750242.295	33.315	32.615	19	22	22	12	
P3	16-Oct-09	03-Mar-22	4630	LEVF	247168.423	5752954.848	111.649	111.1	25	31	150	142	
P6	16-Oct-09	02-Mar-22	4822	LEVF	245608.21	5746425.85	75.622	74.92	7	15	35	27	
P7	05-Nov-09	16-May-16	720	ASA	252943.04	5750691.45	31.978	31.064	0.25	4.22	5	4.22	
P7B	18-Oct-11	02-Mar-22	3792	ASA	252943.04	5750691.45	31.978	31.064	2	3.3	3.3	3.3	

ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
P8	29-Oct-09	02-Mar-22	5616	ASA	253020.594	5750213.956	29.017	28.142	0.5	2.73	3.62	3.62	
P9	08-Oct-09	03-Mar-22	4094	ASA	243141.28	5749338.22	111.29	110.5	0.3	5.23	5.5	5.23	
SB1	24-Sep-09	04-Mar-22	3464	LEVF	254617	5746883	11.012	10.538	266.06	268.06	460	382	
SB2	24-Sep-09	04-Mar-22	5413	UEVF	254256.74	5746415.37	3.93	3.49	223.5	226.5	229.5	229.5	
UEVF MB1	10-Dec-20	23-Feb-22	10402	UEVF (Upper Sands)	251737.19	5745457.26	47.38	46.84	92	98		100	
UEVF MB2	11-May-21	23-Feb-22	6218	UEVF (Upper Sands)	252342.02	5745681.11	60.69	60.12	122	128		130	
UEVF MB3	23-Apr-21	23-Feb-22	7319	UEVF (Upper Sands)	252550.24	5745921.9	56.59	56.38	139.3	145.3		146.3	
UEVF MB4	10-Dec-20	23-Feb-22	10404	UEVF (Upper Sands)	253081.748	5746278.973	20.296	19.76	71	77		79	
UEVF MB5	10-Dec-20	23-Feb-22	10379	UEVF (Upper Sands)	252891.1525	5746682.701	16.9495	16.32	59	65		66	
UEVF MB6	10-Dec-20	23-Feb-22	10400	UEVF (Upper Sands)	252278.4	5746761.66	11.93	11.29	69	75		77	
UEVF MB7	10-Dec-20	23-Feb-22	10397	UEVF (Upper Sands)	251862.3155	5747106.234	17.619	16.96	42	51.6		52.6	
UEVF MB8	11-May-21	23-Feb-22	6161	(UEVF Intermediate Coal)	251272.17	5746026.56	32.93	32.56	81	84		85	
WB1	31-Dec-68	31-Dec-68	1	UEVF	253940	5747252					193.9		
WB10	18-Mar-69	01-May-15	336	UEVF_LEVF	254075.744	5747425.151	11.098	11.098	109.1	112.1	215.79	212.8	
WB12	19-Aug-70	03-Mar-22	3312	UEVF	253527.02	5747169.98	6.45	6.03	147.2	157		238	
WB13	25-Dec-74	20-May-21	4015	UEVF	254368.034	5746937.23	5.137	5.142	165.05	168.25	362.71	234.4	
WB14	05-Dec-79	23-Feb-22	9629	UEVF	253671.333	5747342.693	9.858	9.86	155.9	158.9	223	218.8	
WB15	17-Mar-82	23-Feb-22	10637	UEVF	253857.081	5747075.261	11.938	11.938	186.8	190.8	250.5	247.5	
WB16	14-Oct-87	23-Feb-22	10348	UEVF	253504.105	5747187.52	7.117	7.12	173.7	177.8	237.5	226.4	
WB17	28-Oct-92	20-May-21	3905	UEVF	254267	5747210	7.817	7.82	120.8	123.8	267.5	195.9	
WB3	31-Dec-68	31-Dec-68	1	UEVF	253878	5747119	5.717				221.6		
WB4	12-Feb-69	03-Mar-22	9938	UEVF	253534.93	5747619.43	9.46	8.91	109.1	112.2	220.5	196	
WB5	12-Feb-69	30-Mar-17	2069	UEVF	253693.41	5747370.33	10.38	9.28	110.9	114	220.19	194.8	
WB9	27-May-69	21-May-18	2250	UEVF_LEVF	254248.13	5747185.25	6.36	6.16	126.2	129.2	268.2	266.4	
WTOB1	25-Sep-09	02-Mar-22	4676	ASA	250990.97	5746642.93	18.89	18.1	1.7	13.7		13.7	
WTOB2	24-Sep-09	03-Mar-22	4330	ASA	253313.93	5747866.07	11.05	10.18	1.6	6.6		6.6	

ID	Min Date	Max Date	Count	Monitoring Unit	E g94z55	N g94z55	Ref Elev mAHD	GL RL mAHD	Top Screen Depth [m]	Bottom Screen Depth [m]	Drill Depth [m]	Constr Depth [m]	Notes
WTOB3	24-Sep-09	03-Mar-22	4380	ASA	250732.73	5751967.15	42.29	41.47	7.4	13.4		13.4	
WTOB4	28-Sep-09	03-Mar-22	4542	LEVF	243462.74	5747636.8	89.37	88.45	1.1	7.1		7.1	
WTOB5	08-Oct-09	03-Mar-22	3864	LEVF	243224.74	5748605.17	159.32	158.44	38	68		72	
DBG MB1				Boonah Formation	251736.01	5745457.74	47.21	46.84	37	40	41		Dry
DBG MB2				Boonah Formation	252341.28	5745680.31	60.63	60.12	60	63	64		Dry
DBG MB3				Boonah Formation	252550.03	5745920.6	56.51	56.38	68.78	71.78	72.78		Dry
DBG MB4				Mine Overburden	253083.015	5746278.655	20.4	19.76	35	38	39		Dry
DBG MB5				Mine Overburden	252891.153	5746682.701	16.863	16.32	18	21	22		Dry
DBG MB7				Boonah Formation	251861.709	5747105.244	17.5395	16.96	8	11	12		Dry
DBG MB8				Boonah Formation	251271.43	5746025.66	32.96		28	31	32		Dry



Legend

- Mine Overburden
- ASA
- Boonah Formation
- DBF
- DBF/BF
- UEVF (Lower Sands)
- UEVF (Intermediate Coal)
- UEVF (Upper Sands)
- UEVF_LEVF
- LEVF
- Jan Juc GMA
- Alcoa Mine
- Arterial
- Collector
- Proposed
- Watercourse
- Lake
- Swamp
- River
- Stream
- Channel
- Drain/ Channel/ Other
- National Parks
- Other Parks

Paper Size ISO A3

0 0.5 1 1.5 2

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Barwon Water
Anglesea Groundwater Model Update

Groundwater monitoring network

Project No. 12542999
Revision No. 0
Date 09/01/2023

Appendix C
Figure 1

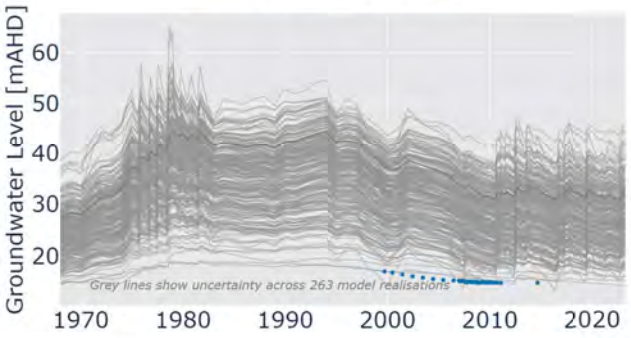
G:\31\12542999\GIS\Maps\Working\31_12542999_06_MonitoringNetwork_A3L_Rev0.mxd
Print date: 09 Jan 2023 - 11:08

Data source: : DELWP, VicMap, 2022; BW, bore locations, 2013; DELWP, Jan Juc GMA, 2017; EHS, Alcoa AOI, 2022; GHD, interpreted outcrop geology, 2012; GHD, syncline and anticline structures, 2007; GHD, groundwater monitoring locations, 2011; BW & Alcoa, bore locations, 2022; . Created by: bsmyth

Appendix D

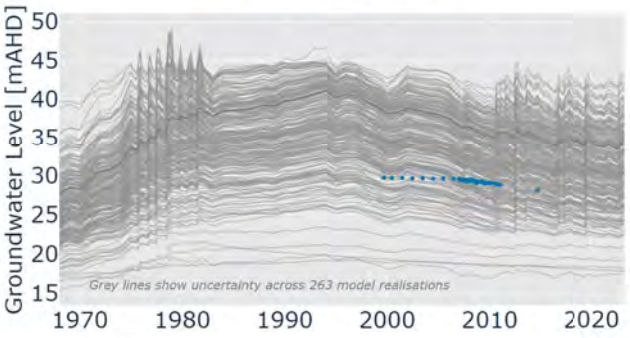
Model History Match Groundwater Level Hydrographs

H762 (VWP3) (DBF)



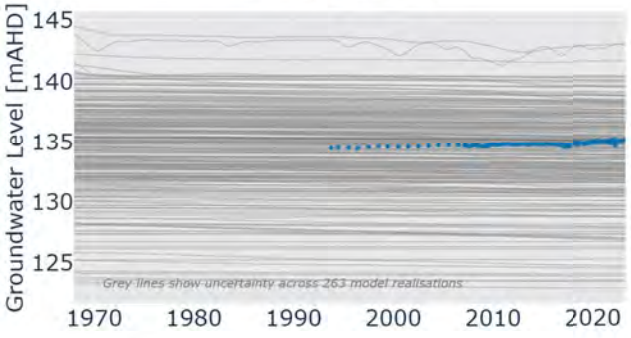
H762 (VWP3)
— DBF
Screen from/to: 47.0m : 47.0m] (modelled historical)
H762 (VWP3)
▪ DBF
Screen from/to: 47.0m : 47.0m] (observed historical)

H764 (VWP5) (DBF)



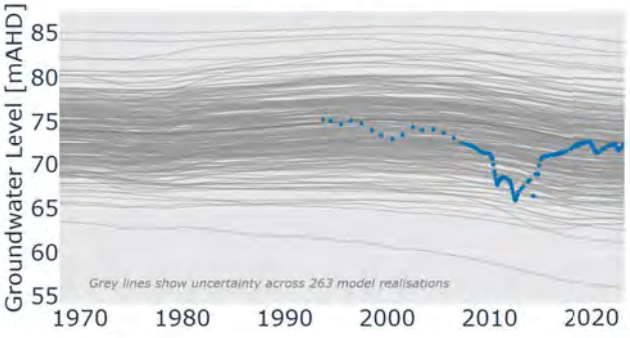
H764 (VWP5)
— DBF
Screen from/to: 34.0m : 34.0m] (modelled historical)
H764 (VWP5)
▪ DBF
Screen from/to: 34.0m : 34.0m] (observed historical)

113004 (LEVF)



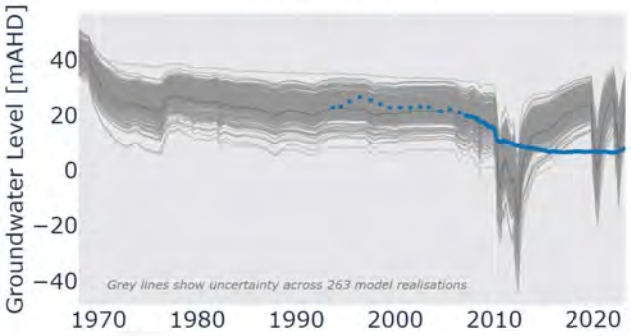
113004
— LEVF
Screen from/to: 51.0m : 57.0m] (modelled historical)
113004
▪ LEVF
Screen from/to: 51.0m : 57.0m] (observed historical)

113470 (LEVF)



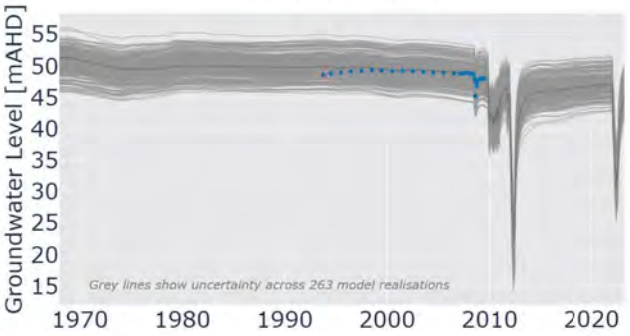
113470
— LEVF
Screen from/to: 192.0m : 195.0m] (modelled historical)
113470
▪ LEVF
Screen from/to: 192.0m : 195.0m] (observed historical)

115867 (LEVF)



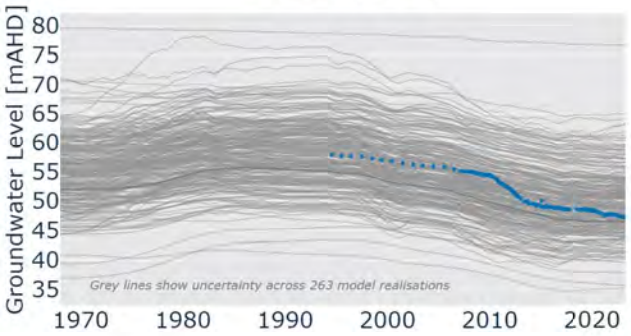
115867
— LEVF
Screen from/to: 359.0m : 362.0m] (modelled historical)
115867
▪ LEVF
Screen from/to: 359.0m : 362.0m] (observed historical)

115873 (LEVF)



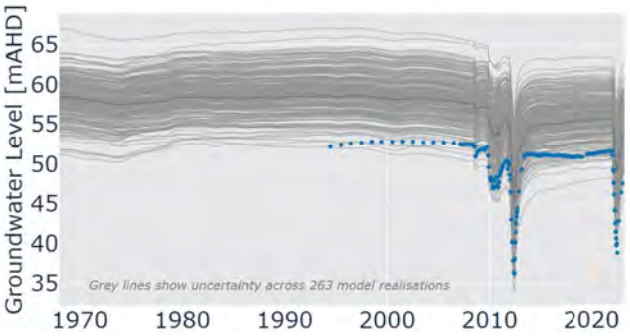
115873
— LEVF
Screen from/to: 330.3m : 333.4m] (modelled historical)
115873
▪ LEVF
Screen from/to: 330.3m : 333.4m] (observed historical)

116460 (LEVF)



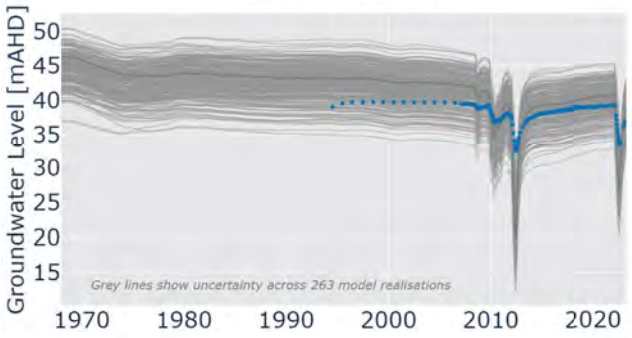
116460
— LEVF
Screen from/to: 174.0m : 180.0m] (modelled historical)
116460
▪ LEVF
Screen from/to: 174.0m : 180.0m] (observed historical)

119347 (LEVF)



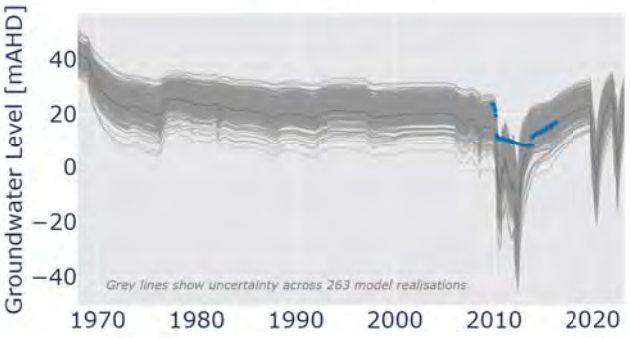
119347
— LEVF
Screen from/to: 197.0m : 200.0m] (modelled historical)
119347
▪ LEVF
Screen from/to: 197.0m : 200.0m] (observed historical)

119348 (LEVF)



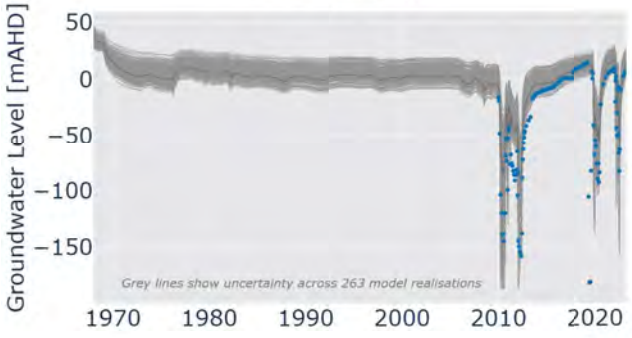
119348
— LEVF
Screen from/to: 277.0m : 280.0m] (modelled historical)
119348
• LEVF
Screen from/to: 277.0m : 280.0m] (observed historical)

122149 (LEVF)



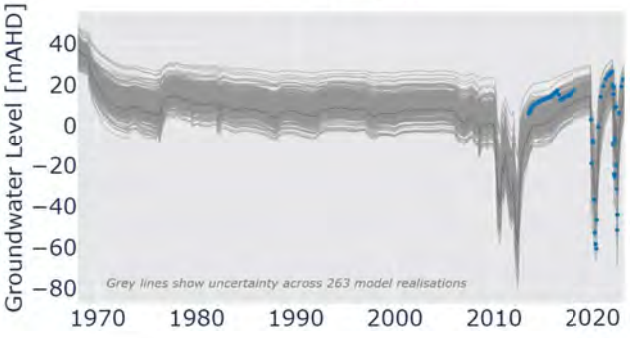
122149
— LEVF
Screen from/to: 349.0m : 352.0m] (modelled historical)
122149
• LEVF
Screen from/to: 349.0m : 352.0m] (observed historical)

GW1 (LEVF)



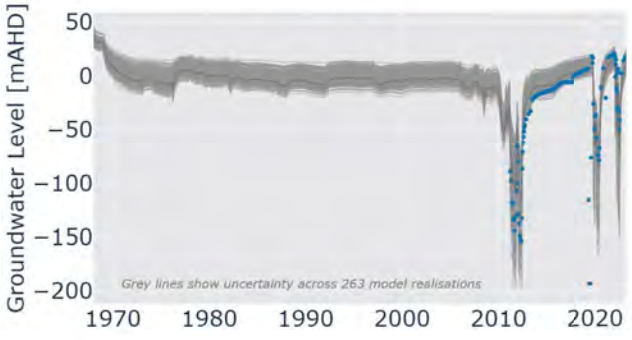
GW1
— LEVF
Screen from/to: 510.5m : 513.5m] (modelled historical)
GW1
• LEVF
Screen from/to: 510.5m : 513.5m] (observed historical)

GW2 (LEVF)



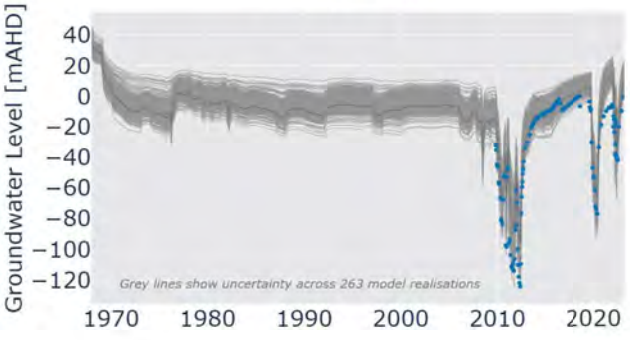
GW2
— LEVF
Screen from/to: 538.0m : 544.5m] (modelled historical)
GW2
• LEVF
Screen from/to: 538.0m : 544.5m] (observed historical)

GW3 (LEVF)



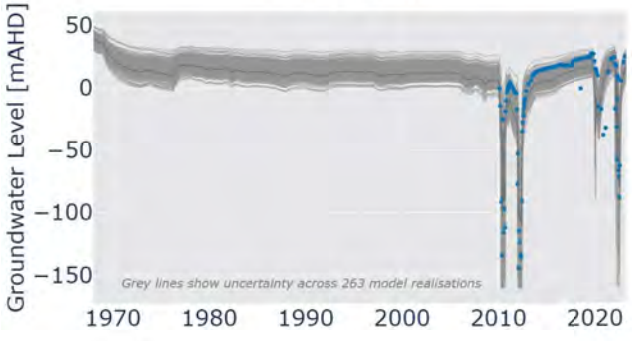
GW3
— LEVF
Screen from/to: 426.0m : 427.5m] (modelled historical)
GW3
• LEVF
Screen from/to: 426.0m : 427.5m] (observed historical)

GW4 (LEVF)



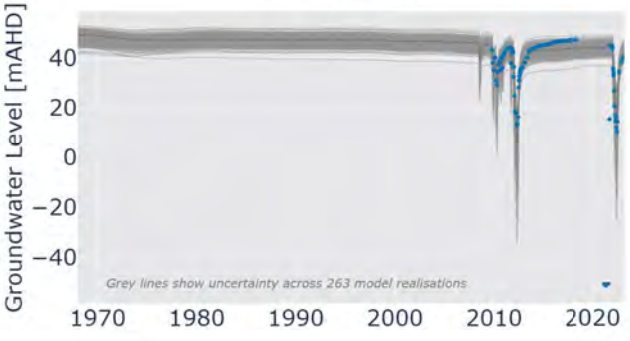
GW4
— LEVF
Screen from/to: 288.0m : 289.5m] (modelled historical)
GW4
• LEVF
Screen from/to: 288.0m : 289.5m] (observed historical)

GW5 (LEVF)



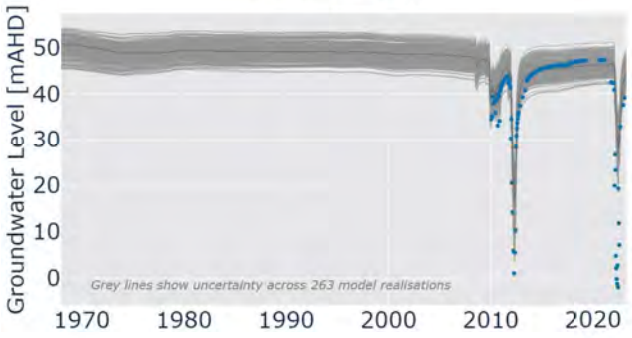
GW5
— LEVF
Screen from/to: 386.0m : 388.0m] (modelled historical)
GW5
• LEVF
Screen from/to: 386.0m : 388.0m] (observed historical)

GW6 (LEVF)



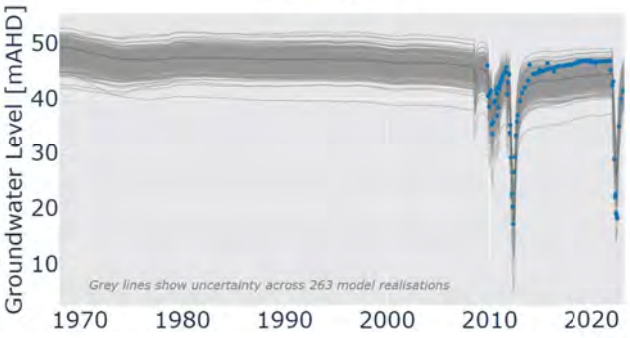
GW6
— LEVF
Screen from/to: 192.5m : 194.0m] (modelled historical)
GW6
• LEVF
Screen from/to: 192.5m : 194.0m] (observed historical)

GW7 (LEVF)



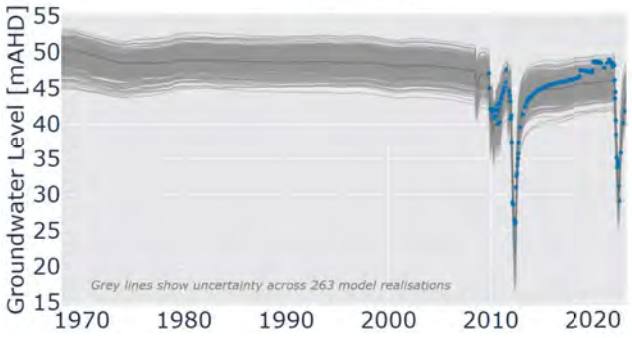
GW7
— LEVF
Screen from/to: 237.5m : 243.0m] (modelled historical)
GW7
▪ LEVF
Screen from/to: 237.5m : 243.0m] (observed historical)

NB1 (LEVF)



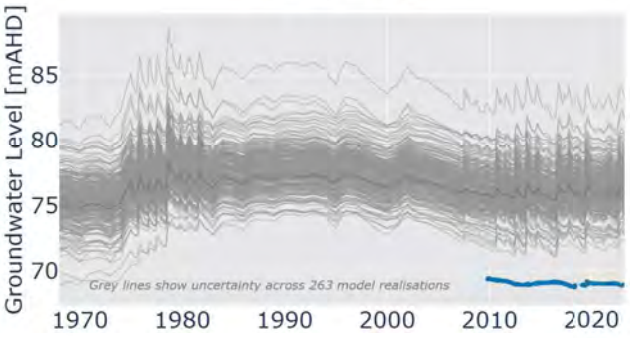
NB1
— LEVF
Screen from/to: 213.3m : 216.3m] (modelled historical)
NB1
▪ LEVF
Screen from/to: 213.3m : 216.3m] (observed historical)

P12 (LEVF)



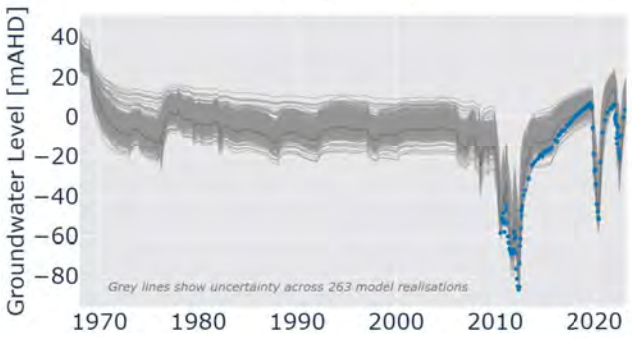
P12
— LEVF
Screen from/to: 40.0m : 43.0m] (modelled historical)
P12
▪ LEVF
Screen from/to: 40.0m : 43.0m] (observed historical)

P13 (LEVF)



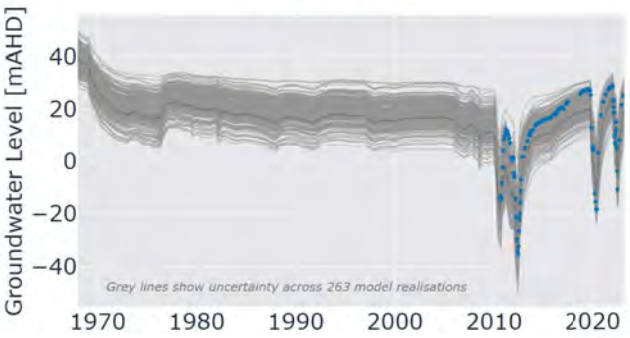
P13
— LEVF
Screen from/to: 36.0m : 39.0m] (modelled historical)
P13
▪ LEVF
Screen from/to: 36.0m : 39.0m] (observed historical)

P14 (LEVF)



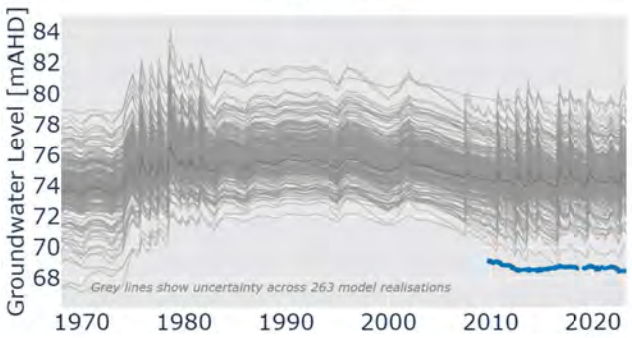
P14
— LEVF
Screen from/to: 394.1m : 396.1m] (modelled historical)
P14
▪ LEVF
Screen from/to: 394.1m : 396.1m] (observed historical)

P15 (LEVF)



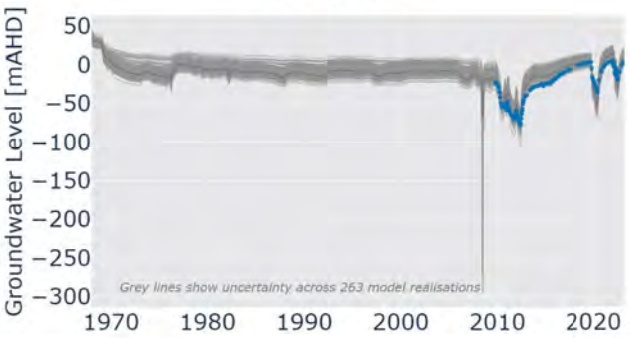
P15
— LEVF
Screen from/to: 362.9m : 363.9m] (modelled historical)
P15
▪ LEVF
Screen from/to: 362.9m : 363.9m] (observed historical)

P3 (LEVF)



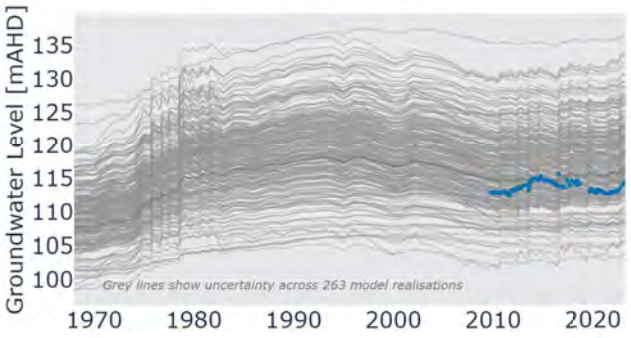
P3
— LEVF
Screen from/to: 25.0m : 31.0m] (modelled historical)
P3
▪ LEVF
Screen from/to: 25.0m : 31.0m] (observed historical)

SB1 (LEVF)



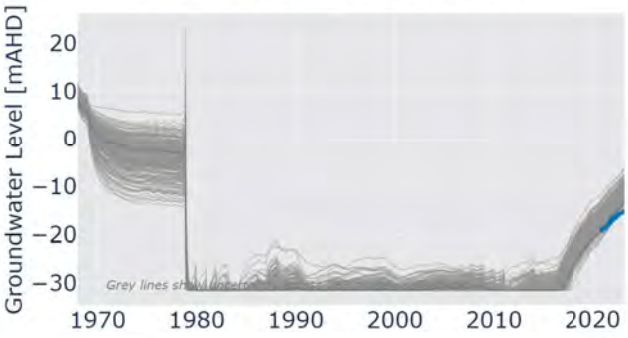
SB1
— LEVF
Screen from/to: 266.1m : 268.1m] (modelled historical)
SB1
▪ LEVF
Screen from/to: 266.1m : 268.1m] (observed historical)

WTOB5 (LEVF)



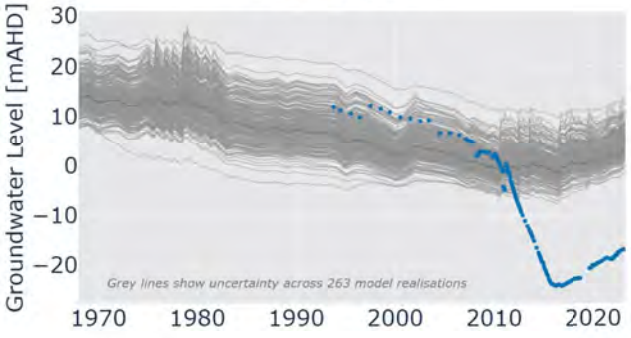
WTOB5
— LEVF
Screen from/to: 1.1m : 7.1m] (modelled historical)
WTOB5
▪ LEVF
Screen from/to: 1.1m : 7.1m] (observed historical)

DBG MB6 (Mine Overburden)



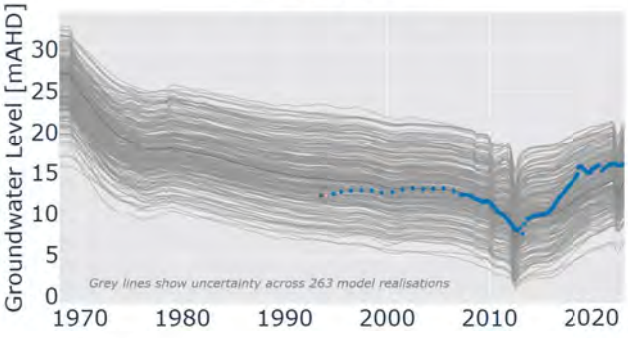
DBG MB6
— Mine Overburden
Screen from/to: 34.0m : 37.0m] (modelled historical)
DBG MB6
▪ Mine Overburden
Screen from/to: 34.0m : 37.0m] (observed historical)

115868 (UEVF)



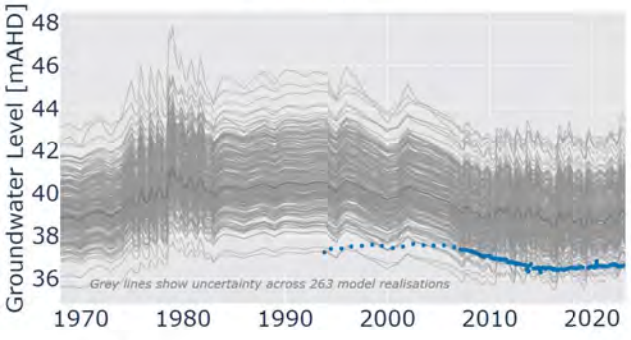
115868
— UEVF
Screen from/to: 178.0m : 184.0m] (modelled historical)
115868
▪ UEVF
Screen from/to: 178.0m : 184.0m] (observed historical)

115869 (UEVF)



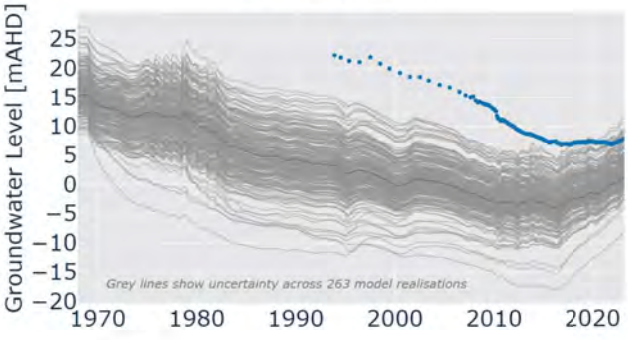
115869
— UEVF
Screen from/to: 127.0m : 130.0m] (modelled historical)
115869
▪ UEVF
Screen from/to: 127.0m : 130.0m] (observed historical)

116458 (UEVF)



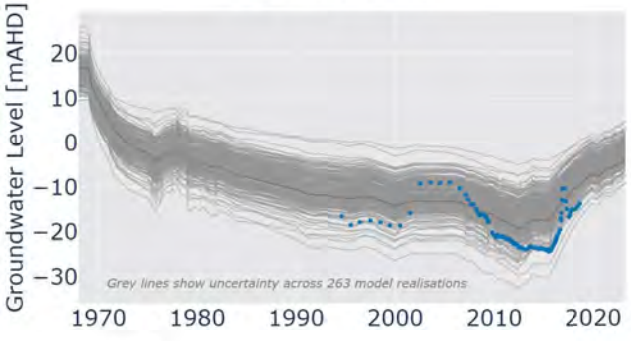
116458
— UEVF
Screen from/to: 100.0m : 112.0m] (modelled historical)
116458
▪ UEVF
Screen from/to: 100.0m : 112.0m] (observed historical)

116459 (UEVF)



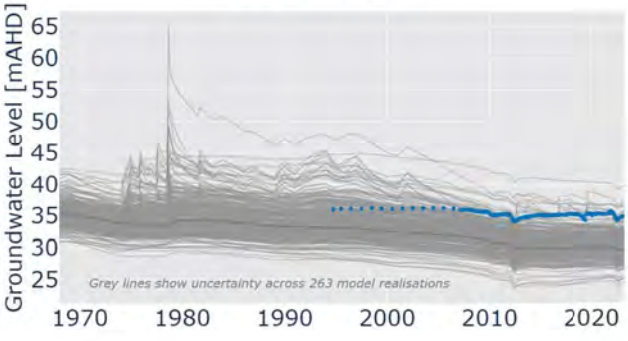
116459
— UEVF
Screen from/to: 243.0m : 246.0m] (modelled historical)
116459
▪ UEVF
Screen from/to: 243.0m : 246.0m] (observed historical)

119349 (UEVF)



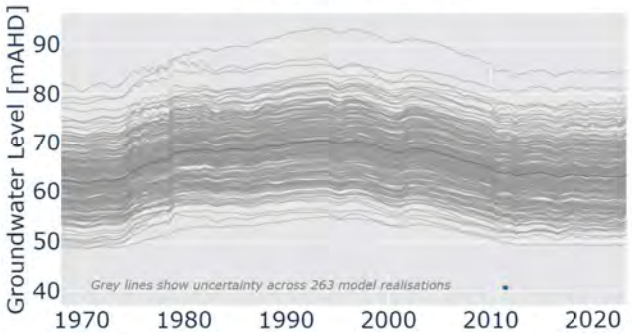
119349
— UEVF
Screen from/to: 183.0m : 186.0m] (modelled historical)
119349
▪ UEVF
Screen from/to: 183.0m : 186.0m] (observed historical)

121768 (UEVF)



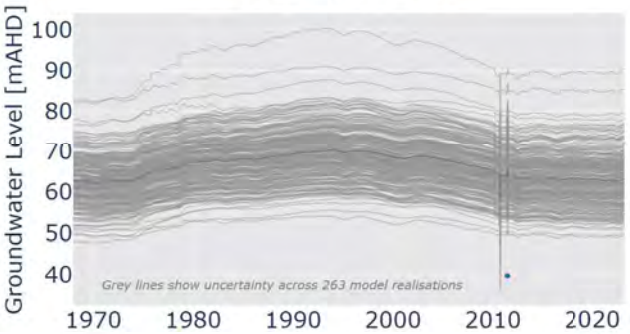
121768
— UEVF
Screen from/to: 100.7m : 108.0m] (modelled historical)
121768
▪ UEVF
Screen from/to: 100.7m : 108.0m] (observed historical)

ASR_OB1 (UEVF)



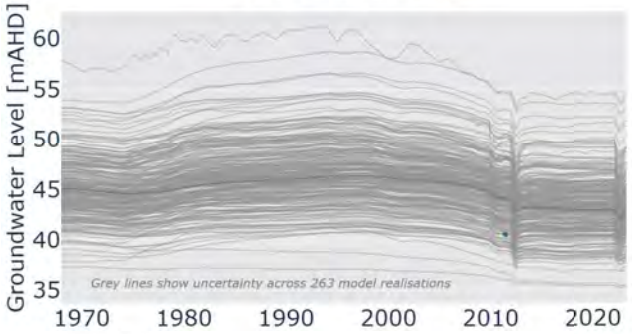
ASR_OB1
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB1
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB2 (UEVF)



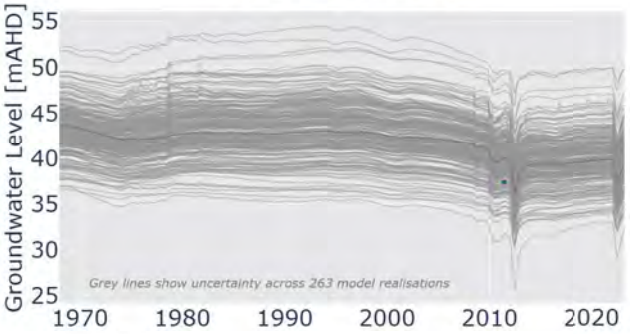
ASR_OB2
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB2
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB3 (UEVF)



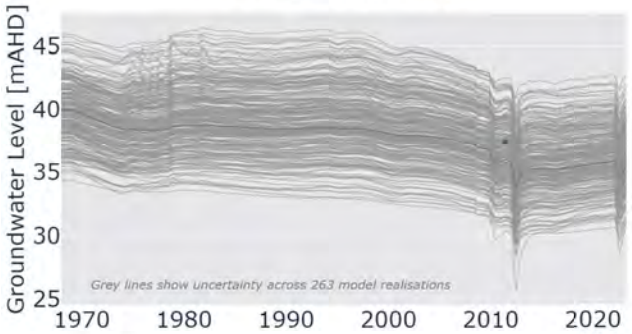
ASR_OB3
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB3
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB4 (UEVF)



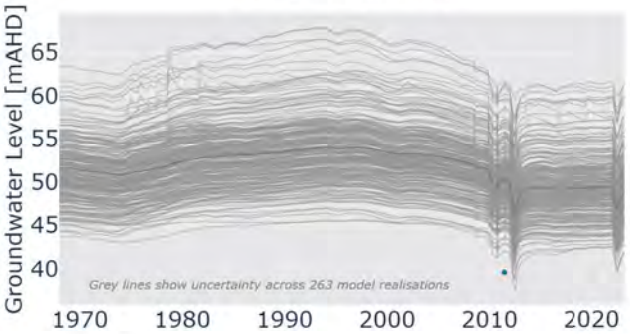
ASR_OB4
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB4
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB5 (UEVF)



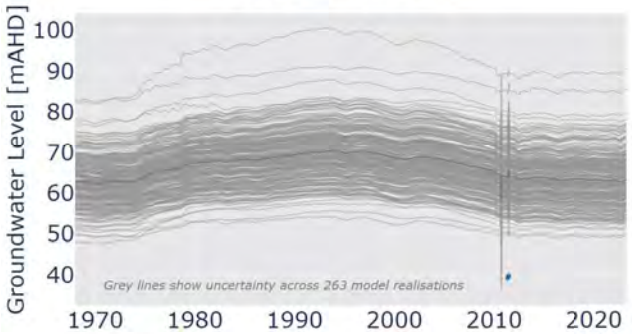
ASR_OB5
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB5
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB6 (UEVF)



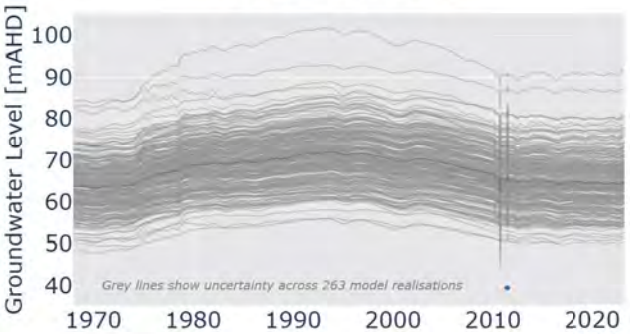
ASR_OB6
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB6
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB7 (UEVF)



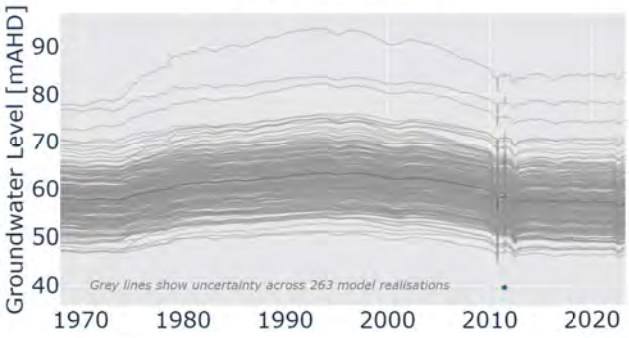
ASR_OB7
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB7
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB8 (UEVF)



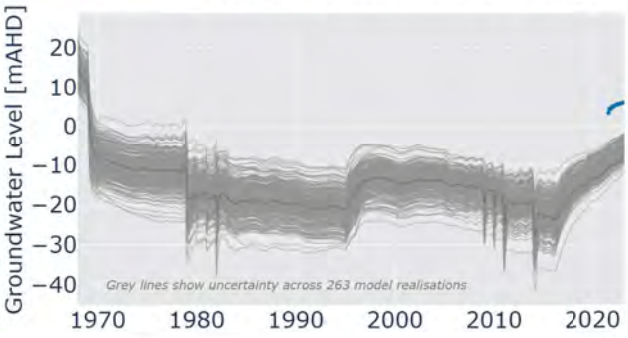
ASR_OB8
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB8
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

ASR_OB9 (UEVF)



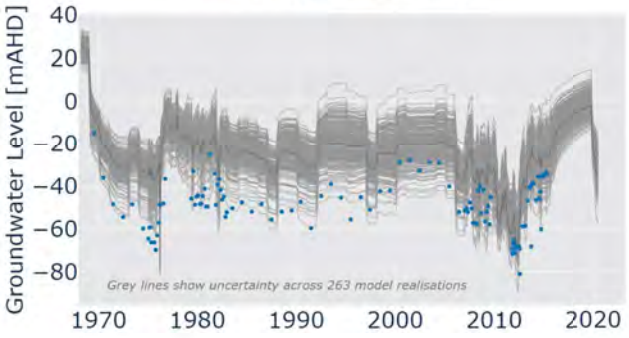
ASR_OB9
— UEVF
Screen from/to: n/a : n/a (modelled historical)
ASR_OB9
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

UEVF MB8 ((UEVF Intermediate Coal))



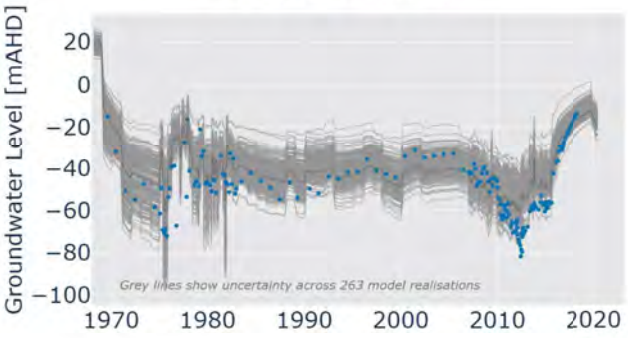
UEVF MB8
— (UEVF Intermediate Coal)
Screen from/to: 81.0m : 84.0m] (modelled historical)
UEVF MB8
▪ (UEVF Intermediate Coal)
Screen from/to: 81.0m : 84.0m] (observed historical)

WB10 (UEVF_LEVF)



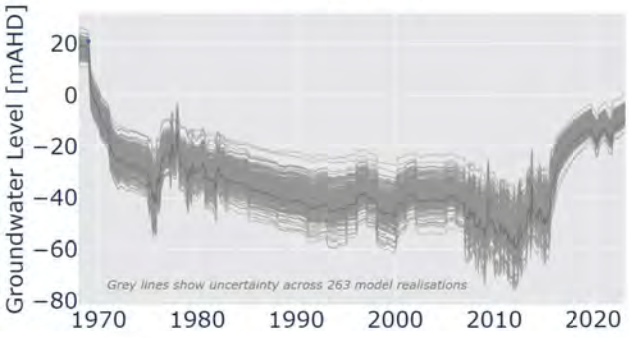
WB10
— UEVF_LEVF
Screen from/to: 109.1m : 112.1m] (modelled historical)
WB10
▪ UEVF_LEVF
Screen from/to: 109.1m : 112.1m] (observed historical)

WB9 (UEVF_LEVF)



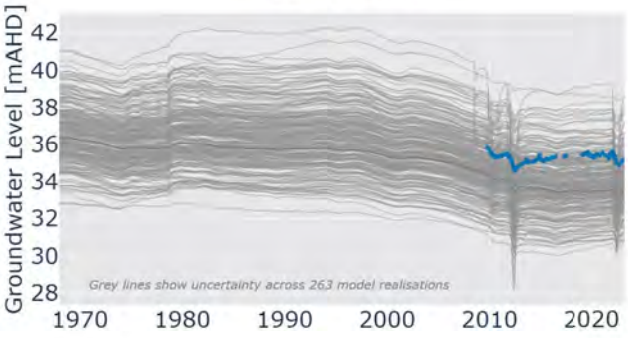
WB9
— UEVF_LEVF
Screen from/to: 126.2m : 129.2m] (modelled historical)
WB9
▪ UEVF_LEVF
Screen from/to: 126.2m : 129.2m] (observed historical)

M274 (UEVF)



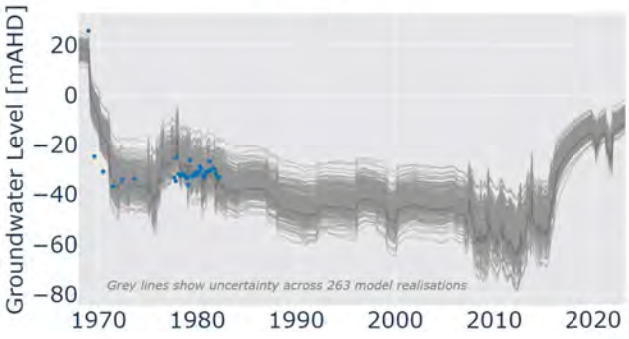
M274
— UEVF
Screen from/to: n/a : n/a (modelled historical)
M274
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

NB2 (UEVF)



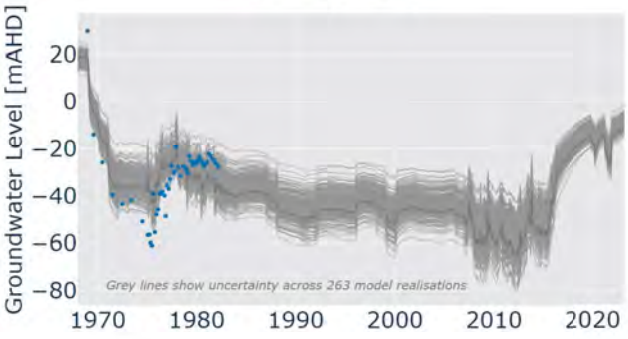
NB2
— UEVF
Screen from/to: 159.0m : 162.0m] (modelled historical)
NB2
▪ UEVF
Screen from/to: 159.0m : 162.0m] (observed historical)

OB-A (UEVF)



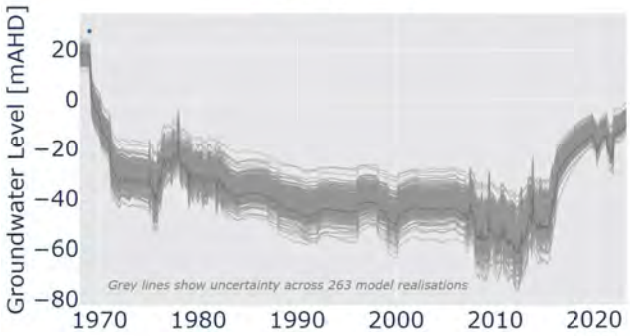
OB-A
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-A
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

OB-B (UEVF)



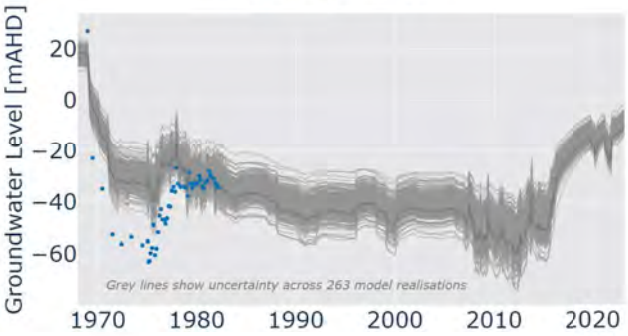
OB-B
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-B
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

OB-C (UEVF)



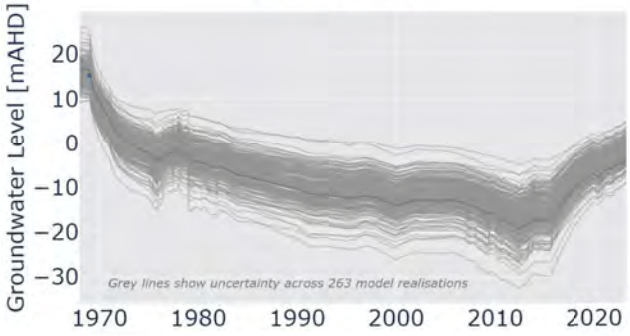
OB-C
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-C
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

OB-D (UEVF)



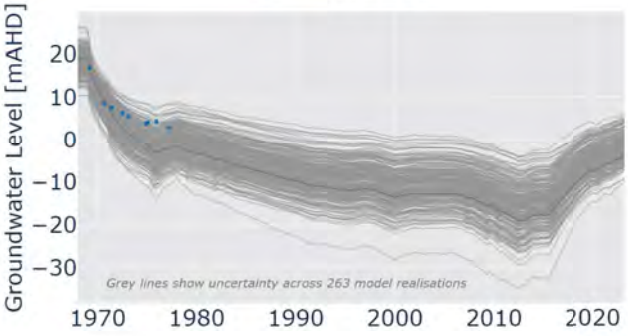
OB-D
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-D
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

OB-E (UEVF)



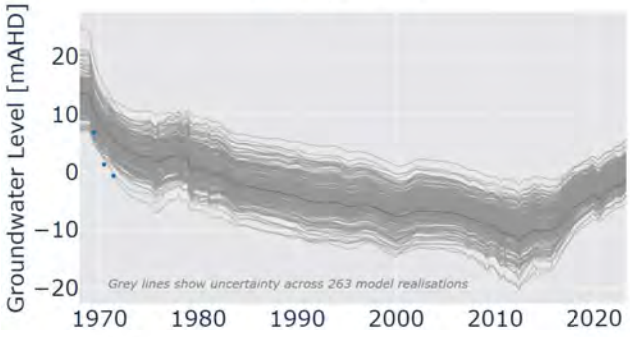
OB-E
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-E
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

OB-F (UEVF)



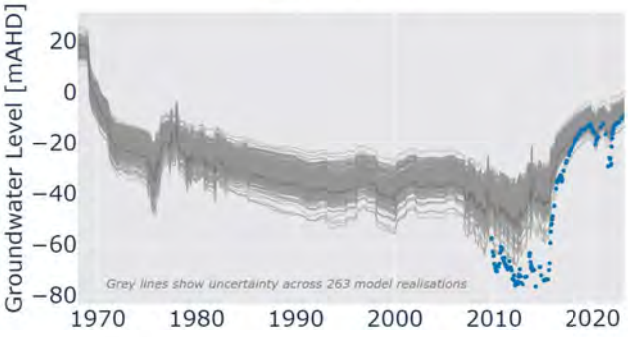
OB-F
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-F
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

OB-G (UEVF)



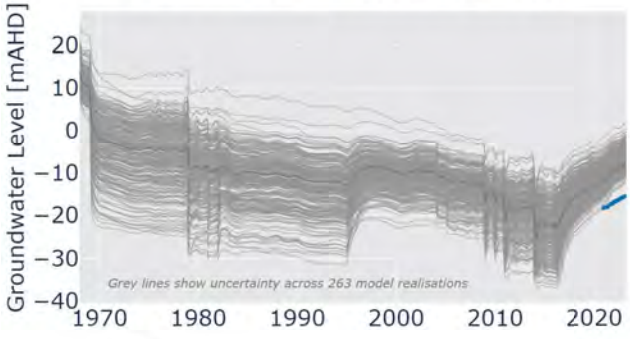
OB-G
— UEVF
Screen from/to: n/a : n/a (modelled historical)
OB-G
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

SB2 (UEVF)



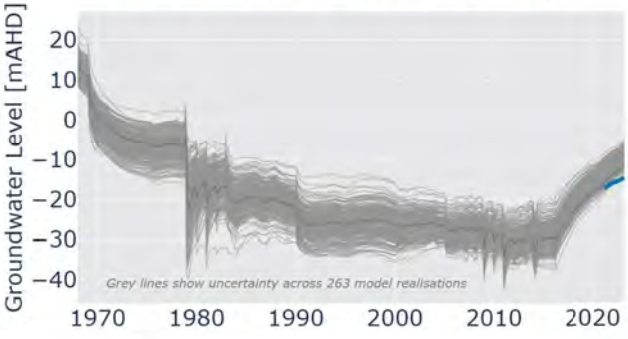
SB2
— UEVF
Screen from/to: 223.5m : 226.5m] (modelled historical)
SB2
▪ UEVF
Screen from/to: 223.5m : 226.5m] (observed historical)

UEVF MB1 (UEVF (Upper Sands))



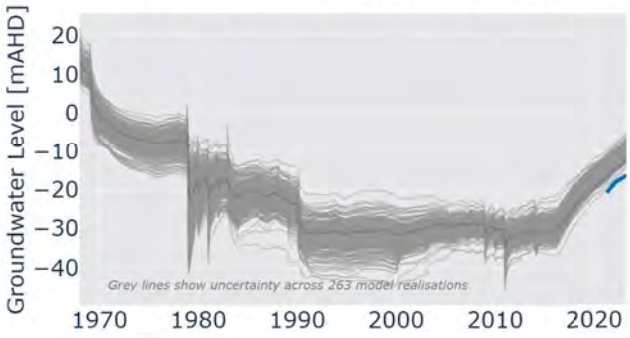
UEVF MB1
— UEVF (Upper Sands)
Screen from/to: 92.0m : 98.0m] (modelled historical)
UEVF MB1
▪ UEVF (Upper Sands)
Screen from/to: 92.0m : 98.0m] (observed historical)

UEVF MB2 (UEVF (Upper Sands))



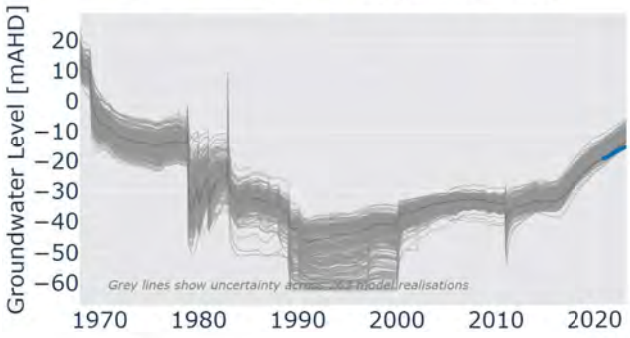
UEVF MB2
— UEVF (Upper Sands)
Screen from/to: 122.0m : 128.0m] (modelled historical)
UEVF MB2
▪ UEVF (Upper Sands)
Screen from/to: 122.0m : 128.0m] (observed historical)

UEVF MB3 (UEVF (Upper Sands))



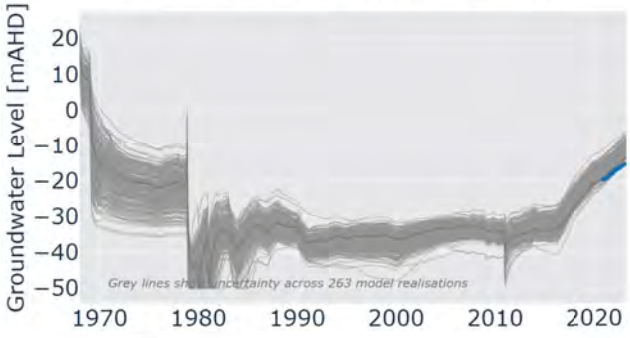
UEVF MB3
— UEVF (Upper Sands)
Screen from/to: 139.3m : 145.3m] (modelled historical)
UEVF MB3
▪ UEVF (Upper Sands)
Screen from/to: 139.3m : 145.3m] (observed historical)

UEVF MB4 (UEVF (Upper Sands))



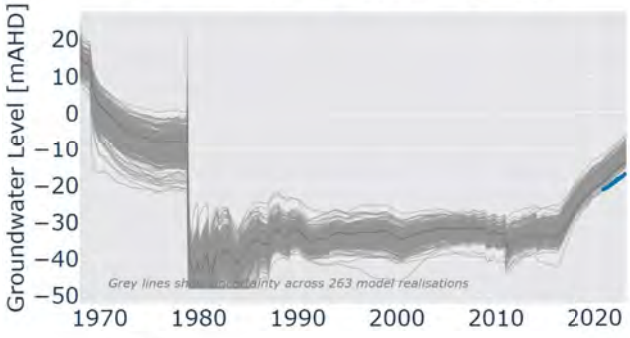
UEVF MB4
— UEVF (Upper Sands)
Screen from/to: 71.0m : 77.0m] (modelled historical)
UEVF MB4
▪ UEVF (Upper Sands)
Screen from/to: 71.0m : 77.0m] (observed historical)

UEVF MB5 (UEVF (Upper Sands))



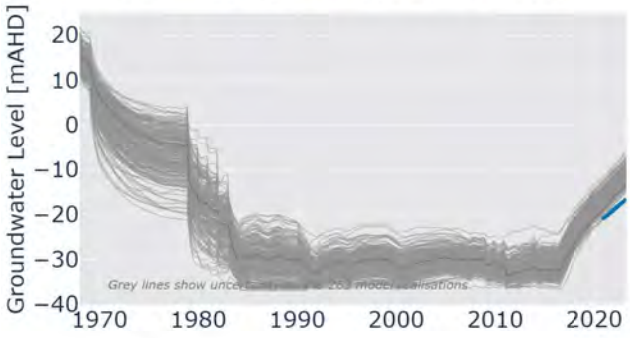
UEVF MB5
— UEVF (Upper Sands)
Screen from/to: 59.0m : 65.0m] (modelled historical)
UEVF MB5
▪ UEVF (Upper Sands)
Screen from/to: 59.0m : 65.0m] (observed historical)

UEVF MB6 (UEVF (Upper Sands))



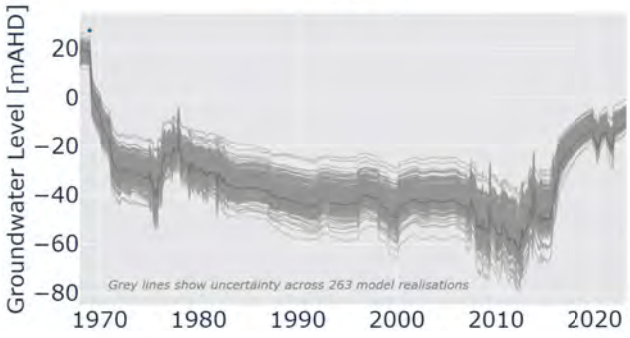
UEVF MB6
— UEVF (Upper Sands)
Screen from/to: 69.0m : 75.0m] (modelled historical)
UEVF MB6
▪ UEVF (Upper Sands)
Screen from/to: 69.0m : 75.0m] (observed historical)

UEVF MB7 (UEVF (Upper Sands))



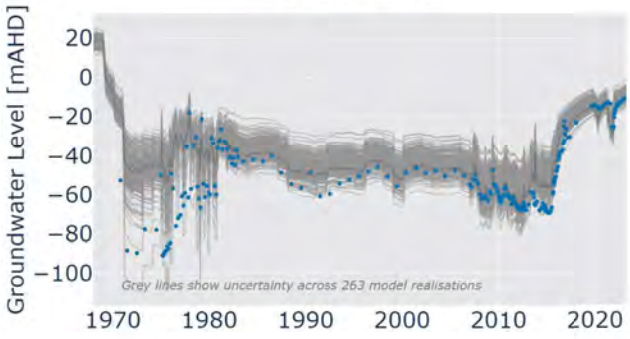
UEVF MB7
— UEVF (Upper Sands)
Screen from/to: 42.0m : 51.6m] (modelled historical)
UEVF MB7
▪ UEVF (Upper Sands)
Screen from/to: 42.0m : 51.6m] (observed historical)

WB1 (UEVF)



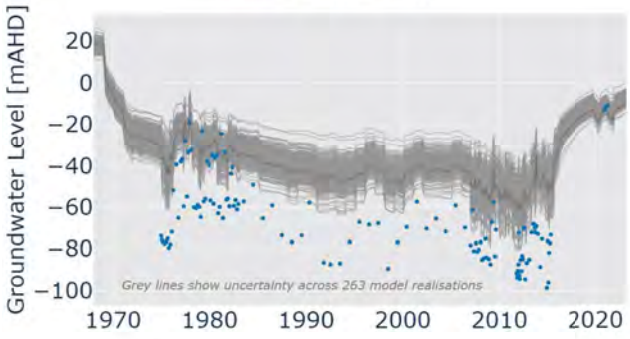
WB1
— UEVF
Screen from/to: n/a : n/a (modelled historical)
WB1
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

WB12 (UEVF)



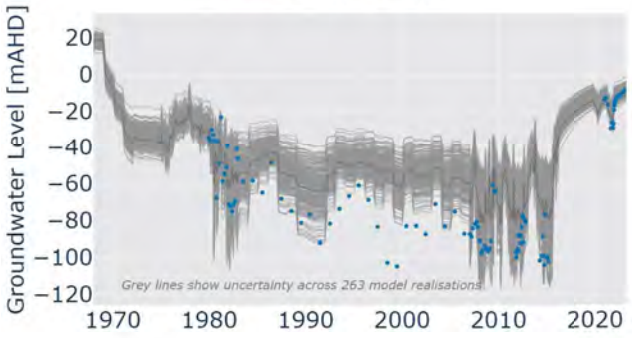
WB12
— UEVF
Screen from/to: 147.2m : 157.0m] (modelled historical)
WB12
▪ UEVF
Screen from/to: 147.2m : 157.0m] (observed historical)

WB13 (UEVF)



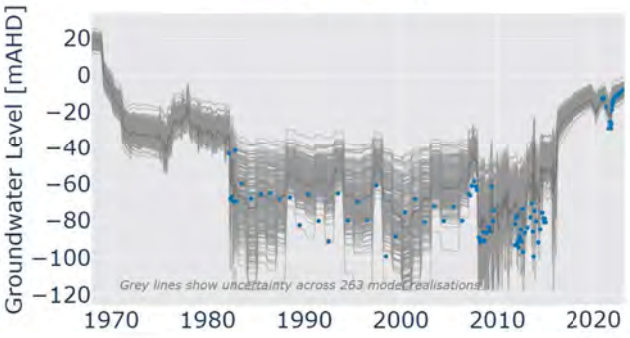
WB13
— UEVF
Screen from/to: 165.1m : 168.3m] (modelled historical)
WB13
▪ UEVF
Screen from/to: 165.1m : 168.3m] (observed historical)

WB14 (UEVF)



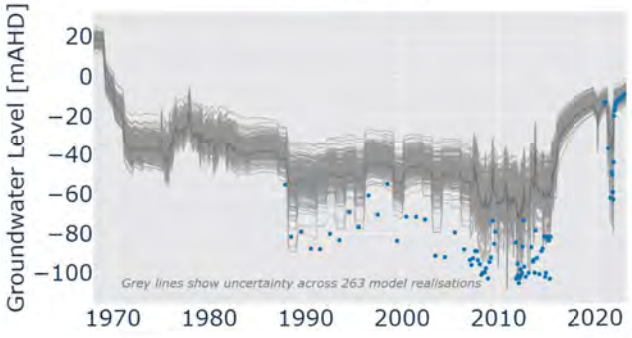
WB14
— UEVF
Screen from/to: 155.9m : 158.9m] (modelled historical)
WB14
▪ UEVF
Screen from/to: 155.9m : 158.9m] (observed historical)

WB15 (UEVF)



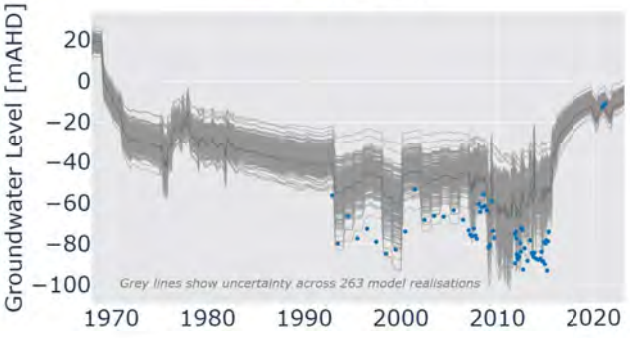
WB15
— UEVF
Screen from/to: 186.8m : 190.8m] (modelled historical)
WB15
▪ UEVF
Screen from/to: 186.8m : 190.8m] (observed historical)

WB16 (UEVF)



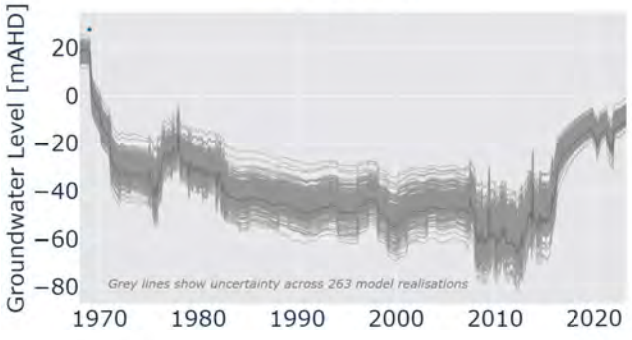
WB16
— UEVF
Screen from/to: 173.7m : 177.8m] (modelled historical)
WB16
▪ UEVF
Screen from/to: 173.7m : 177.8m] (observed historical)

WB17 (UEVF)



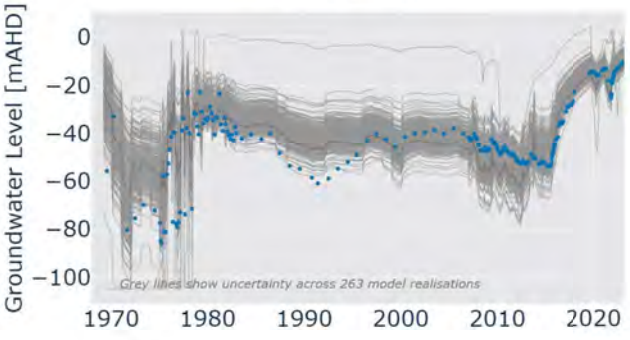
WB17
— UEVF
Screen from/to: 120.8m : 123.8m] (modelled historical)
WB17
▪ UEVF
Screen from/to: 120.8m : 123.8m] (observed historical)

WB3 (UEVF)



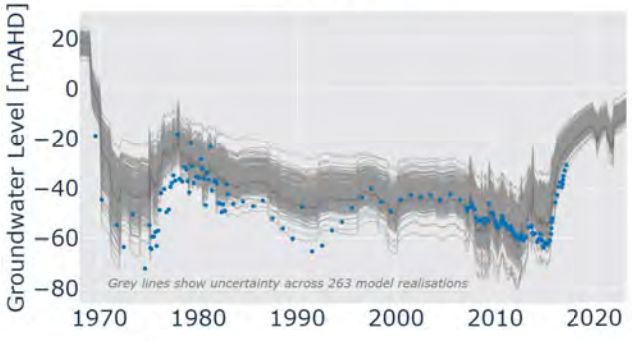
WB3
— UEVF
Screen from/to: n/a : n/a (modelled historical)
WB3
▪ UEVF
Screen from/to: n/a : n/a (observed historical)

WB4 (UEVF)



WB4
— UEVF
Screen from/to: 109.1m : 112.2m] (modelled historical)
WB4
▪ UEVF
Screen from/to: 109.1m : 112.2m] (observed historical)

WB5 (UEVF)

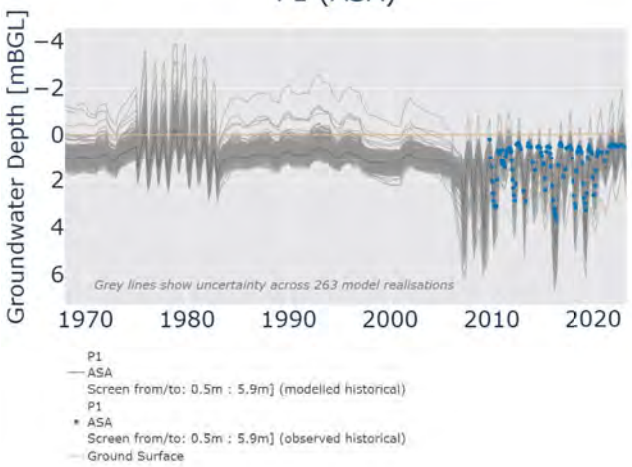


WB5
— UEVF
Screen from/to: 110.9m : 114.0m] (modelled historical)
WB5
▪ UEVF
Screen from/to: 110.9m : 114.0m] (observed historical)

Appendix E

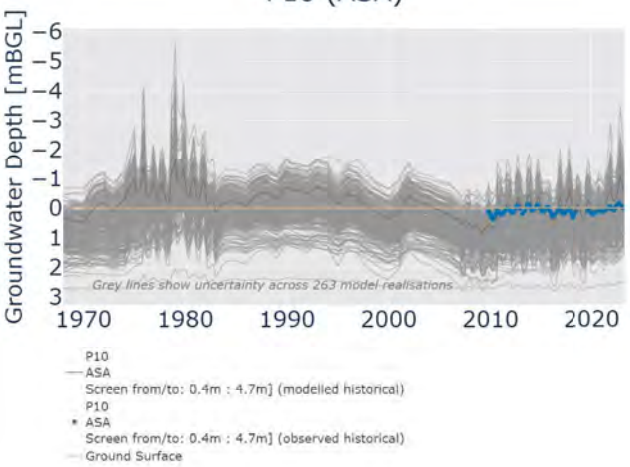
Model History Match Watertable Depth Hydrograph

P1 (ASA)



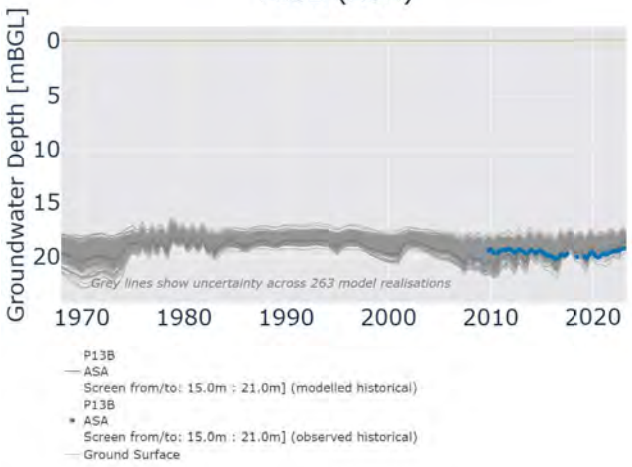
P1
ASA
Screen from/to: 0.5m : 5.9m] (modelled historical)
P1
ASA
Screen from/to: 0.5m : 5.9m] (observed historical)
Ground Surface

P10 (ASA)



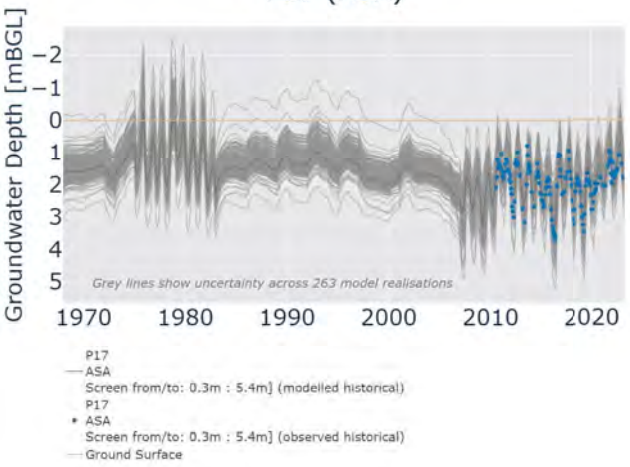
P10
ASA
Screen from/to: 0.4m : 4.7m] (modelled historical)
P10
ASA
Screen from/to: 0.4m : 4.7m] (observed historical)
Ground Surface

P13B (ASA)



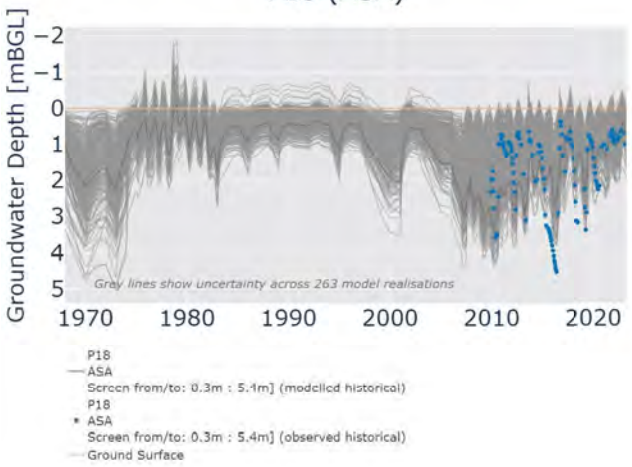
P13B
ASA
Screen from/to: 15.0m : 21.0m] (modelled historical)
P13B
ASA
Screen from/to: 15.0m : 21.0m] (observed historical)
Ground Surface

P17 (ASA)



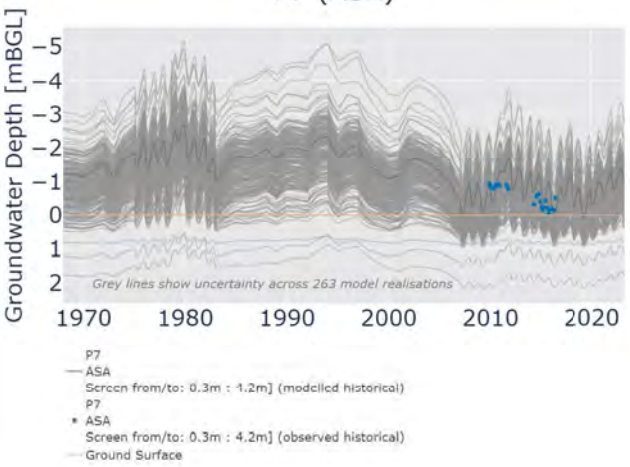
P17
ASA
Screen from/to: 0.3m : 5.4m] (modelled historical)
P17
ASA
Screen from/to: 0.3m : 5.4m] (observed historical)
Ground Surface

P18 (ASA)



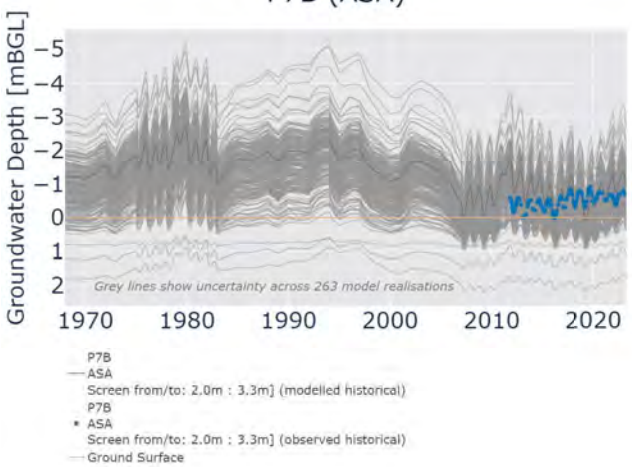
P18
ASA
Screen from/to: 0.3m : 5.4m] (modelled historical)
P18
ASA
Screen from/to: 0.3m : 5.4m] (observed historical)
Ground Surface

P7 (ASA)



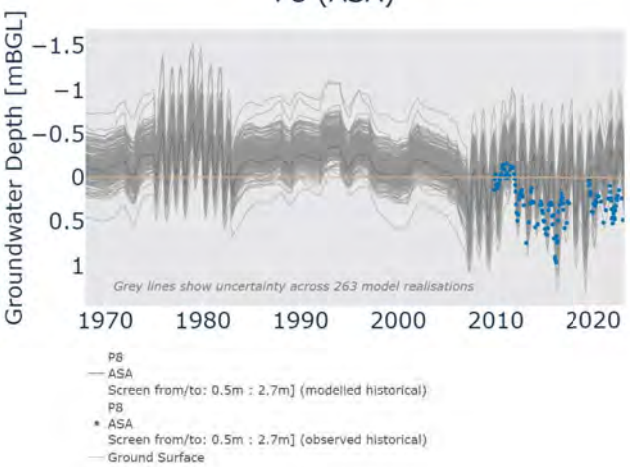
P7
ASA
Screen from/to: 0.3m : 4.2m] (modelled historical)
P7
ASA
Screen from/to: 0.3m : 4.2m] (observed historical)
Ground Surface

P7B (ASA)



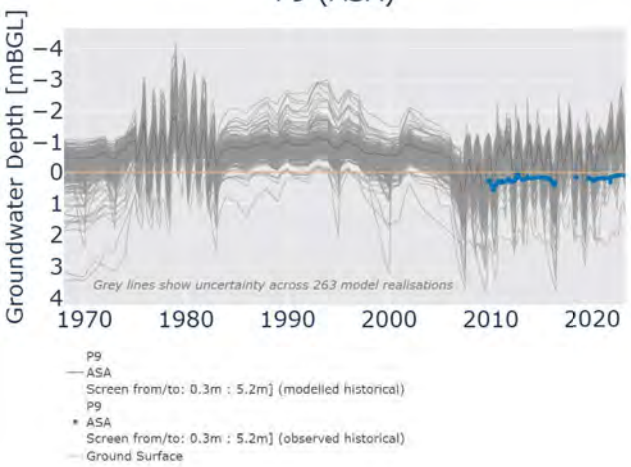
P7B
ASA
Screen from/to: 2.0m : 3.3m] (modelled historical)
P7B
ASA
Screen from/to: 2.0m : 3.3m] (observed historical)
Ground Surface

P8 (ASA)

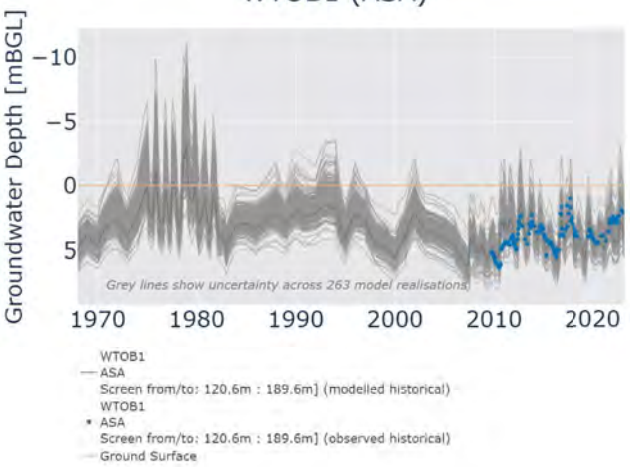


P8
ASA
Screen from/to: 0.5m : 2.7m] (modelled historical)
P8
ASA
Screen from/to: 0.5m : 2.7m] (observed historical)
Ground Surface

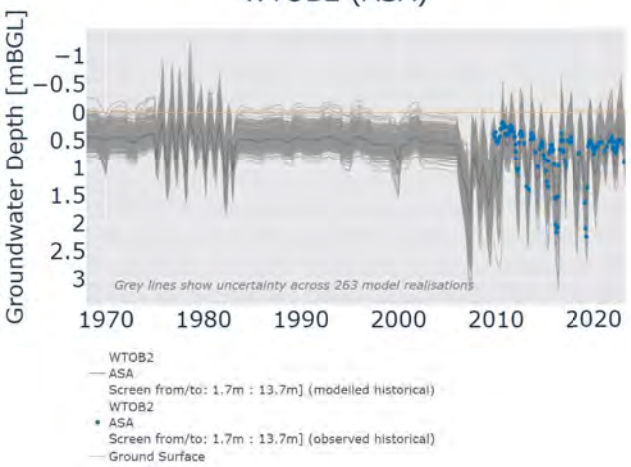
P9 (ASA)



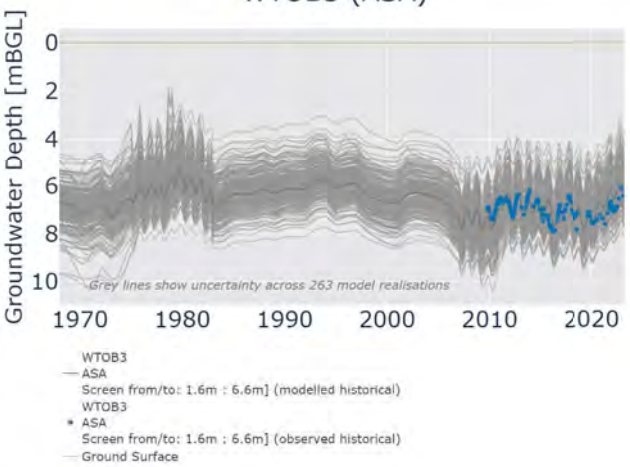
WTOB1 (ASA)



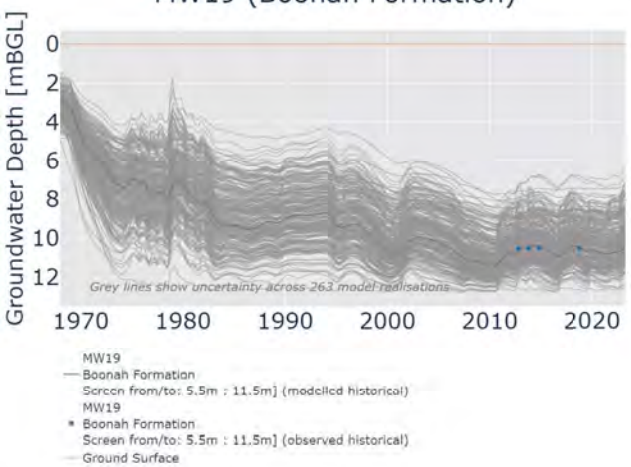
WTOB2 (ASA)



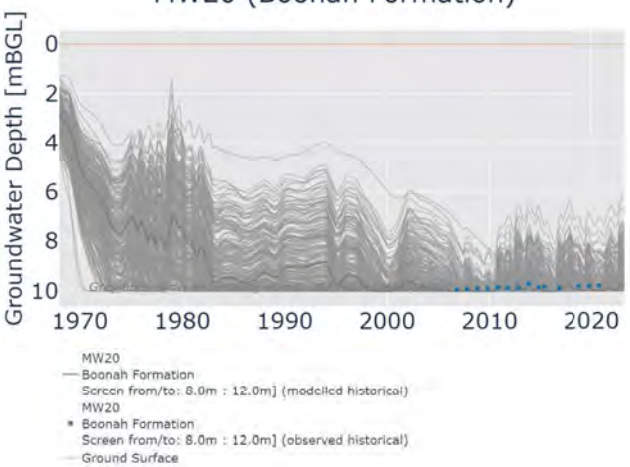
WTOB3 (ASA)



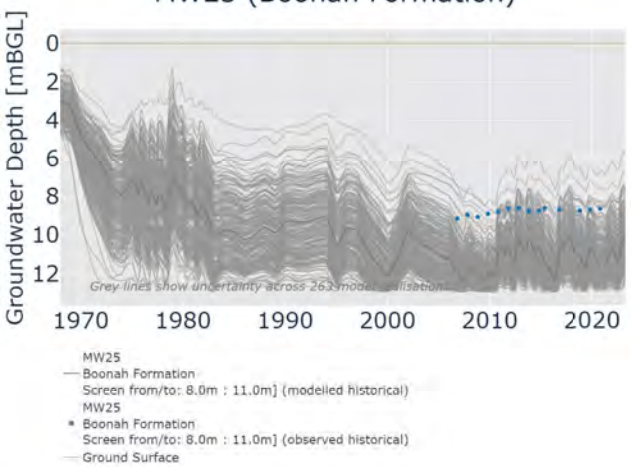
MW19 (Boonah Formation)



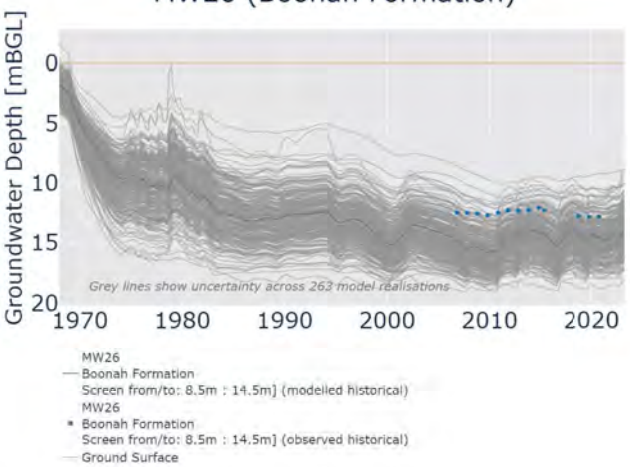
MW20 (Boonah Formation)

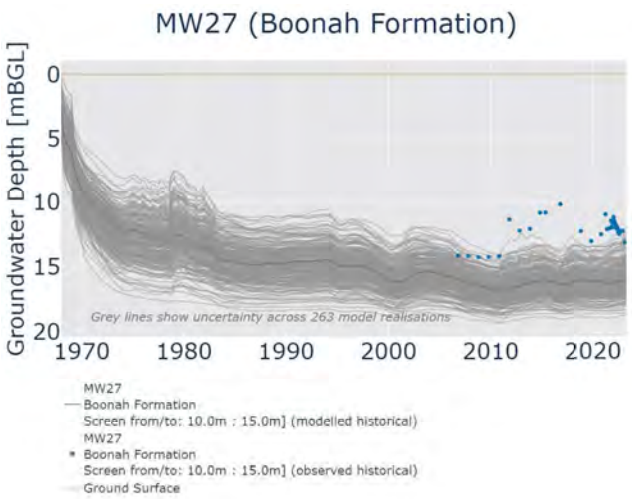


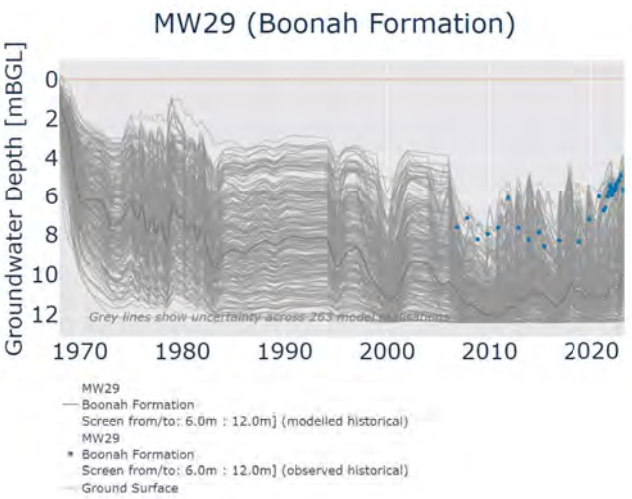
MW25 (Boonah Formation)

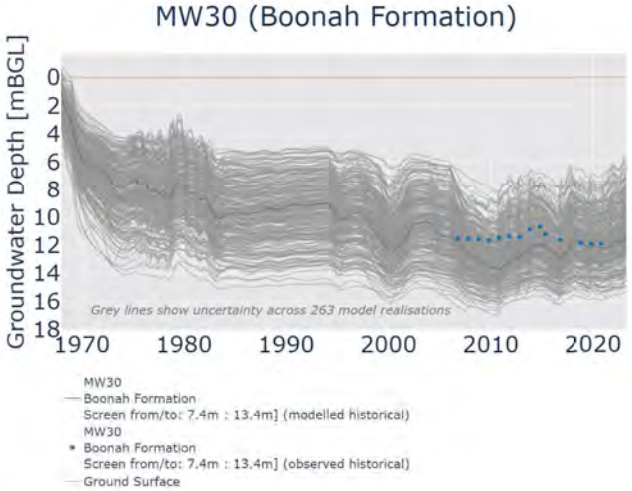


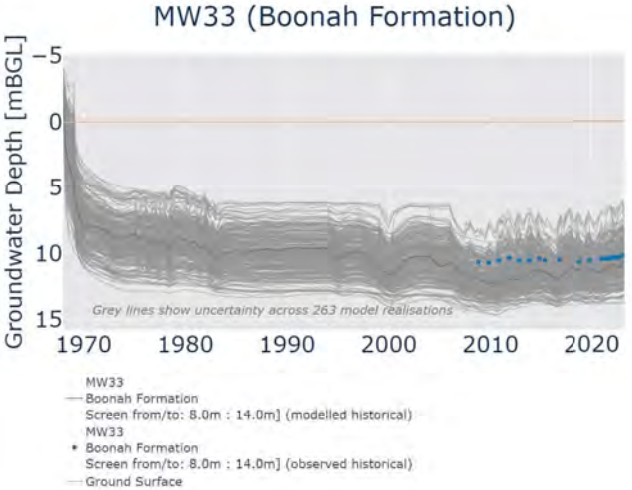
MW26 (Boonah Formation)

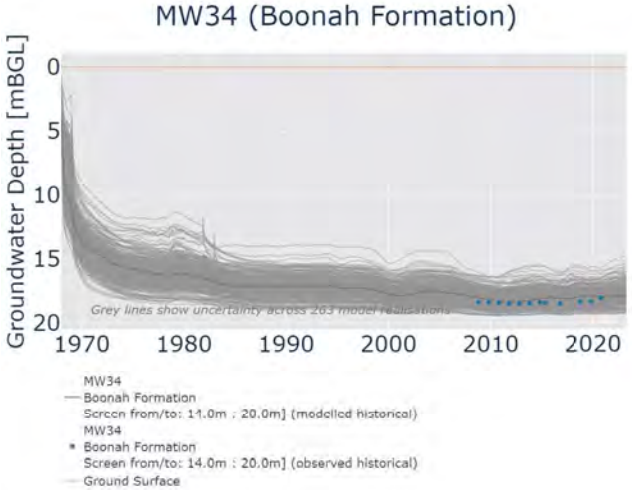


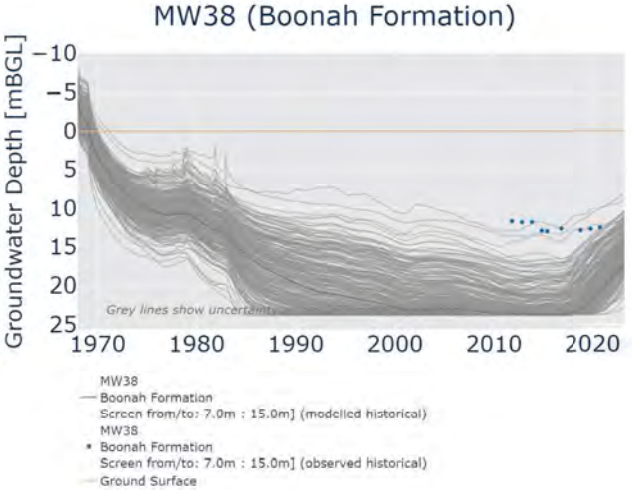

MW27 (Boonah Formation)
Groundwater Depth [mBGL]
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty across 263 model realisations
MW27
Boonah Formation
Screen from/to: 10.0m : 15.0m] (modelled historical)
MW27
Boonah Formation
Screen from/to: 10.0m : 15.0m] (observed historical)
Ground Surface

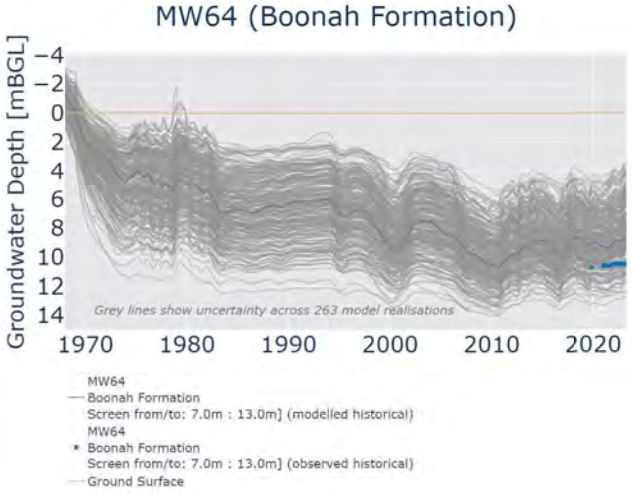

MW29 (Boonah Formation)
Groundwater Depth [mBGL]
0
2
4
6
8
10
12
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty across 263 model realisations
MW29
Boonah Formation
Screen from/to: 6.0m : 12.0m] (modelled historical)
MW29
Boonah Formation
Screen from/to: 6.0m : 12.0m] (observed historical)
Ground Surface

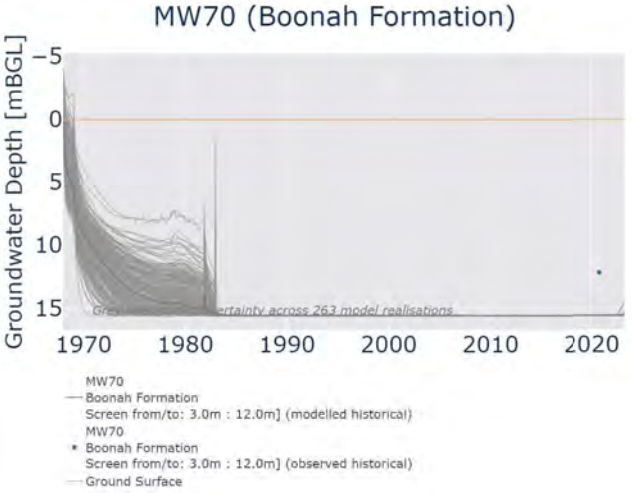

MW30 (Boonah Formation)
Groundwater Depth [mBGL]
0
2
4
6
8
10
12
14
16
18
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty across 263 model realisations
MW30
Boonah Formation
Screen from/to: 7.4m : 13.4m] (modelled historical)
MW30
Boonah Formation
Screen from/to: 7.4m : 13.4m] (observed historical)
Ground Surface


MW33 (Boonah Formation)
Groundwater Depth [mBGL]
−5
0
5
10
15
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty across 263 model realisations
MW33
Boonah Formation
Screen from/to: 8.0m : 14.0m] (modelled historical)
MW33
Boonah Formation
Screen from/to: 8.0m : 14.0m] (observed historical)
Ground Surface

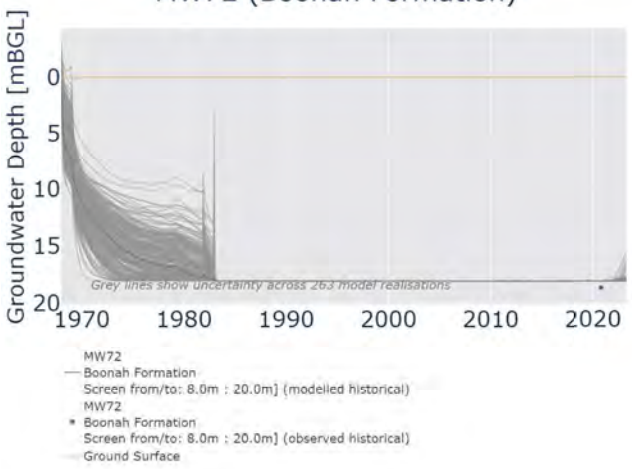

MW34 (Boonah Formation)
Groundwater Depth [mBGL]
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty across 263 model realisations
MW34
Boonah Formation
Screen from/to: 14.0m : 20.0m] (modelled historical)
MW34
Boonah Formation
Screen from/to: 14.0m : 20.0m] (observed historical)
Ground Surface


MW38 (Boonah Formation)
Groundwater Depth [mBGL]
−10
−5
0
5
10
15
20
25
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty
MW38
Boonah Formation
Screen from/to: 7.0m : 15.0m] (modelled historical)
MW38
Boonah Formation
Screen from/to: 7.0m : 15.0m] (observed historical)
Ground Surface


MW64 (Boonah Formation)
Groundwater Depth [mBGL]
−4
−2
0
2
4
6
8
10
12
14
1970
1980
1990
2000
2010
2020
Grey lines show uncertainty across 263 model realisations
MW64
Boonah Formation
Screen from/to: 7.0m : 13.0m] (modelled historical)
MW64
Boonah Formation
Screen from/to: 7.0m : 13.0m] (observed historical)
Ground Surface

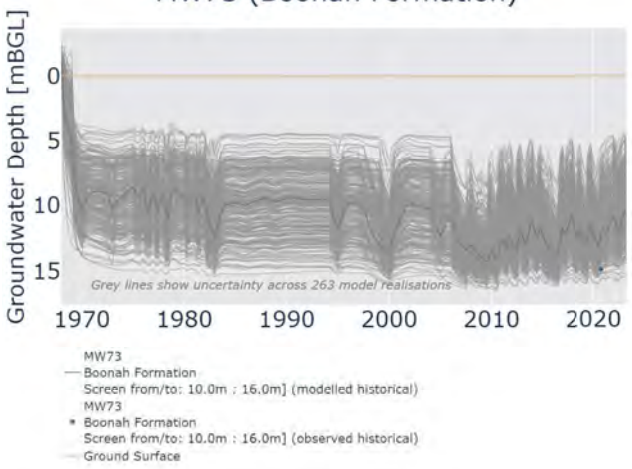

MW70 (Boonah Formation)
Groundwater Depth [mBGL]
−5
0
5
10
15
1970
1980
1990
2000
2010
2020
MW70
Boonah Formation
Screen from/to: 3.0m : 12.0m] (modelled historical)
MW70
Boonah Formation
Screen from/to: 3.0m : 12.0m] (observed historical)
Ground Surface

MW72 (Boonah Formation)



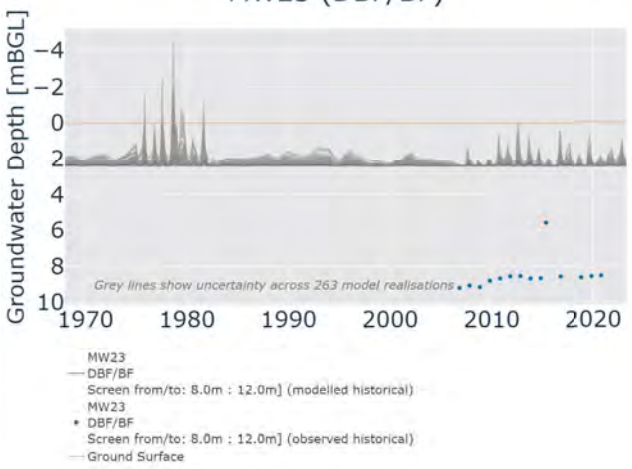
MW72
— Boonah Formation
Screen from/to: 8.0m : 20.0m] (modelled historical)
MW72
• Boonah Formation
Screen from/to: 8.0m : 20.0m] (observed historical)
Ground Surface

MW73 (Boonah Formation)



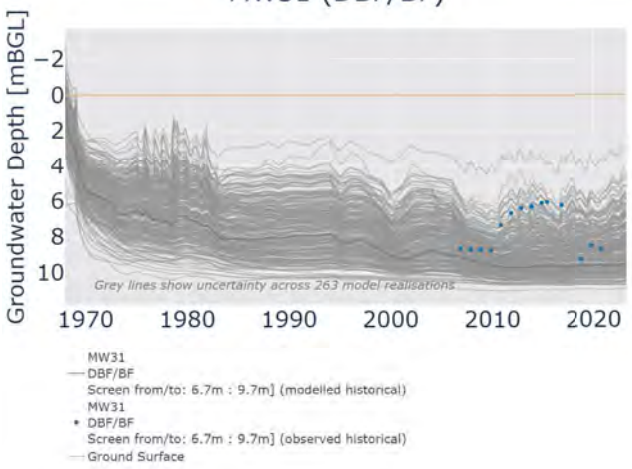
MW73
— Boonah Formation
Screen from/to: 10.0m : 16.0m] (modelled historical)
MW73
• Boonah Formation
Screen from/to: 10.0m : 16.0m] (observed historical)
Ground Surface

MW23 (DBF/BF)



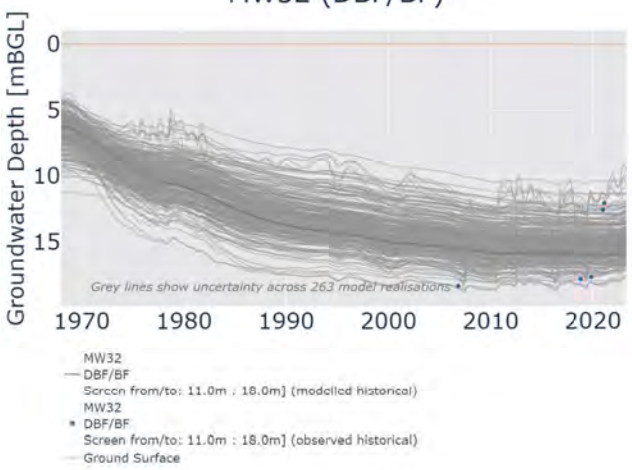
MW23
— DBF/BF
Screen from/to: 8.0m : 12.0m] (modelled historical)
MW23
• DBF/BF
Screen from/to: 8.0m : 12.0m] (observed historical)
Ground Surface

MW31 (DBF/BF)



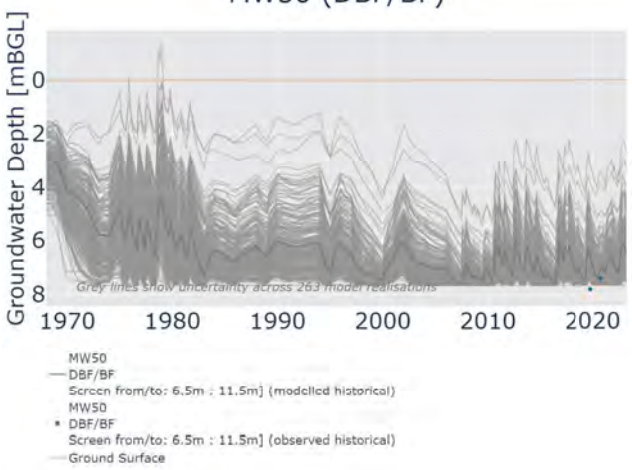
MW31
— DBF/BF
Screen from/to: 6.7m : 9.7m] (modelled historical)
MW31
• DBF/BF
Screen from/to: 6.7m : 9.7m] (observed historical)
Ground Surface

MW32 (DBF/BF)



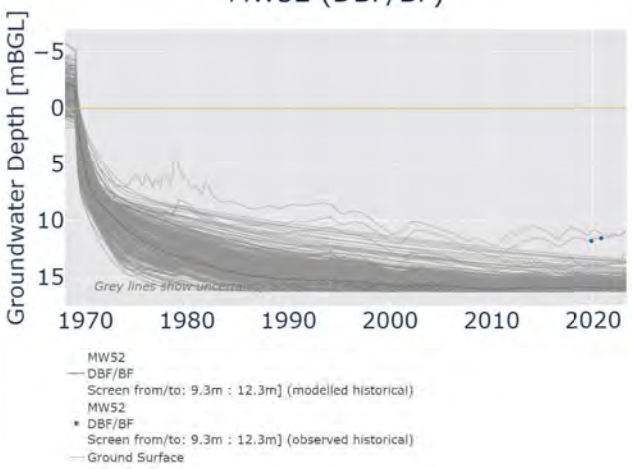
MW32
— DBF/BF
Screen from/to: 11.0m : 18.0m] (modelled historical)
MW32
• DBF/BF
Screen from/to: 11.0m : 18.0m] (observed historical)
Ground Surface

MW50 (DBF/BF)



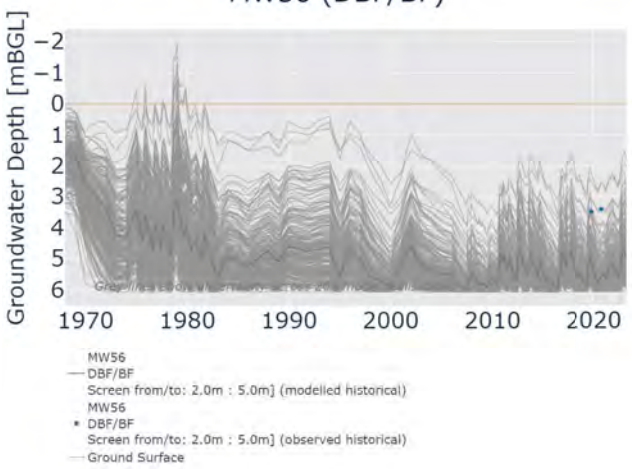
MW50
— DBF/BF
Screen from/to: 6.5m : 11.5m] (modelled historical)
MW50
• DBF/BF
Screen from/to: 6.5m : 11.5m] (observed historical)
Ground Surface

MW52 (DBF/BF)



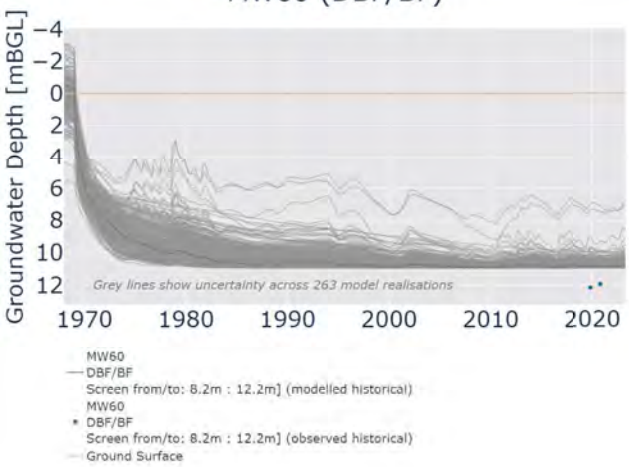
MW52
— DBF/BF
Screen from/to: 9.3m : 12.3m] (modelled historical)
MW52
• DBF/BF
Screen from/to: 9.3m : 12.3m] (observed historical)
Ground Surface

MW56 (DBF/BF)



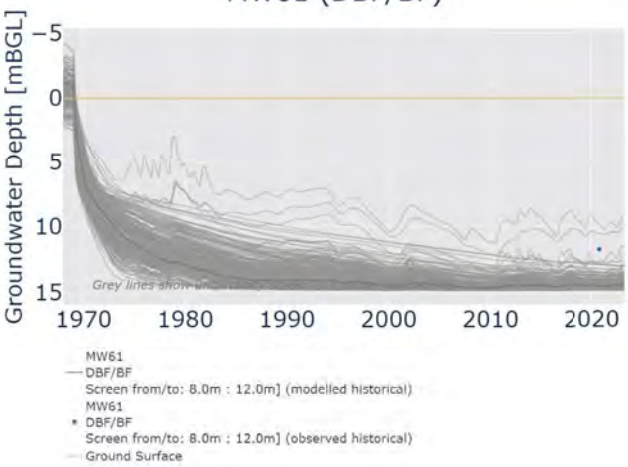
MW56
— DBF/BF
Screen from/to: 2.0m : 5.0m] (modelled historical)
MW56
• DBF/BF
Screen from/to: 2.0m : 5.0m] (observed historical)
Ground Surface

MW60 (DBF/BF)



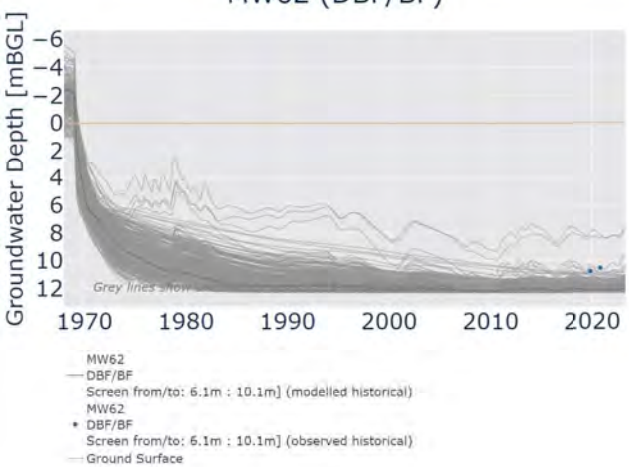
MW60
— DBF/BF
Screen from/to: 8.2m : 12.2m] (modelled historical)
MW60
• DBF/BF
Screen from/to: 8.2m : 12.2m] (observed historical)
Ground Surface

MW61 (DBF/BF)



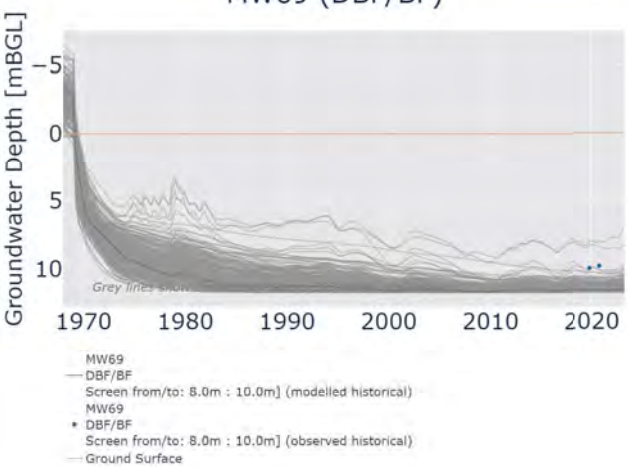
MW61
— DBF/BF
Screen from/to: 8.0m : 12.0m] (modelled historical)
MW61
• DBF/BF
Screen from/to: 8.0m : 12.0m] (observed historical)
Ground Surface

MW62 (DBF/BF)



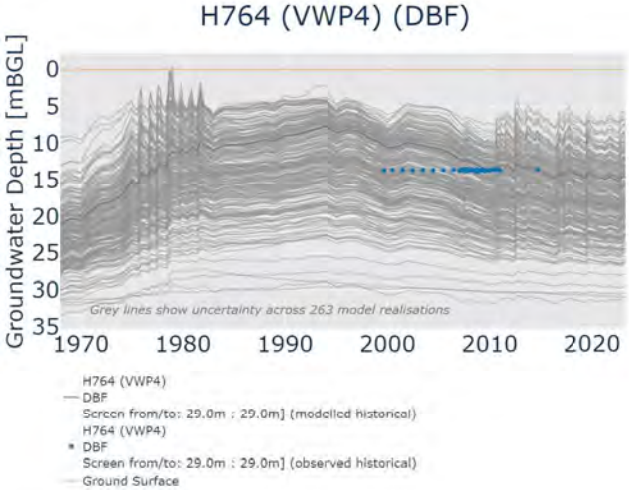
MW62
— DBF/BF
Screen from/to: 6.1m : 10.1m] (modelled historical)
MW62
• DBF/BF
Screen from/to: 6.1m : 10.1m] (observed historical)
Ground Surface

MW69 (DBF/BF)



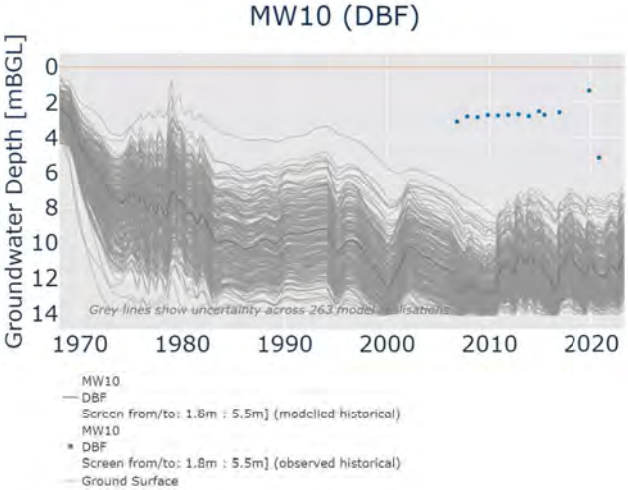
MW69
— DBF/BF
Screen from/to: 8.0m : 10.0m] (modelled historical)
MW69
• DBF/BF
Screen from/to: 8.0m : 10.0m] (observed historical)
Ground Surface

H764 (VWP4) (DBF)



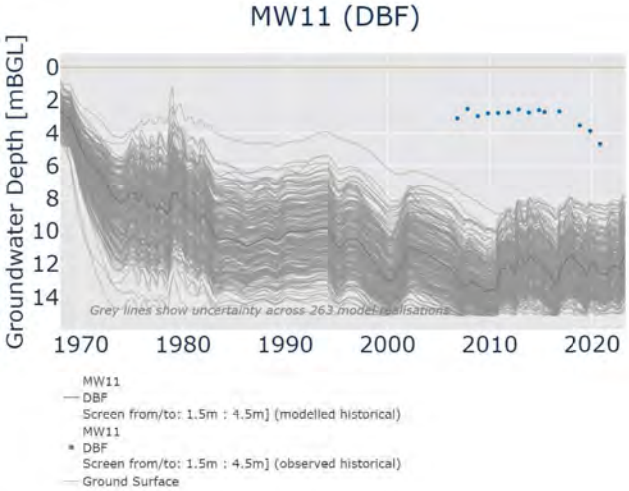
H764 (VWP4)
— DBF
Screen from/to: 29.0m : 29.0m] (modelled historical)
H764 (VWP4)
• DBF
Screen from/to: 29.0m : 29.0m] (observed historical)
Ground Surface

MW10 (DBF)



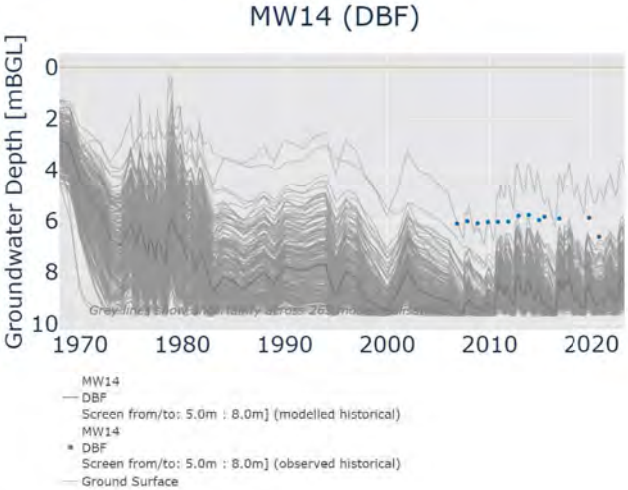
MW10
— DBF
Screen from/to: 1.8m : 5.5m] (modelled historical)
MW10
• DBF
Screen from/to: 1.8m : 5.5m] (observed historical)
Ground Surface

MW11 (DBF)

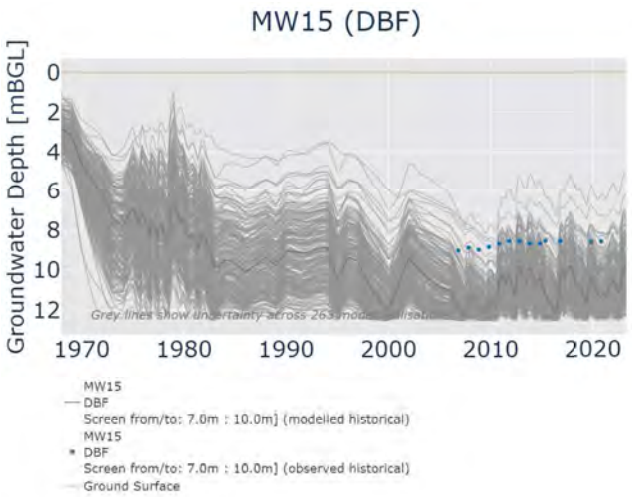


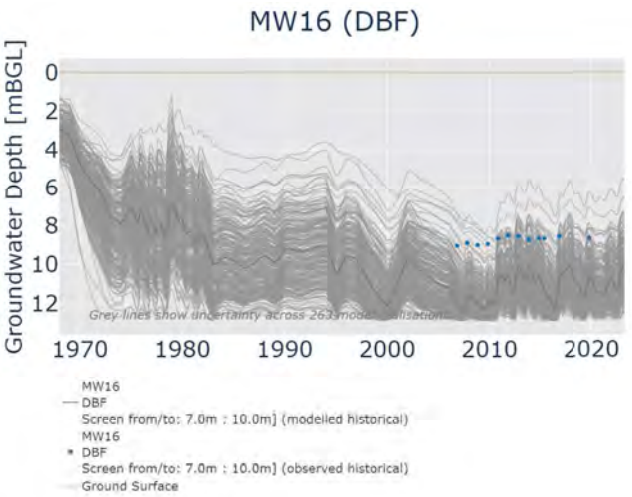
MW11
— DBF
Screen from/to: 1.5m : 4.5m] (modelled historical)
MW11
• DBF
Screen from/to: 1.5m : 4.5m] (observed historical)
Ground Surface

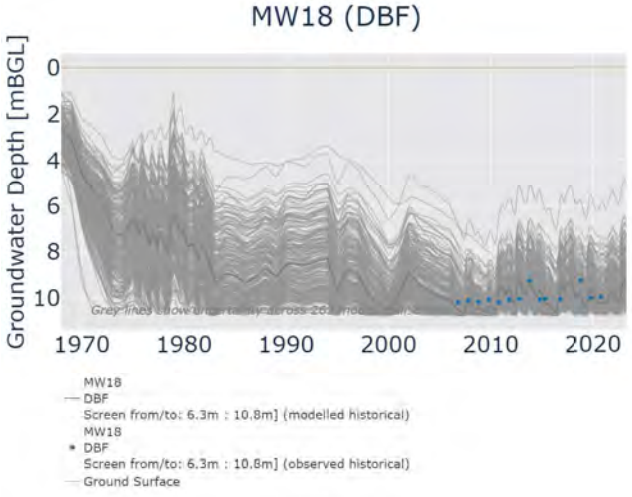
MW14 (DBF)

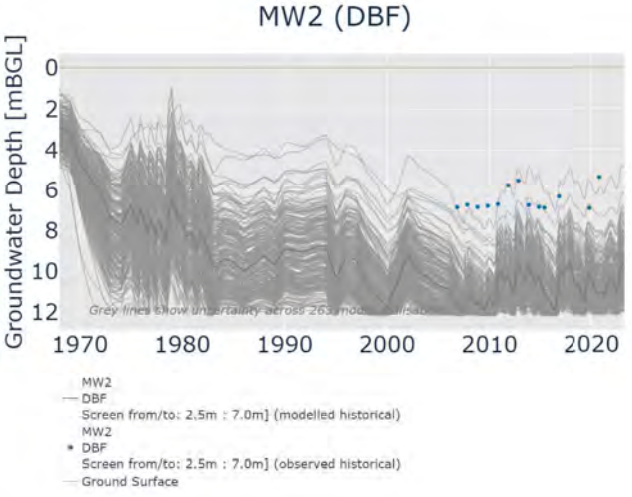


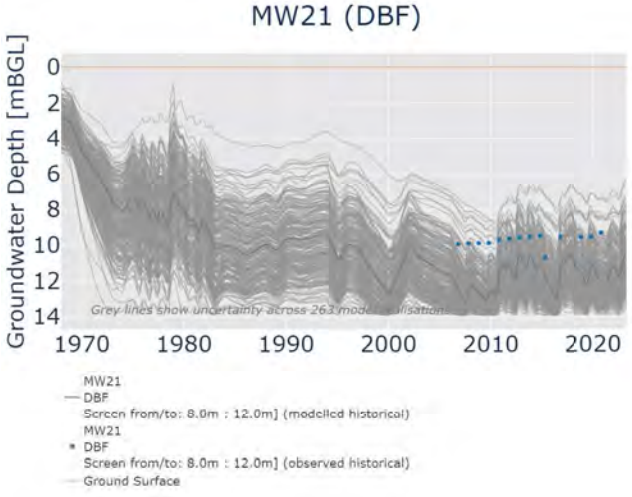
MW14
— DBF
Screen from/to: 5.0m : 8.0m] (modelled historical)
MW14
• DBF
Screen from/to: 5.0m : 8.0m] (observed historical)
Ground Surface

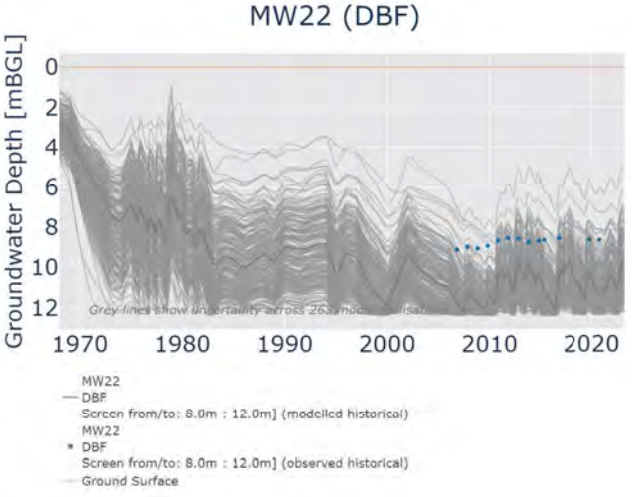

MW15 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW15
DBF
Screen from/to: 7.0m : 10.0m] (modelled historical)
MW15
DBF
Screen from/to: 7.0m : 10.0m] (observed historical)
Ground Surface

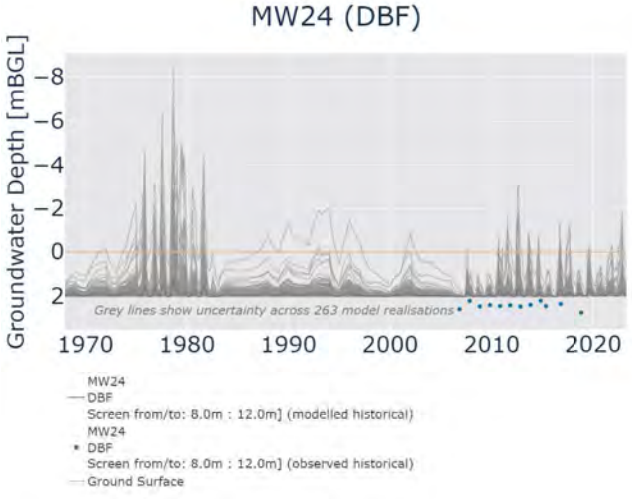

MW16 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW16
DBF
Screen from/to: 7.0m : 10.0m] (modelled historical)
MW16
DBF
Screen from/to: 7.0m : 10.0m] (observed historical)
Ground Surface

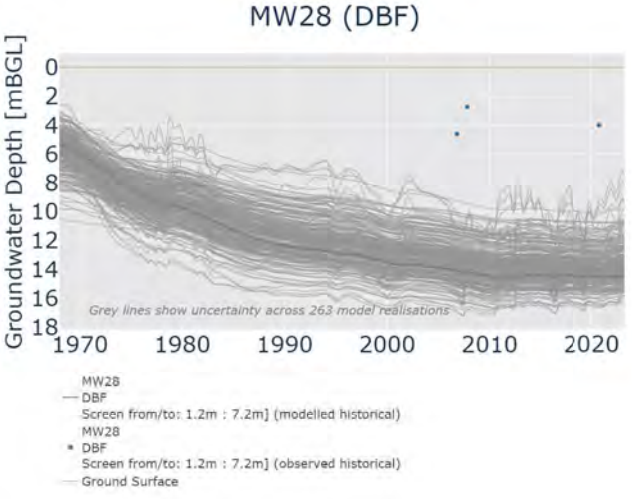

MW18 (DBF)
Groundwater Depth [mBGL]
MW18
DBF
Screen from/to: 6.3m : 10.8m] (modelled historical)
MW18
DBF
Screen from/to: 6.3m : 10.8m] (observed historical)
Ground Surface


MW2 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW2
DBF
Screen from/to: 2.5m : 7.0m] (modelled historical)
MW2
DBF
Screen from/to: 2.5m : 7.0m] (observed historical)
Ground Surface

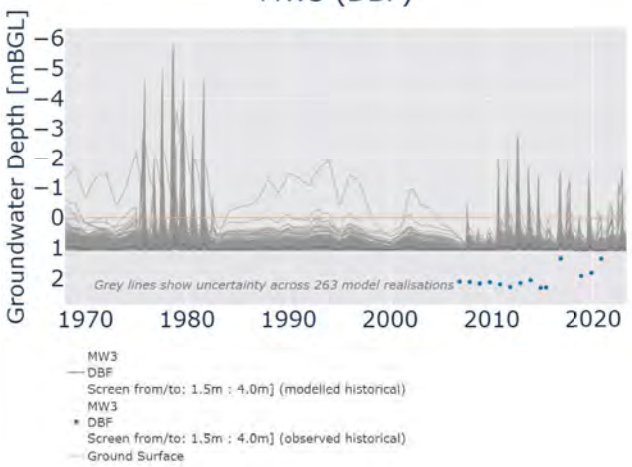

MW21 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW21
DBF
MW21
DBF
Screen from/to: 8.0m : 12.0m] (observed historical)
Ground Surface


MW22 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW22
DBF
MW22
DBF
Screen from/to: 8.0m : 12.0m] (observed historical)
Ground Surface


MW24 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW24
DBF
Screen from/to: 8.0m : 12.0m] (modelled historical)
MW24
DBF
Screen from/to: 8.0m : 12.0m] (observed historical)
Ground Surface

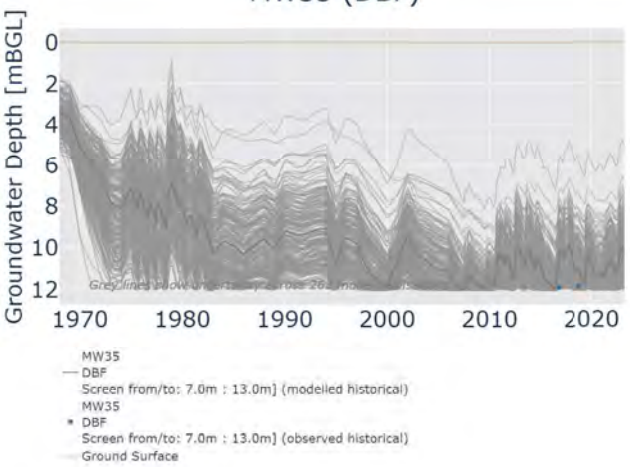

MW28 (DBF)
Groundwater Depth [mBGL]
Grey lines show uncertainty across 263 model realisations
MW28
DBF
Screen from/to: 1.2m : 7.2m] (modelled historical)
MW28
DBF
Screen from/to: 1.2m : 7.2m] (observed historical)
Ground Surface

MW3 (DBF)



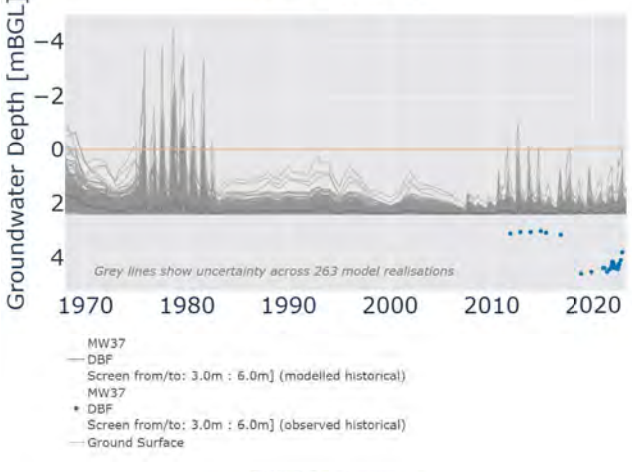
MW3
DBF
Screen from/to: 1.5m : 4.0m] (modelled historical)
MW3
DBF
Screen from/to: 1.5m : 4.0m] (observed historical)
Ground Surface

MW35 (DBF)



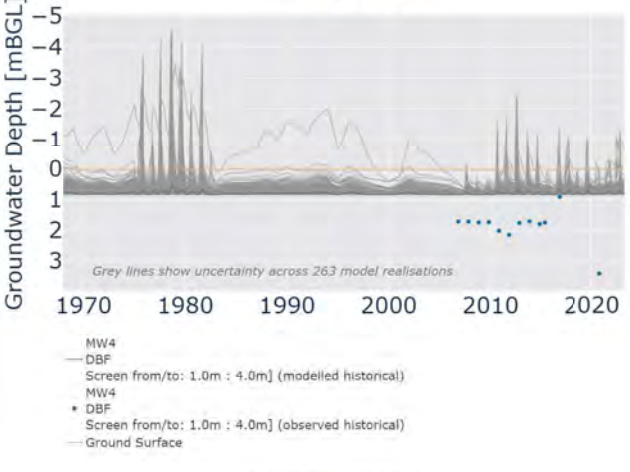
MW35
DBF
Screen from/to: 7.0m : 13.0m] (modelled historical)
MW35
DBF
Screen from/to: 7.0m : 13.0m] (observed historical)
Ground Surface

MW37 (DBF)



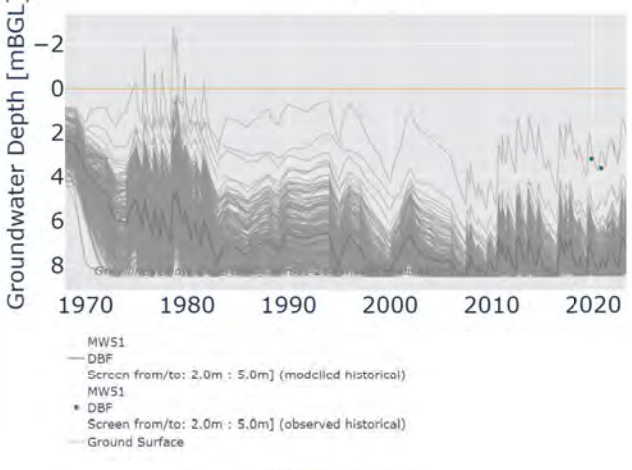
MW37
DBF
Screen from/to: 3.0m : 6.0m] (modelled historical)
MW37
DBF
Screen from/to: 3.0m : 6.0m] (observed historical)
Ground Surface

MW4 (DBF)



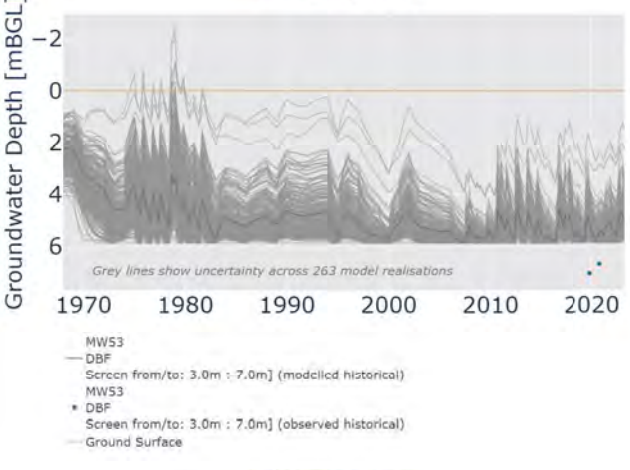
MW4
DBF
Screen from/to: 1.0m : 4.0m] (modelled historical)
MW4
DBF
Screen from/to: 1.0m : 4.0m] (observed historical)
Ground Surface

MW51 (DBF)



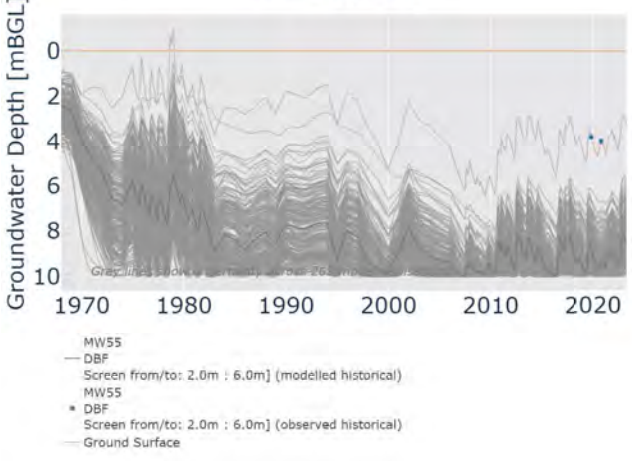
MW51
DBF
Screen from/to: 2.0m : 5.0m] (modelled historical)
MW51
DBF
Screen from/to: 2.0m : 5.0m] (observed historical)
Ground Surface

MW53 (DBF)



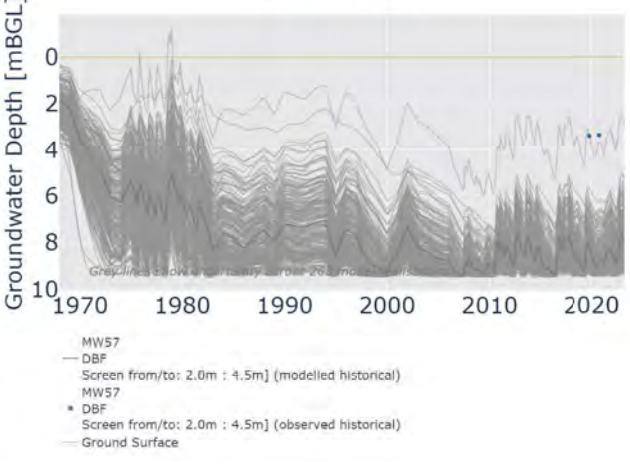
MW53
DBF
Screen from/to: 3.0m : 7.0m] (modelled historical)
MW53
DBF
Screen from/to: 3.0m : 7.0m] (observed historical)
Ground Surface

MW55 (DBF)



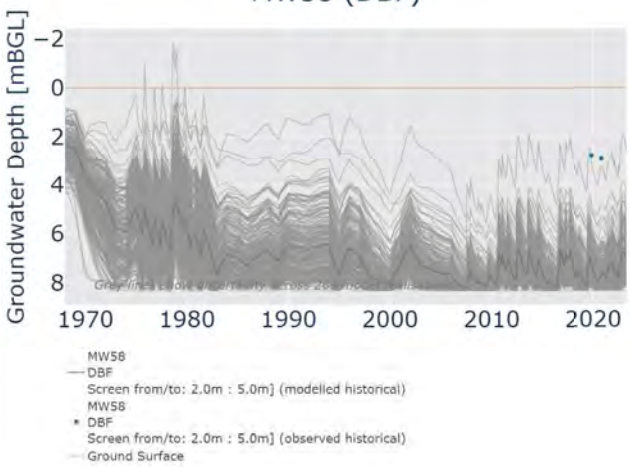
MW55
DBF
Screen from/to: 2.0m : 6.0m] (modelled historical)
MW55
DBF
Screen from/to: 2.0m : 6.0m] (observed historical)
Ground Surface

MW57 (DBF)



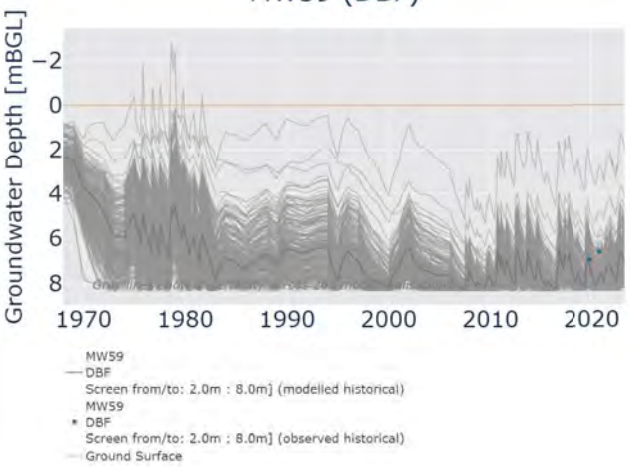
MW57
DBF
Screen from/to: 2.0m : 4.5m] (modelled historical)
MW57
DBF
Screen from/to: 2.0m : 4.5m] (observed historical)
Ground Surface

MW58 (DBF)



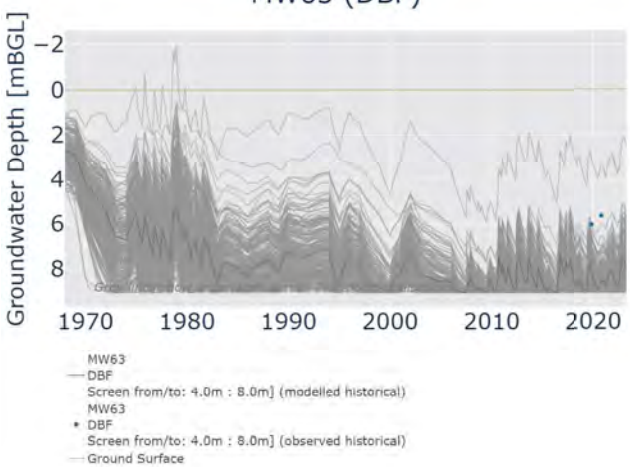
MW58
DBF
Screen from/to: 2.0m : 5.0m] (modelled historical)
MW58
DBF
Screen from/to: 2.0m : 5.0m] (observed historical)
Ground Surface

MW59 (DBF)



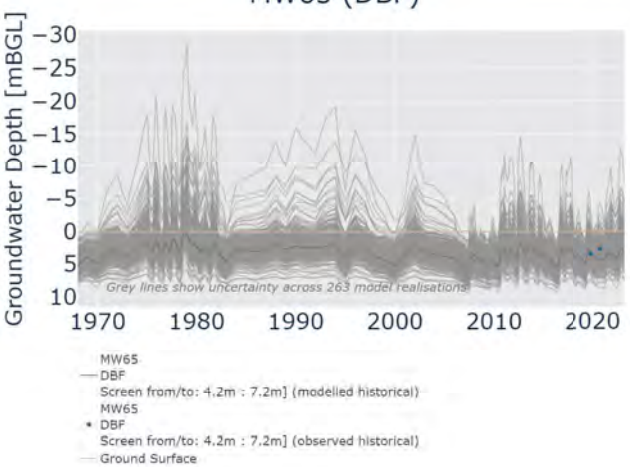
MW59
DBF
Screen from/to: 2.0m : 8.0m] (modelled historical)
MW59
DBF
Screen from/to: 2.0m : 8.0m] (observed historical)
Ground Surface

MW63 (DBF)



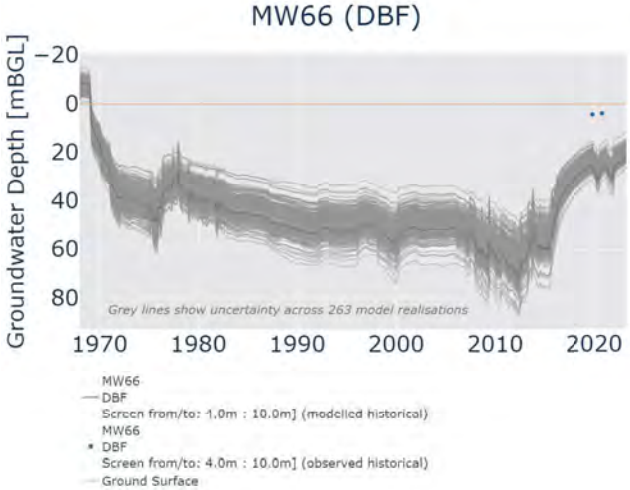
MW63
DBF
Screen from/to: 4.0m : 8.0m] (modelled historical)
MW63
DBF
Screen from/to: 4.0m : 8.0m] (observed historical)
Ground Surface

MW65 (DBF)



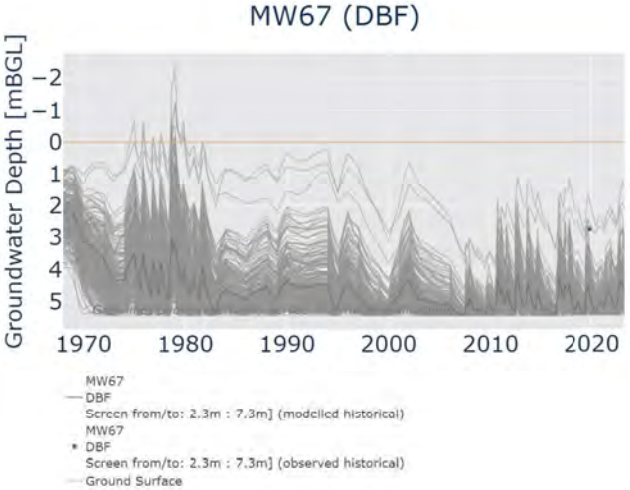
MW65
DBF
Screen from/to: 4.2m : 7.2m] (modelled historical)
MW65
DBF
Screen from/to: 4.2m : 7.2m] (observed historical)
Ground Surface

MW66 (DBF)



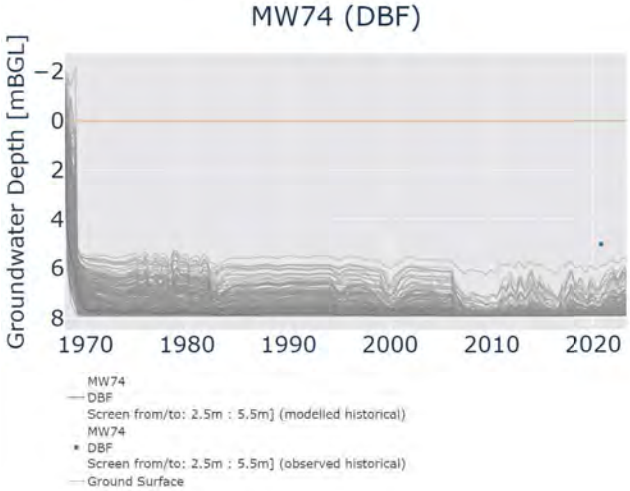
MW66
DBF
Screen from/to: 1.0m : 10.0m] (modelled historical)
MW66
DBF
Screen from/to: 4.0m : 10.0m] (observed historical)
Ground Surface

MW67 (DBF)



MW67
DBF
Screen from/to: 2.3m : 7.3m] (modelled historical)
MW67
DBF
Screen from/to: 2.3m : 7.3m] (observed historical)
Ground Surface

MW74 (DBF)



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DBF
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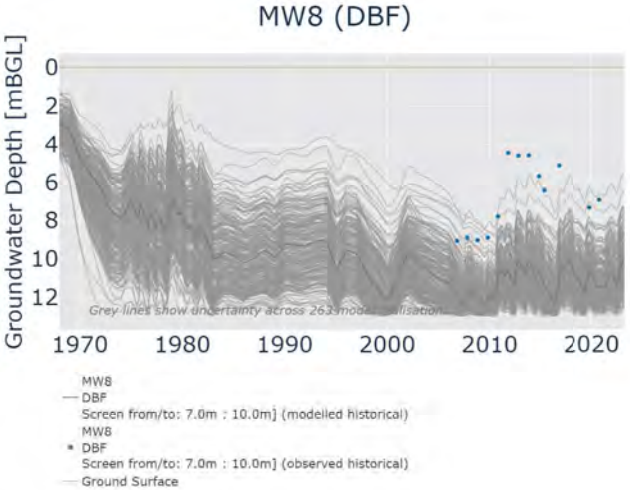
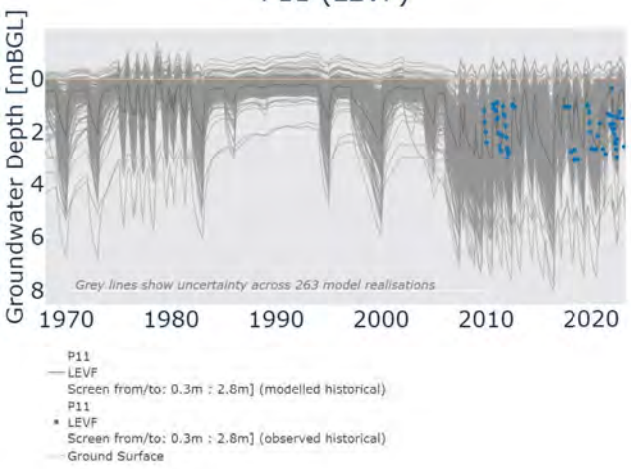
MW74
DBF
Screen from/to: 2.5m : 5.5m] (observed historical)
Ground Surface

MW8 (DBF)

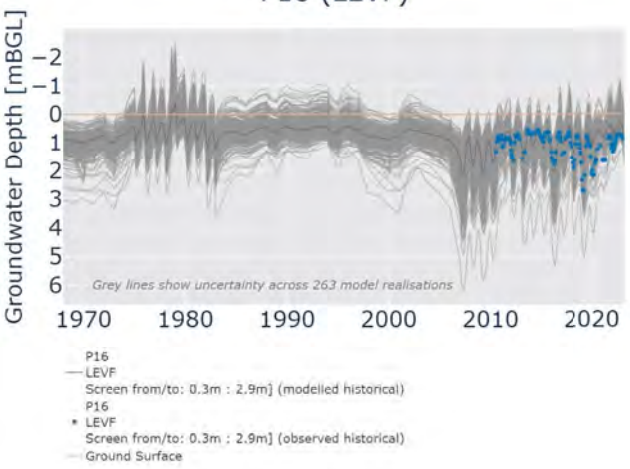


MW8
DBF
Screen from/to: 7.0m : 10.0m] (modelled historical)
MW8
DBF
Screen from/to: 7.0m : 10.0m] (observed historical)
Ground Surface

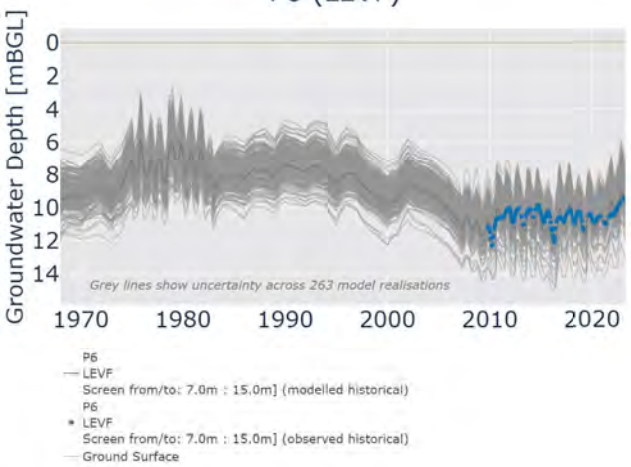
P11 (LEVF)



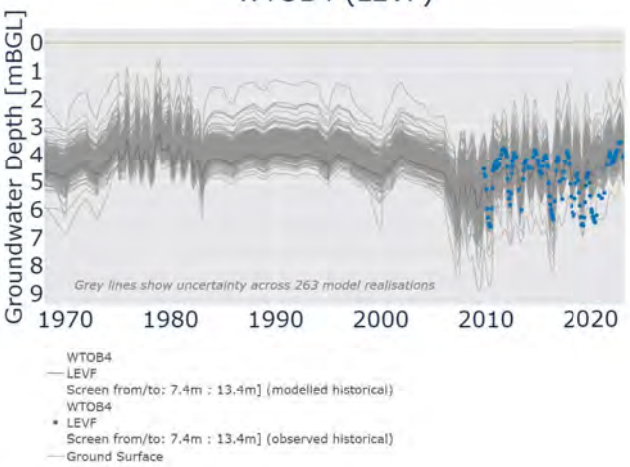
P16 (LEVF)



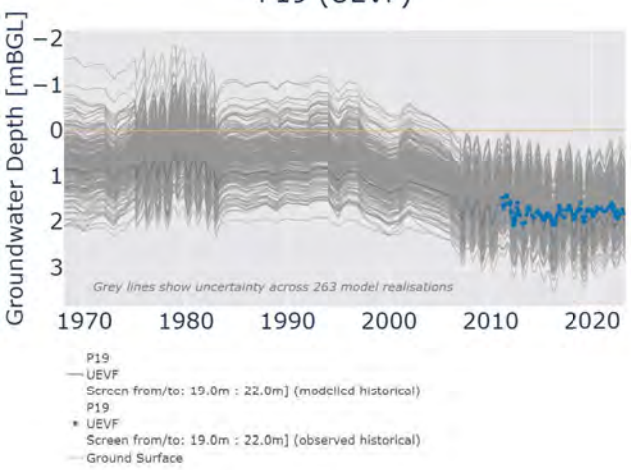
P6 (LEVF)



WTOB4 (LEVF)



P19 (UEVF)



Appendix F

Observation Bore Integrity Memo

Technical Memorandum

02 March 2023

To	Barwon Water	**Contact No.**	0427700781
Copy to		**Email**	jeffrey.morgan@ghd.com
From	Jeff Morgan	**Project No.**	12542999
Project Name	Anglesea Borefield: Groundwater Model Update		
Subject	Observation Bore Integrity		

1. Introduction

There are several Government observation bores in the Anglesea area that were constructed in the early-mid 1990's. These are currently monitored, however the integrity of these bores, and therefore the monitored groundwater level data, is questionable. Most of these bores have been used for history matching in the recent model update completed (GHD, 2022) and the integrity of two bores (116459 and 115868) was specifically questioned.

The purpose of this memo is to highlight the older State Observation Bore Network (SOBN) bores that appear to have integrity issues, and the reasoning behind this conclusion. This additional detailed information is planned to be included in the report as an additional appendix to add clarity to this issue, and can be further considered in future model history matching which is planned in 2023 and clarify these potential issues for the TRP.

The monitoring bore network in the Anglesea area is shown in Figure 1

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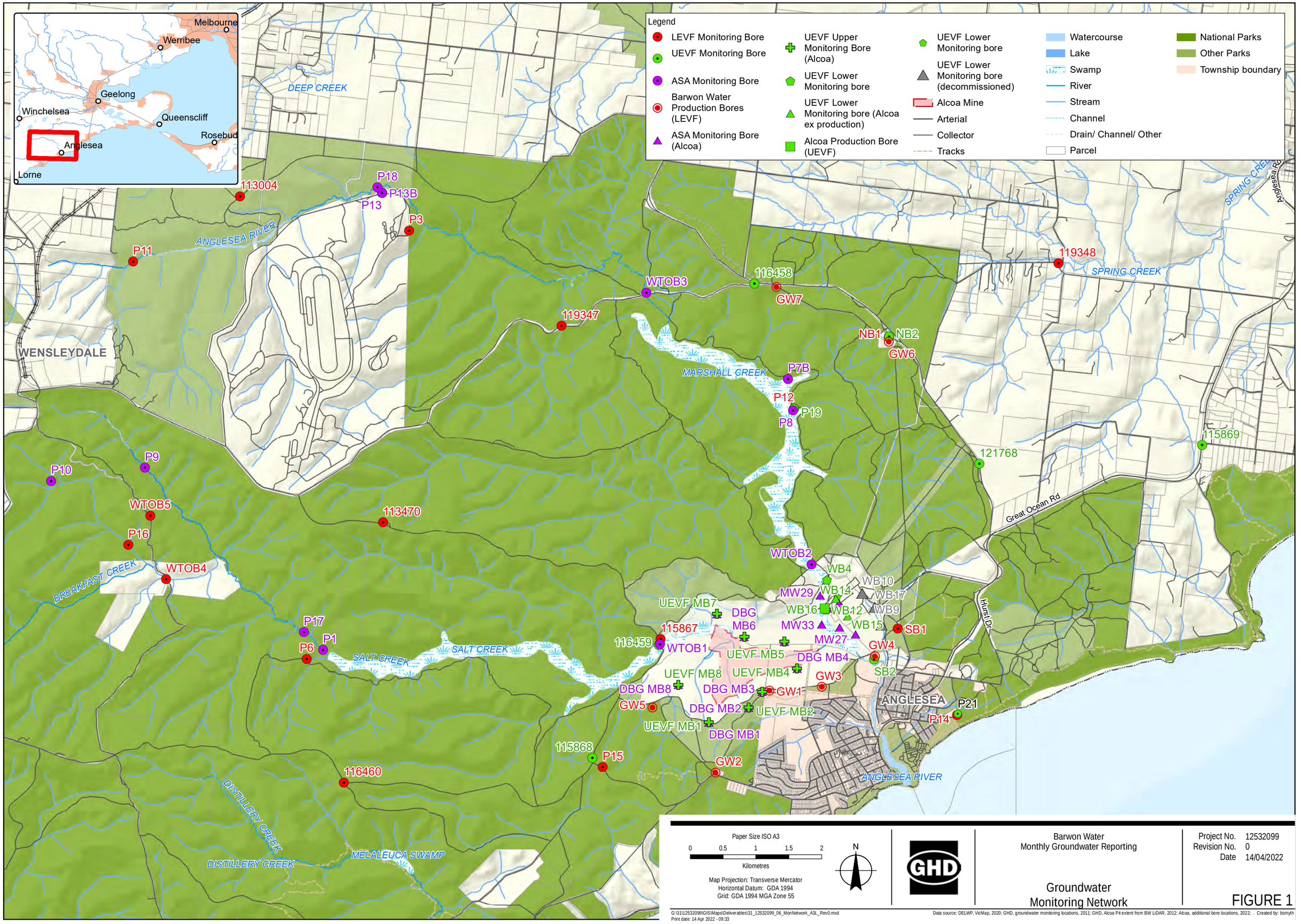
Melbourne
Werribee
Geelong
Winchelsea
Queenscliff
Rosebud
Anglesea
Lorne
Legend
LEVF Monitoring Bore
UEVF Monitoring Bore
ASA Monitoring Bore
Barwon Water Production Bores (LEVF)
ASA Monitoring Bore (Alcoa)
UEVF Upper Monitoring Bore (Alcoa)
UEVF Lower Monitoring bore
UEVF Lower Monitoring bore (Alcoa ex production)
Alcoa Production Bore (UEVF)
UEVF Lower Monitoring bore
UEVF Lower Monitoring bore (decommissioned)
Alcoa Mine
Arterial
Collector
Tracks
Watercourse
Lake
Swamp
River
Stream
Channel
Drain/ Channel/ Other
Parcel
National Parks
Other Parks
Township boundary
DEEP CREEK
ANGLESEA RIVER
SALT CREEK
BREAKFAST CREEK
DISTILLERY CREEK
MARSHALL CREEK
SPRING CREEK
MELALEUCA SWAMP
WENSLEYDALE
ANGLESEA
Great Ocean Rd
Hurst Dr
113004
P18
P13B
P13
P3
P11
119348
116458
WTOB3
GW7
119347
NB1
NB2
GW6
P7B
P12
P19
P8
115869
121768
P9
P10
WTOB5
113470
P16
WTOB4
WTOB2
WB4
WB10
WB14
WB17
MW29
WB16
WB12
WB9
WB15
SB1
UEVF MB7
DBG MB6
115867
MW33
MW27
GW4
116459
WTOB1
UEVF MB5
DBG MB4
SB2
P17
P1
P6
UEVF MB8
UEVF MB4
GW3
DBG MB8
DBG MB3
GW1
GW5
DBG MB2
UEVF MB2
P21
P14
UEVF MB1
DBG MB1
115868
P15
GW2
116460
Paper Size ISO A3
0 0.5 1 1.5 2
Kilometres
N
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55
GHD
Barwon Water
Monthly Groundwater Reporting
Groundwater
Monitoring Network
Project No. 12532099
Revision No. 0
Date 14/04/2022
FIGURE 1
G:\31\12532099\GIS\Maps\Deliverables\31_12532099_06_MonNetwork_A3L_Rev0.mxd
Print date: 14 Apr 2022 - 09:33
Data source: DELWP, VicMap, 2020; GHD, groundwater monitoring locations, 2011; GHD, Alcoa Pit extent from BW LiDAR, 2012; Alcoa, additional bore locations, 2022; . Created by: bsmyth

2. Nested Bores- 116459 (UEVF) and 115867 (LEVF)

These nested bores are located on Bald Hills Rd to the west of Alcoa's pit (refer Figure 1). These two bores are part of the SOBN and were drilled by Hydrotechnology in 1994 as part of a groundwater investigation program in the Torquay Basin.

The bore construction is summarised in Table 1 below and the long term hydrographs of these two bores, and a third adjacent bore 122149 (LEVF) is shown in Figure 2 (1993-2022), and the shorter term hydrograph (2009-2022) shown in Figure 3.

Table 1 State Observation Bore 116459 and 115867 details

Bore ID	Aquifer	Drilled Date	Drilled Depth (m)	Screen From (m)	Screen To (m)	Notes
115867	LEVF	1992	495.7	359	362	DELWP consider failed based on camera inspection DELWP No long monitor this bore Barwon Water do monitor the bore
116459	UEVF	1992	253	243	246	Refurbishment_June 2019 3m screen
122149	LEVF	1992	383	349	383	Decommissioned in 2015/16

Figure 2 Long term Hydrograph 115867 (LEVF), 116459 (UEVF), 122149 (UEVF)

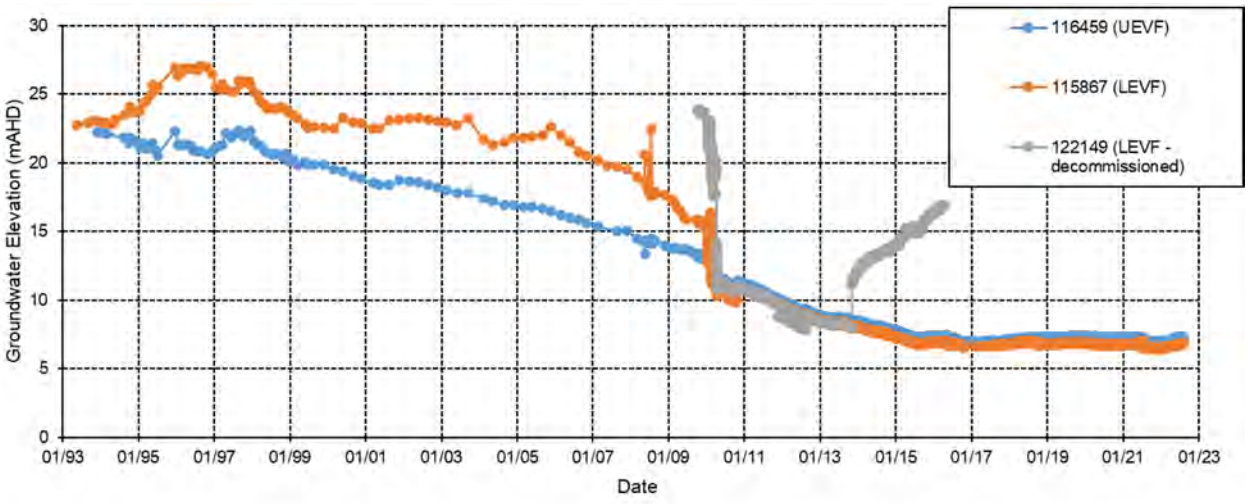

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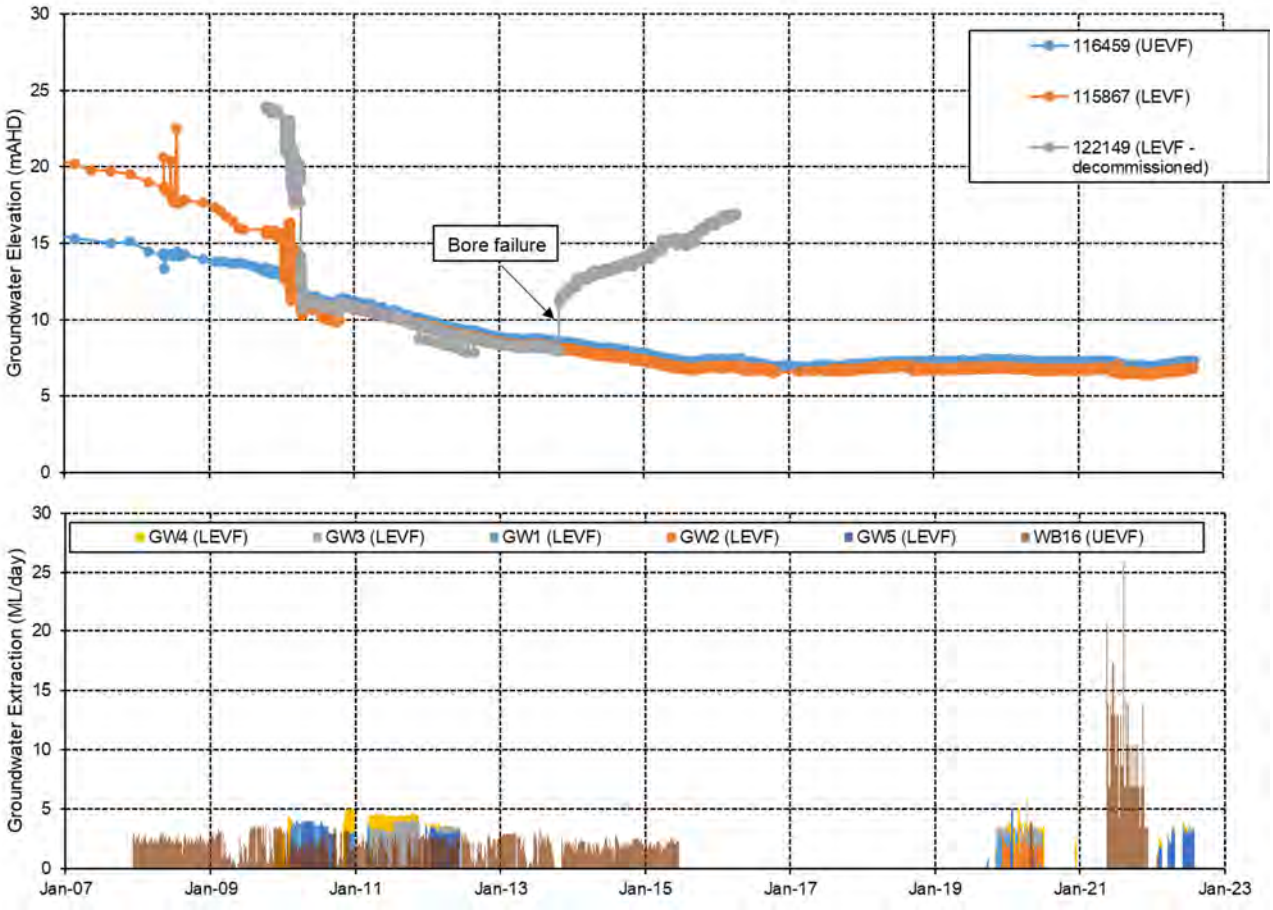
Figure 3 Hydrograph 115867 (LEVF), 116459 (UEVF), 122149 (UEVF) 2009-2022



When 116459 (UEVF) was first drilled the bore was artesian with a head of +3.3m above ground level (mAGL) recorded, and the 115867 (LEVF) was also artesian +0.42mAGL. As can be seen in the hydrograph the LEVF head was generally higher than the UEVF head by around 2-4m pre 2009 (i.e., an upward vertical hydraulic gradient). Groundwater levels in both bores are generally declining since around 1998.

In 2009/2010, when Barwon Water started extraction from the LEVF, the groundwater levels in 115867 (LEVF) and 122149 (LEVF) initially declines, but then as can be seen in Figure 3, the potentiometric head in all three bores stabilised around the same level. This response is indicative of at least one bore failure, with either a hole in the casing or an issue with the grout seal around the casing, and inter-aquifer flow is now occurring around these nested bores.

The heads in these bores remained similar unit 2013 when a sudden head recovery of around 3m occurred in 122149 (LEVF). This sudden change again may indicate a failure of the bore casing or an associated seal, or alternatively a pathway of inter-aquifer flow was closed off. Subsequently DELWP completed a bore condition assessment and confirmed the bore casing was in poor condition, the bore was blocked and was likely to have failed. Bore 122149 was decommissioned by DELWP in 2016.

It is also noted that many of the SOBN bores in the area were not constructed to today's standards, with the seals between aquifers generally being short grout plugs, rather than full pressure grouting which is required to ensure an effective long-term seal between aquifer systems.

The potential inter-aquifer connection at this Salt Creek site has been noted in many previous reports (including GHD, 2013- the last BE review). Since 2009, the remaining two bores 116459 and 115867 continue to mirror each other; the **groundwater level in both bores is likely compromised and the reliability of the data is questionable.** Since Alcoa has reduced and then ceased large scale extraction in

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late 2015 / early 2016, both these observation bores have recorded a slow increase in groundwater levels. Interestingly, when Alcoa completed a 6-month pumping test on UEVF production bore WB16 from May 2021 to December 2021, groundwater levels at 115867 (LEVF) and 116459 (UEVF) were both relatively stable throughout the Alcoa extraction period, although they appear to show a slight drawdown/stabilisation response between June 2021 and August 2021 when extraction rates at WB16 were at their highest. There was no distinct response in either of these bores to the end of Alcoa's UEVF extraction or Barwon Water's changes in extraction from the LEVF over the period of January to July 2022. Over the last few months there appears to be a slight recovery trend that starts around a month after Alcoa extraction ceases. This recovery trend does not seem to be impacted by the LEVF extraction.

Following a camera inspection in 2019, DELWP concluded that 115867 (LEVF) had failed and ceased monitoring the bore, whilst Barwon Water has continued to monitor the bore despite the bore reliability being questionable, as it is in a key location being just west of the mine pit.

DELWP refurbished bore 116459 (UEVF) in 2019, however if the adjacent LEVF bore is a pathway for inter aquifer flow then the water level in this bore will also still likely be compromised.

In conclusion, the potentiometric head in both 116459(UEVF) and 115867 (LEVF) appear to be impacted by inter aquifer flow possibly due to bore failure or poor inter aquifer seals. It is possible (even considered likely) that the drawdown response in 116459 (UEVF) has been dampened or reduced due to leakage from the LEVF aquifer around these nested bores. Similarly, the drawdown and recovery response in 115867 (LEVF) during Barwon Water extraction in 2012 and 2022 was probably restricted by inter aquifer leakage in this area. The true magnitude of drawdown or leakage impacts are not known.

It is obvious that these nested bores stopped being reliable post-2009, but the data pre-2009 may have also been influenced by inter aquifer leakage, albeit to a lesser degree and not to such an obvious degree**.**

3. Bore 115868 (UEVF)

Bore 115868 (UEVF) is loosely nested with bore P15 (LEVF), and located to the south west of the mine void and west of the Barwon Water's Anglesea borefield (Figure 1). Bore 115868 was drilled in the early 1990's as was part of the SOBN, while P15 was installed by Barwon Water in 2009.

The bore construction is summarised in Table 2 below. Long-term hydrographs of these two bores are shown in Figure 2 and the shorter-term hydrographs (2007-2022) are shown in Figure 3.

Table 2 115868 and P15 Details

Bore ID	Aquifer	Drilled Date	Drilled Depth (m)	Screen From (m)	Screen To (m)	Notes
115868	UEVF	1992	245.4	178	184	1 x 6m screen DELWP consider that bore is possible blocked. DELWP No long monitor this bore. Barwon Water do monitor the bore
P15	LEVF	2010	530	362.9	460.4	5 screens through the LEVF

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Figure 4 Long term Hydrograph 115868 (UEVF), P15 (LEVF)

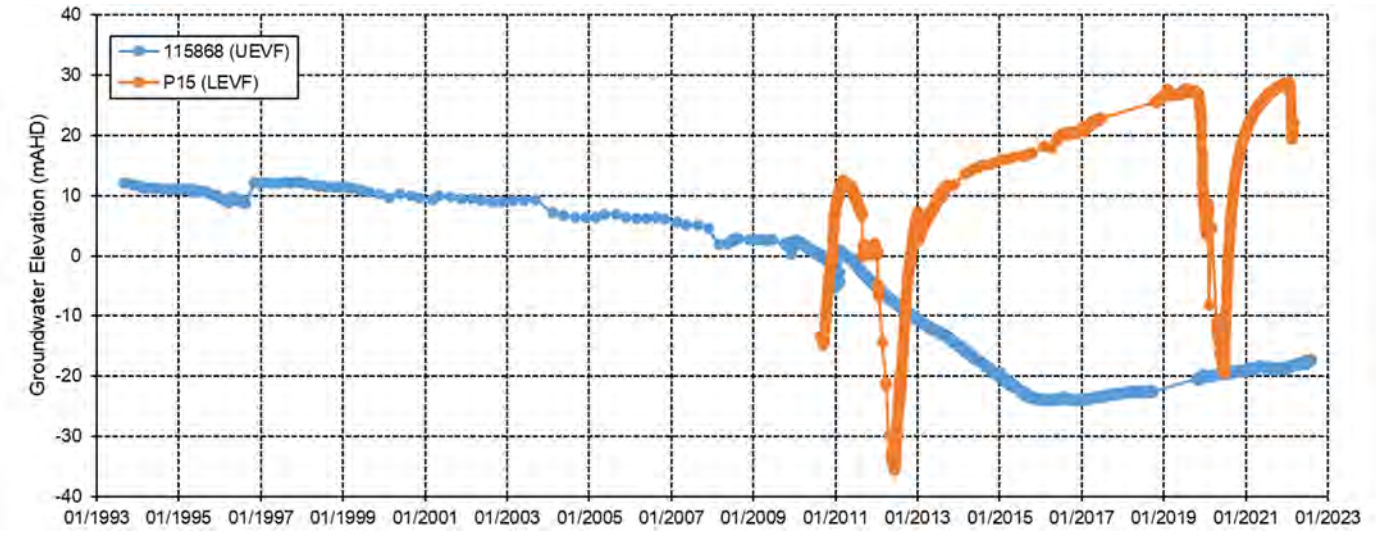
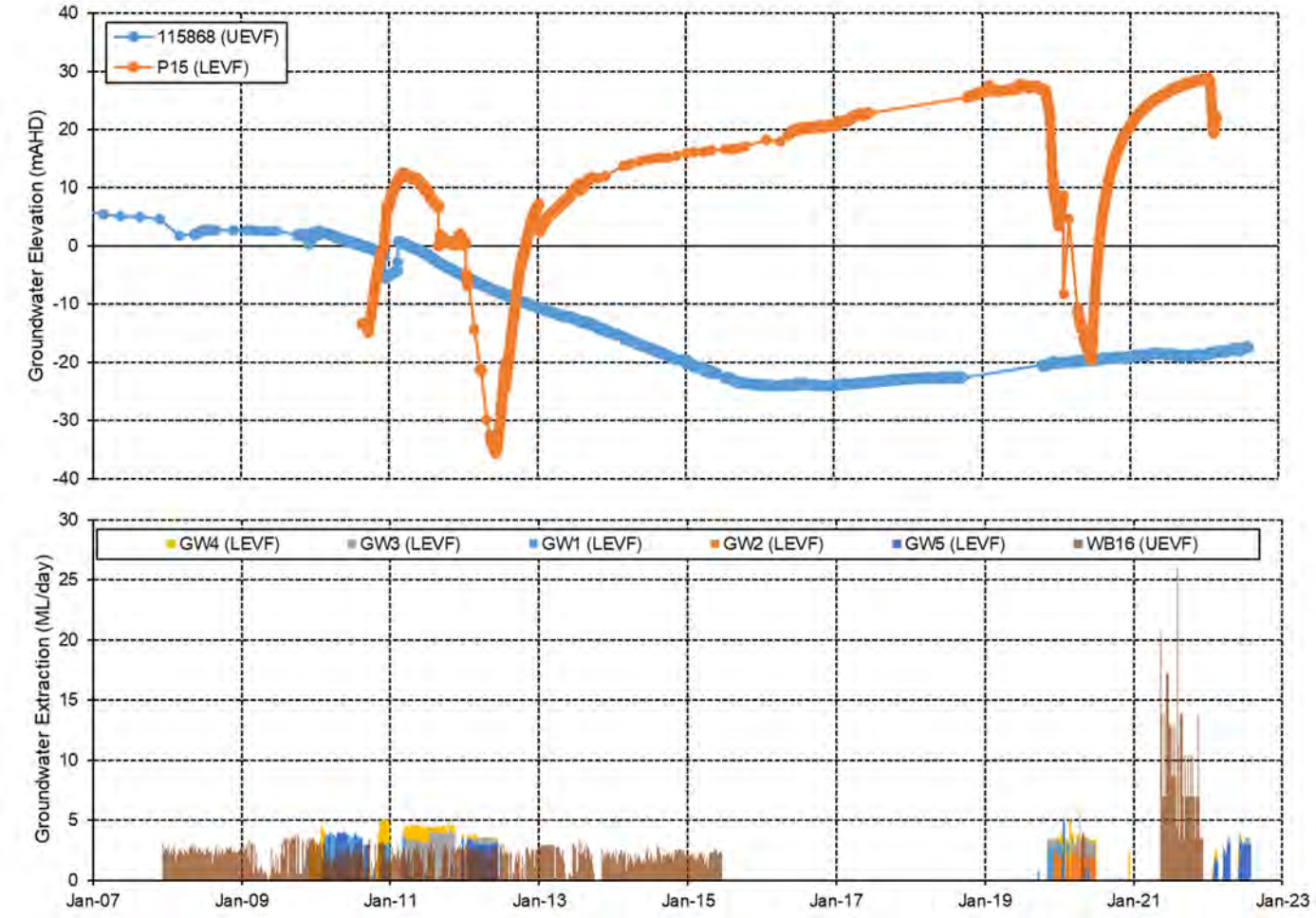


Figure 5 Hydrograph 115868 (UEVF) and P15 (LEVF) 2007-2022



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When 115868 (UEVF) was first drilled the groundwater depth was 71.8 m below ground level (11 mAHD). From 1993 to 2007 the groundwater level in the bore gradually declined by around 10 m. In early 2010, around the time Barwon Water started testing their LEVF extraction bores, the groundwater level in this UEVF bore started to decline rapidly. From 2010 to 2016 the groundwater level in this bore declined around 25m. The declining trend did not cease or return to the pre-2009 rate, even when LEVF extraction was ceased in 2012. In fact, there was no response in this UEVF bore, apart from the start point in 2010; this suggests that the sudden decline was related to LEVF extraction. The groundwater levels in the bore started to stabilise in late 2015, corresponding with a decline and eventual ceasing of large scale UEVF extraction by Alcoa. Since then, groundwater levels have slowly recovered, with a similar pattern to 116459, located around 2.5km to the north-west (refer Figure 6). The recovery tend was temporarily stabilised in 2021 when Alcoa did the test pumping on WB16, and has now continued.

The decline in bore 115868 (UEVF) was approximately 31m in comparison to 116459 (UEVF) which declined around 10m, and which is closer to Alcoa's extraction bores (from 2006 to 2015) and mine void groundwater sink, as summarised in Table 3 (keeping in mind as noted above 116459 itself has integrity issues).

Table 3 Changes in Groundwater heads between Bore 116459 (UEVF) and 115868 (LEVF) between 2006 and 2015

Bore	Approximate Distance from Alcoa extraction bores (Kms)	Approximate Potentiometric level (m RL) in 2006	Approximate Potentiometric level (m RL) in 2015 (1)	Approximate water level Decline (m) between 2006 and 2015	Comment
116459 (UEVF)	2.5	17	7	10	Has integrity issues (as noted in Section 2)
115868 (UEVF)	4.5	6	-24	31	Further from Alcoa production bores so no reason why drawdown should have exceeded 116459
Head difference between 2 bores		9	31		

Notes (1) Prior to Alcoa Ceasing extraction

It is concluded that UEVF bore 15868 also has integrity issues and groundwater heads many be unreliable, based on the following reasons:

- Water levels in the bore suddenly declined from 2010 to 2016 for no logical reason.
- The water level decline is much greater than that at bore 116459 (closer to the pit and other groundwater stresses).
- The bore is considered blocked by DELWP**.**

GHD postulates that the LEVF extraction in 2010, for some unknown reason (pressure changes?), caused clearing of a screen blockage and allowed reconnection with the UEVF aquifer (or the one sand layer screened). Subsequently the bore may have monitored the UEVF to some degree/level since 2010, but it appears to be compromised given its conspicuously low head relative to other bores located closer to centres of UEVF stress (the Alcoa mine and pumping bores). The large decline in groundwater level noted since 2010 in this bore could potentially also be influenced by the individual sand zone screened, but this is unclear. If. This potential issue is relevant for most of the SOBN bores, whilst the newer monitoring bores normally screen numerous sand layers, like the production bores do, and therefore provide more representative results of groundwater levels with the aquifer system as a whole.

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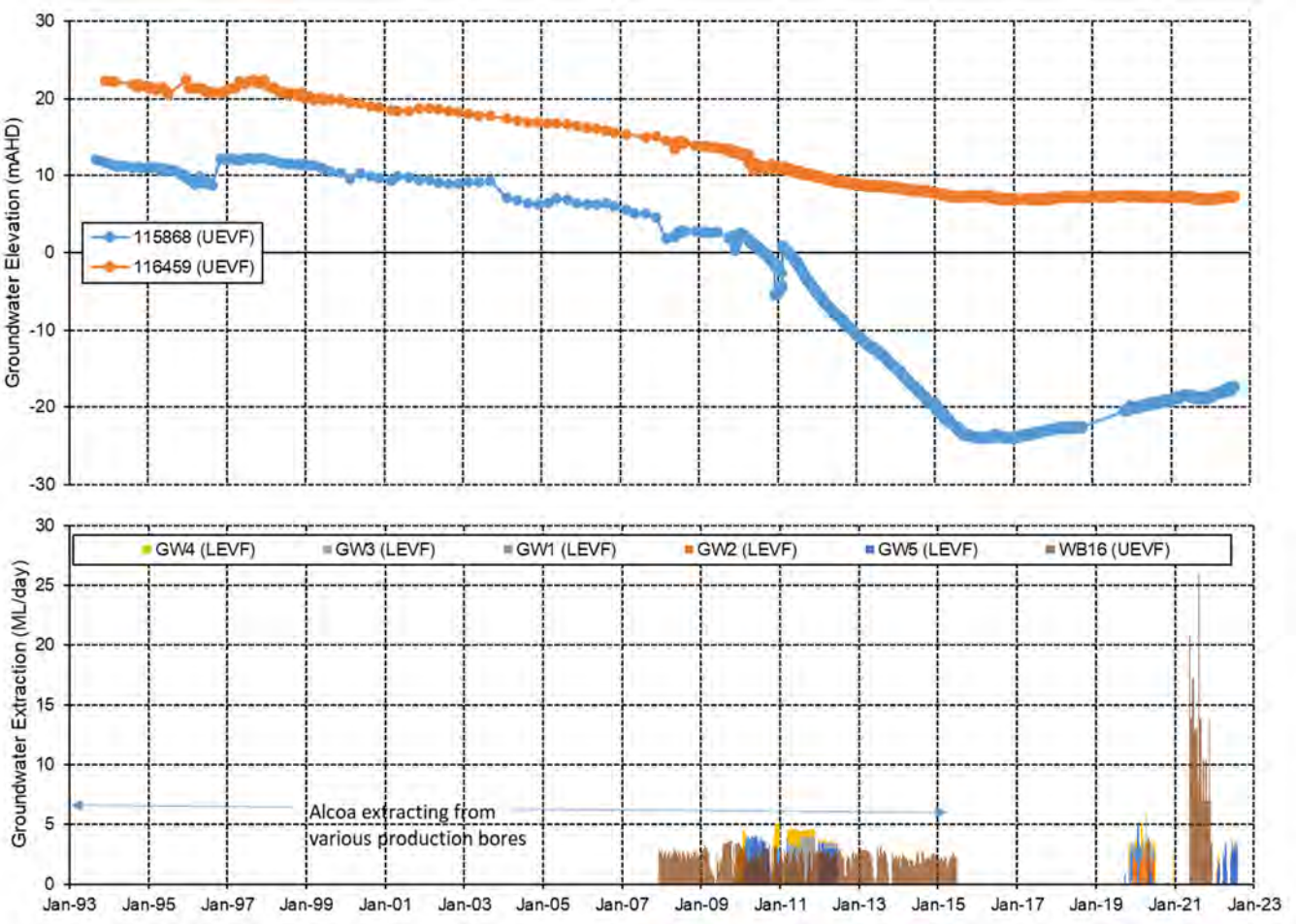
Figure 6 Long term Hydrograph 115868 (UEVF) and 116459 (UEVF)



4. Other Observation bores

For completeness, some additional commentary in regard to bore integrity and bore responses has been included (which has been documented in other reports and memos).

– **UEVF southern syncline**

Alcoa observation bores monitoring the UEVF, WB4, WB5, WB12, WB14 and WB15 (Figure 1) show a minor but distinct response to Barwon Water extraction from the LEVF aquifer prior to July 2020. This response had been discussed with Alcoa, and was a subject of review (GHD, June 2020), where inter-aquifer connection was concluded to likely be related to a number of Alcoa bores which intersected the MEVF aquitard (i.e., WB9, WB10). A number of these Alcoa bores have since been decommissioned by Alcoa (WB5, WB9, WB10, WB13, WB17) to attempt to minimise interaction. The historical groundwater levels may be impacted to some degree from this potential inter aquifer flow (noting that some bores like WB9 have been assigned screens in both aquifers in the model).

– **SOBN bores**

DELWP have refurbished the following SOBN bores over the last few years:

- 116460 (LEVF): 2019
- 119347 (LEVF): 2020
- 116459 (UEVF): 2019

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- 119348 (LEVF):2019

As noted previously, in general it was considered by GHD and DELWP that many of these bores were poorly constructed and may have allowed inter aquifer flow, and therefore the reliability of the historical record could be questionable.

– **Bore 121768 (UEVF)**

This bore is screened across two intervals between 100.7 to 120.8. The bore is located on the Bells Beach anticline, the bedrock high between the northern and southern Barwon Water borefields. Hydrotechnology, 1992 concluded that the sand screened was UEVF based on core and palynological analysis. Bedrock was intersected at 122.5m (i.e., no LEVF is present over the anticline).

Despite screening the UEVF there was a distinct recovery trend in this bore in 2012 following Barwon Water's 6-month extraction test from the LEVF. Similarly, a decline in groundwater levels in this bore was noted in mid-2022, while Barwon Water were undertaking their latest extraction test, indicating that extraction from the LEVF is having some effect on groundwater levels in the UEVF in the area of the anticline.

It is hypothesised that on the flanks of the anticline the sediments are thinner (including the MEVF aquitard), possibly inter-layered and the UEVF and LEVF aquifers potentially become more hydraulically connected in this area, causing the response observed.

5. References

Hydrotechnology (1994). Preliminary Appraisal of the Groundwater Resource Potential of the Torquay Basin for Urban Supply Development. Barwon Water Government Service Contract

GHD, (2020), *Anglesea Borefield: Alcoa pumping test review: Response to Alcoa Queries*, Letter for Barwon Water

GHD, (2022). Anglesea Borefield Monthly Groundwater Review: July 2022. Report prepared for Barwon Water

6. Concluding remarks

If there are any queries in regard to the content of this memo, please do not hesitate to contact me.

Regards

Jeff Morgan
Senior Hydrogeologist

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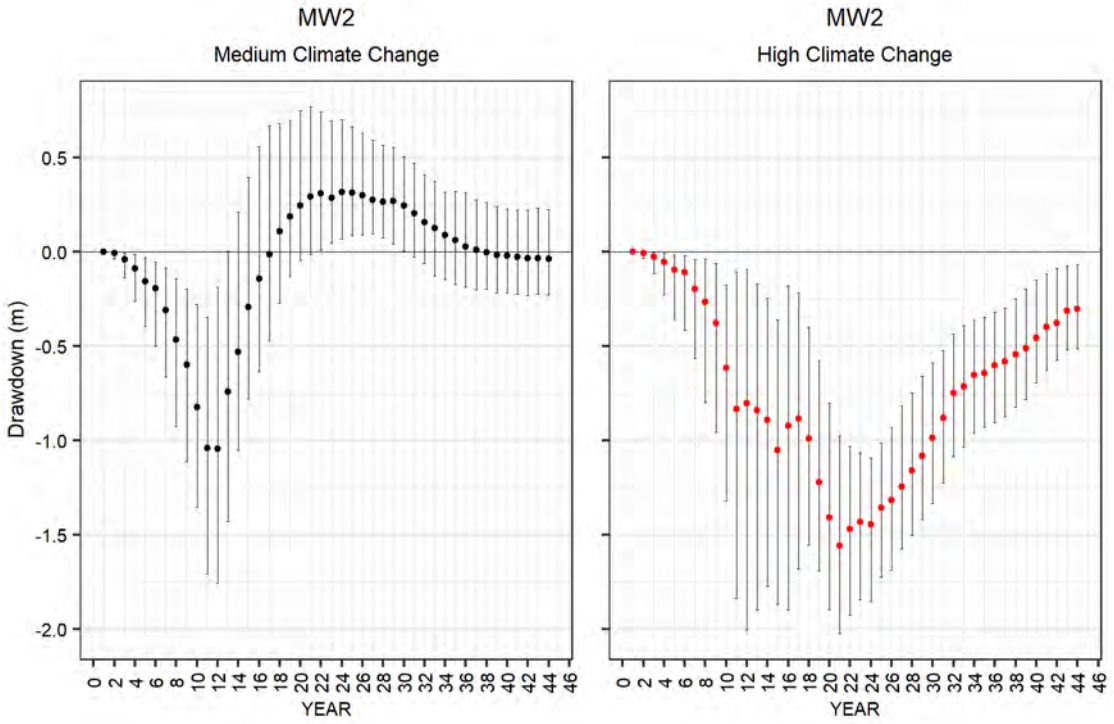
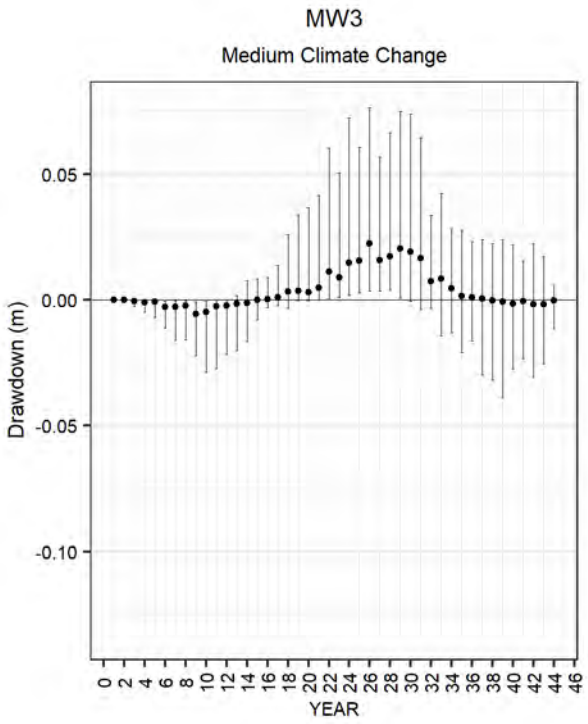
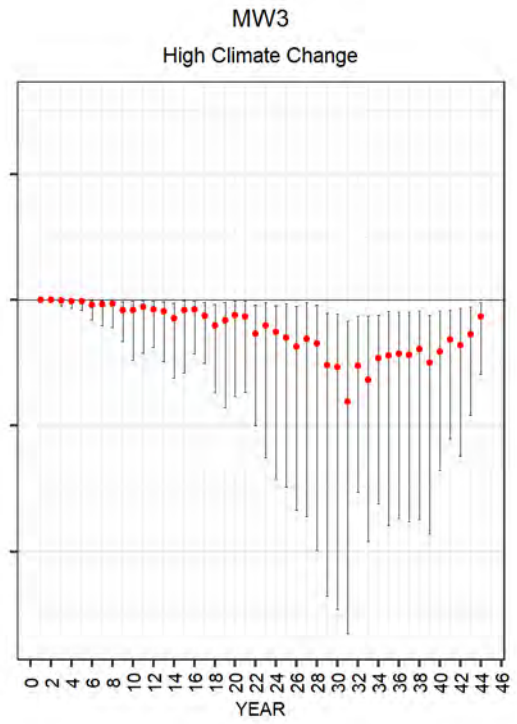
→ The Power of Commitment

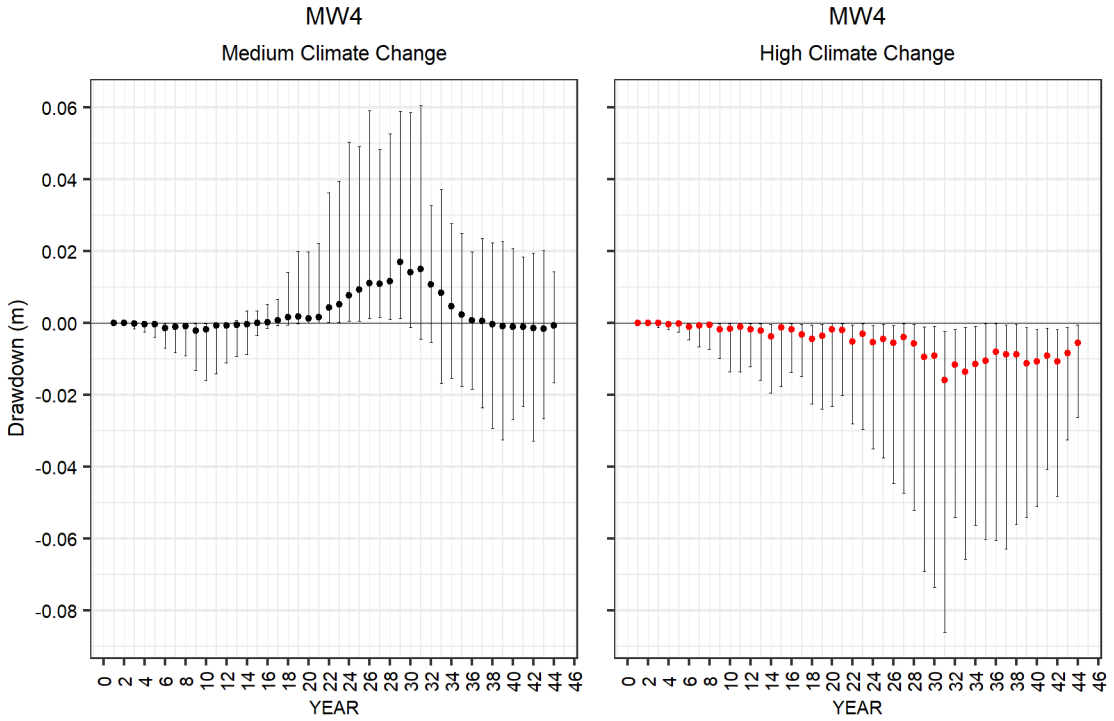
Appendix F1 Numerical Modelling Outputs (Drawdown)

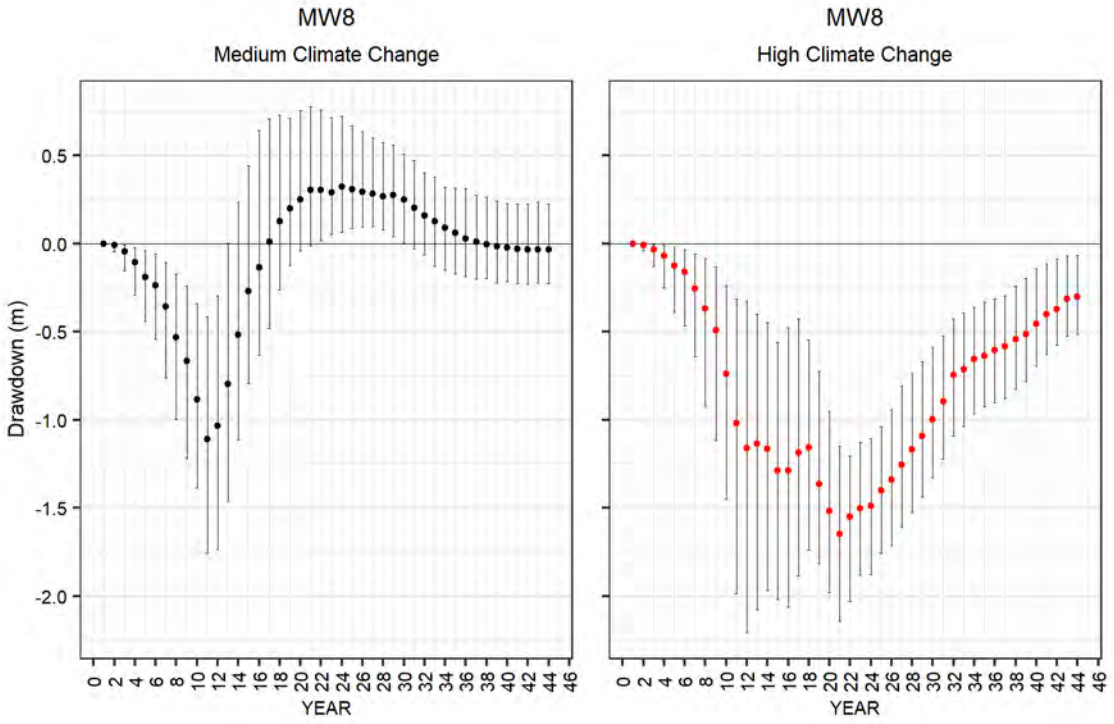

MW2
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

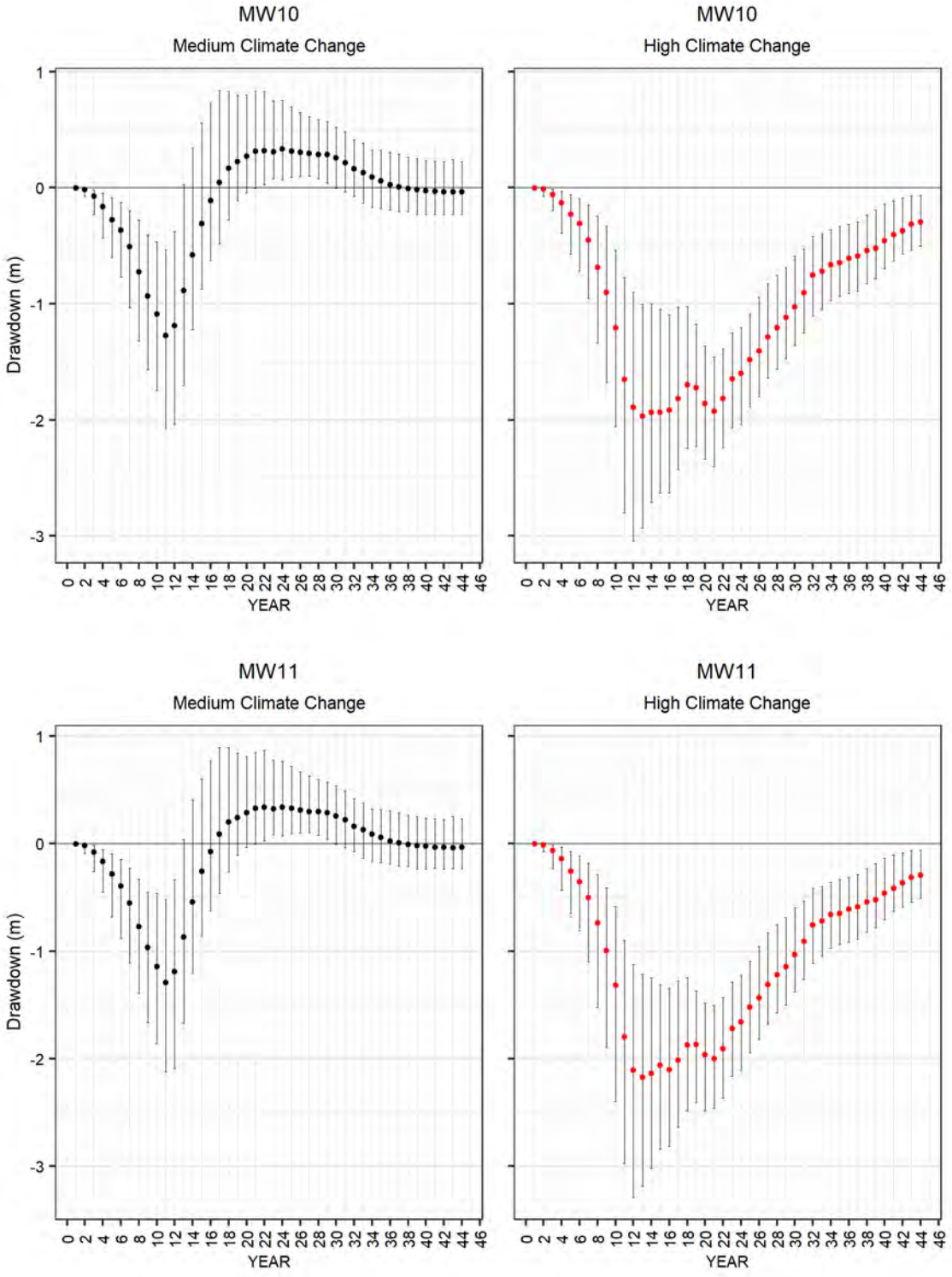
MW2
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

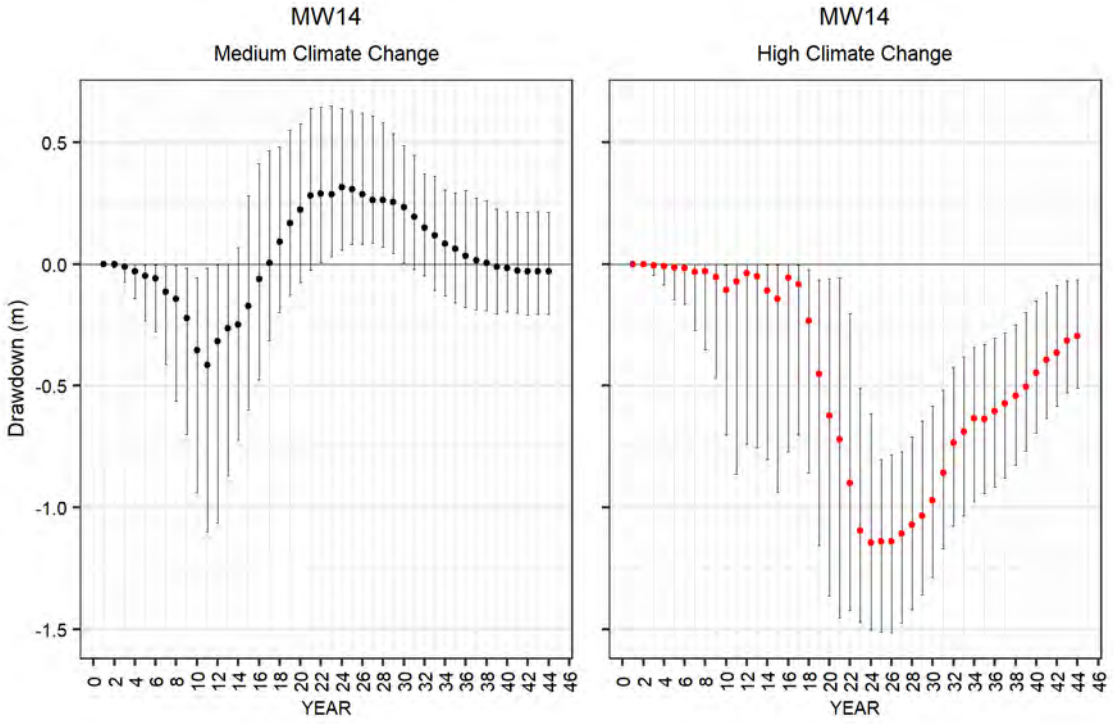

MW3
Medium Climate Change
Drawdown (m)
0.05
0.00
-0.05
-0.10
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW3
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

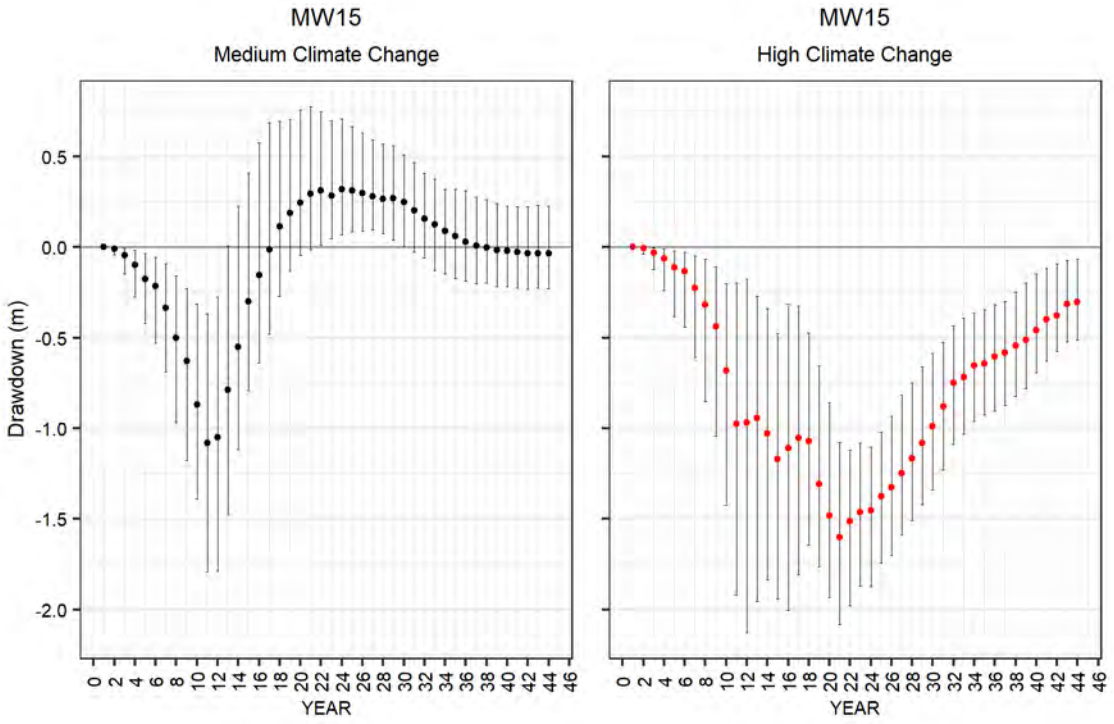

MW4
Medium Climate Change
MW4
High Climate Change
Drawdown (m)
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW8
Medium Climate Change
MW8
High Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

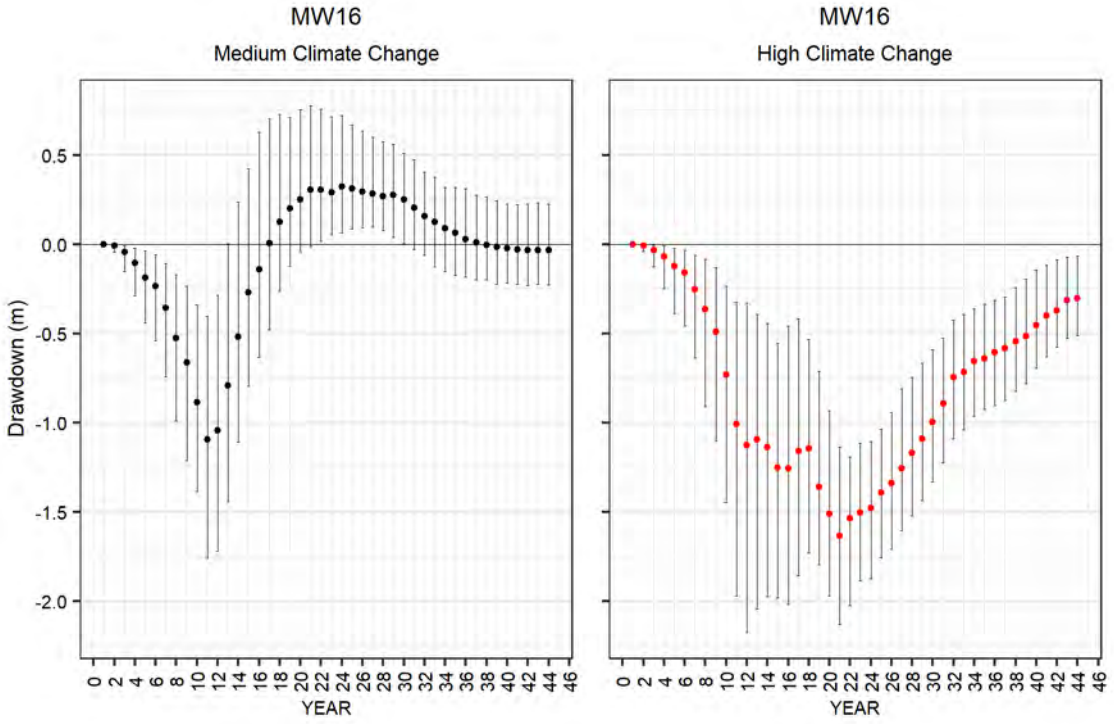

MW10
Medium Climate Change
MW10
High Climate Change
MW11
Medium Climate Change
MW11
High Climate Change
Drawdown (m)
YEAR


MW14
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

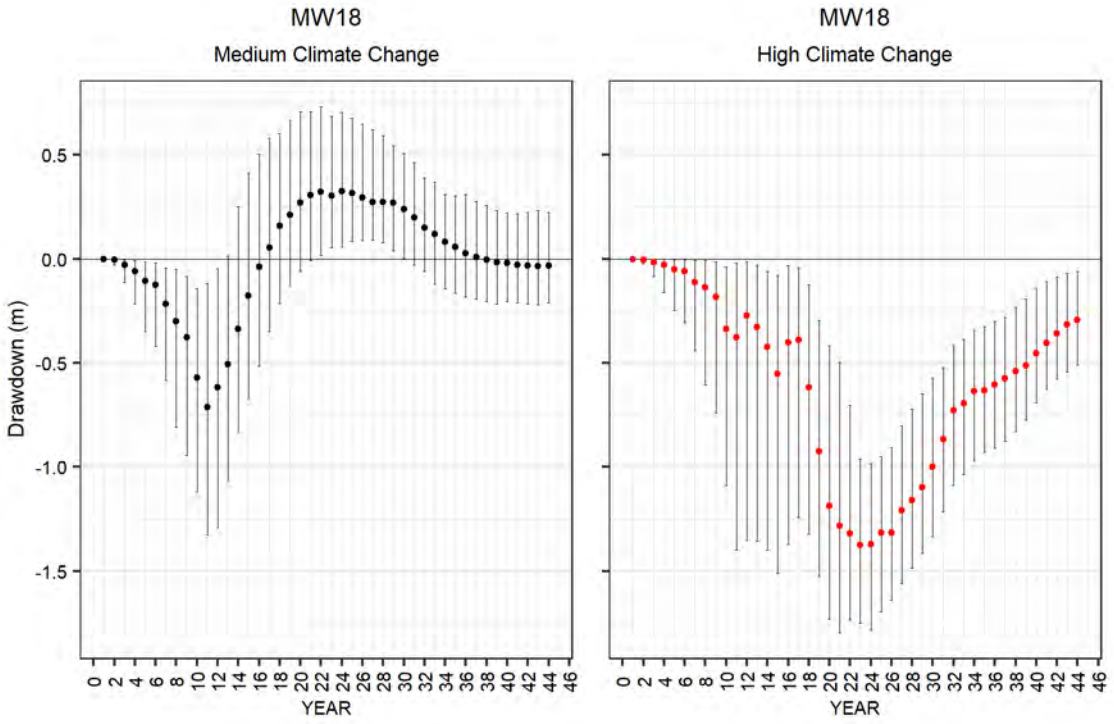
MW14
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW15
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

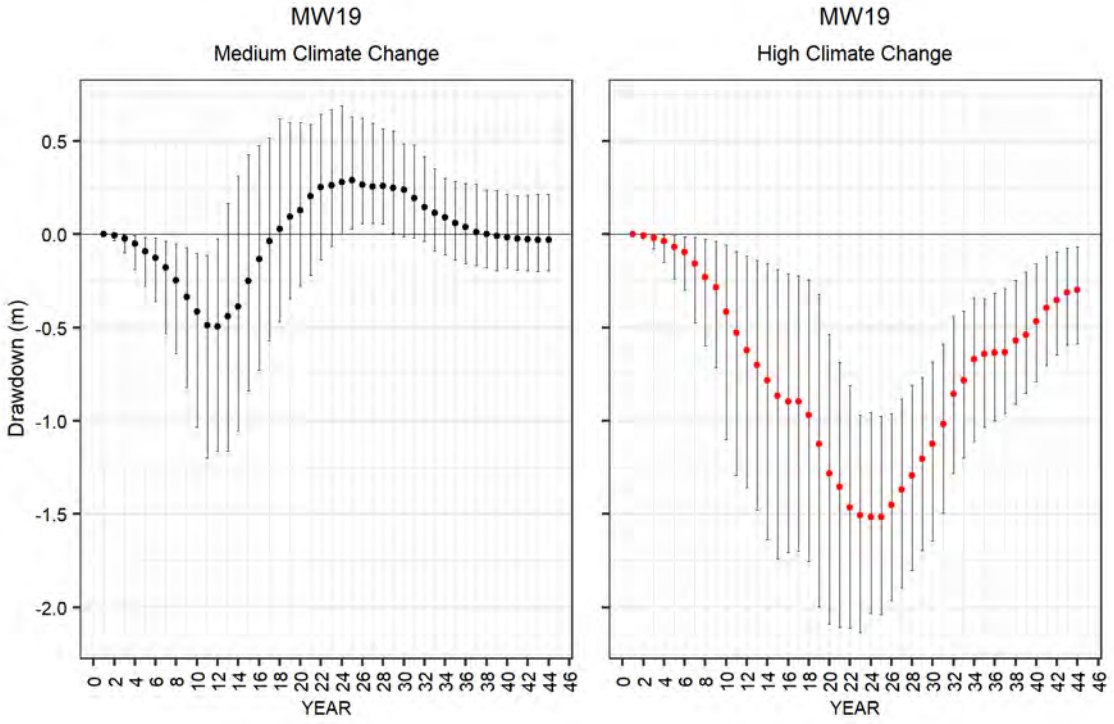
MW15
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW16
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

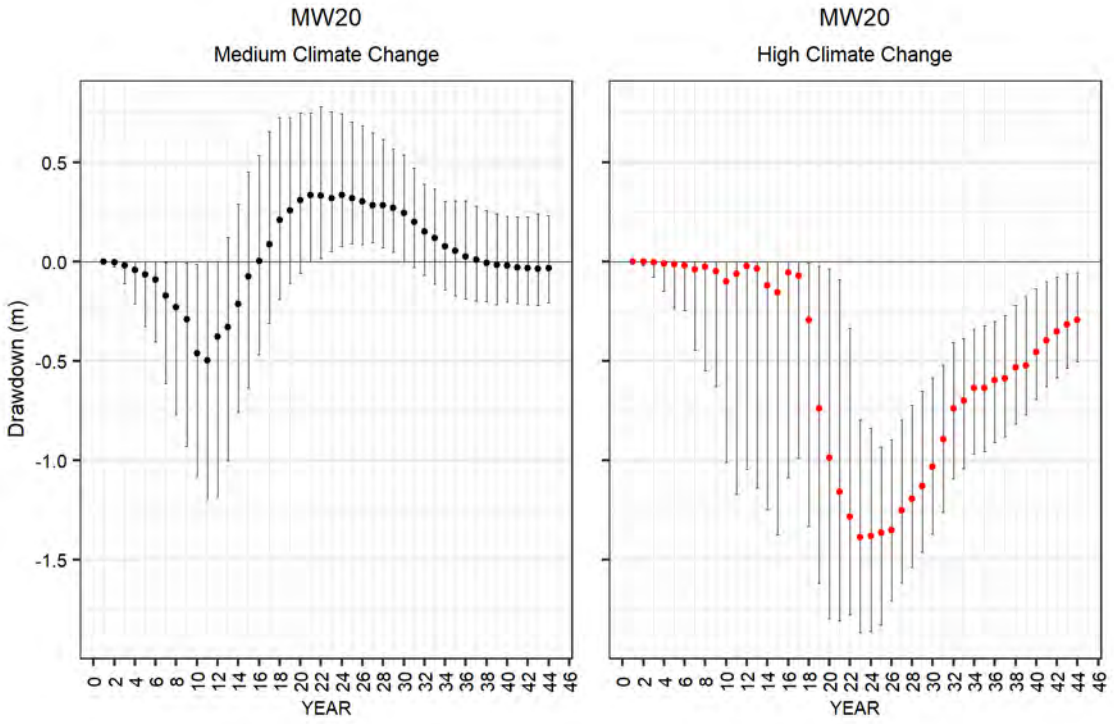
MW16
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW18
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

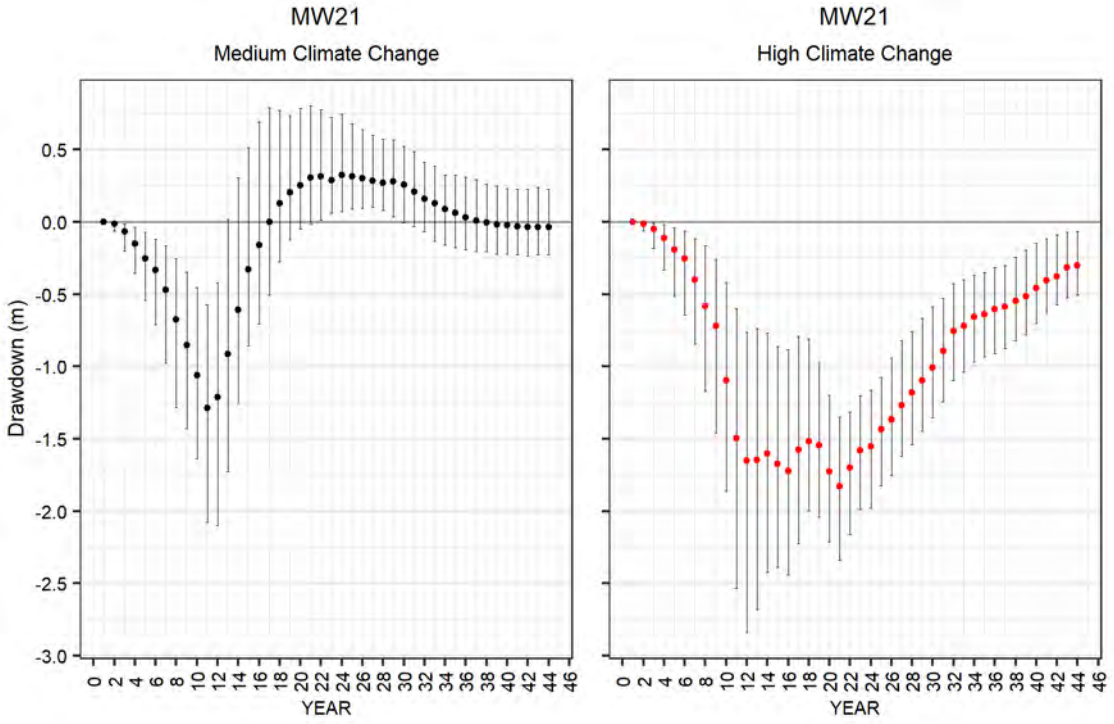
MW18
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW19
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

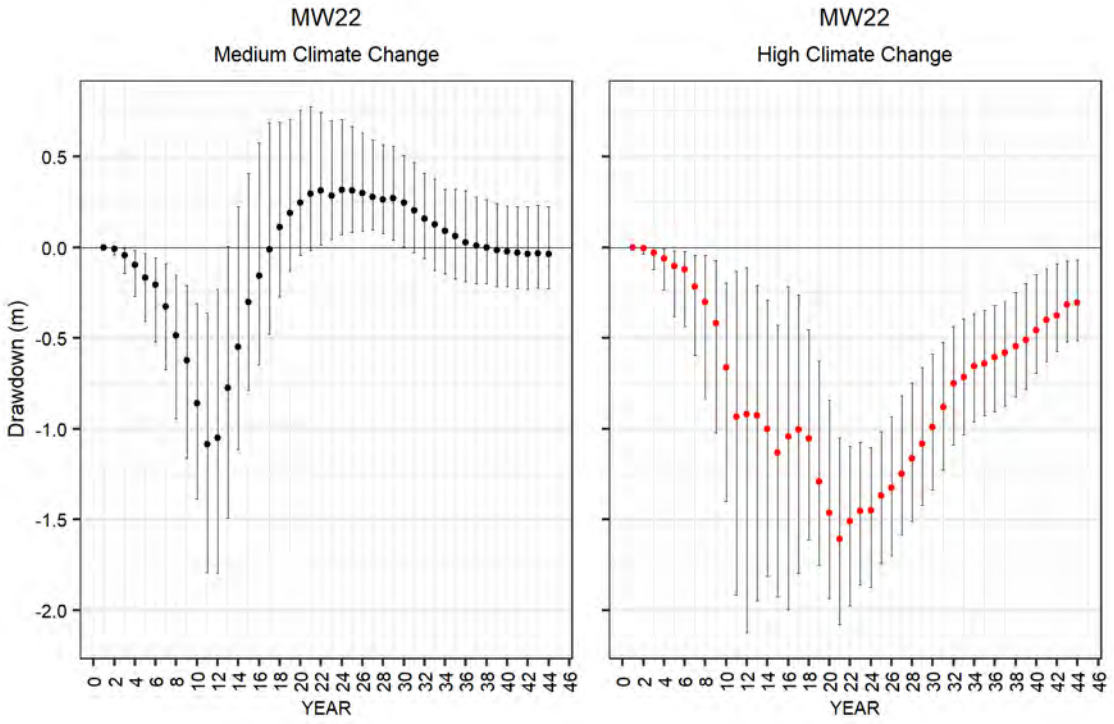
MW19
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW20
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

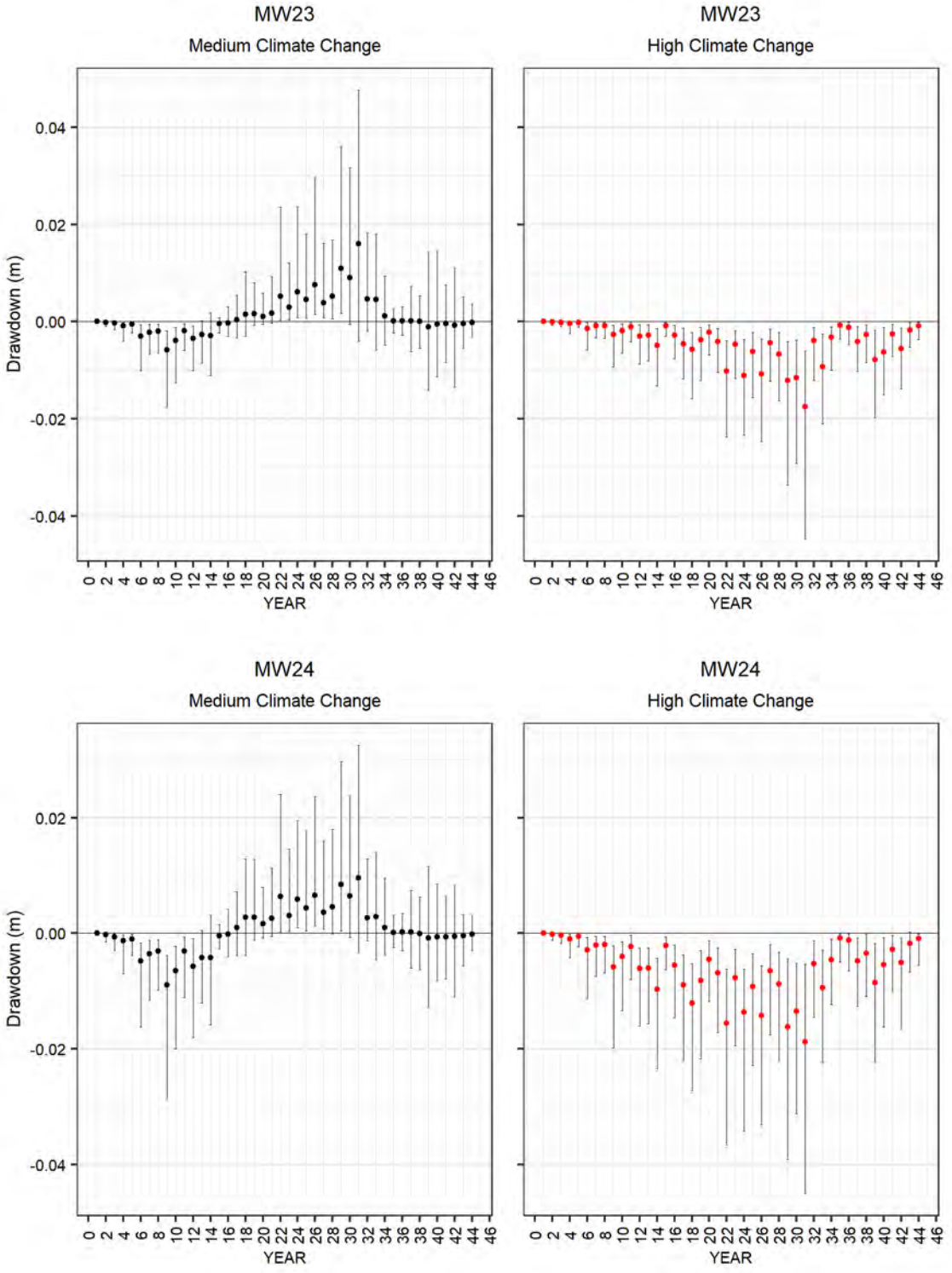
MW20
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

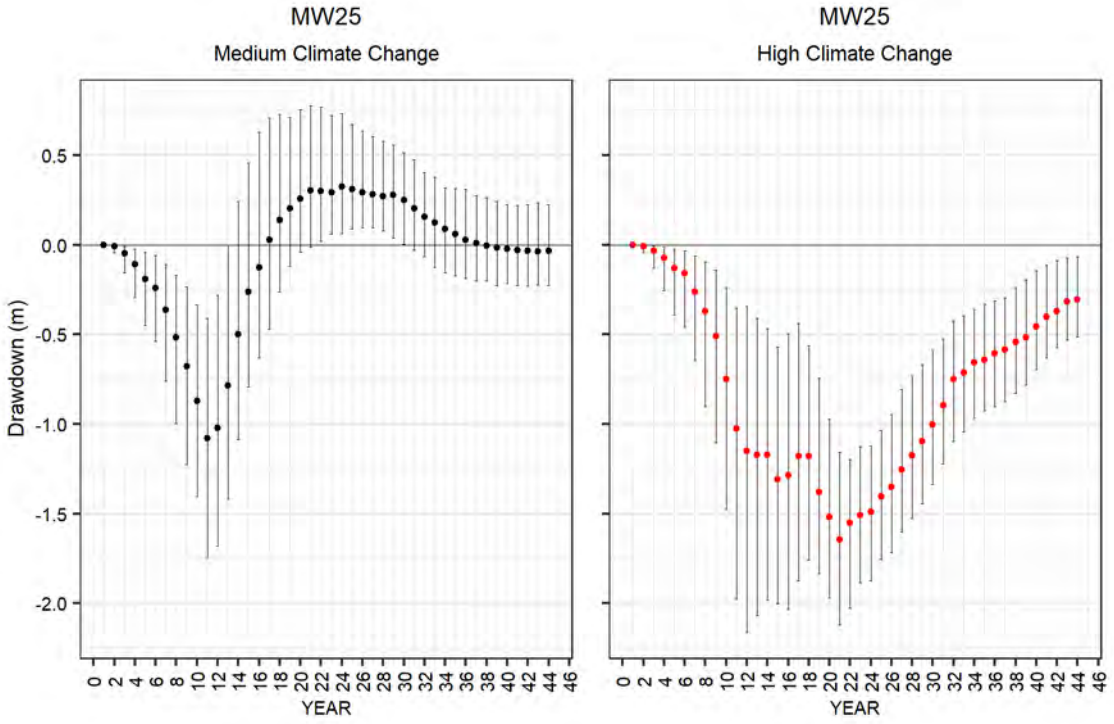

MW21
Medium Climate Change
Drawdown (m)
YEAR

MW21
High Climate Change
YEAR

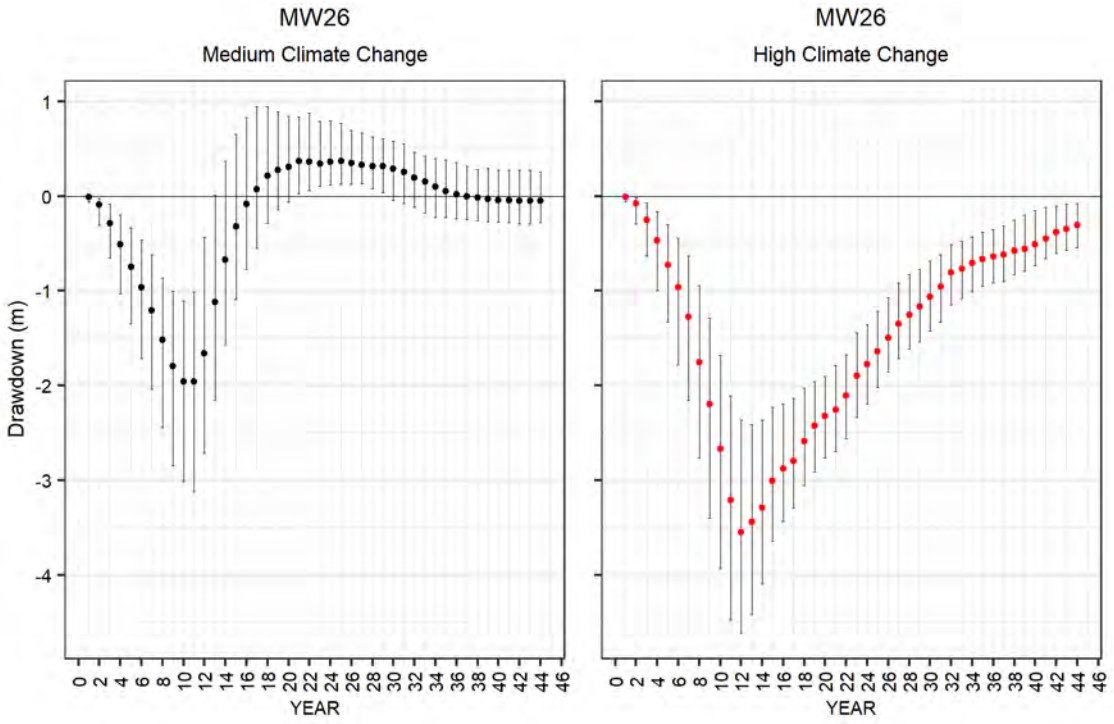

MW22
Medium Climate Change
Drawdown (m)
YEAR

MW22
High Climate Change
YEAR

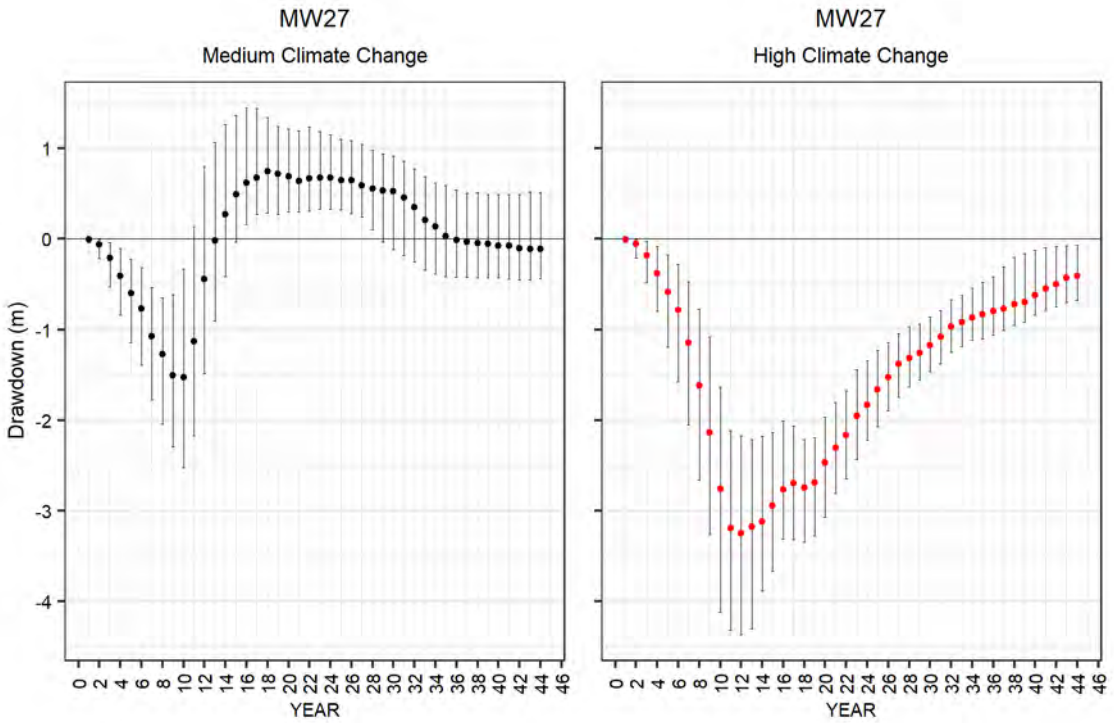

MW23
Medium Climate Change
MW23
High Climate Change
MW24
Medium Climate Change
MW24
High Climate Change
Drawdown (m)
YEAR


MW25
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

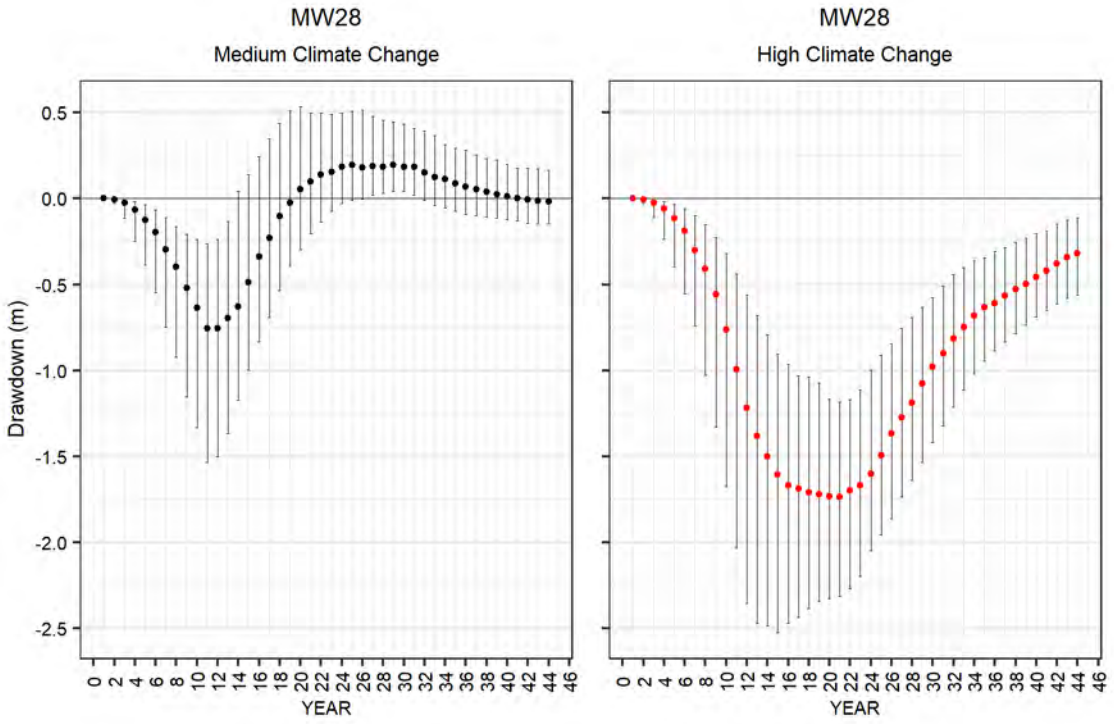
MW25
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW26
Medium Climate Change
Drawdown (m)
1
0
-1
-2
-3
-4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

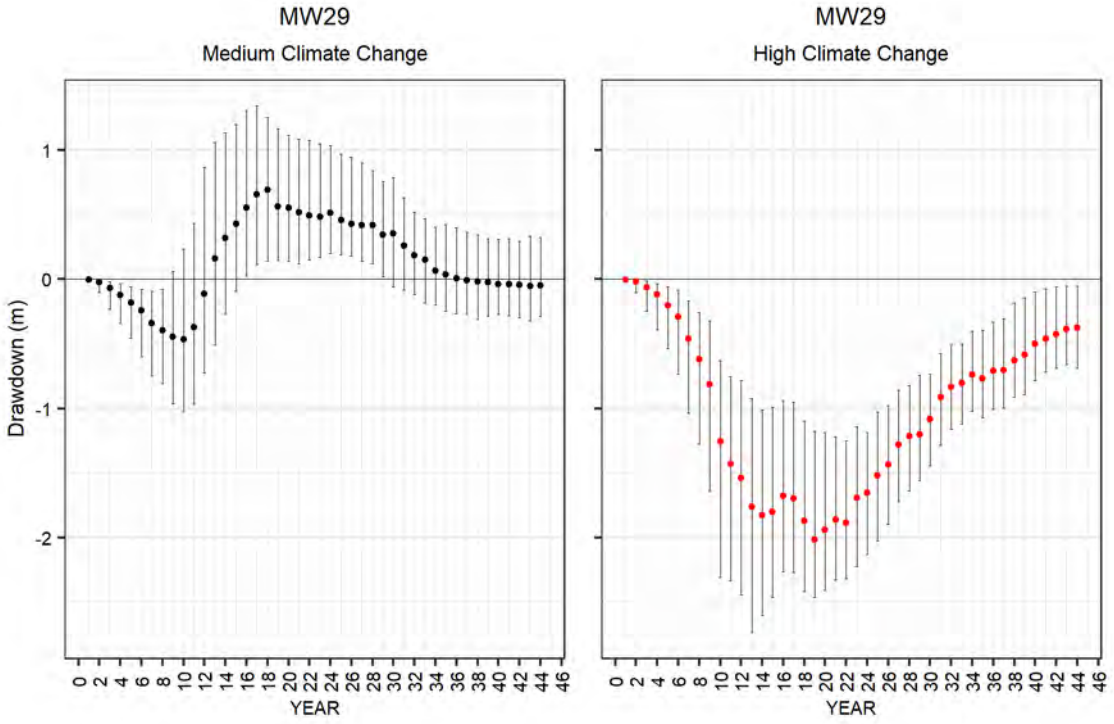
MW26
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW27
Medium Climate Change
Drawdown (m)
YEAR

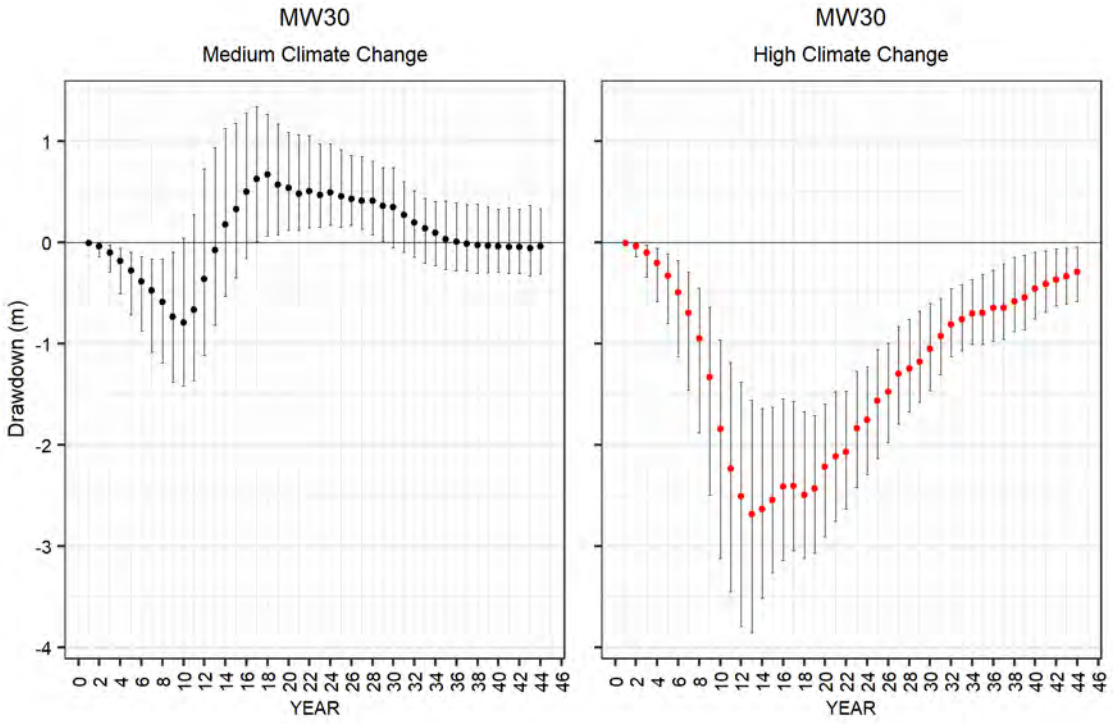
MW27
High Climate Change
YEAR


MW28
Medium Climate Change
Drawdown (m)
YEAR

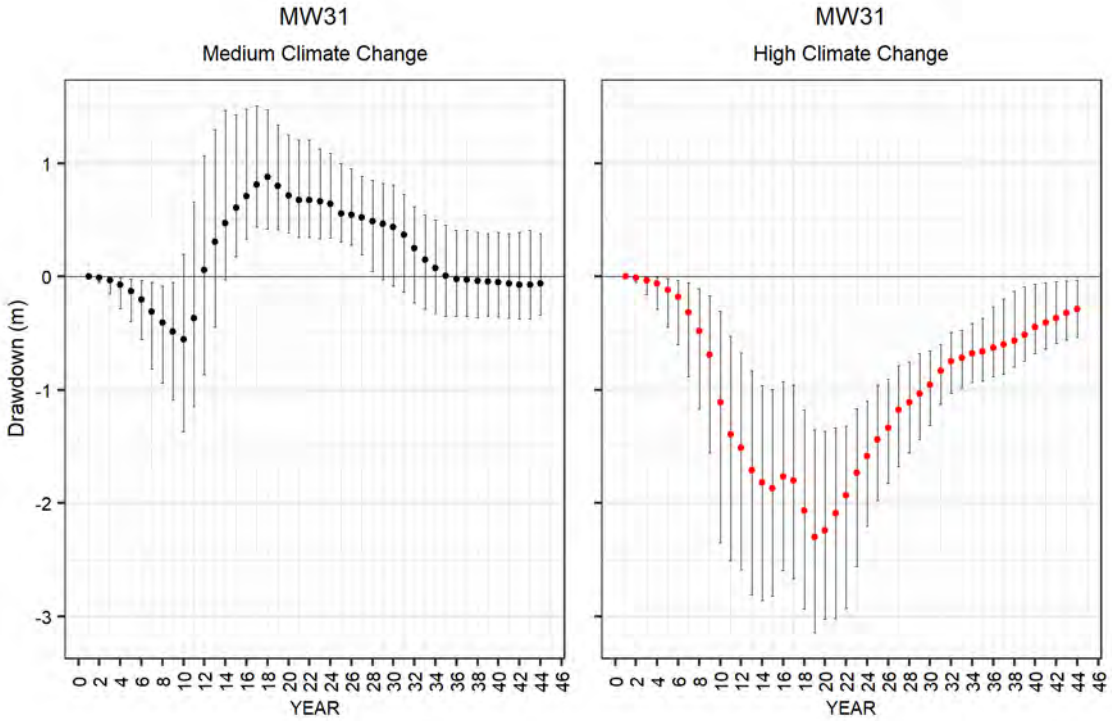
MW28
High Climate Change
YEAR

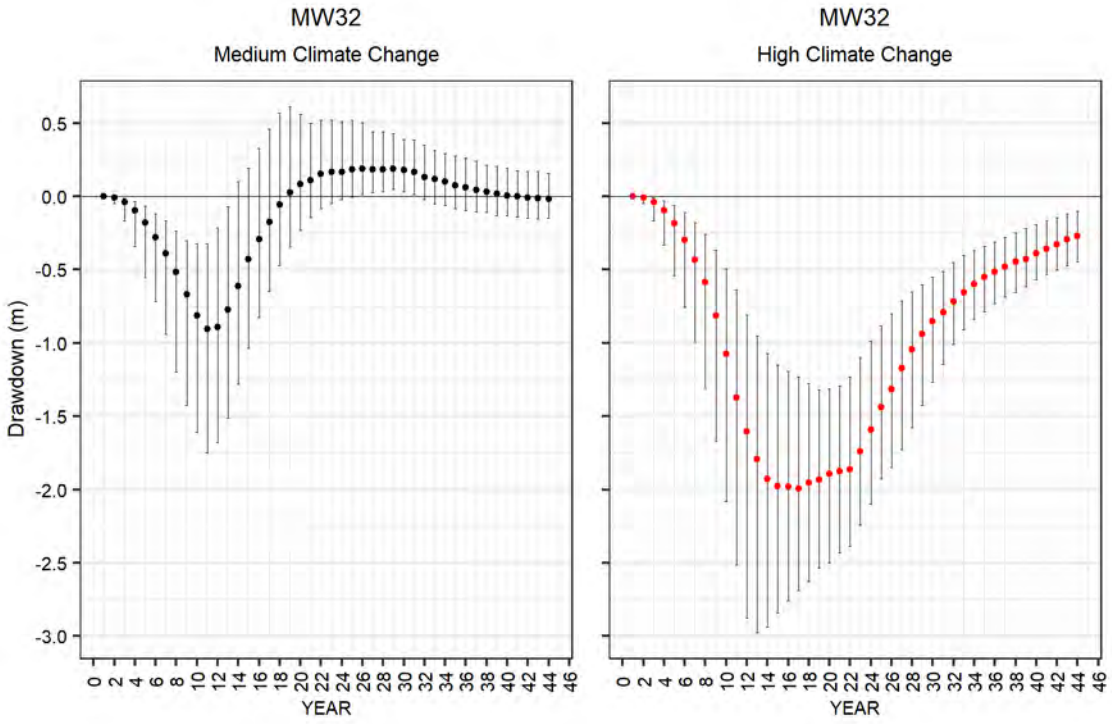

MW29
Medium Climate Change
Drawdown (m)
YEAR

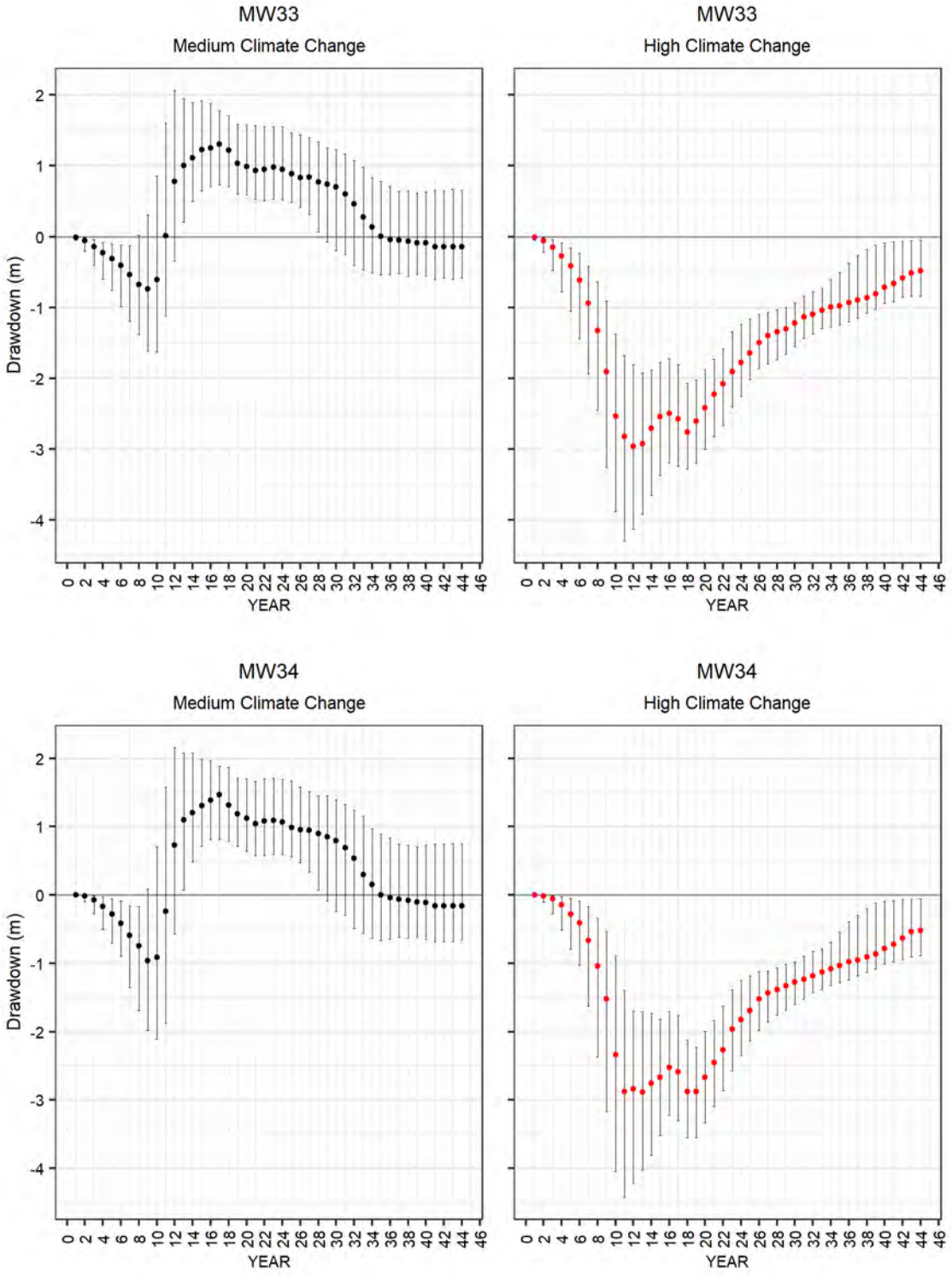
MW29
High Climate Change
YEAR

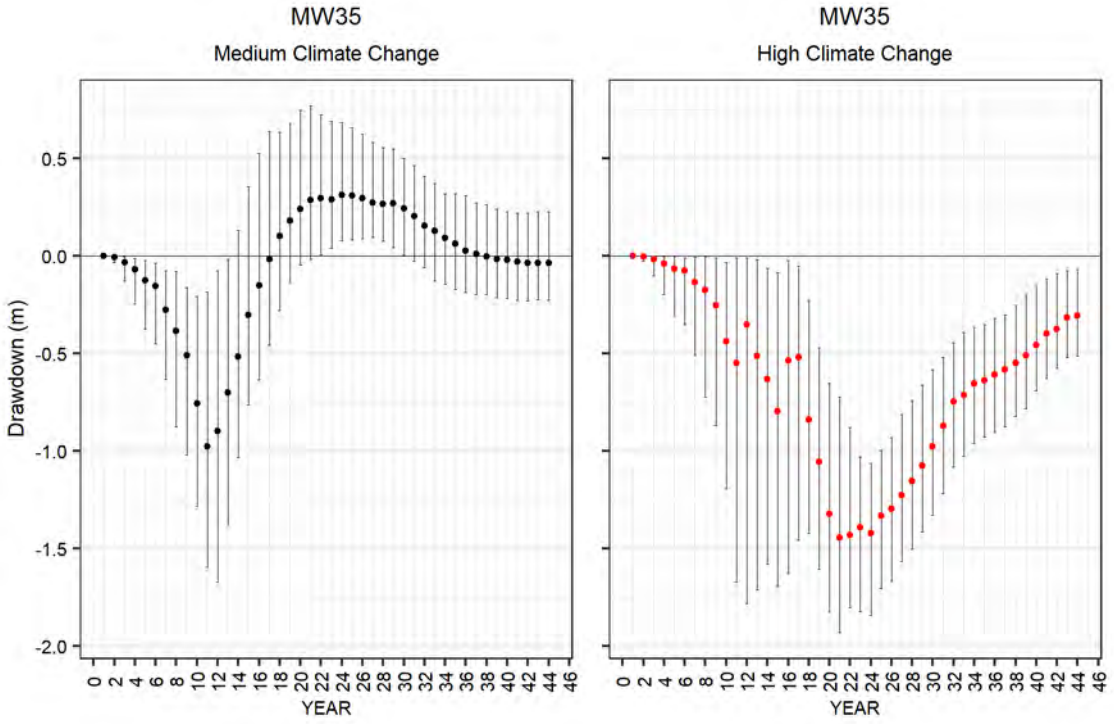

MW30
Medium Climate Change
Drawdown (m)
YEAR

MW30
High Climate Change
YEAR

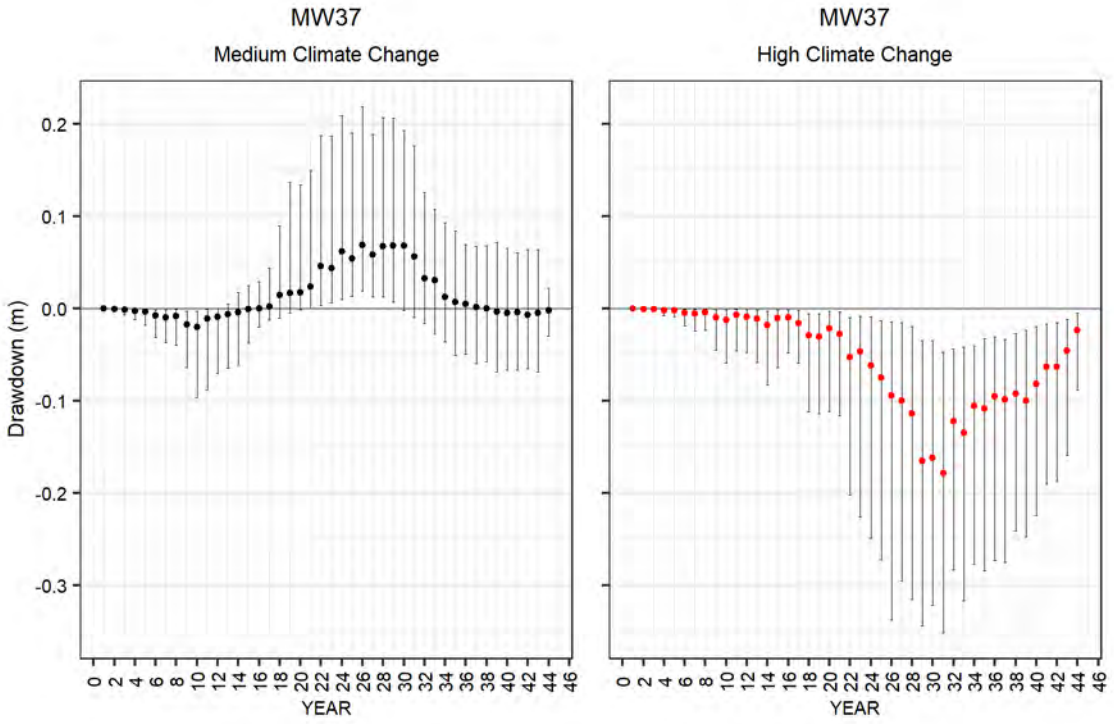

MW31
Medium Climate Change
MW31
High Climate Change
Drawdown (m)
YEAR


MW32
Medium Climate Change
MW32
High Climate Change
Drawdown (m)
YEAR

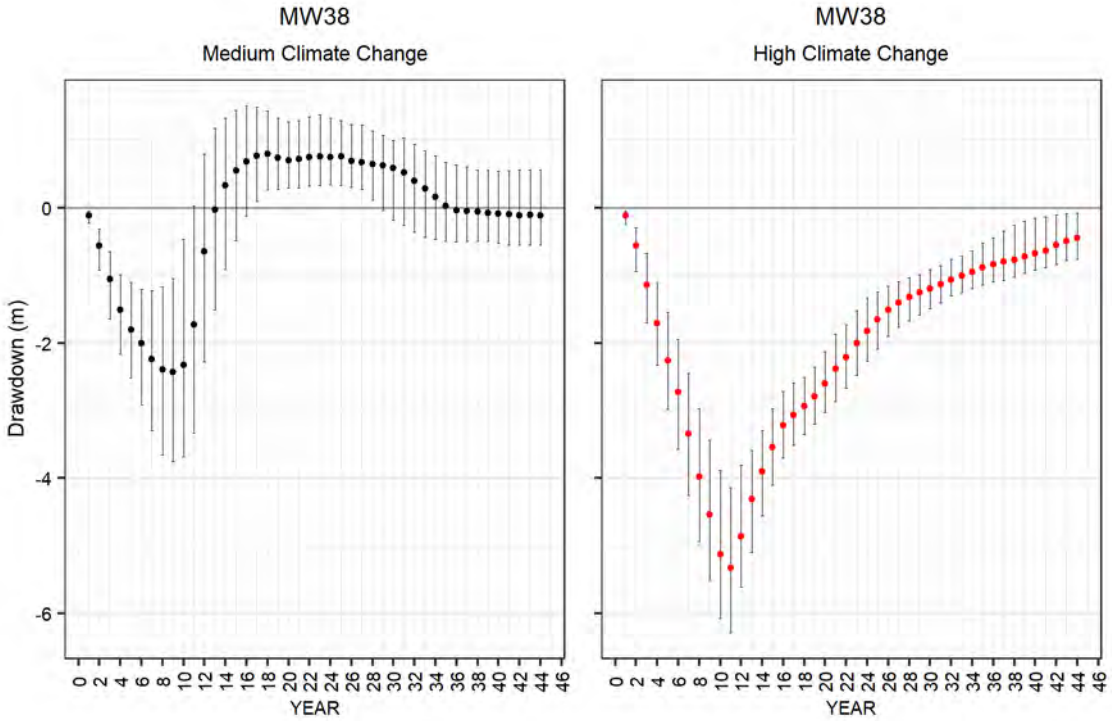

MW33
Medium Climate Change
MW33
High Climate Change
MW34
Medium Climate Change
MW34
High Climate Change
Drawdown (m)
YEAR


MW35
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

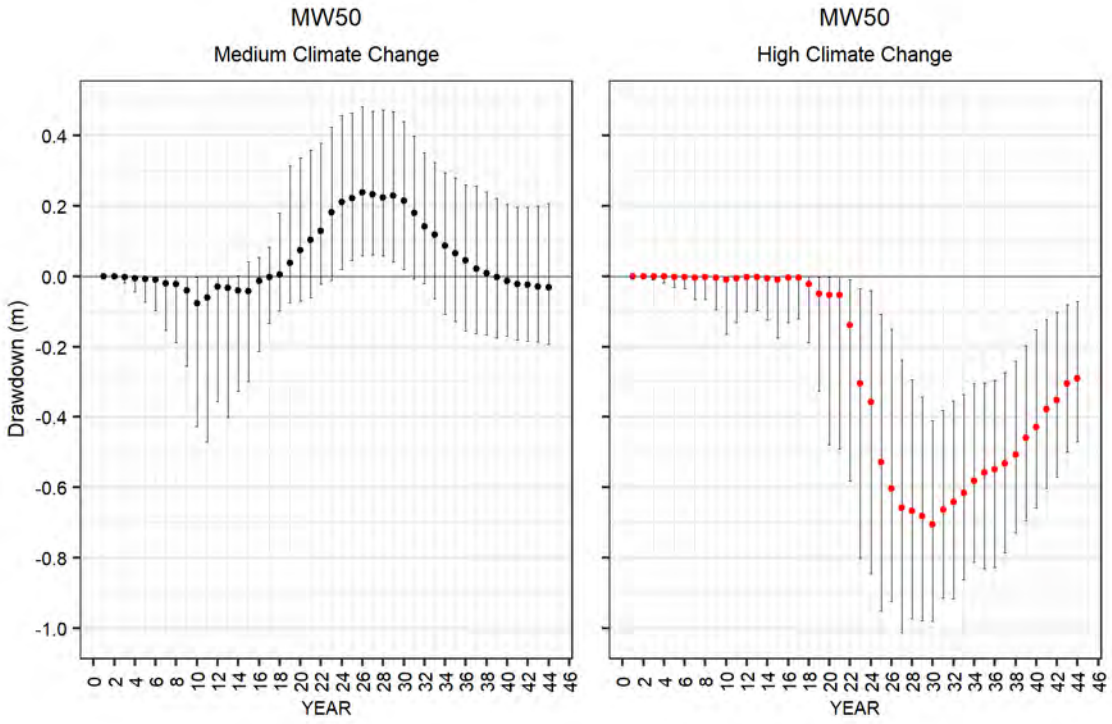
MW35
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW37
Medium Climate Change
Drawdown (m)
0.2
0.1
0.0
-0.1
-0.2
-0.3
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

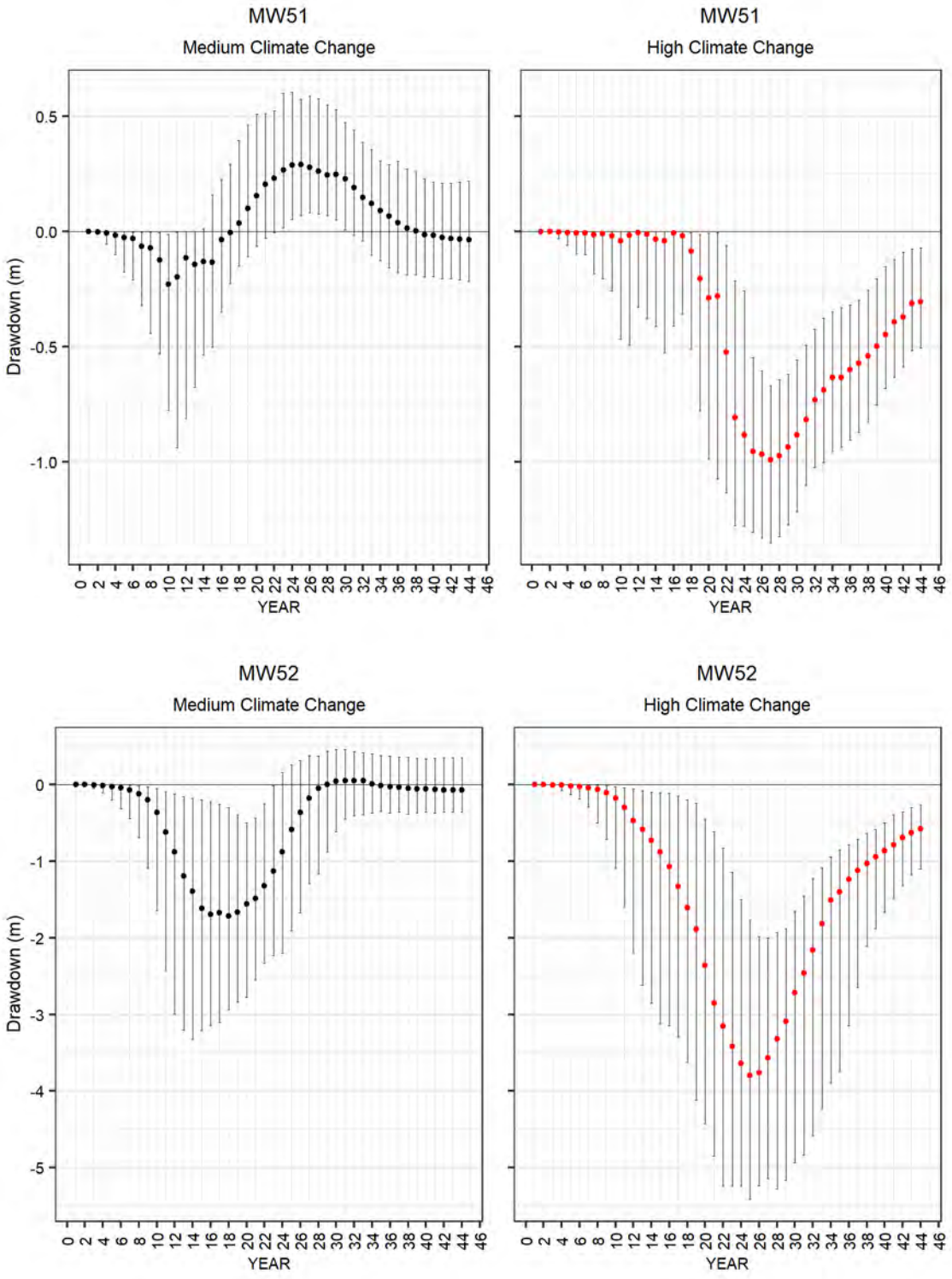
MW37
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

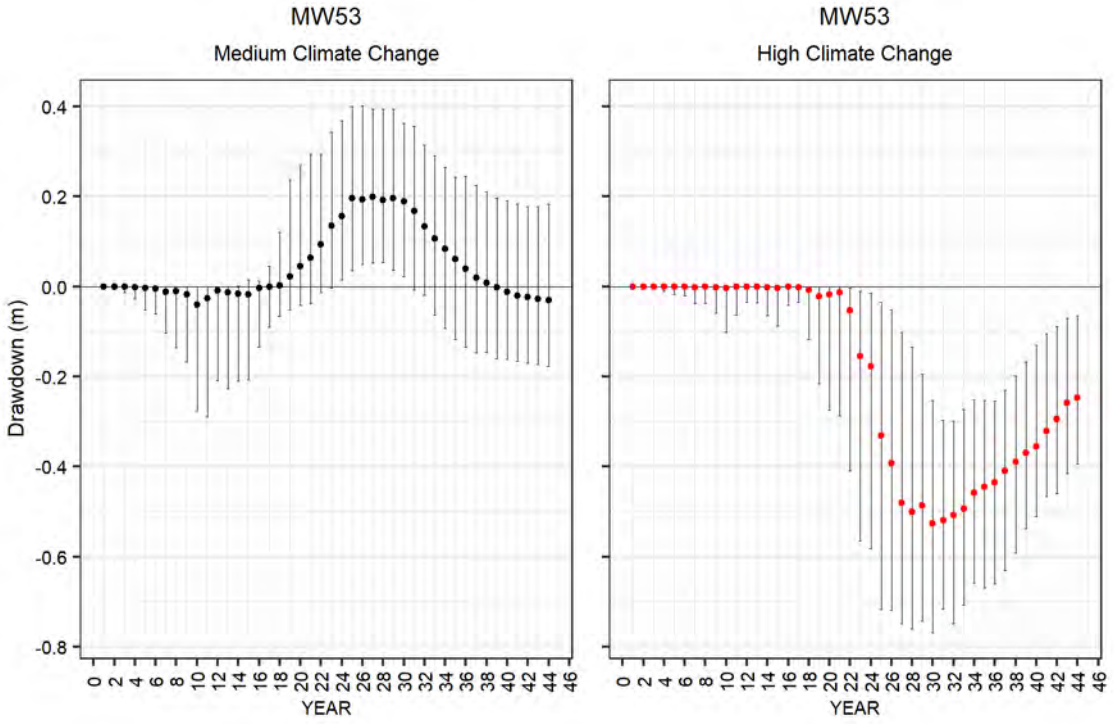

MW38
Medium Climate Change
Drawdown (m)
YEAR

MW38
High Climate Change
YEAR

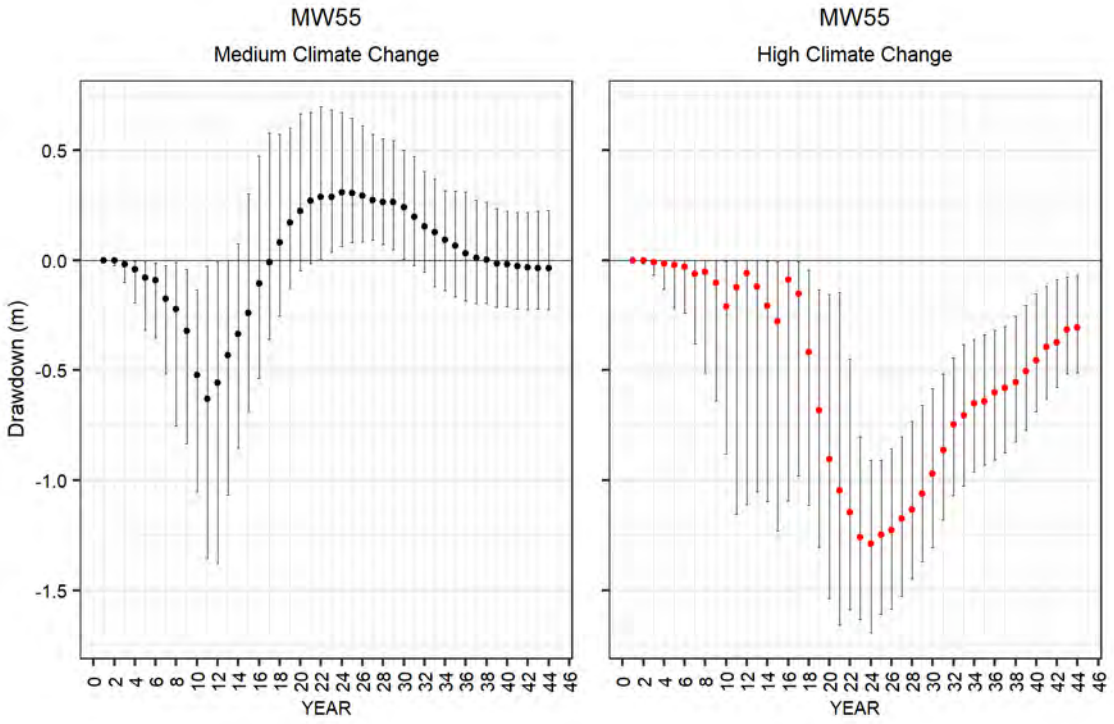

MW50
Medium Climate Change
Drawdown (m)
YEAR

MW50
High Climate Change
YEAR

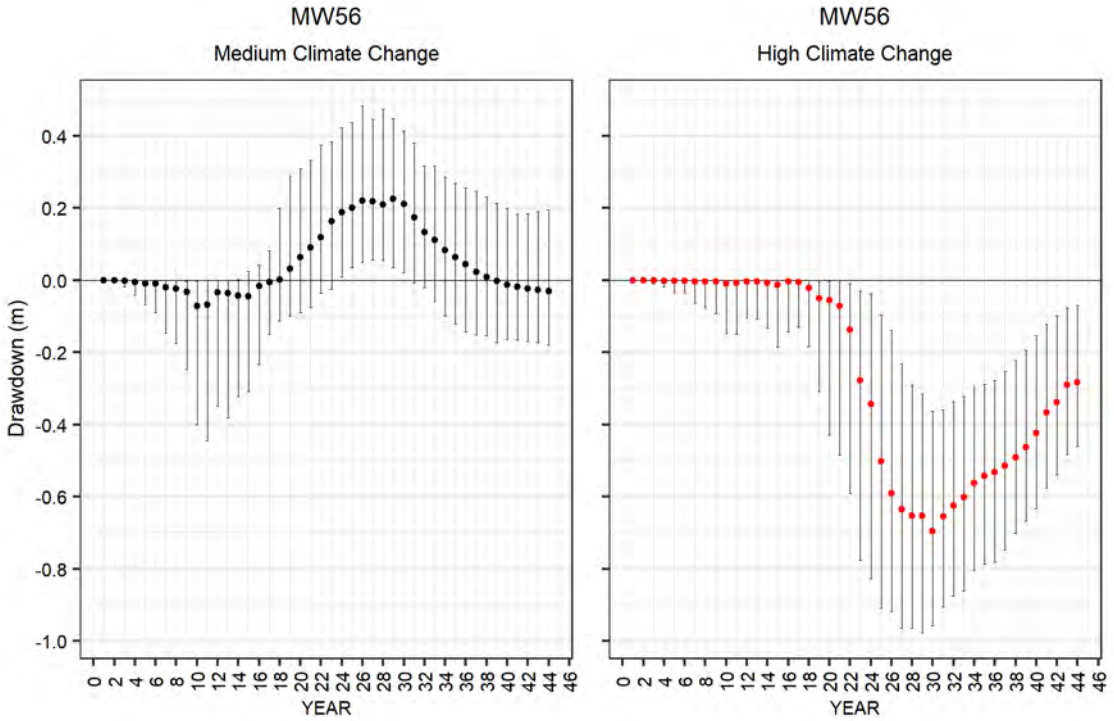

MW51
Medium Climate Change
MW51
High Climate Change
MW52
Medium Climate Change
MW52
High Climate Change
Drawdown (m)
YEAR


MW53
Medium Climate Change
Drawdown (m)
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

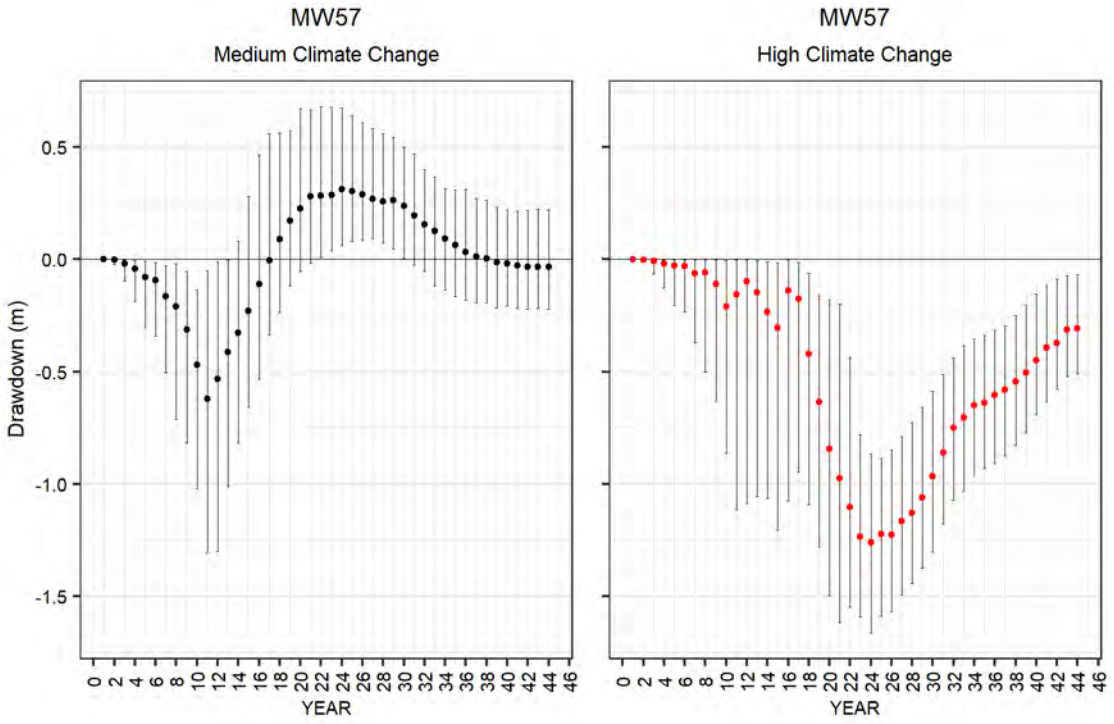
MW53
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR


MW55
Medium Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
-1.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

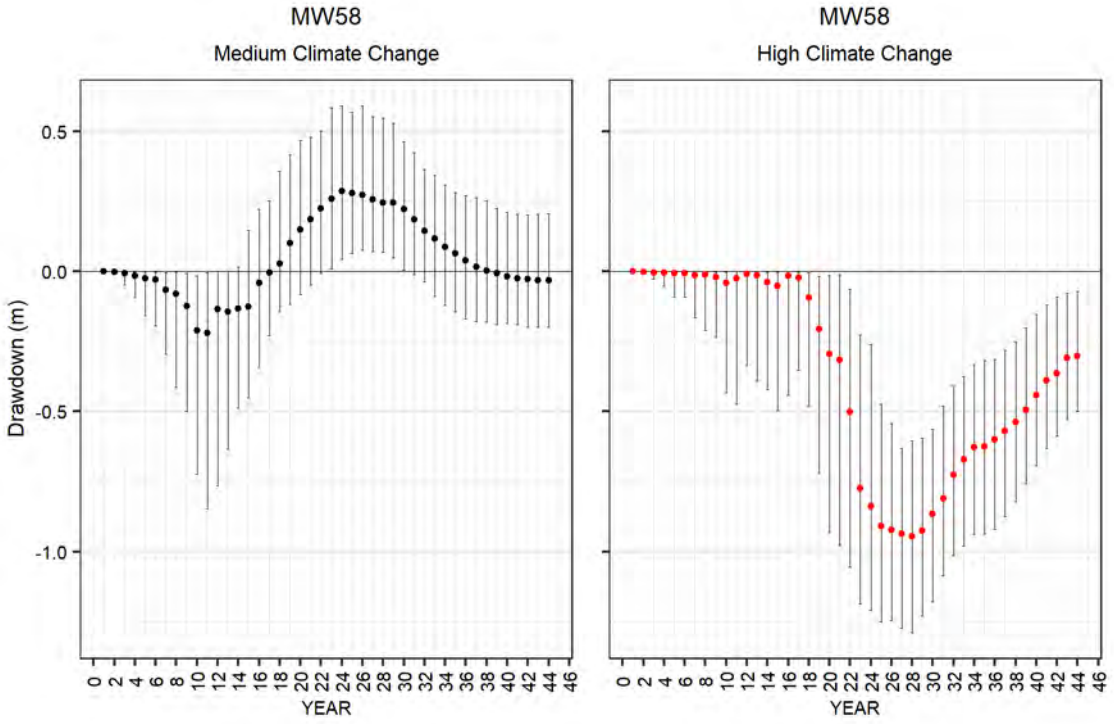
MW55
High Climate Change
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

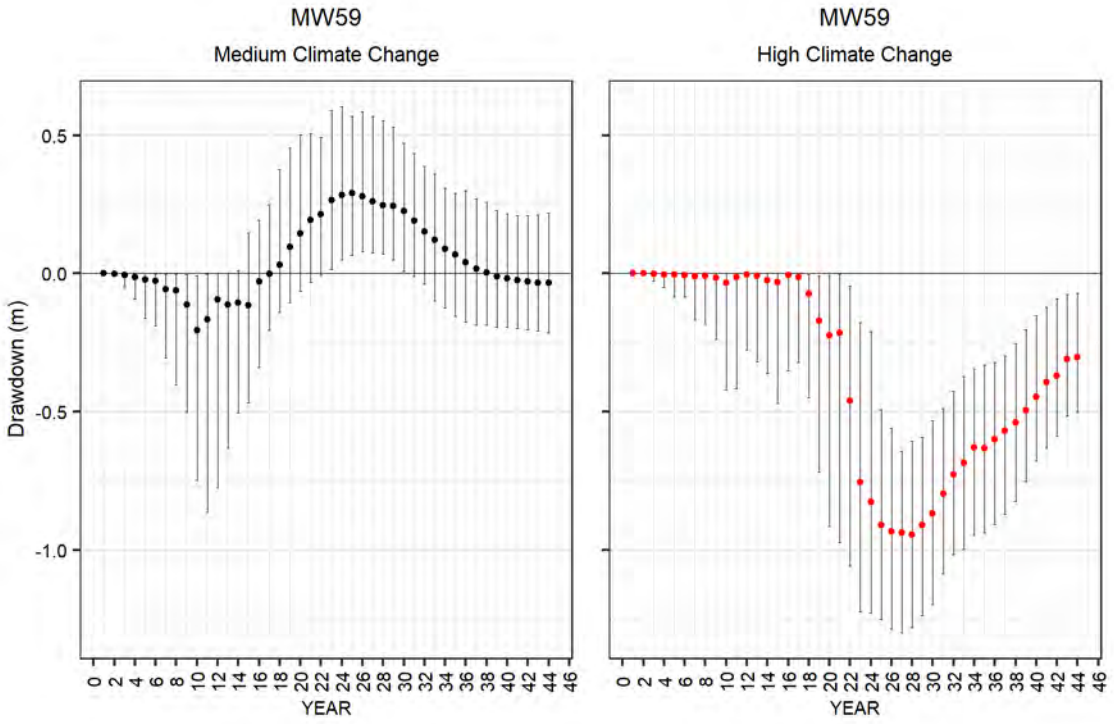

MW56
Medium Climate Change
Drawdown (m)
YEAR

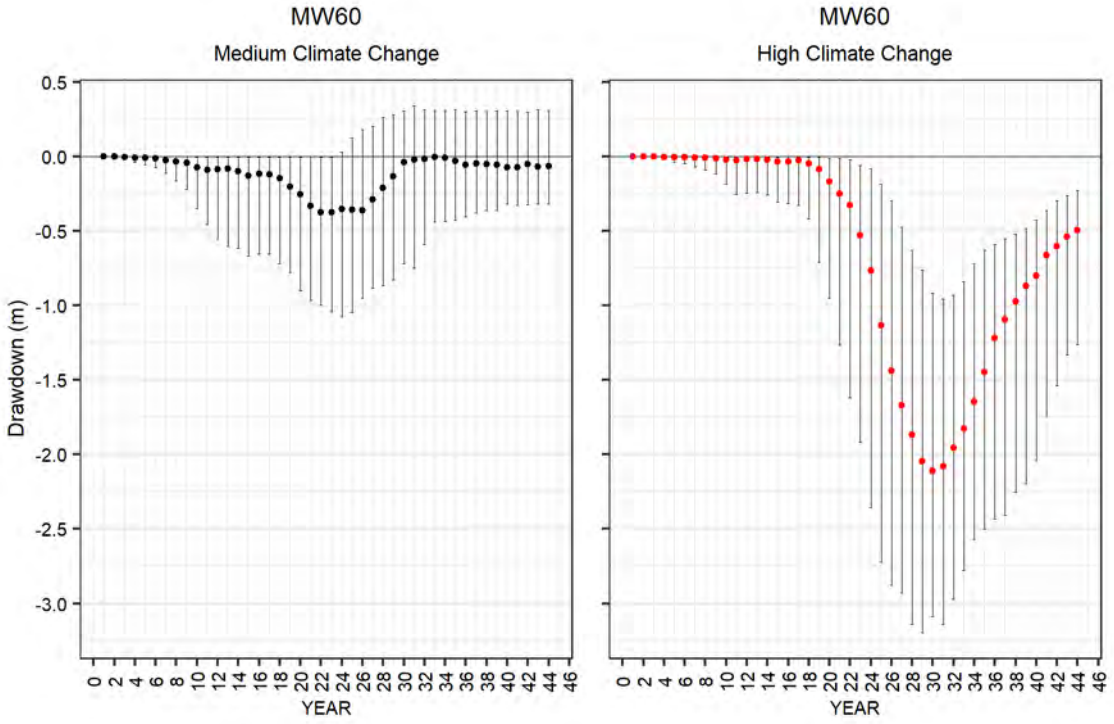
MW56
High Climate Change
YEAR

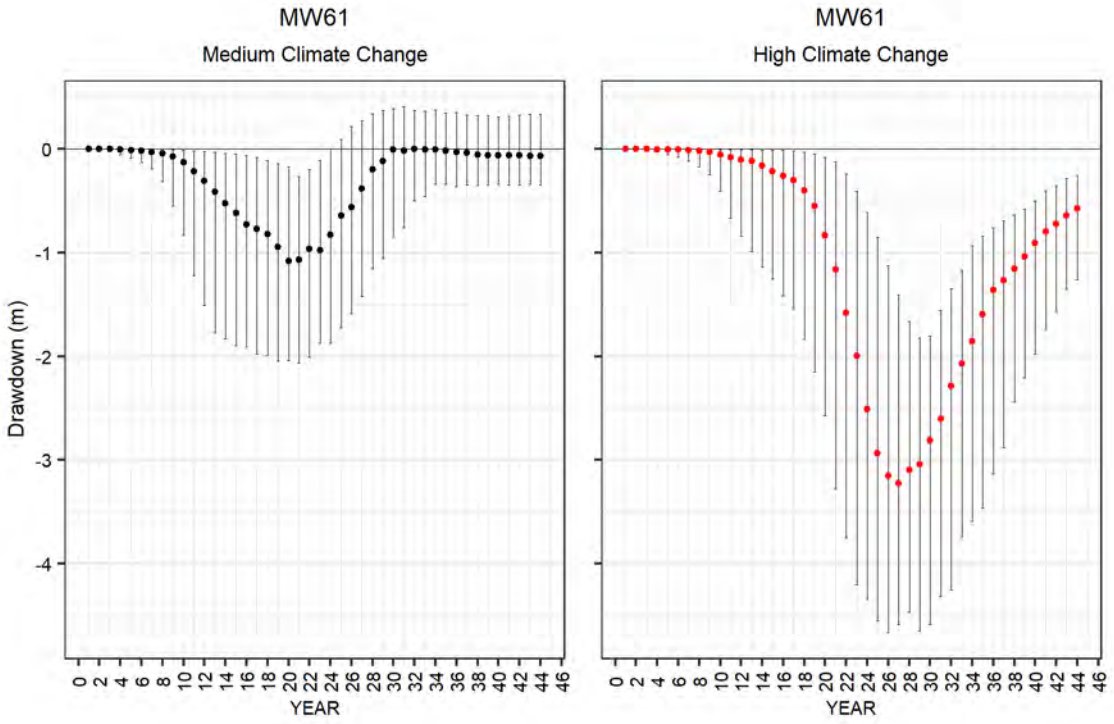

MW57
Medium Climate Change
Drawdown (m)
YEAR

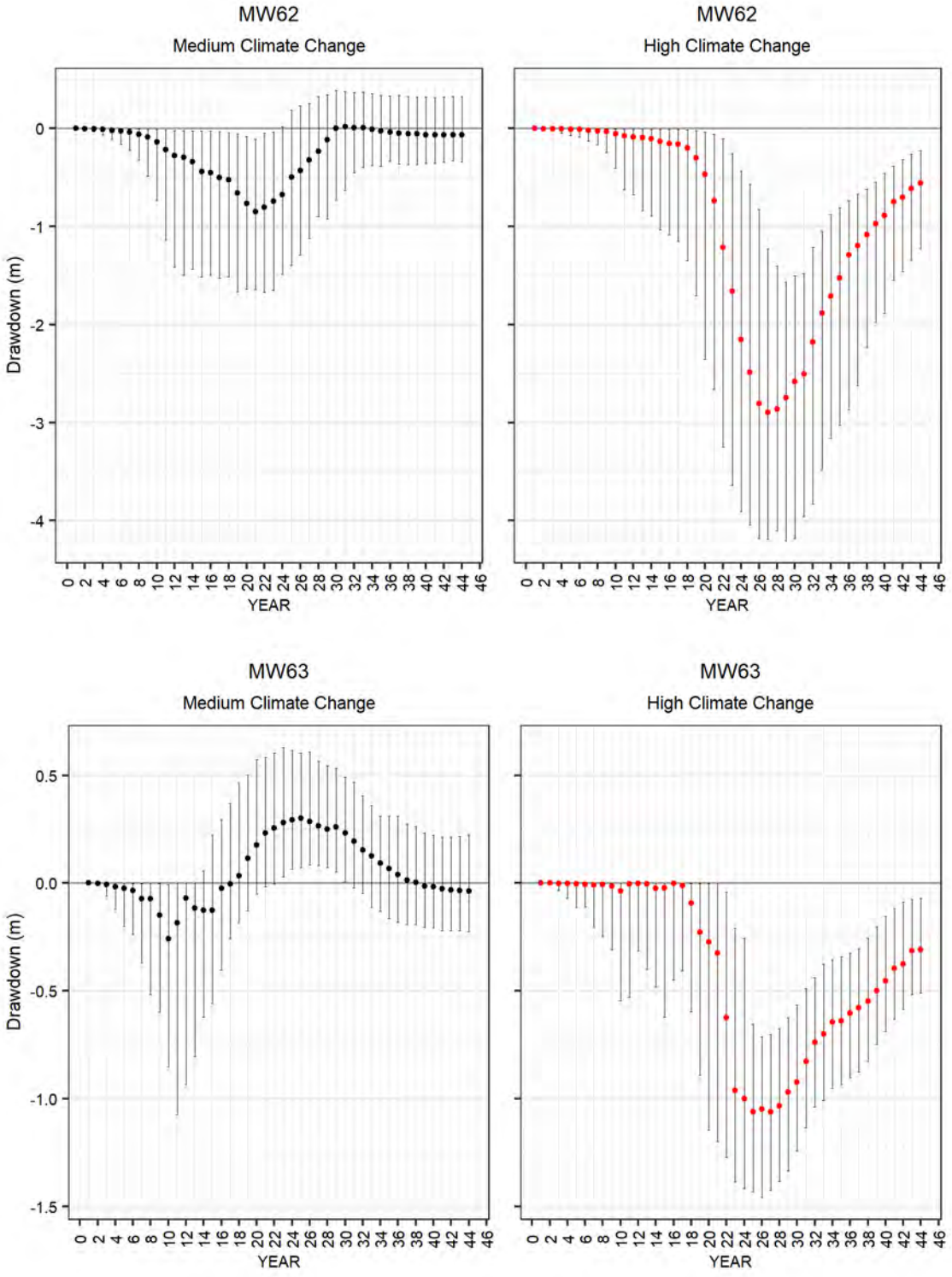
MW57
High Climate Change
YEAR

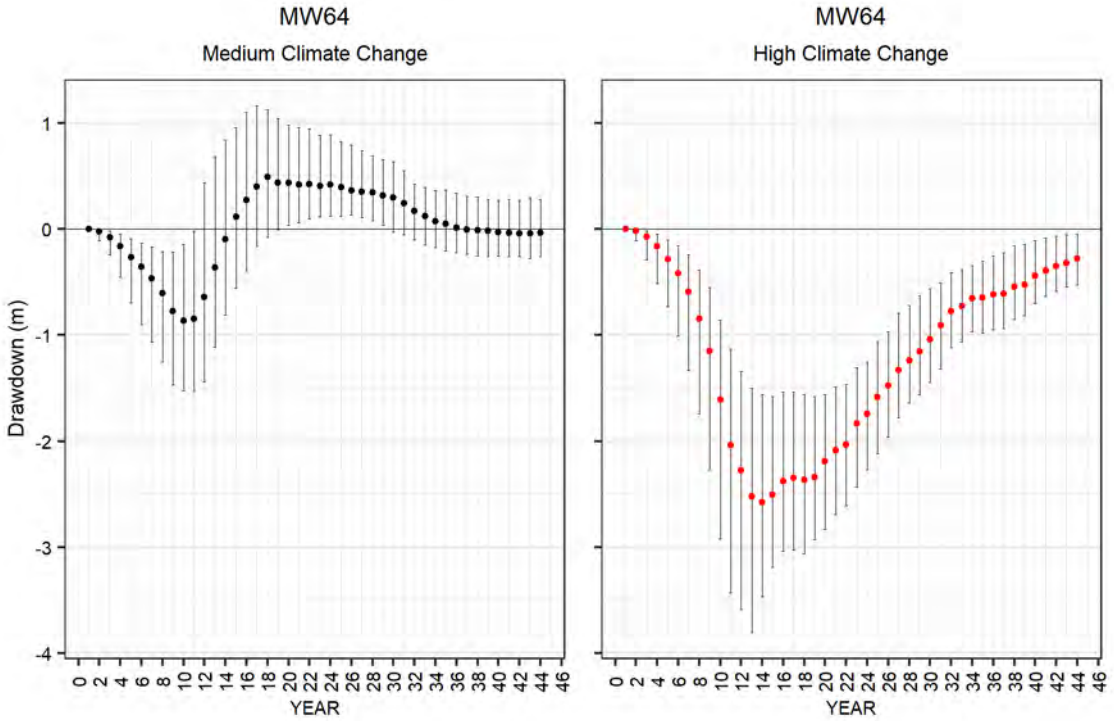

MW58
Medium Climate Change
MW58
High Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

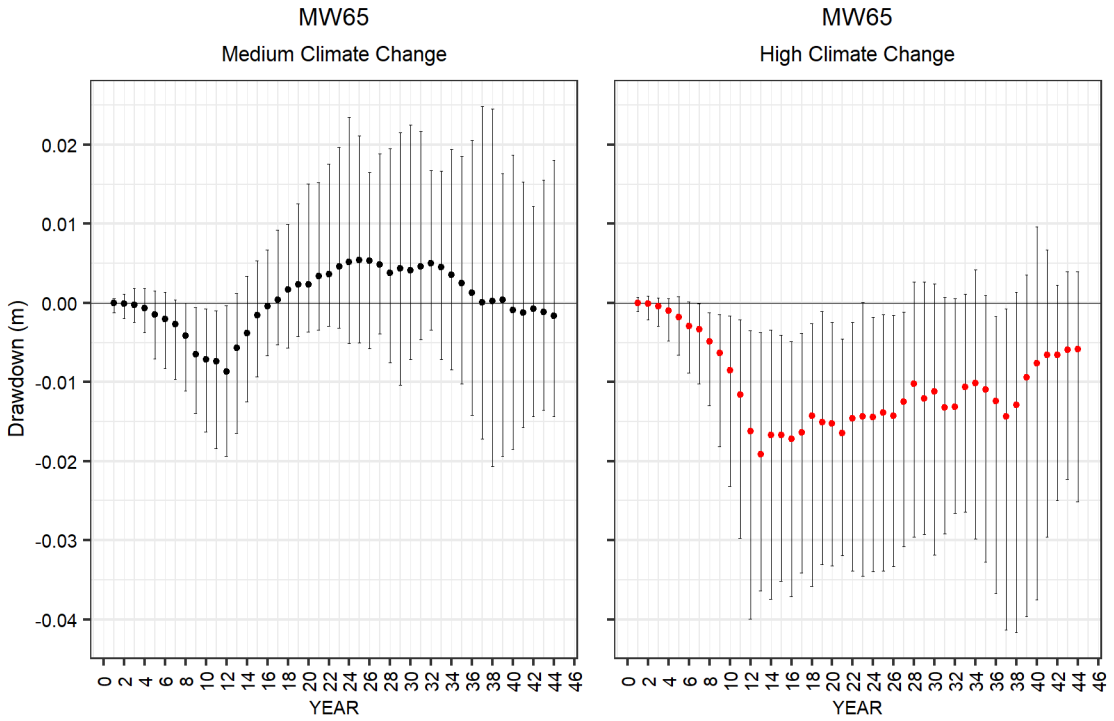

MW59
Medium Climate Change
MW59
High Climate Change
Drawdown (m)
0.5
0.0
-0.5
-1.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

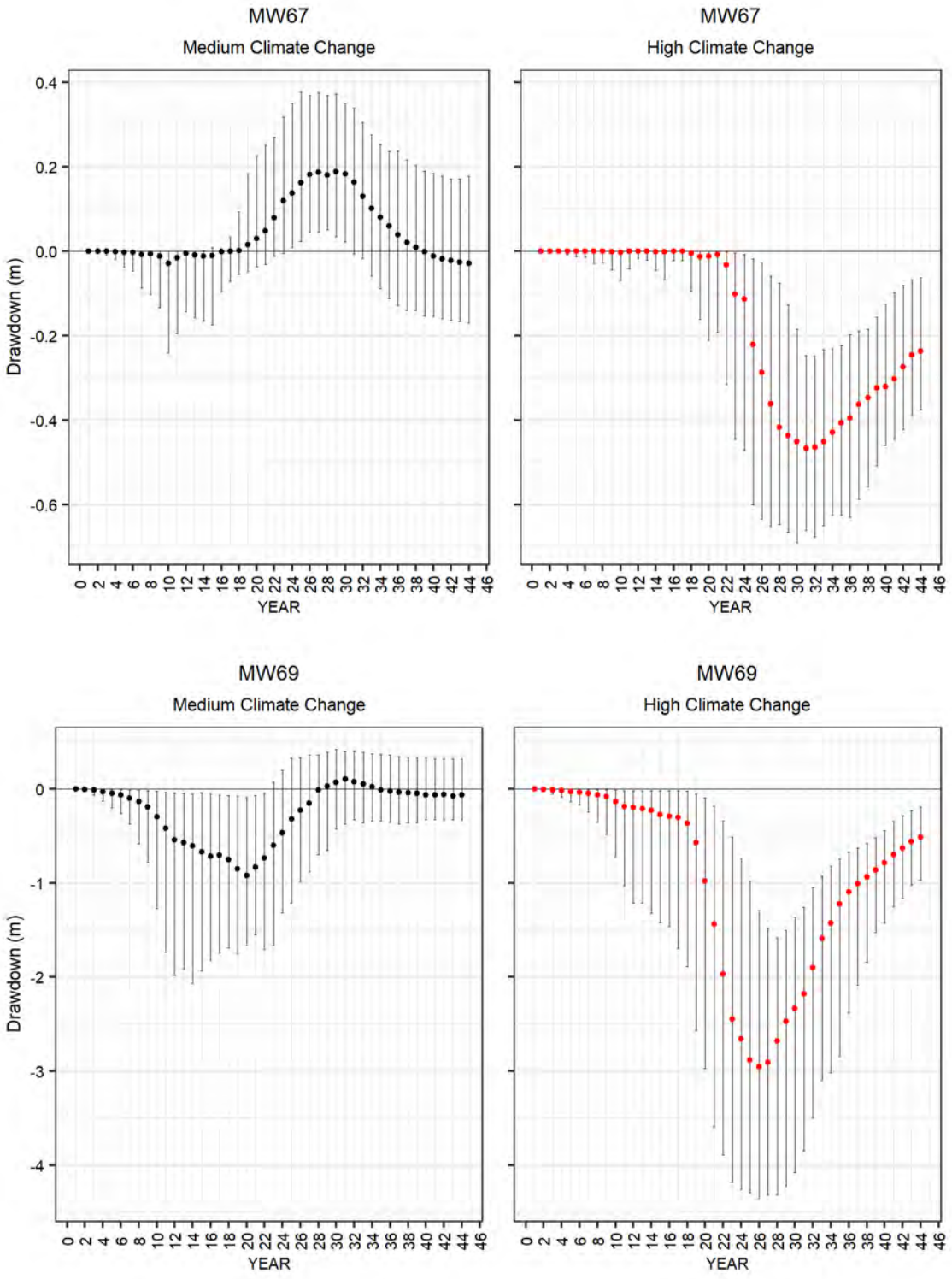

MW60
Medium Climate Change
MW60
High Climate Change
Drawdown (m)
YEAR

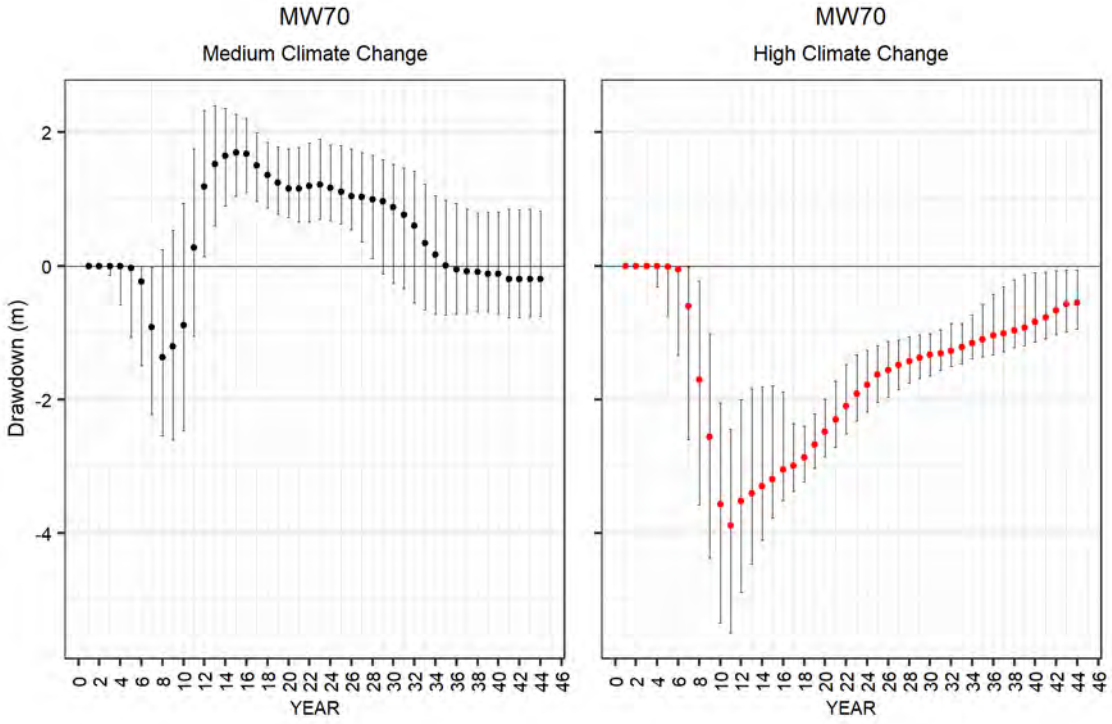

MW61
Medium Climate Change
MW61
High Climate Change
Drawdown (m)
YEAR

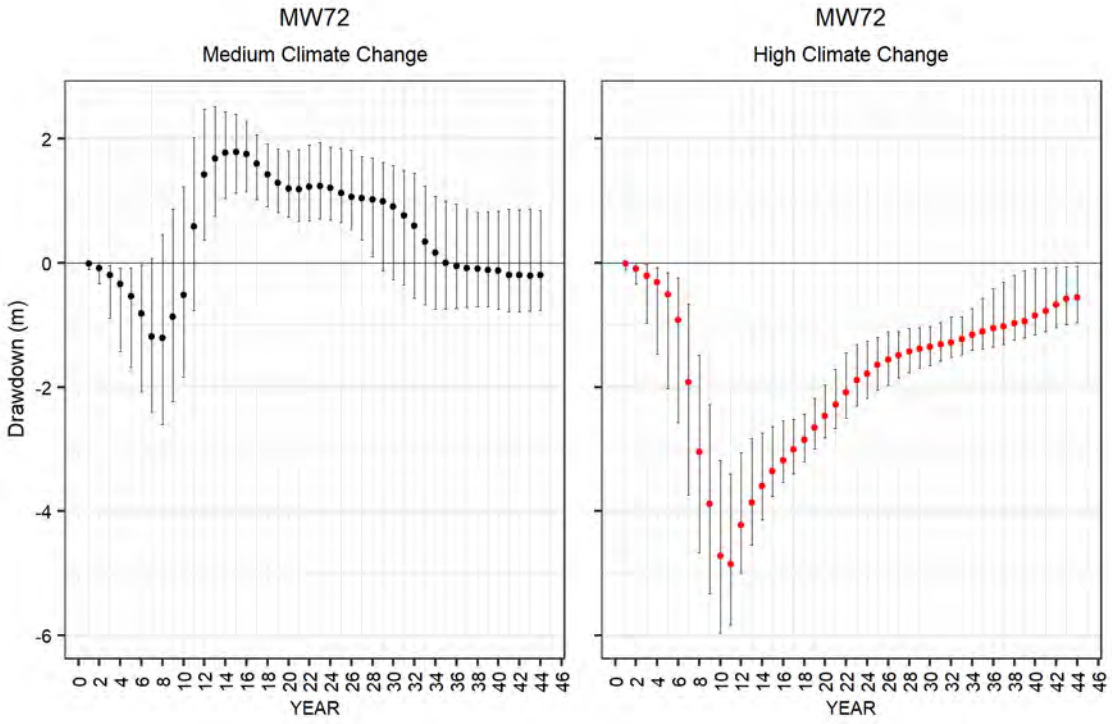

MW62
Medium Climate Change
MW62
High Climate Change
Drawdown (m)
YEAR
MW63
Medium Climate Change
MW63
High Climate Change
Drawdown (m)
YEAR

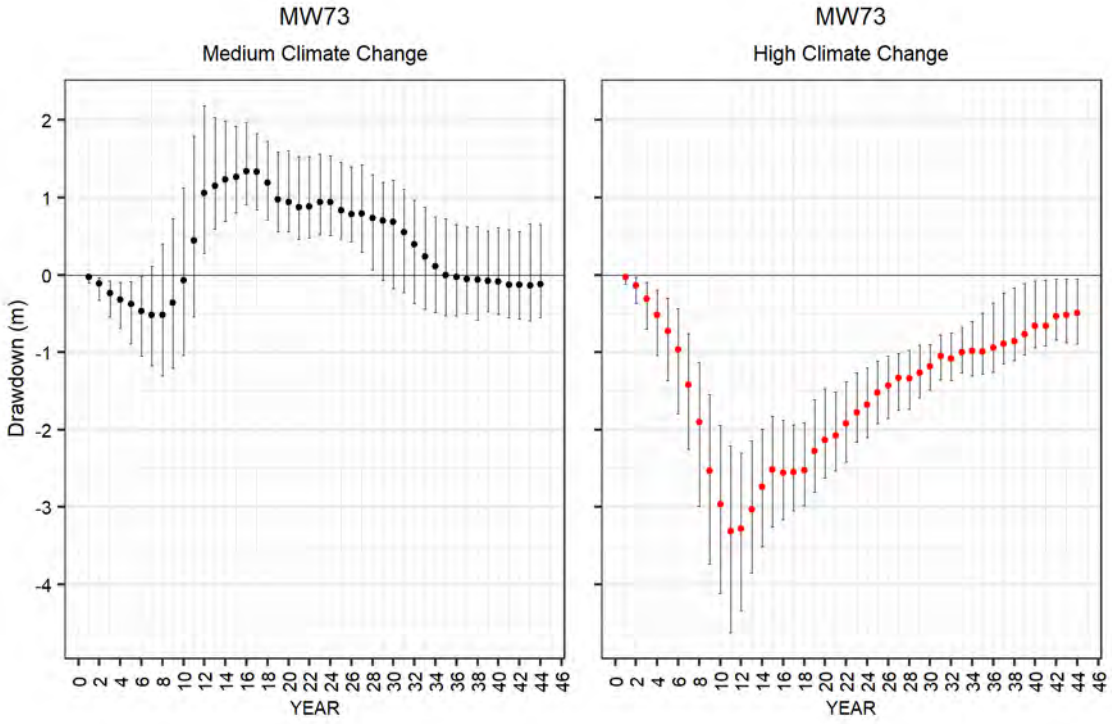

MW64
Medium Climate Change
MW64
High Climate Change
Drawdown (m)
YEAR


MW65
Medium Climate Change
MW65
High Climate Change
Drawdown (m)
YEAR

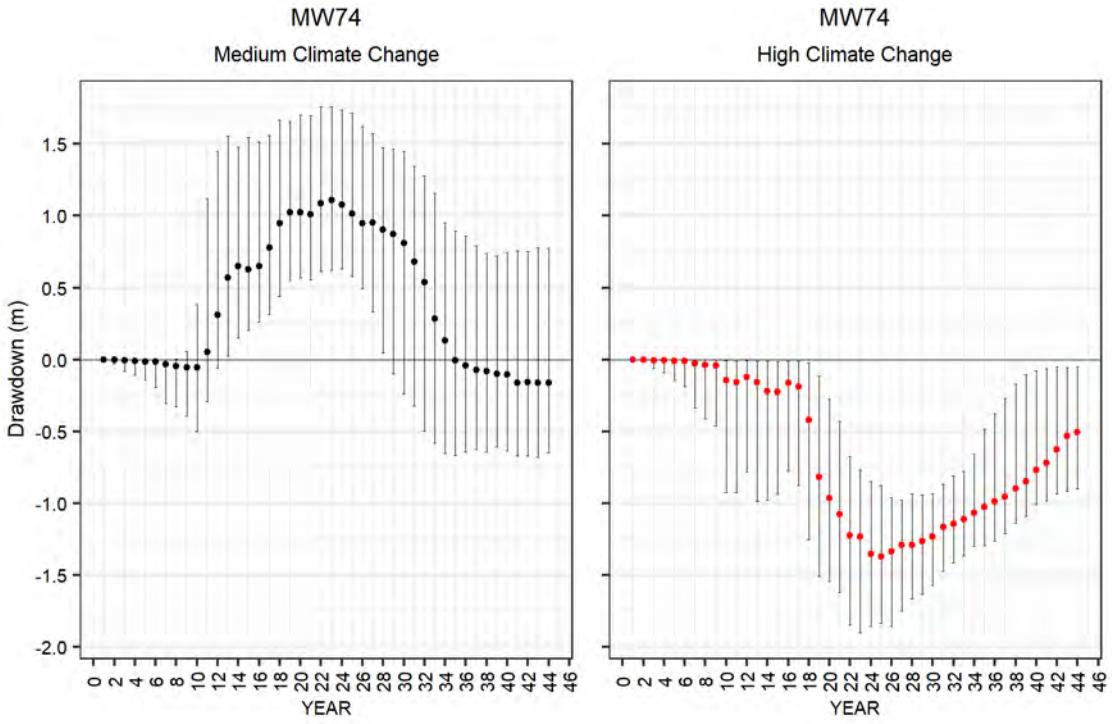

MW67
Medium Climate Change
MW67
High Climate Change
MW69
Medium Climate Change
MW69
High Climate Change
Drawdown (m)
YEAR


MW70
Medium Climate Change
Drawdown (m)
YEAR
MW70
High Climate Change
YEAR

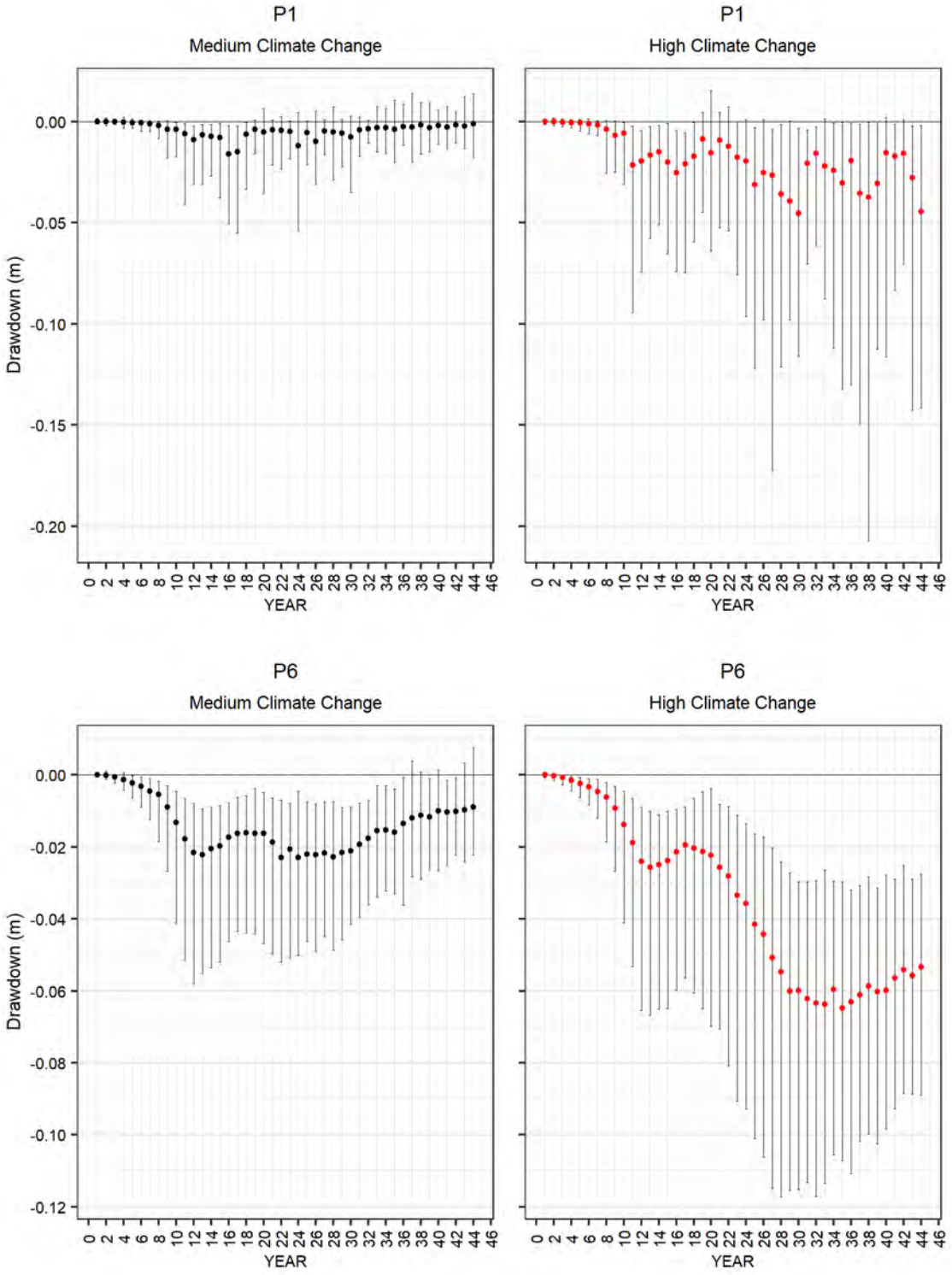

MW72
Medium Climate Change
Drawdown (m)
YEAR
MW72
High Climate Change
YEAR

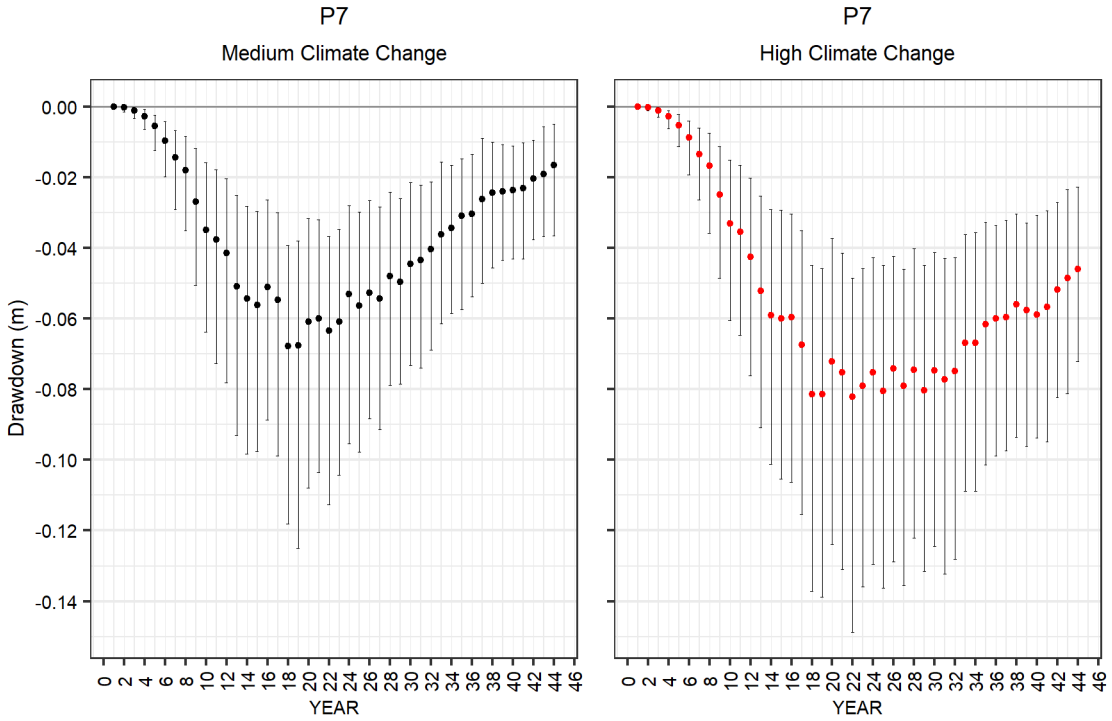

MW73
Medium Climate Change
Drawdown (m)
YEAR

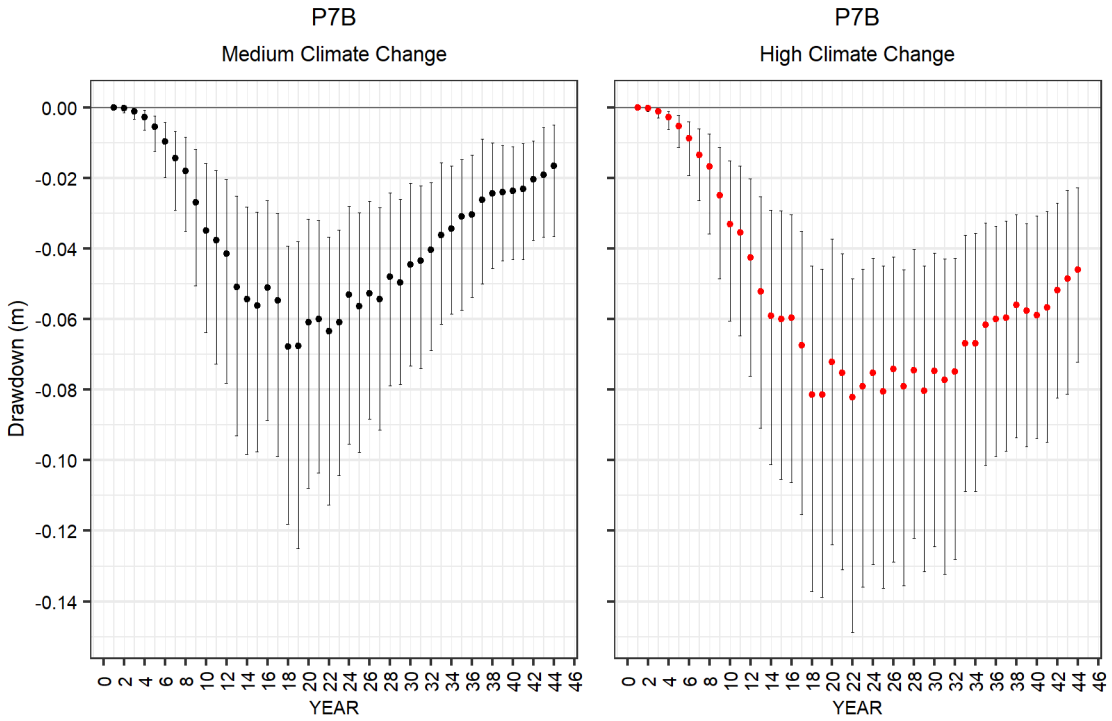
MW73
High Climate Change
YEAR

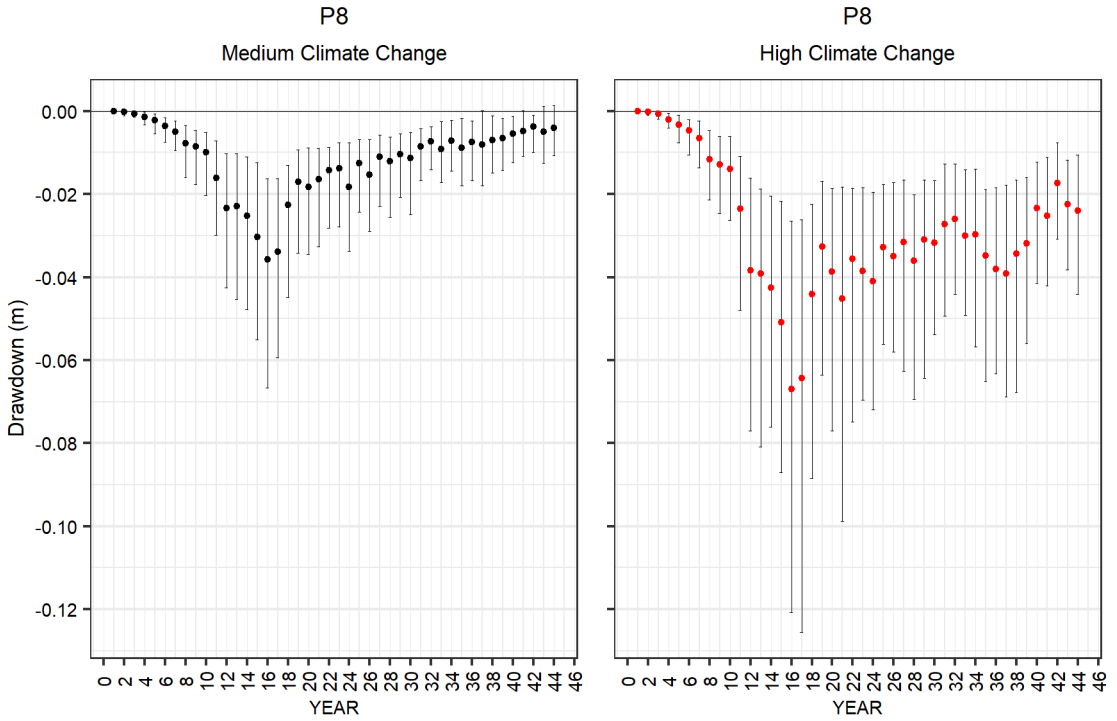

MW74
Medium Climate Change
Drawdown (m)
YEAR

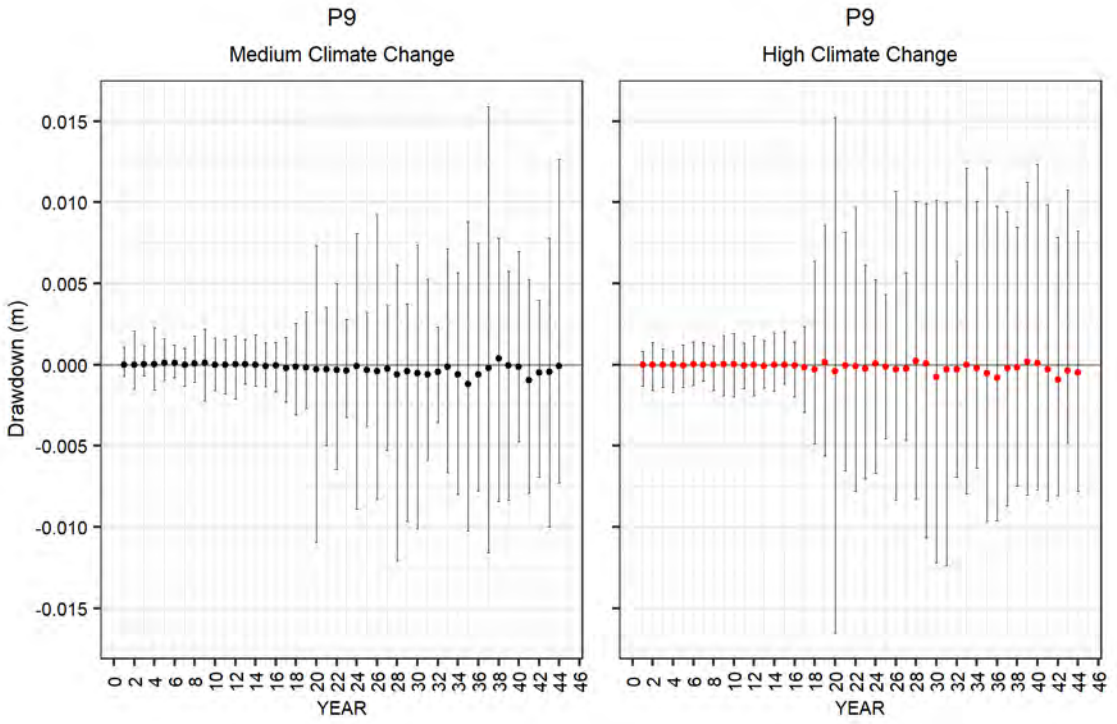
MW74
High Climate Change
YEAR

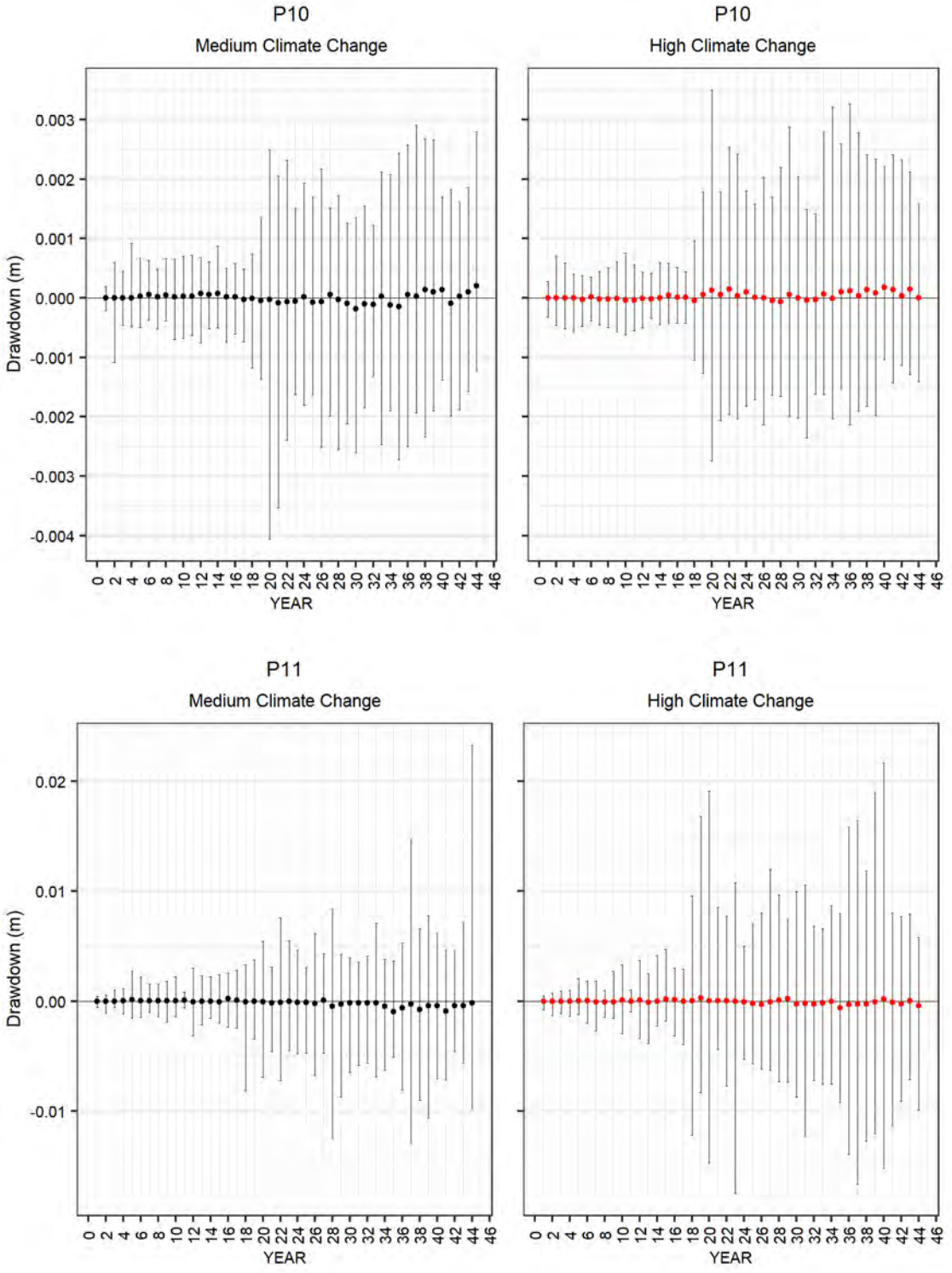

P1
Medium Climate Change
P1
High Climate Change
P6
Medium Climate Change
P6
High Climate Change
Drawdown (m)
YEAR
0.00
-0.05
-0.10
-0.15
-0.20
-0.02
-0.04
-0.06
-0.08
-0.12
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46

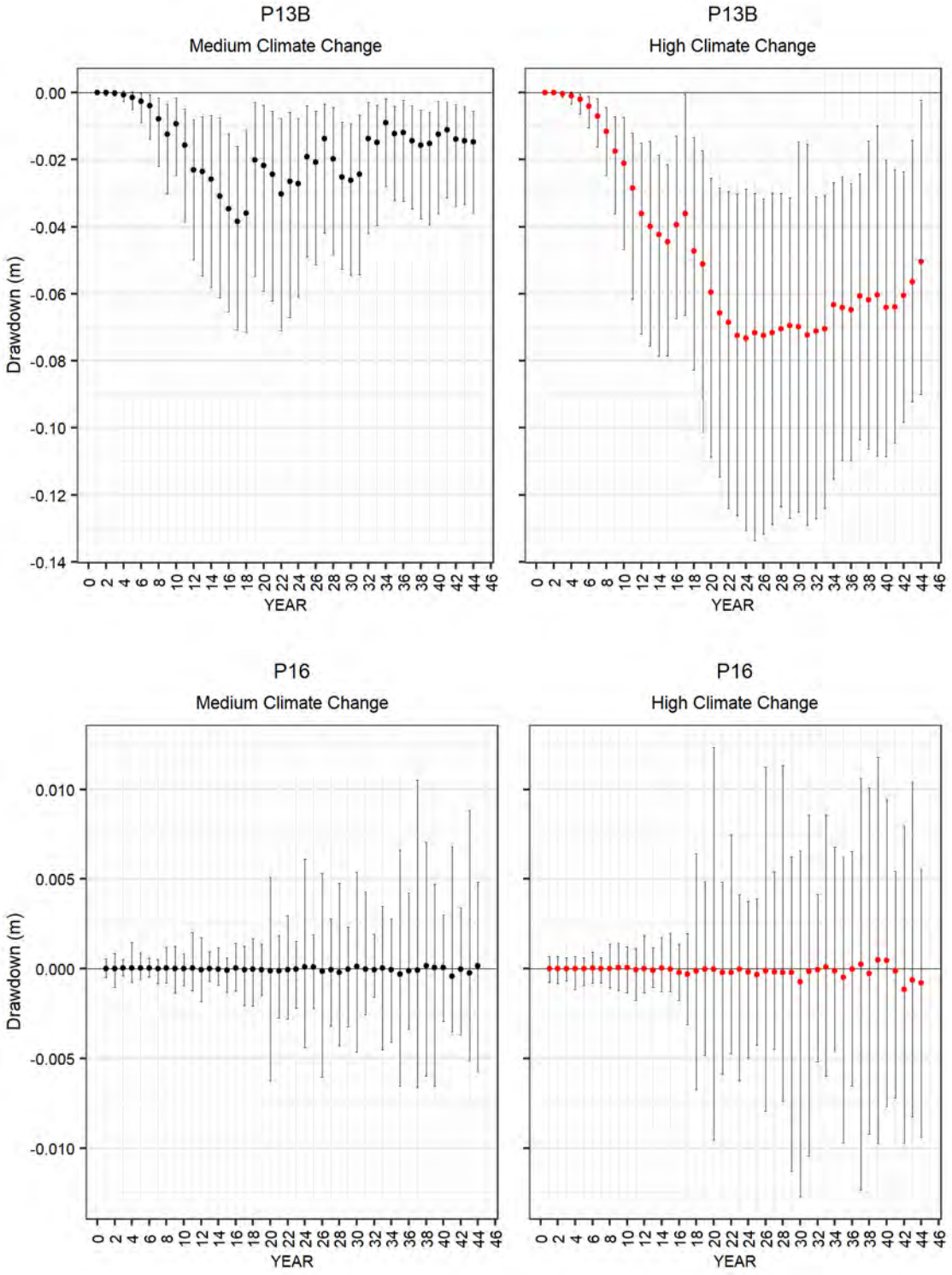

P7
Medium Climate Change
P7
High Climate Change
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

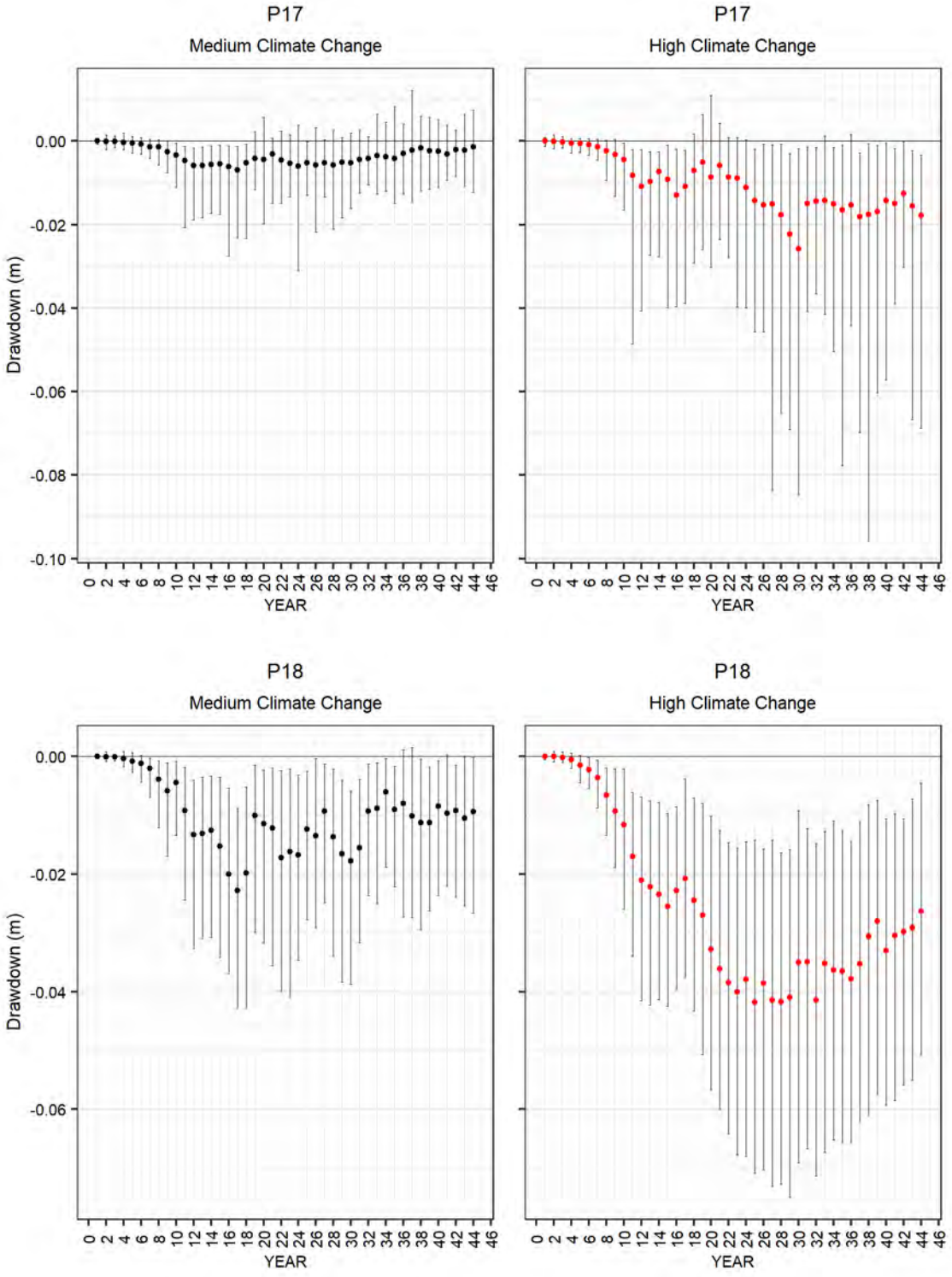

P7B
Medium Climate Change
P7B
High Climate Change
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

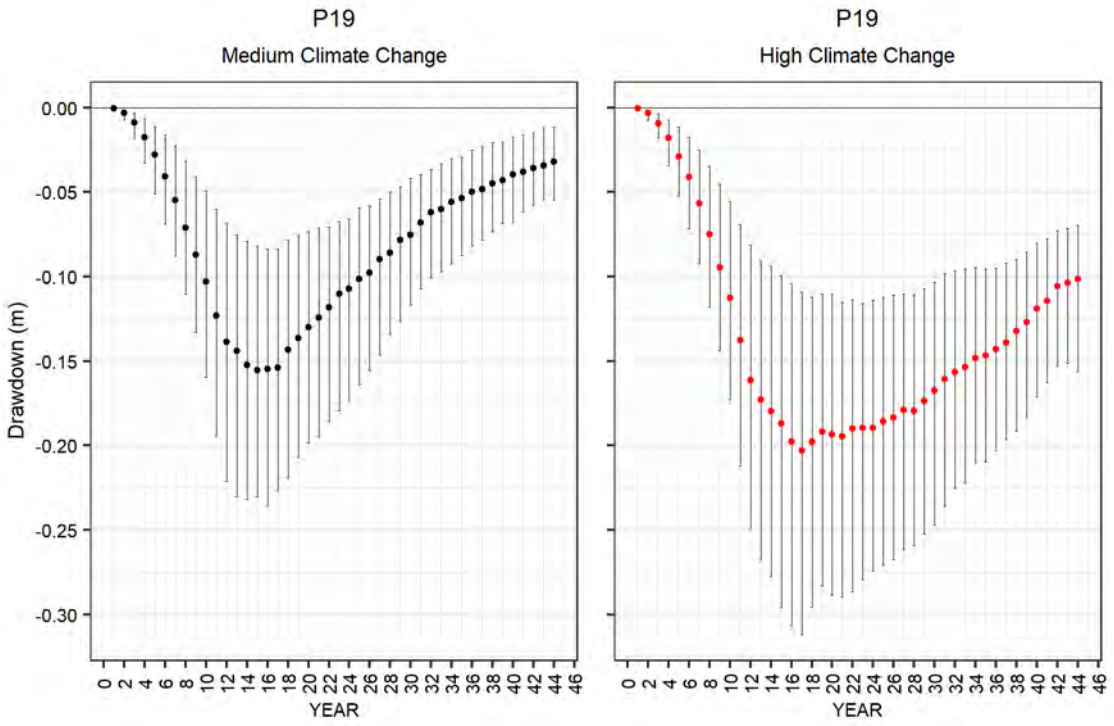

P8
Medium Climate Change
P8
High Climate Change
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

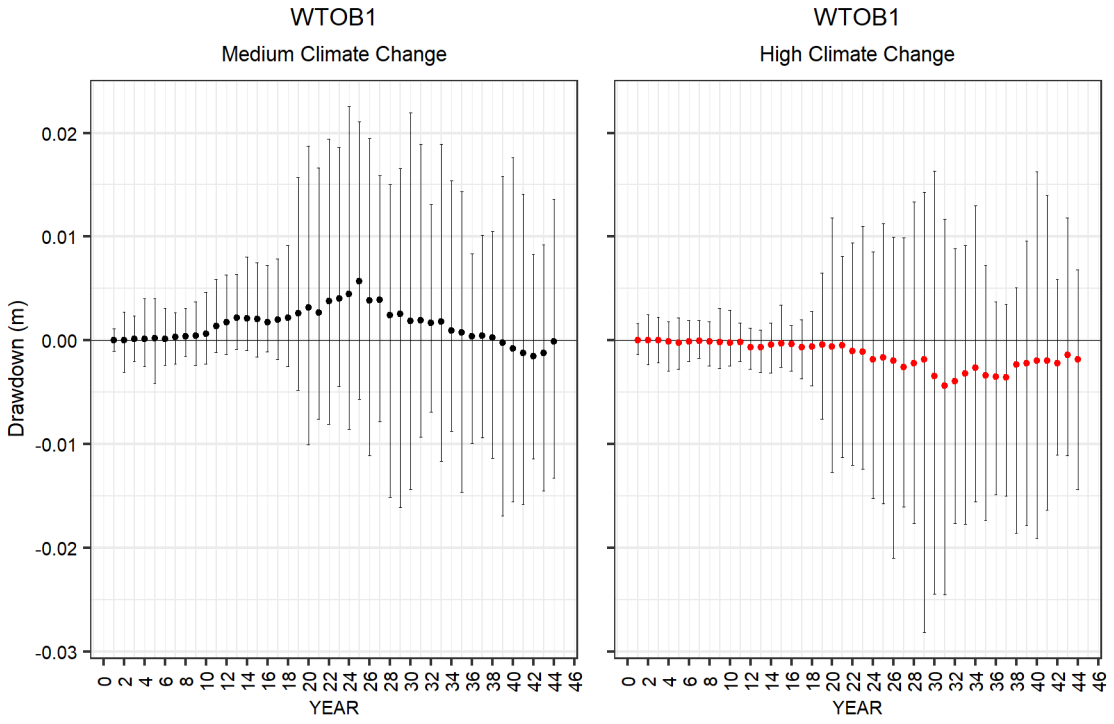

P9
Medium Climate Change
P9
High Climate Change
Drawdown (m)
0.015
0.010
0.005
0.000
-0.005
-0.010
-0.015
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

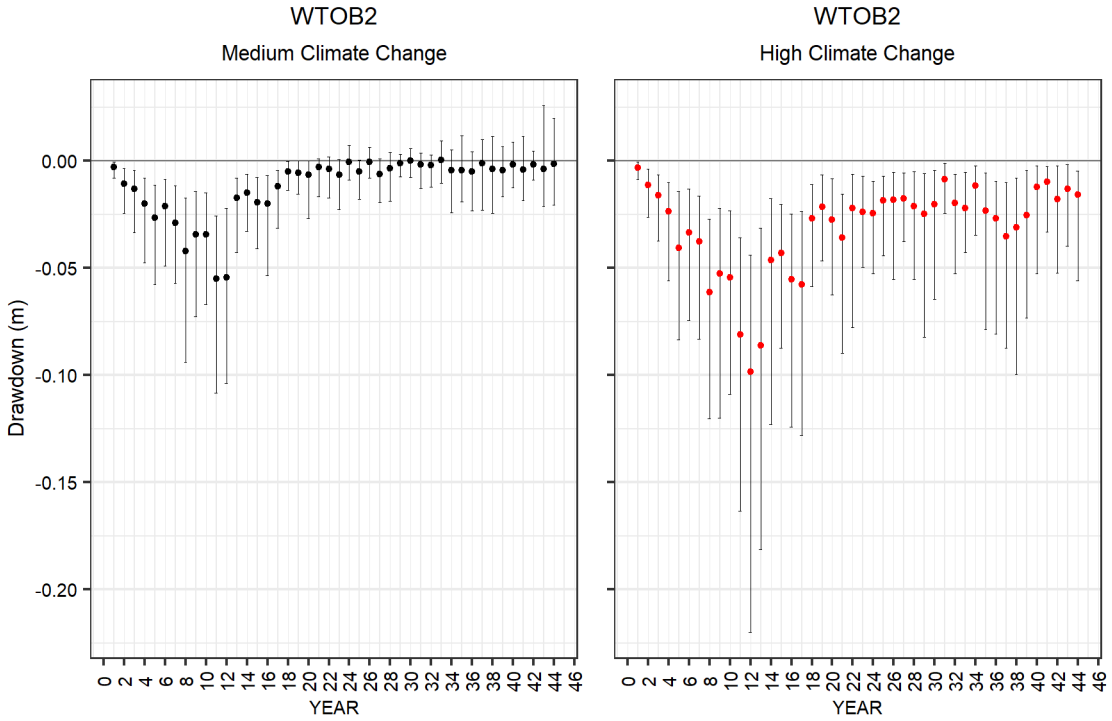

P10
Medium Climate Change
P10
High Climate Change
Drawdown (m)
0.003
0.002
0.001
0.000
-0.001
-0.002
-0.003
-0.004
YEAR
P11
Medium Climate Change
P11
High Climate Change
Drawdown (m)
0.02
0.01
0.00
-0.01
YEAR

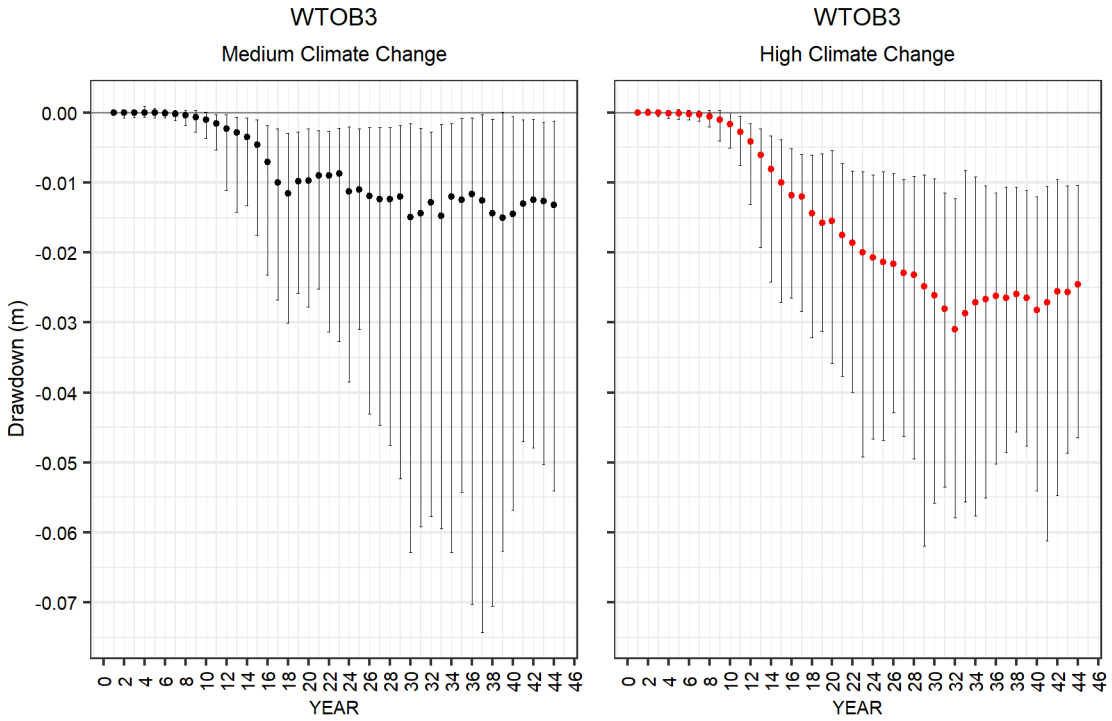

P13B
Medium Climate Change
P13B
High Climate Change
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
YEAR
P16
Medium Climate Change
P16
High Climate Change
Drawdown (m)
0.010
0.005
0.000
-0.005
-0.010
YEAR

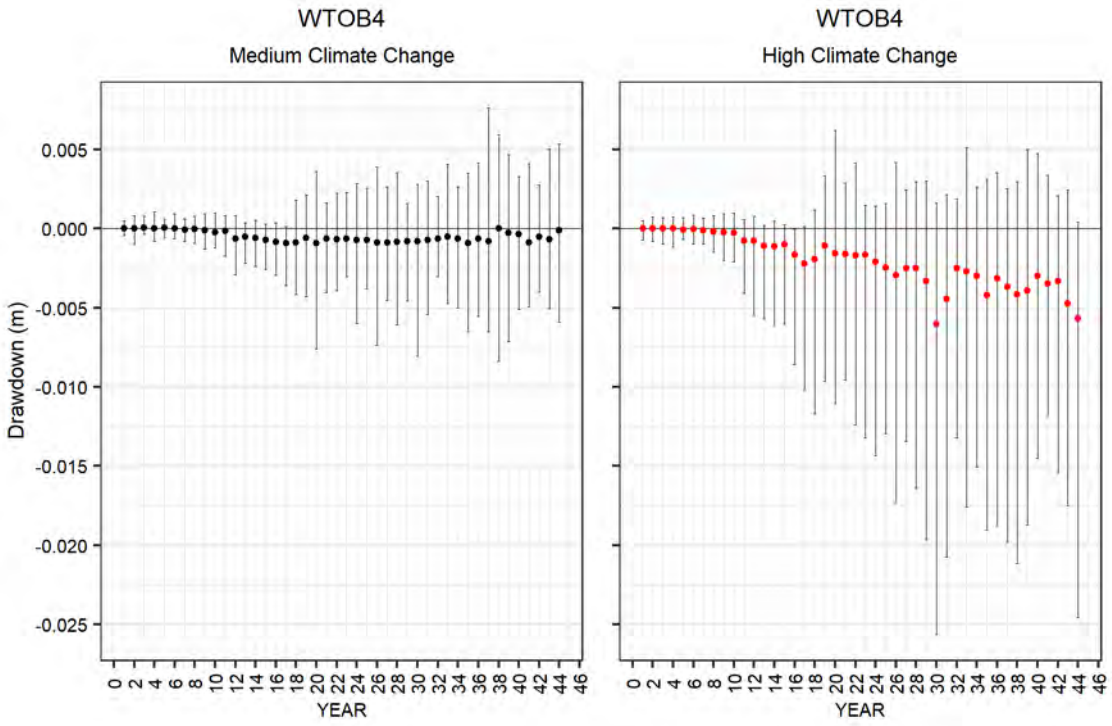

P17
Medium Climate Change
P17
High Climate Change
P18
Medium Climate Change
P18
High Climate Change
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
YEAR
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46

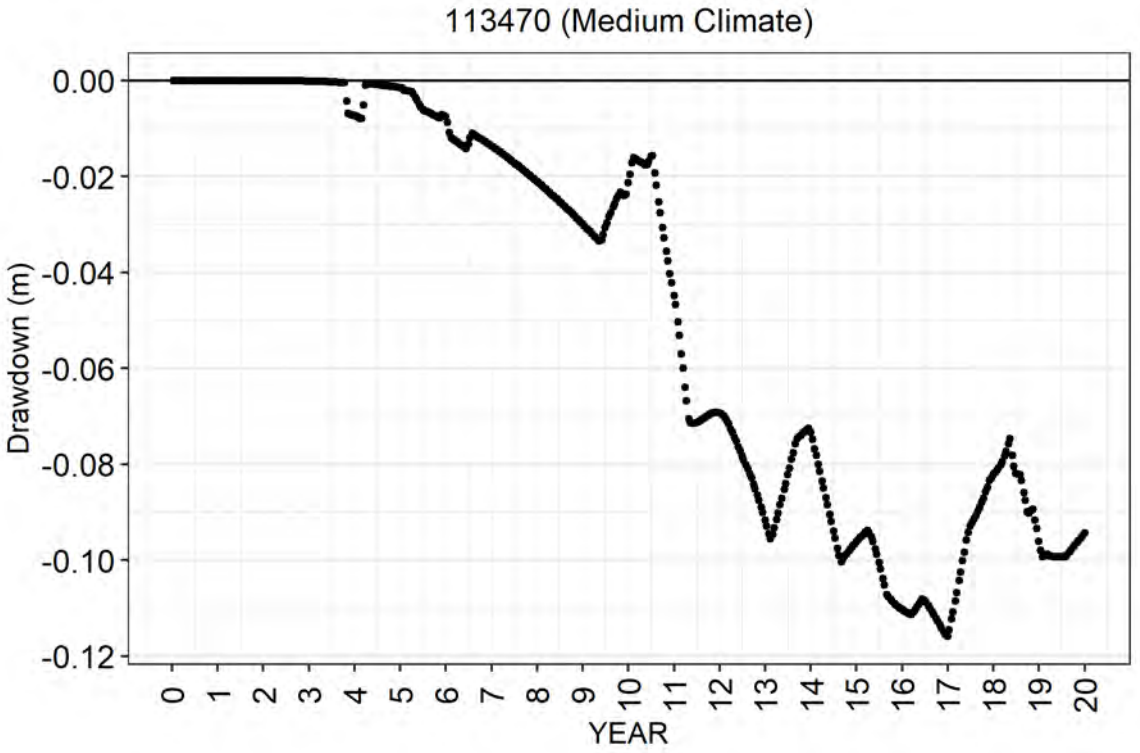

P19
Medium Climate Change
P19
High Climate Change
Drawdown (m)
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

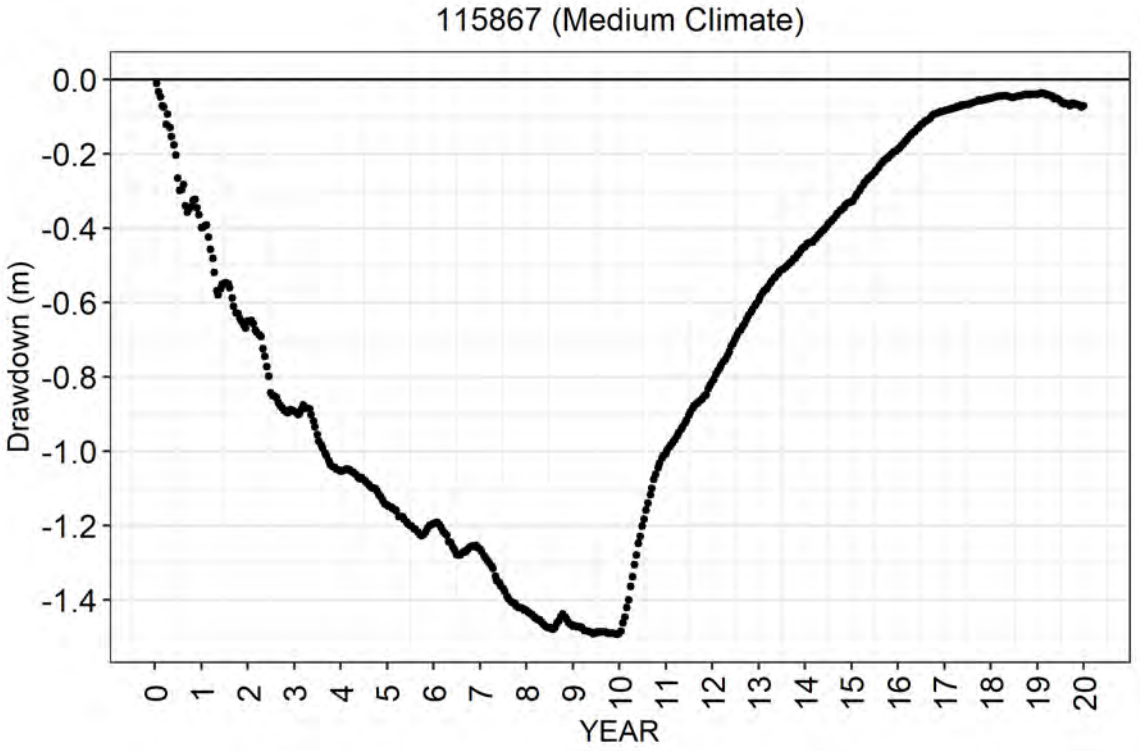

WTOB1
Medium Climate Change
WTOB1
High Climate Change
Drawdown (m)
0.02
0.01
0.00
-0.01
-0.02
-0.03
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

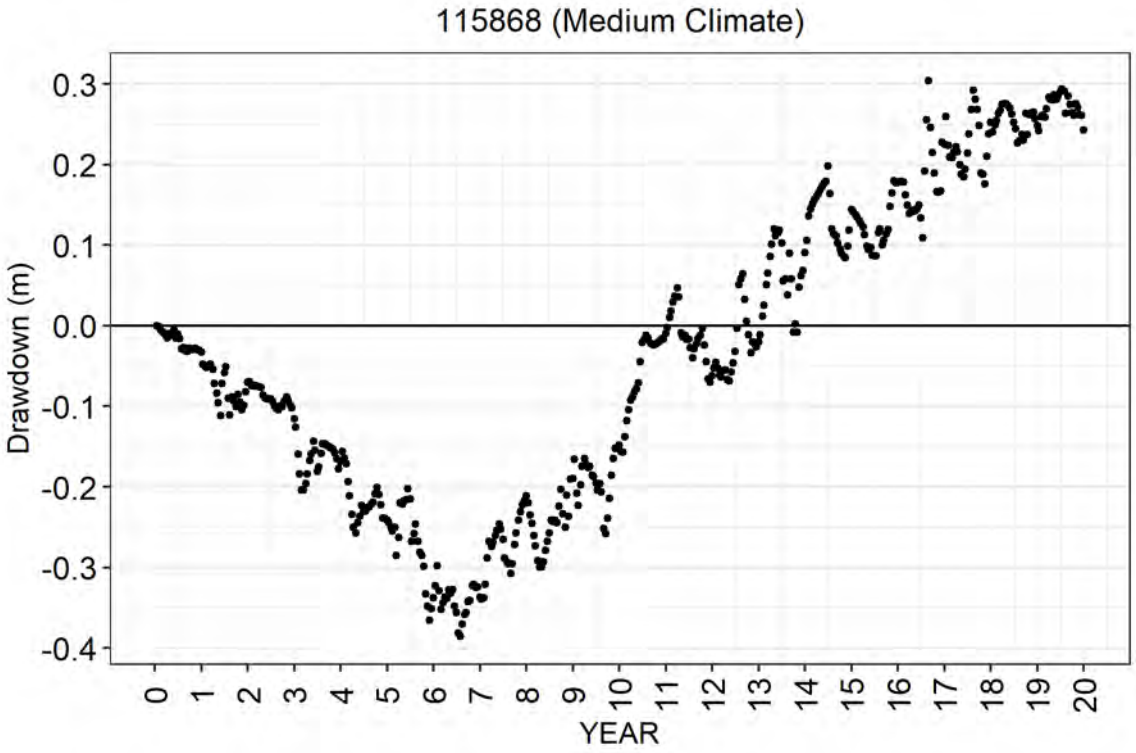

WTOB2
Medium Climate Change
WTOB2
High Climate Change
Drawdown (m)
0.00
-0.05
-0.10
-0.15
-0.20
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

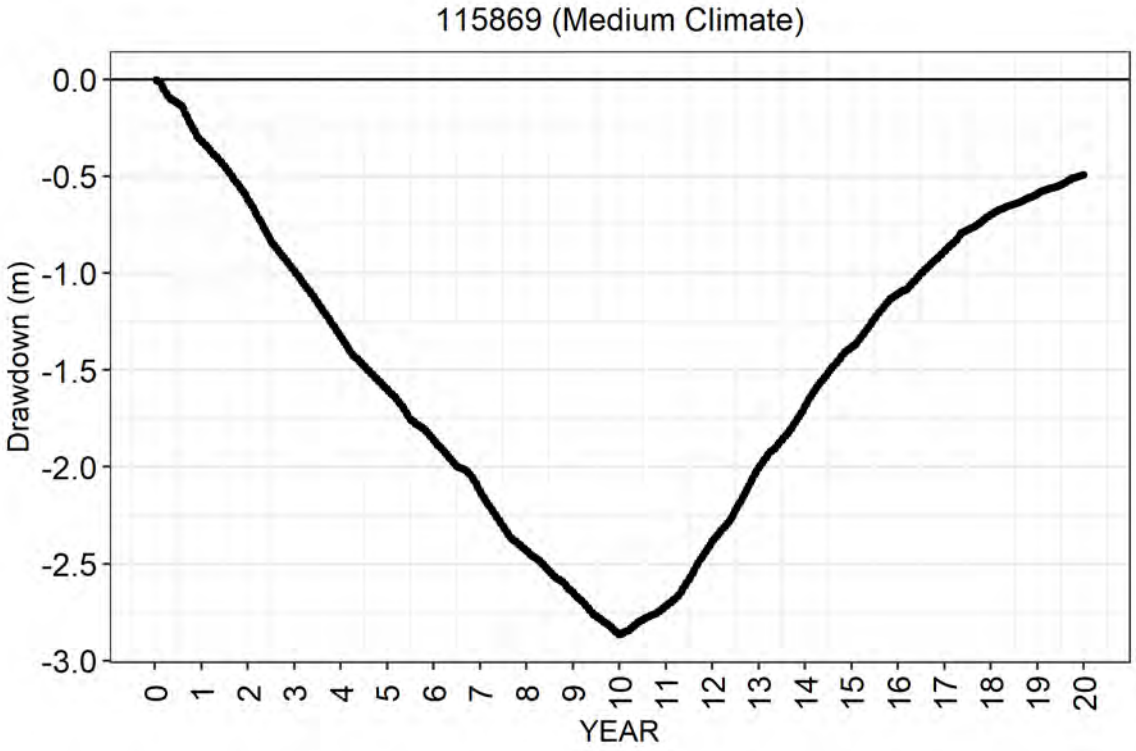

WTOB3
Medium Climate Change
WTOB3
High Climate Change
Drawdown (m)
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

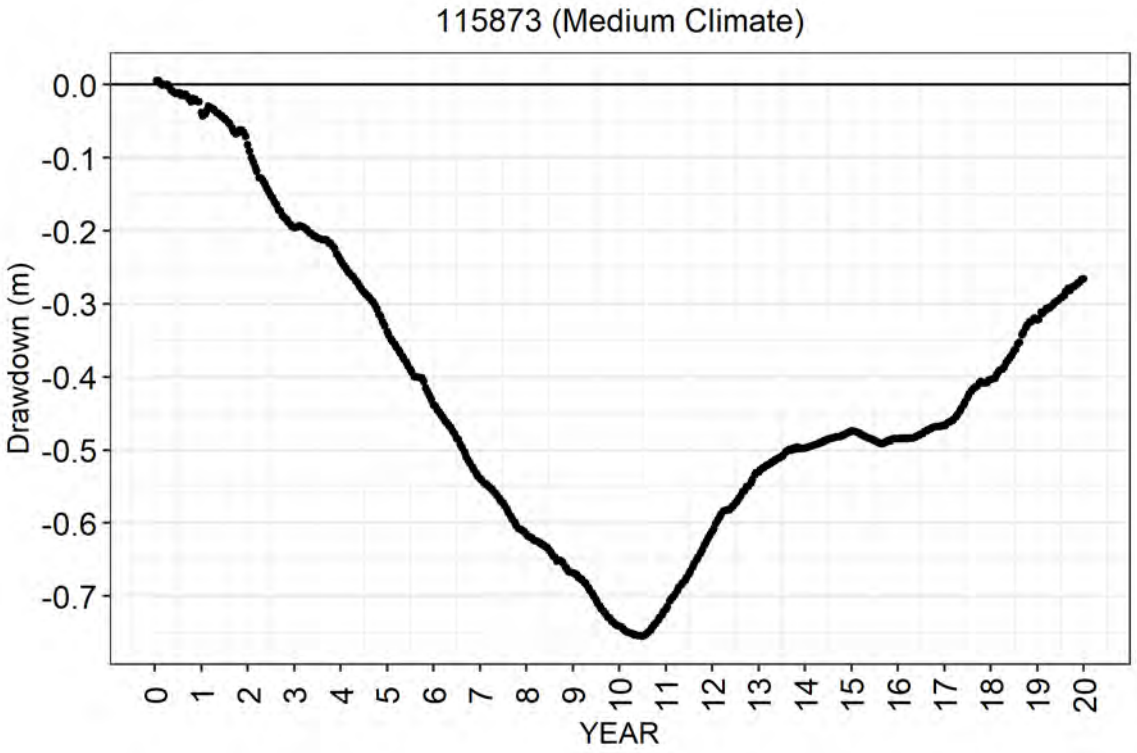

WTOB4
Medium Climate Change
WTOB4
High Climate Change
Drawdown (m)
0.005
0.000
-0.005
-0.010
-0.015
-0.020
-0.025
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46
YEAR

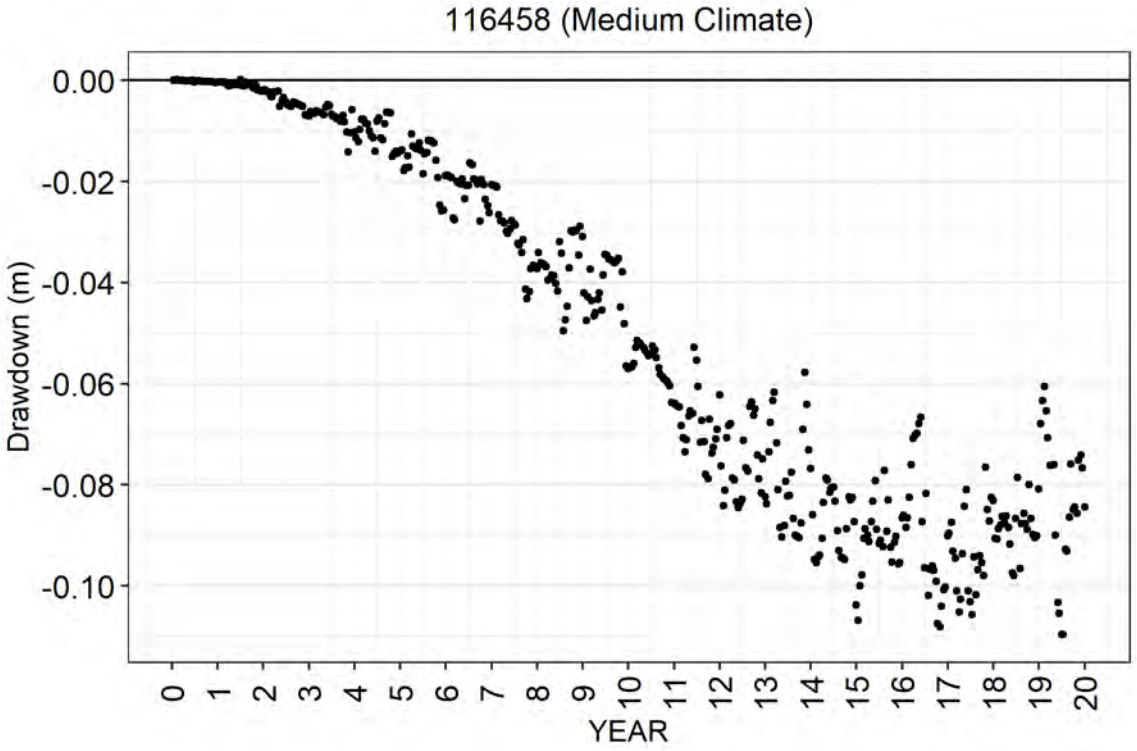

113470 (Medium Climate)
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

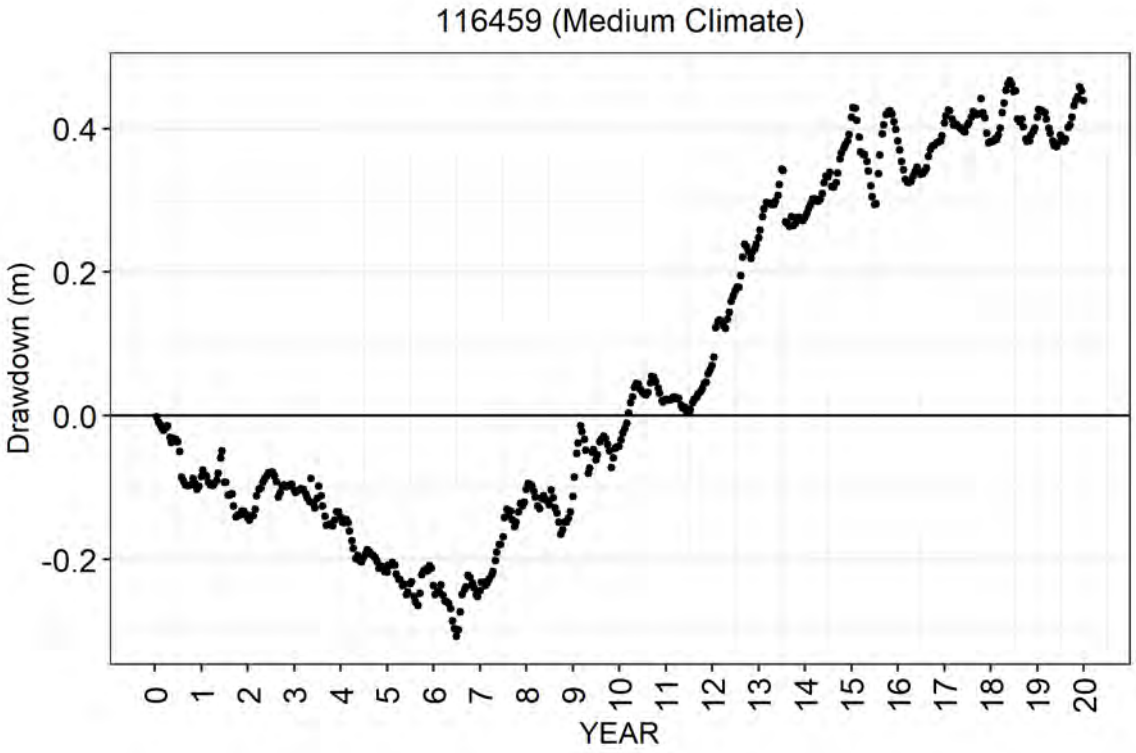

115867 (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

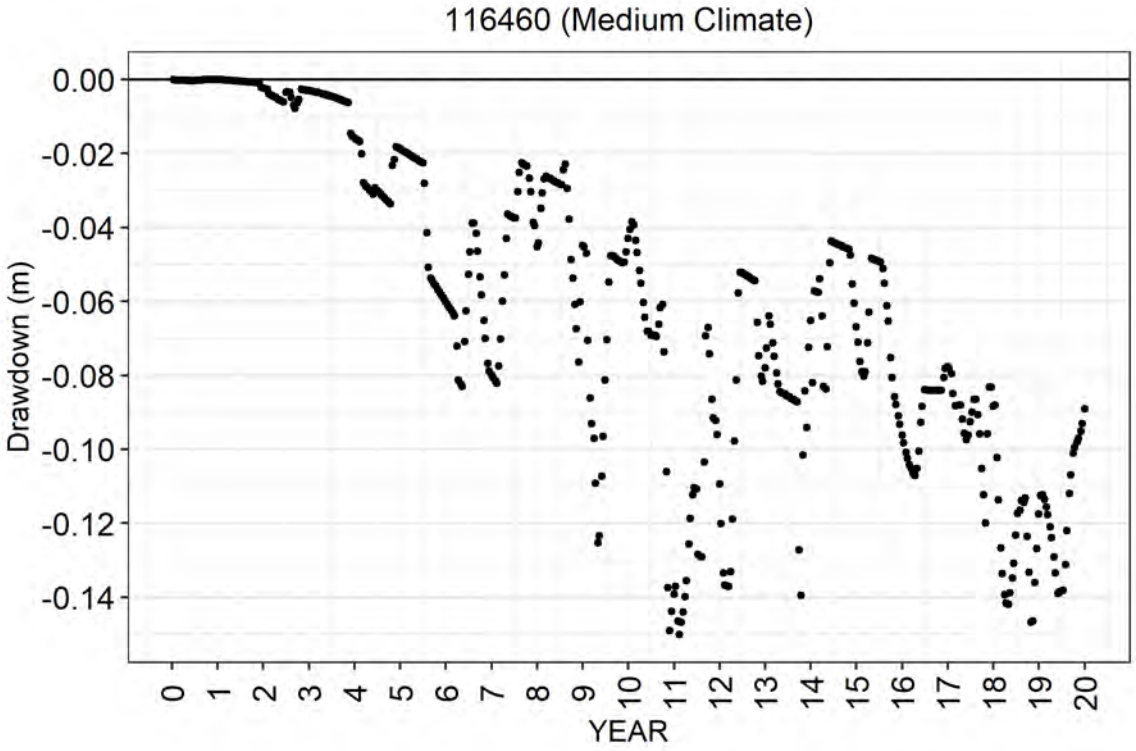

115868 (Medium Climate)
Drawdown (m)
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

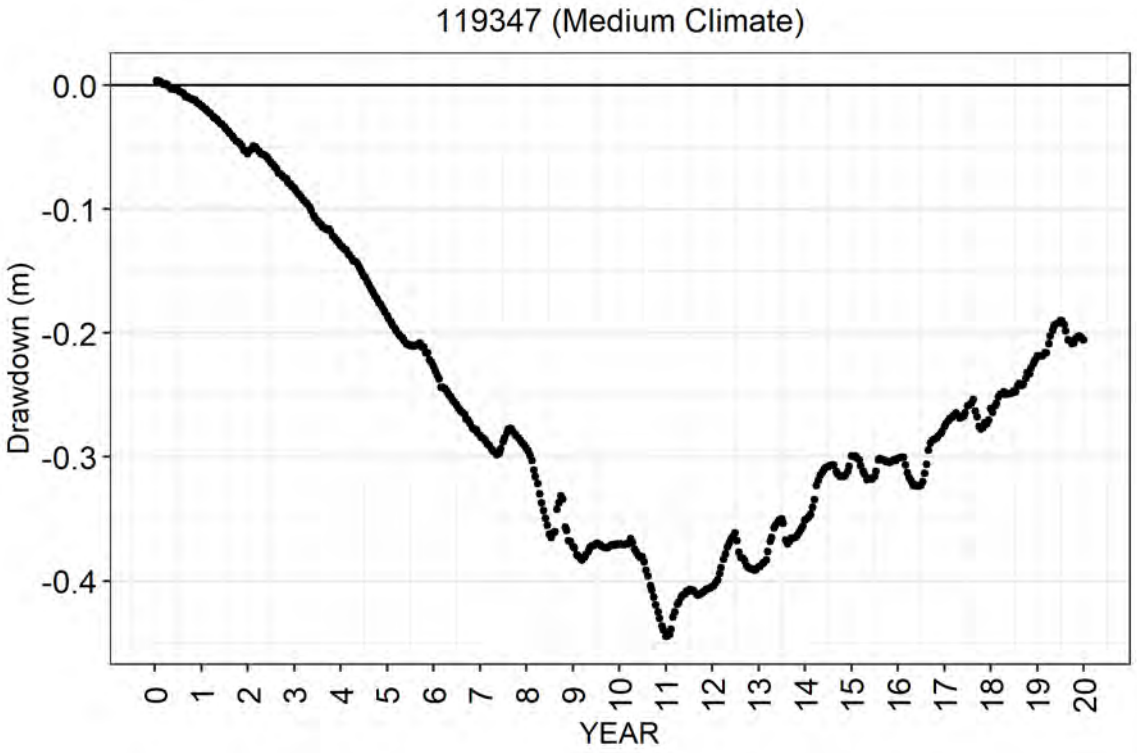

115869 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

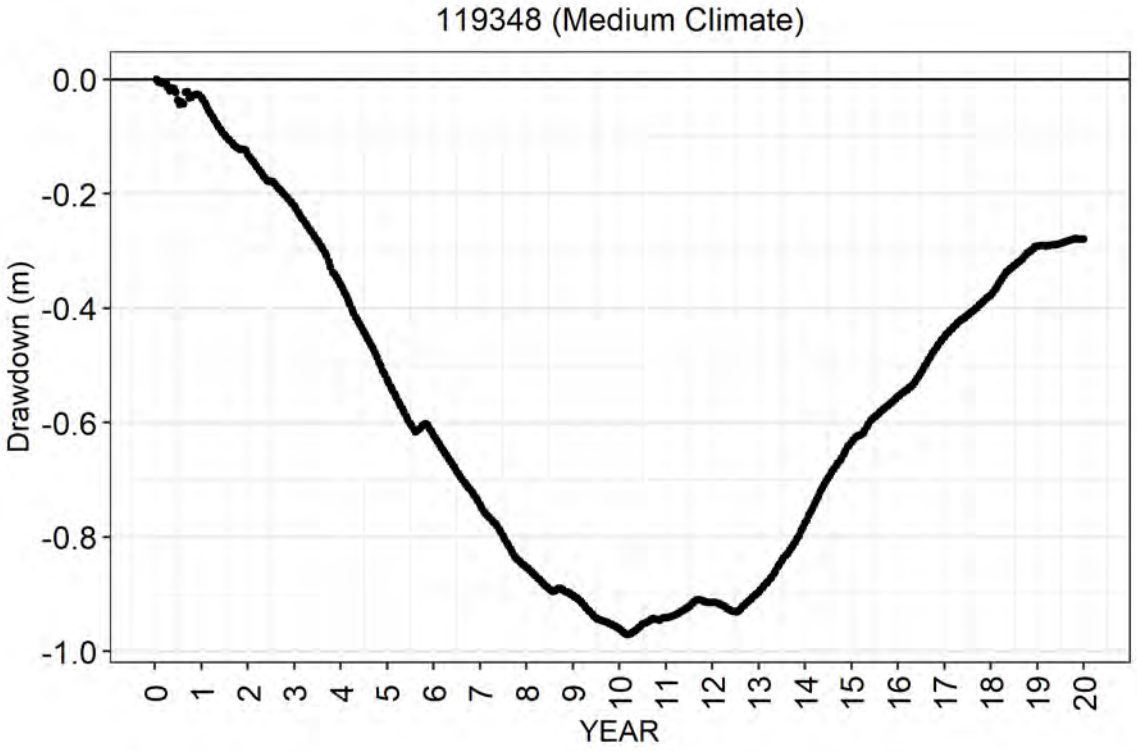

115873 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

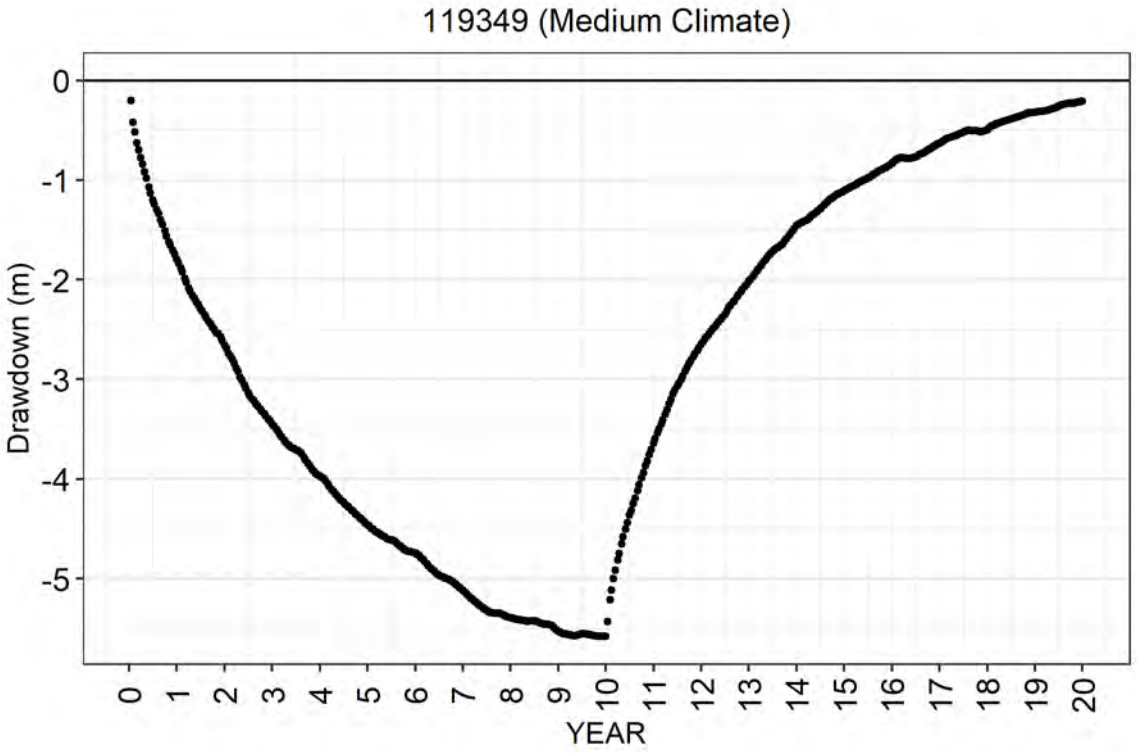

116458 (Medium Climate)
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

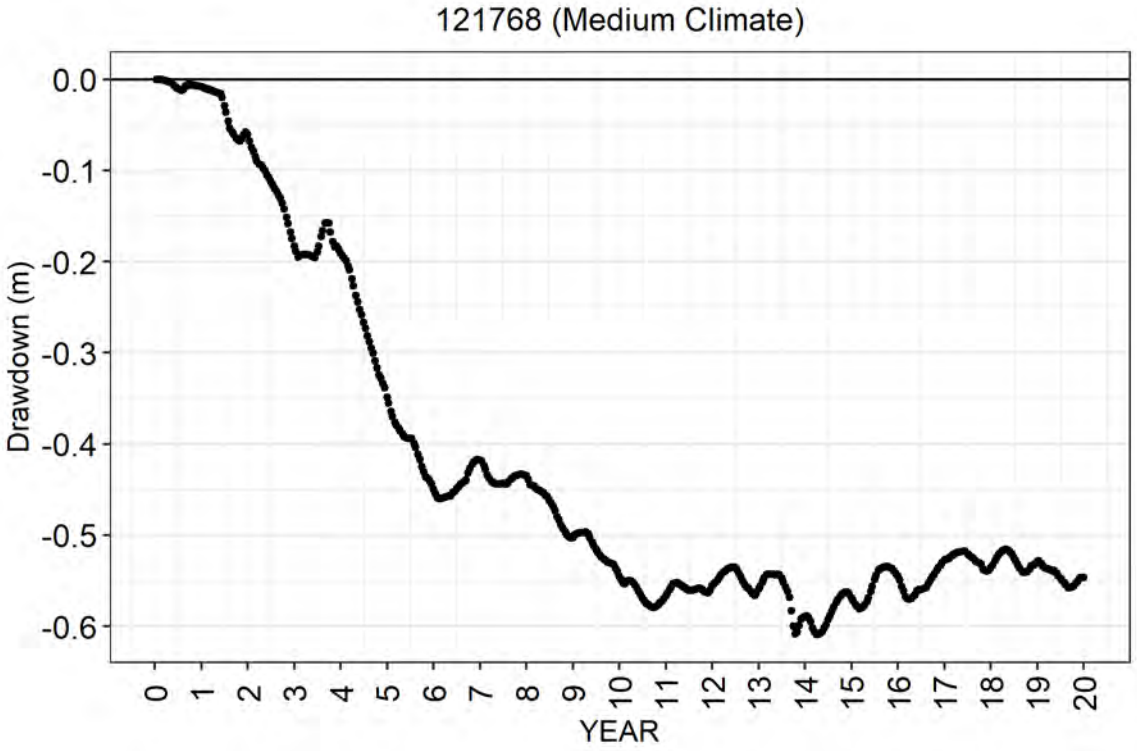

116459 (Medium Climate)
Drawdown (m)
0.4
0.2
0.0
-0.2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

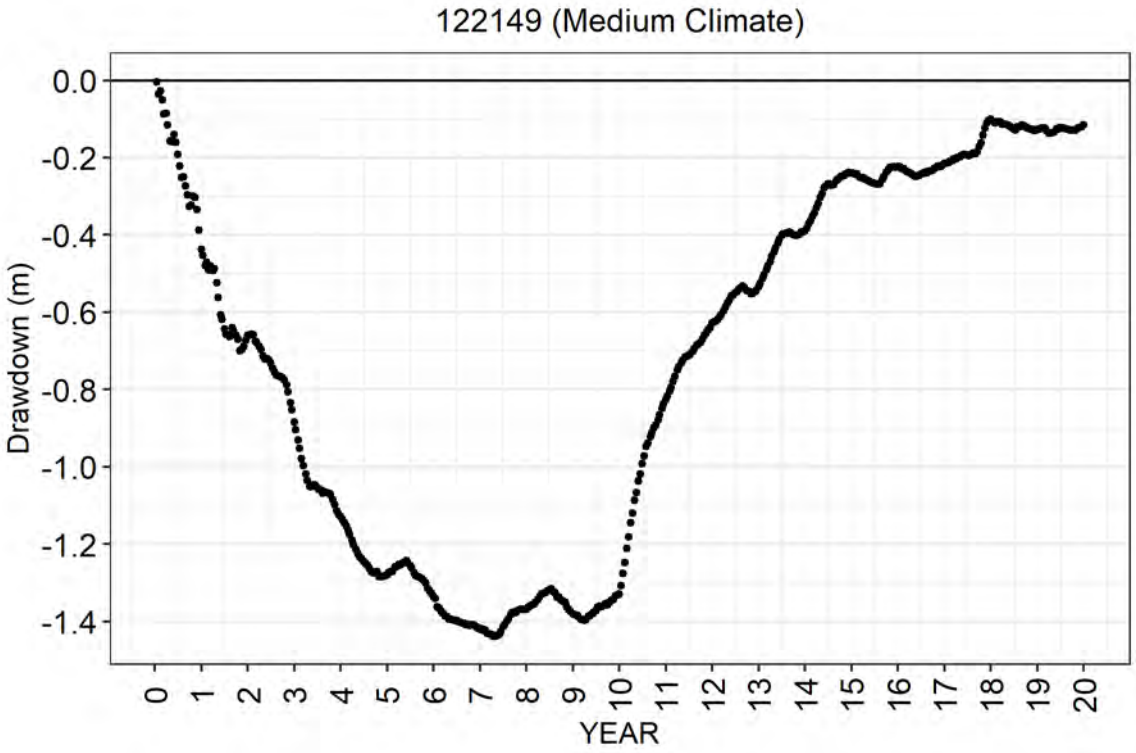

116460 (Medium Climate)
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

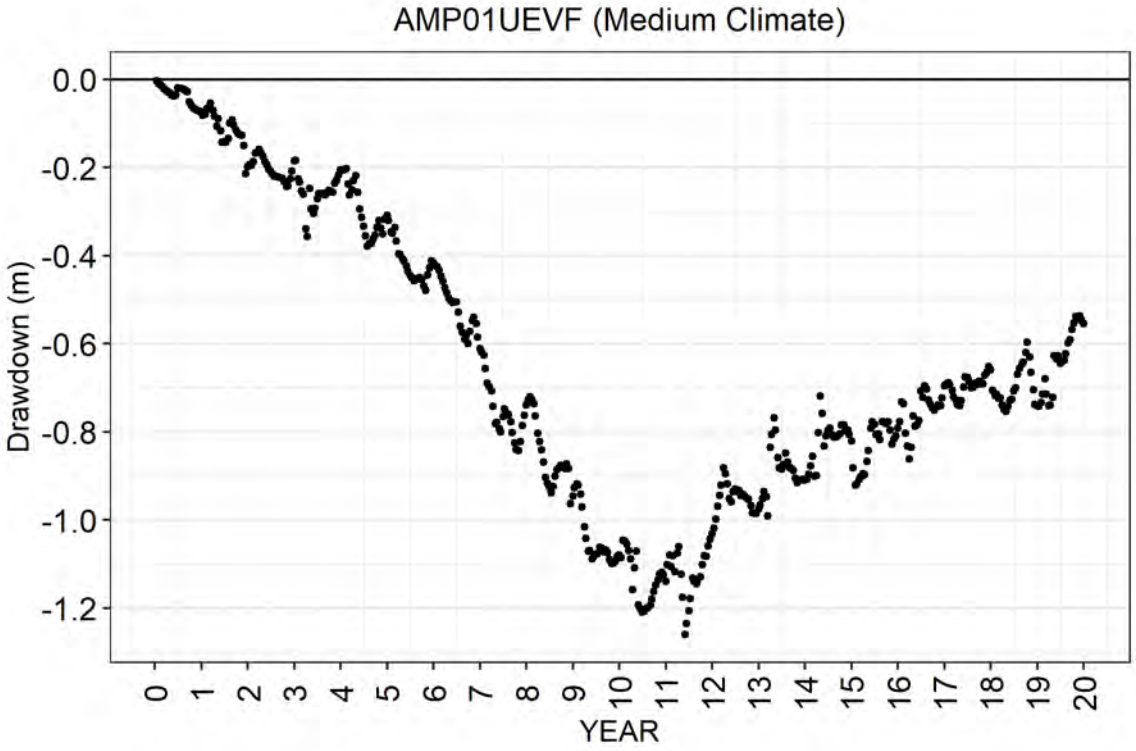

119347 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

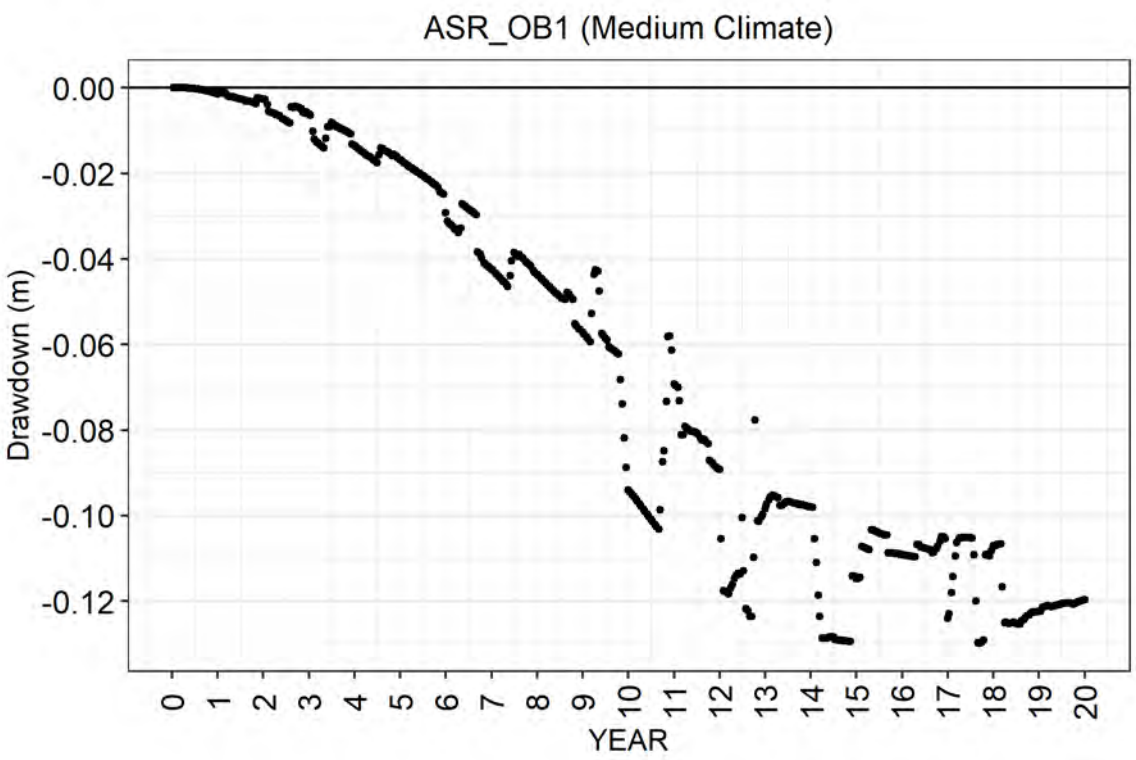

119348 (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

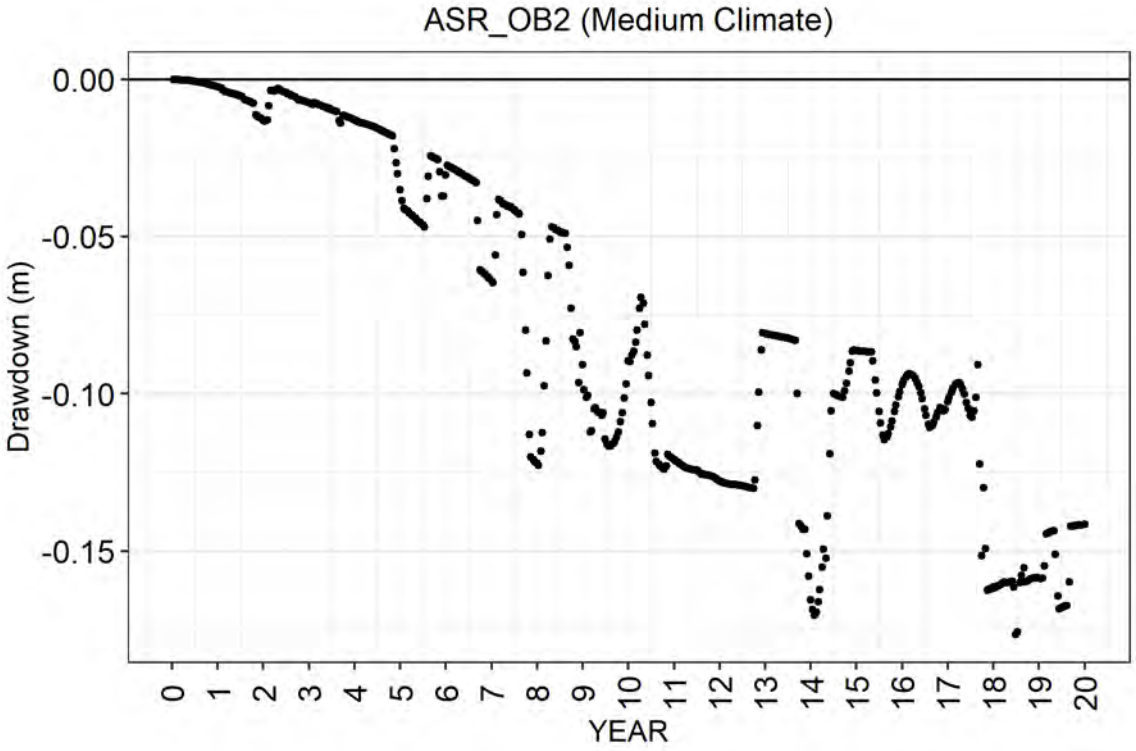

119349 (Medium Climate)
Drawdown (m)
0
-1
-2
-3
-4
-5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

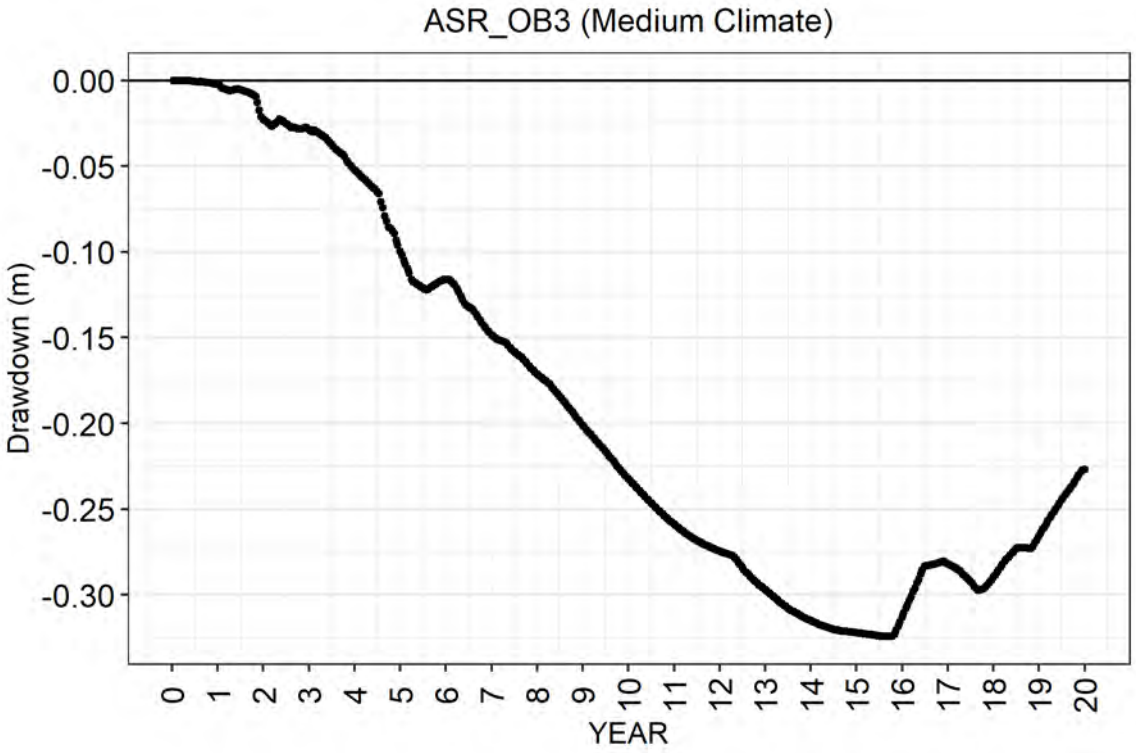

121768 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

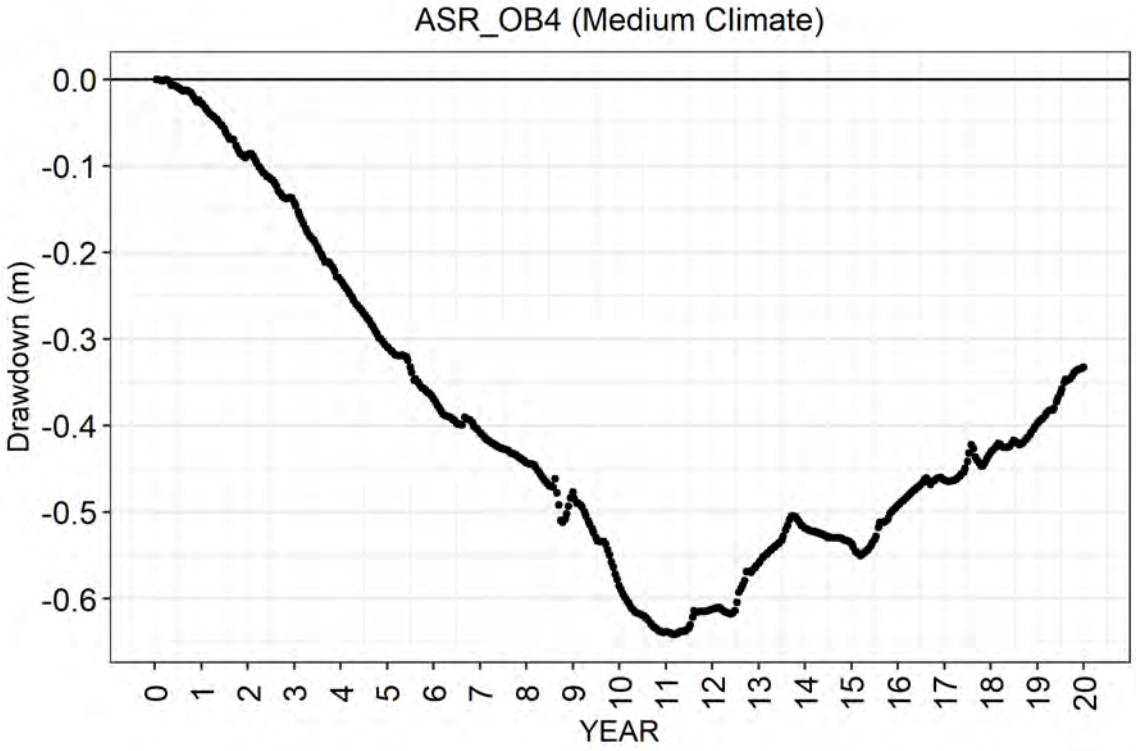

122149 (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

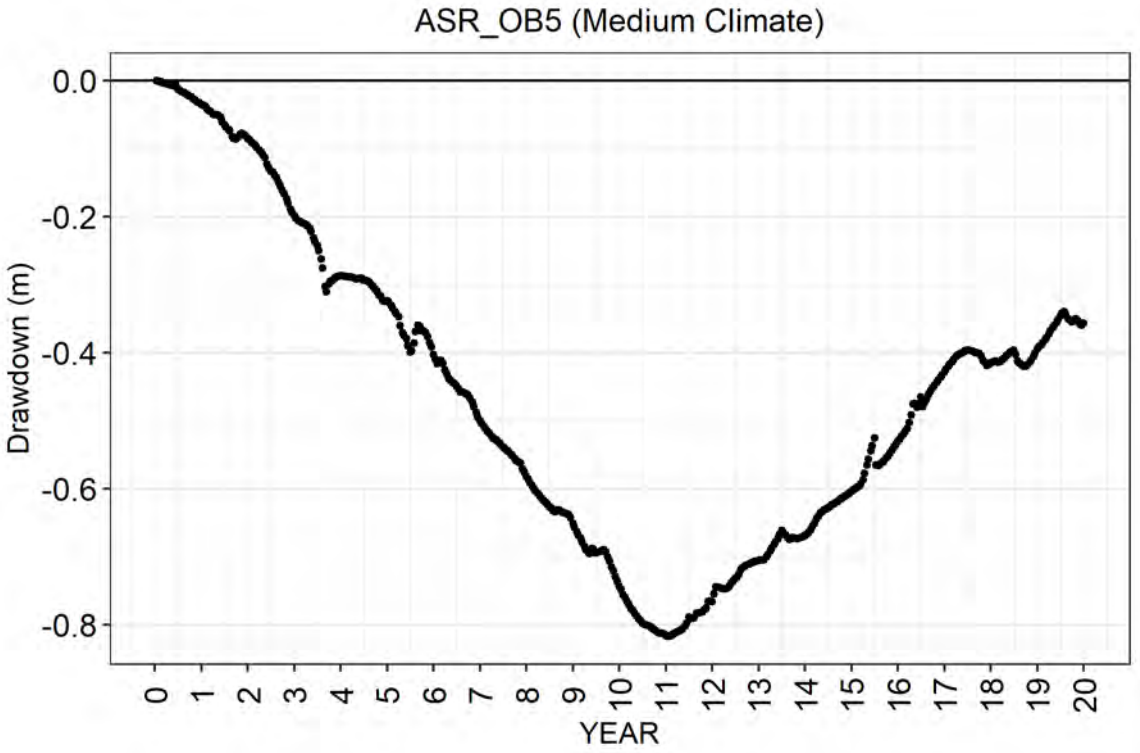

AMP01UEVF (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

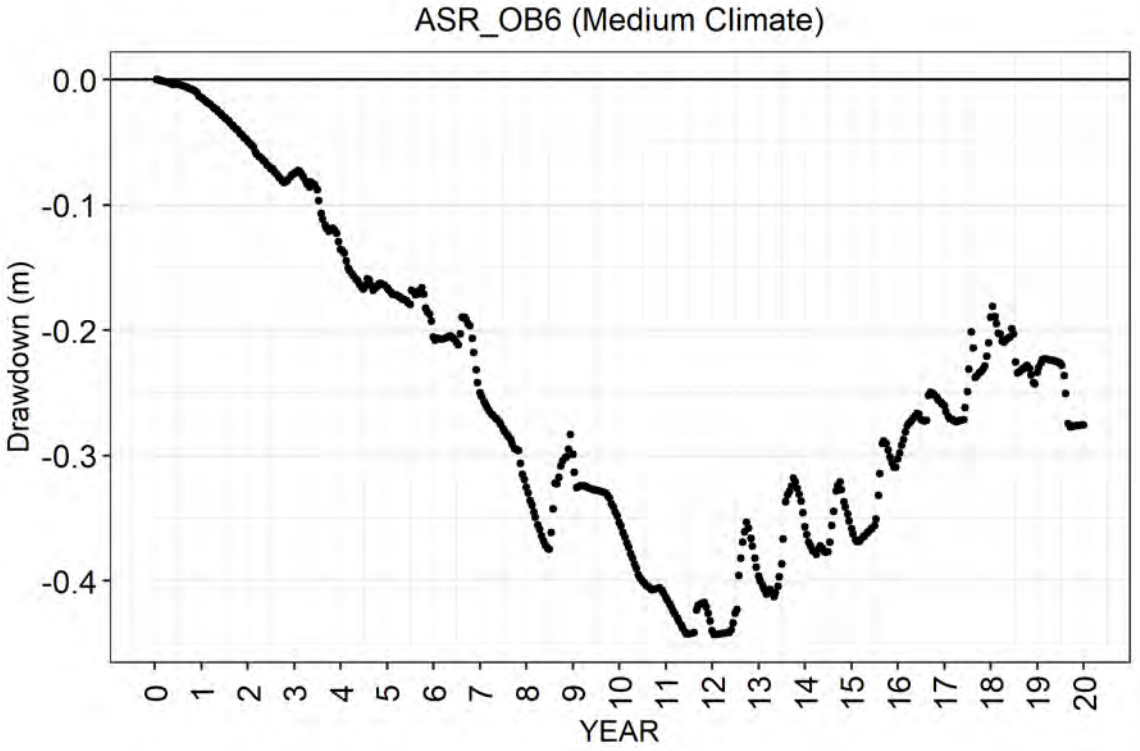

ASR_OB1 (Medium Climate)
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

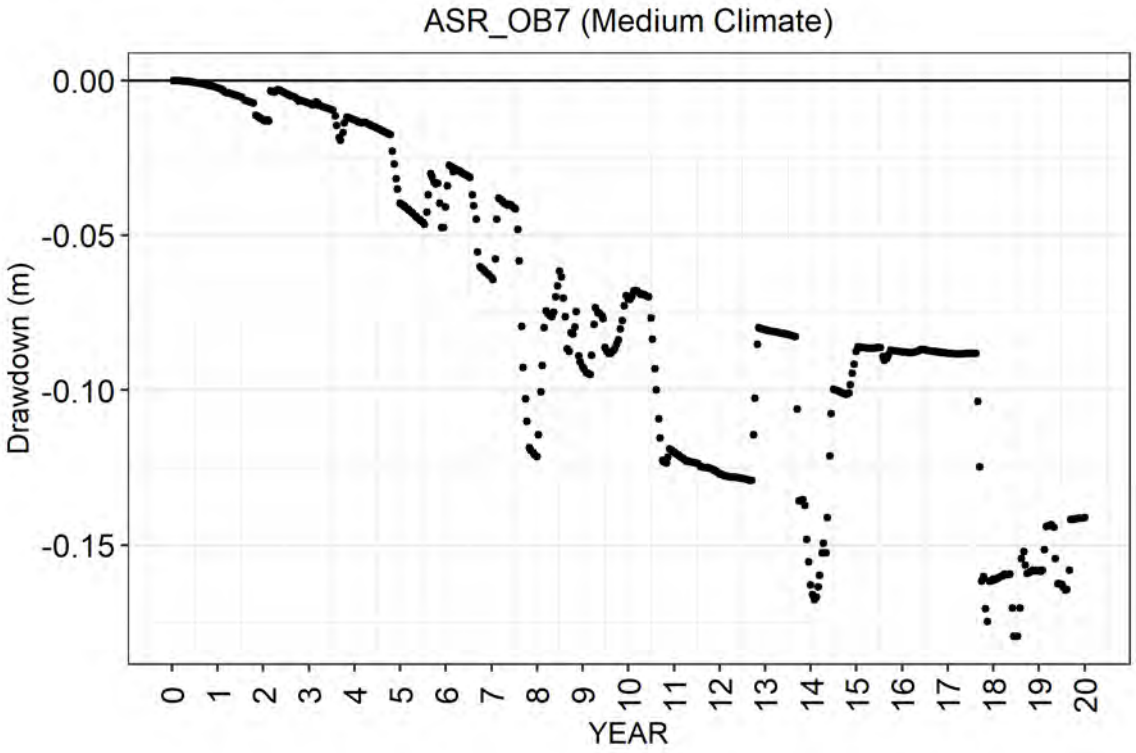

ASR_OB2 (Medium Climate)
Drawdown (m)
0.00
-0.05
-0.10
-0.15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

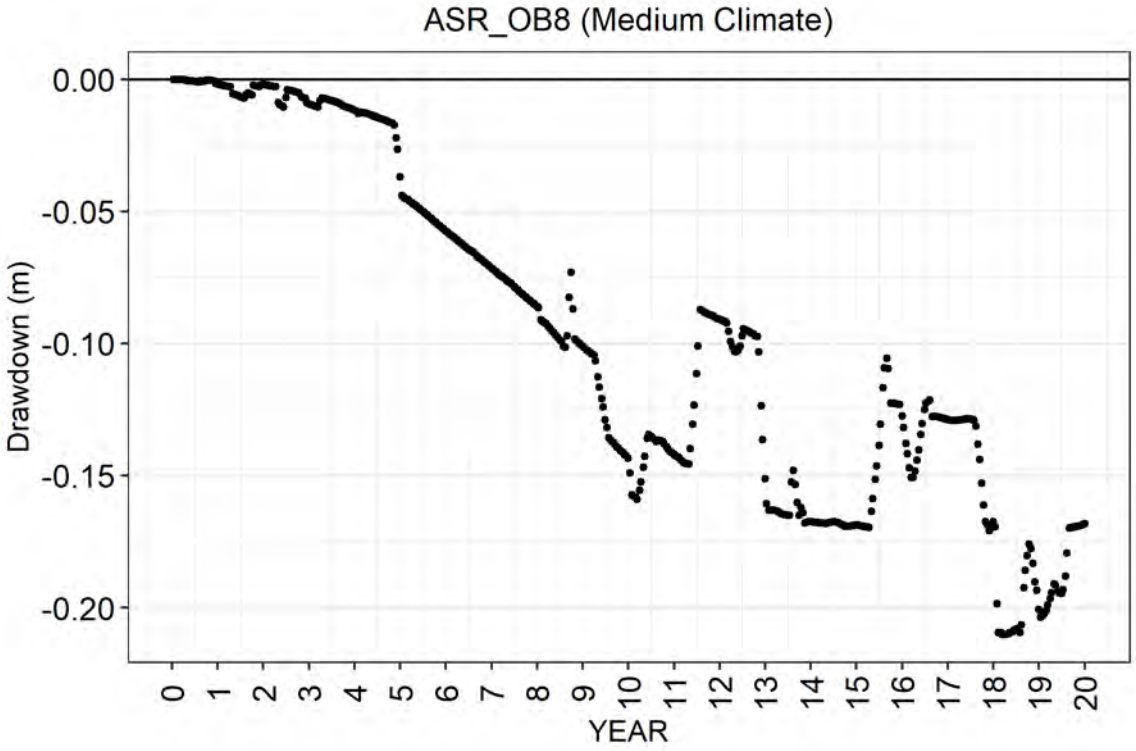

ASR_OB3 (Medium Climate)
Drawdown (m)
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

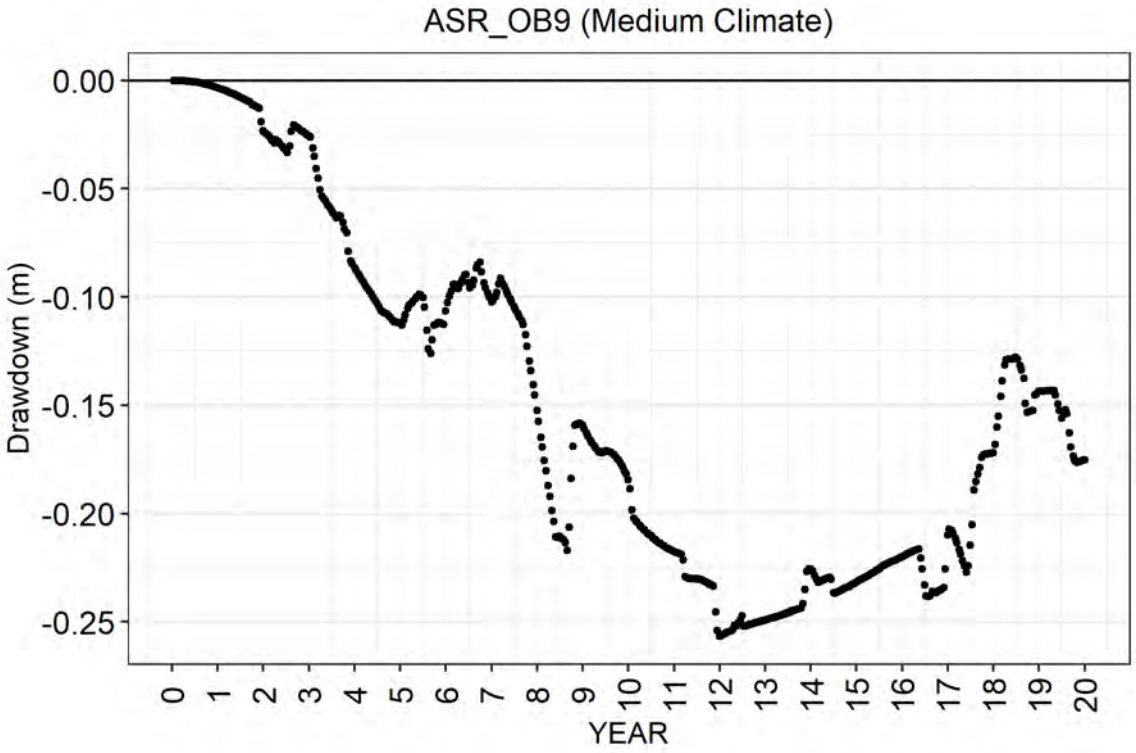

ASR_OB4 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

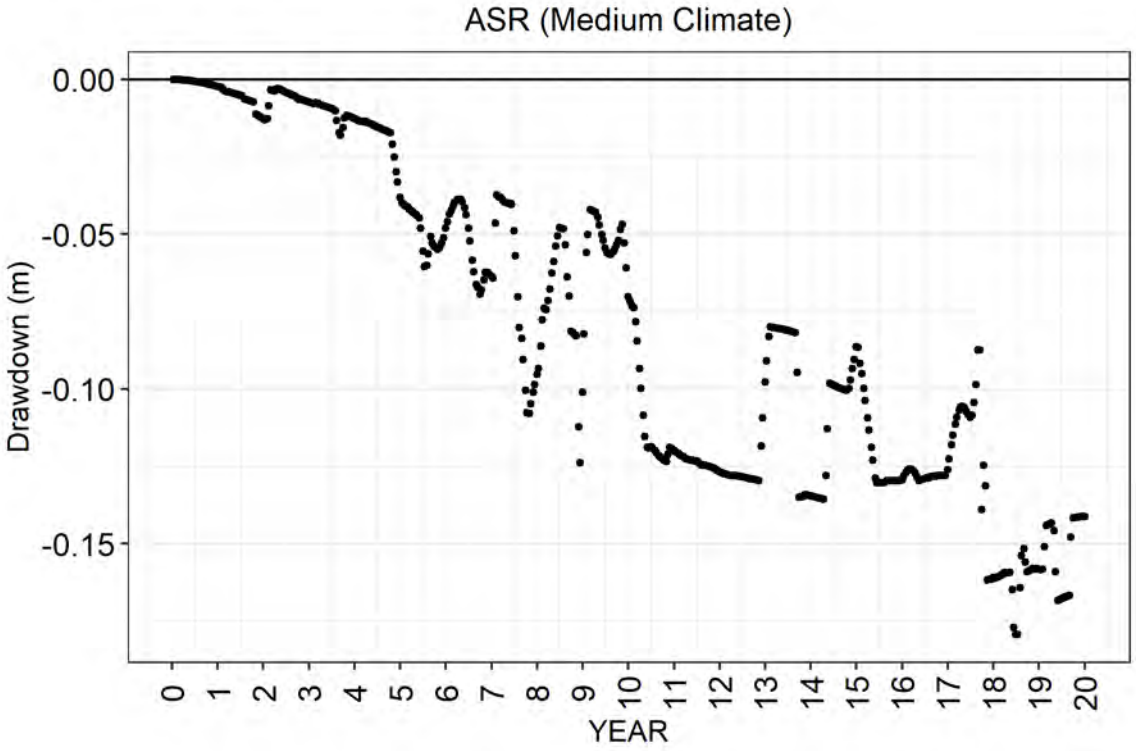

ASR_OB5 (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

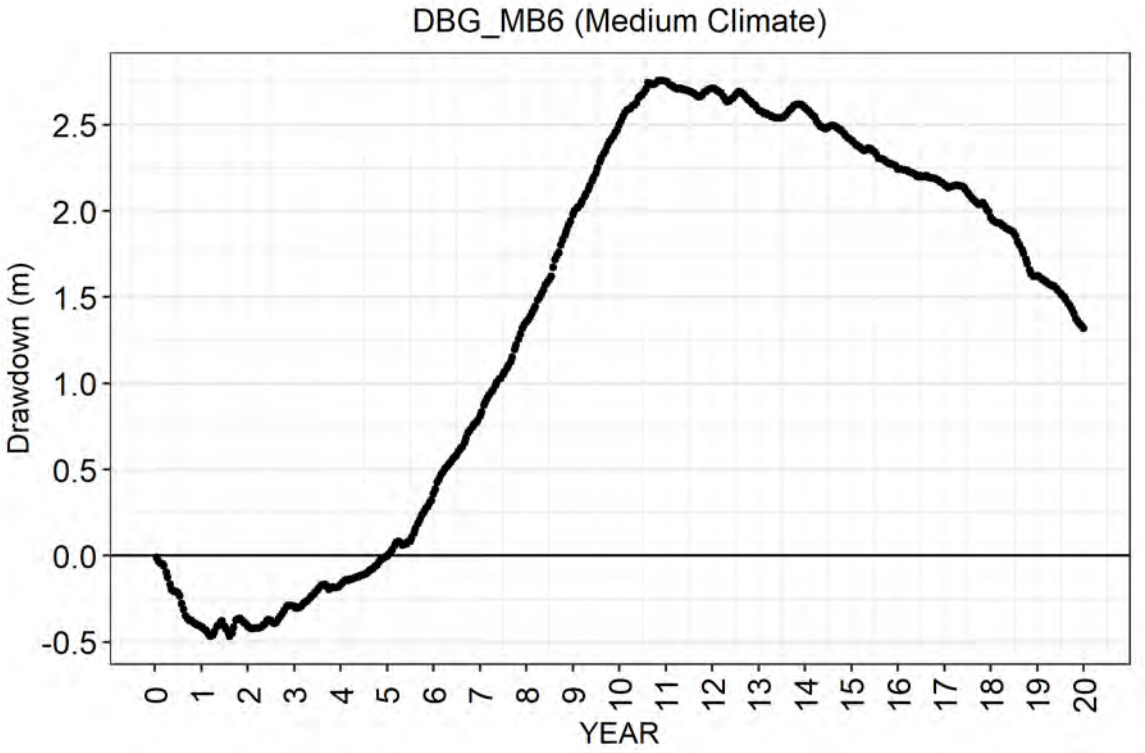

ASR_OB6 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

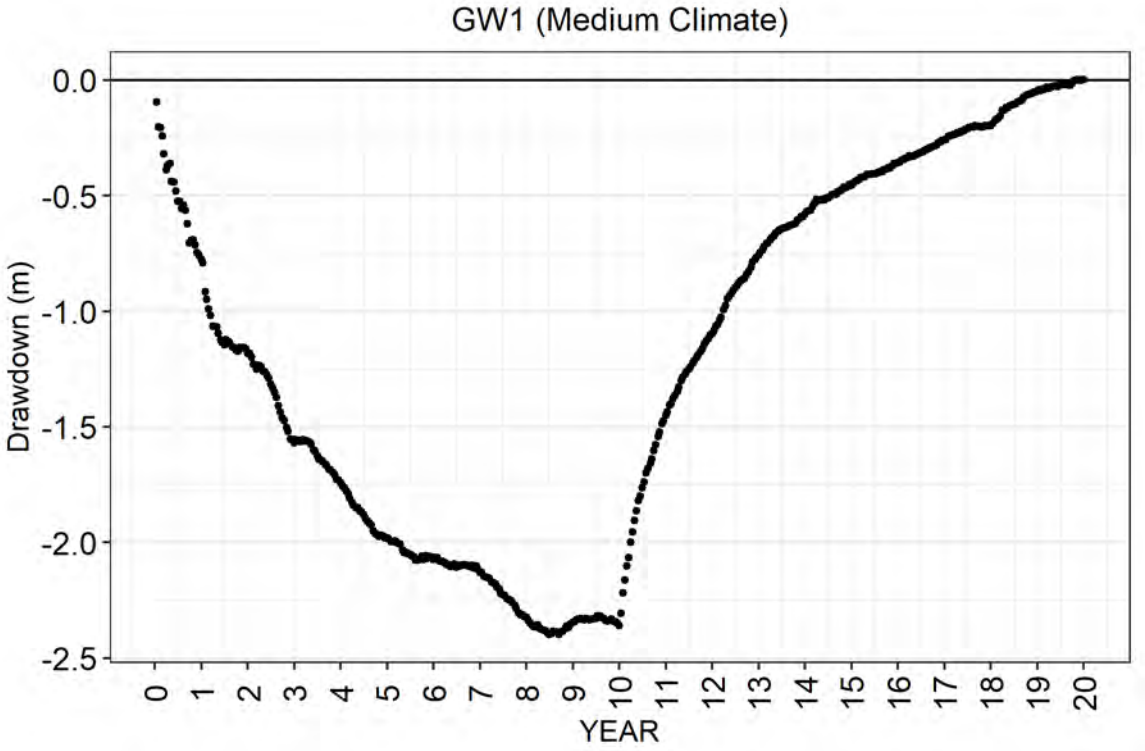

ASR_OB7 (Medium Climate)
Drawdown (m)
0.00
-0.05
-0.10
-0.15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

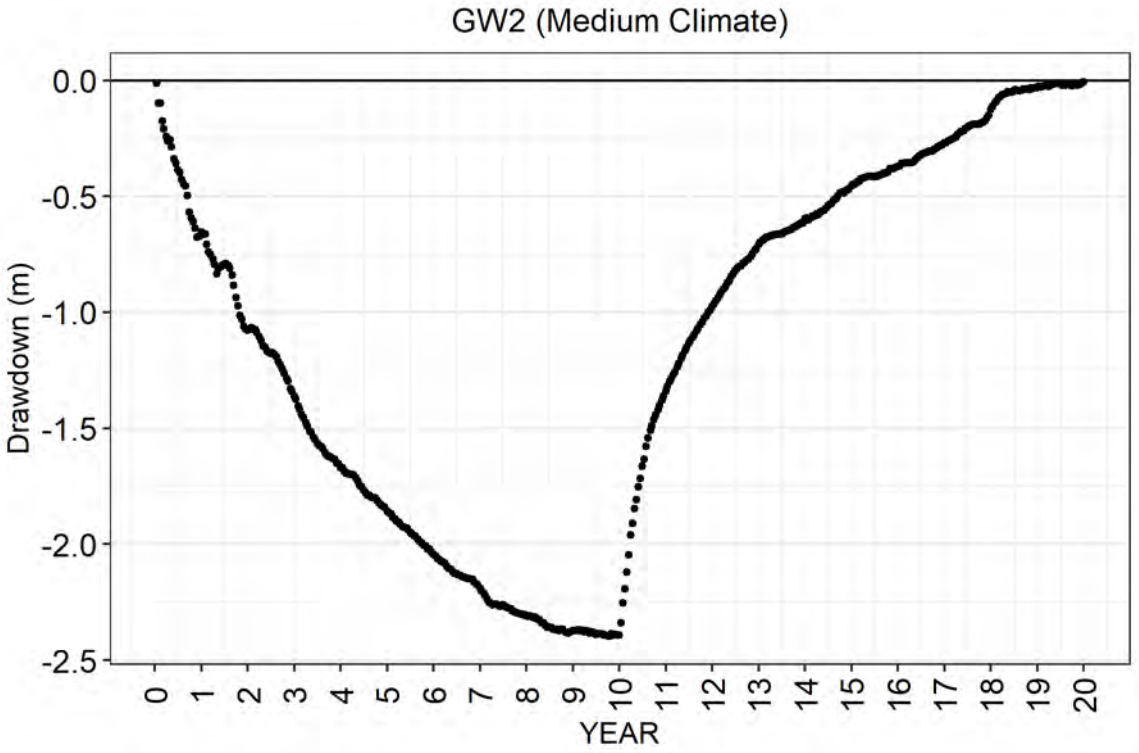

ASR_OB8 (Medium Climate)
Drawdown (m)
0.00
-0.05
-0.10
-0.15
-0.20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

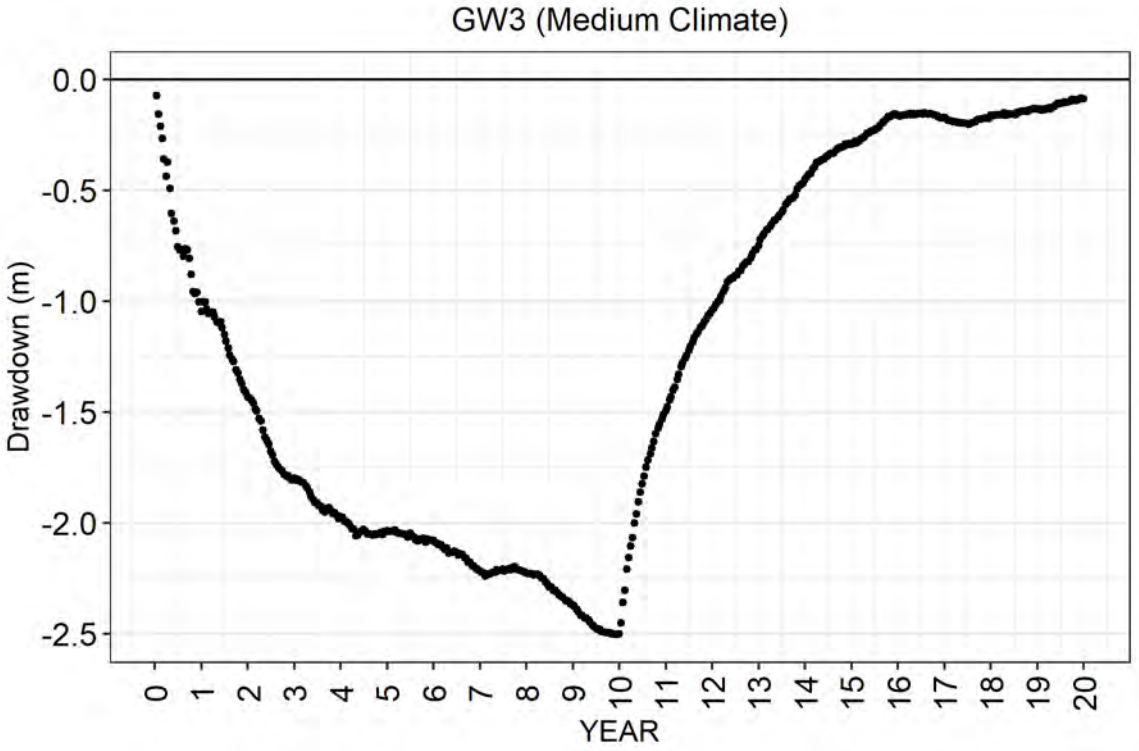

ASR_OB9 (Medium Climate)
Drawdown (m)
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

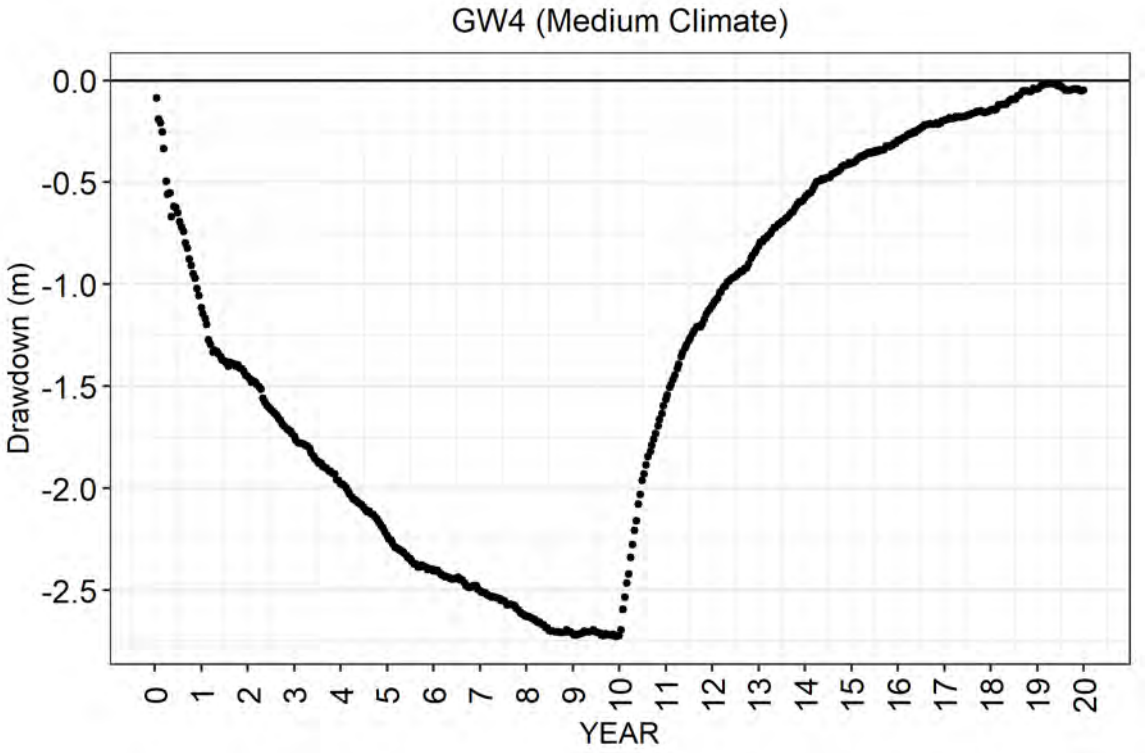

ASR (Medium Climate)
Drawdown (m)
0.00
-0.05
-0.10
-0.15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

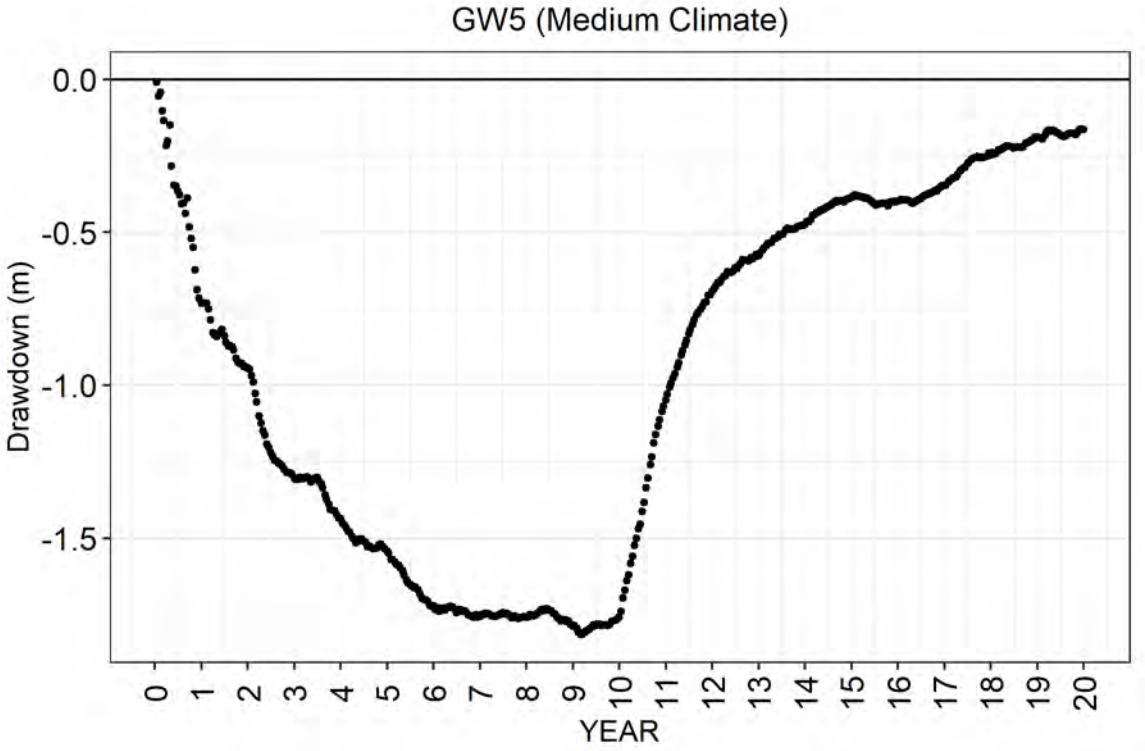

DBG_MB6 (Medium Climate)
Drawdown (m)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

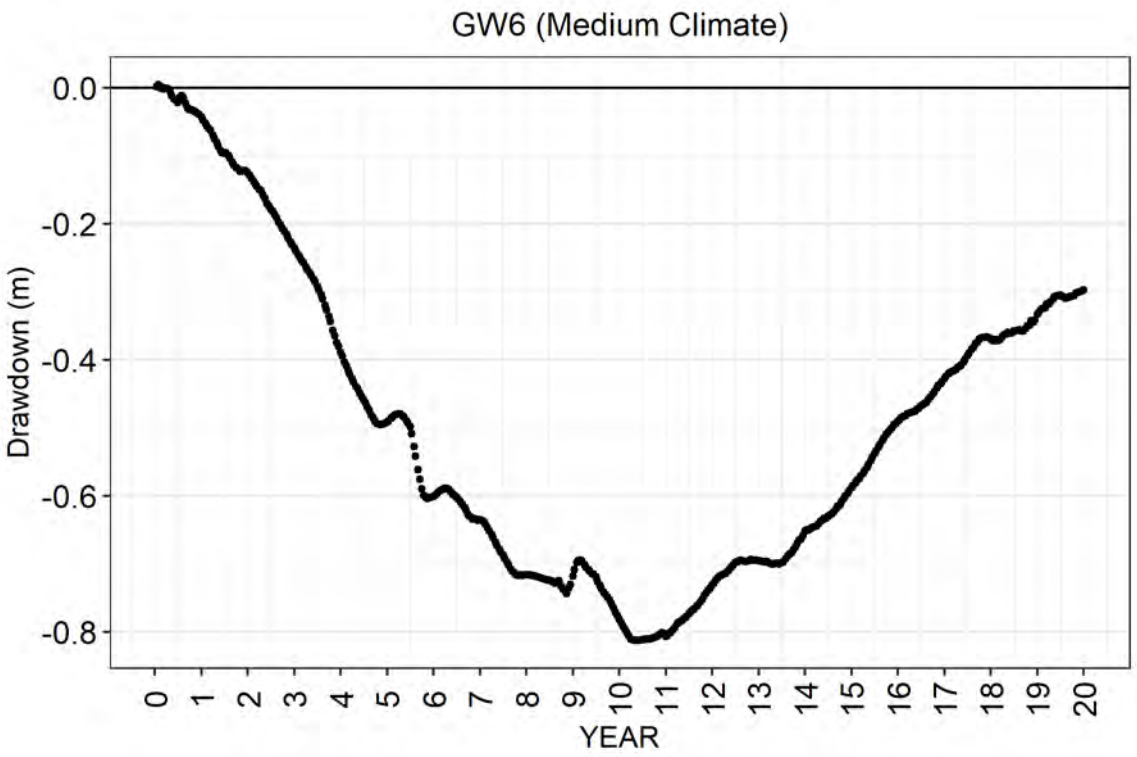

GW1 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

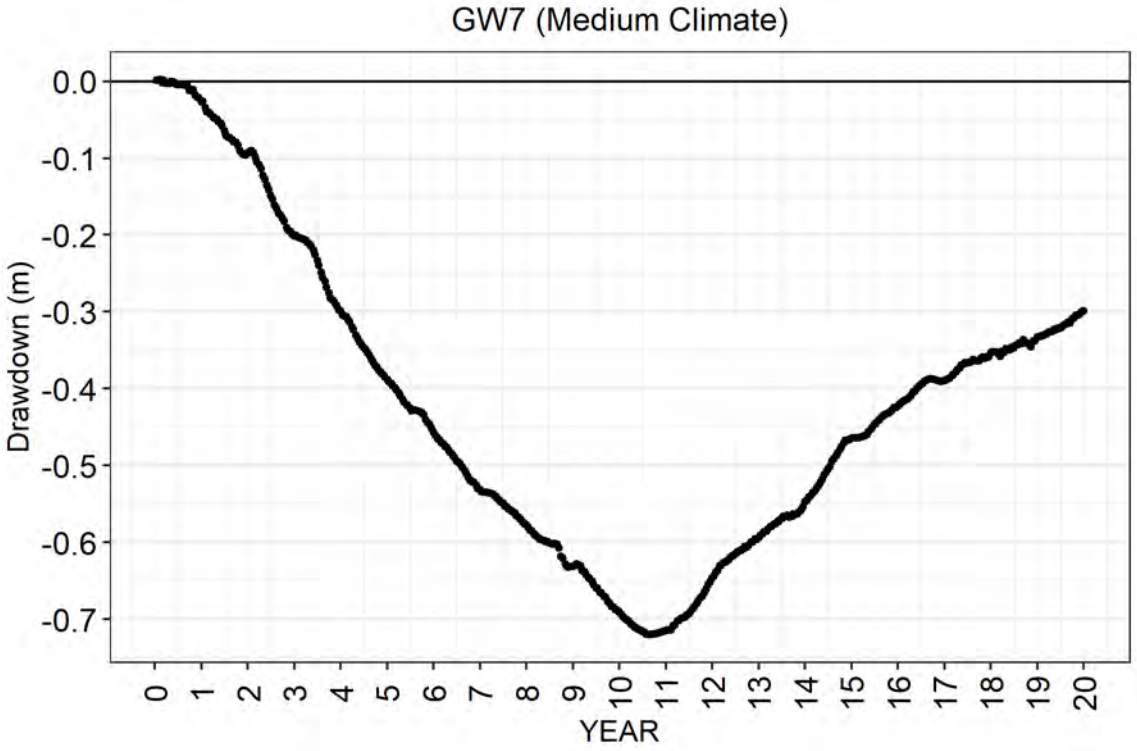

GW2 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

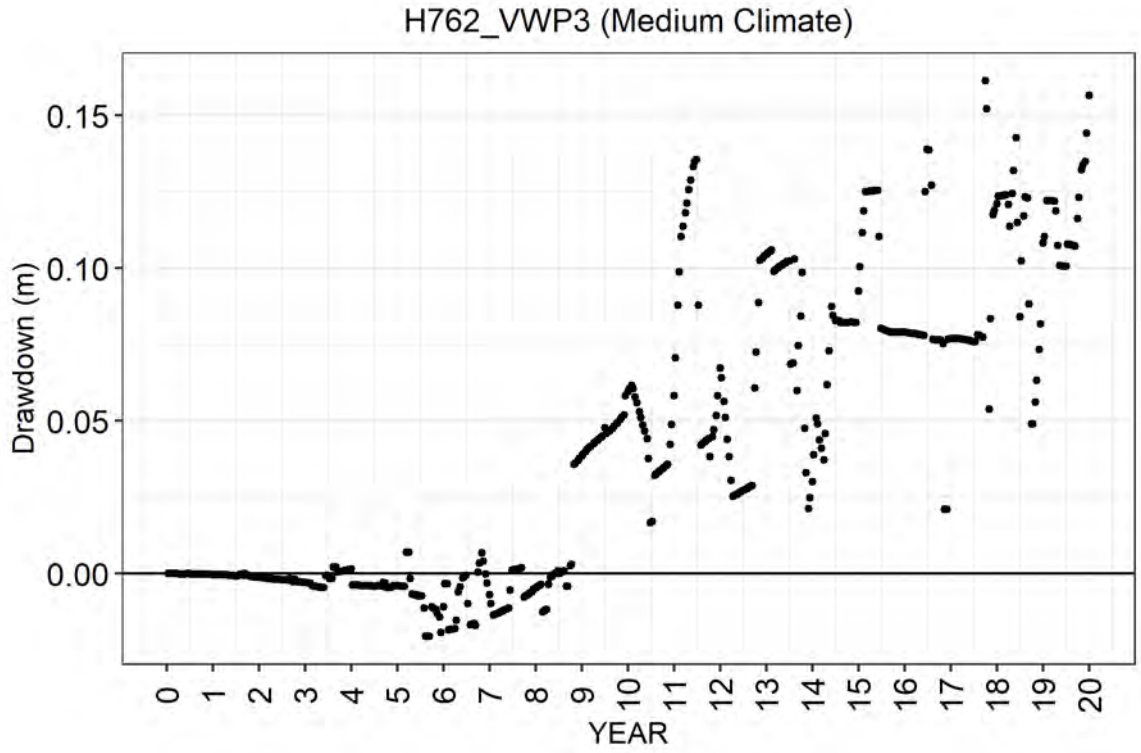

GW3 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

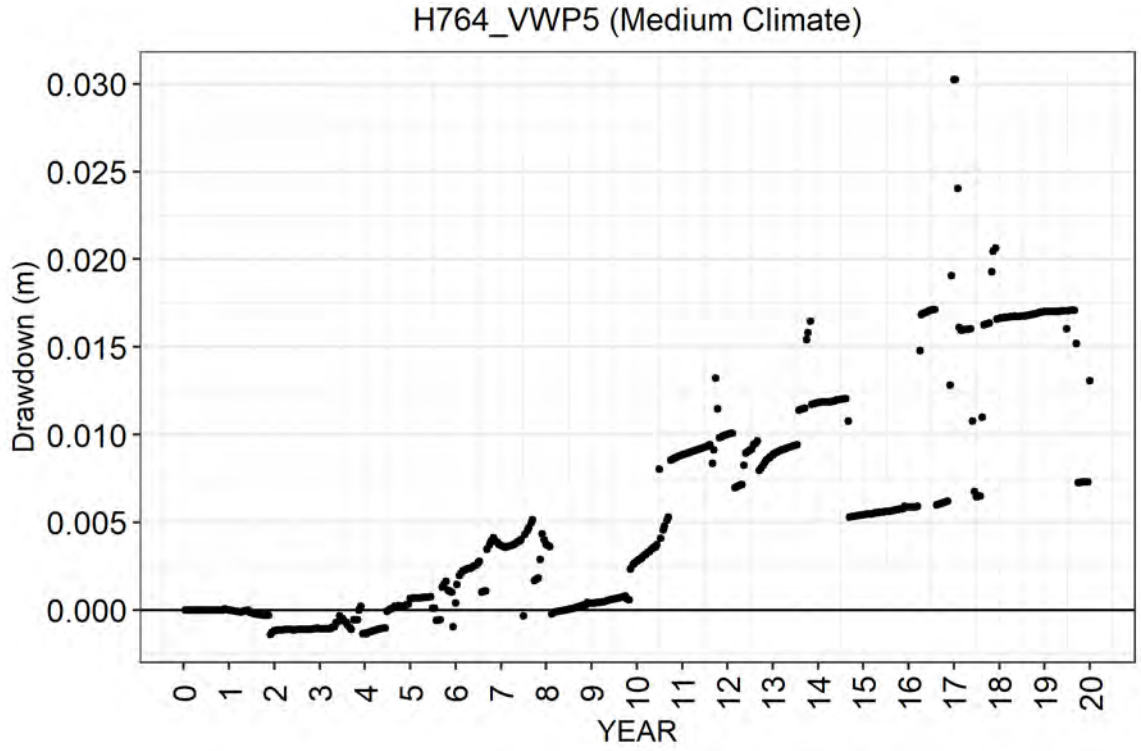

GW4 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

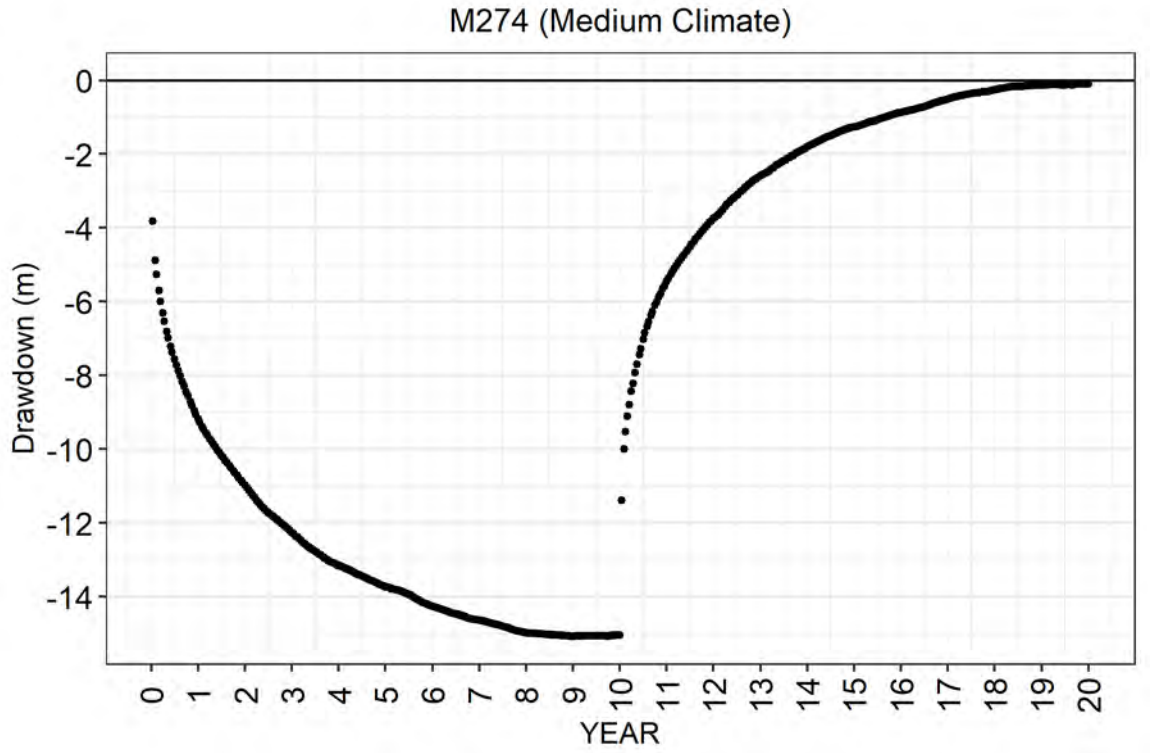

GW5 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

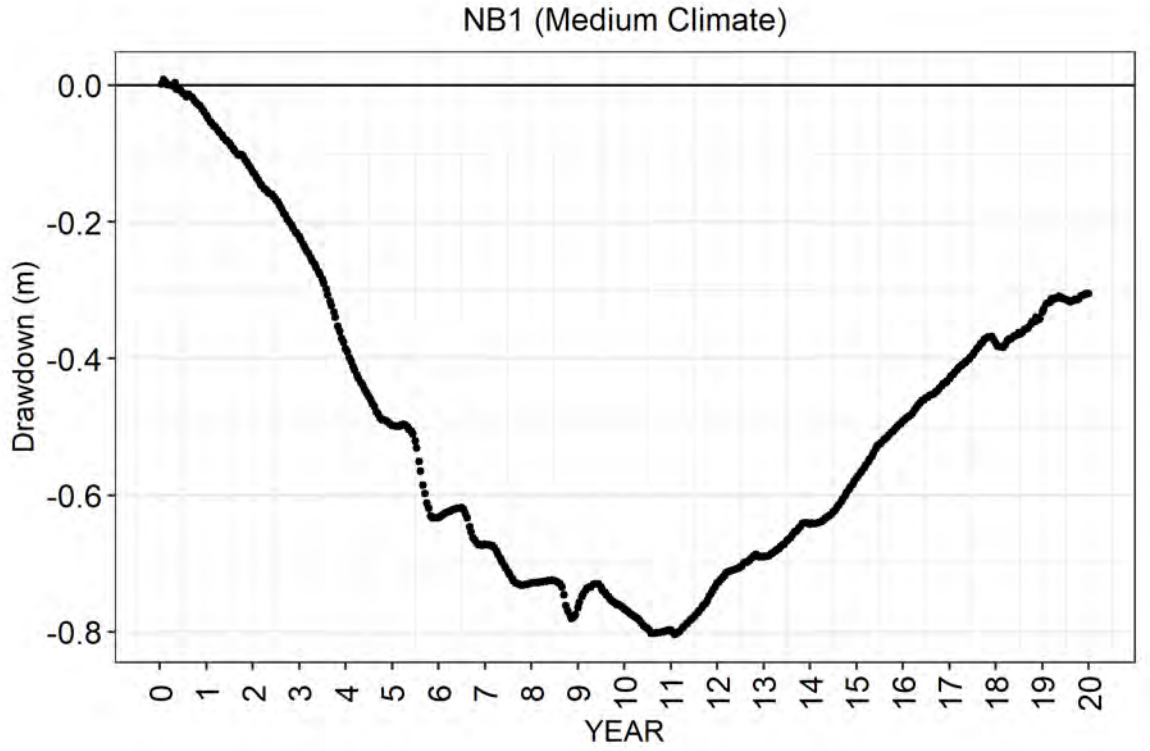

GW6 (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

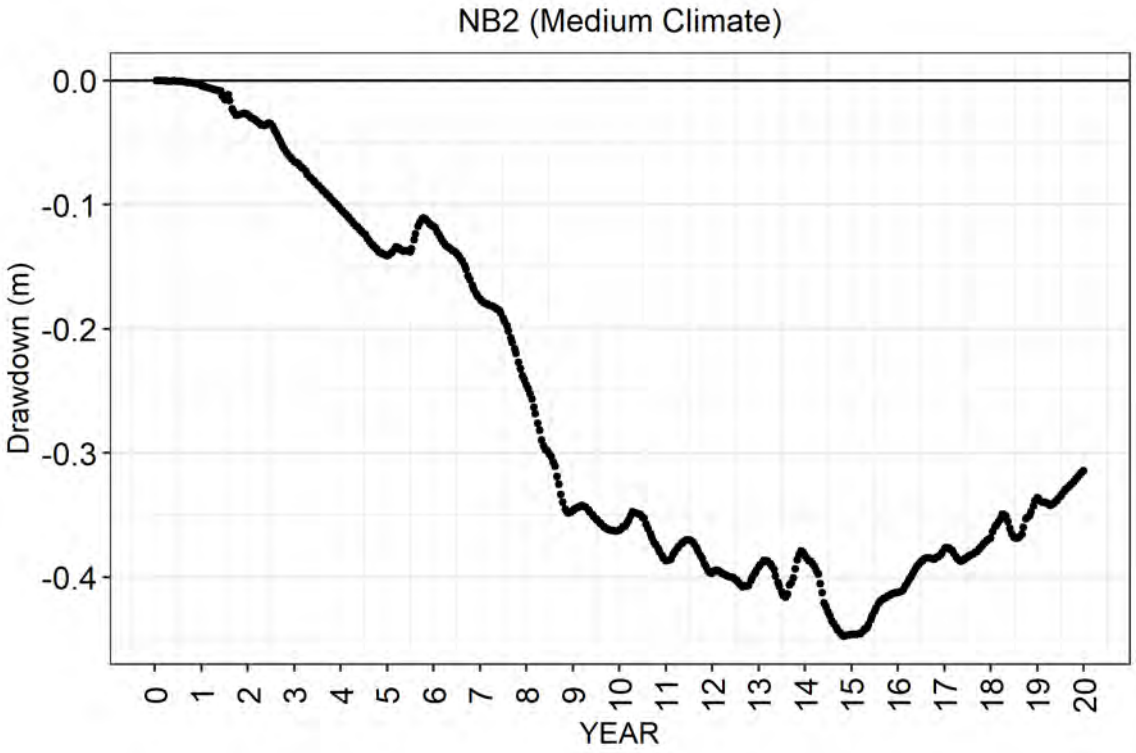

GW7 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

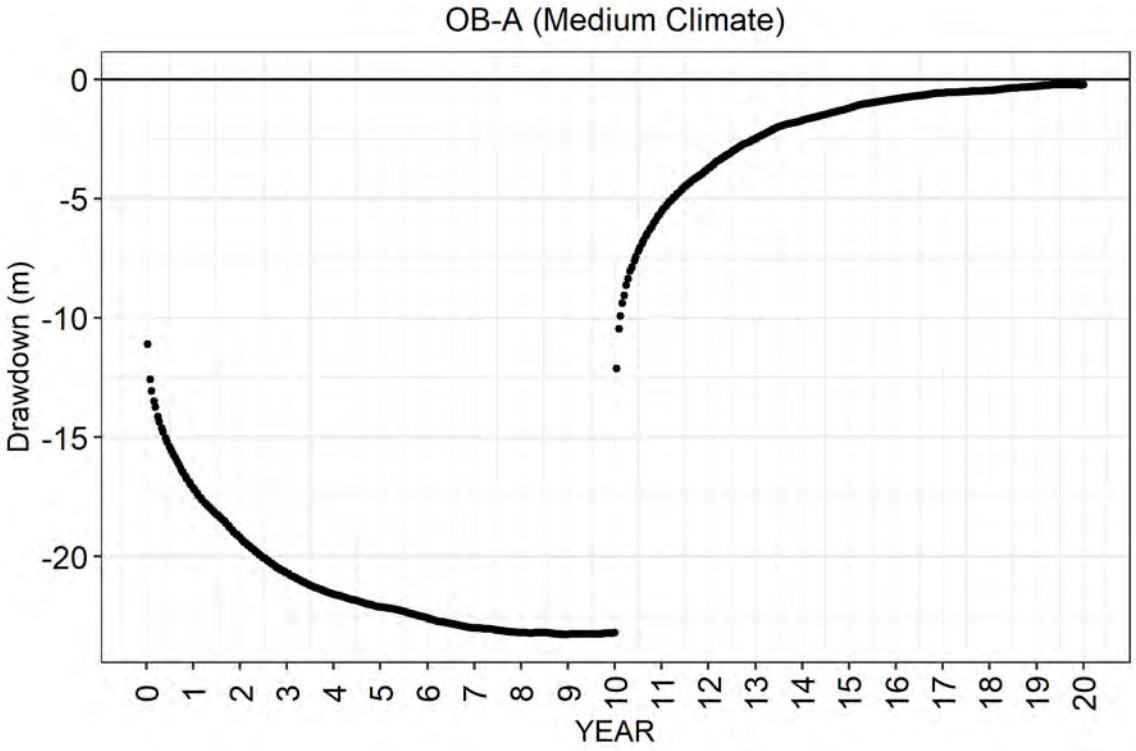

H762_VWP3 (Medium Climate)
Drawdown (m)
0.15
0.10
0.05
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

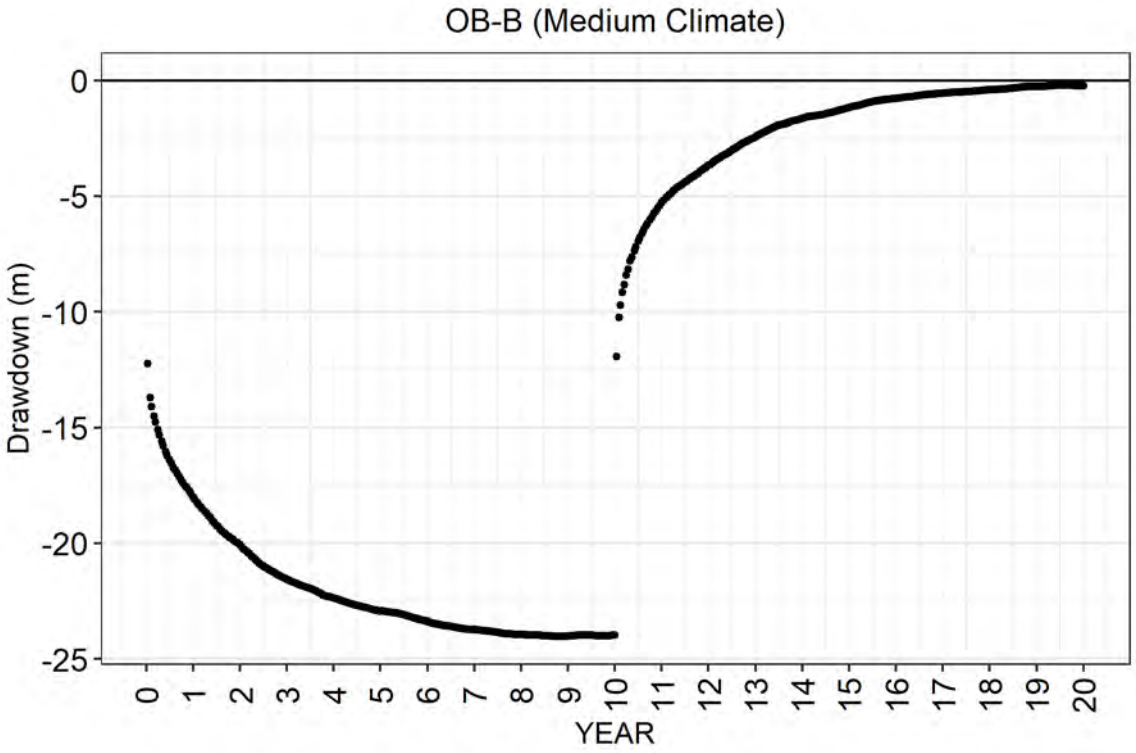

H764_VWP5 (Medium Climate)
Drawdown (m)
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

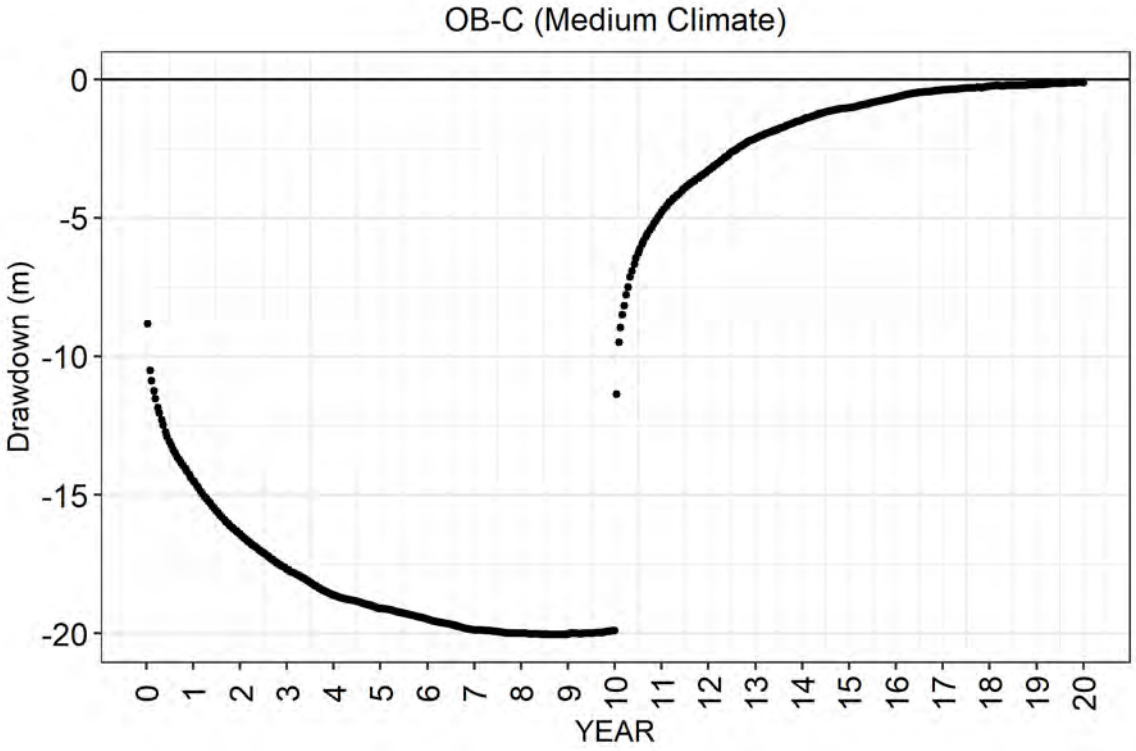

M274 (Medium Climate)
Drawdown (m)
0
-2
-4
-6
-8
-10
-12
-14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

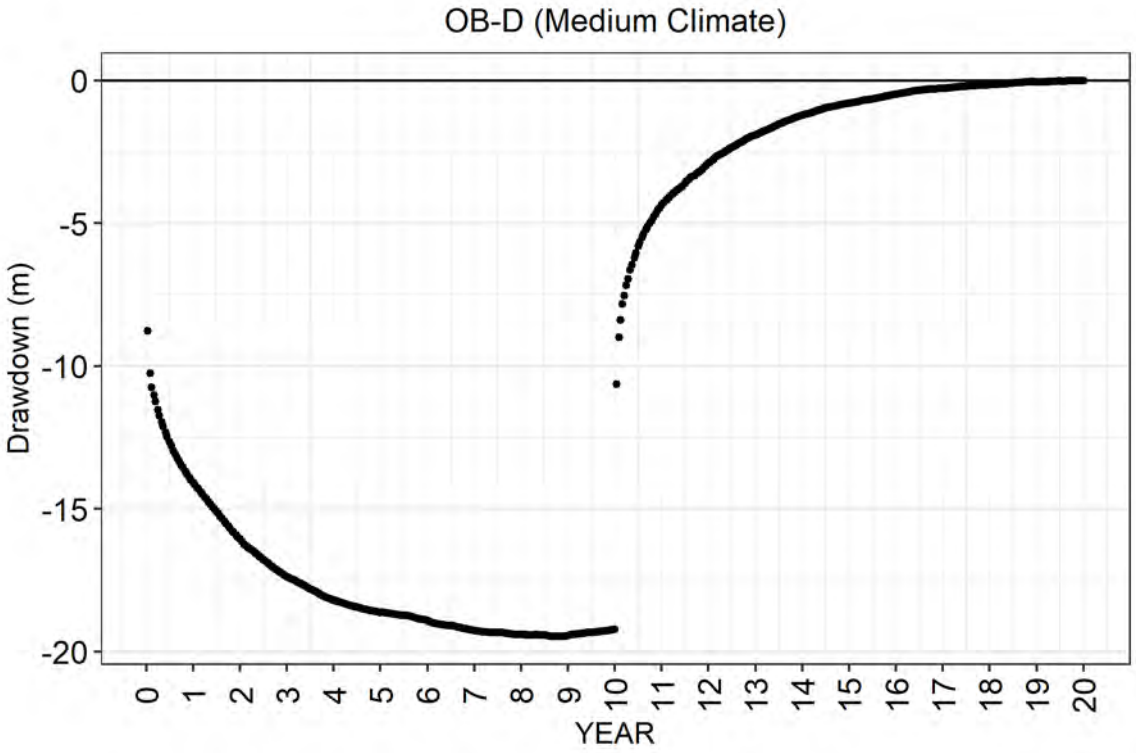

NB1 (Medium Climate)
Drawdown (m)
0.0
-0.2
-0.4
-0.6
-0.8
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

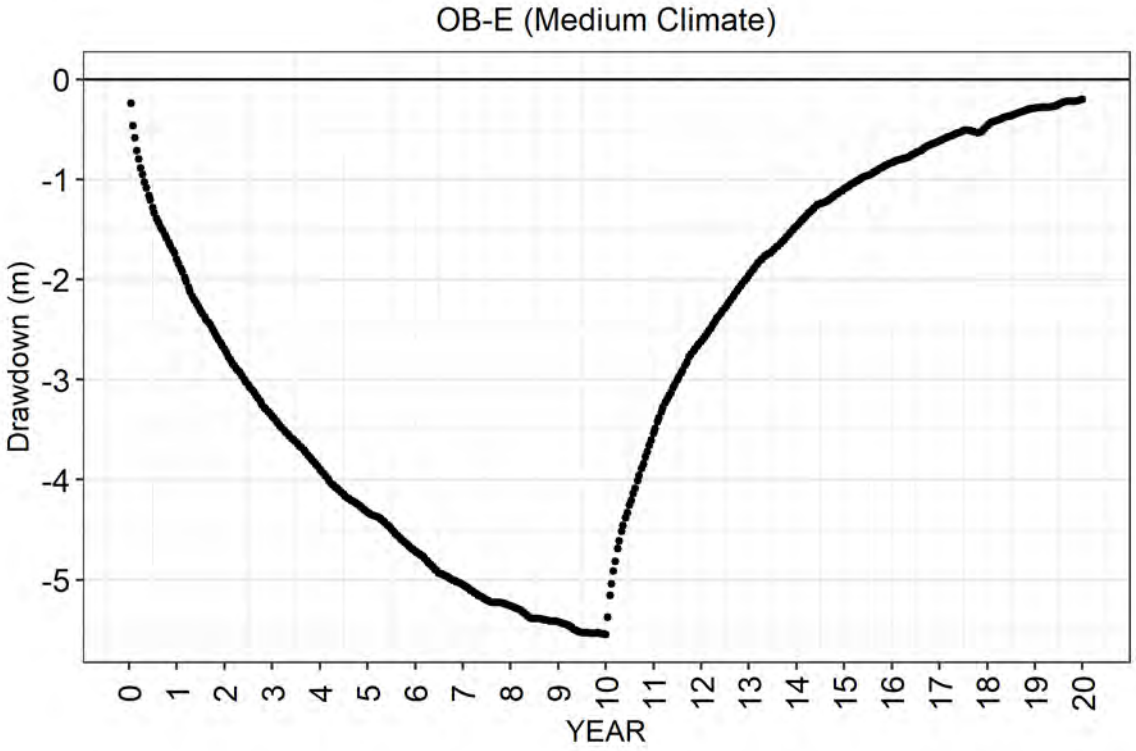

NB2 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

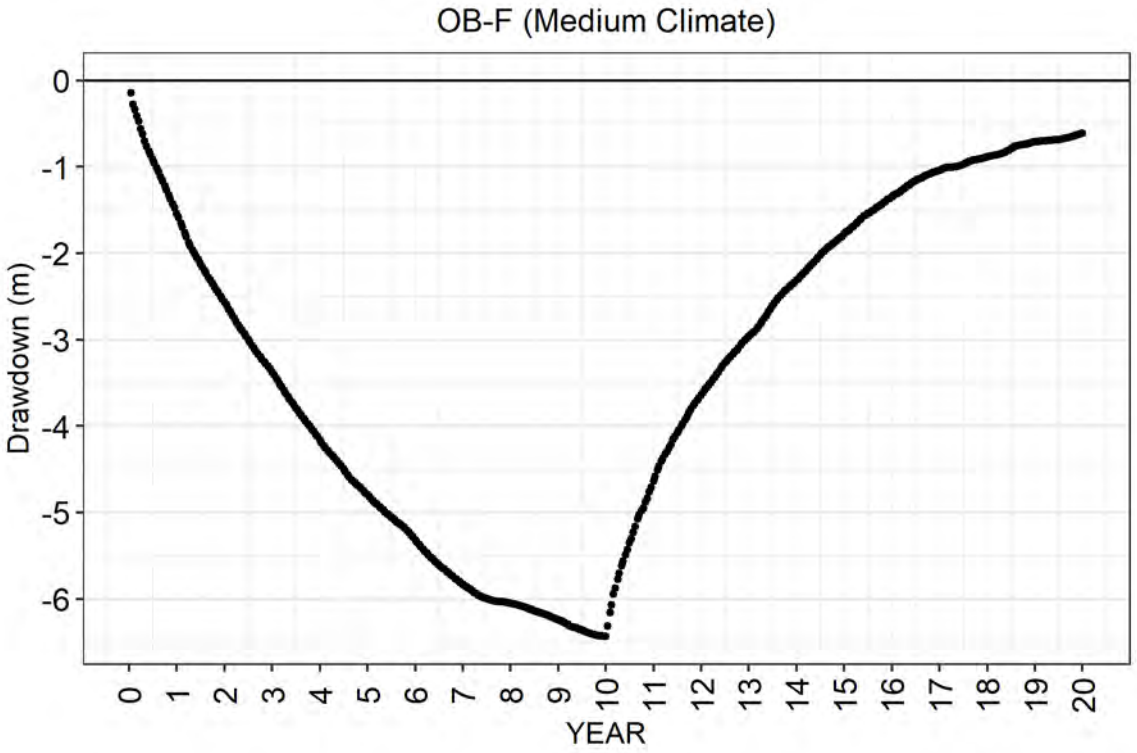

OB-A (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

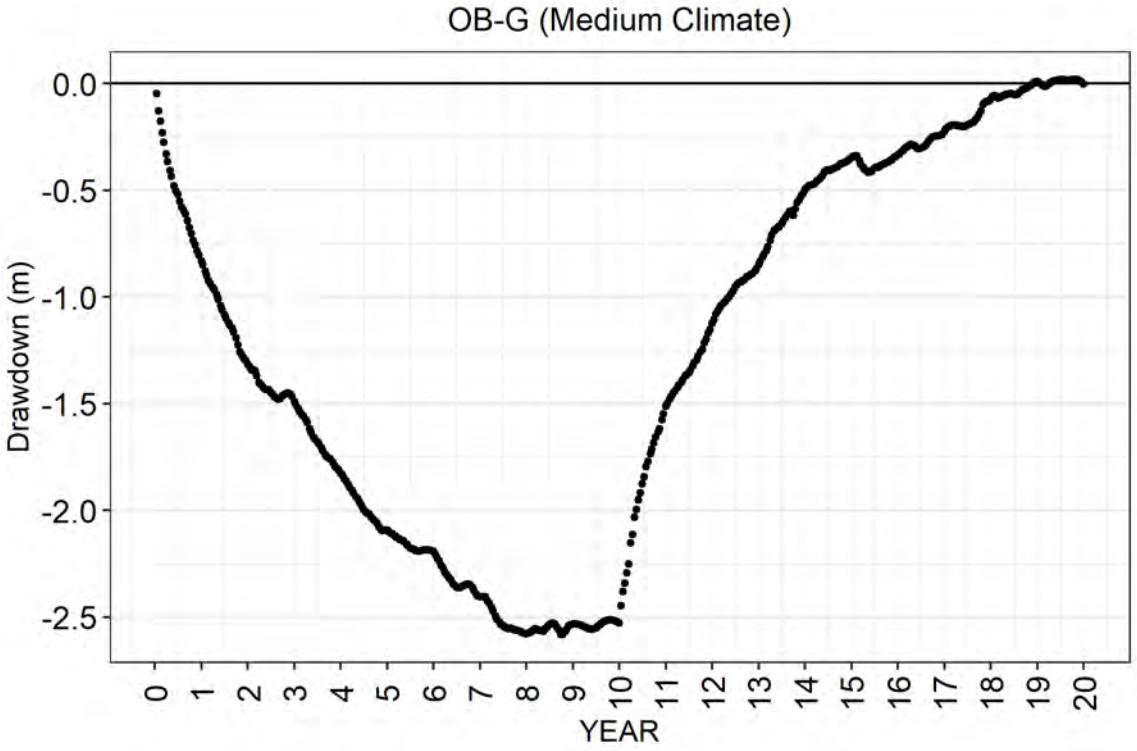

OB-B (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
-25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

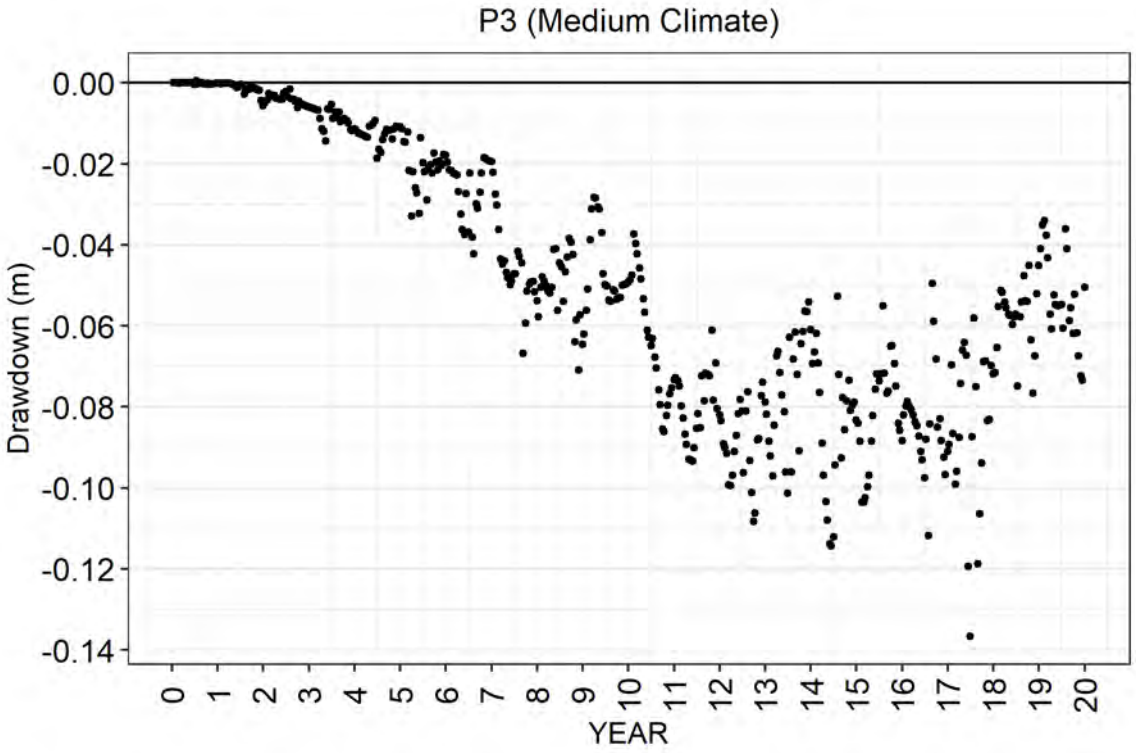

OB-C (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

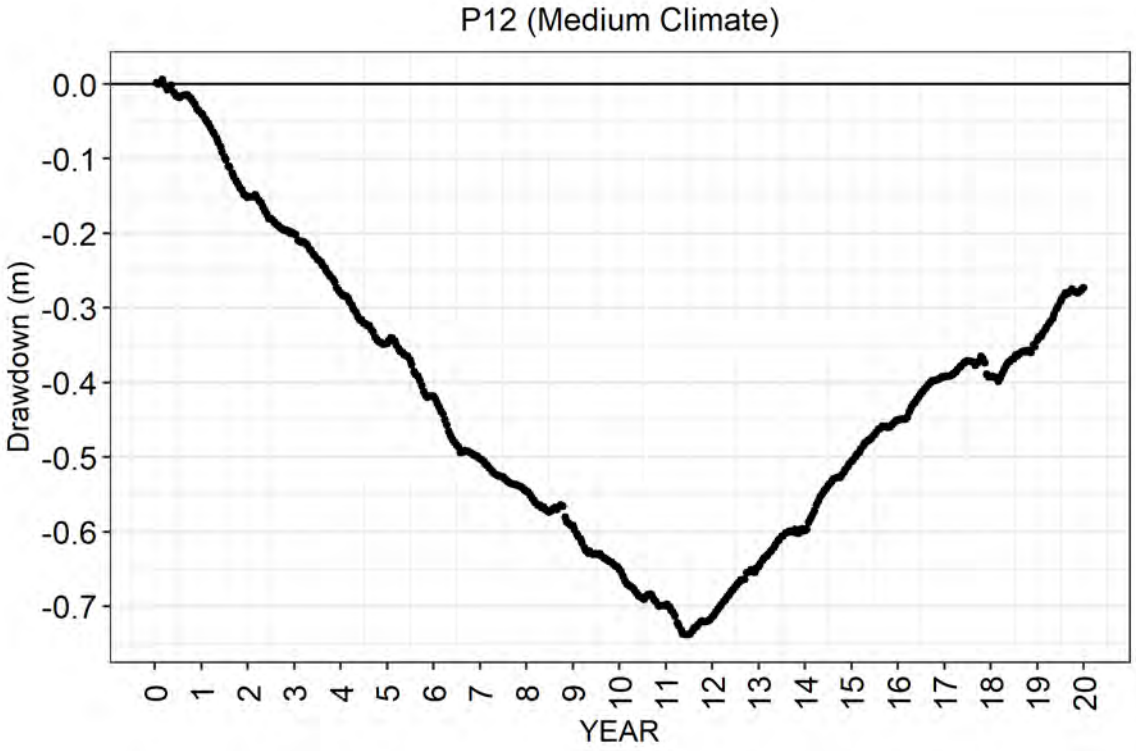

OB-D (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

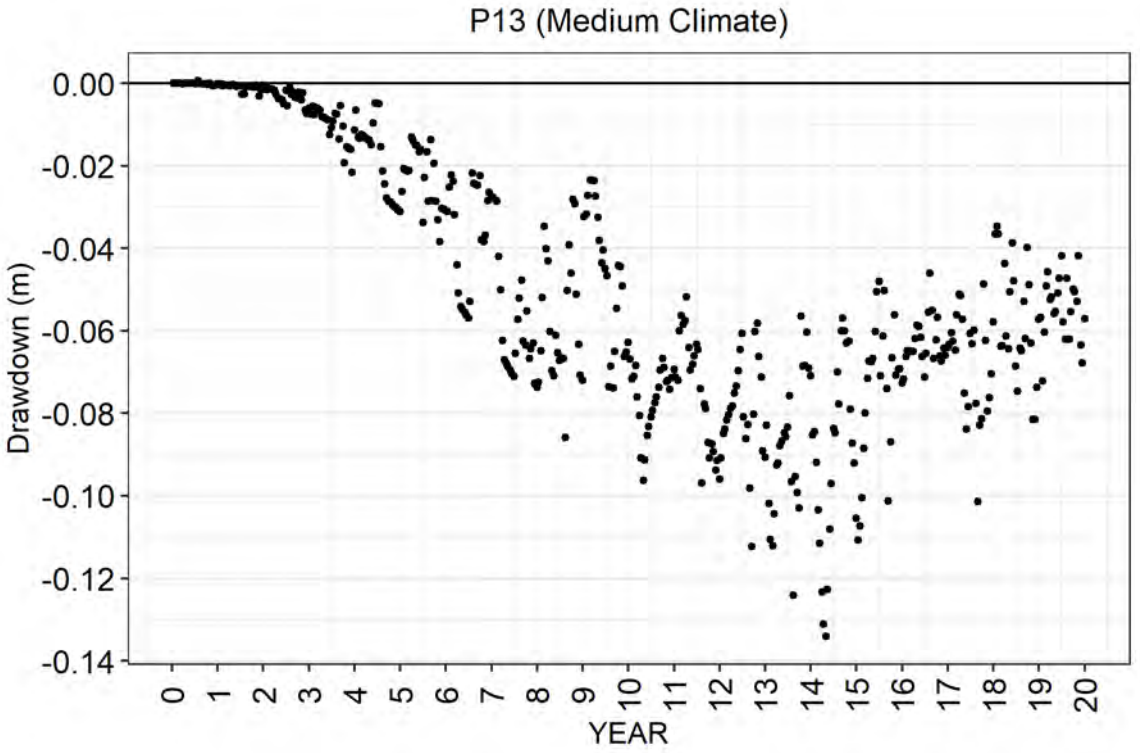

OB-E (Medium Climate)
Drawdown (m)
0
-1
-2
-3
-4
-5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

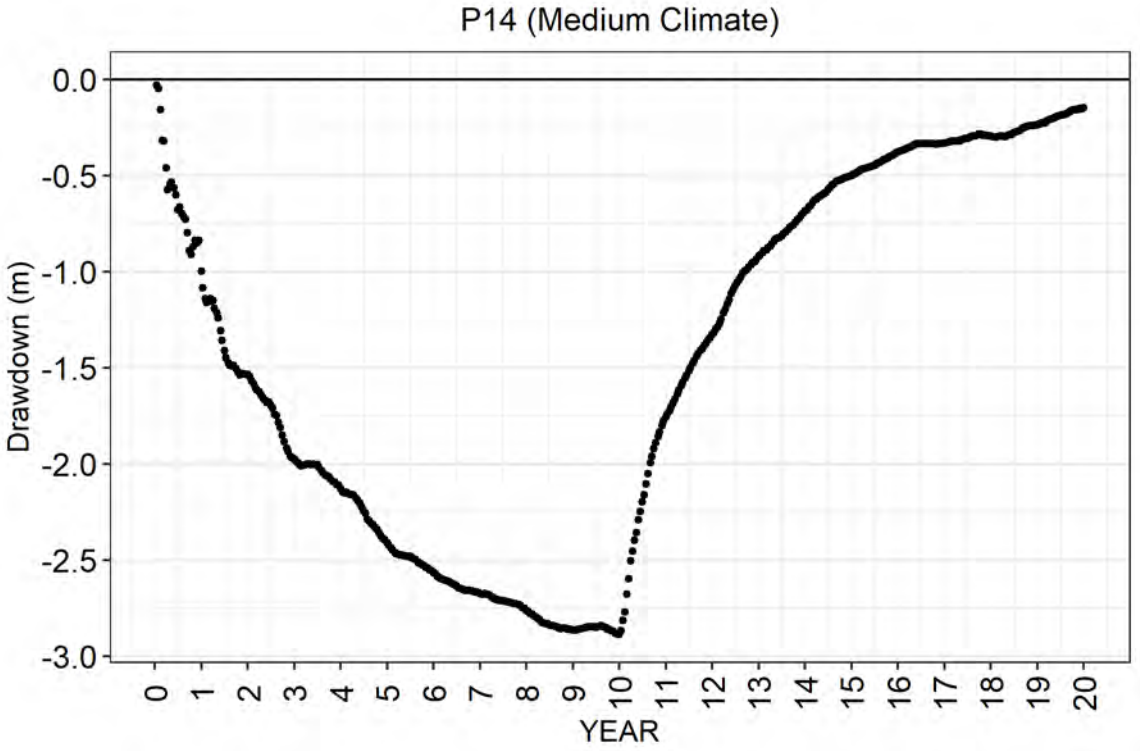

OB-F (Medium Climate)
Drawdown (m)
0
-1
-2
-3
-4
-5
-6
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

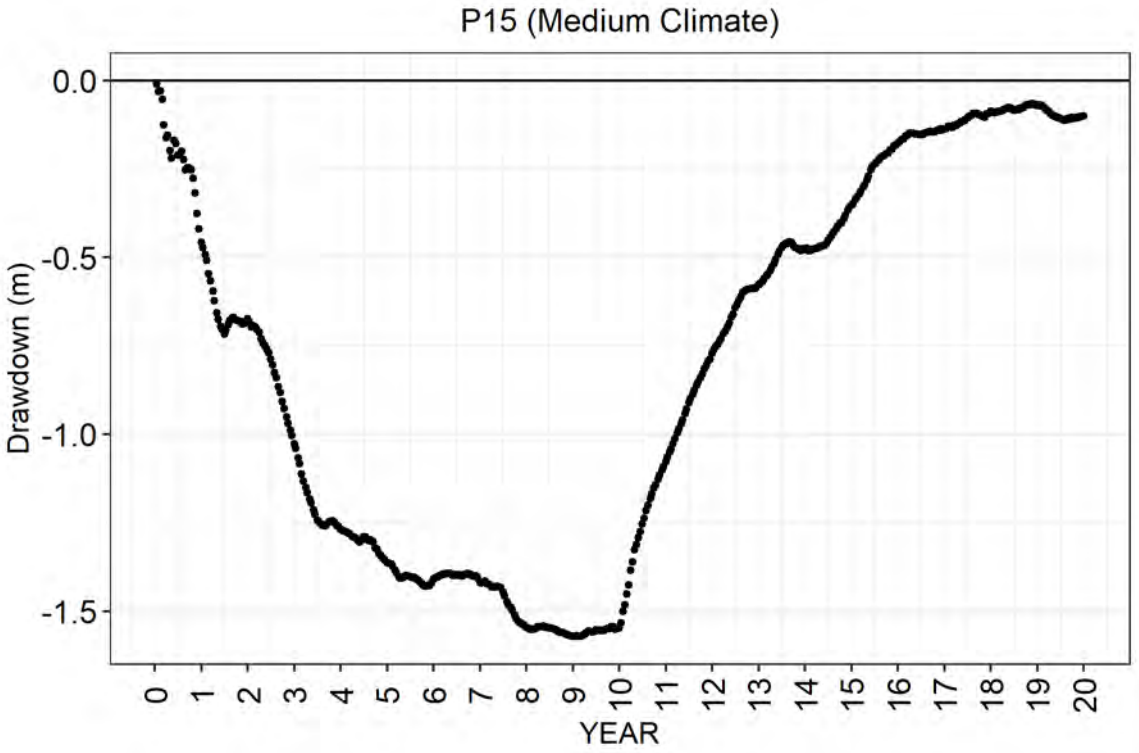

OB-G (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

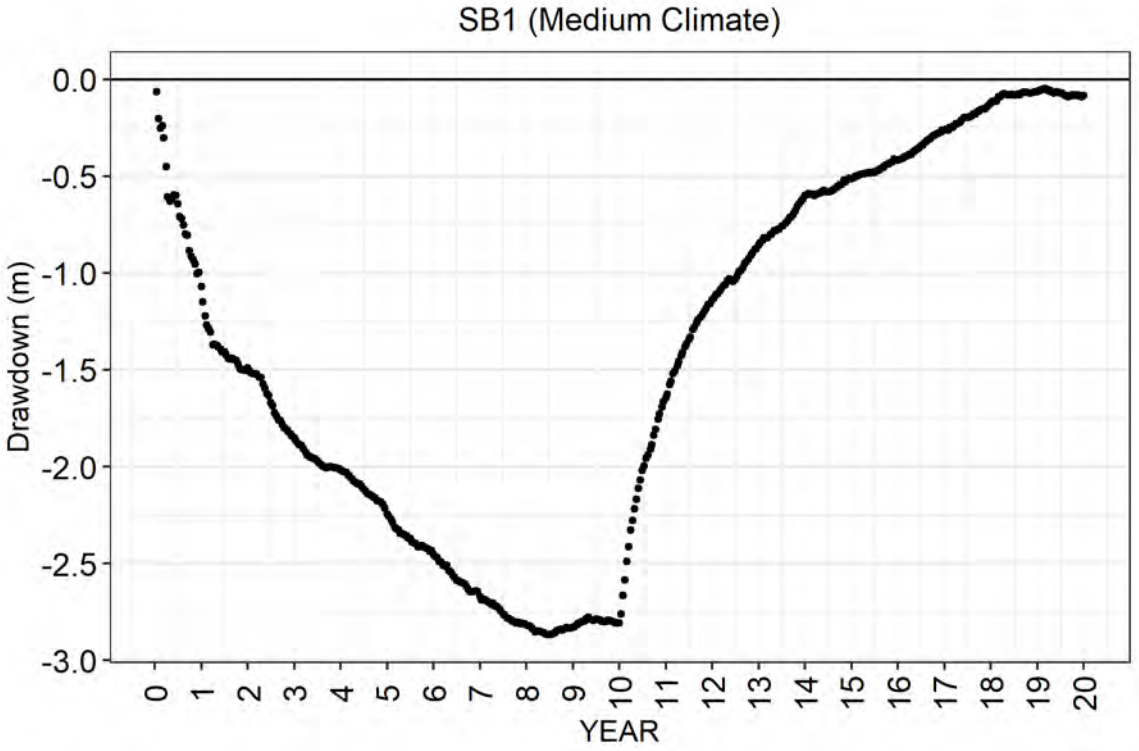

P3 (Medium Climate)
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

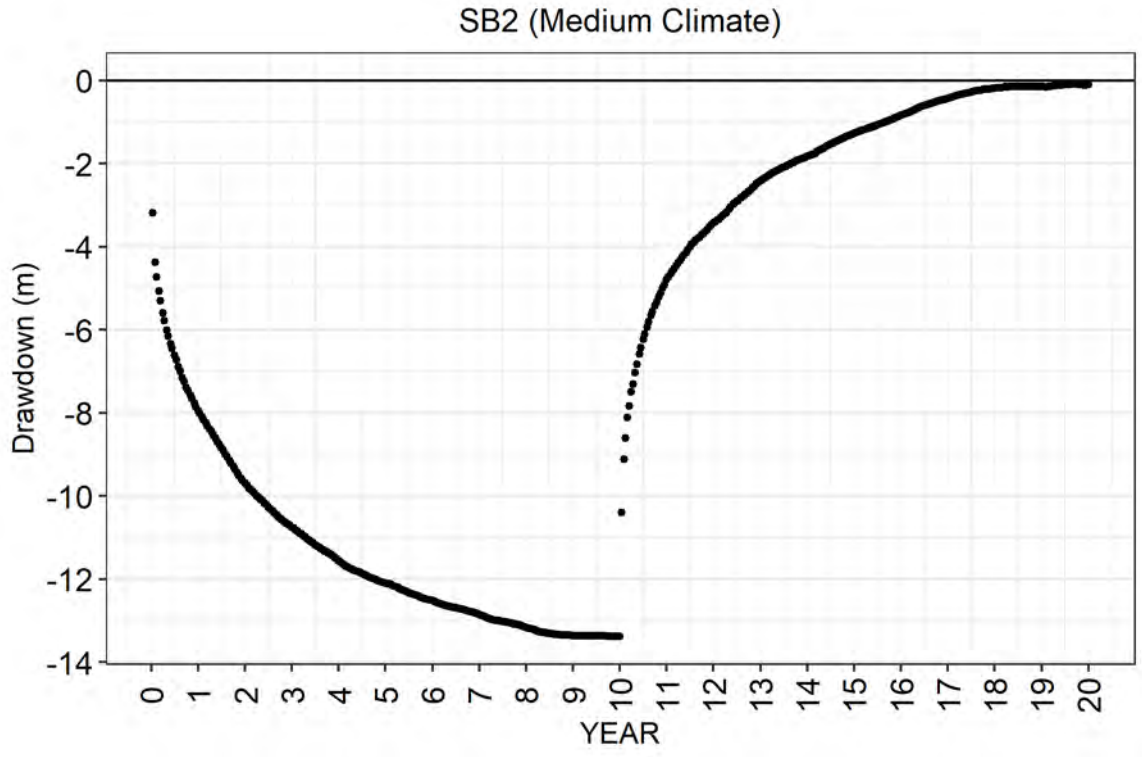

P12 (Medium Climate)
Drawdown (m)
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

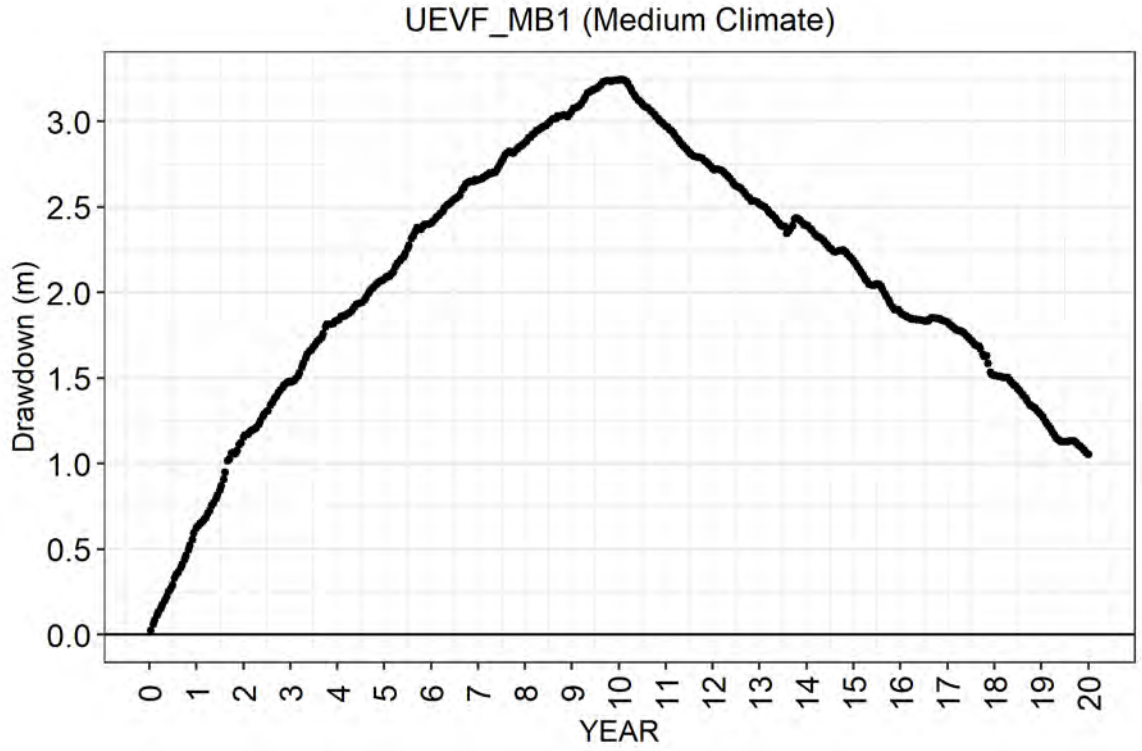

P13 (Medium Climate)
Drawdown (m)
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

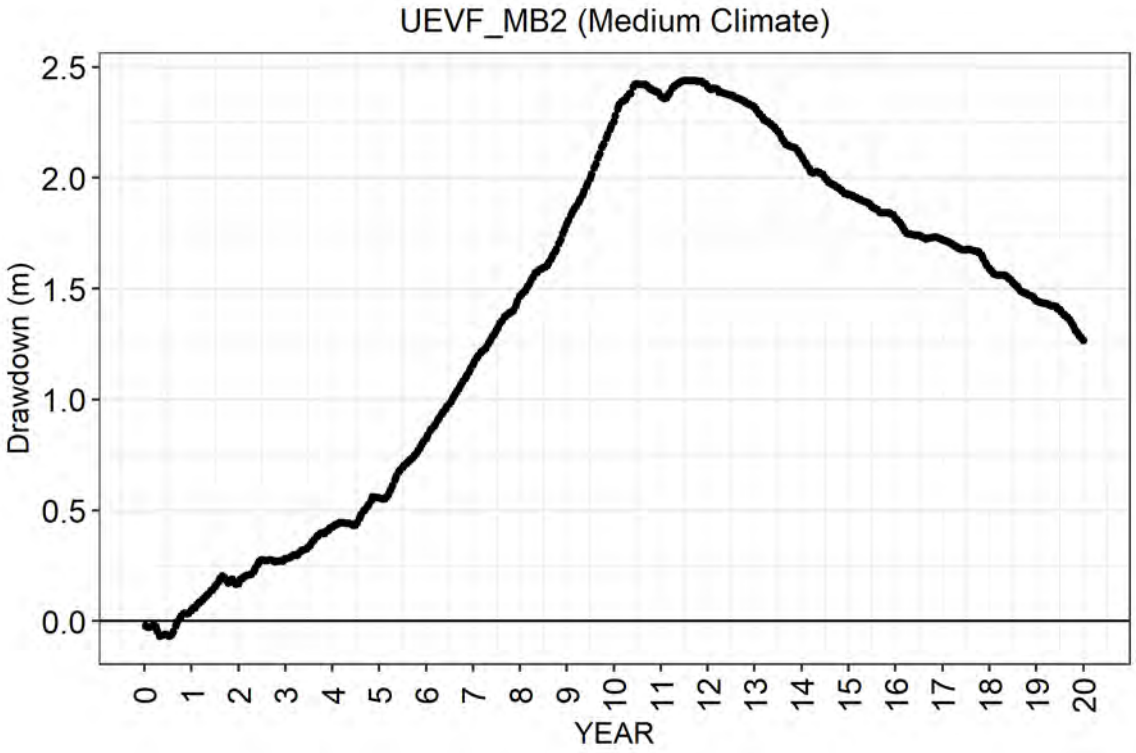

P14 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

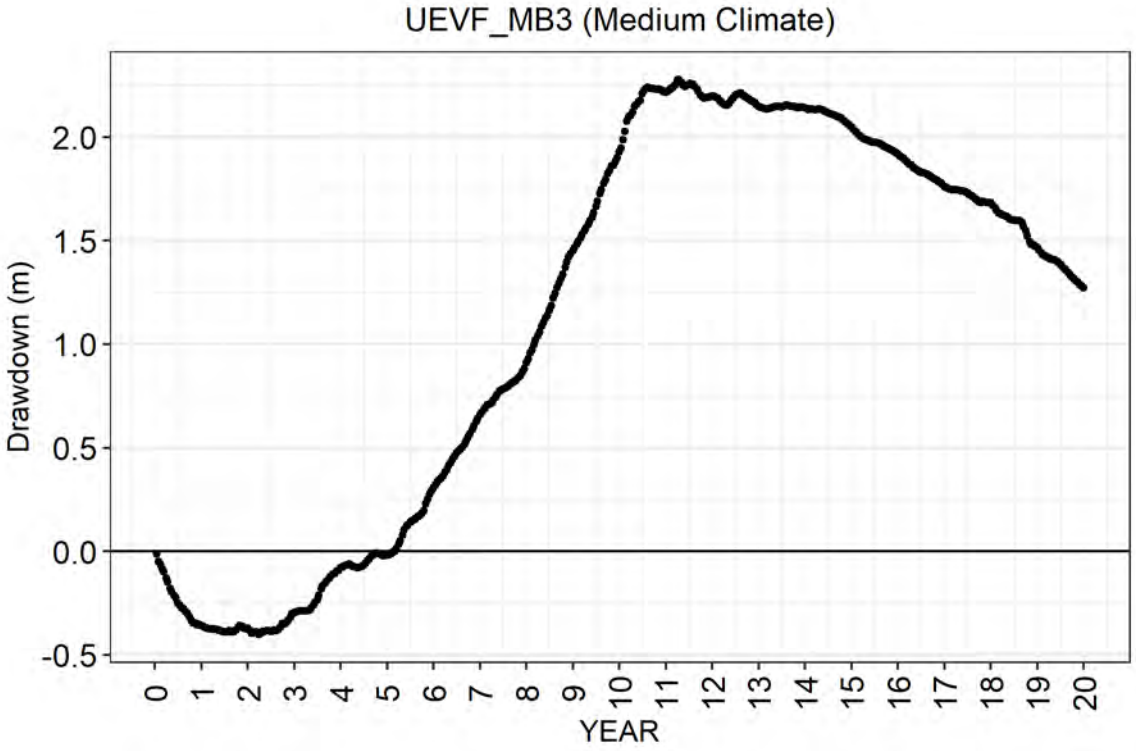

P15 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

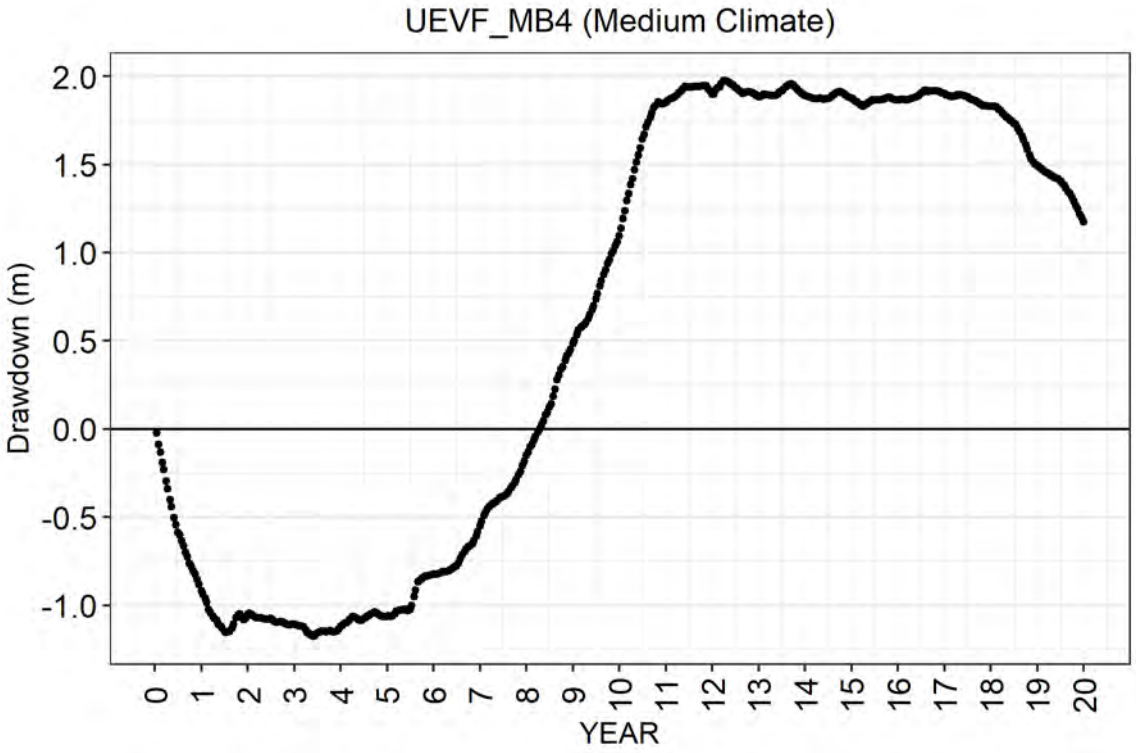

SB1 (Medium Climate)
Drawdown (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

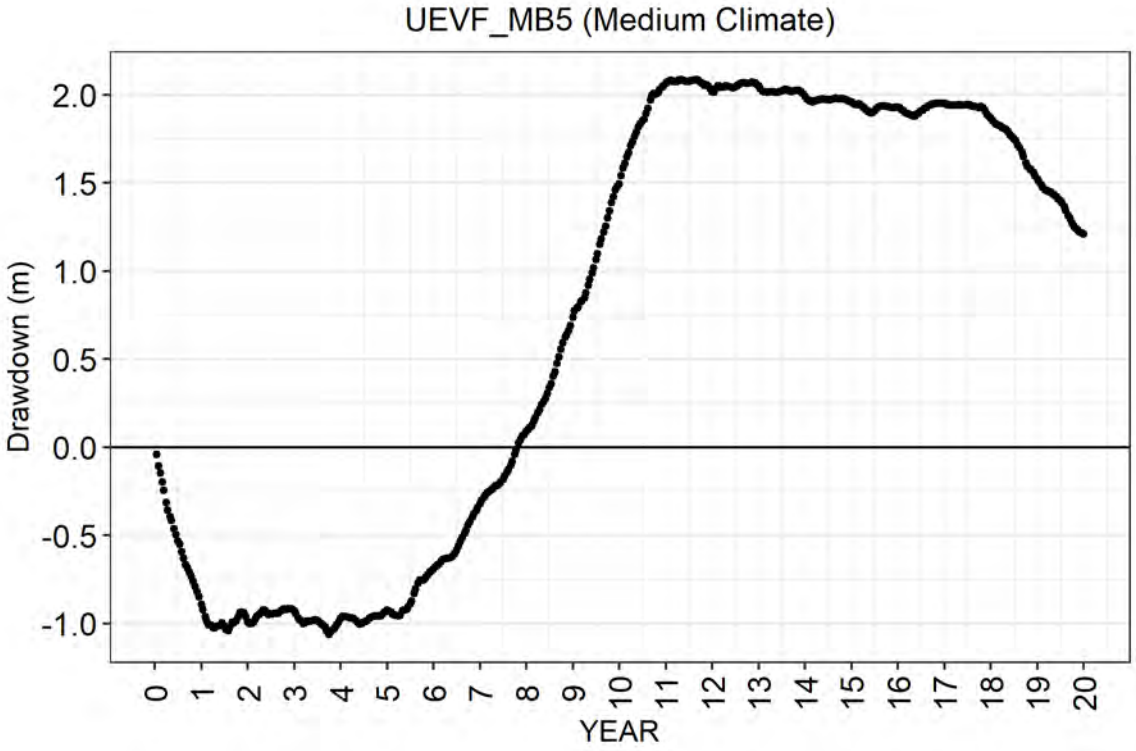

SB2 (Medium Climate)
Drawdown (m)
0
-2
-4
-6
-8
-10
-12
-14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

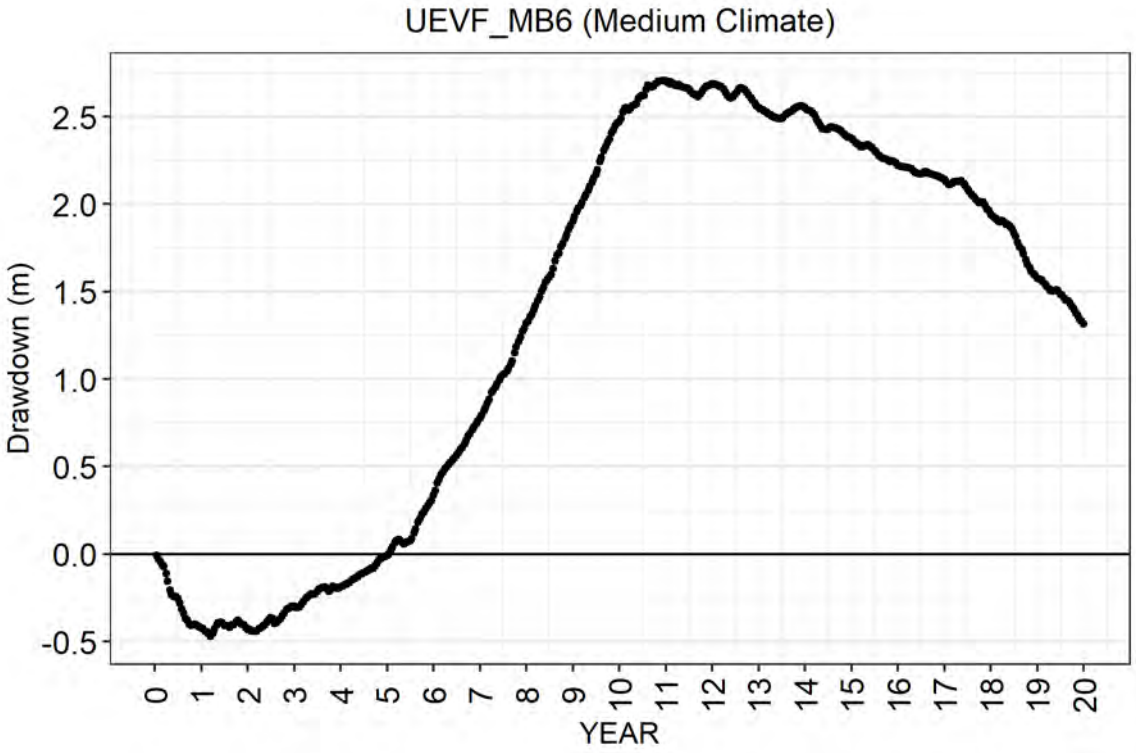

UEVF_MB1 (Medium Climate)
Drawdown (m)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

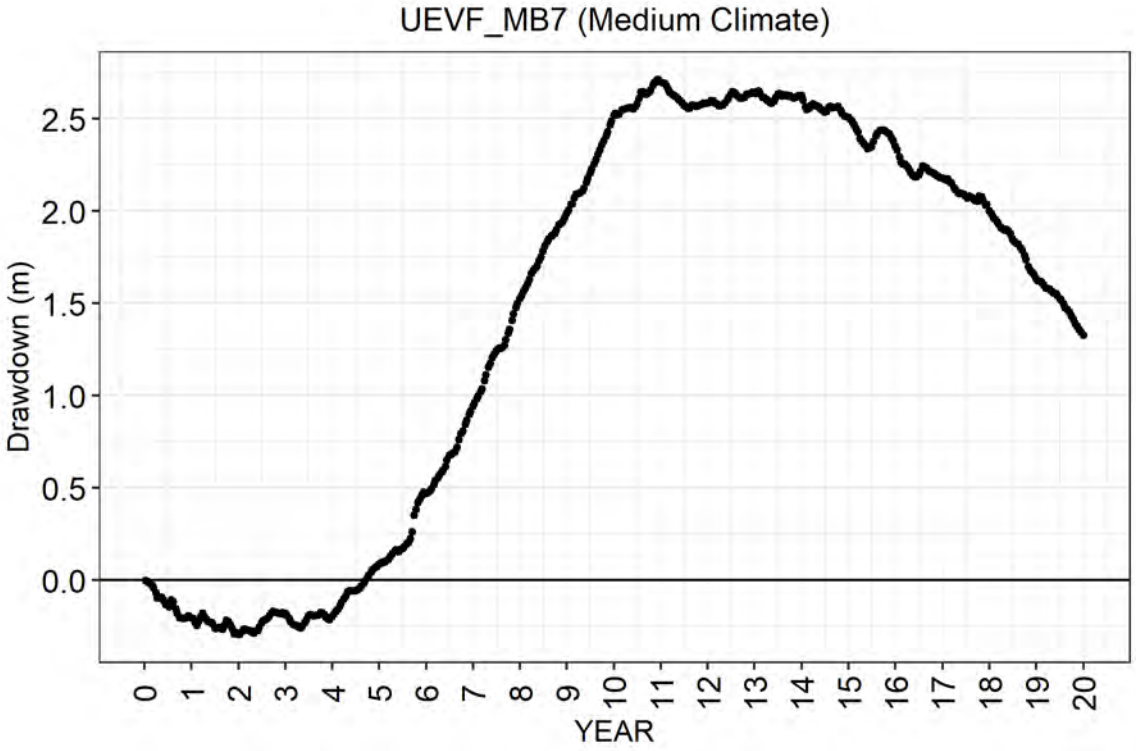

UEVF_MB2 (Medium Climate)
Drawdown (m)
2.5
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

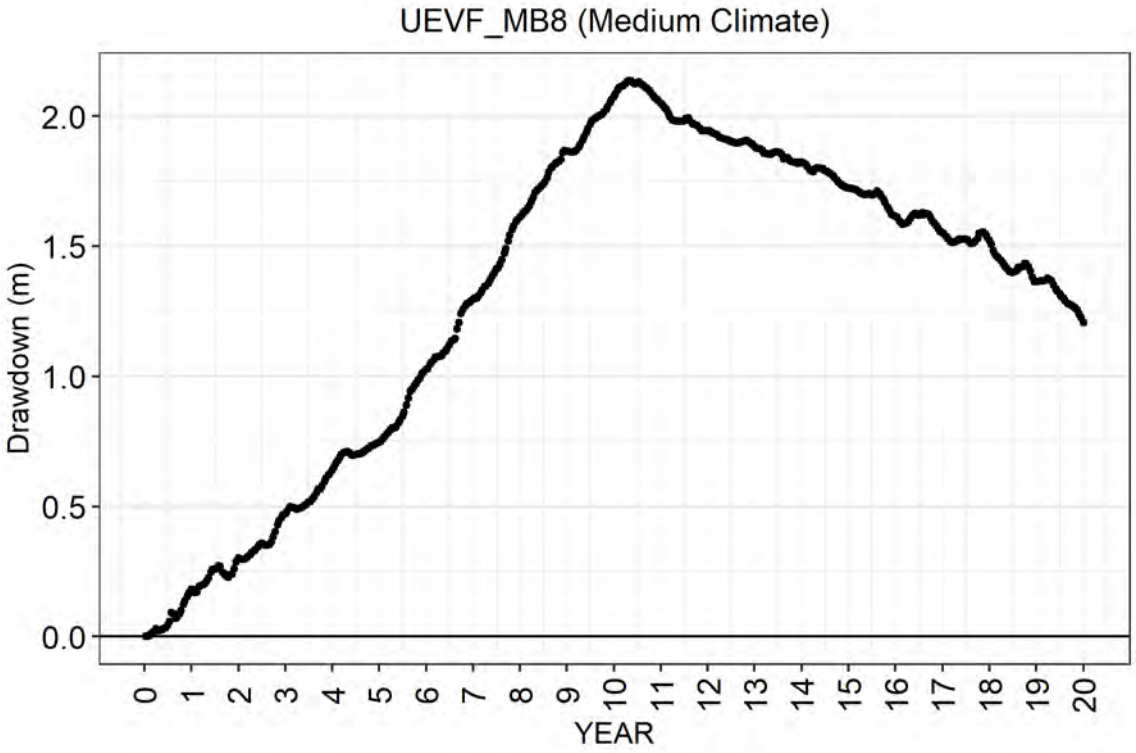

UEVF_MB3 (Medium Climate)
Drawdown (m)
2.0
1.5
1.0
0.5
0.0
-0.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

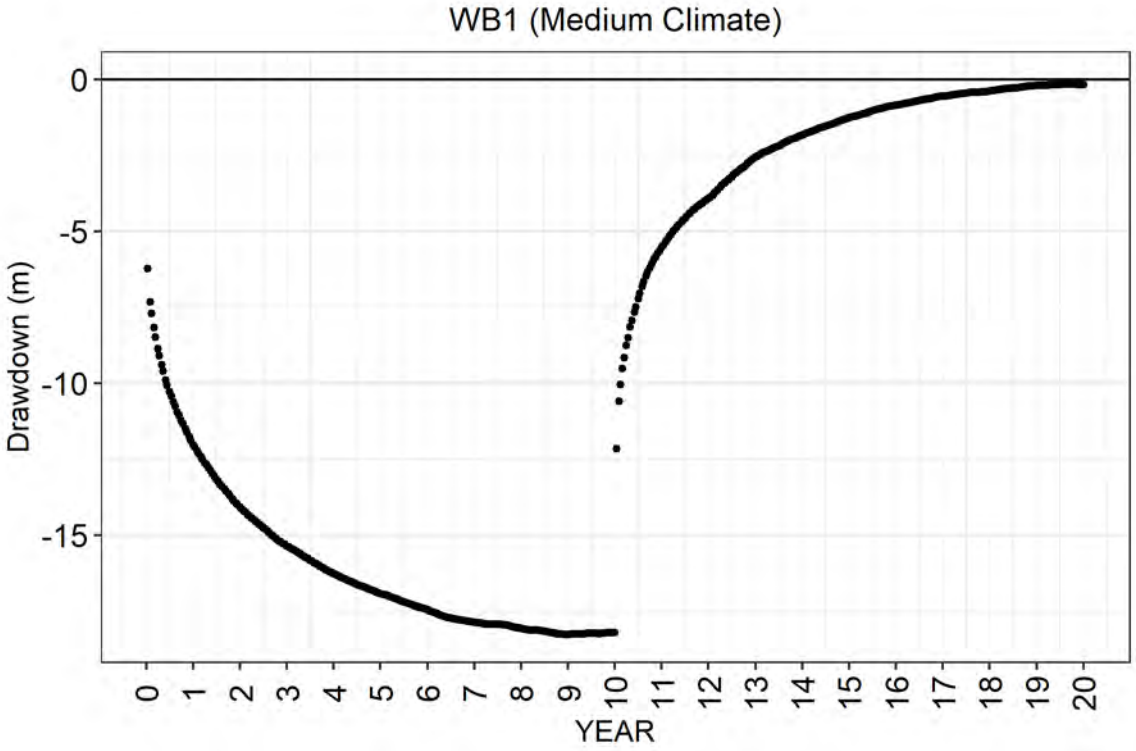

UEVF_MB4 (Medium Climate)
Drawdown (m)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

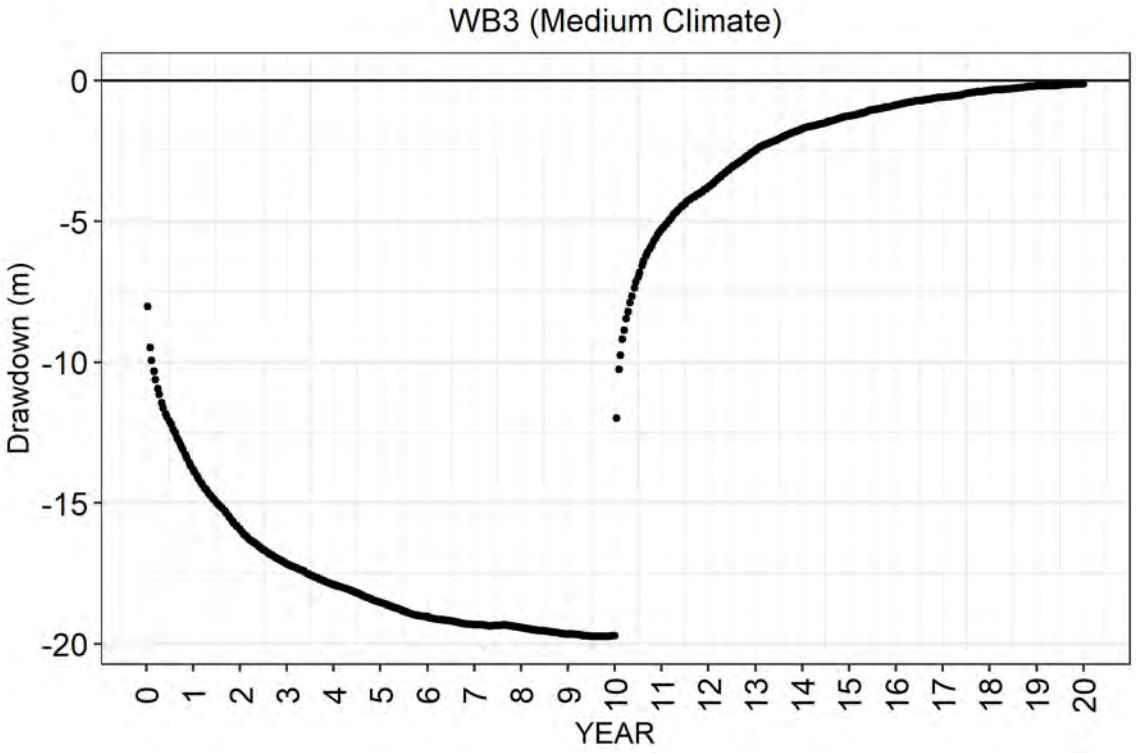

UEVF_MB5 (Medium Climate)
Drawdown (m)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

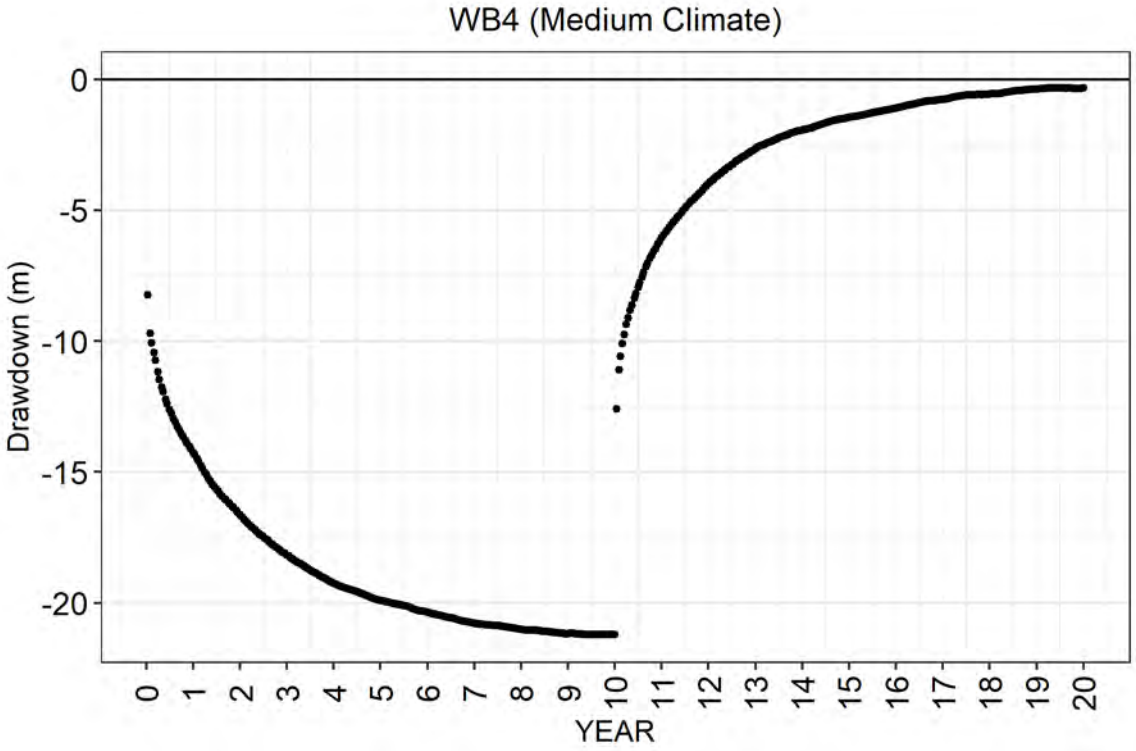

UEVF_MB6 (Medium Climate)
Drawdown (m)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

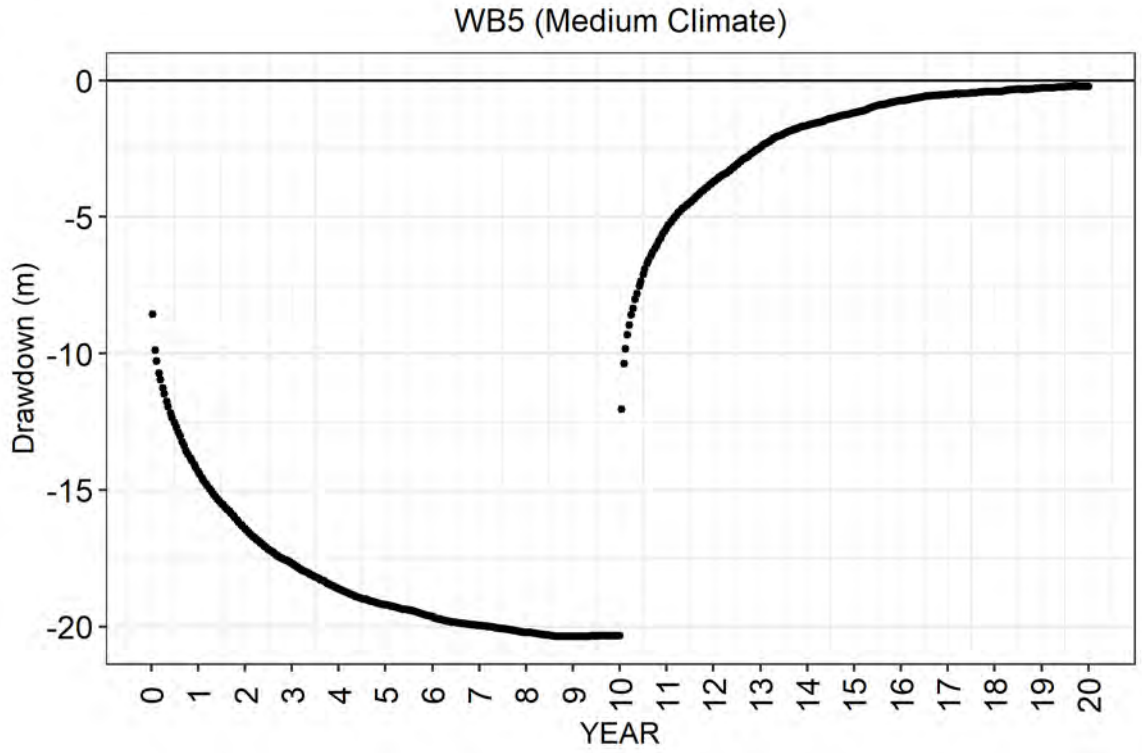

UEVF_MB7 (Medium Climate)
Drawdown (m)
2.5
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

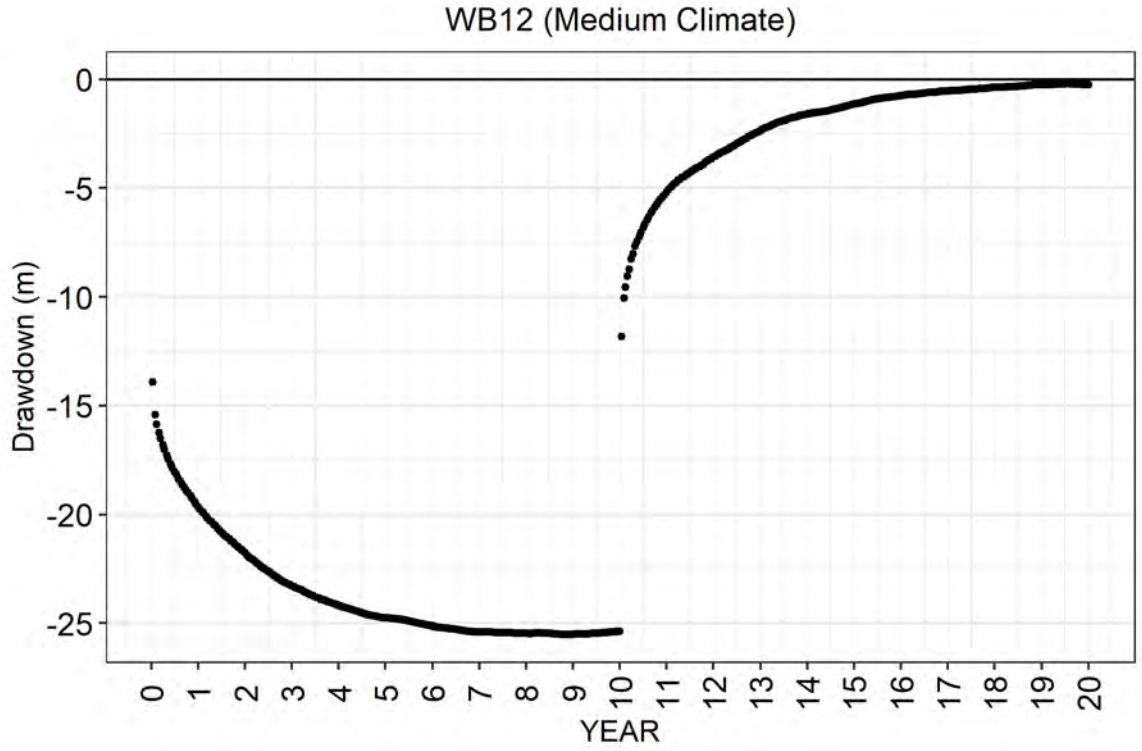

UEVF_MB8 (Medium Climate)
Drawdown (m)
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

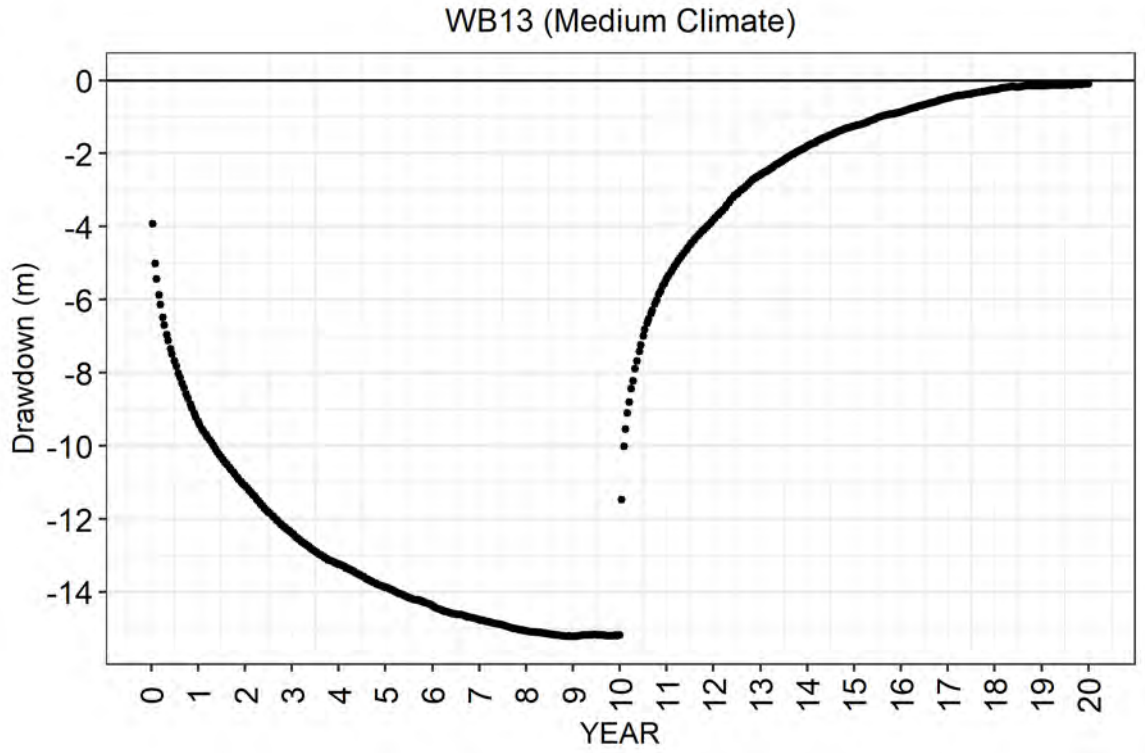

WB1 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

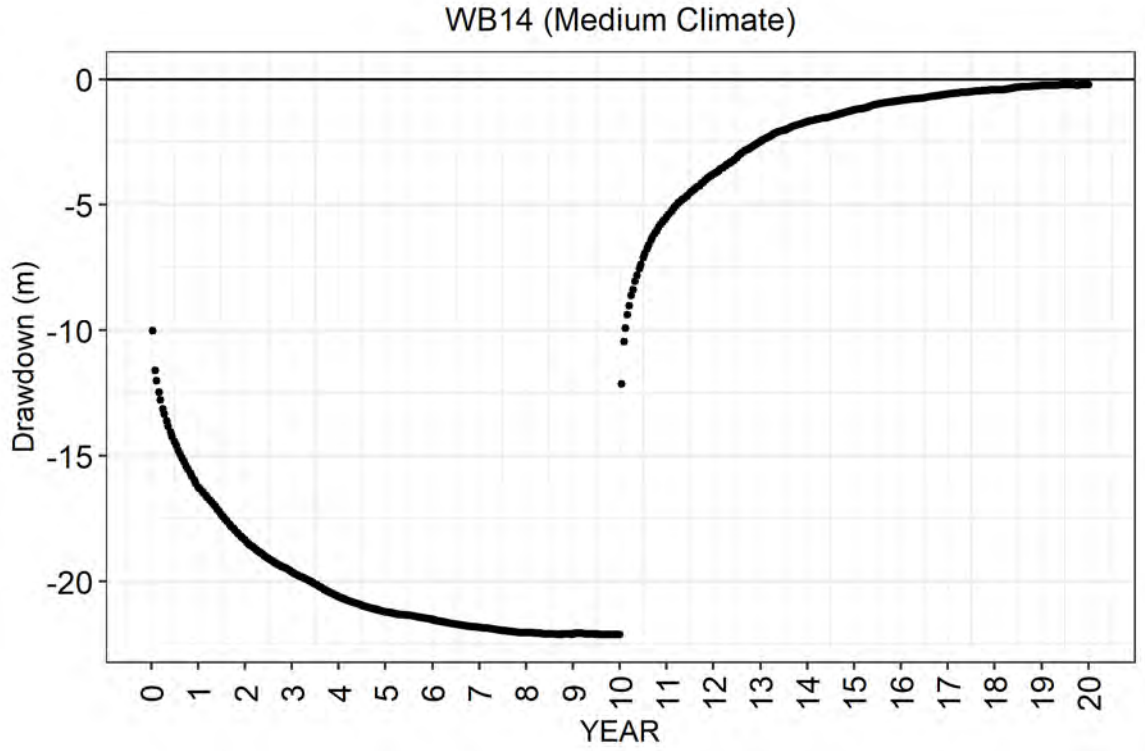

WB3 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

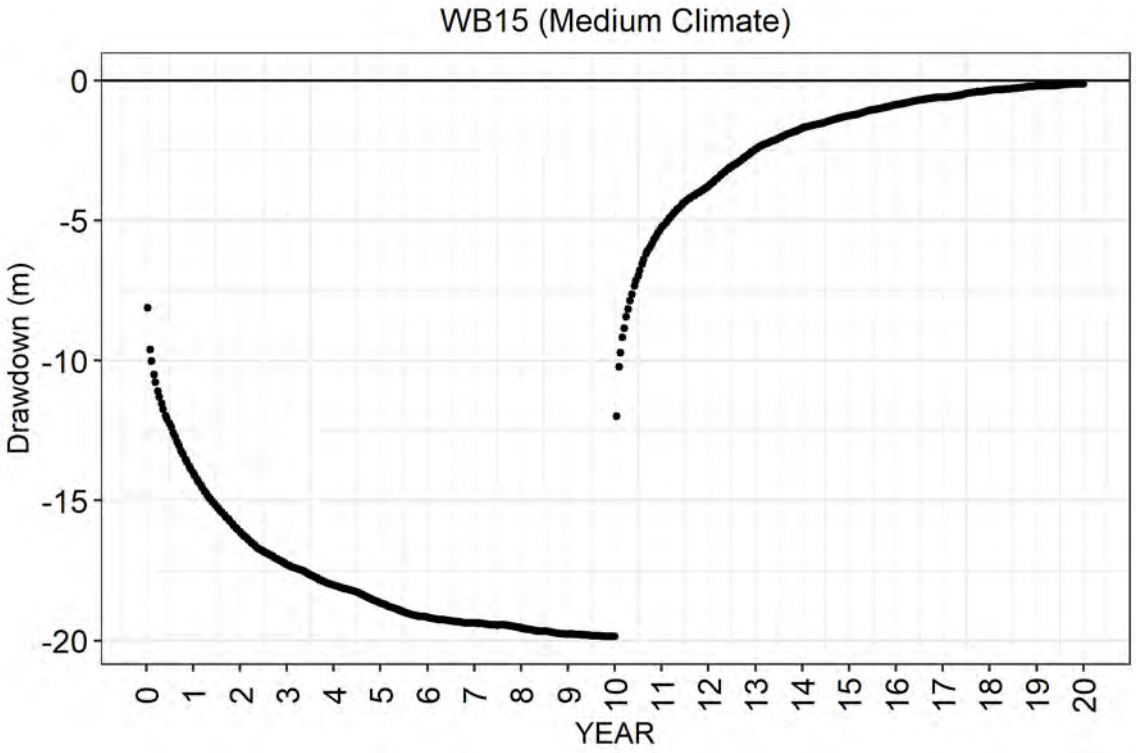

WB4 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

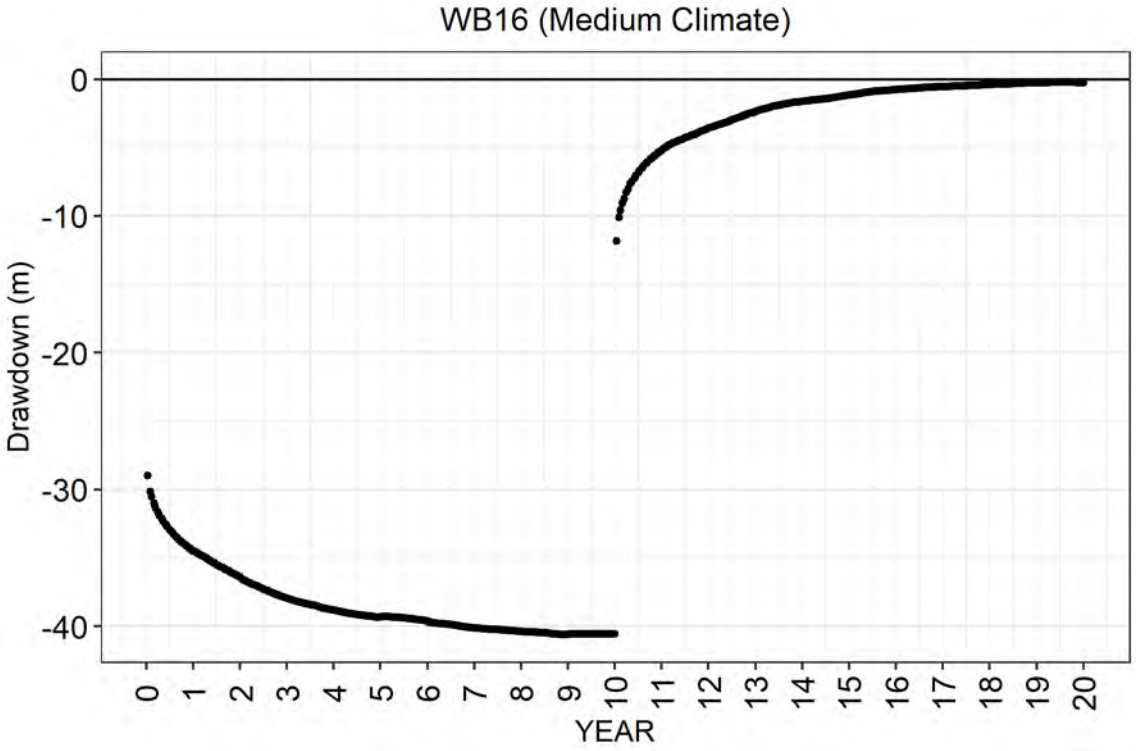

WB5 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR


WB12 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
-25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

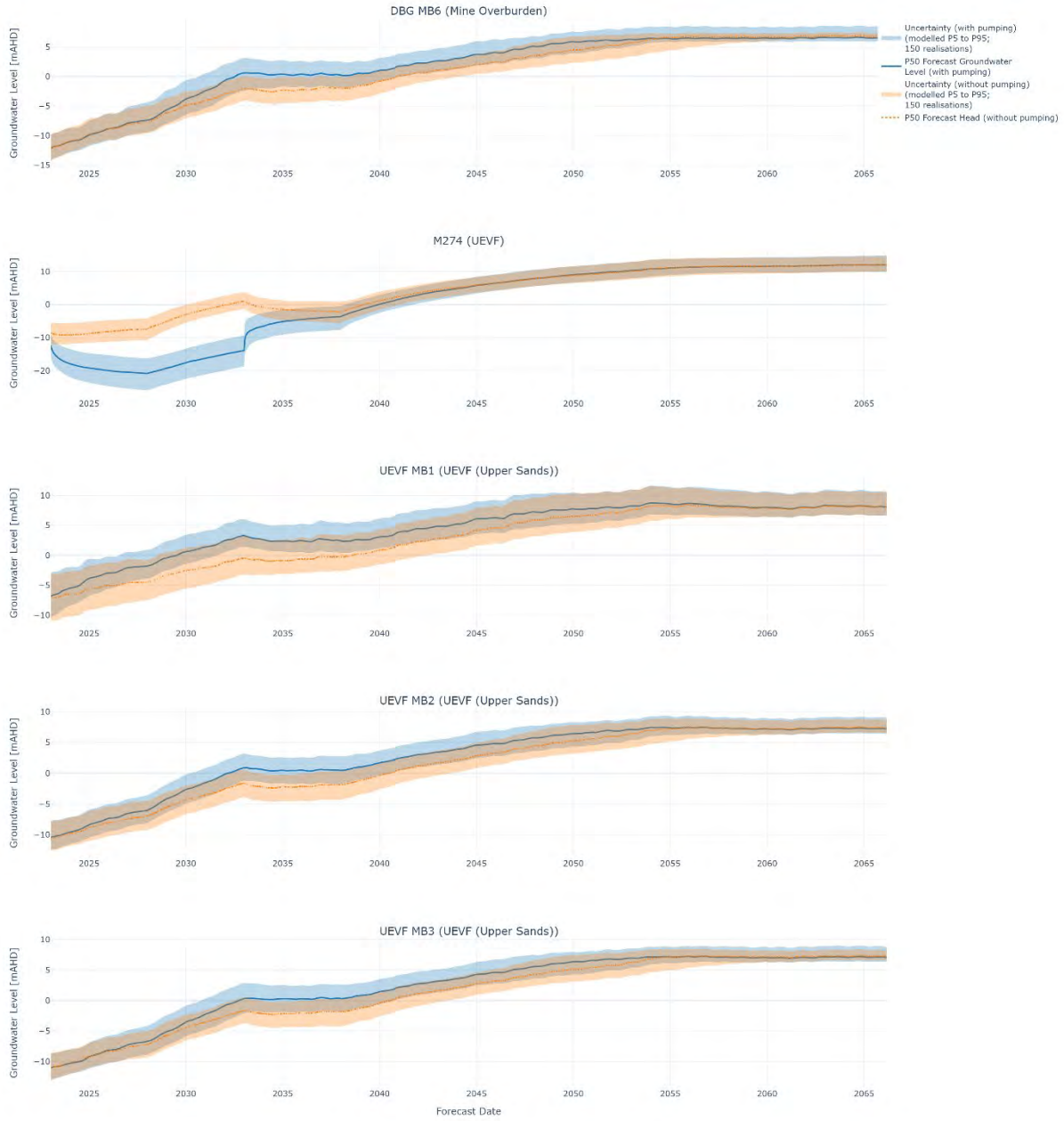

WB13 (Medium Climate)
Drawdown (m)
0
-2
-4
-6
-8
-10
-12
-14
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

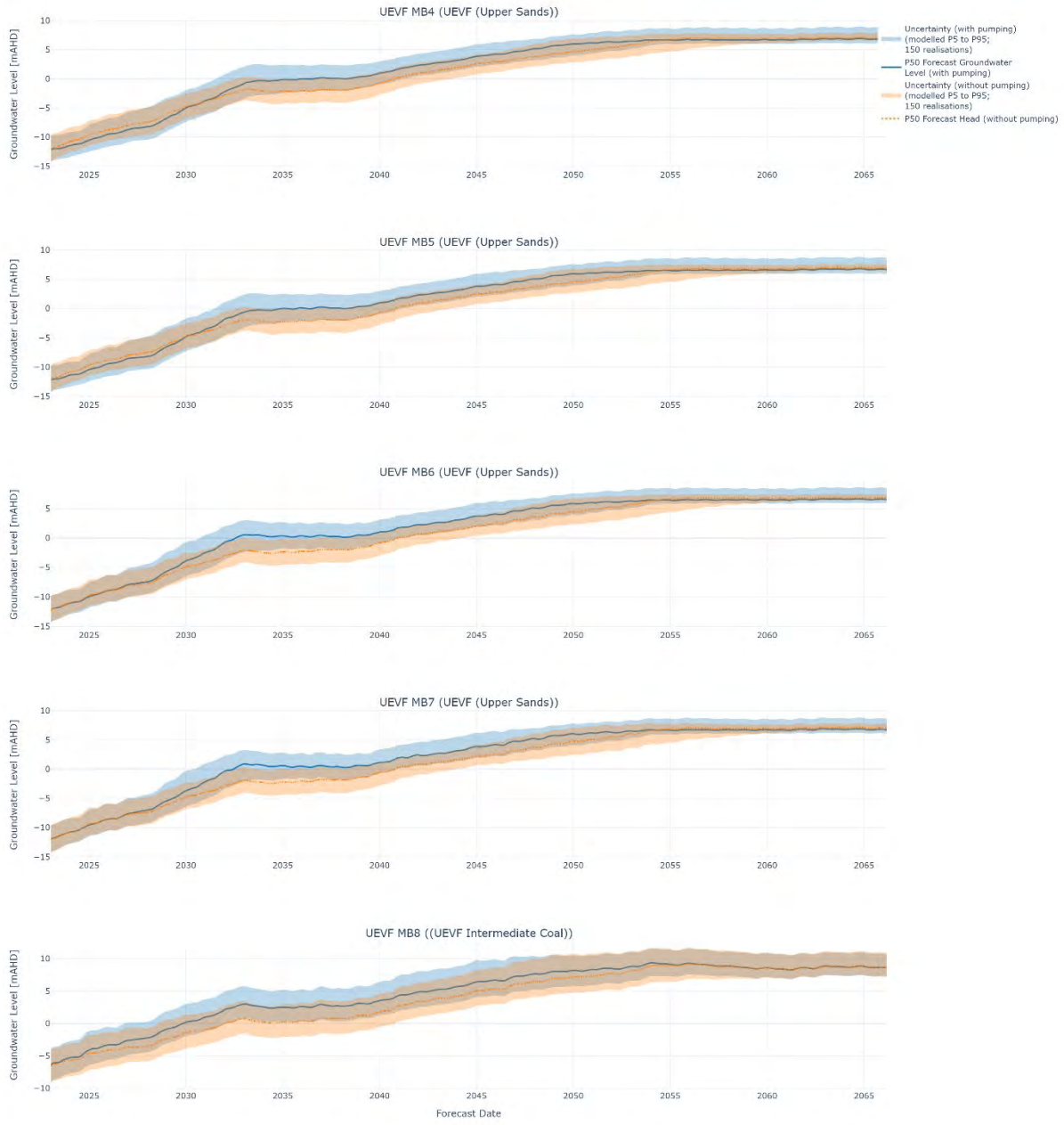

WB14 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

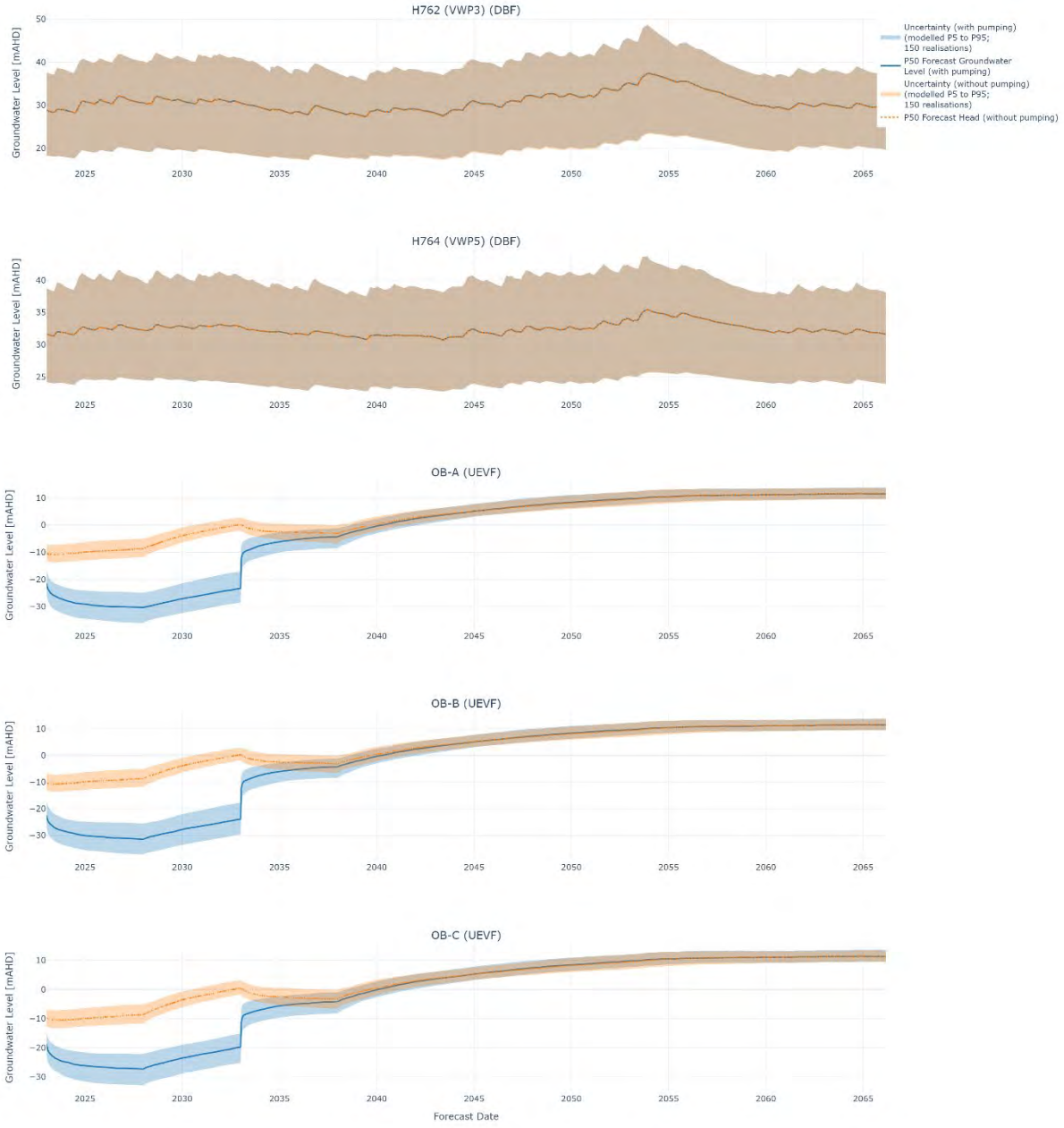

WB15 (Medium Climate)
Drawdown (m)
0
-5
-10
-15
-20
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

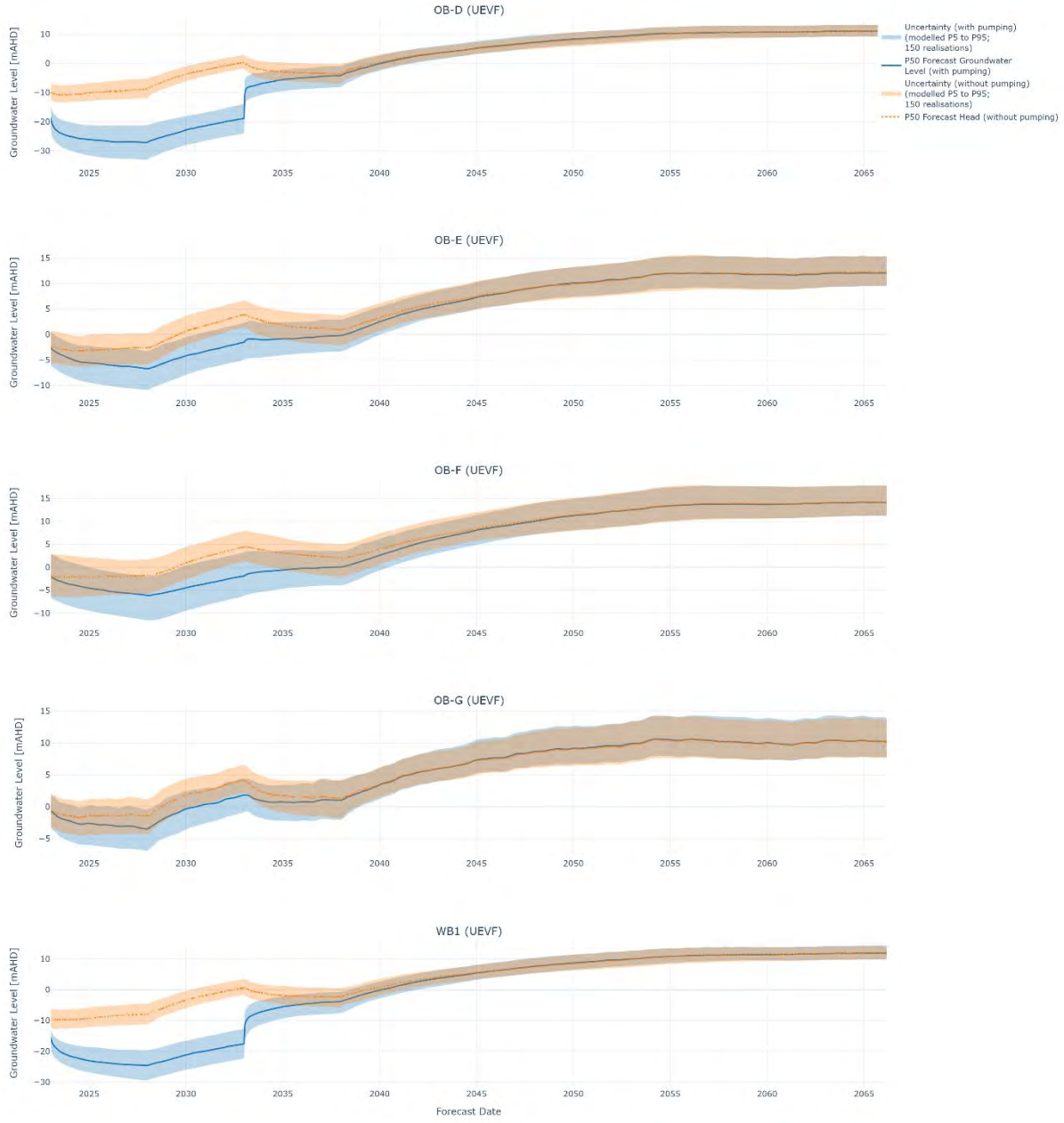

WB16 (Medium Climate)
Drawdown (m)
0
-10
-20
-30
-40
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
YEAR

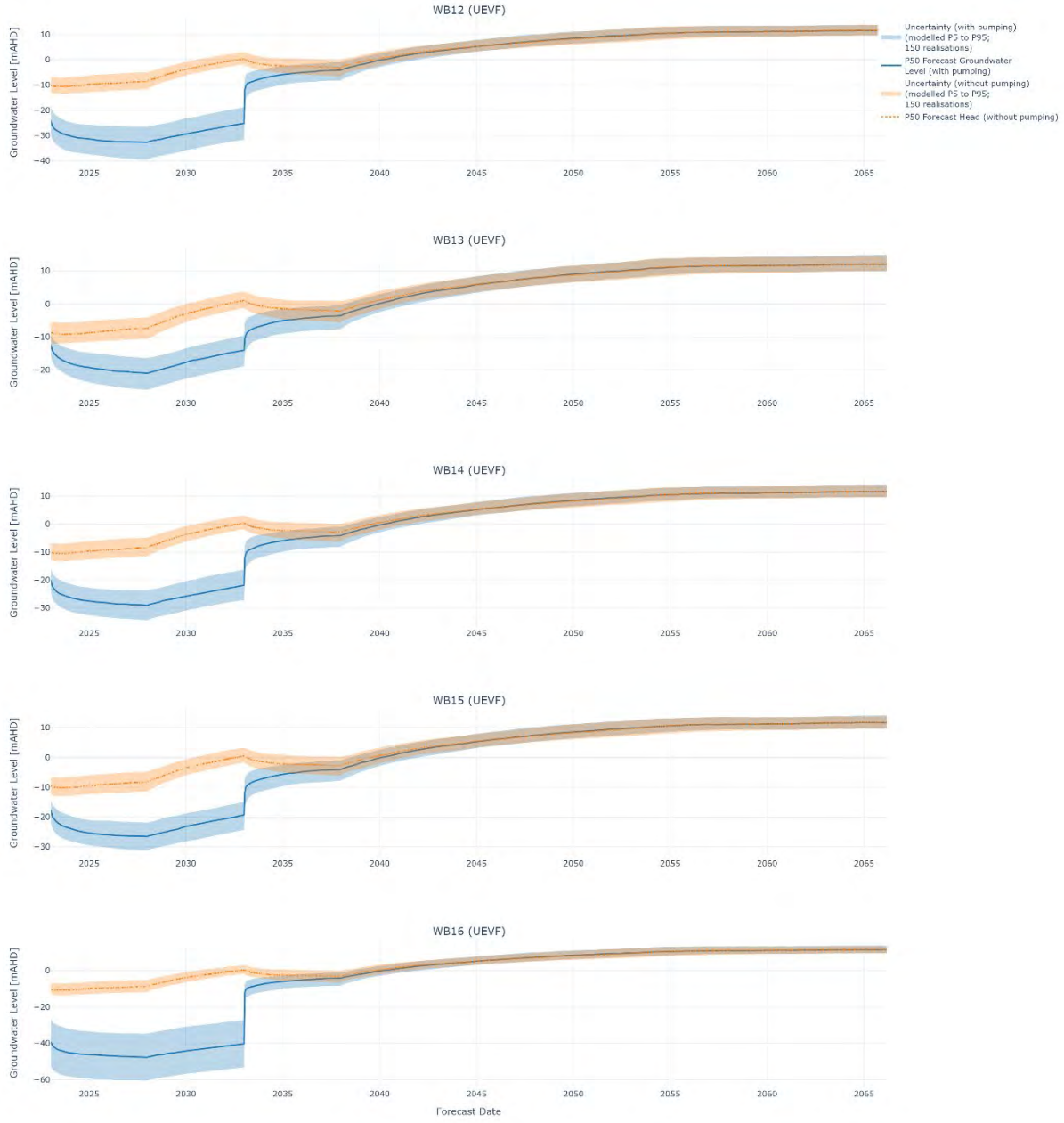
Appendix F2 Numerical Modelling Outputs (Groundwater Hydrographs)

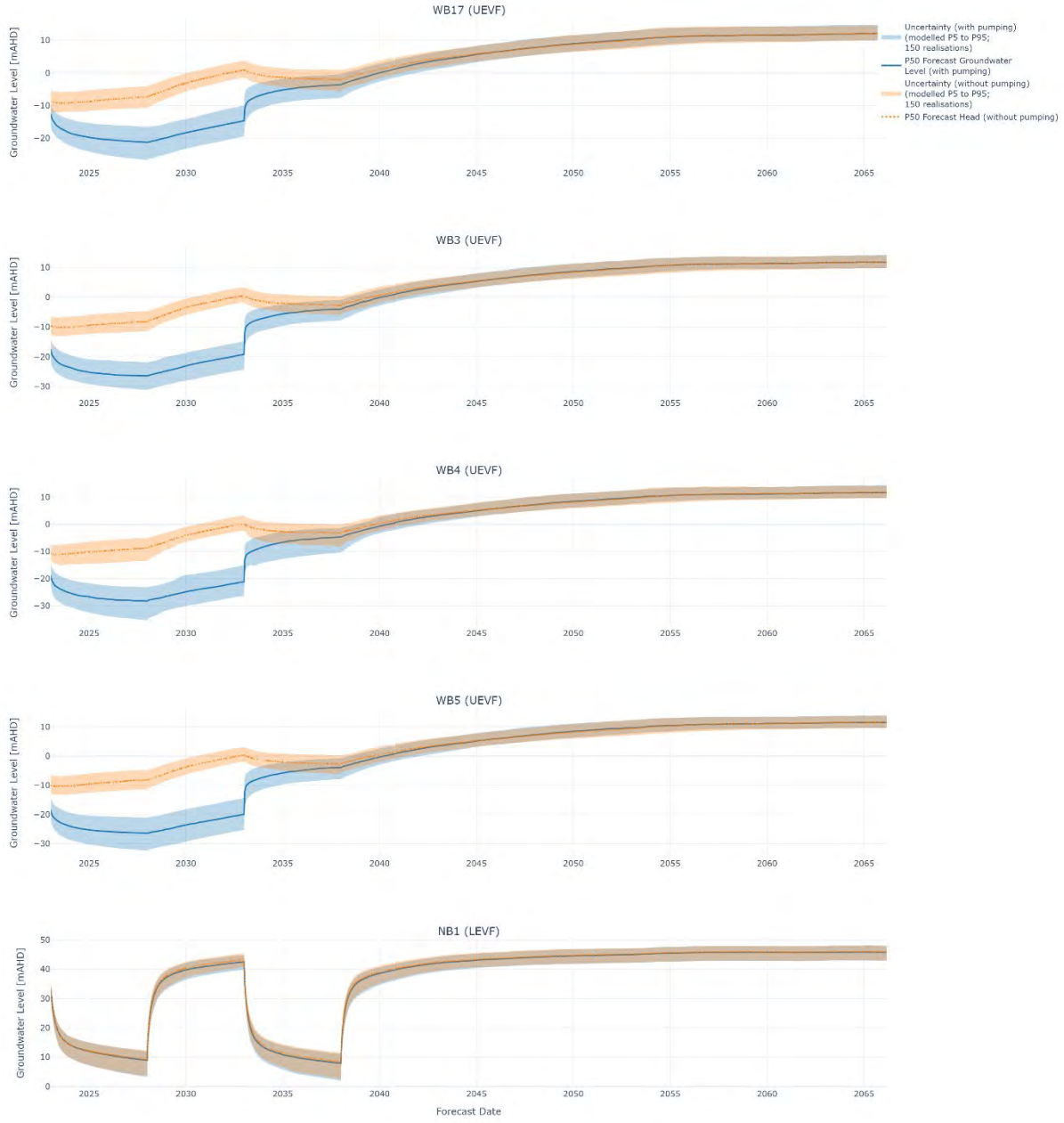

DBG MB6 (Mine Overburden)
M274 (UEVF)
UEVF MB1 (UEVF (Upper Sands))
UEVF MB2 (UEVF (Upper Sands))
UEVF MB3 (UEVF (Upper Sands))
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)

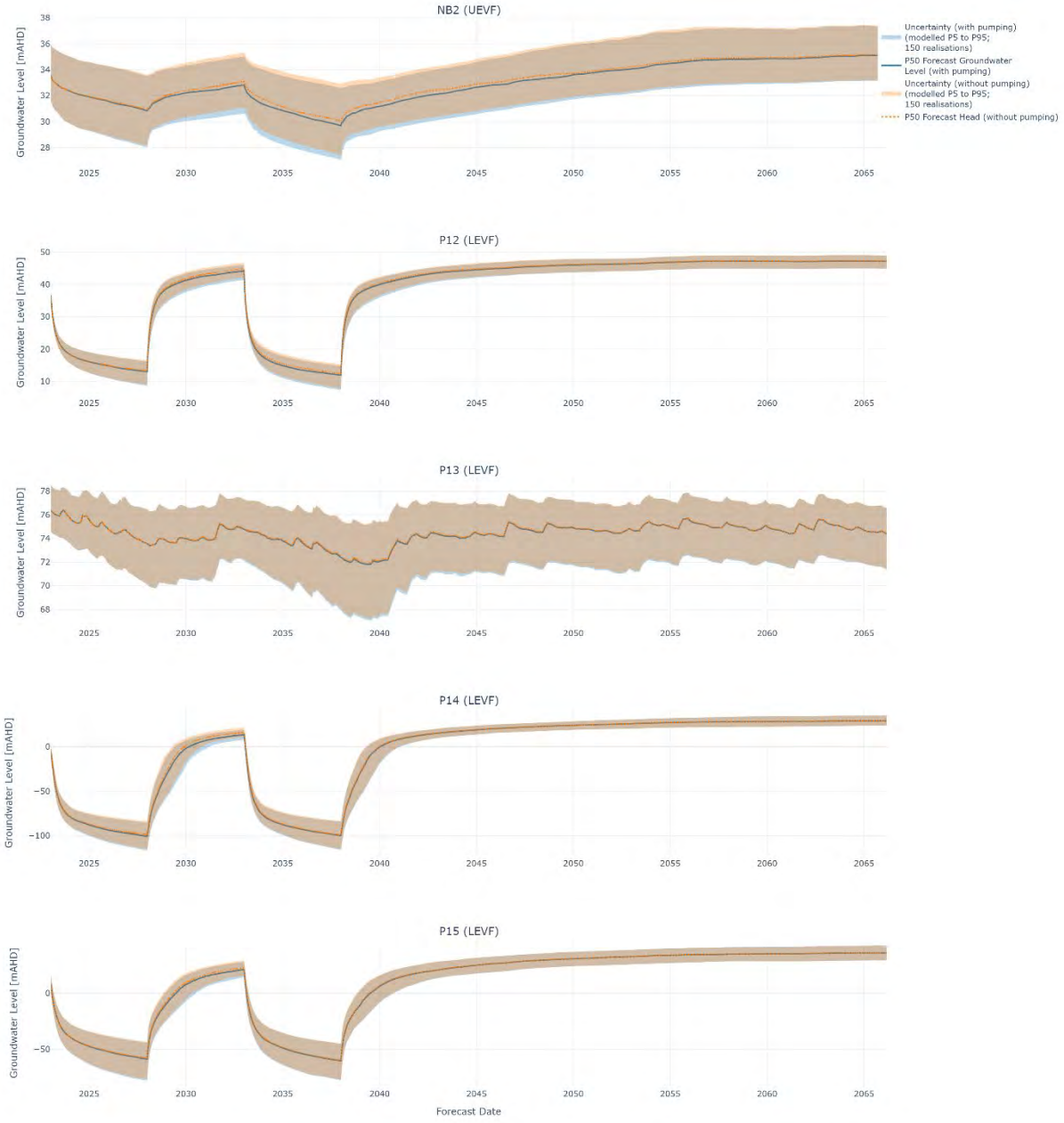

UEVF MB4 (UEVF (Upper Sands))
UEVF MB5 (UEVF (Upper Sands))
UEVF MB6 (UEVF (Upper Sands))
UEVF MB7 (UEVF (Upper Sands))
UEVF MB8 ((UEVF Intermediate Coal))
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)

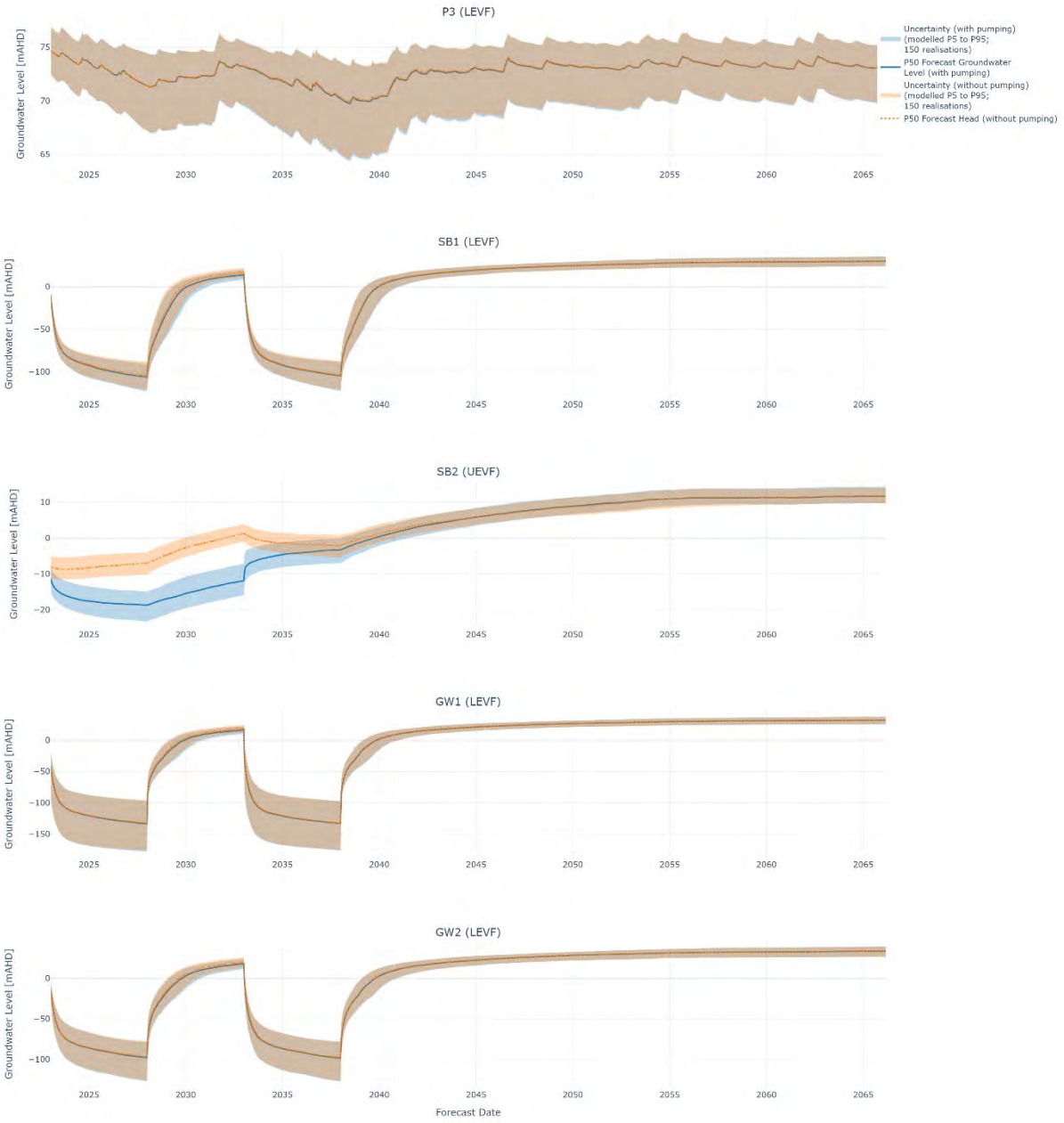

H762 (VWP3) (DBF)
Groundwater Level [mAHD]
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
H764 (VWP5) (DBF)
OB-A (UEVF)
OB-B (UEVF)
OB-C (UEVF)
Forecast Date

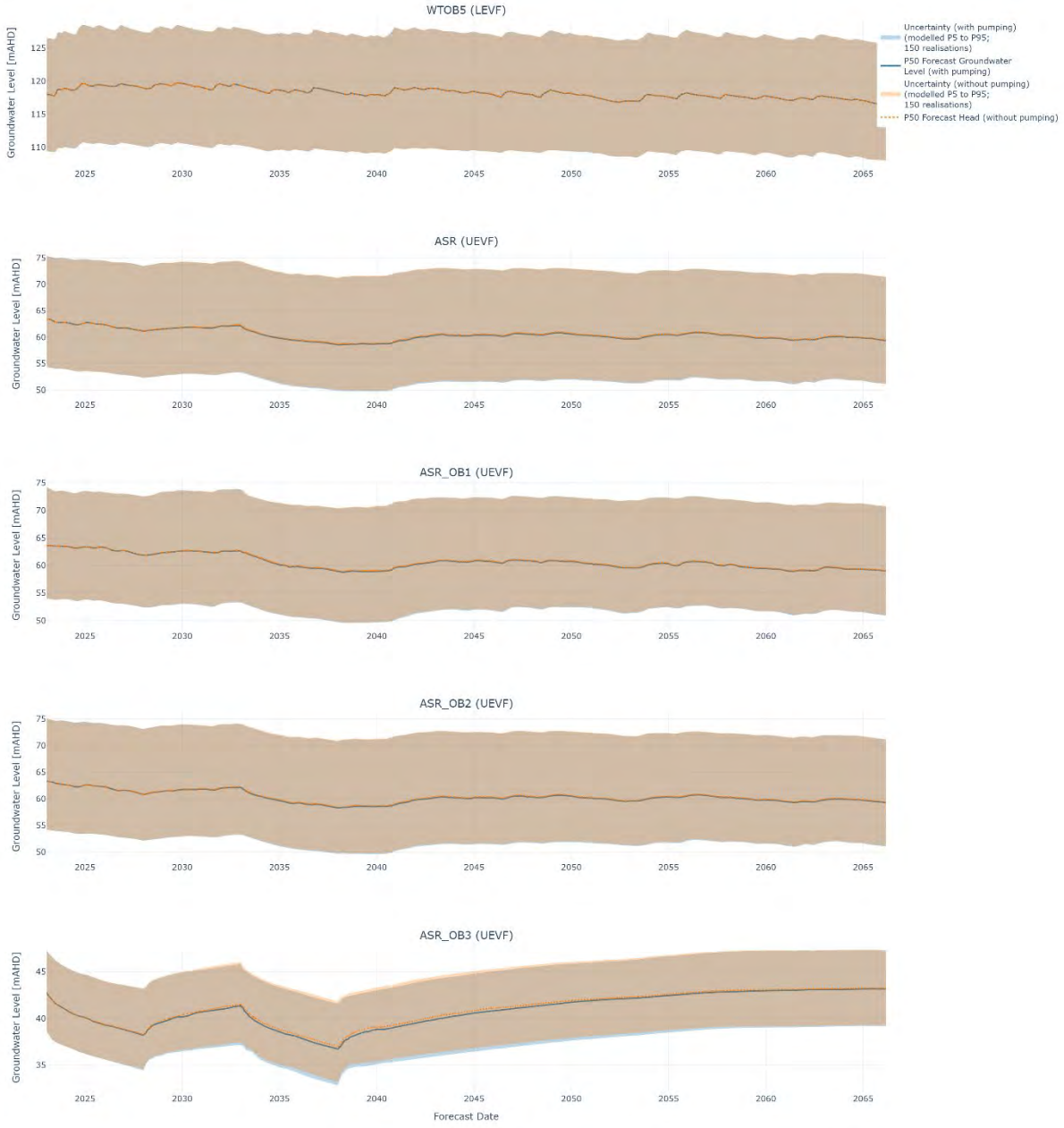

OB-D (UEVF)
OB-E (UEVF)
OB-F (UEVF)
OB-G (UEVF)
WB1 (UEVF)
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)

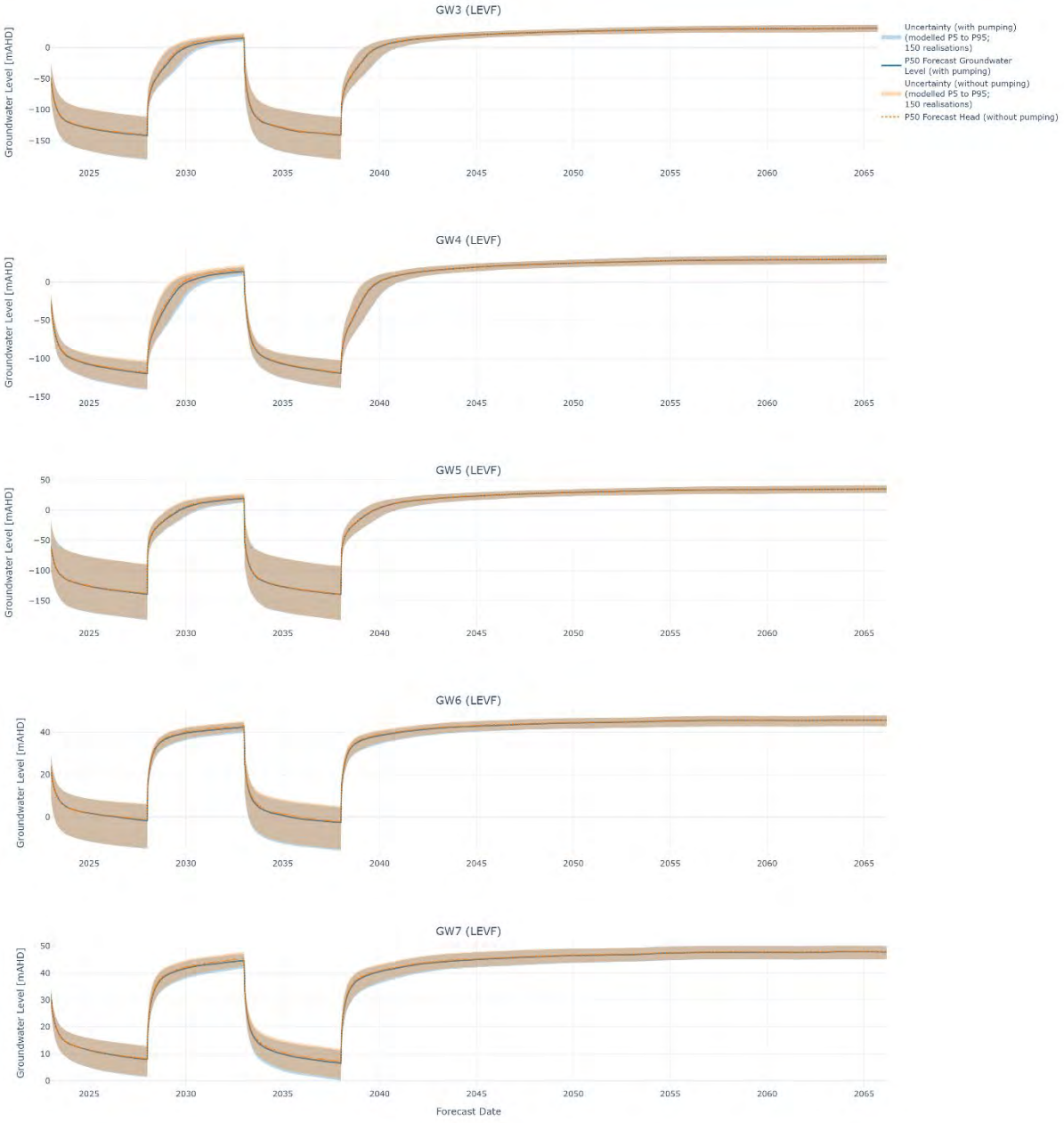

WB12 (UEVF)
WB13 (UEVF)
WB14 (UEVF)
WB15 (UEVF)
WB16 (UEVF)
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)

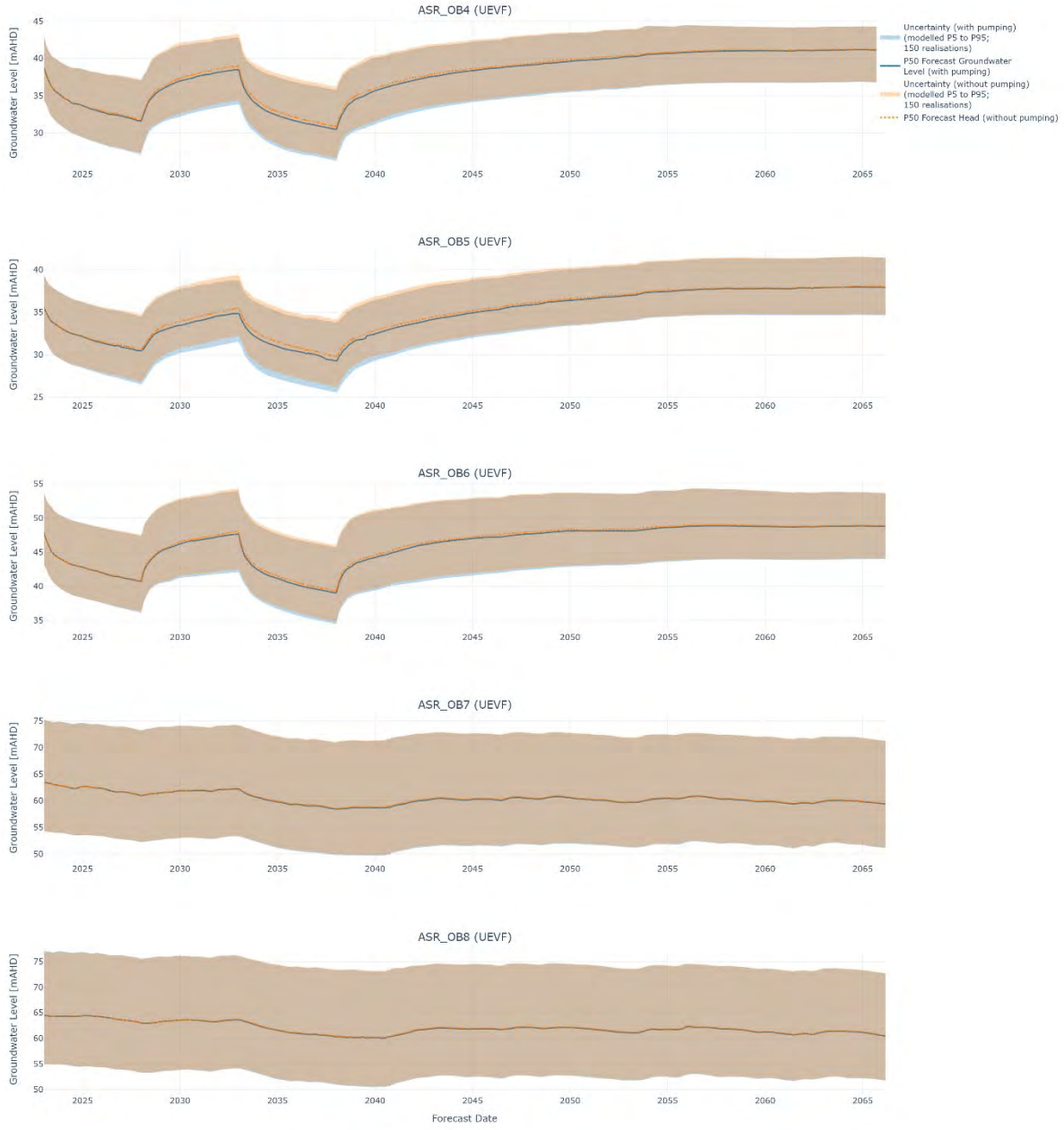

WB17 (UEVF)
Groundwater Level [mAHD]
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
WB3 (UEVF)
WB4 (UEVF)
WB5 (UEVF)
NB1 (LEVF)
Forecast Date

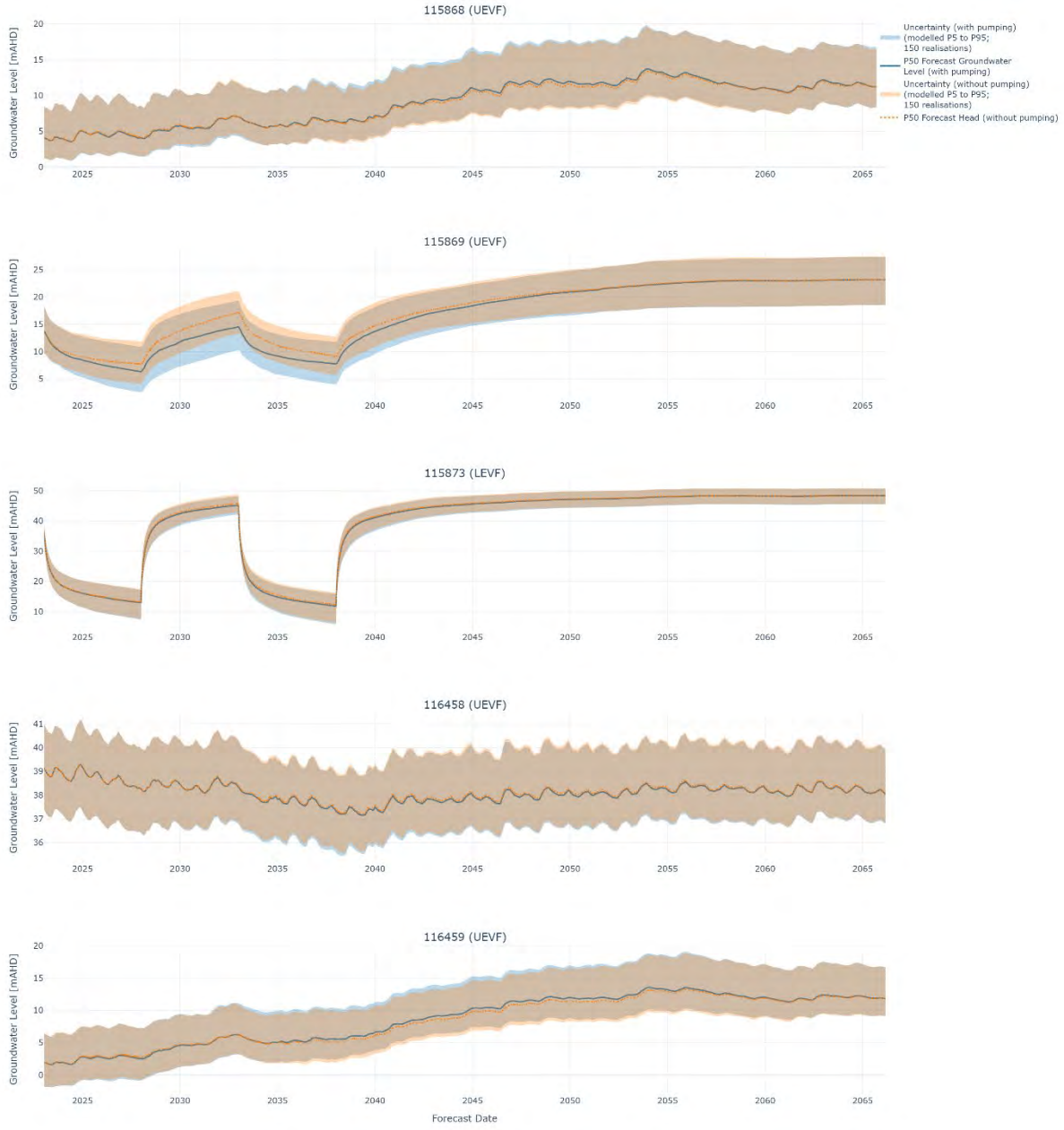

NB2 (UEVF)
Groundwater Level [mAHD]
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
P12 (LEVF)
P13 (LEVF)
P14 (LEVF)
P15 (LEVF)
Forecast Date

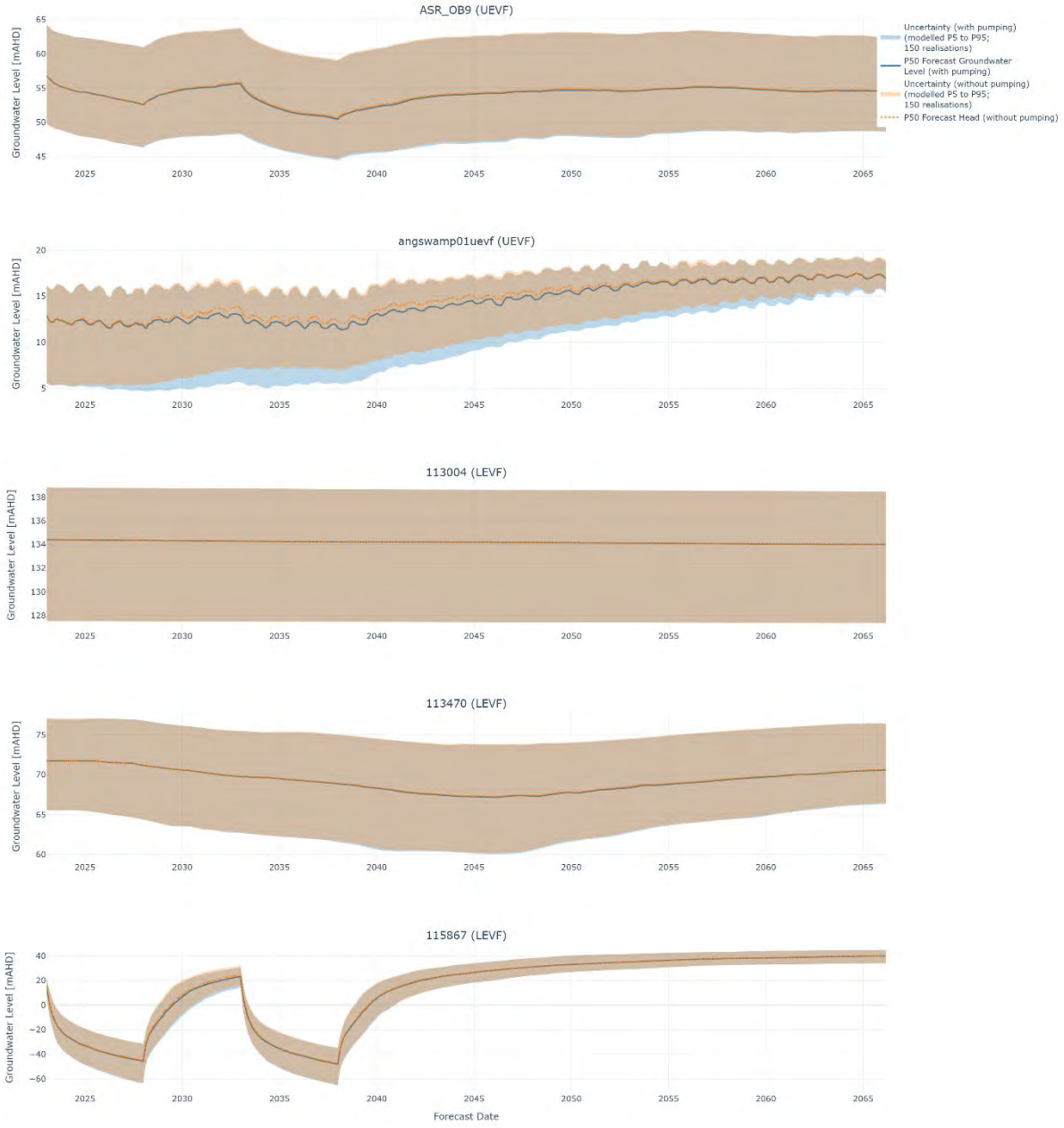

P3 (LEVF)
Groundwater Level [mAHD]
75
70
65
2025
2030
2035
2040
2045
2050
2055
2060
2065
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
SB1 (LEVF)
Groundwater Level [mAHD]
0
−50
−100
SB2 (UEVF)
Groundwater Level [mAHD]
10
0
−10
−20
GW1 (LEVF)
Groundwater Level [mAHD]
0
−50
−100
−150
GW2 (LEVF)
Groundwater Level [mAHD]
0
−50
−100
Forecast Date

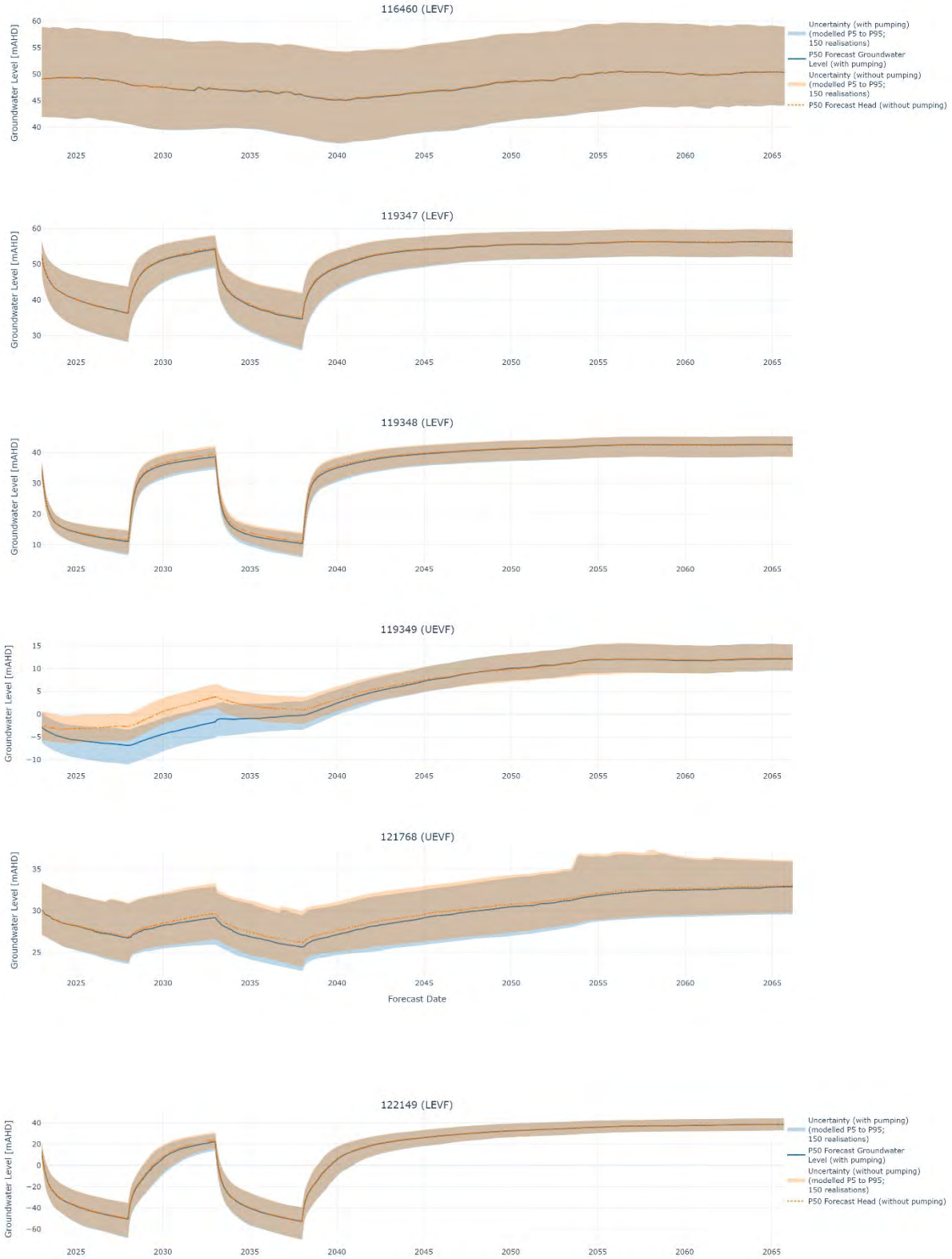

WTOB5 (LEVF)
Groundwater Level [mAHD]
125
120
115
110
2025
2030
2035
2040
2045
2050
2055
2060
2065
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
ASR (UEVF)
Groundwater Level [mAHD]
75
70
65
60
55
50
ASR_OB1 (UEVF)
ASR_OB2 (UEVF)
ASR_OB3 (UEVF)
45
40
35
Forecast Date


GW3 (LEVF)
GW4 (LEVF)
GW5 (LEVF)
GW6 (LEVF)
GW7 (LEVF)
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)


ASR_OB4 (UEVF)
ASR_OB5 (UEVF)
ASR_OB6 (UEVF)
ASR_OB7 (UEVF)
ASR_OB8 (UEVF)
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)


115868 (UEVF)
Groundwater Level [mAHD]
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
115869 (UEVF)
Groundwater Level [mAHD]
115873 (LEVF)
Groundwater Level [mAHD]
116458 (UEVF)
Groundwater Level [mAHD]
116459 (UEVF)
Groundwater Level [mAHD]
Forecast Date

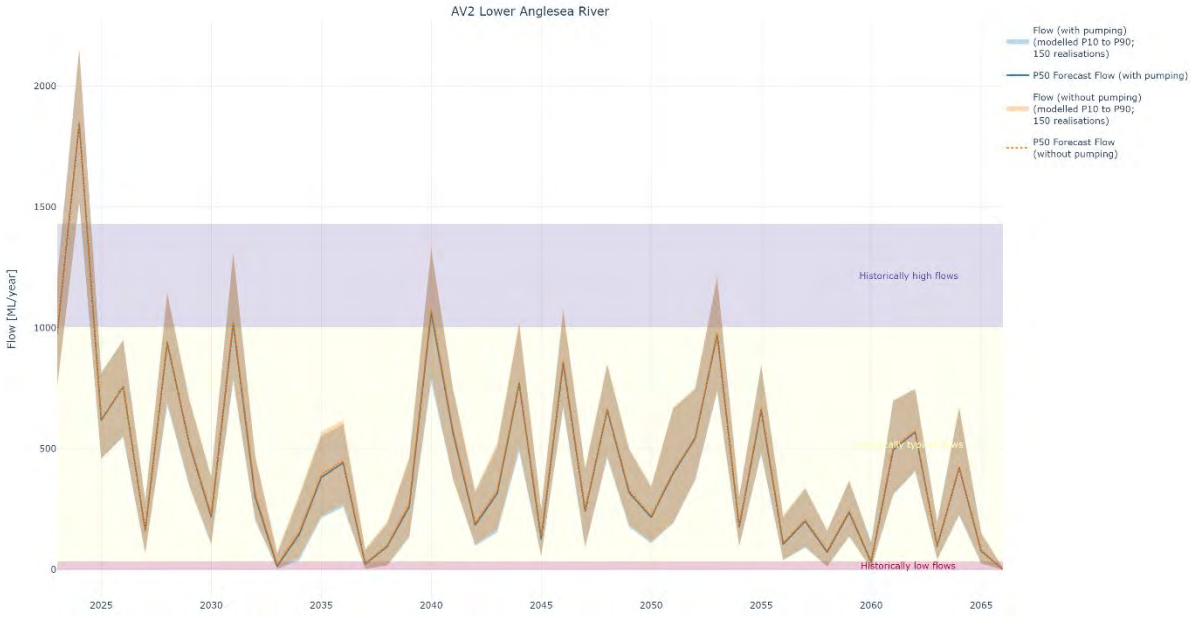

ASR_OB9 (UEVF)
Groundwater Level [mAHD]
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)
angswamp01uevf (UEVF)
113004 (LEVF)
113470 (LEVF)
115867 (LEVF)
Forecast Date

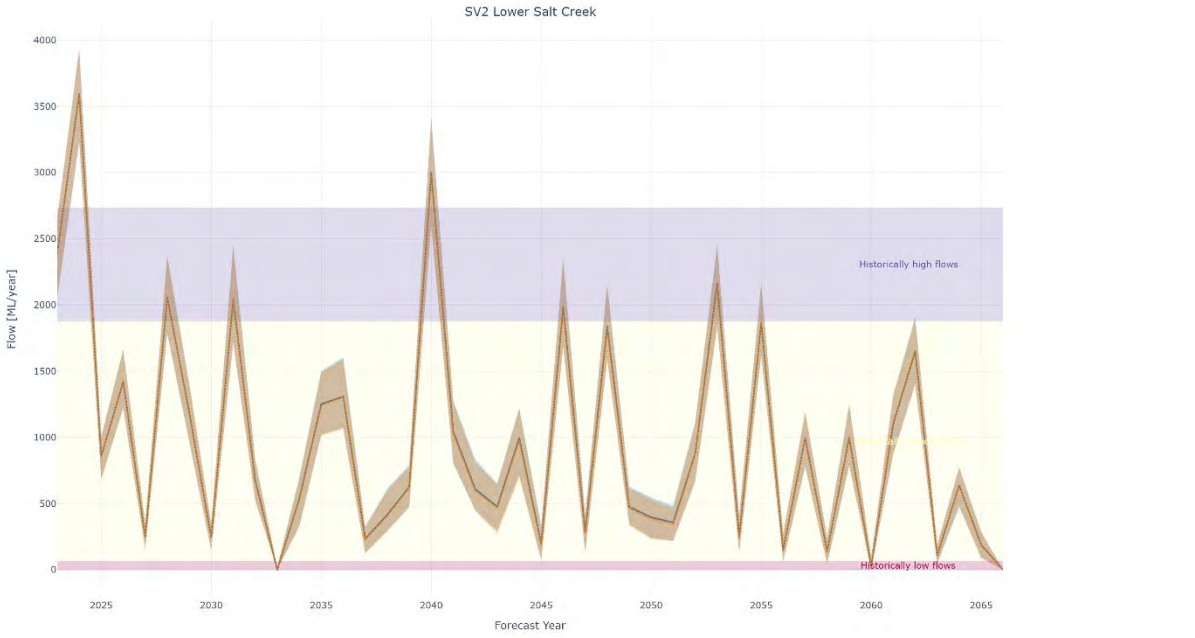

116460 (LEVF)
119347 (LEVF)
119348 (LEVF)
119349 (UEVF)
121768 (UEVF)
122149 (LEVF)
Groundwater Level [mAHD]
Forecast Date
Uncertainty (with pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Groundwater Level (with pumping)
Uncertainty (without pumping) (modelled P5 to P95; 150 realisations)
P50 Forecast Head (without pumping)

Appendix F3 Numerical Modelling Outputs (Annual flow hydrographs for QOI3 for SV2 and AV2 (plus all other gauges)

AV2 Lower Anglesea River
Flow [ML/day]
Historically high flows
Historically low flows
AV1 Upper Anglesea River
Flow [ML/day]
Historically high flows
Historically low flows
SV1 Breakfast Creek
Flow [ML/day]
Historically high flows
Historically low flows
Forecast Date
Flow (with pumping) (modelled P10 to P90; 150 realisations)
P50 Forecast Flow (with pumping)
Flow (without pumping) (modelled P10 to P90; 150 realisations)
P50 Forecast Flow (without pumping)

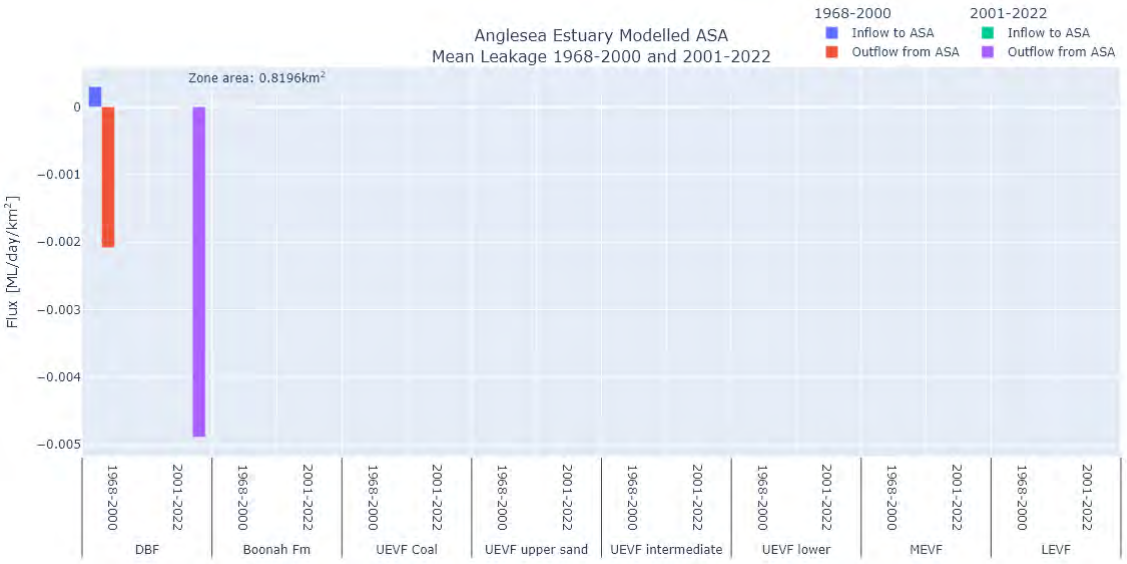
SV3 Breakfast Crk Trib
Flow [ML/day]
Historically high flows
Historically low flows
Flow (with pumping) (modelled P10 to P90; 150 realisations)
P50 Forecast Flow (with pumping)
Flow (without pumping) (modelled P10 to P90; 150 realisations)
P50 Forecast Flow (without pumping)
SV2 Lower Salt Creek
Flow [ML/day]
Historically high flows
Historically low flows
SV4 Mid Salt Creek
Flow [ML/day]
Historically high flows
Historically low flows
2025
2030
2035
2040
2045
2050
2055
2060
2065
Forecast Date

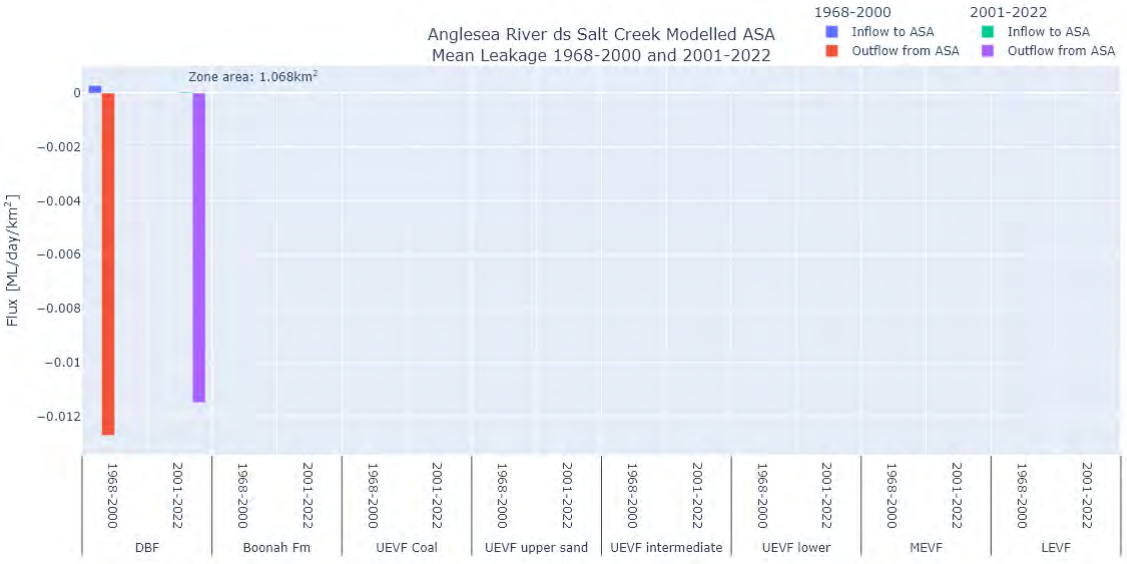

AV2 Lower Anglesea River
Flow [ML/year]
2000
1500
1000
500
0
2025
2030
2035
2040
2045
2050
2055
2060
2065
Historically high flows
Historically low flows
Flow (with pumping) (modelled P10 to P90; 150 realisations)
P50 Forecast Flow (with pumping)
Flow (without pumping) (modelled P10 to P90; 150 realisations)
P50 Forecast Flow (without pumping)

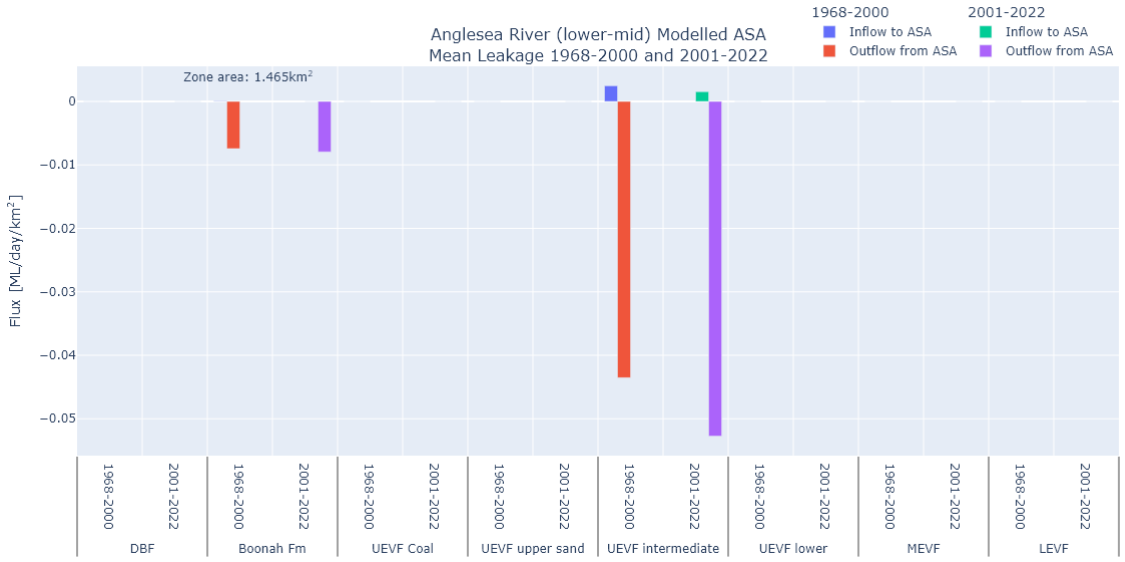

SV2 Lower Salt Creek
Flow [ML/year]
4000
3500
3000
2500
2000
1500
1000
500
0
2025
2030
2035
2040
2045
2050
2055
2060
2065
Forecast Year
Historically high flows
Historically low flows

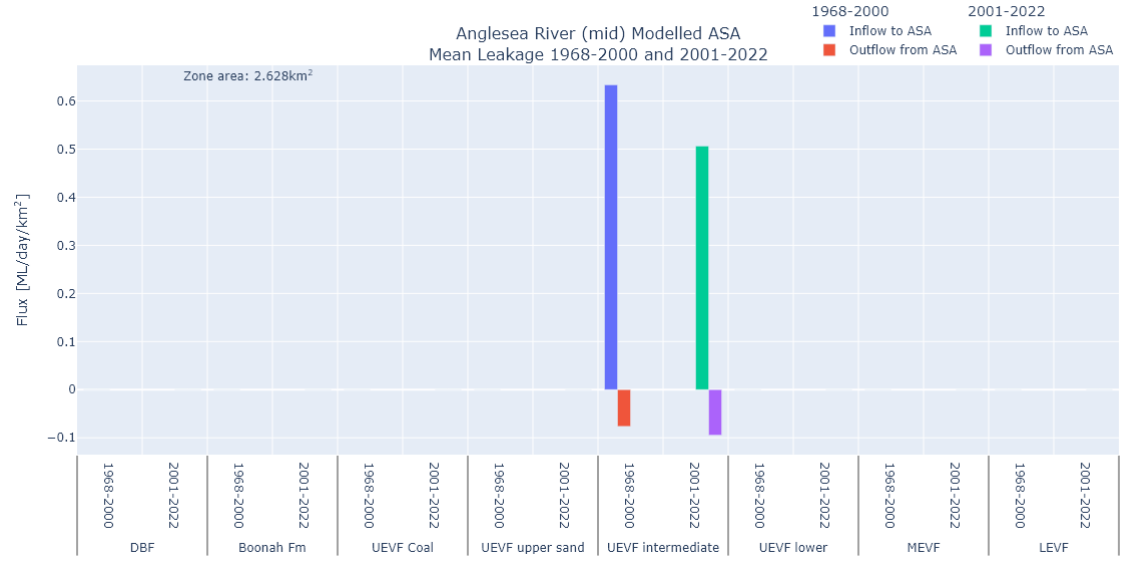
Appendix F4 Numerical Modelling Outputs (Water balances for Historical actual; Barwon Water pumping as per historical actuals; Alcoa as per historical actuals)

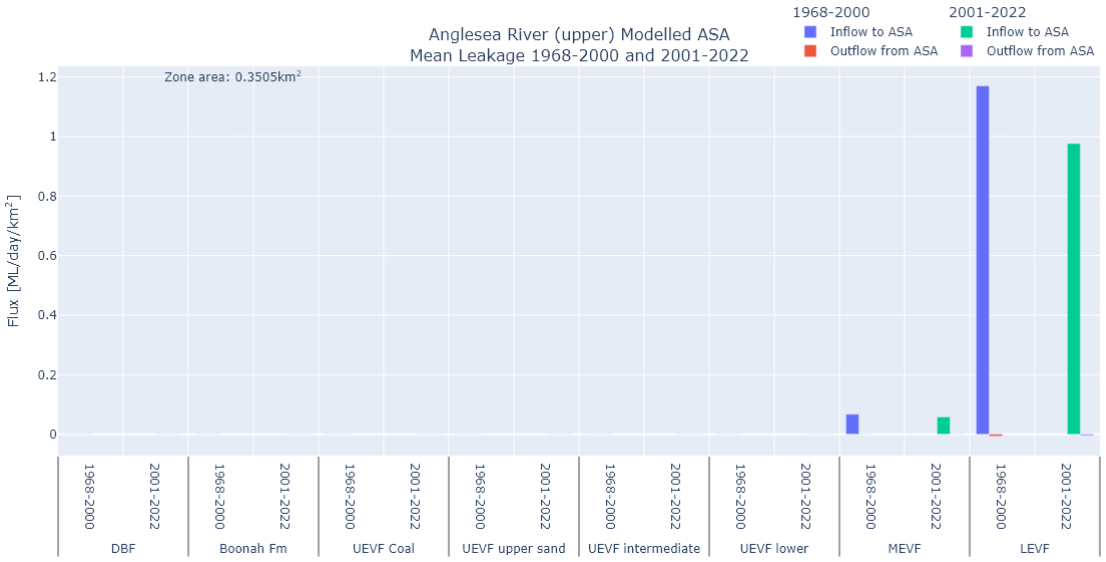
Mean ASA leakage to the various underlying HGUs for specified stream reaches (one plot each)
UNITS: ML/day/km2 (unit area)

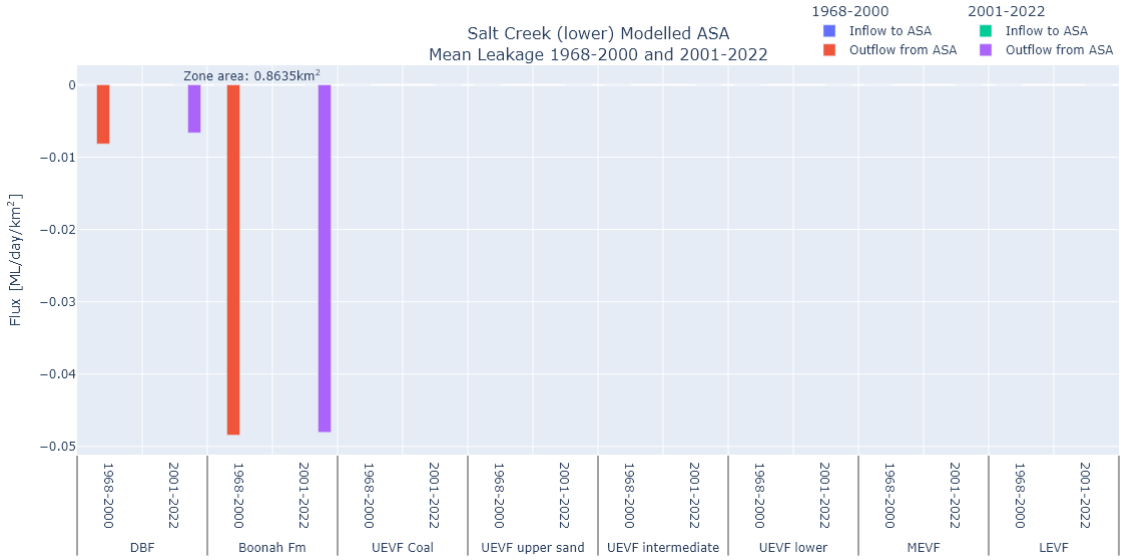


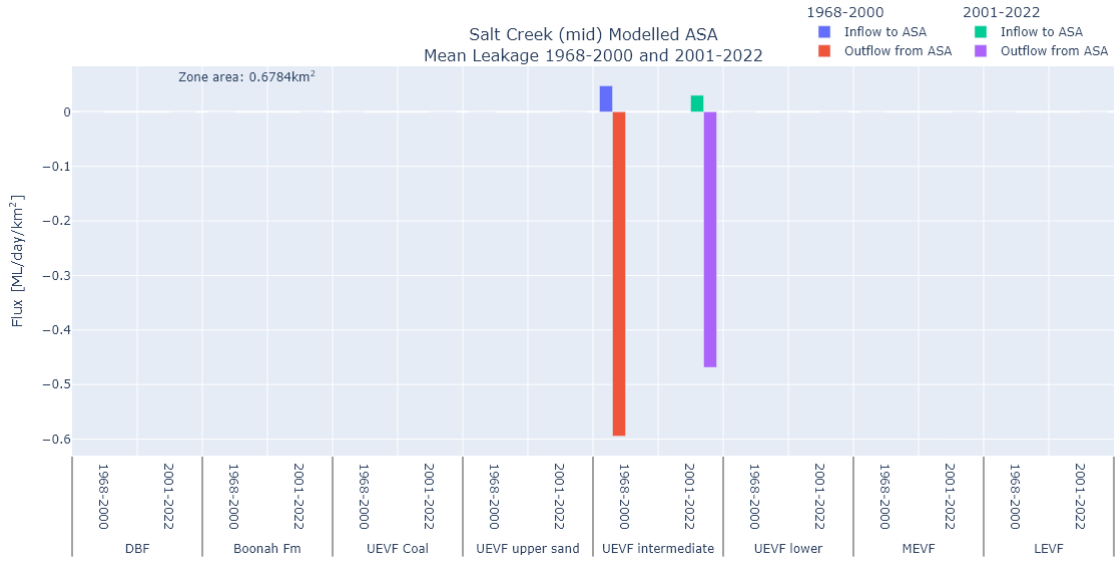


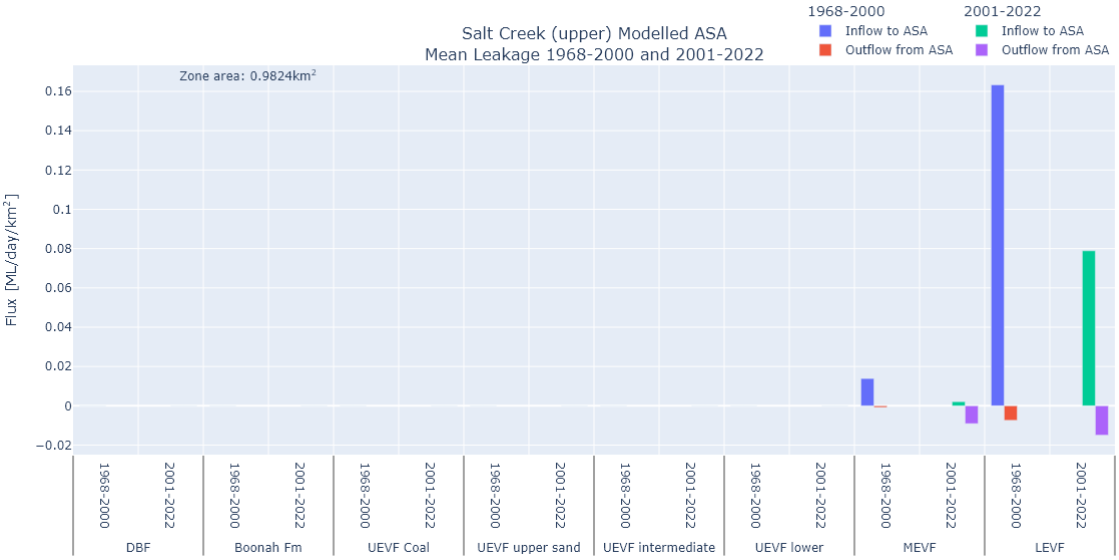

Anglesea River (lower-mid) Modelled ASA
Mean Leakage 1968-2000 and 2001-2022
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

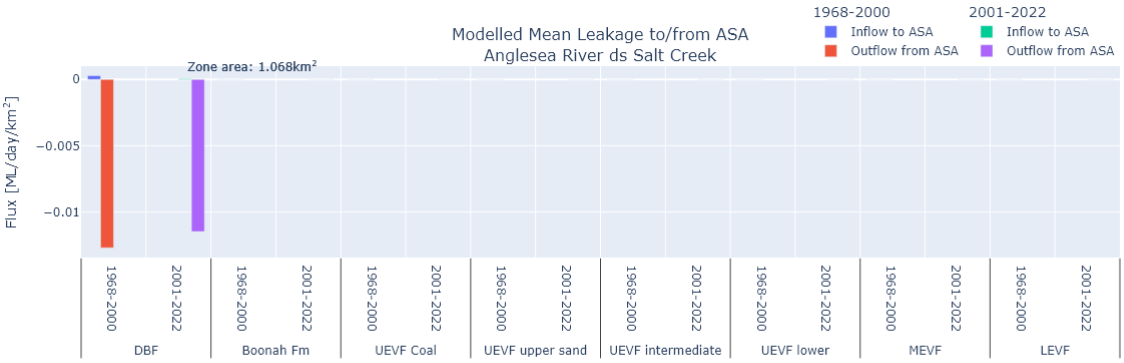

Anglesea River (mid) Modelled ASA
Mean Leakage 1968-2000 and 2001-2022
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 2.628km²
Flux [ML/day/km²]
0.6
0.5
0.4
0.3
0.2
0.1
0
−0.1
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

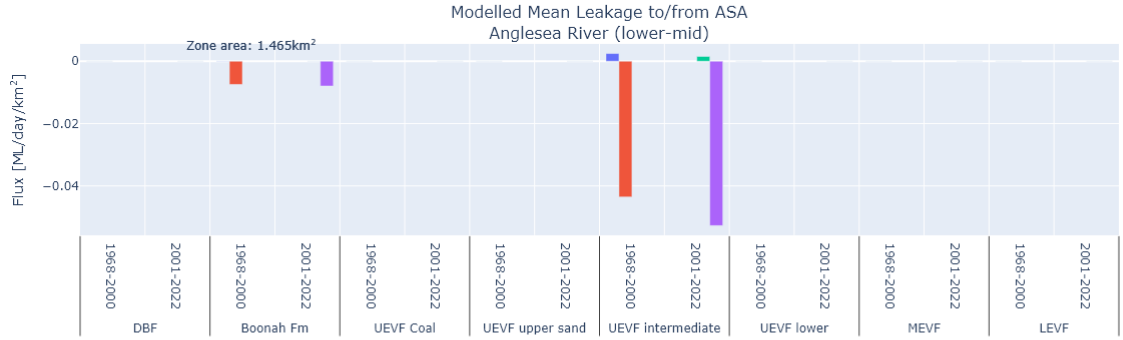

Anglesea River (upper) Modelled ASA
Mean Leakage 1968-2000 and 2001-2022
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 0.3505km²
Flux [ML/day/km²]
1.2
1
0.8
0.6
0.4
0.2
0
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

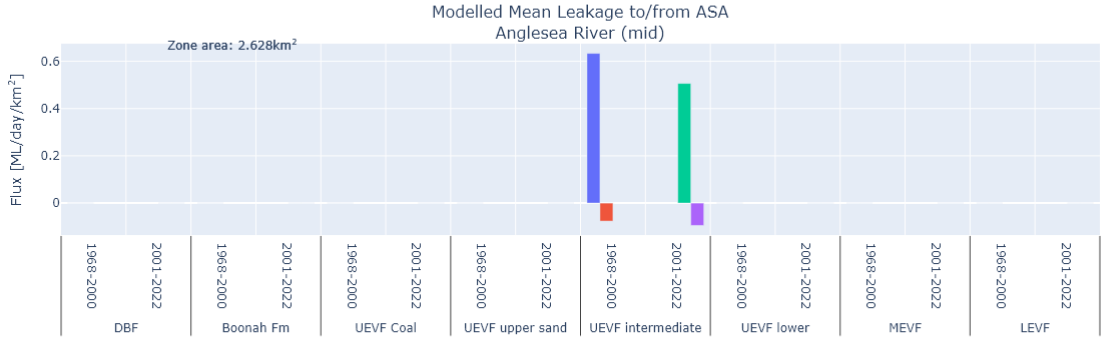

Salt Creek (lower) Modelled ASA
Mean Leakage 1968-2000 and 2001-2022
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

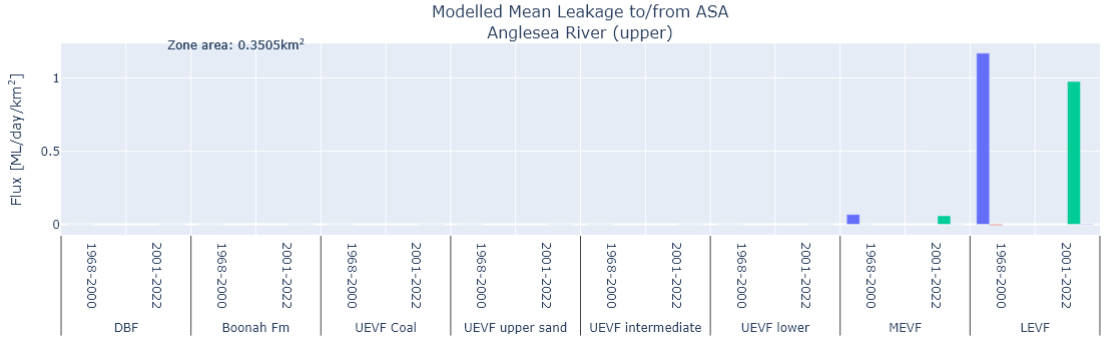

Salt Creek (mid) Modelled ASA
Mean Leakage 1968-2000 and 2001-2022
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

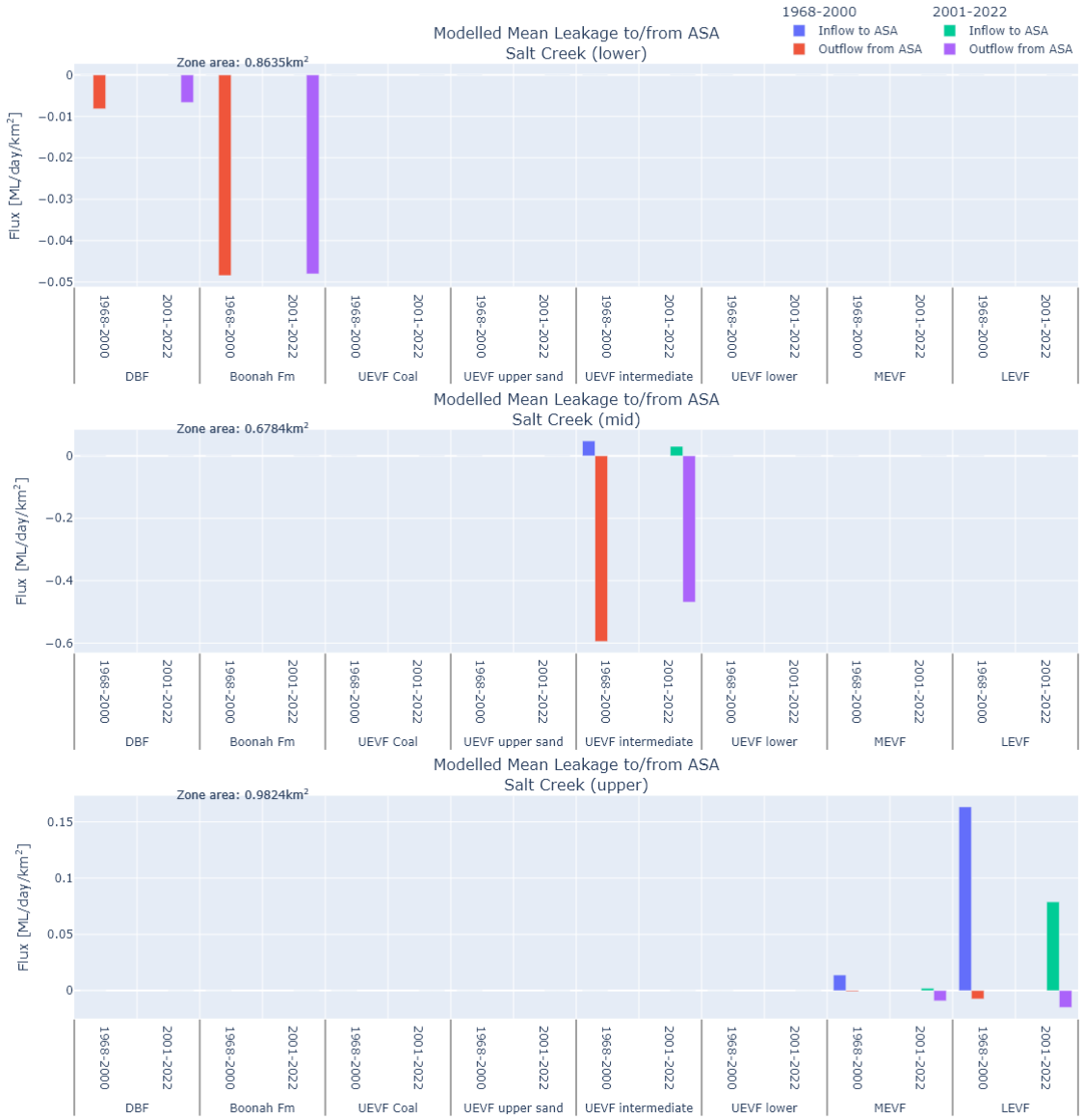

Salt Creek (upper) Modelled ASA
Mean Leakage 1968-2000 and 2001-2022
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 0.9824km²
Flux [ML/day/km²]
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
−0.02
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF


Modelled Mean Leakage to/from ASA
Anglesea River ds Salt Creek
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Zone area: 1.068km²
Flux [ML/day/km²]
0
−0.005
−0.01
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

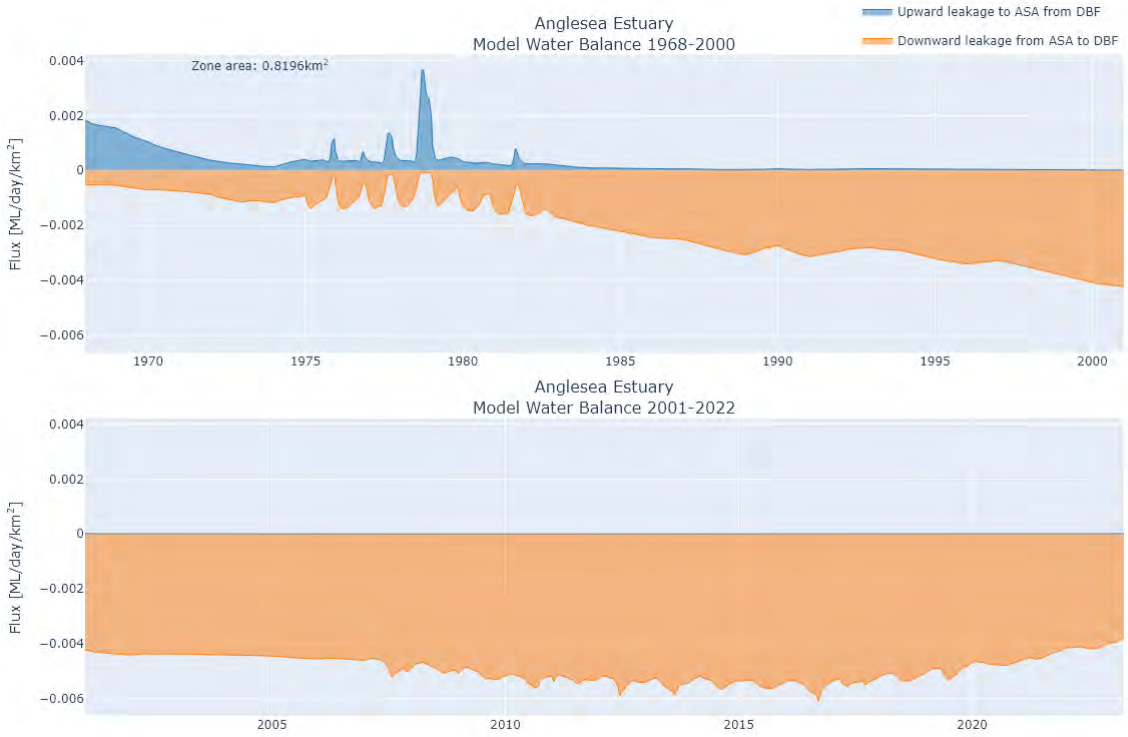

Modelled Mean Leakage to/from ASA
Anglesea River (lower-mid)
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.02
−0.04
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

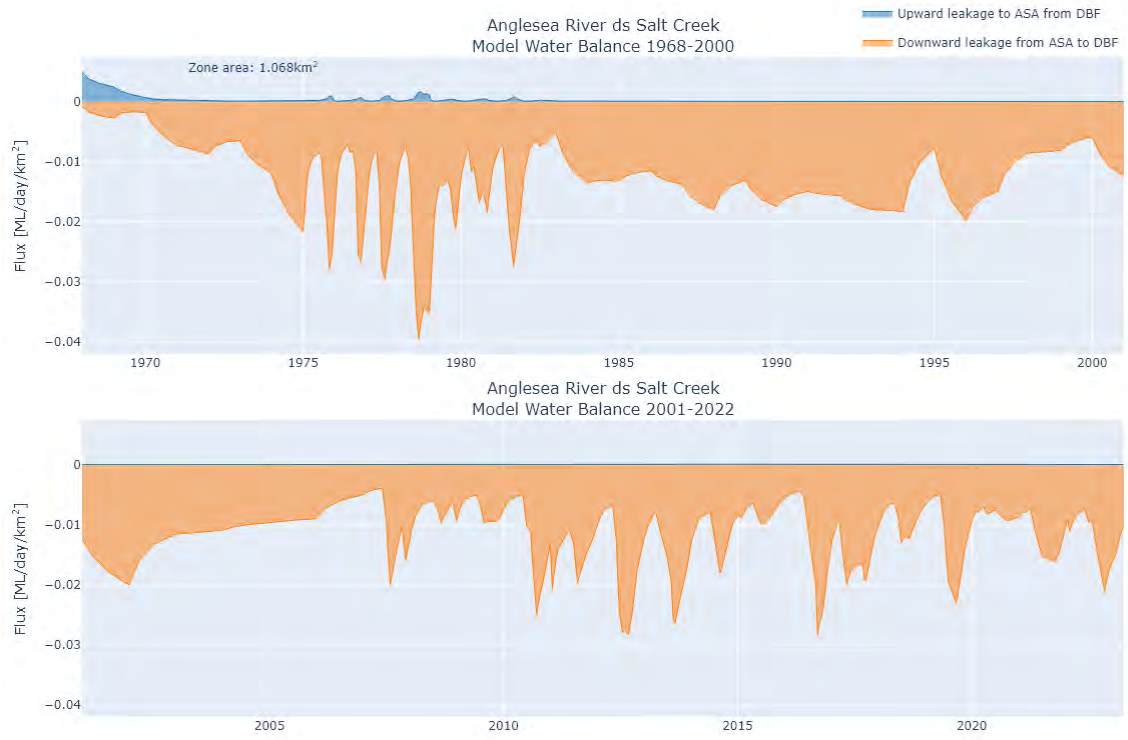

Modelled Mean Leakage to/from ASA
Anglesea River (mid)
Zone area: 2.628km²
Flux [ML/day/km²]
0.6
0.4
0.2
0
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

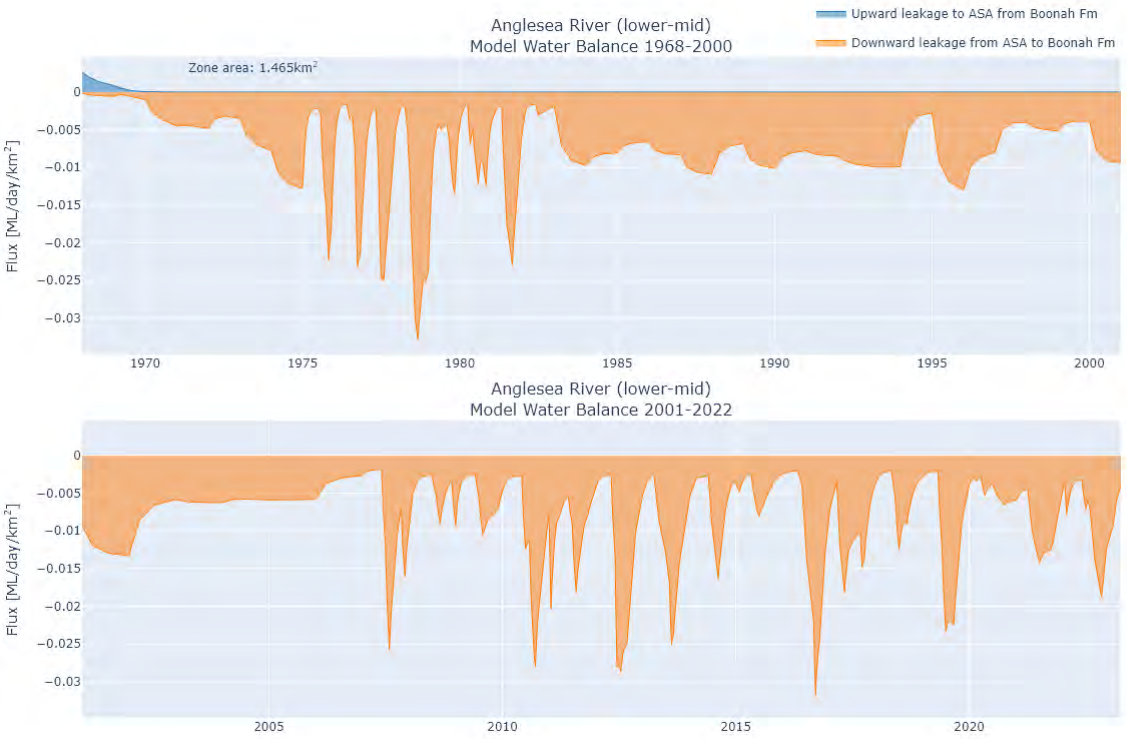

Modelled Mean Leakage to/from ASA
Anglesea River (upper)
Zone area: 0.3505km²
Flux [ML/day/km²]
1
0.5
0
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

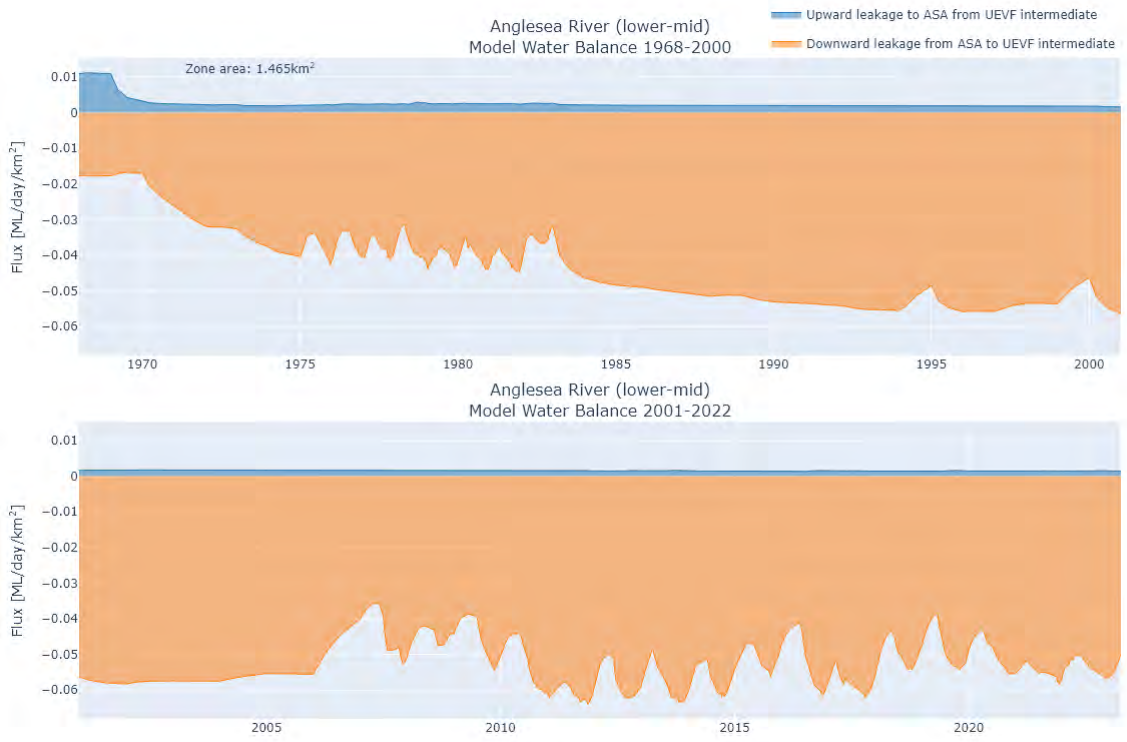

1968-2000
2001-2022
Inflow to ASA
Outflow from ASA
Modelled Mean Leakage to/from ASA
Salt Creek (lower)
Zone area: 0.8635km²
Flux x [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF
Modelled Mean Leakage to/from ASA
Salt Creek (mid)
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.2
−0.4
−0.6
Modelled Mean Leakage to/from ASA
Salt Creek (upper)
Zone area: 0.9824km²
Flux x [ML/day/km²]
0.15
0.1
0.05
0

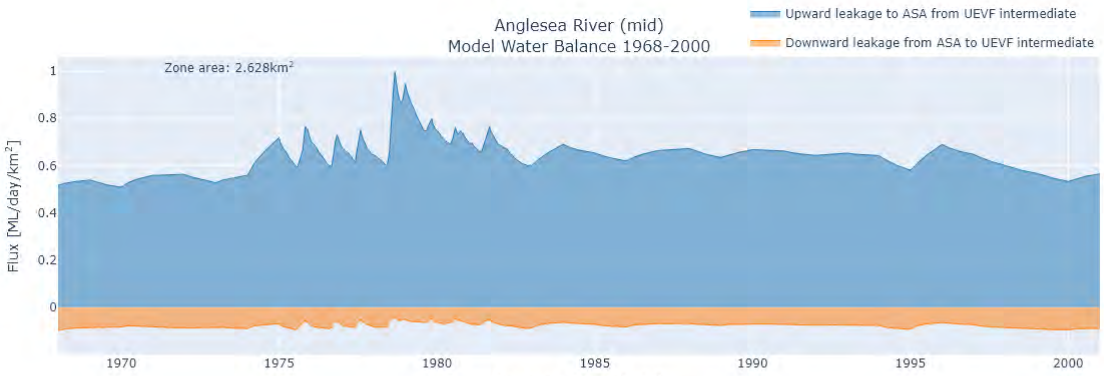
Timeseries ASA leakage to the various underlying HGUs for specified stream reaches (one plot each)

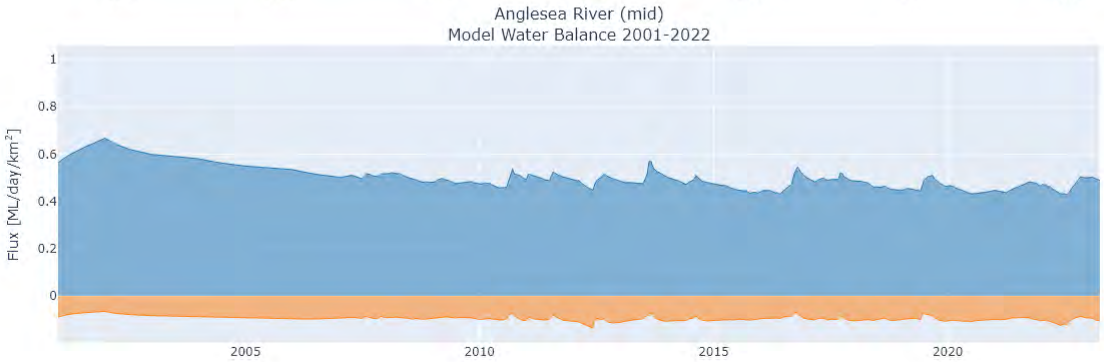


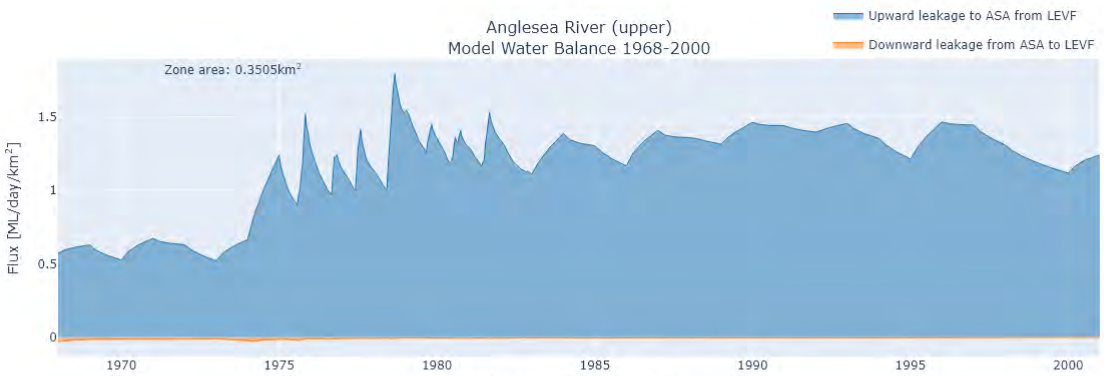


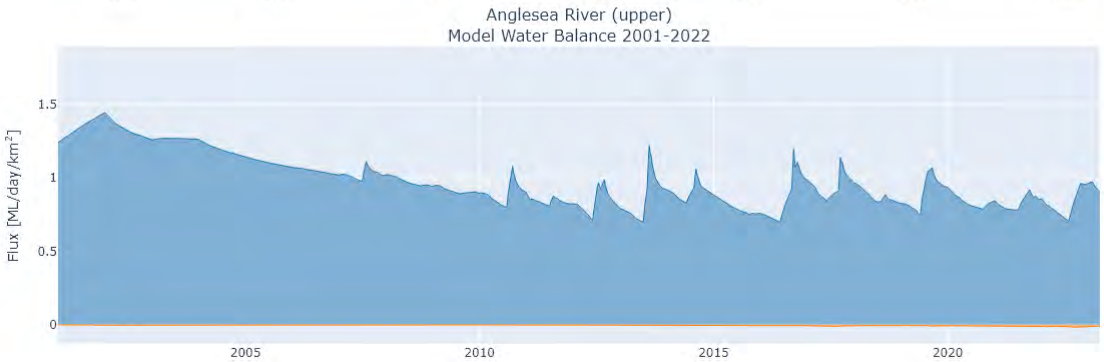

Anglesea River (lower-mid)
Model Water Balance 1968-2000
Upward leakage to ASA from Boonah Fm
Downward leakage from ASA to Boonah Fm
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
−0.03
1970
1975
1980
1985
1990
1995
2000
Anglesea River (lower-mid)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
−0.03
2005
2010
2015
2020

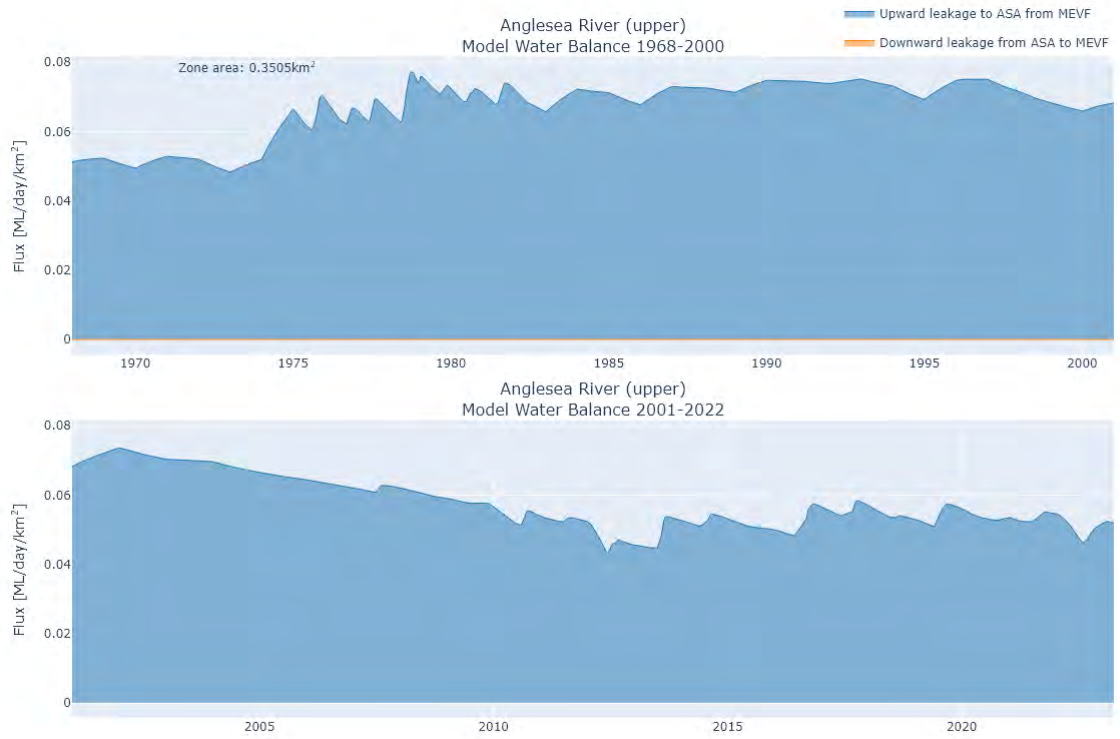

Anglesea River (lower-mid)
Model Water Balance 1968-2000
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 1.465km²
Flux [ML/day/km²]
0.01
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
1970
1975
1980
1985
1990
1995
2000
Anglesea River (lower-mid)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0.01
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
2005
2010
2015
2020

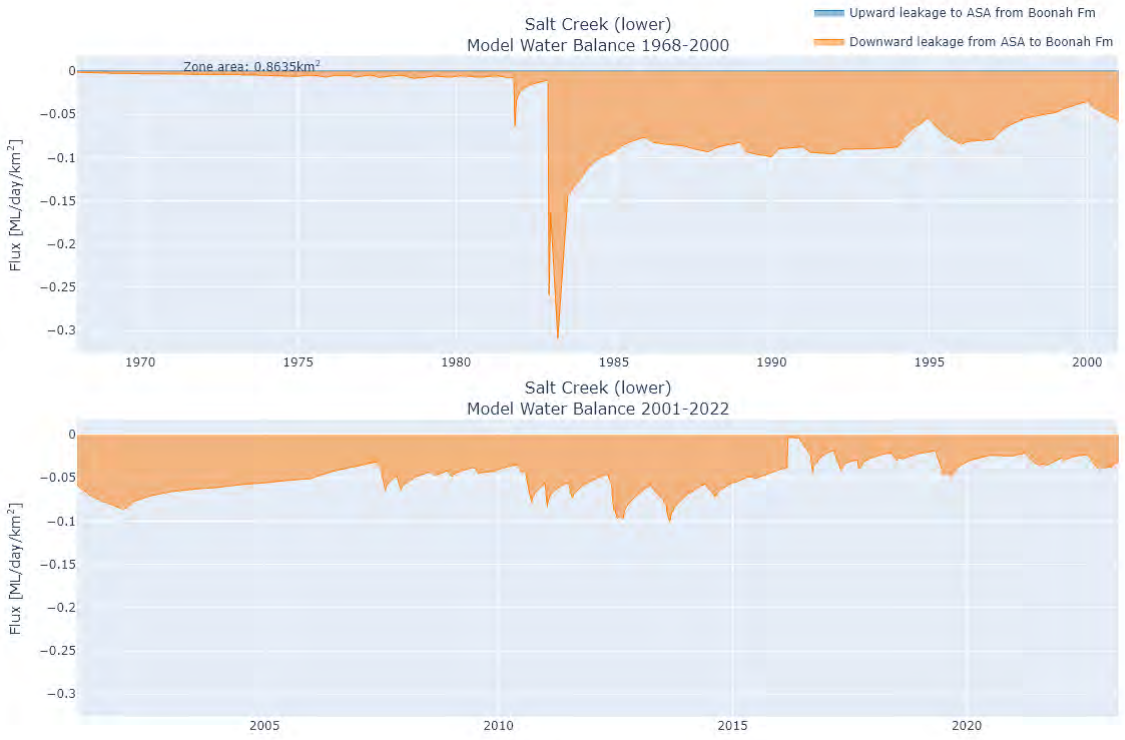

Anglesea River (mid)
Model Water Balance 1968-2000
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 2.628km²
Flux [ML/day/km²]
0
0.2
0.4
0.6
0.8
1
1970
1975
1980
1985
1990
1995
2000

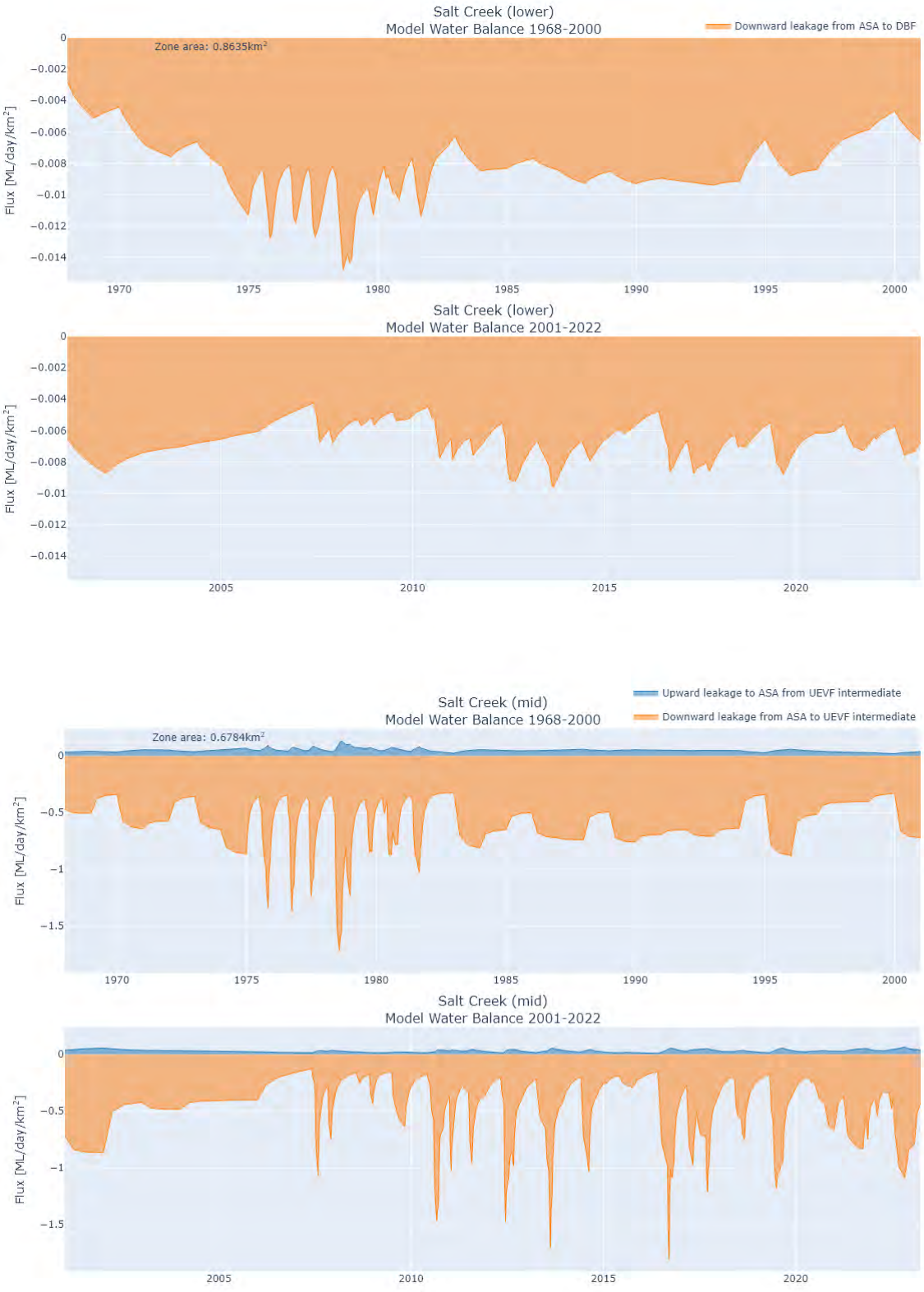

Anglesea River (mid)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0
0.2
0.4
0.6
0.8
1
2005
2010
2015
2020

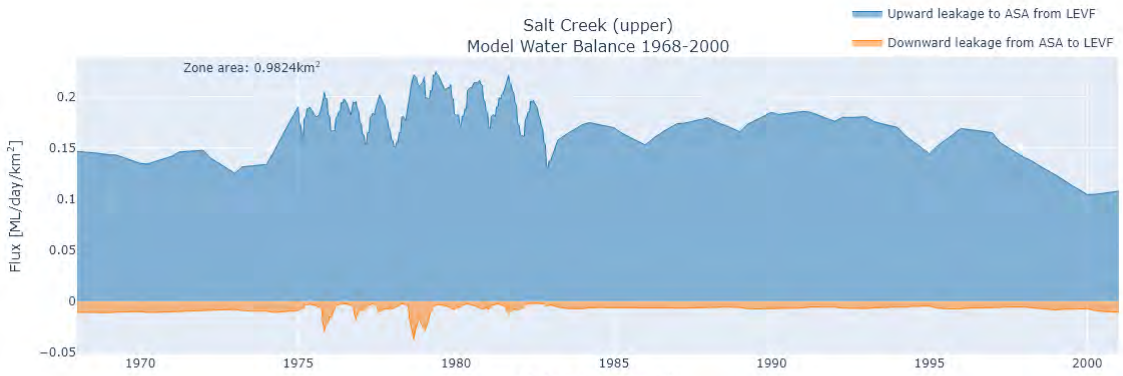

Anglesea River (upper)
Model Water Balance 1968-2000
Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Zone area: 0.3505km²
Flux [ML/day/km²]
0
0.5
1
1.5
1970
1975
1980
1985
1990
1995
2000

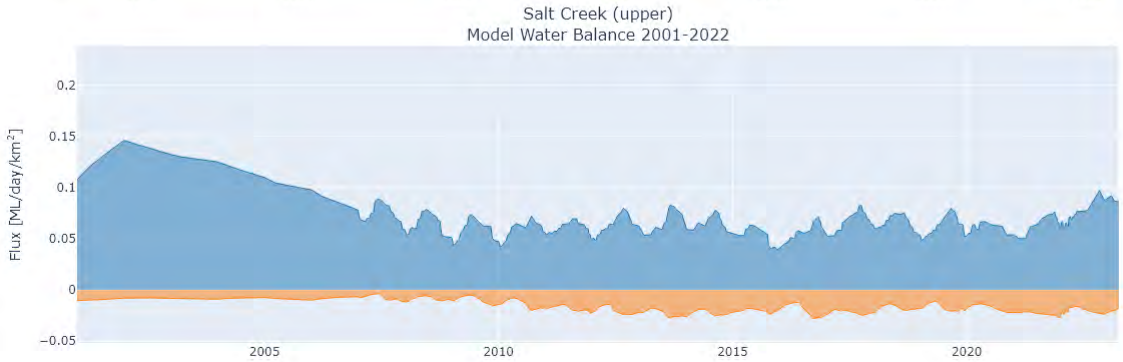

Anglesea River (upper)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0
0.5
1
1.5
2005
2010
2015
2020

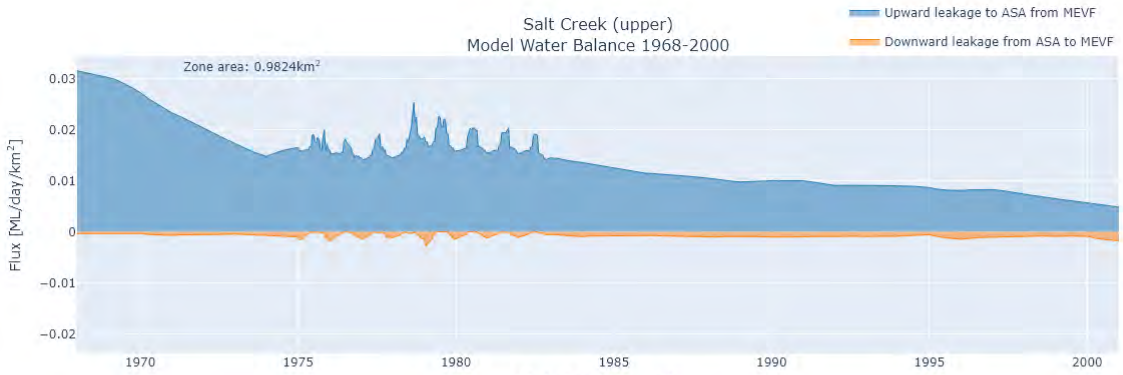

Anglesea River (upper)
Model Water Balance 1968-2000
Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Zone area: 0.3505km²
Flux [ML/day/km²]
0.08
0.06
0.04
0.02
0
1970
1975
1980
1985
1990
1995
2000
Anglesea River (upper)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0.08
0.06
0.04
0.02
0
2005
2010
2015
2020

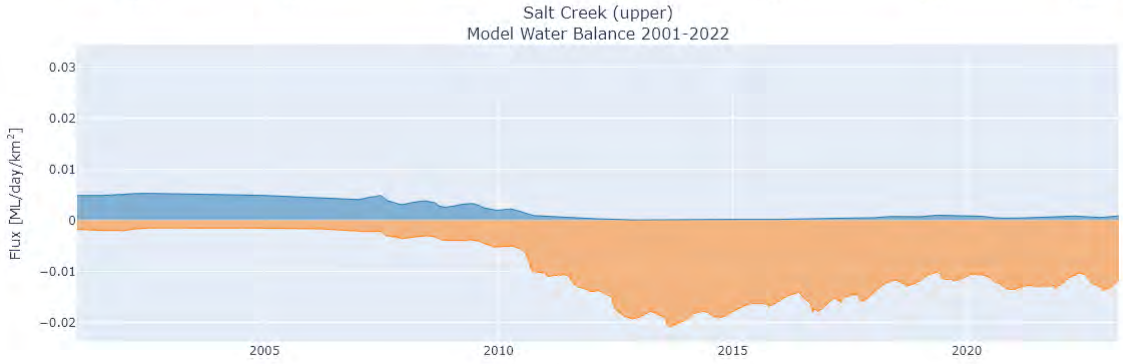

Salt Creek (lower)
Model Water Balance 1968-2000
Upward leakage to ASA from Boonah Fm
Downward leakage from ASA to Boonah Fm
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.05
−0.1
−0.15
−0.2
−0.25
−0.3
1970
1975
1980
1985
1990
1995
2000
Salt Creek (lower)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0
−0.05
−0.1
−0.15
−0.2
−0.25
−0.3
2005
2010
2015
2020


Salt Creek (lower)
Model Water Balance 1968-2000
Downward leakage from ASA to DBF
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.002
−0.004
−0.006
−0.008
−0.01
−0.012
−0.014
1970
1975
1980
1985
1990
1995
2000
Salt Creek (lower)
Model Water Balance 2001-2022
2005
2010
2015
2020
Salt Creek (mid)
Model Water Balance 1968-2000
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 0.6784km²
−0.5
−1
−1.5
Salt Creek (mid)
Model Water Balance 2001-2022

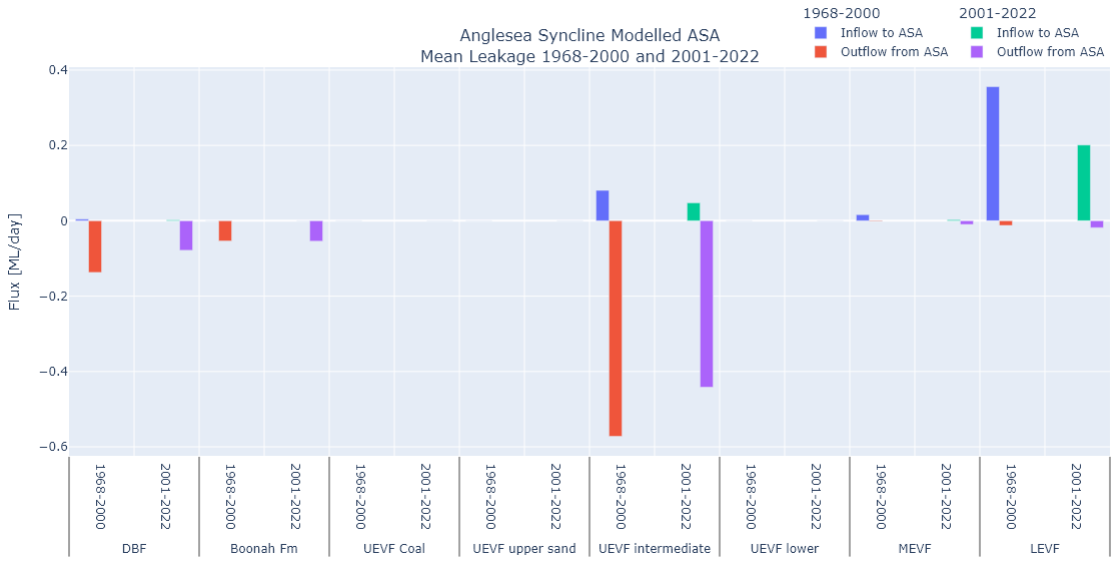

Salt Creek (upper)
Model Water Balance 1968-2000
Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Zone area: 0.9824km²
Flux [ML/day/km²]
0.2
0.15
0.1
0.05
0
−0.05
1970
1975
1980
1985
1990
1995
2000

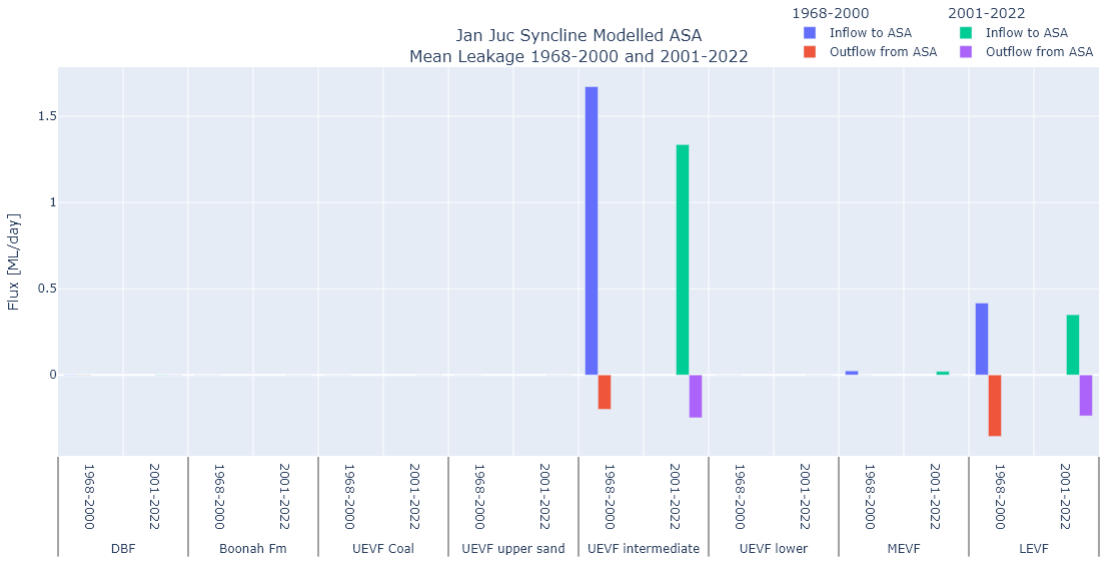

Salt Creek (upper)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0.2
0.15
0.1
0.05
0
−0.05
2005
2010
2015
2020

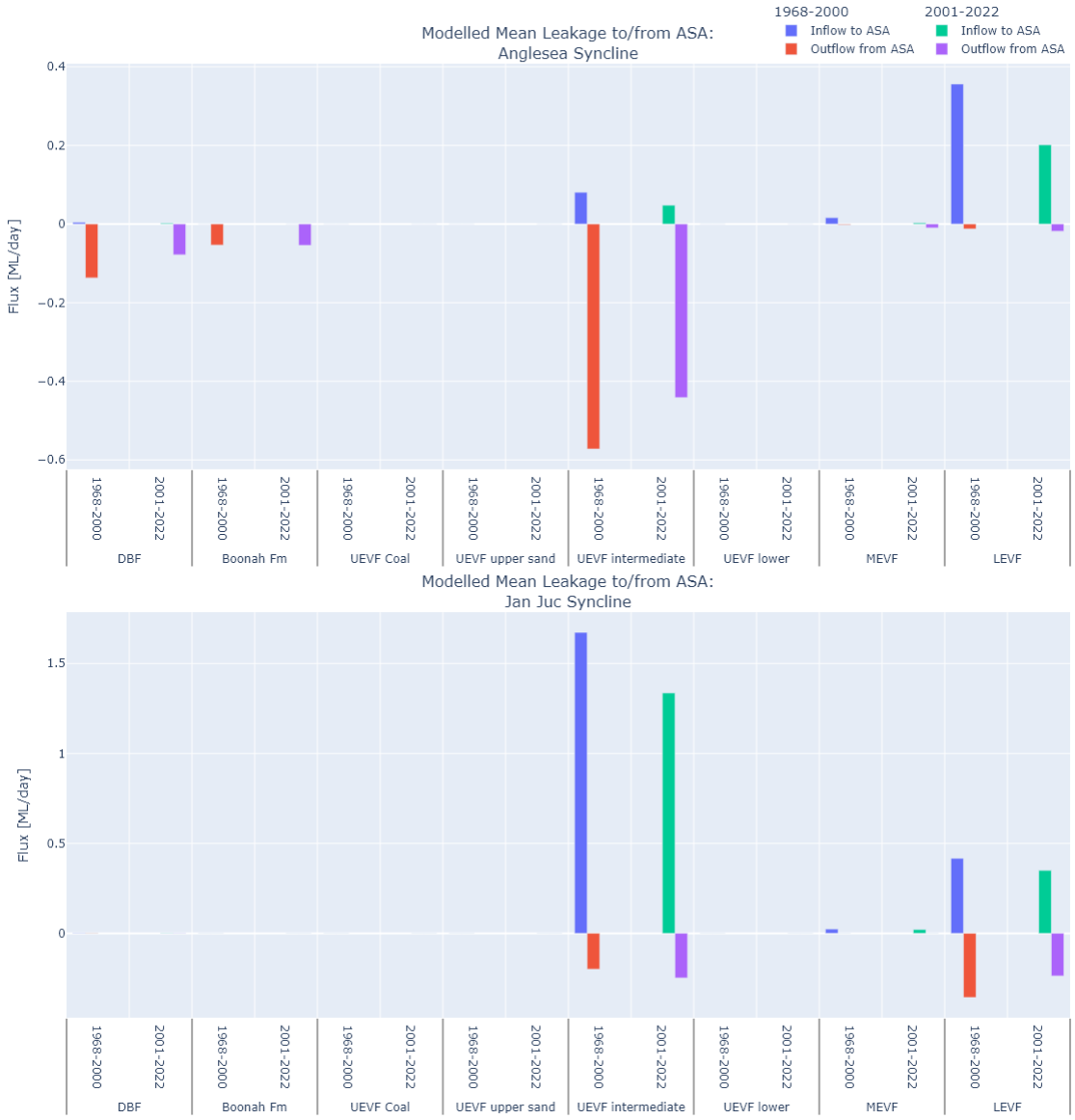

Salt Creek (upper)
Model Water Balance 1968-2000
Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Zone area: 0.9824km²
Flux [ML/day/km²]
0.03
0.02
0.01
0
−0.01
−0.02
1970
1975
1980
1985
1990
1995
2000


Salt Creek (upper)
Model Water Balance 2001-2022
Flux [ML/day/km²]
0.03
0.02
0.01
0
−0.01
−0.02
2005
2010
2015
2020

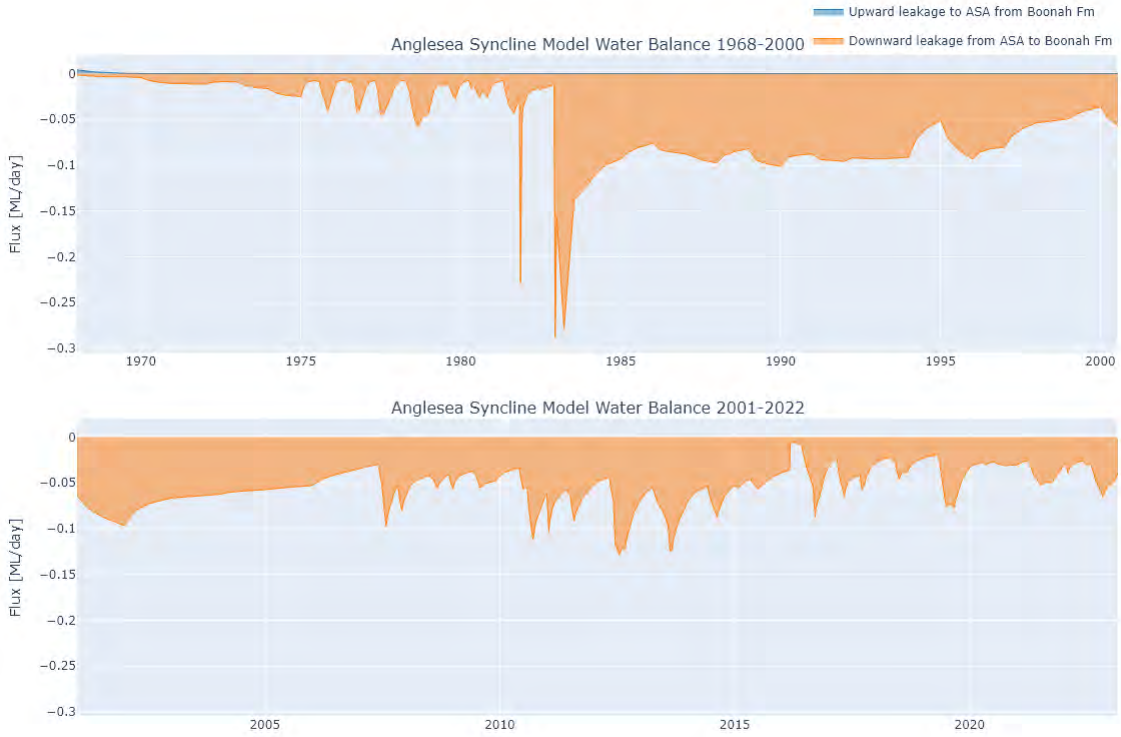
Mean ASA leakage to the various underlying HGUs for each of the Anglesea and Jan Juc Synclines (on plot each) and Single plot showing both syncline charts of mean ASA leakage per HGU.

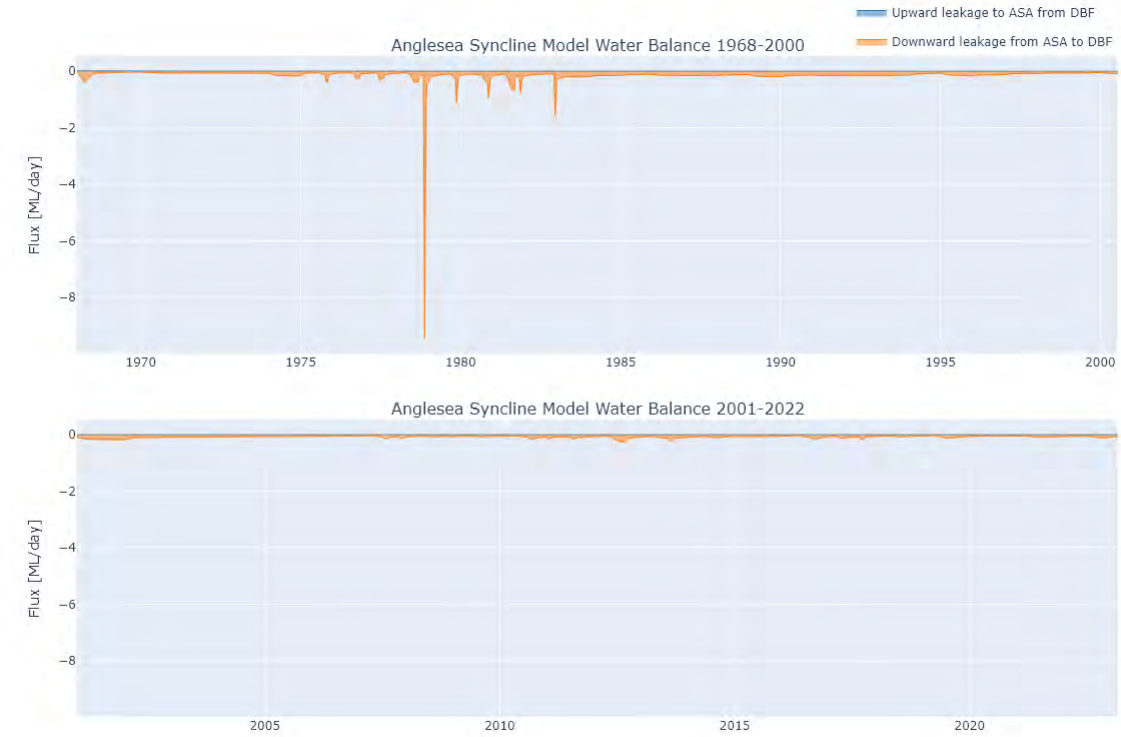


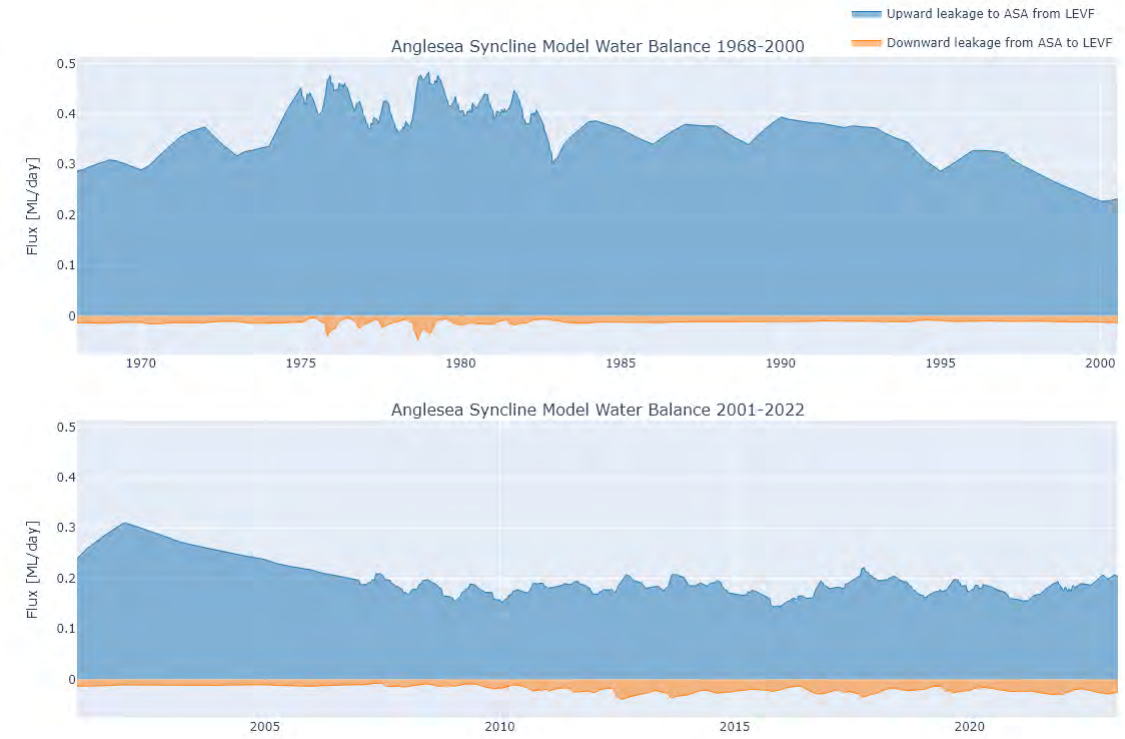


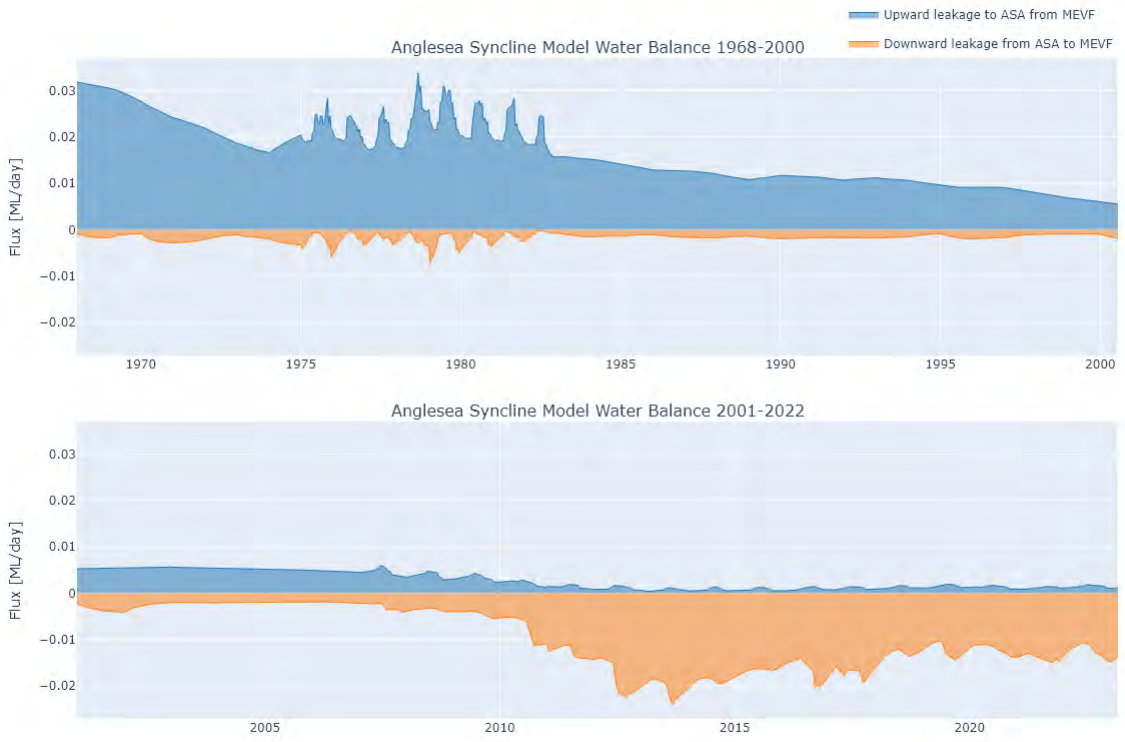

Modelled Mean Leakage to/from ASA:
Anglesea Syncline
1968-2000
Inflow to ASA
Outflow from ASA
2001-2022
Inflow to ASA
Outflow from ASA
Flux [ML/day]
0.4
0.2
0
−0.2
−0.4
−0.6
1968-2000
2001-2022
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF
Modelled Mean Leakage to/from ASA:
Jan Juc Syncline
Flux [ML/day]
1.5
1
0.5
0

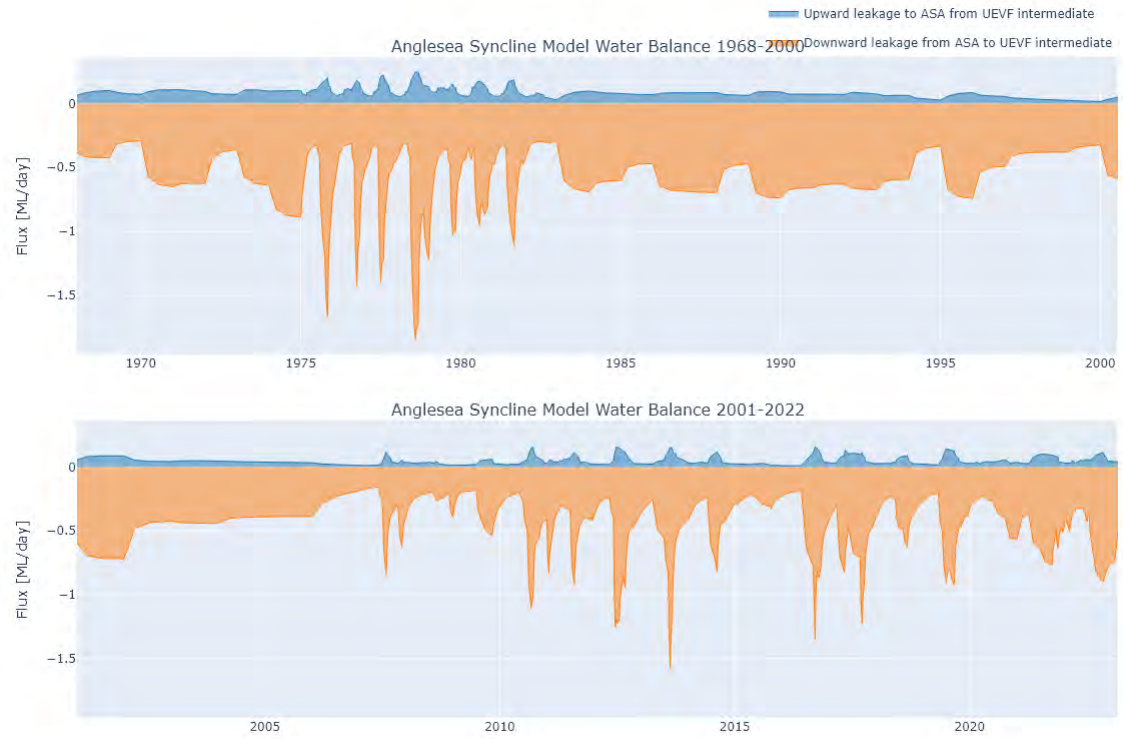
Timeseries ASA leakage per HGU, for each of the Jan Juc and Anglesea Synclines

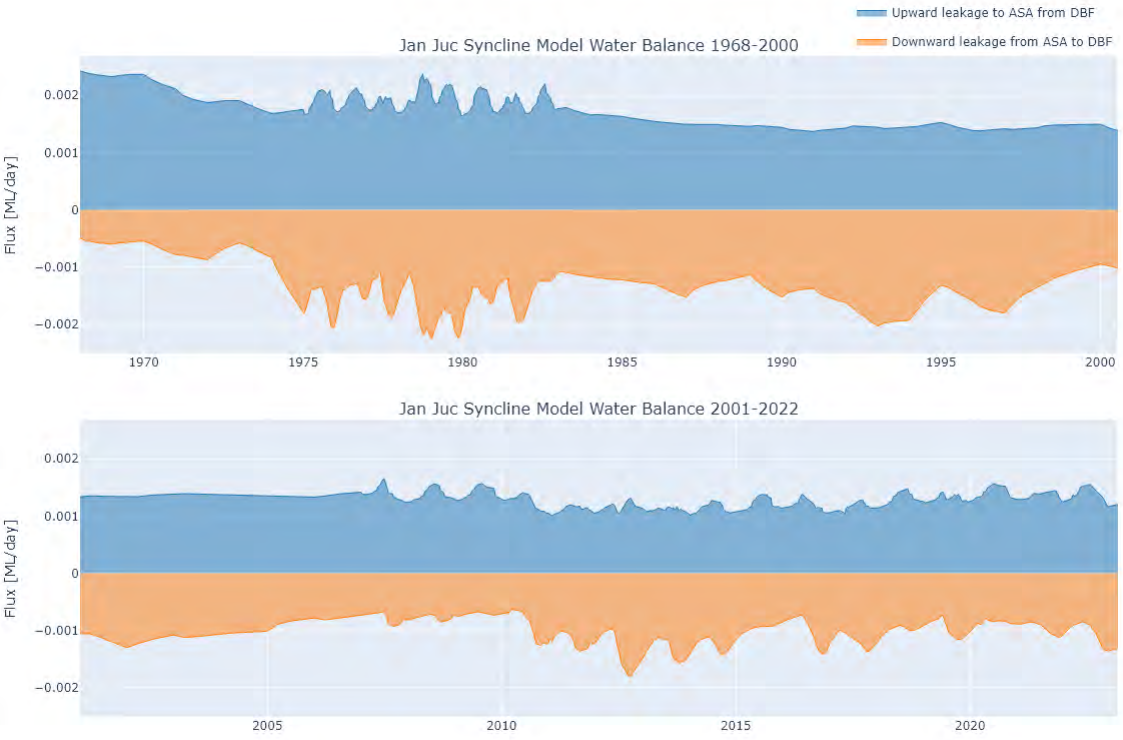


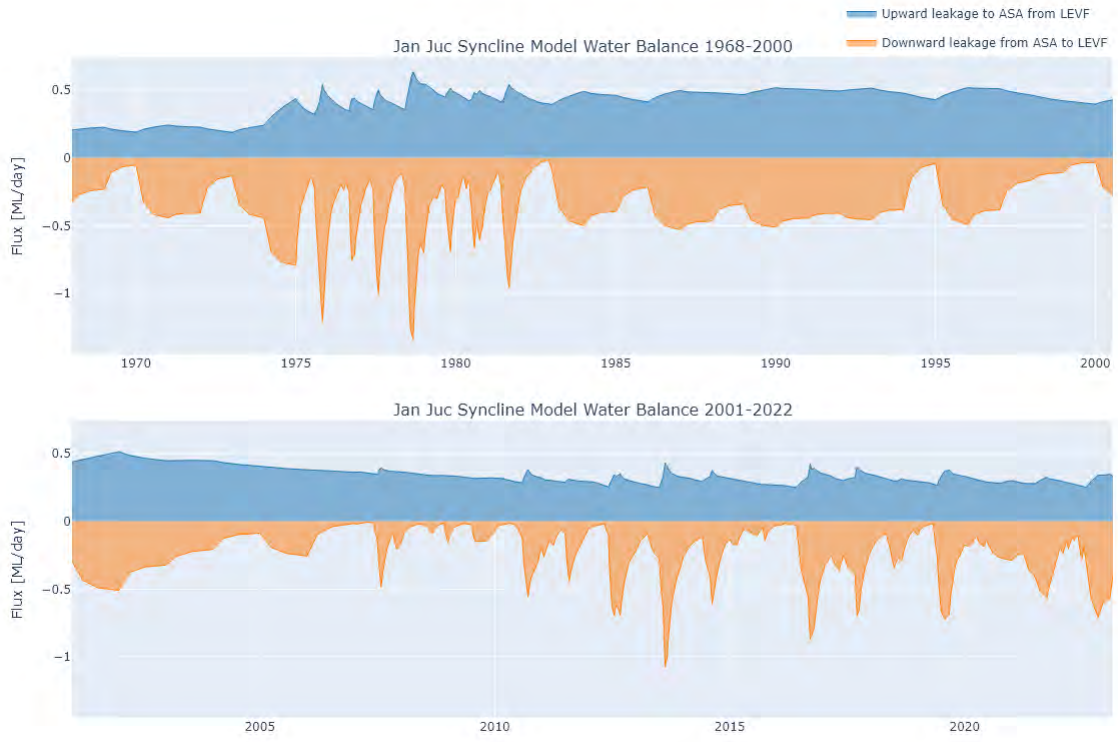


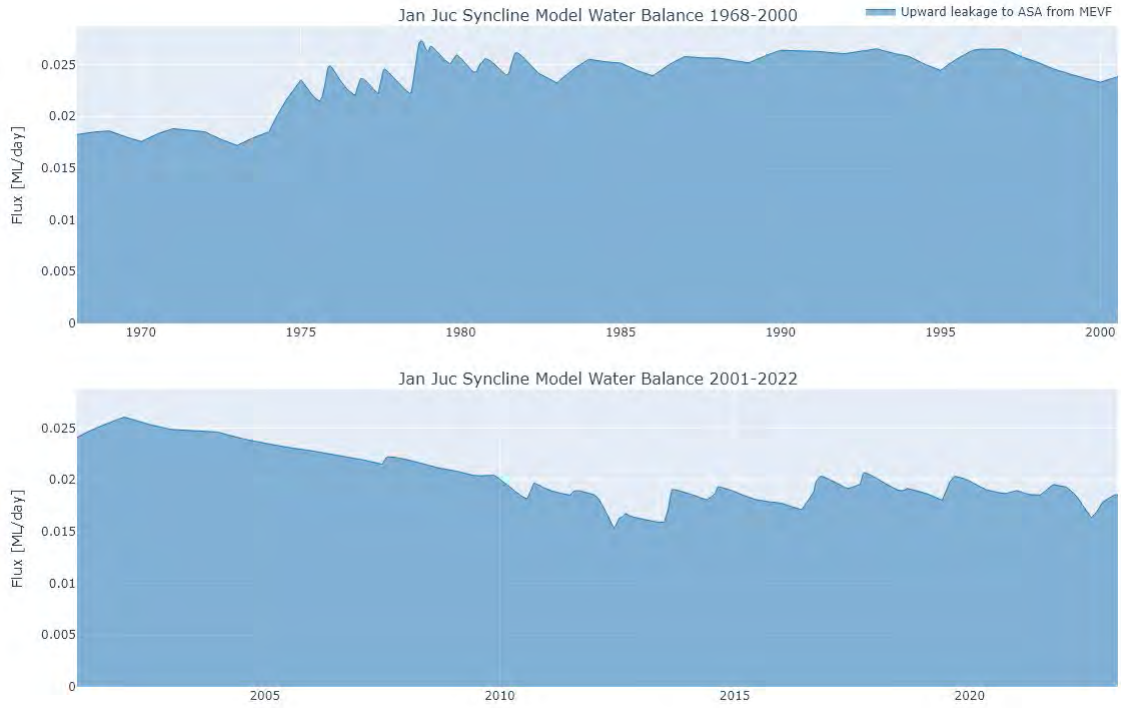

Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Anglesea Syncline Model Water Balance 1968-2000
Flux [ML/day]
0.5
0.4
0.3
0.2
0.1
0
1970
1975
1980
1985
1990
1995
2000
Anglesea Syncline Model Water Balance 2001-2022
Flux [ML/day]
0.5
0.4
0.3
0.2
0.1
0
2005
2010
2015
2020


Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Anglesea Syncline Model Water Balance 1968-2000
Flux [ML/day]
0.03
0.02
0.01
0
−0.01
−0.02
1970
1975
1980
1985
1990
1995
2000
Anglesea Syncline Model Water Balance 2001-2022
Flux [ML/day]
0.03
0.02
0.01
0
−0.01
−0.02
2005
2010
2015
2020

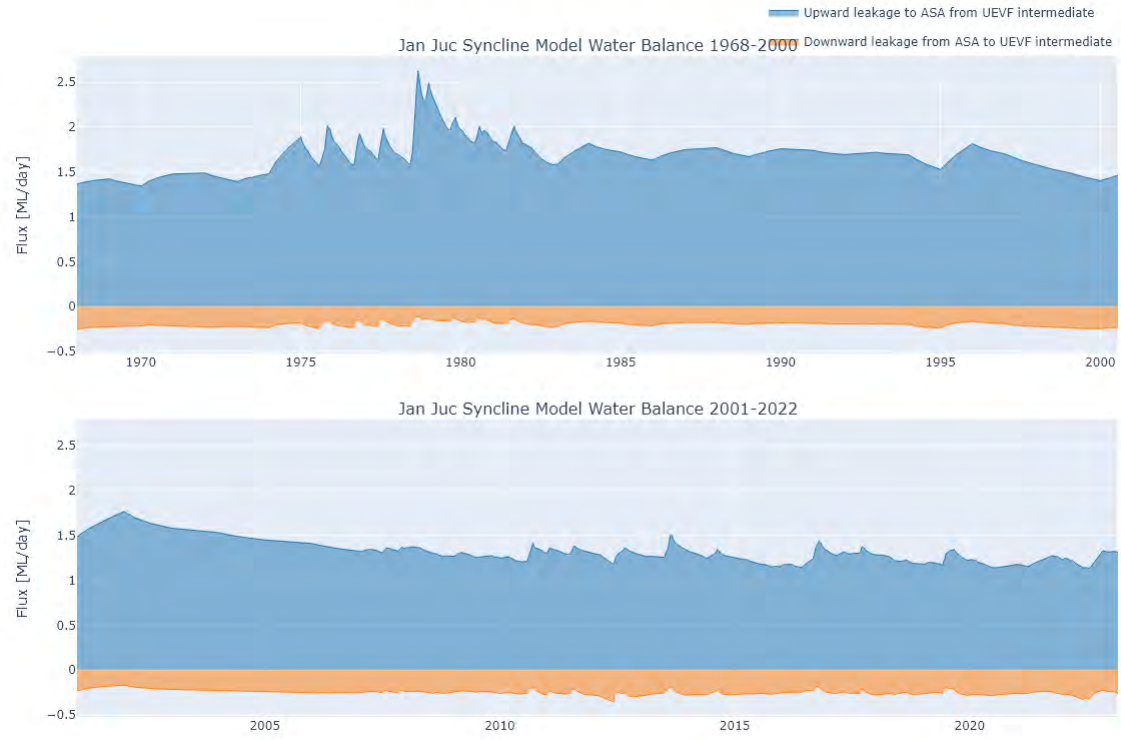

Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Anglesea Syncline Model Water Balance 1968-2000
Flux [ML/day]
0
−0.5
−1
−1.5
1970
1975
1980
1985
1990
1995
2000
Anglesea Syncline Model Water Balance 2001-2022
Flux [ML/day]
0
−0.5
−1
−1.5
2005
2010
2015
2020


Upward leakage to ASA from DBF
Downward leakage from ASA to DBF
Jan Juc Syncline Model Water Balance 1968-2000
Flux [ML/day]
0.002
0.001
0
−0.001
−0.002
1970
1975
1980
1985
1990
1995
2000
Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
0.002
0.001
0
−0.001
−0.002
2005
2010
2015
2020


Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Jan Juc Syncline Model Water Balance 1968-2000
Flux [ML/day]
0.5
0
−0.5
−1
1970
1975
1980
1985
1990
1995
2000
Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
0.5
0
−0.5
−1
2005
2010
2015
2020

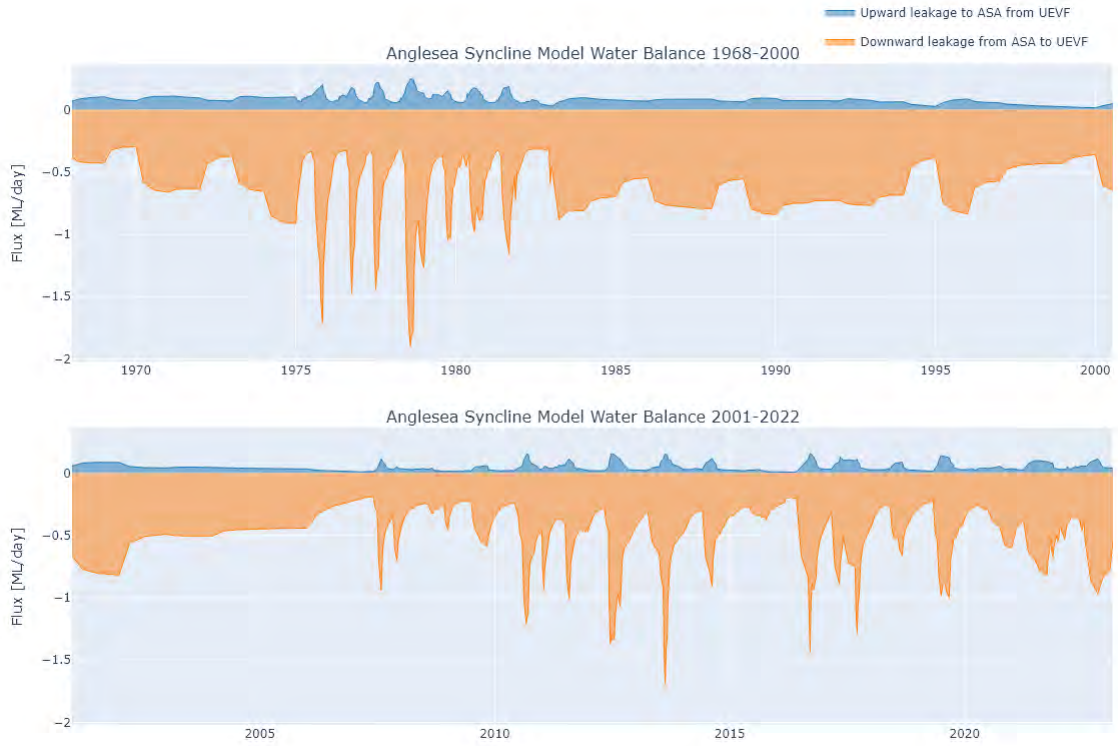

Jan Juc Syncline Model Water Balance 1968-2000
Upward leakage to ASA from MEVF
Flux [ML/day]
0.025
0.02
0.015
0.01
0.005
0
1970
1975
1980
1985
1990
1995
2000

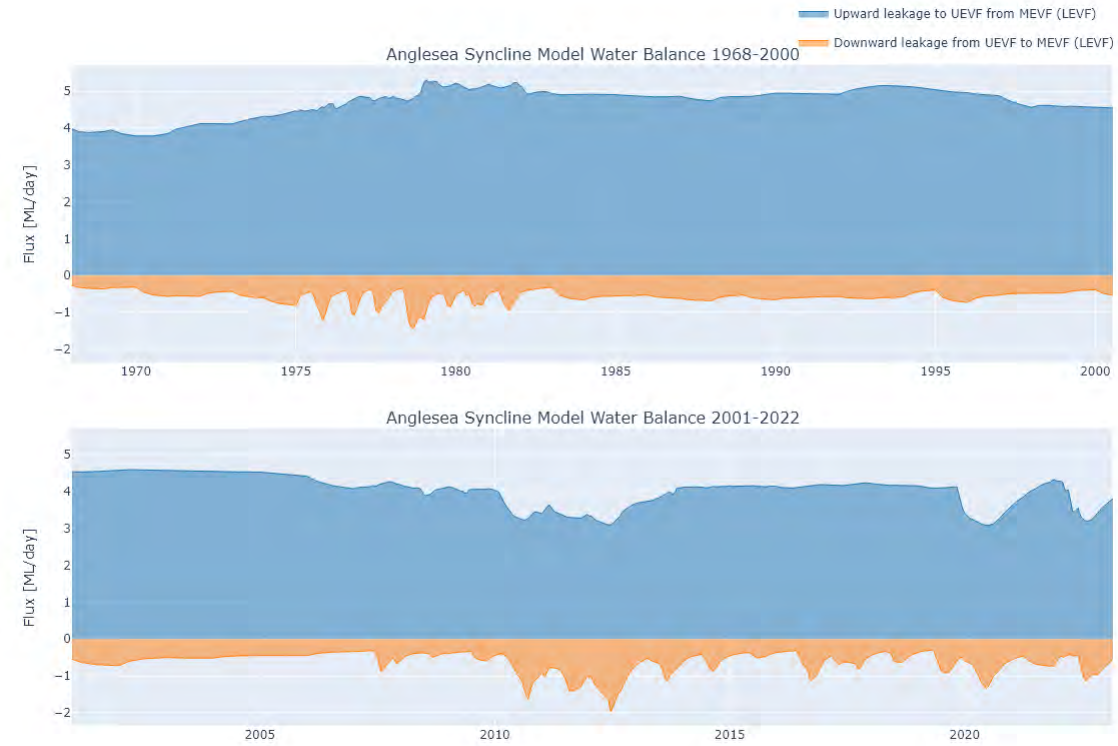
Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
0.025
0.02
0.015
0.01
0.005
0
2005
2010
2015
2020

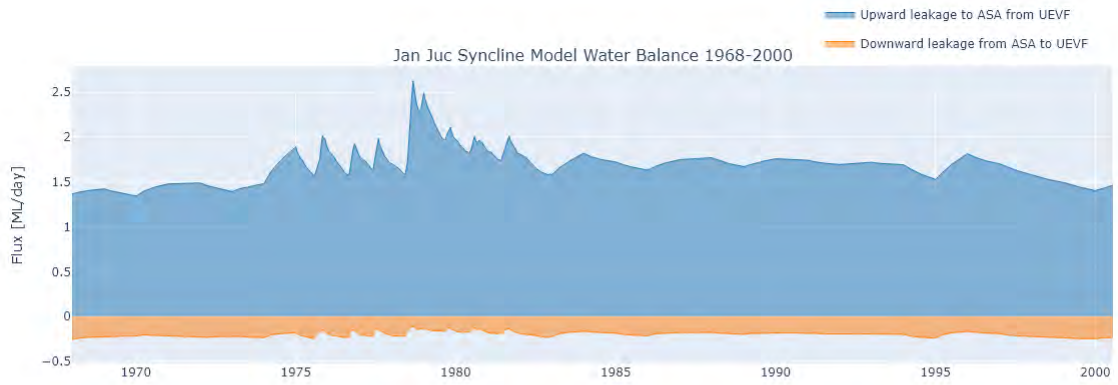

Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Jan Juc Syncline Model Water Balance 1968-2000
Flux [ML/day]
2.5
2
1.5
1
0.5
0
−0.5
1970
1975
1980
1985
1990
1995
2000

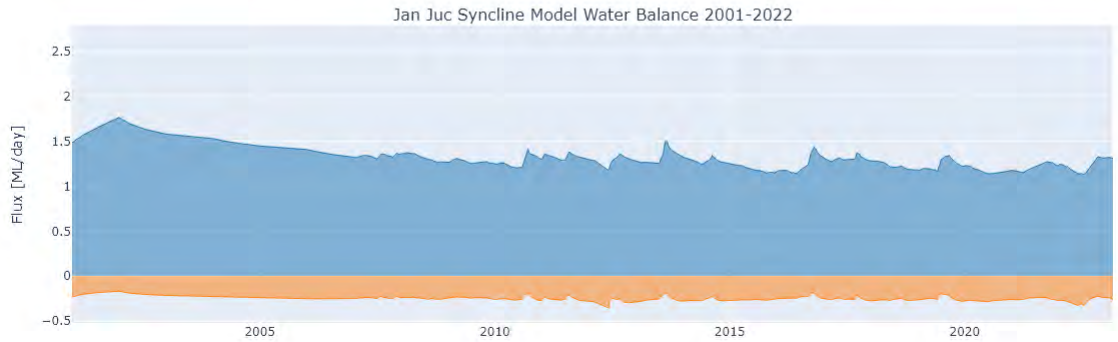
Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
2.5
2
1.5
1
0.5
0
−0.5
2005
2010
2015
2020

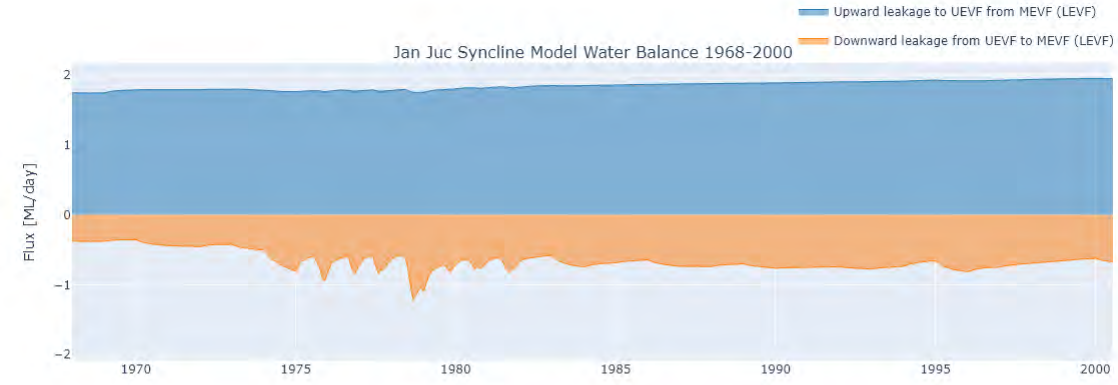
ASA-UEVF inter-aquifer flow by HGU (anglesea/jan juc synclines)

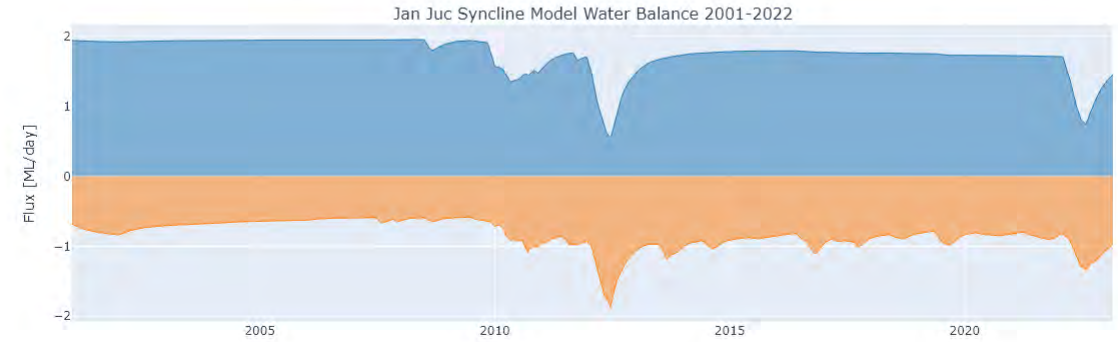




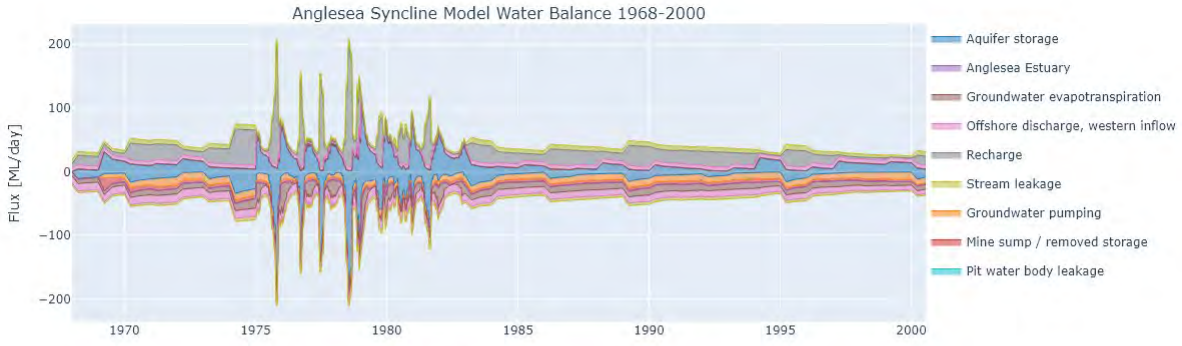

Upward leakage to ASA from UEVF
Downward leakage from ASA to UEVF
Jan Juc Syncline Model Water Balance 1968-2000
Flux [ML/day]
2.5
2
1.5
1
0.5
0
−0.5
1970
1975
1980
1985
1990
1995
2000

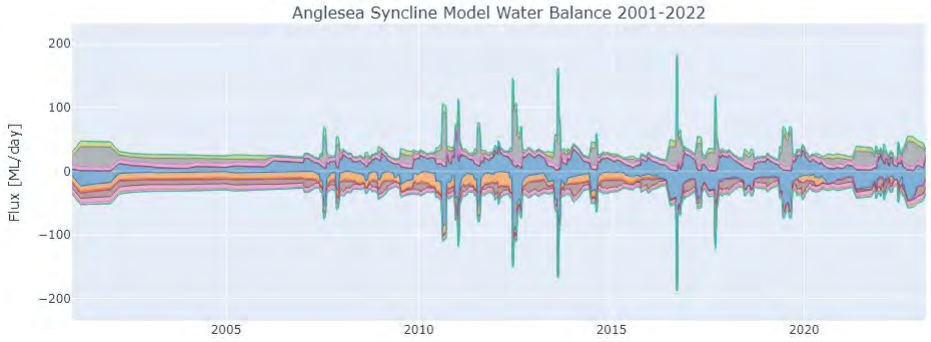

Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
2.5
2
1.5
1
0.5
0
−0.5
2005
2010
2015
2020

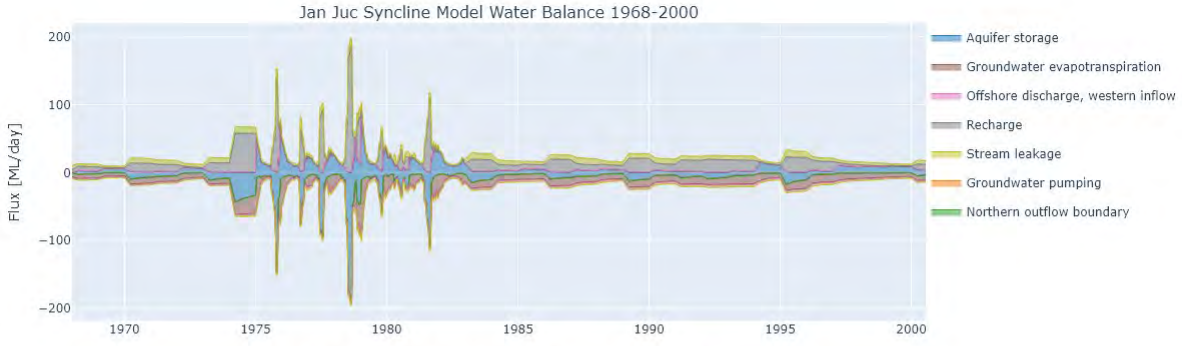

Upward leakage to UEVF from MEVF (LEVF)
Downward leakage from UEVF to MEVF (LEVF)
Jan Juc Syncline Model Water Balance 1968-2000
Flux [ML/day]
2
1
0
−1
−2
1970
1975
1980
1985
1990
1995
2000

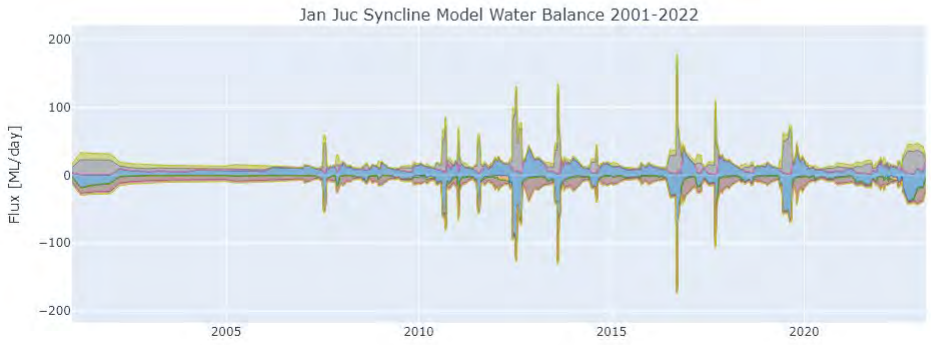

Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
2
1
0
−1
−2
2005
2010
2015
2020

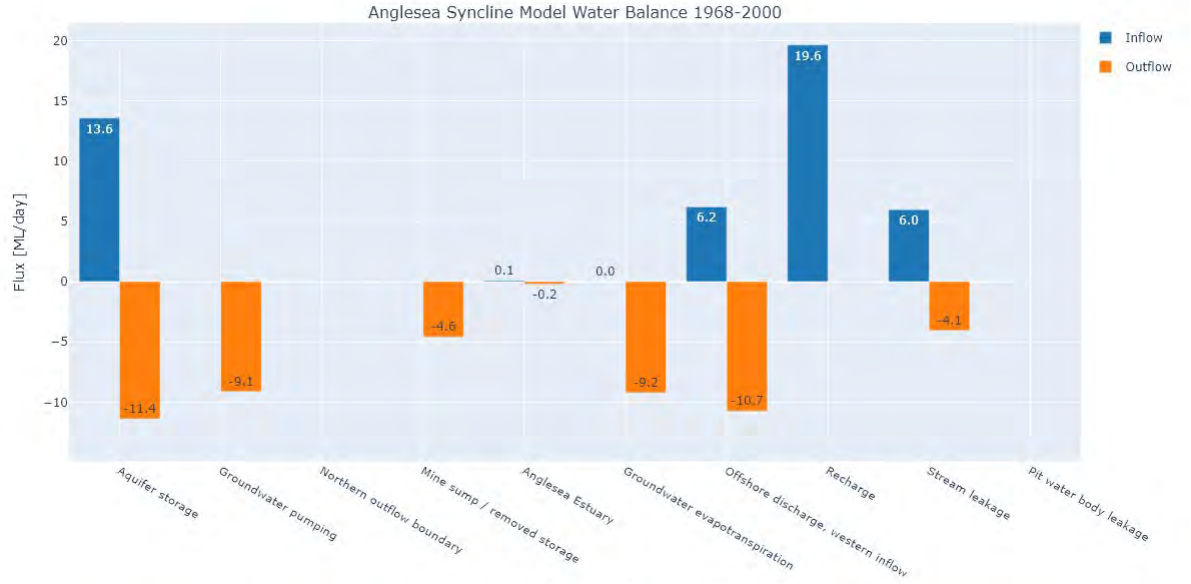
Water balance flow components for all layers as a whole (anglesea and jan juc syncline)

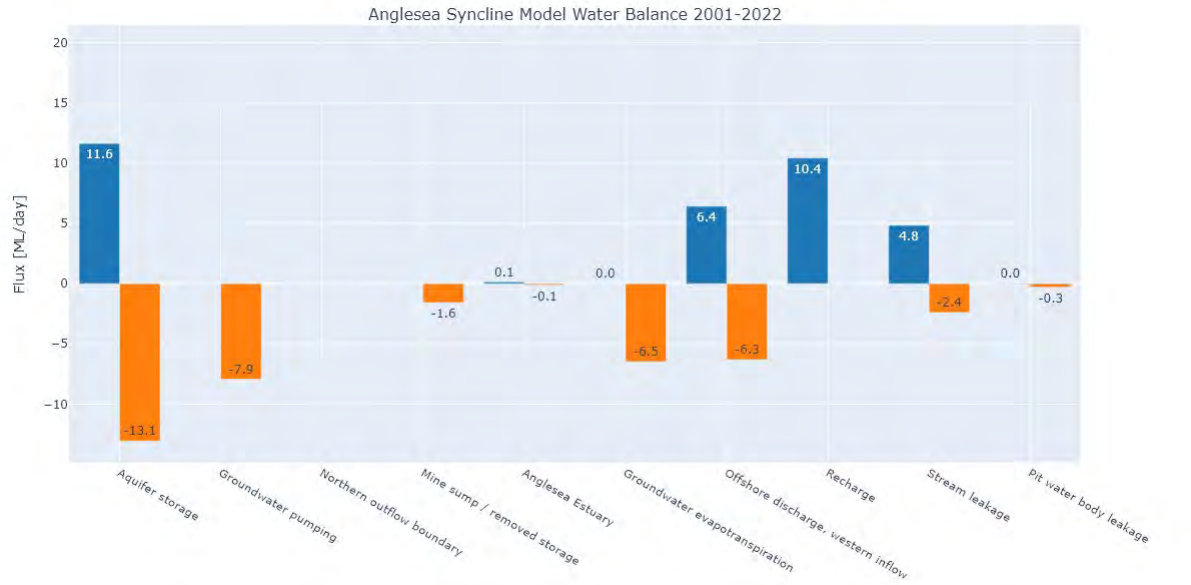


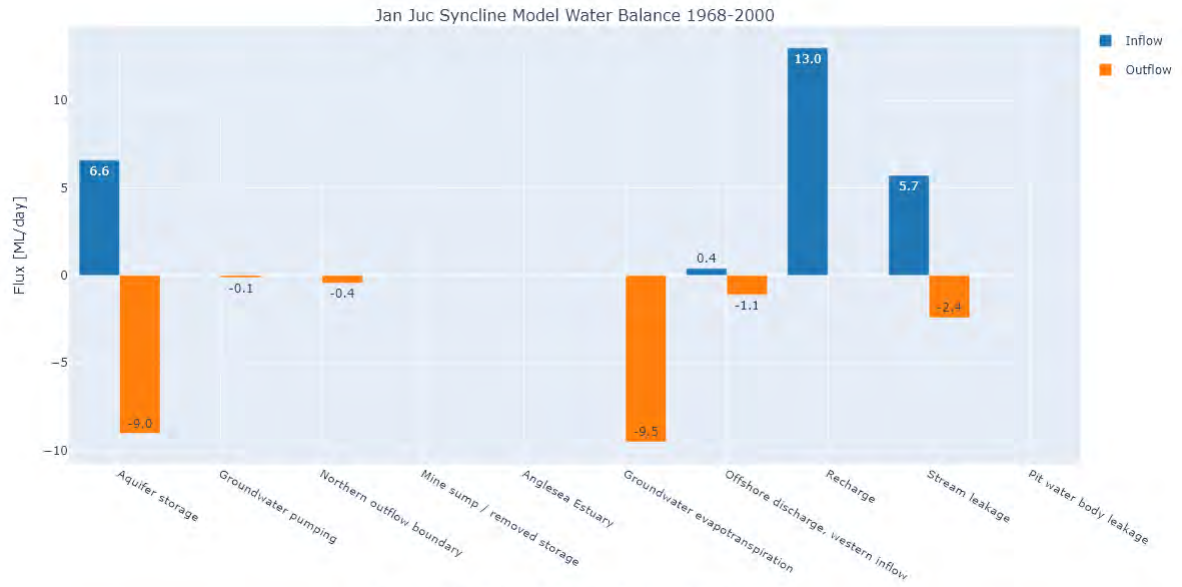


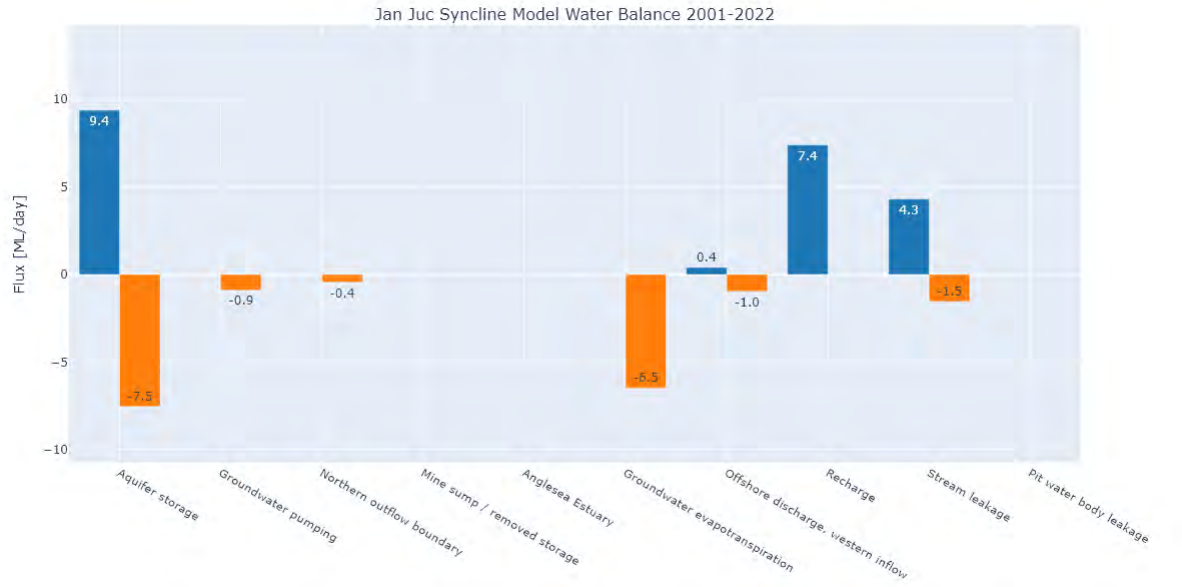




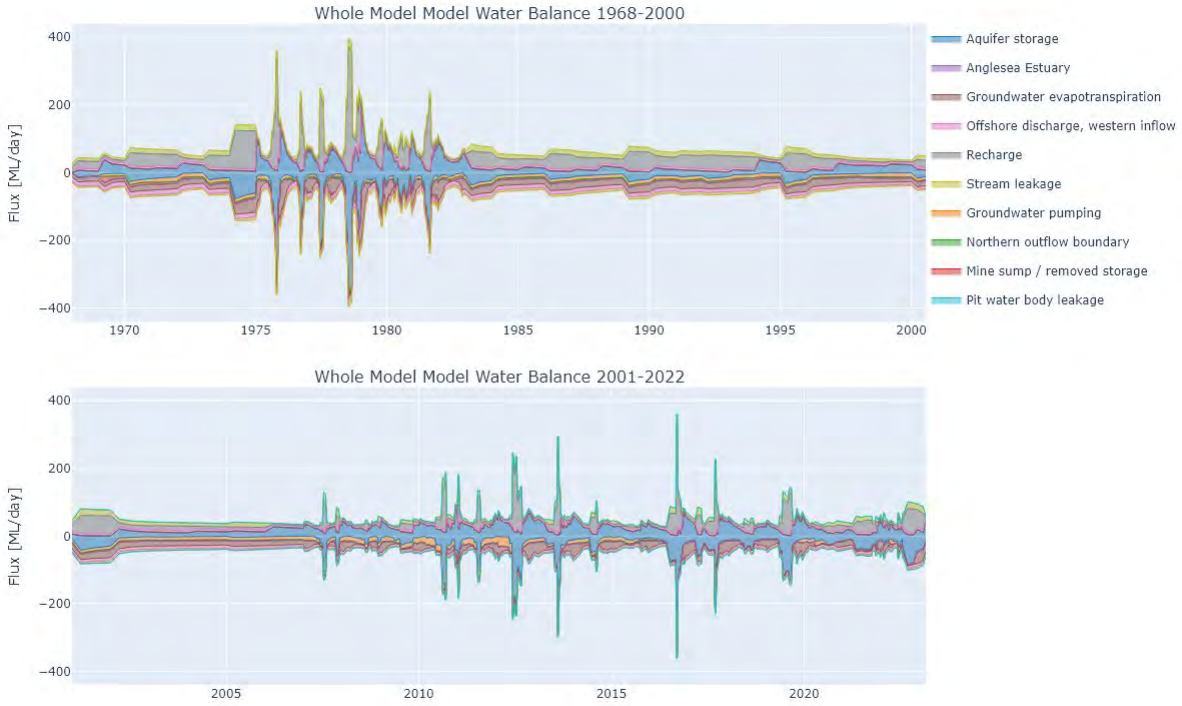

Anglesea Syncline Model Water Balance 1968-2000
Inflow
Outflow
Flux [ML/day]
20
15
10
5
0
−5
−10
13.6
-11.4
-9.1
-4.6
0.1
-0.2
0.0
-9.2
6.2
-10.7
19.6
6.0
-4.1
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

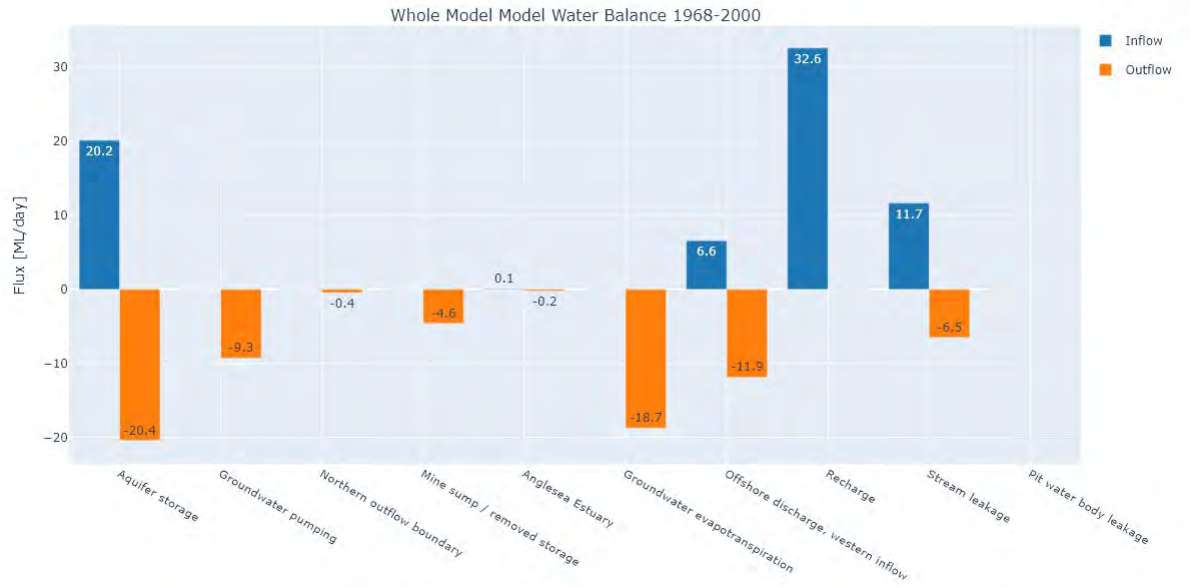

Anglesea Syncline Model Water Balance 2001-2022
Flux [ML/day]
20
15
10
5
0
−5
−10
11.6
-13.1
-7.9
-1.6
0.1
-0.1
0.0
-6.5
6.4
-6.3
10.4
4.8
-2.4
0.0
-0.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

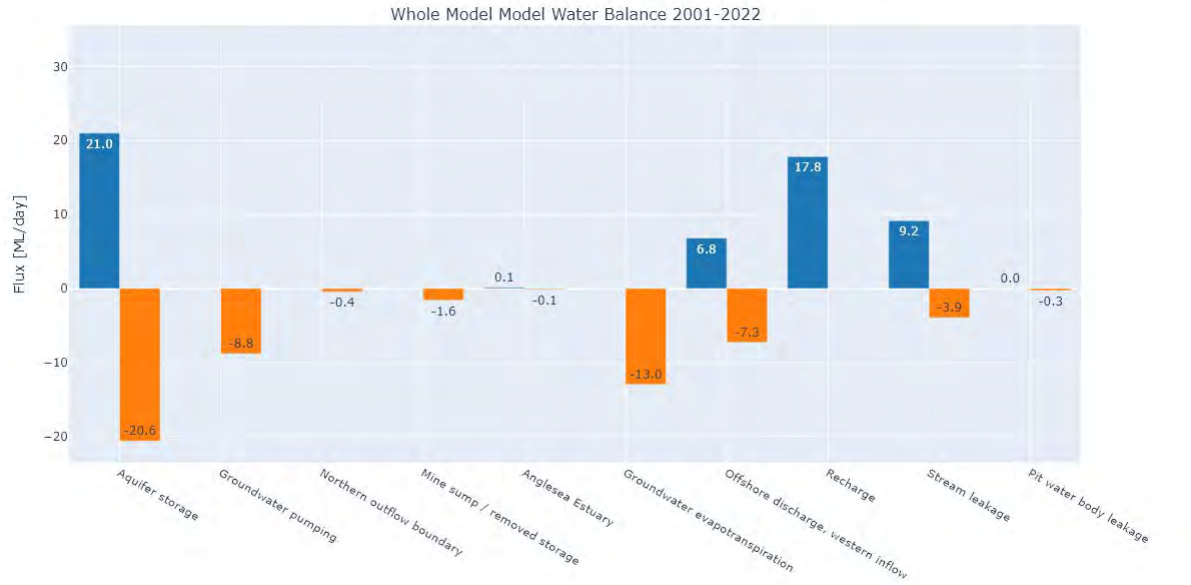

Jan Juc Syncline Model Water Balance 1968-2000
Inflow
Outflow
Flux [ML/day]
10
5
0
−5
−10
6.6
-9.0
-0.1
-0.4
-9.5
0.4
-1.1
13.0
5.7
-2.4
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage


Jan Juc Syncline Model Water Balance 2001-2022
Flux [ML/day]
10
5
0
−5
−10
9.4
-7.5
-0.9
-0.4
-6.5
0.4
-1.0
7.4
4.3
-1.5
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

Water balance flow components for all layers as a whole (over full model domain)

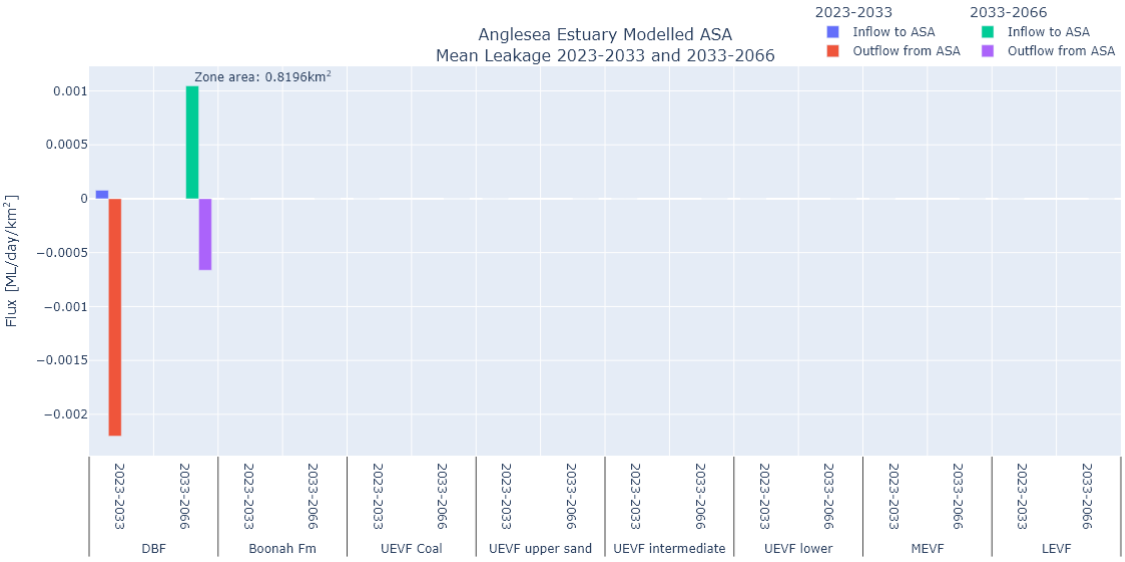


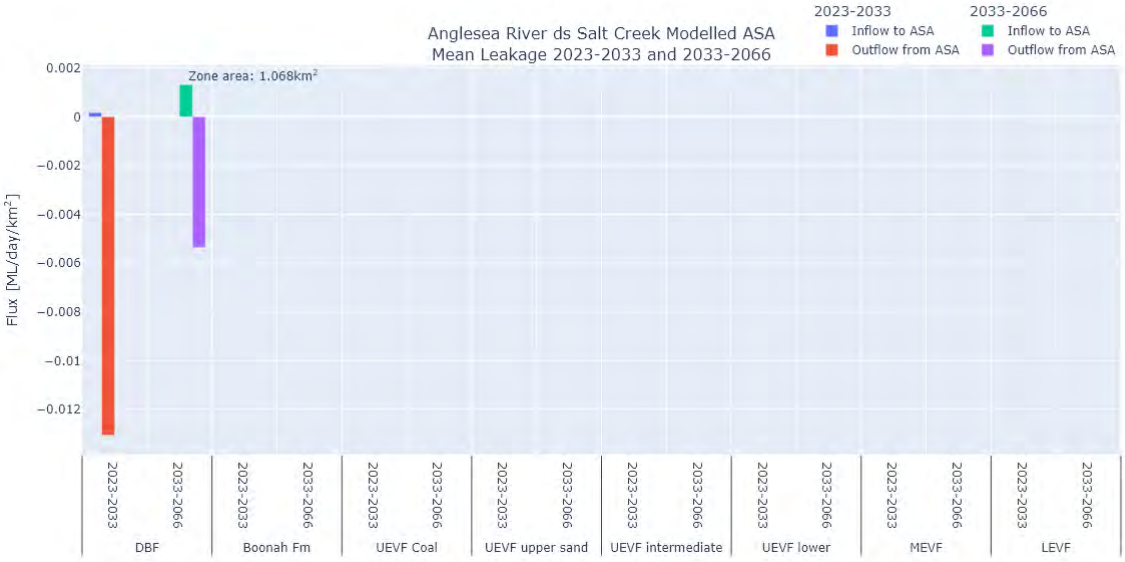

Whole Model Model Water Balance 1968-2000
Inflow
Outflow
Flux [ML/day]
30
20
10
0
−10
−20
20.2
-20.4
-9.3
-0.4
-4.6
0.1
-0.2
-18.7
6.6
-11.9
32.6
11.7
-6.5
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

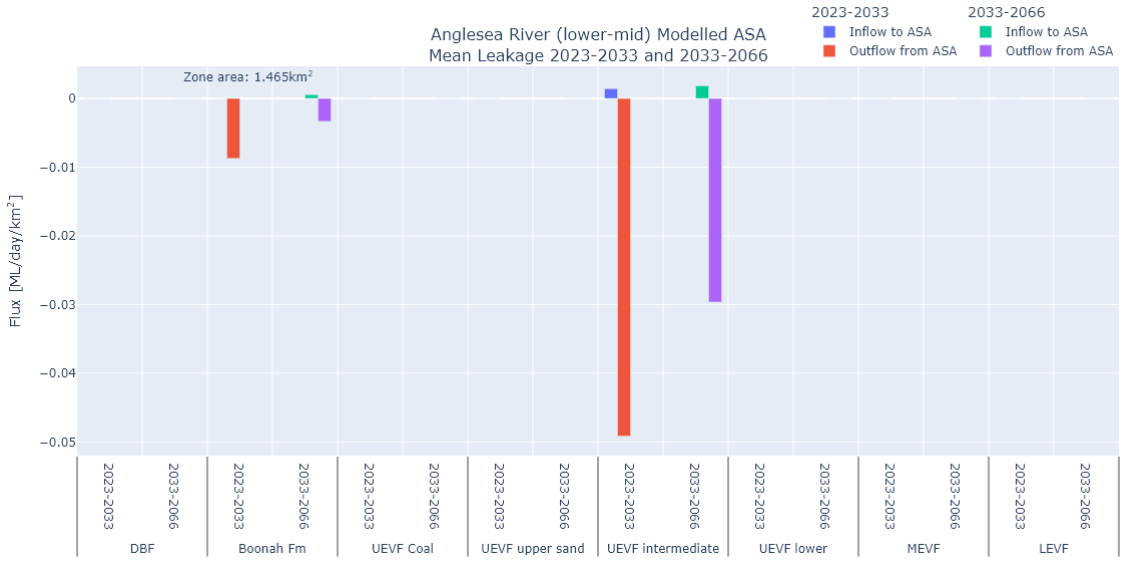

Whole Model Model Water Balance 2001-2022
Flux [ML/day]
30
20
10
0
−10
−20
21.0
-20.6
-8.8
-0.4
-1.6
0.1
-0.1
-13.0
6.8
-7.3
17.8
9.2
-3.9
0.0
-0.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

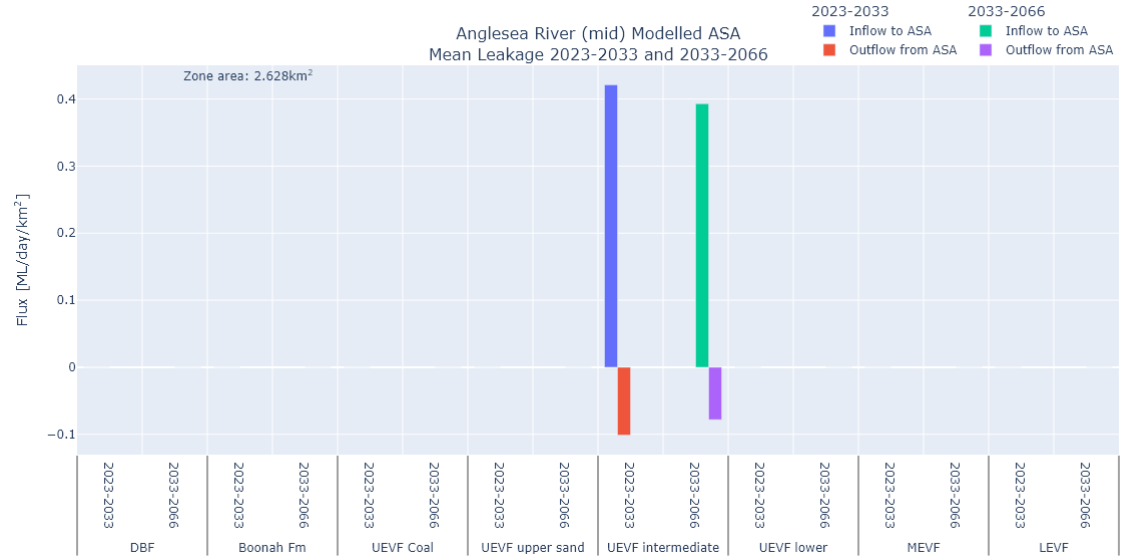
Appendix F5 Numerical Modelling Outputs (Water balances for Medium climate change; Barwon Water pumping 7GL/year for 5 years, then off for 5 years; No Alcoa pumping)

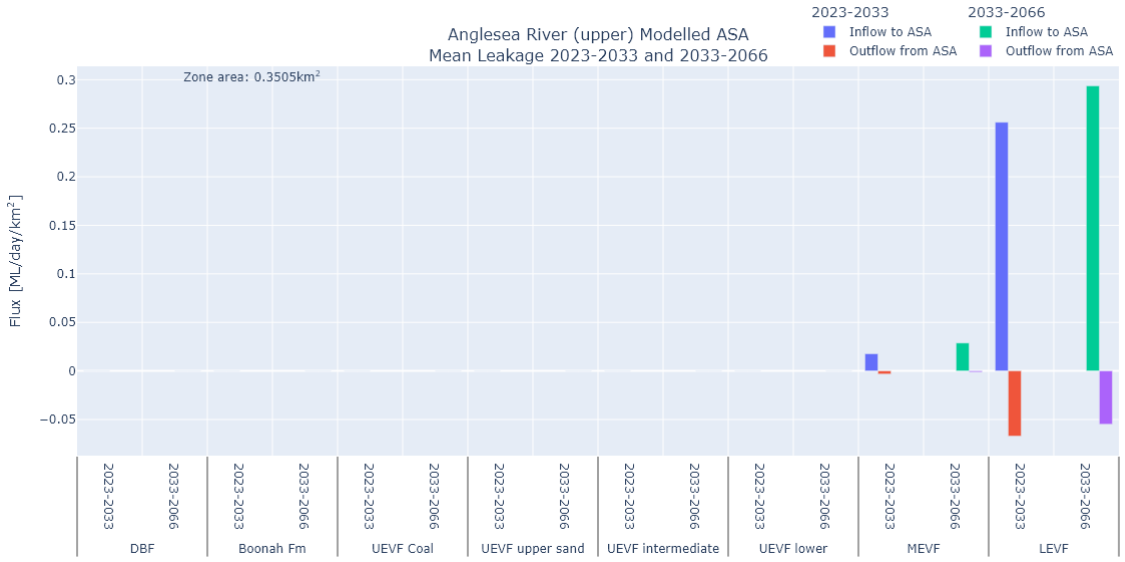
Mean ASA leakage to the various underlying HGUs for specified stream reaches (one plot each)
UNITS: ML/day/km2 (unit area)

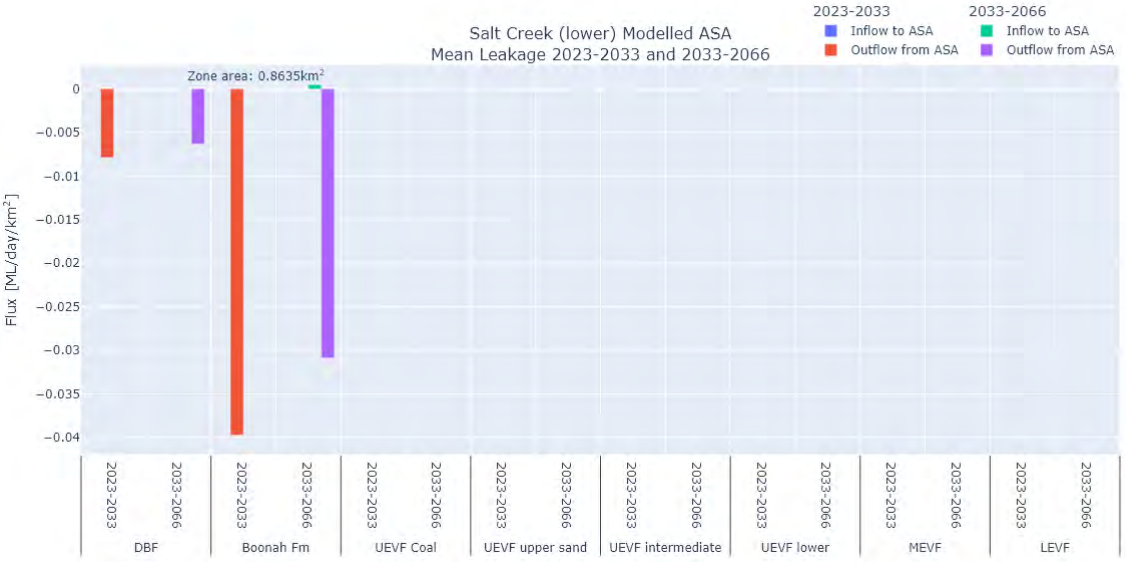


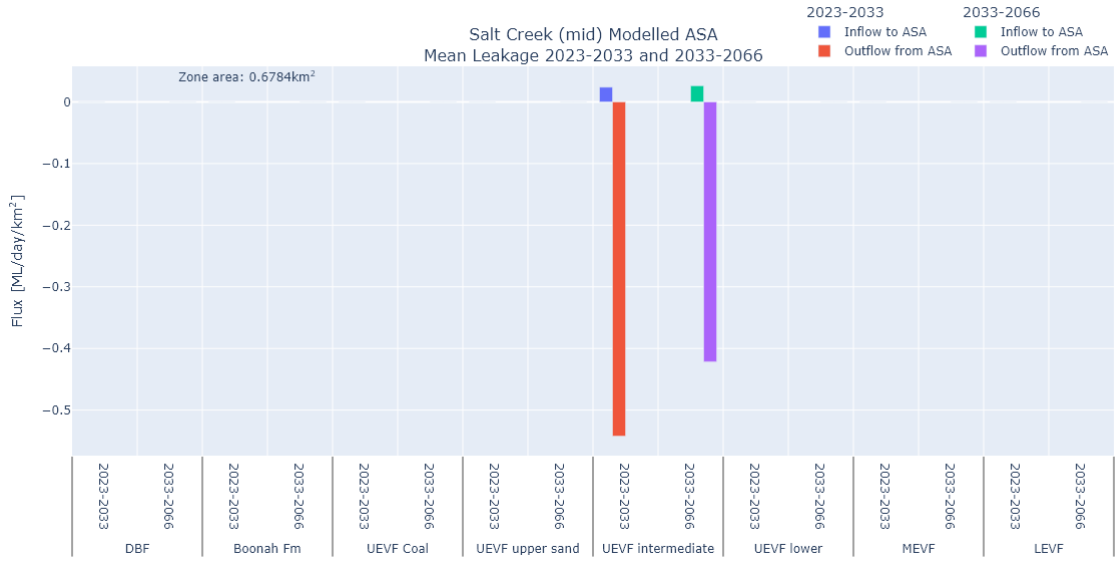


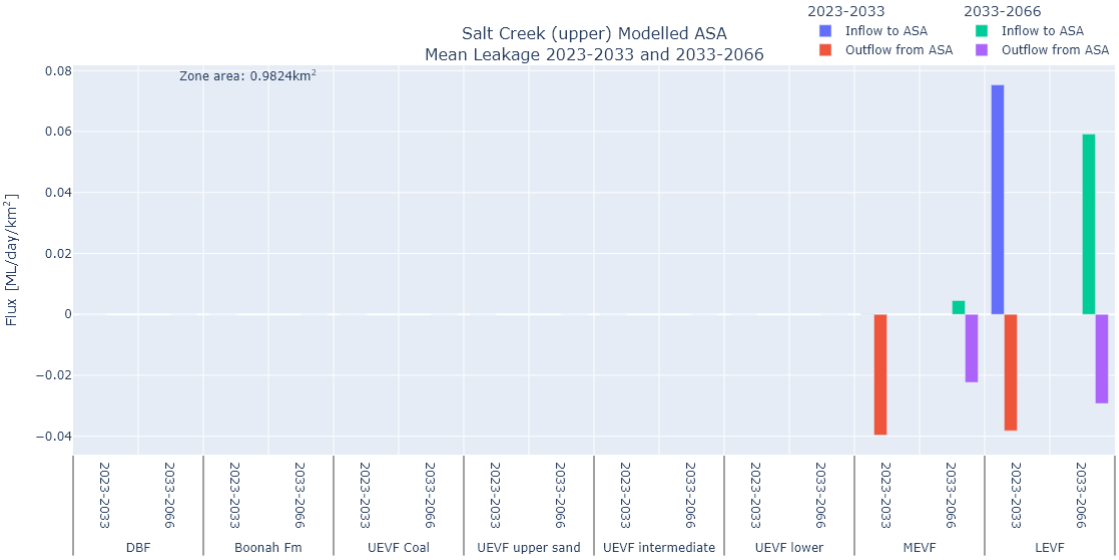

Anglesea River (lower-mid) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

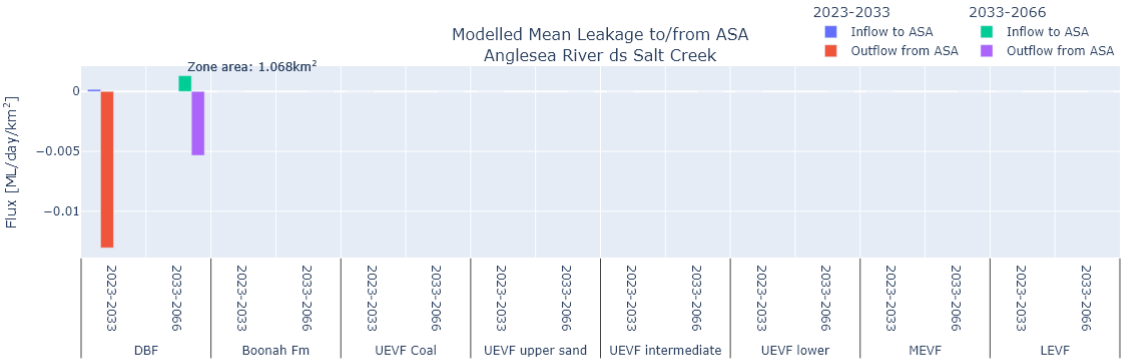

Anglesea River (mid) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 2.628km²
Flux [ML/day/km²]
0.4
0.3
0.2
0.1
0
−0.1
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

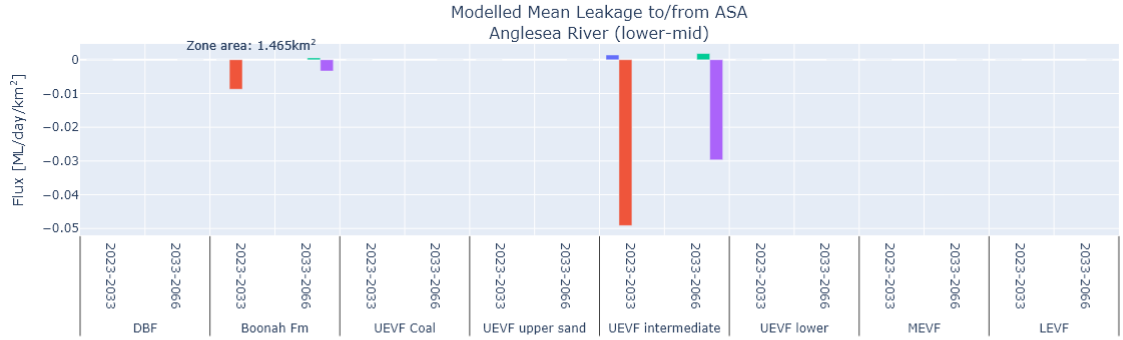

Anglesea River (upper) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.3505km²
Flux [ML/day/km²]
0.3
0.25
0.2
0.15
0.1
0.05
0
−0.05
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

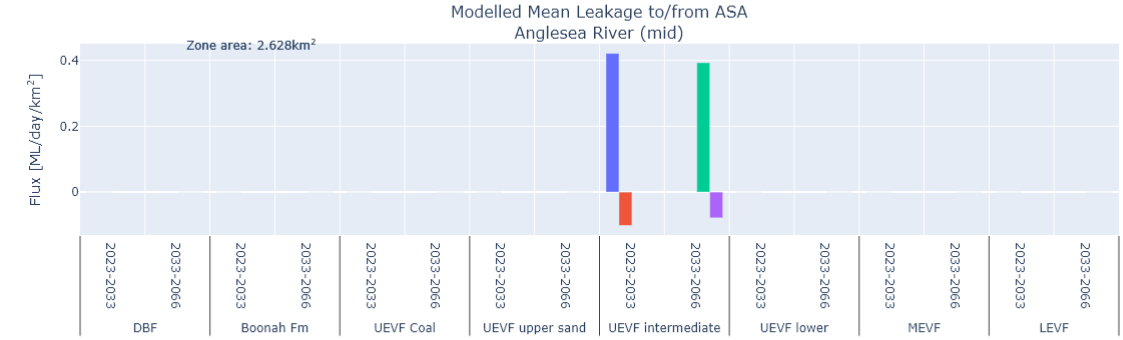

Salt Creek (lower) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
−0.03
−0.035
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

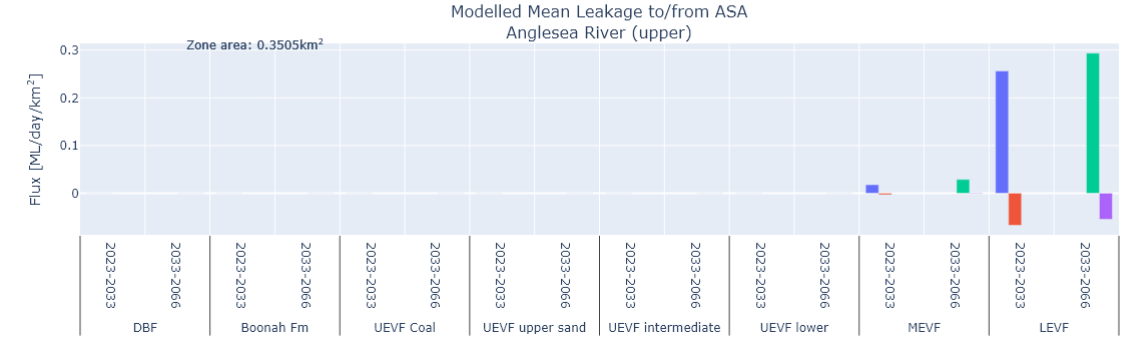

Salt Creek (mid) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.1
−0.2
−0.3
−0.4
−0.5
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

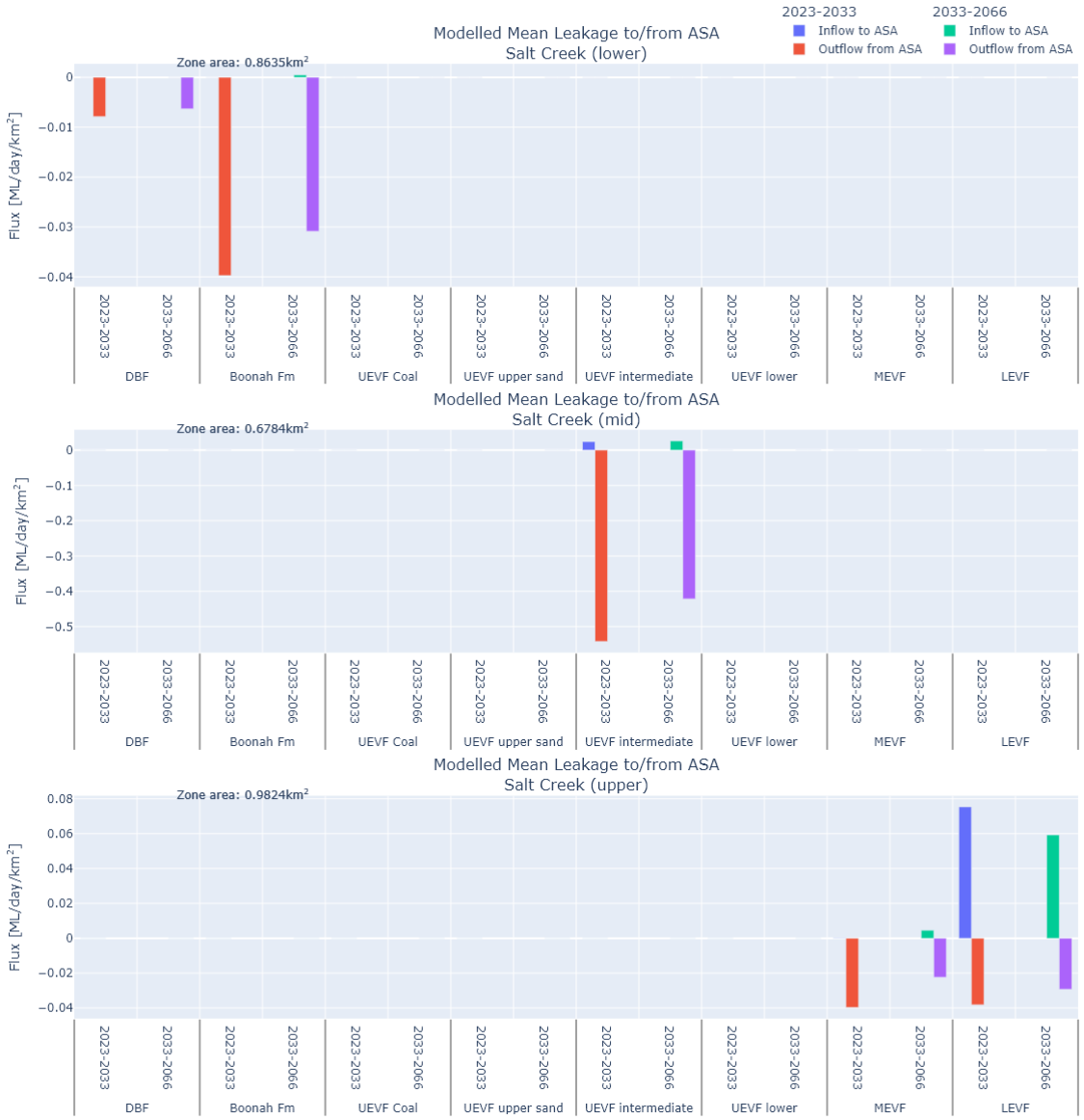

Salt Creek (upper) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.9824km²
Flux [ML/day/km²]
0.08
0.06
0.04
0.02
0
−0.02
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF


Modelled Mean Leakage to/from ASA
Anglesea River ds Salt Creek
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 1.068km²
Flux [ML/day/km²]
0
−0.005
−0.01
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

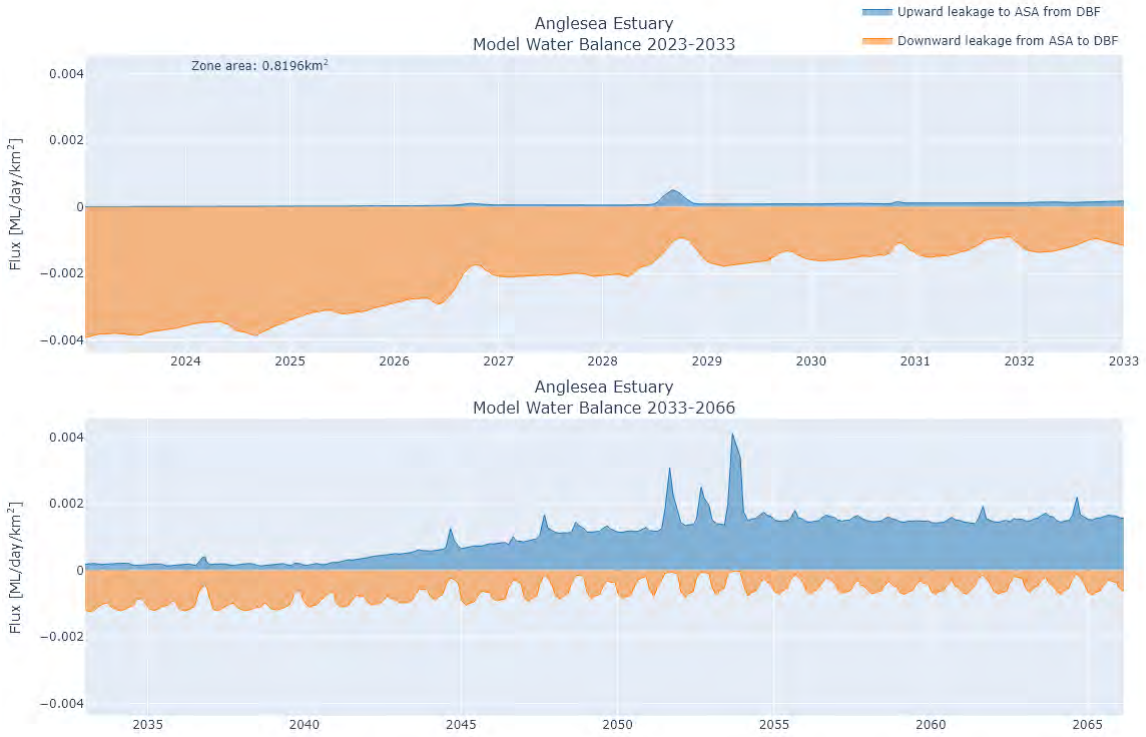

Modelled Mean Leakage to/from ASA
Anglesea River (lower-mid)
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

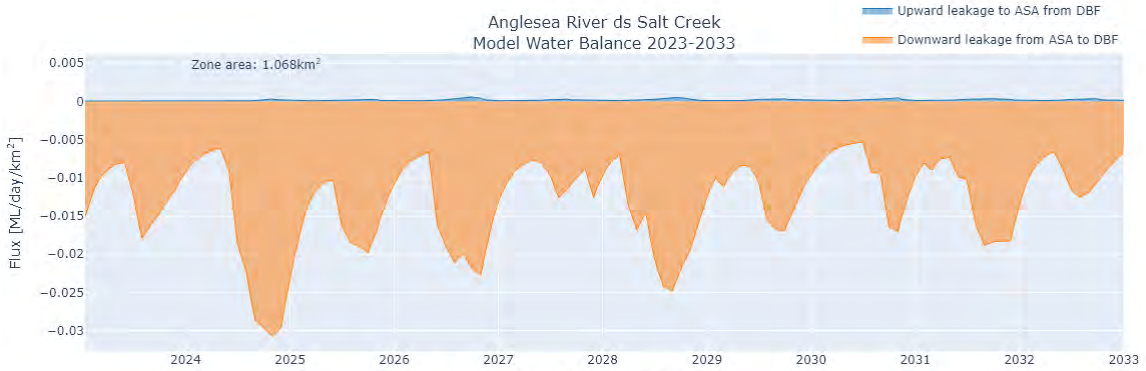

Modelled Mean Leakage to/from ASA
Anglesea River (mid)
Zone area: 2.628km²
Flux [ML/day/km²]
0.4
0.2
0
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

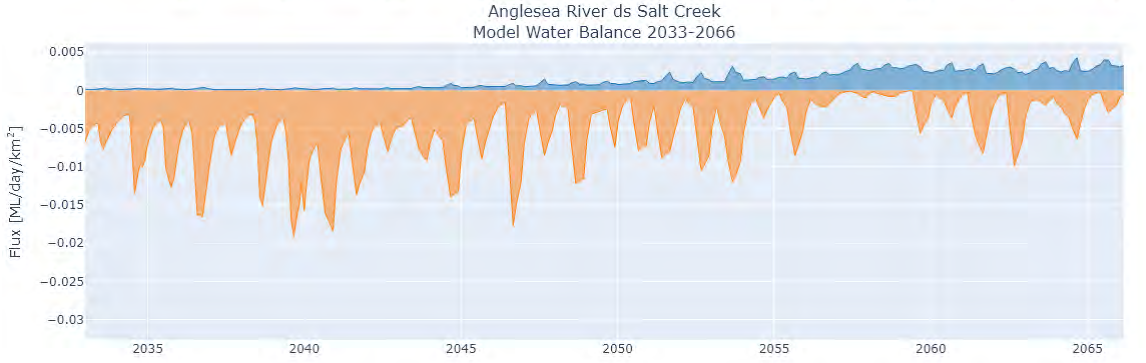

Modelled Mean Leakage to/from ASA
Anglesea River (upper)
Zone area: 0.3505km²
Flux [ML/day/km²]
0.3
0.2
0.1
0
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

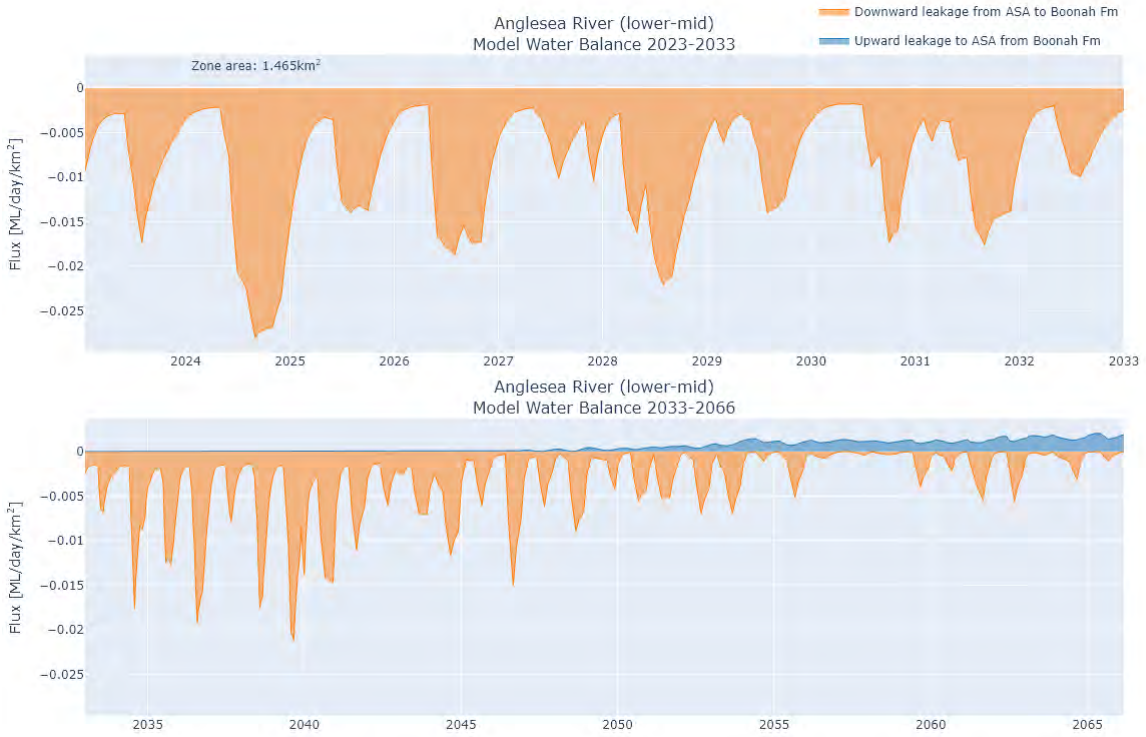

Modelled Mean Leakage to/from ASA
Salt Creek (lower)
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF
Modelled Mean Leakage to/from ASA
Salt Creek (mid)
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.1
−0.2
−0.3
−0.4
−0.5
Modelled Mean Leakage to/from ASA
Salt Creek (upper)
Zone area: 0.9824km²
Flux [ML/day/km²]
0.08
0.06
0.04
0.02
0
−0.02
−0.04

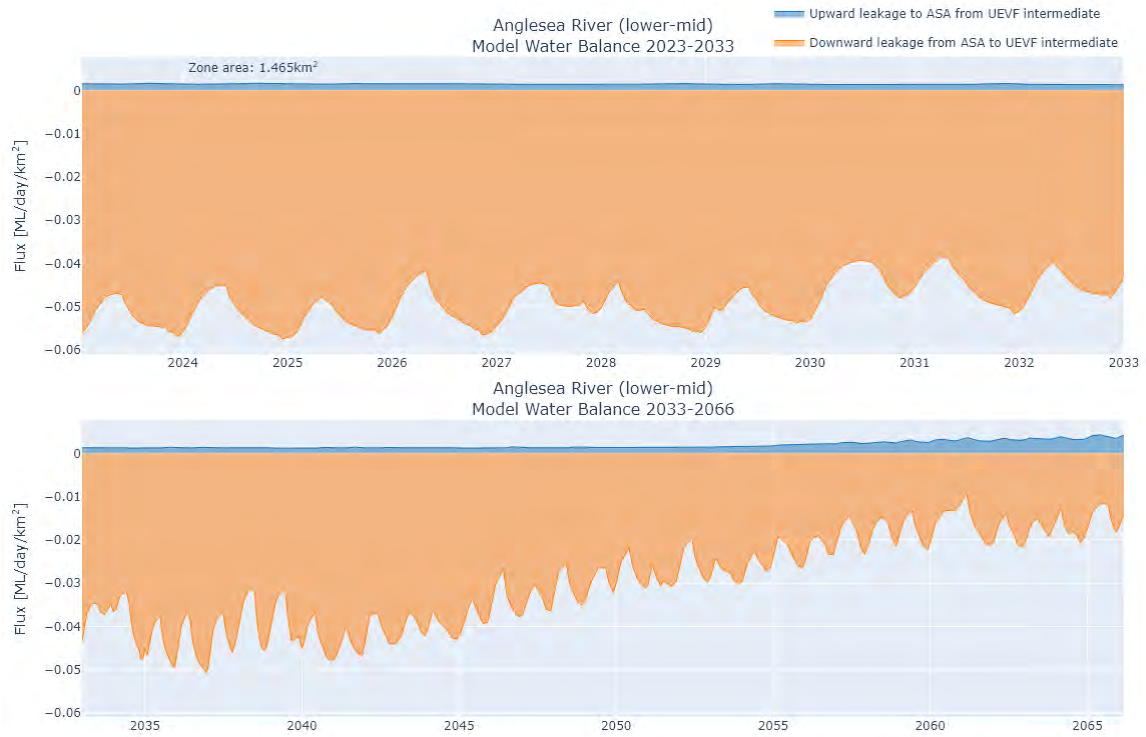
Timeseries ASA leakage to the various underlying HGUs for specified stream reaches (one plot each)

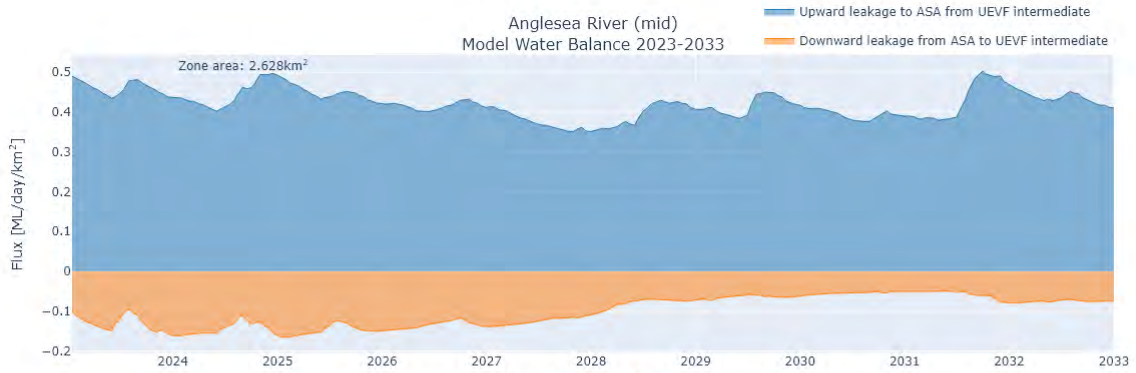


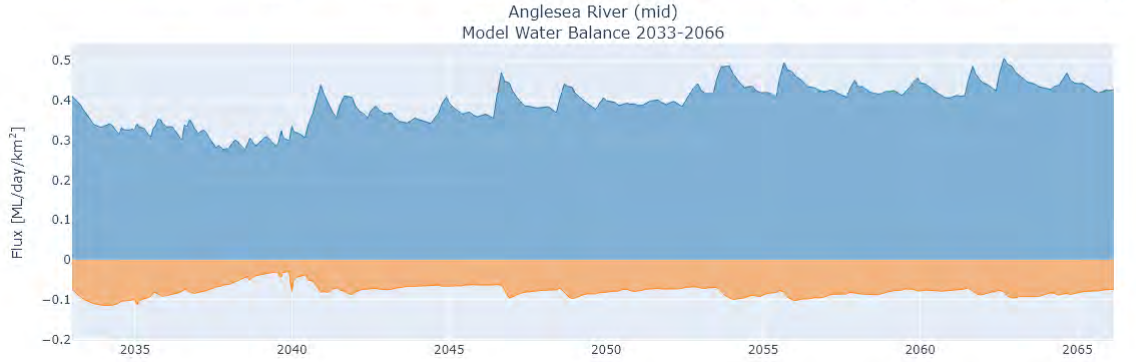


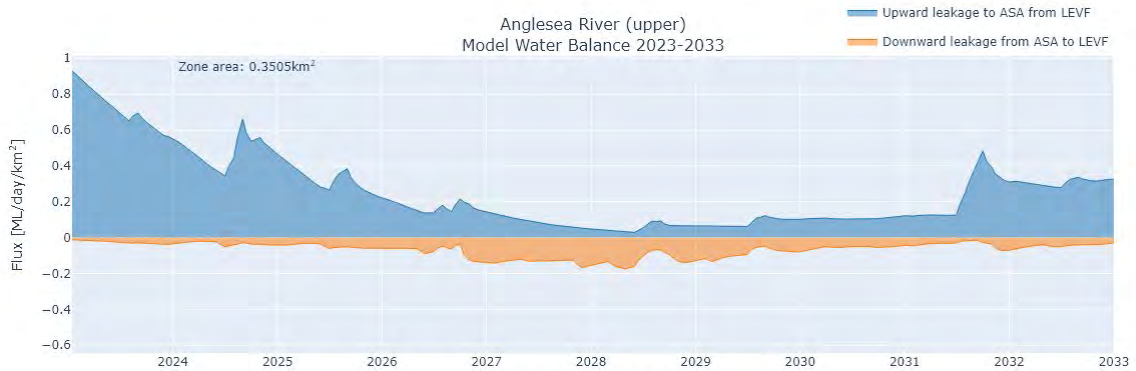


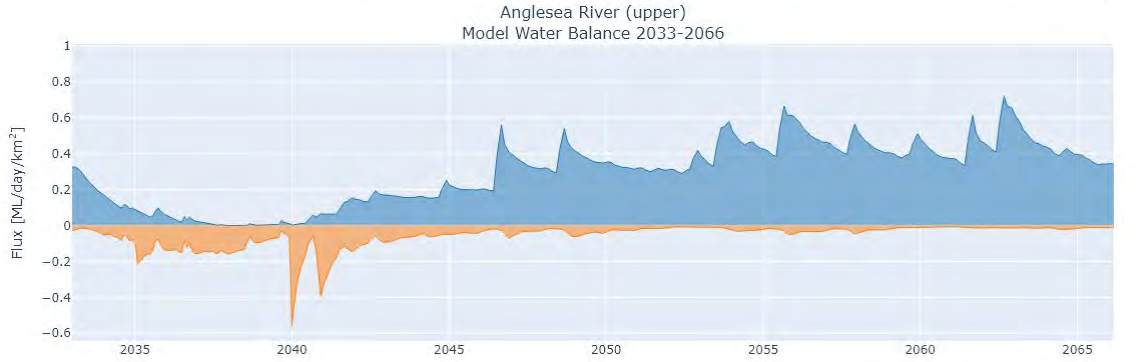

Anglesea River (lower-mid)
Model Water Balance 2023-2033
Downward leakage from ASA to Boonah Fm
Upward leakage to ASA from Boonah Fm
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Anglesea River (lower-mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
2035
2040
2045
2050
2055
2060
2065

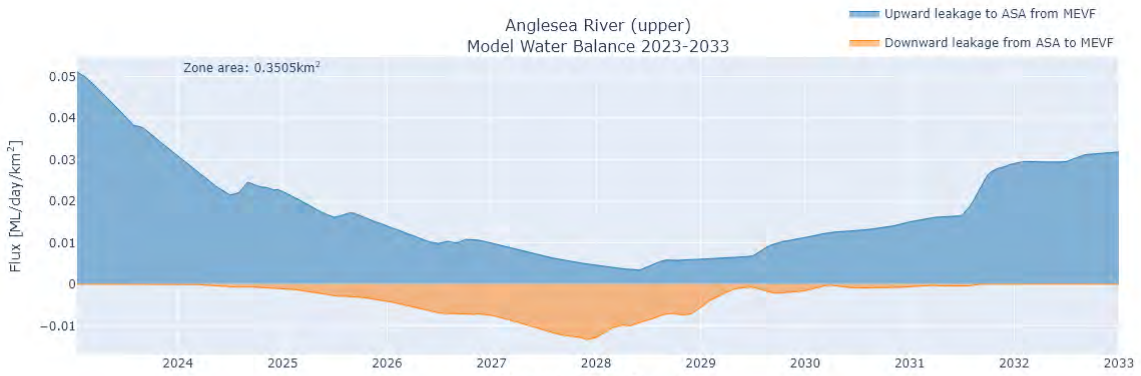

Anglesea River (lower-mid)
Model Water Balance 2023-2033
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Anglesea River (lower-mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
2035
2040
2045
2050
2055
2060
2065

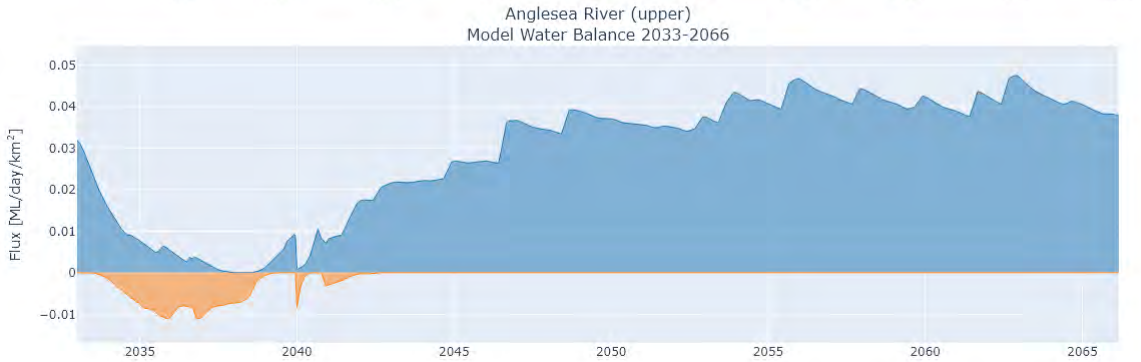

Anglesea River (mid)
Model Water Balance 2023-2033
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 2.628km²
Flux [ML/day/km²]
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

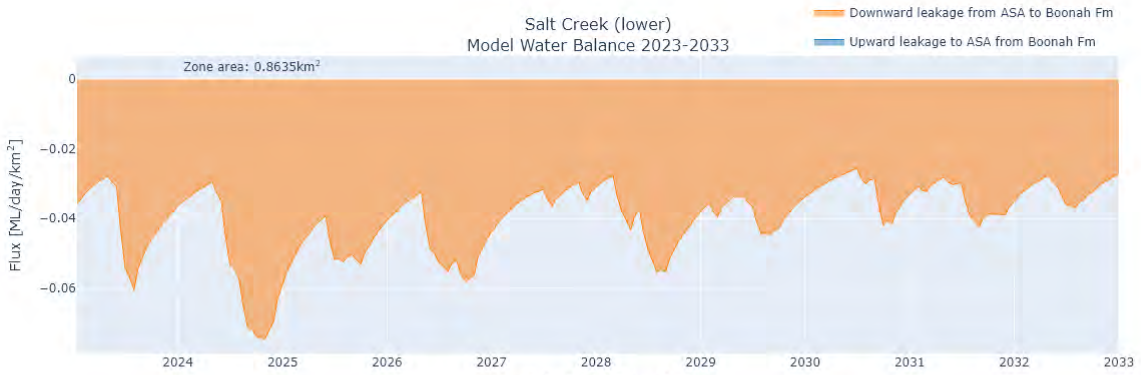

Anglesea River (mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
2035
2040
2045
2050
2055
2060
2065

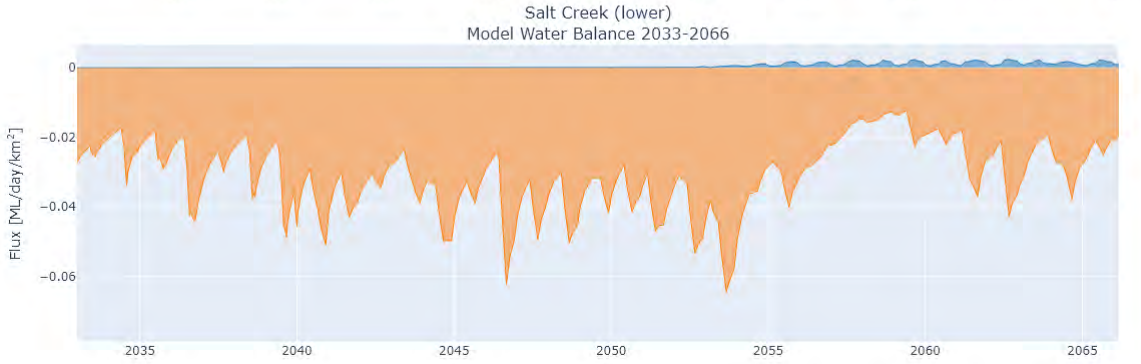

Anglesea River (upper)
Model Water Balance 2023-2033
Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Zone area: 0.3505km²
Flux [ML/day/km²]
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

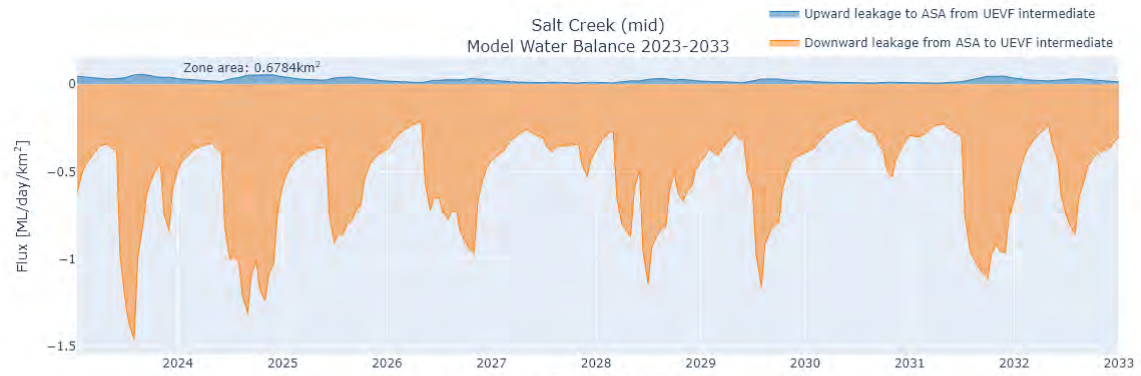

Anglesea River (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
2035
2040
2045
2050
2055
2060
2065

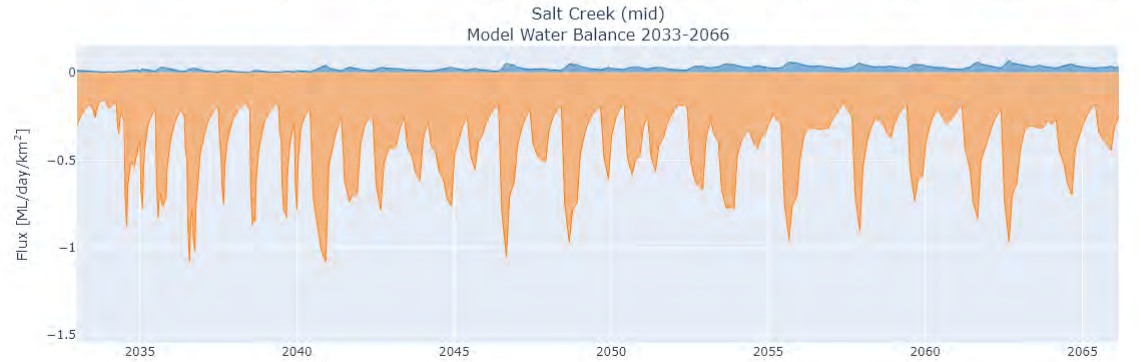

Anglesea River (upper)
Model Water Balance 2023-2033
Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Zone area: 0.3505km²
Flux [ML/day/km²]
0.05
0.04
0.03
0.02
0.01
0
−0.01
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

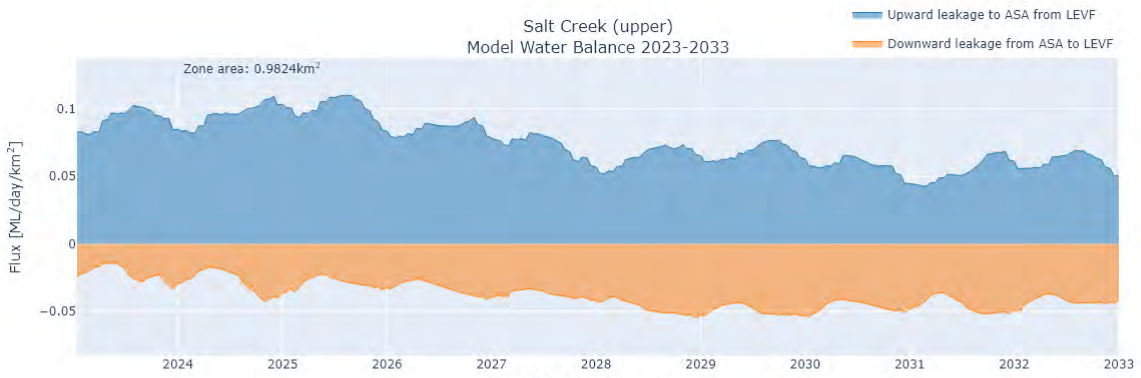

Anglesea River (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.05
0.04
0.03
0.02
0.01
0
−0.01
2035
2040
2045
2050
2055
2060
2065

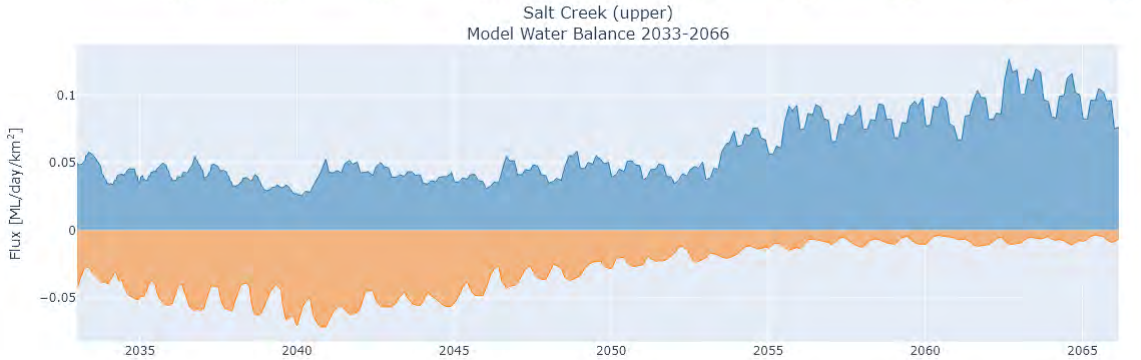

Salt Creek (lower)
Model Water Balance 2023-2033
Downward leakage from ASA to Boonah Fm
Upward leakage to ASA from Boonah Fm
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.02
−0.04
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

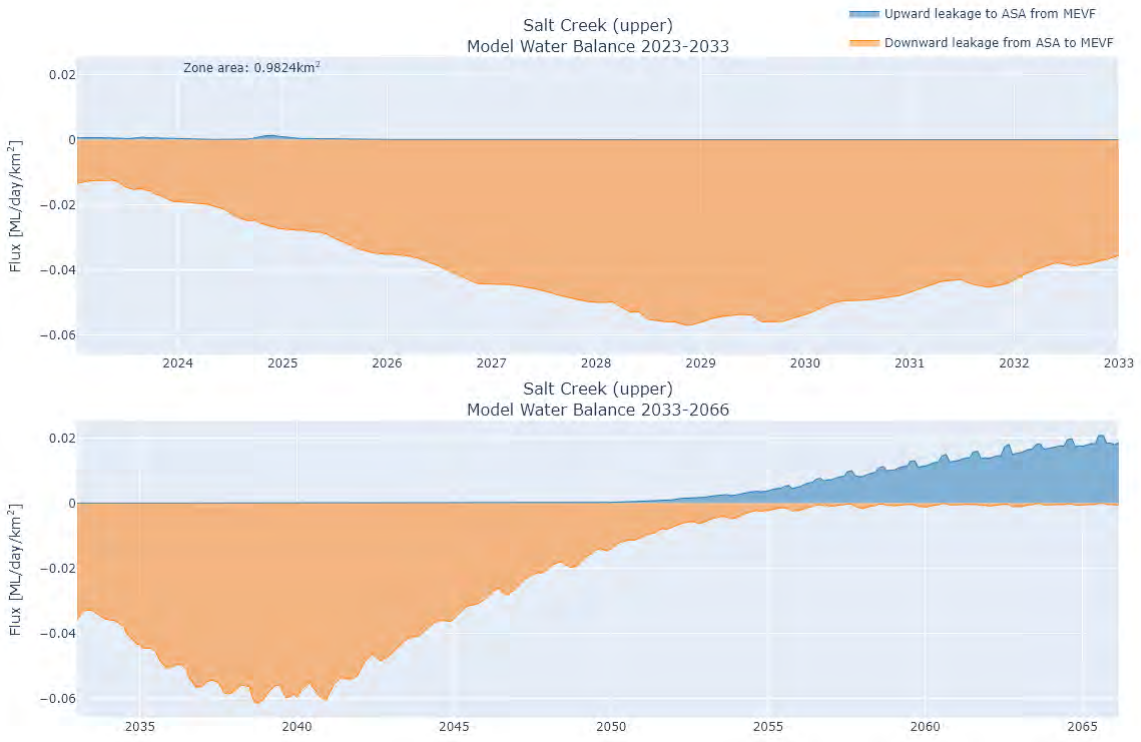

Salt Creek (lower)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.02
−0.04
−0.06
2035
2040
2045
2050
2055
2060
2065


Salt Creek (mid)
Model Water Balance 2023-2033
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.5
−1
−1.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

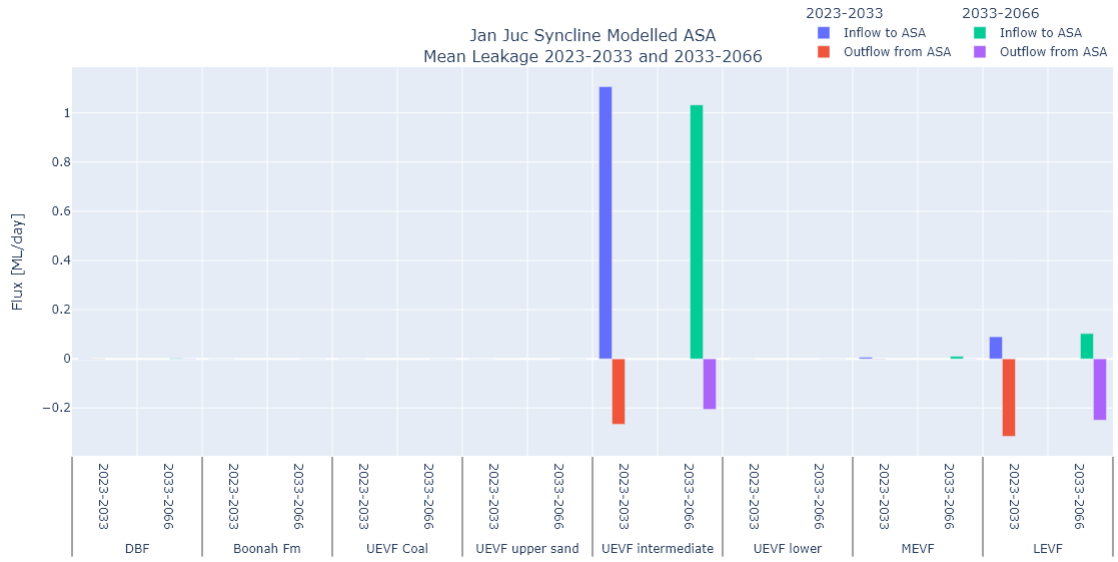

Salt Creek (mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.5
−1
−1.5
2035
2040
2045
2050
2055
2060
2065

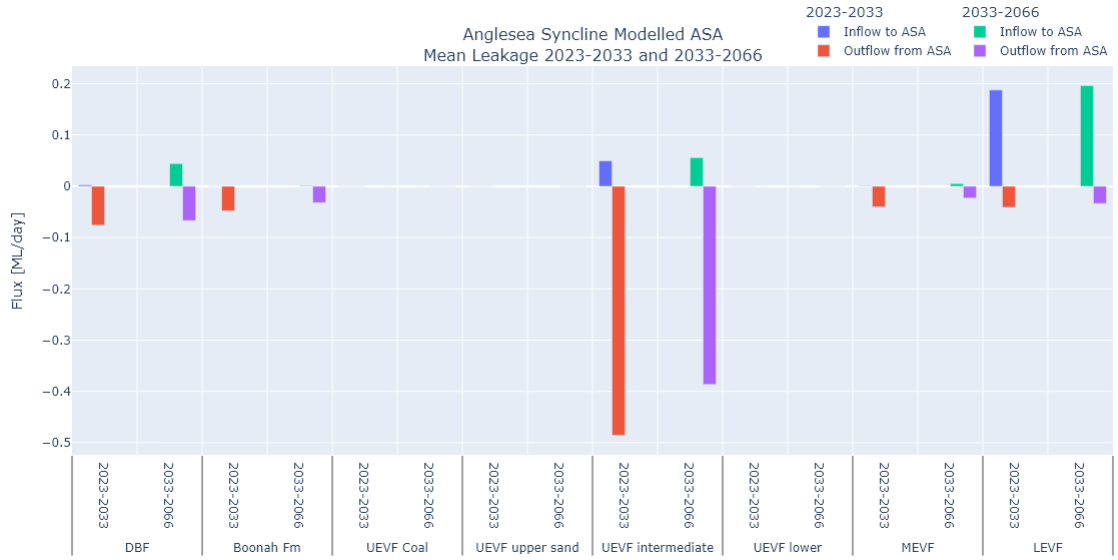

Salt Creek (upper)
Model Water Balance 2023-2033
Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Zone area: 0.9824km²
Flux [ML/day/km²]
0.1
0.05
0
−0.05
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

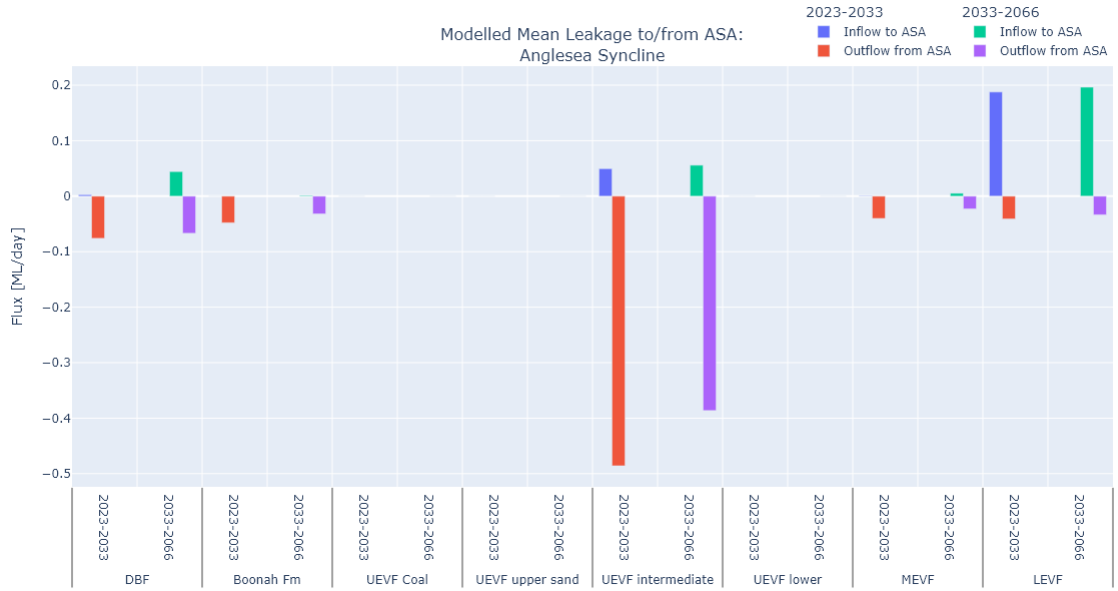

Salt Creek (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.1
0.05
0
−0.05
2035
2040
2045
2050
2055
2060
2065

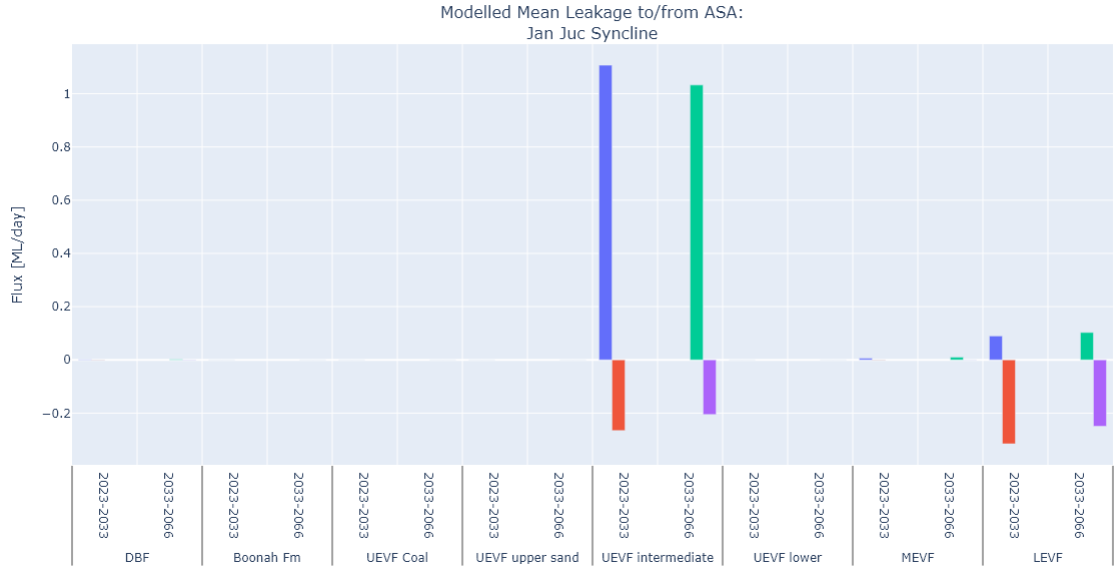

Salt Creek (upper)
Model Water Balance 2023-2033
Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Zone area: 0.9824km²
Flux [ML/day/km²]
0.02
0
−0.02
−0.04
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Salt Creek (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.02
0
−0.02
−0.04
−0.06
2035
2040
2045
2050
2055
2060
2065

Mean ASA leakage to the various underlying HGUs for each of the Anglesea and Jan Juc Synclines (on plot each) and Single plot showing both syncline charts of mean ASA leakage per HGU.

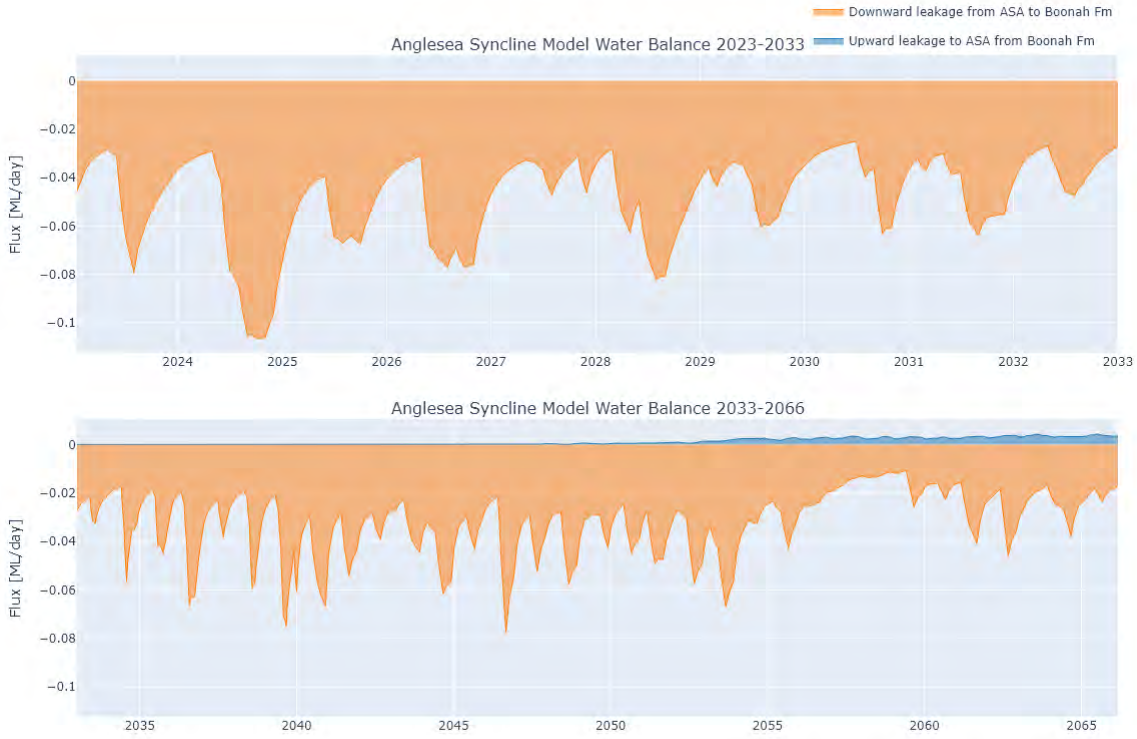


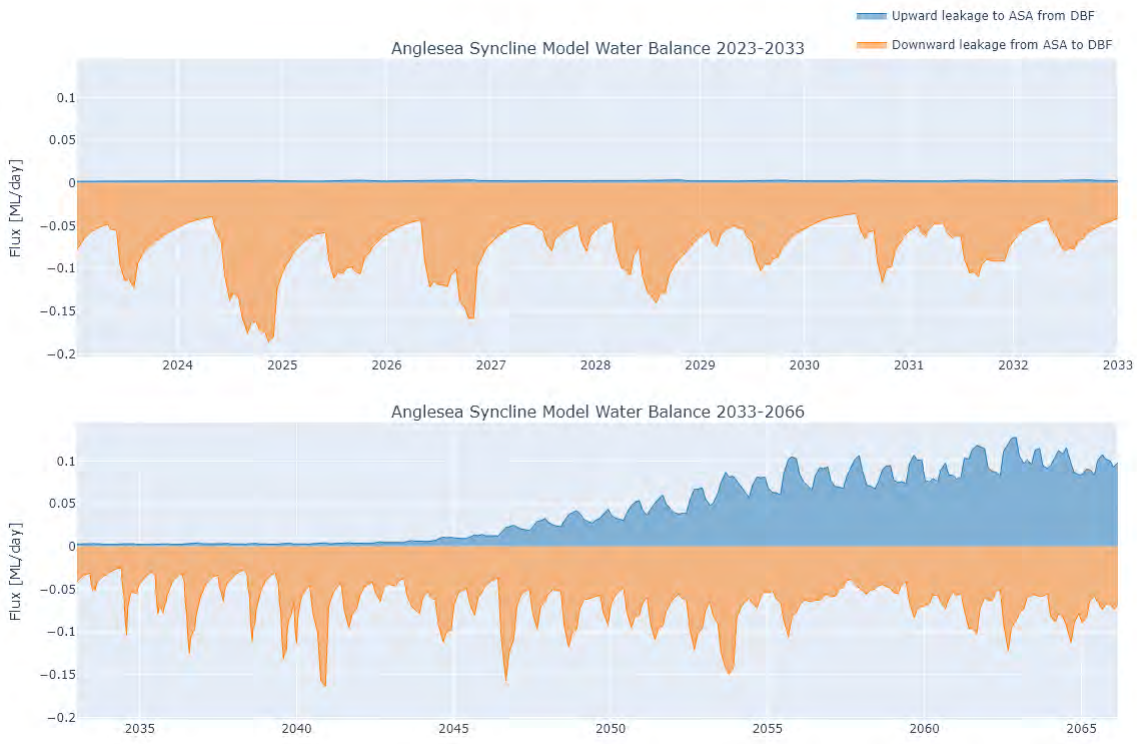


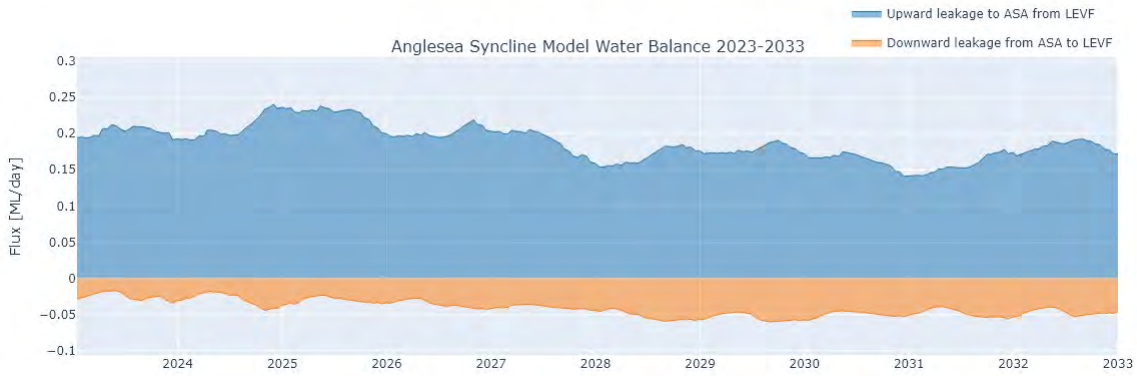

Modelled Mean Leakage to/from ASA:
Anglesea Syncline
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Flux [ML/day]
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

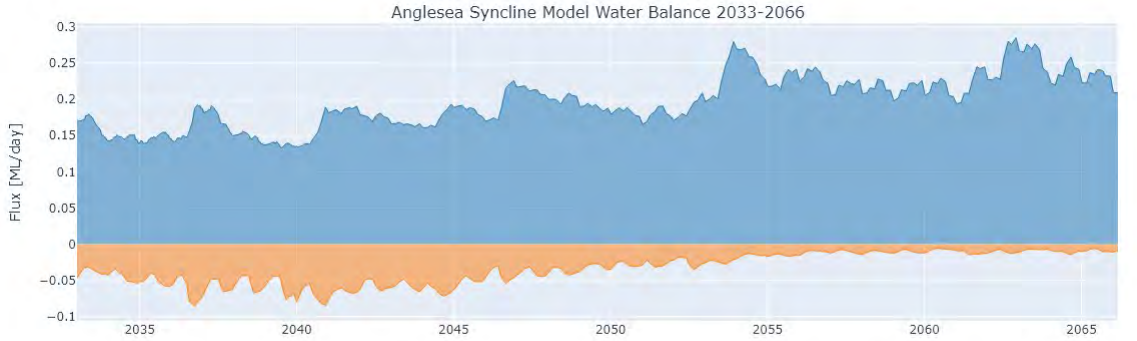

Modelled Mean Leakage to/from ASA:
Jan Juc Syncline
Flux [ML/day]
1
0.8
0.6
0.4
0.2
0
−0.2
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

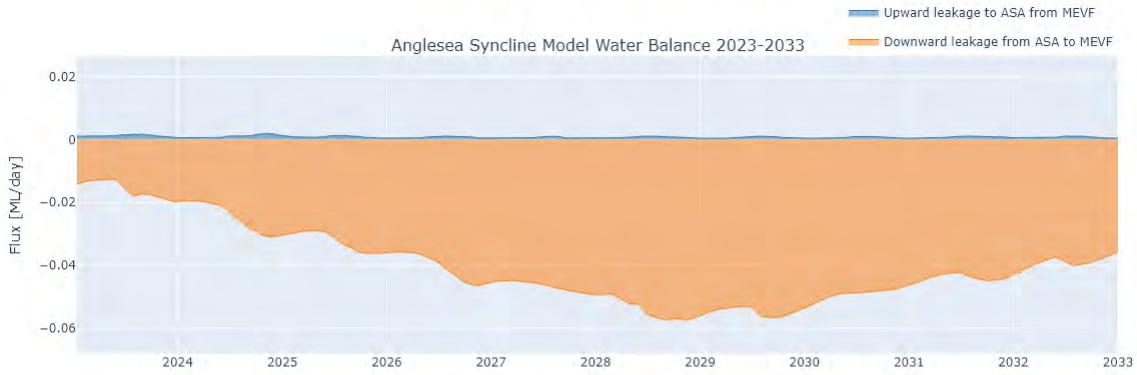
Timeseries ASA leakage per HGU, for each of the Jan Juc and Anglesea Synclines

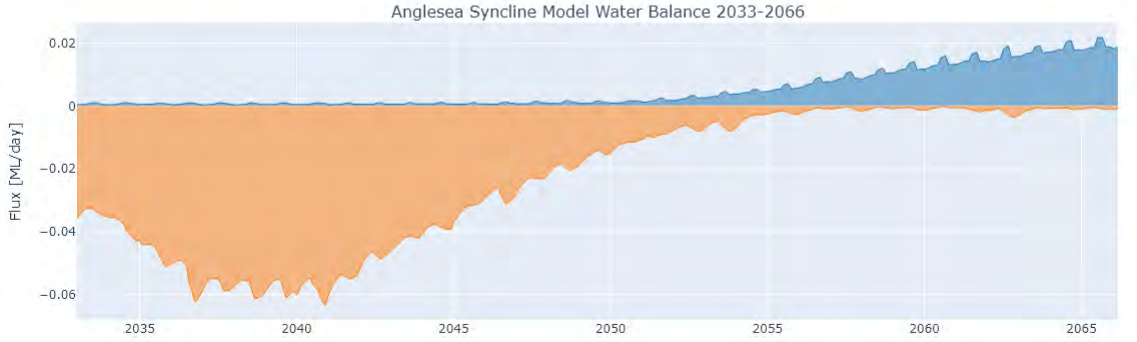


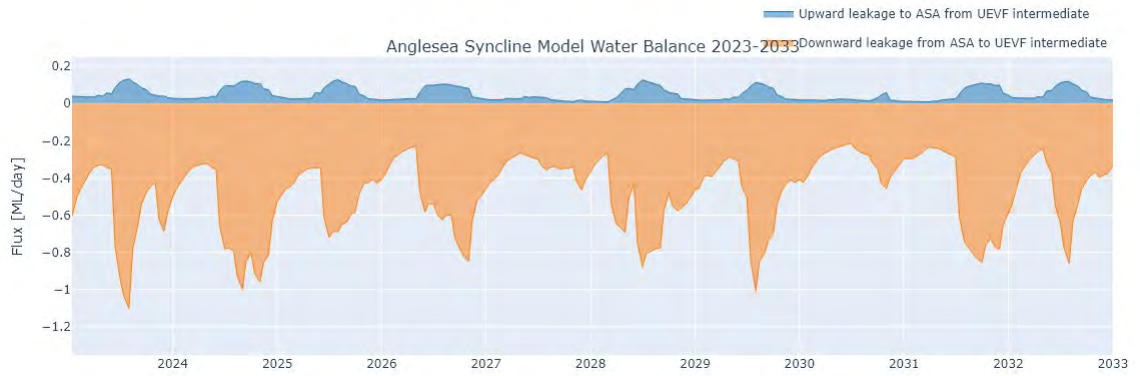


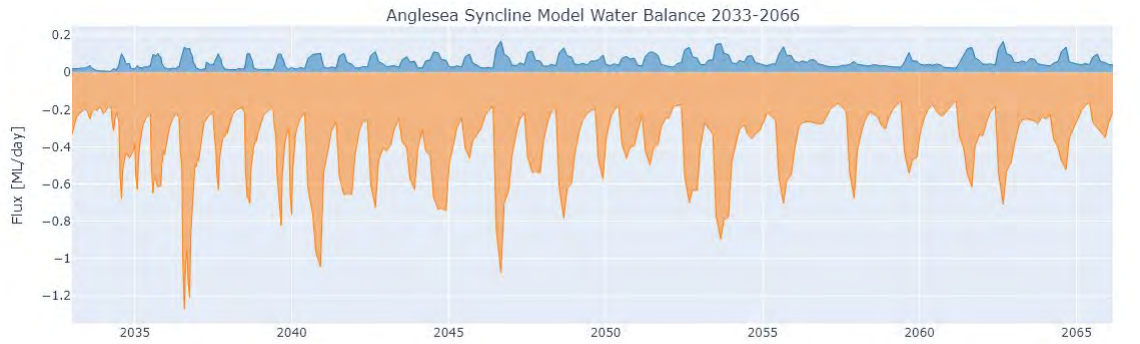

Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Anglesea Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.3
0.25
0.2
0.15
0.1
0.05
0
−0.05
−0.1
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

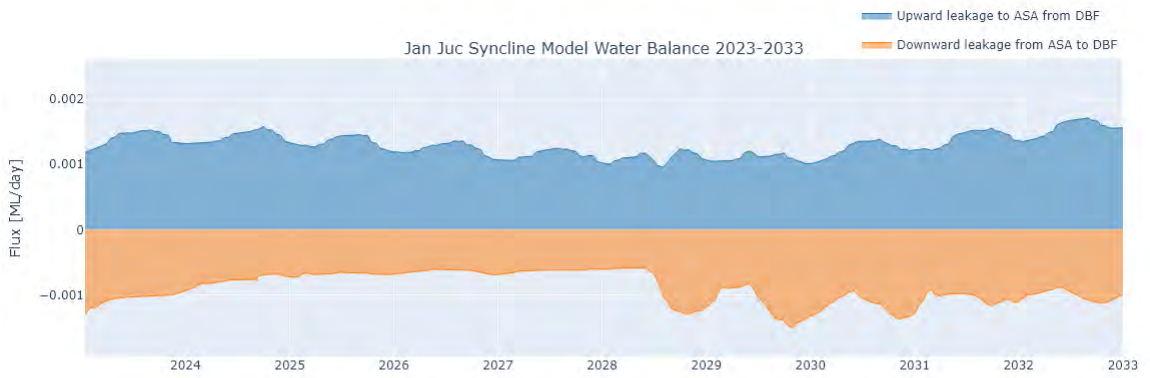

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.3
0.25
0.2
0.15
0.1
0.05
0
−0.05
−0.1
2035
2040
2045
2050
2055
2060
2065

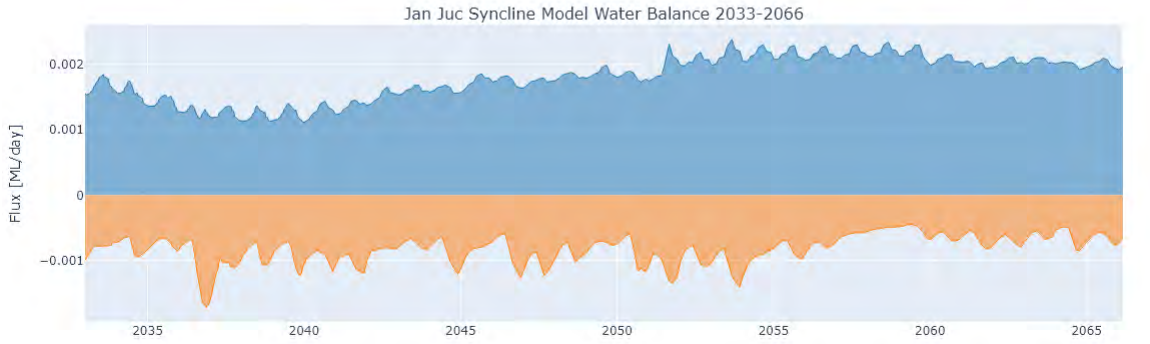

Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Anglesea Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.02
0
−0.02
−0.04
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

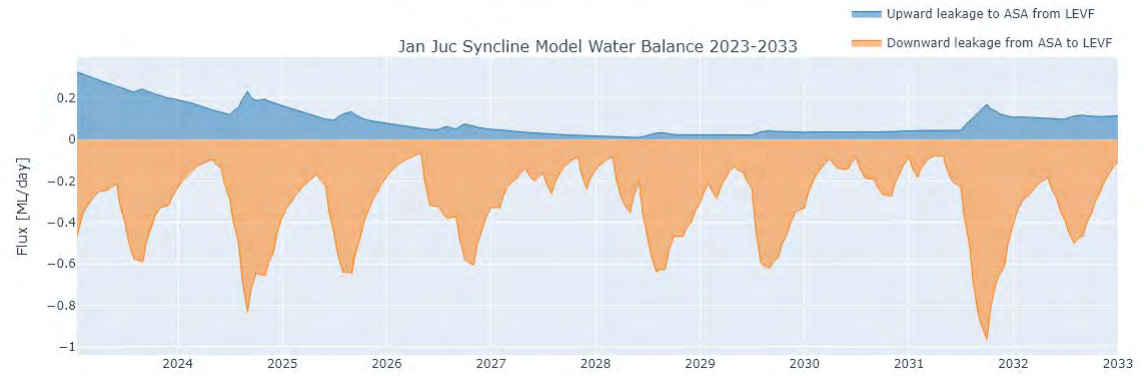

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.02
0
−0.02
−0.04
−0.06
2035
2040
2045
2050
2055
2060
2065

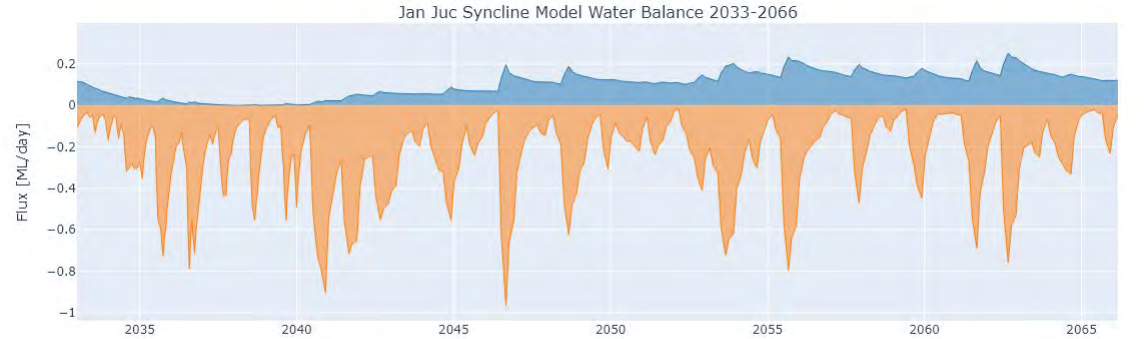

Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Anglesea Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

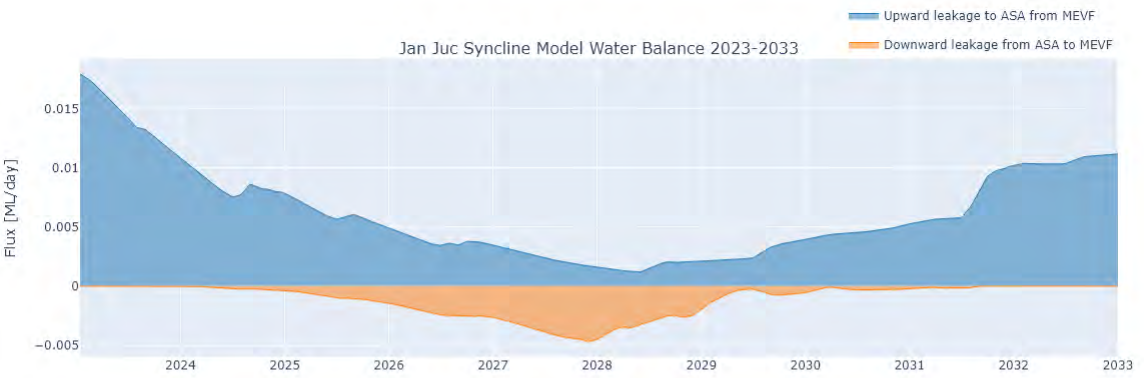

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
2035
2040
2045
2050
2055
2060
2065

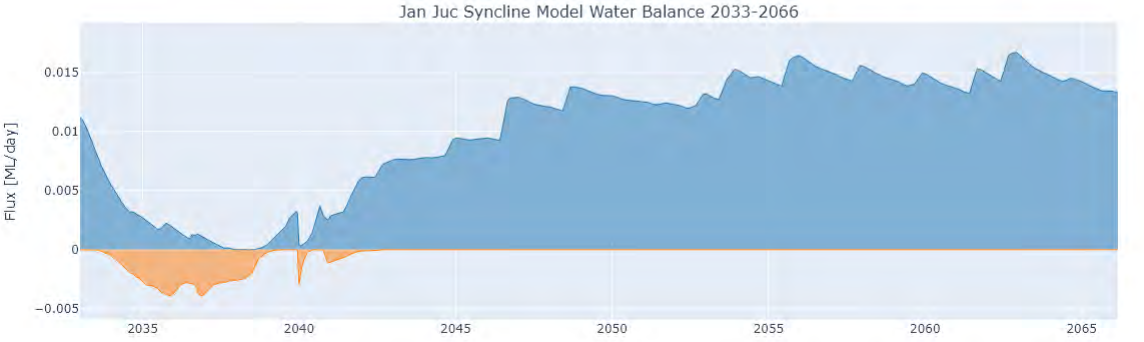

Upward leakage to ASA from DBF
Downward leakage from ASA to DBF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.002
0.001
0
−0.001
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

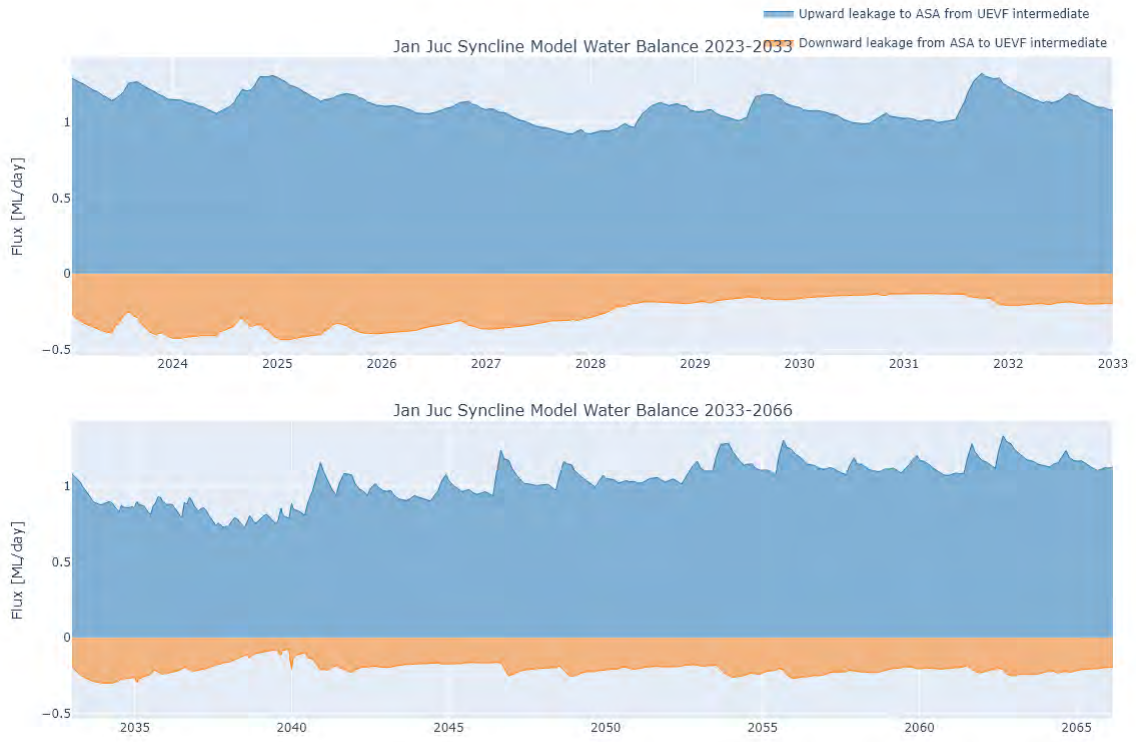

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.002
0.001
0
−0.001
2035
2040
2045
2050
2055
2060
2065


Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

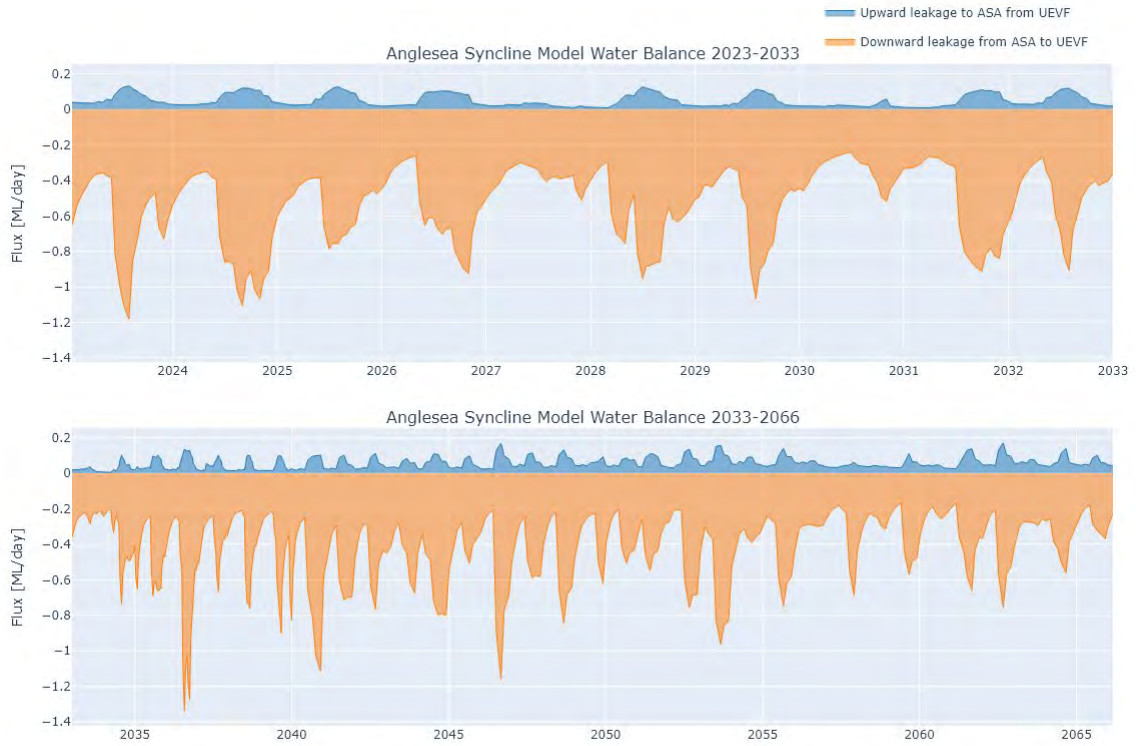

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
2035
2040
2045
2050
2055
2060
2065

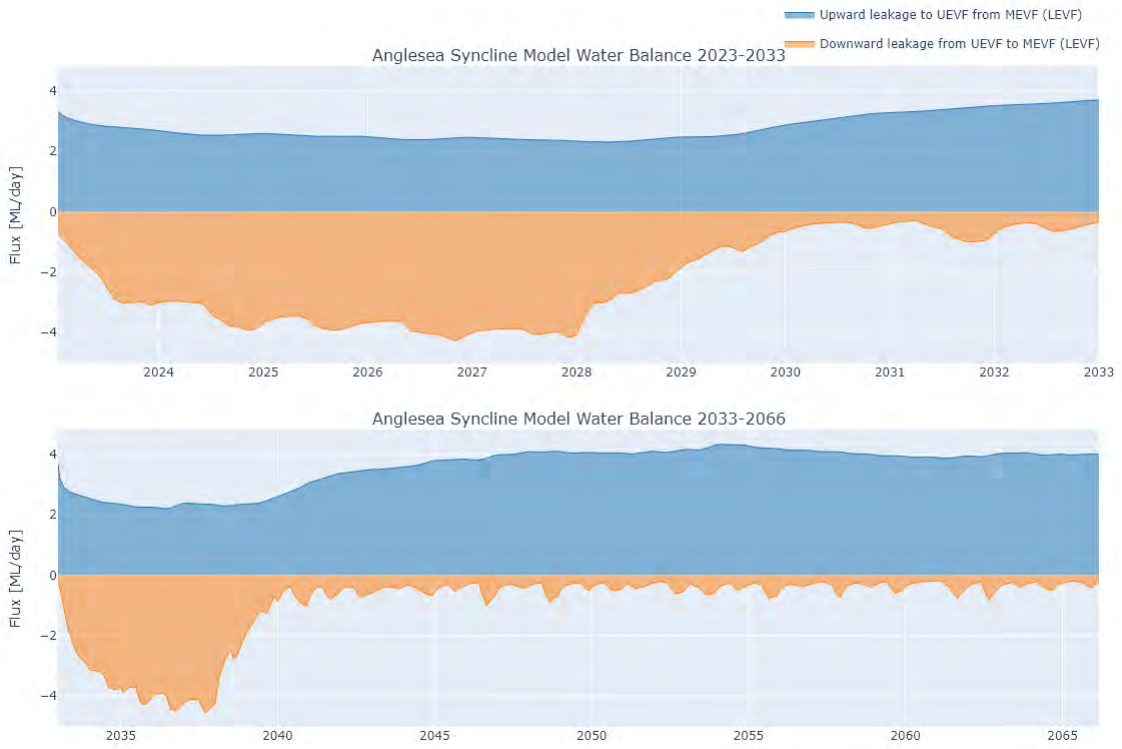

Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.015
0.01
0.005
0
−0.005
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

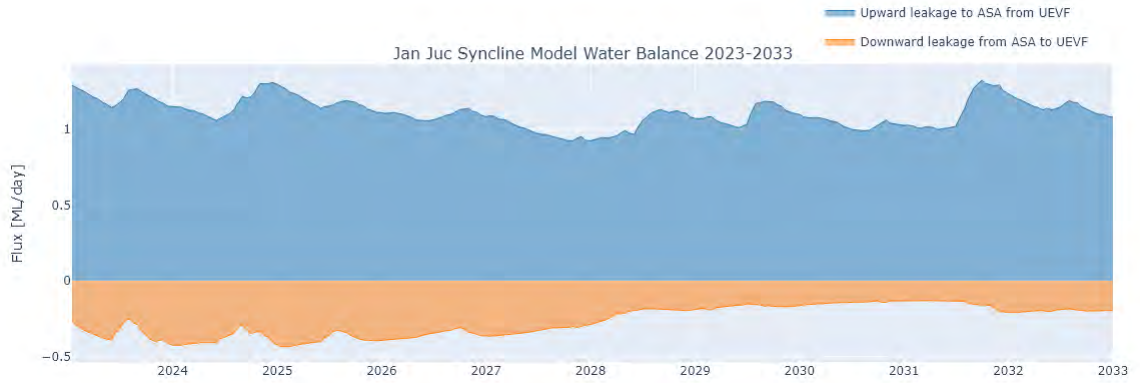

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.015
0.01
0.005
0
−0.005
2035
2040
2045
2050
2055
2060
2065

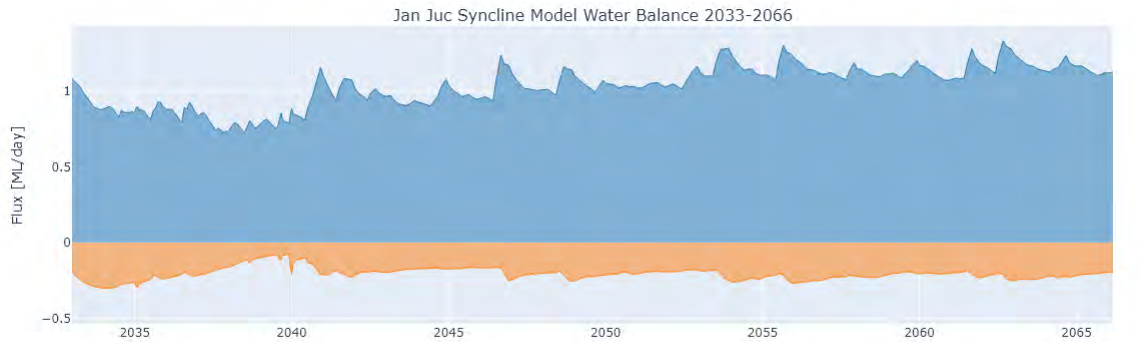

Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
1
0.5
0
−0.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
1
0.5
0
−0.5
2035
2040
2045
2050
2055
2060
2065

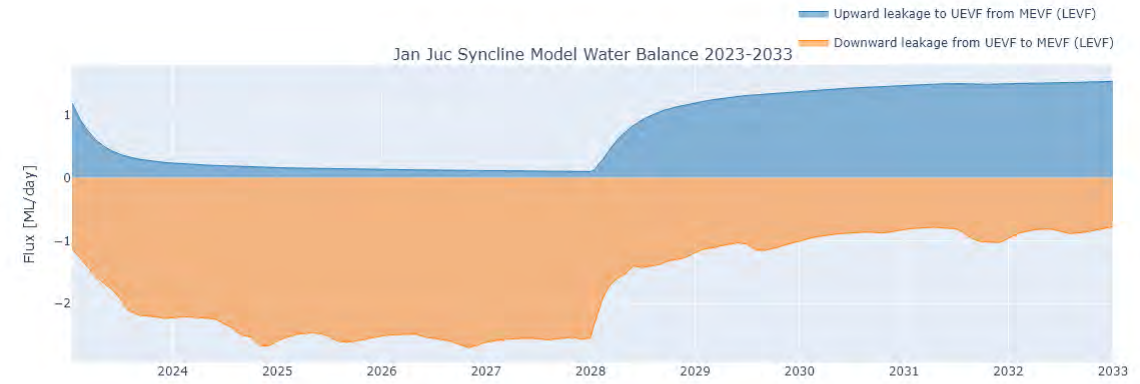
ASA-UEVF inter-aquifer flow by HGU (anglesea/jan juc synclines)

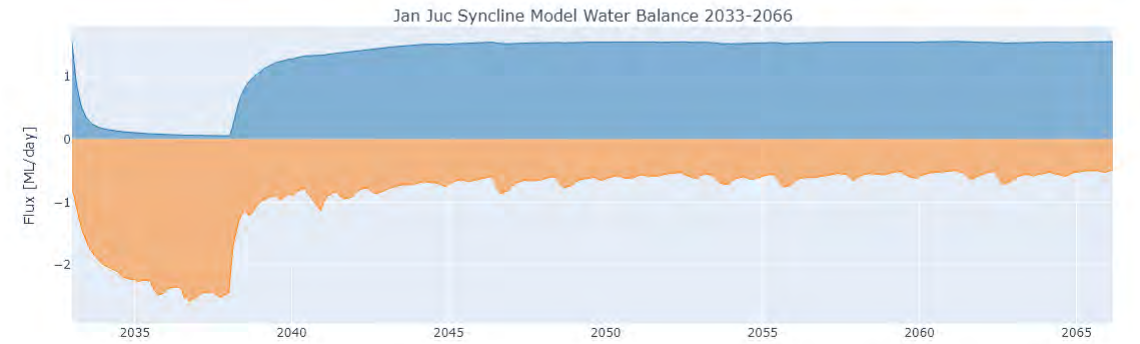




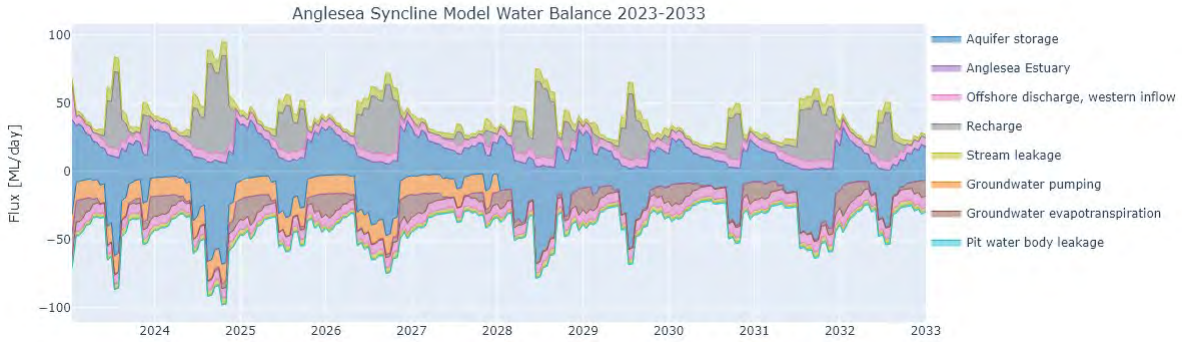

Upward leakage to ASA from UEVF
Downward leakage from ASA to UEVF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
1
0.5
0
−0.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

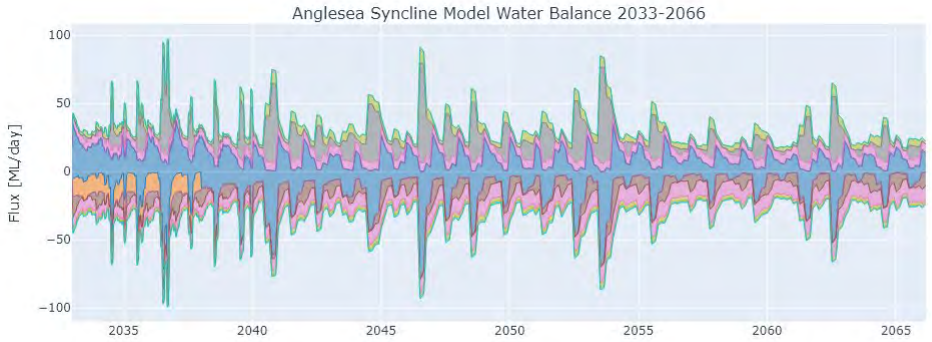

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
1
0.5
0
−0.5
2035
2040
2045
2050
2055
2060
2065

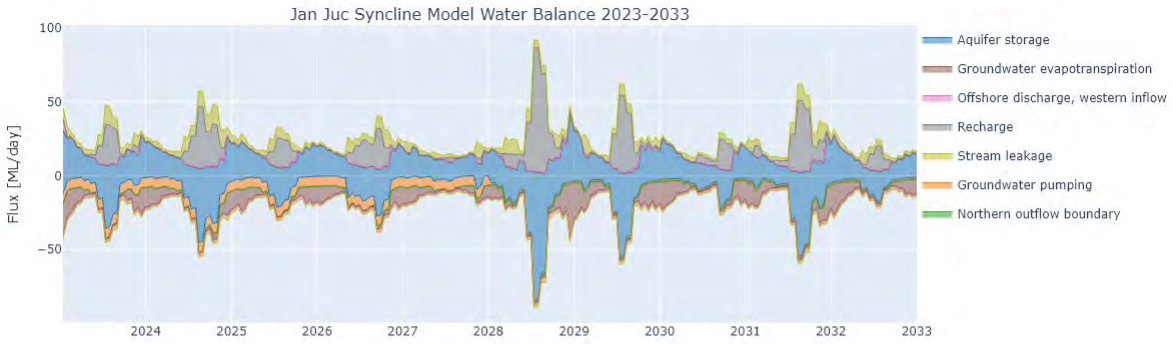

Upward leakage to UEVF from MEVF (LEVF)
Downward leakage from UEVF to MEVF (LEVF)
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
1
0
−1
−2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

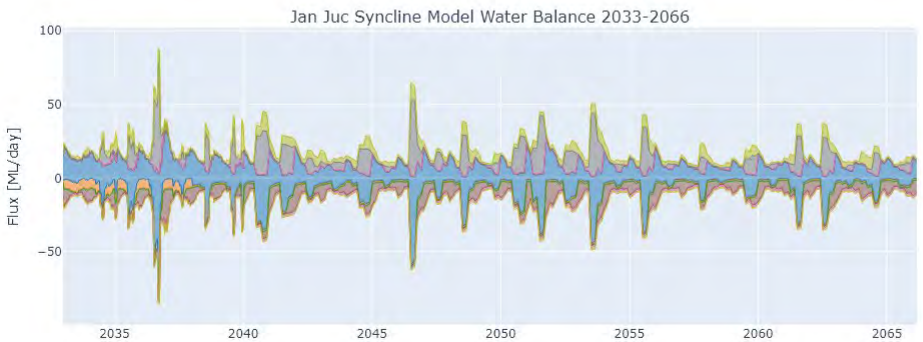

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
1
0
−1
−2
2035
2040
2045
2050
2055
2060
2065

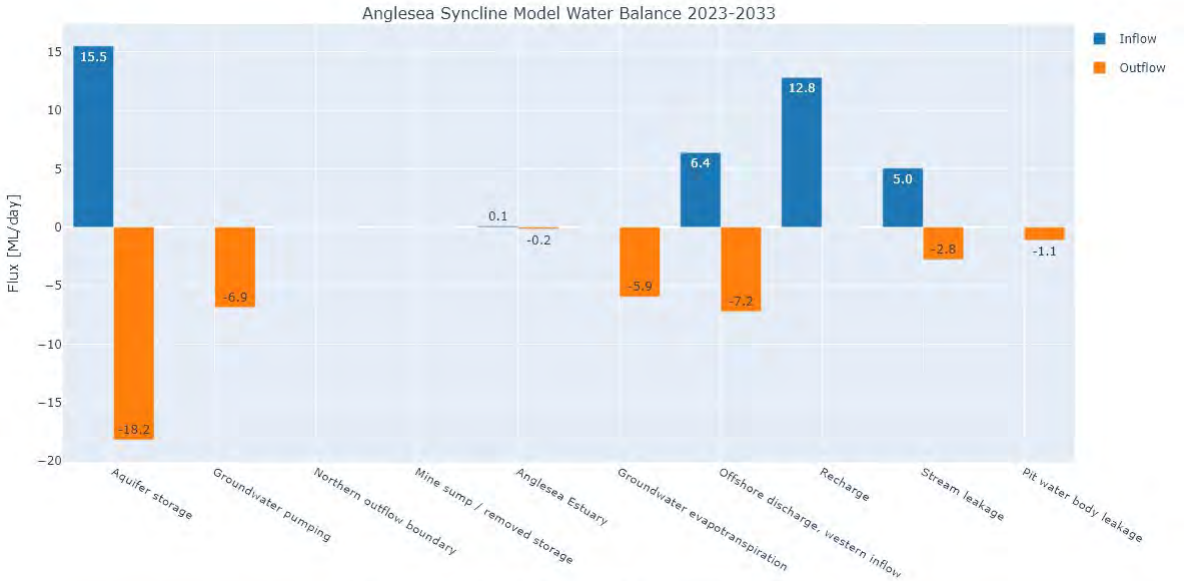
Water balance flow components for all layers as a whole (anglesea and jan juc syncline)

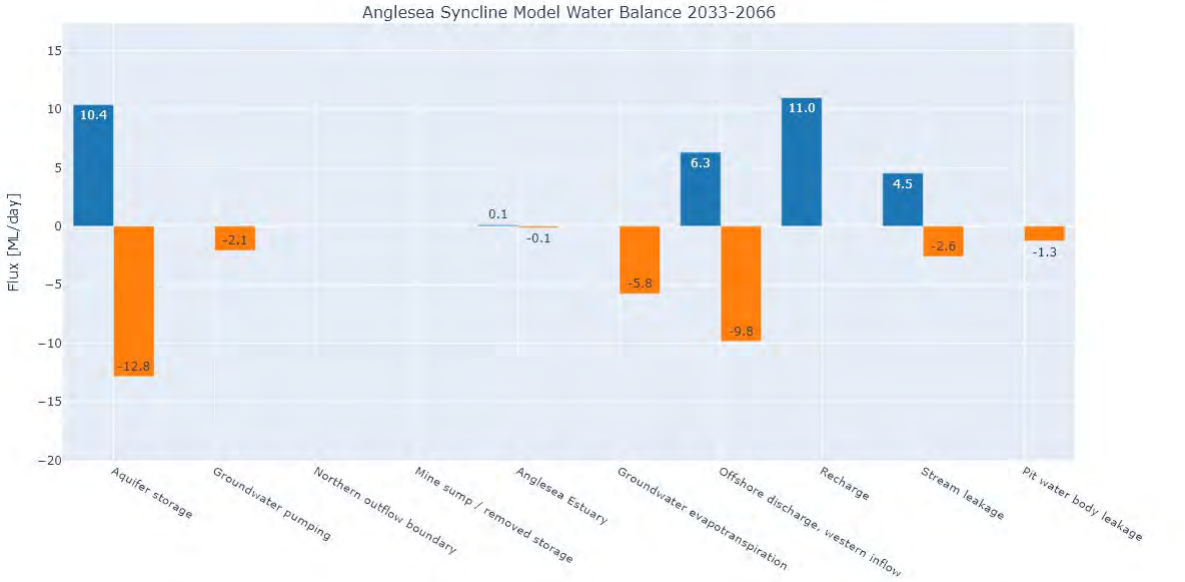


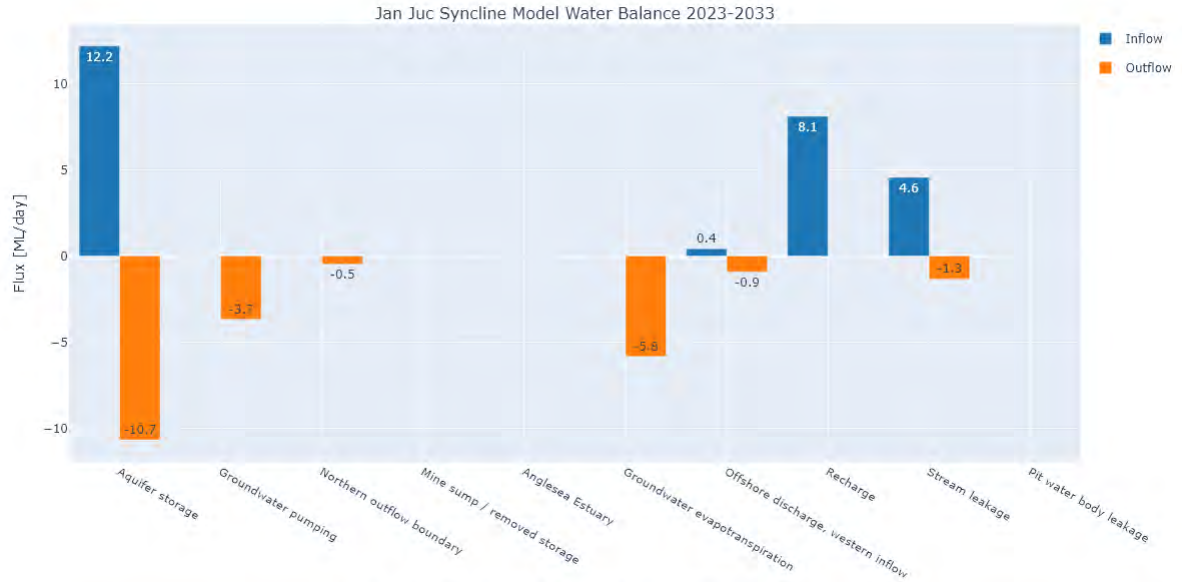


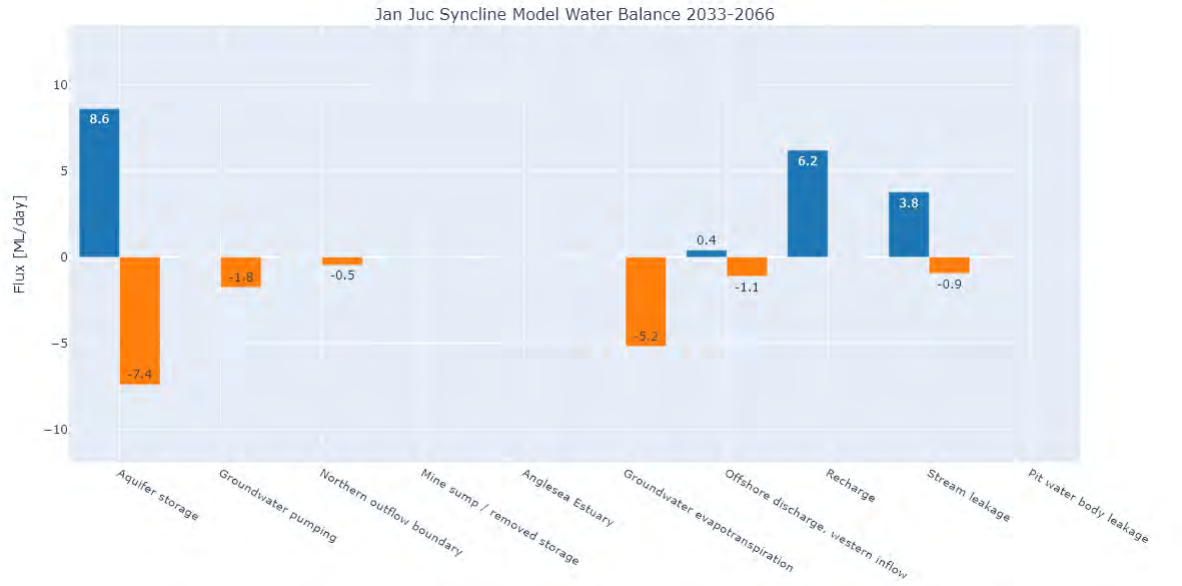




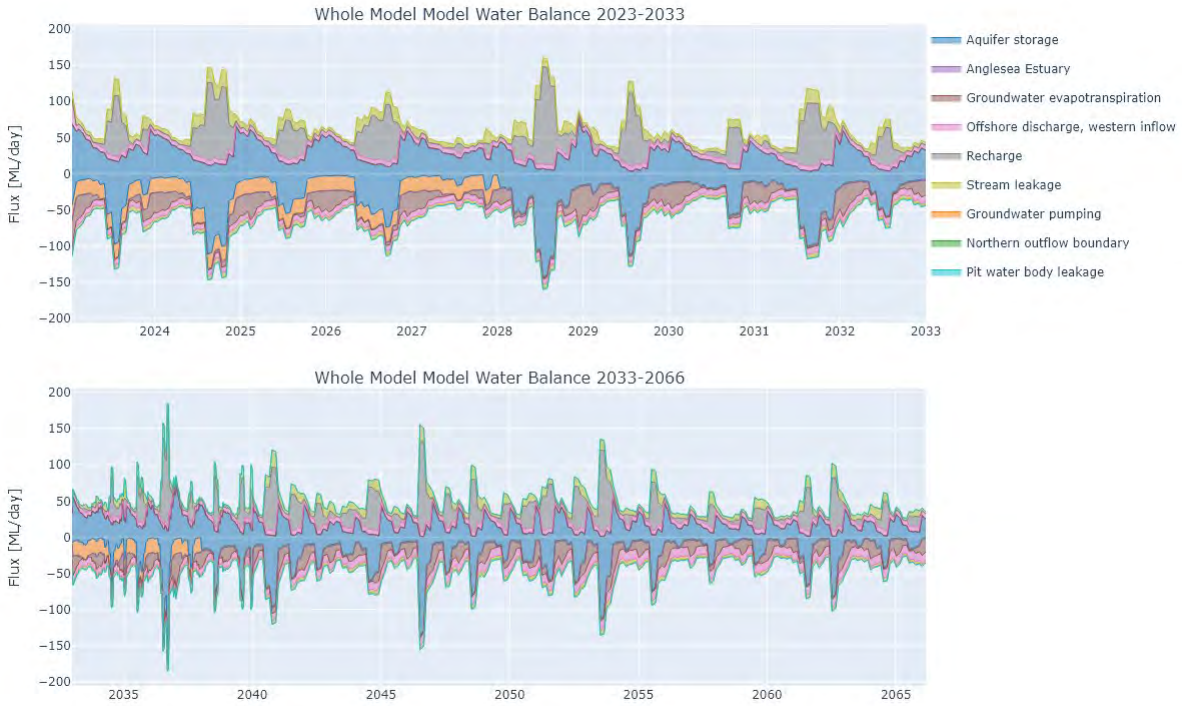

Anglesea Syncline Model Water Balance 2023-2033
Inflow
Outflow
Flux [ML/day]
15
10
5
0
−5
−10
−15
−20
15.5
-18.2
-6.9
0.1
-0.2
-5.9
6.4
-7.2
12.8
5.0
-2.8
-1.1
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

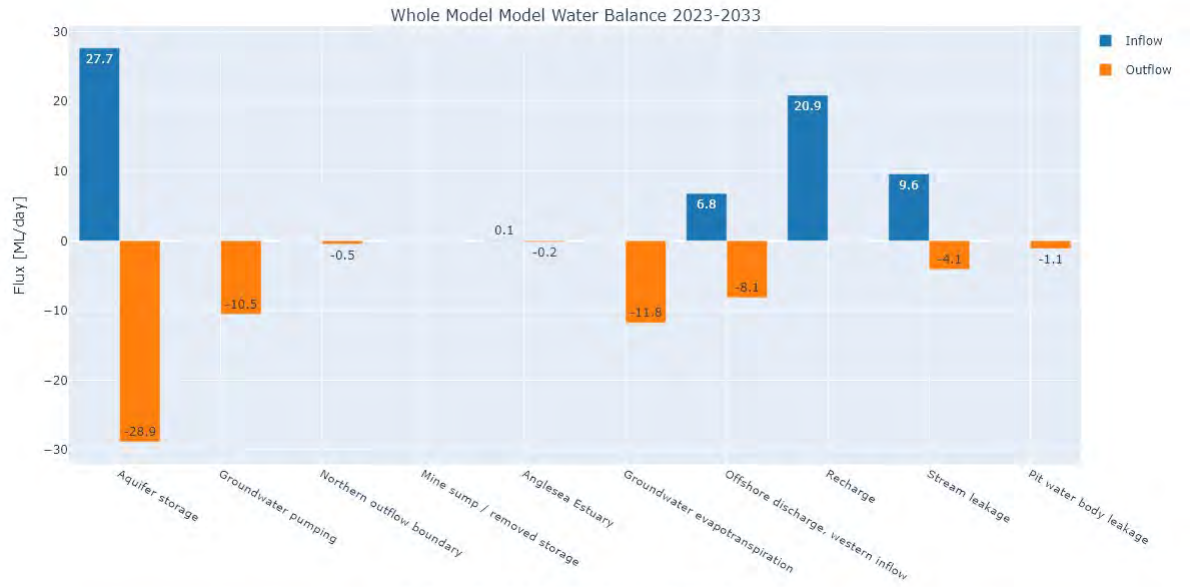

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
15
10
5
0
−5
−10
−15
−20
10.4
-12.8
-2.1
0.1
-0.1
-5.8
6.3
-9.8
11.0
4.5
-2.6
-1.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

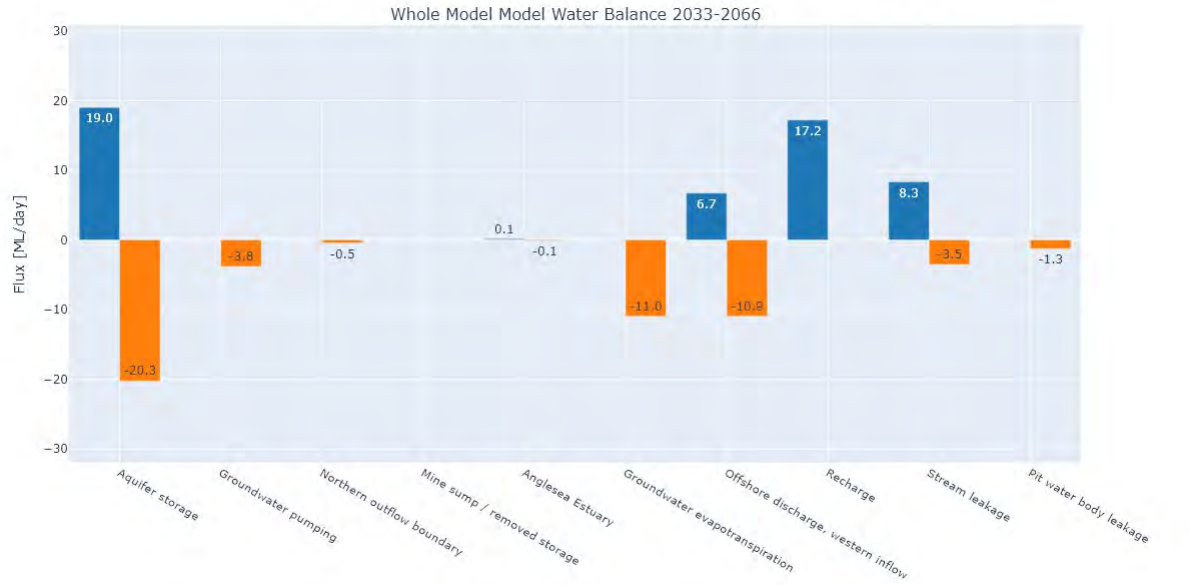

Jan Juc Syncline Model Water Balance 2023-2033
Inflow
Outflow
Flux [ML/day]
12.2
-10.7
-3.7
-0.5
0.4
-0.9
-5.8
8.1
4.6
-1.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage


Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
8.6
-7.4
-1.8
-0.5
0.4
-1.1
-5.2
6.2
3.8
-0.9
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

Water balance flow components for all layers as a whole (over full model domain)

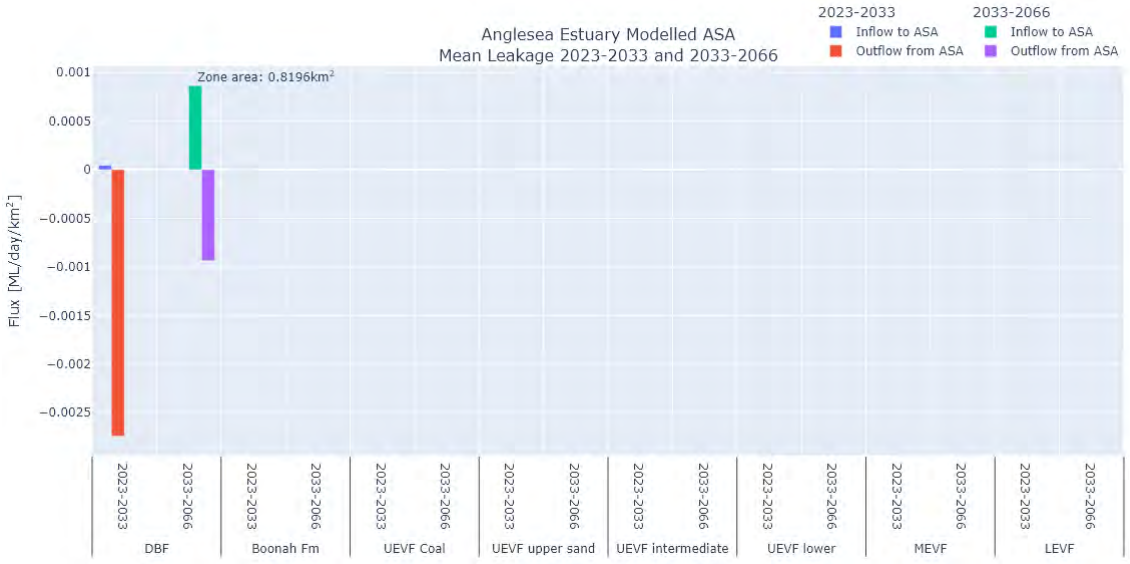


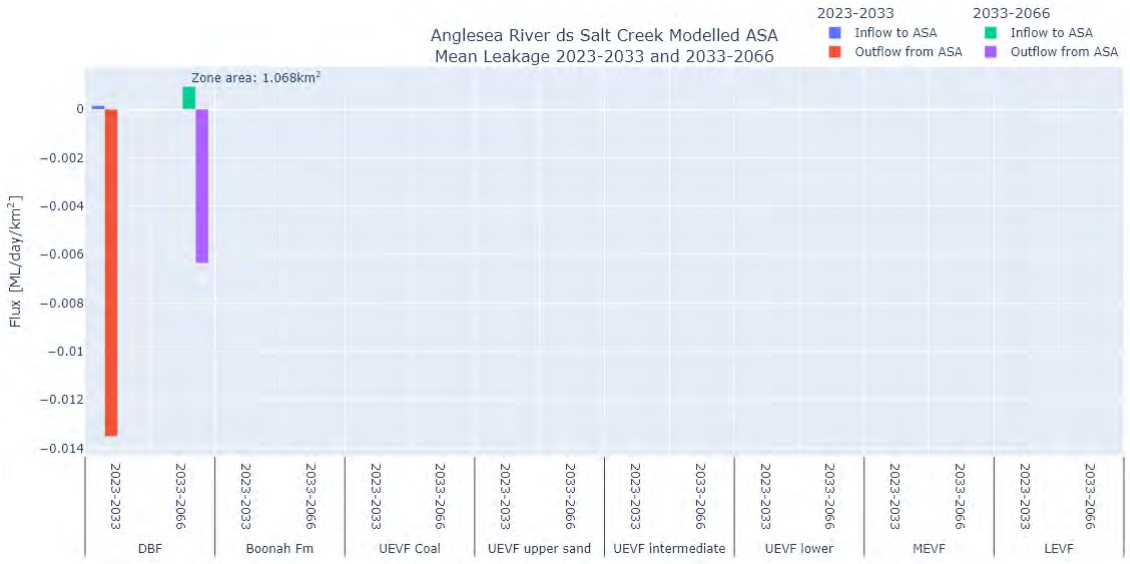

Whole Model Model Water Balance 2023-2033
Inflow
Outflow
Flux [ML/day]
30
20
10
0
−10
−20
−30
27.7
-28.9
-10.5
-0.5
0.1
-0.2
-11.8
6.8
-8.1
20.9
9.6
-4.1
-1.1
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

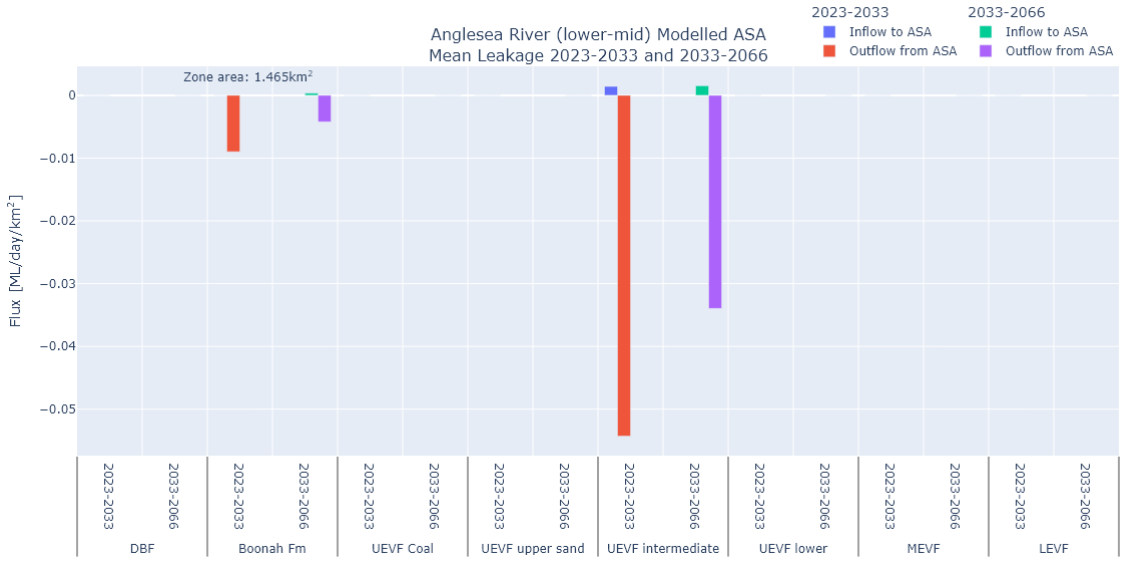

Whole Model Model Water Balance 2033-2066
Flux [ML/day]
30
20
10
0
−10
−20
−30
19.0
-20.3
-3.8
-0.5
0.1
-0.1
-11.0
6.7
-10.9
17.2
8.3
-3.5
-1.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

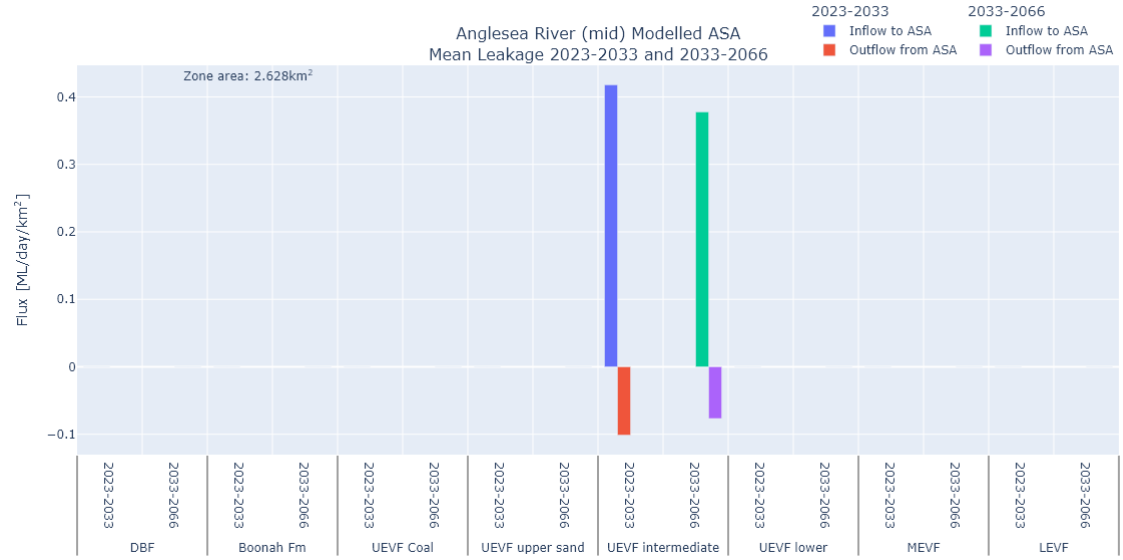
Appendix F6 Numerical Modelling Outputs (Water balances for Medium climate change; Barwon Water pumping 7GL/year for 5 years, then off for 5 years; Alcoa pumping from WB16 @ 1.5GL/year for 10 years. Discharge into the pit water body)

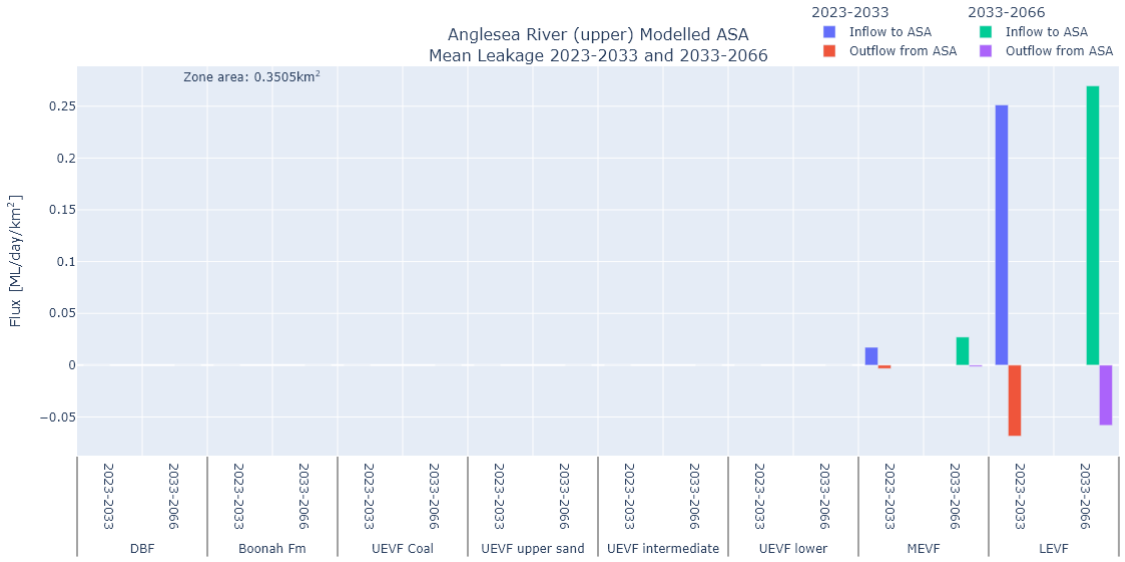
Mean ASA leakage to the various underlying HGUs for specified stream reaches (one plot each)
UNITS: ML/day/km2 (unit area)

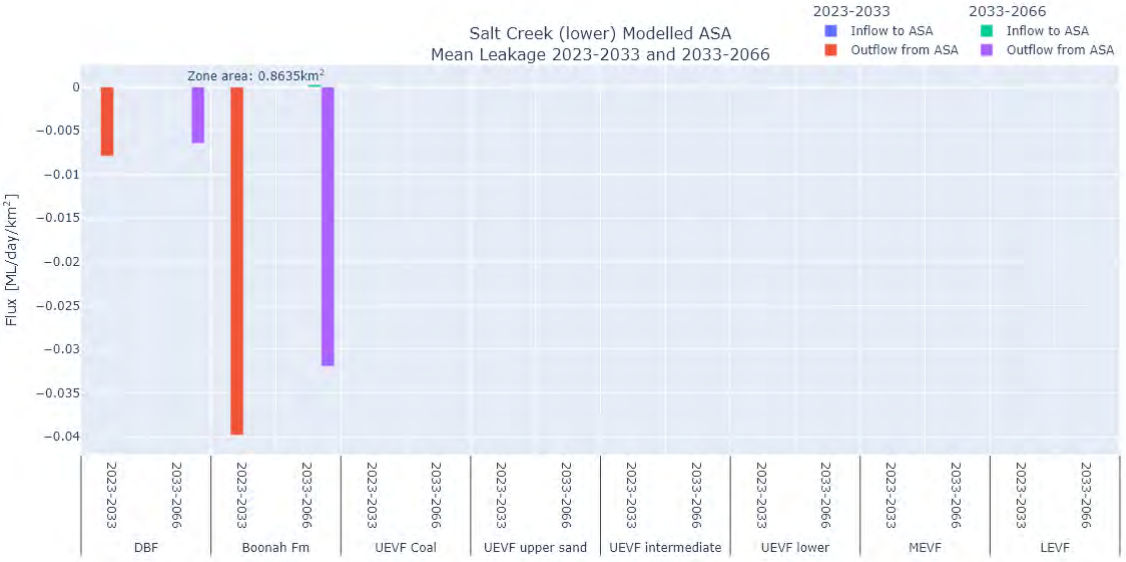


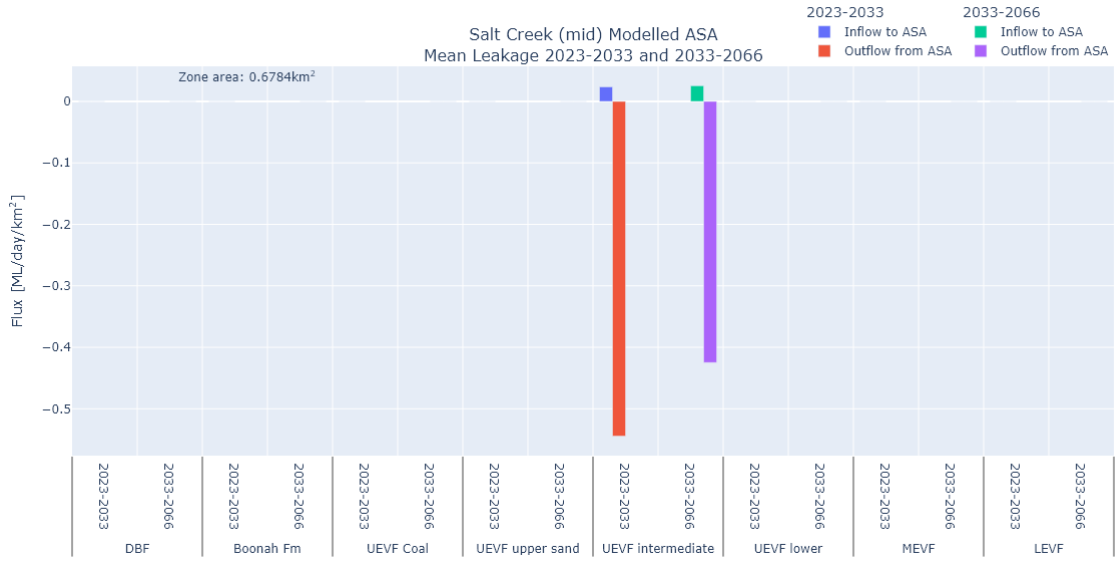


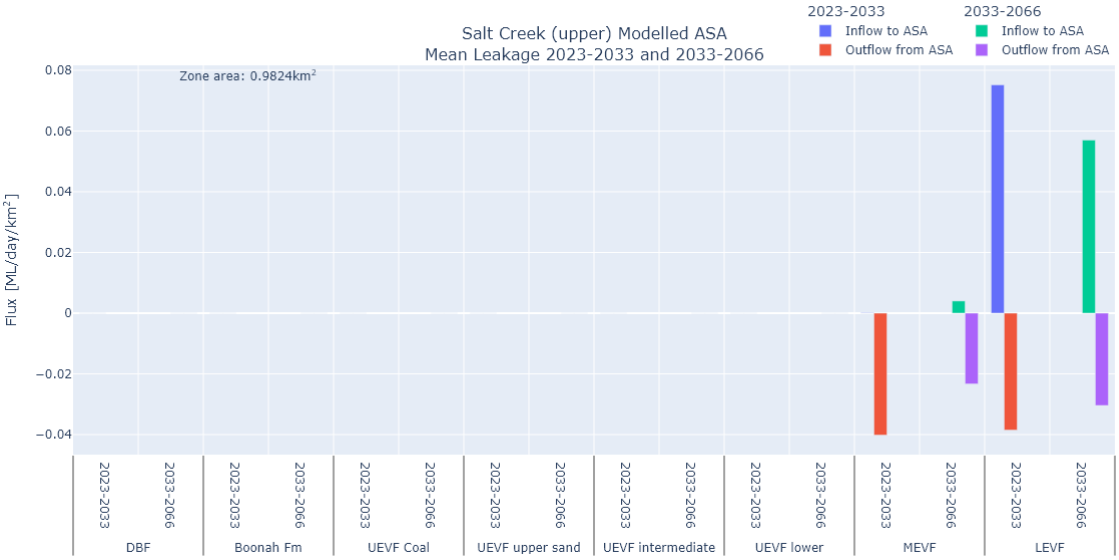

Anglesea River (lower-mid) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

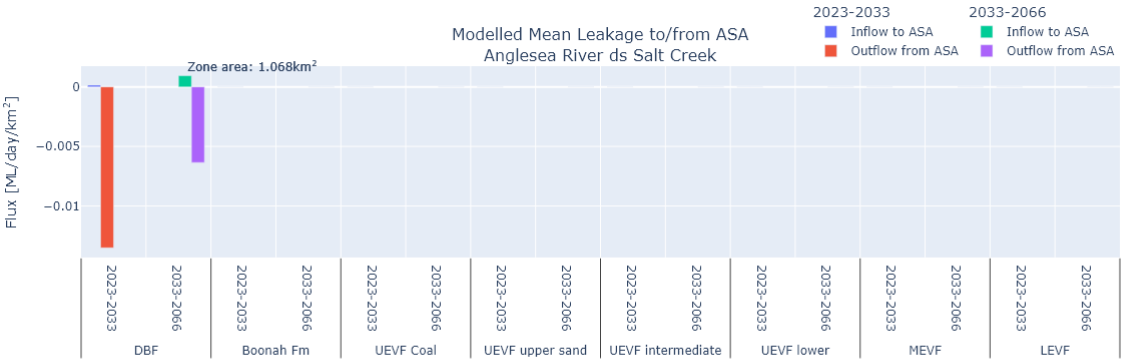

Anglesea River (mid) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 2.628km²
Flux [ML/day/km²]
0.4
0.3
0.2
0.1
0
−0.1
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

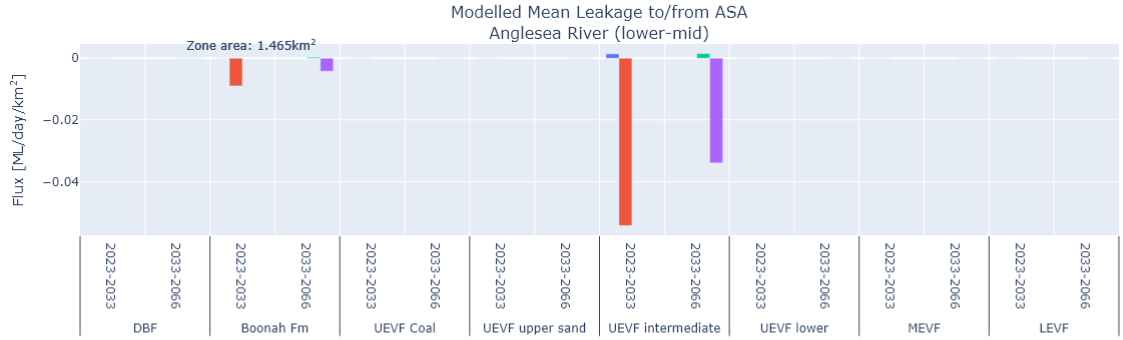

Anglesea River (upper) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.3505km²
Flux [ML/day/km²]
0.25
0.2
0.15
0.1
0.05
0
−0.05
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

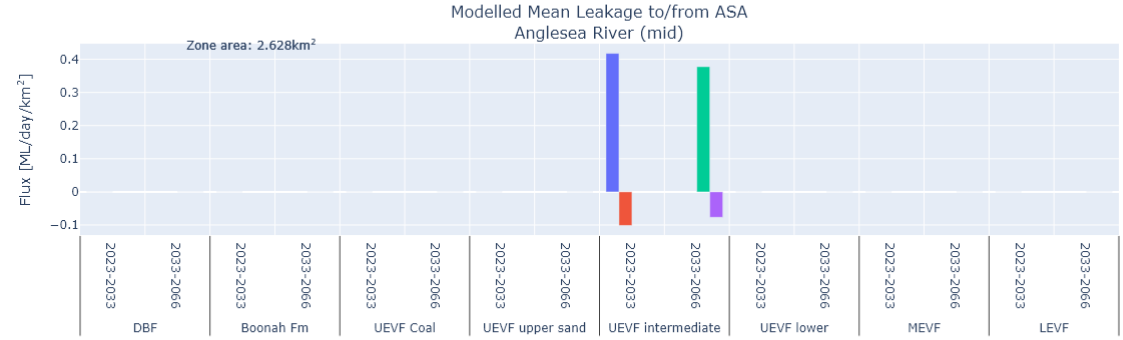

Salt Creek (lower) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
−0.03
−0.035
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

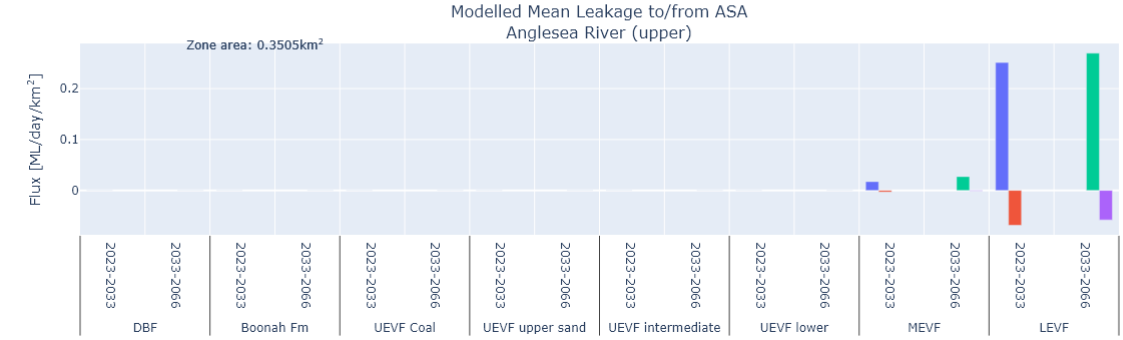

Salt Creek (mid) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.1
−0.2
−0.3
−0.4
−0.5
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

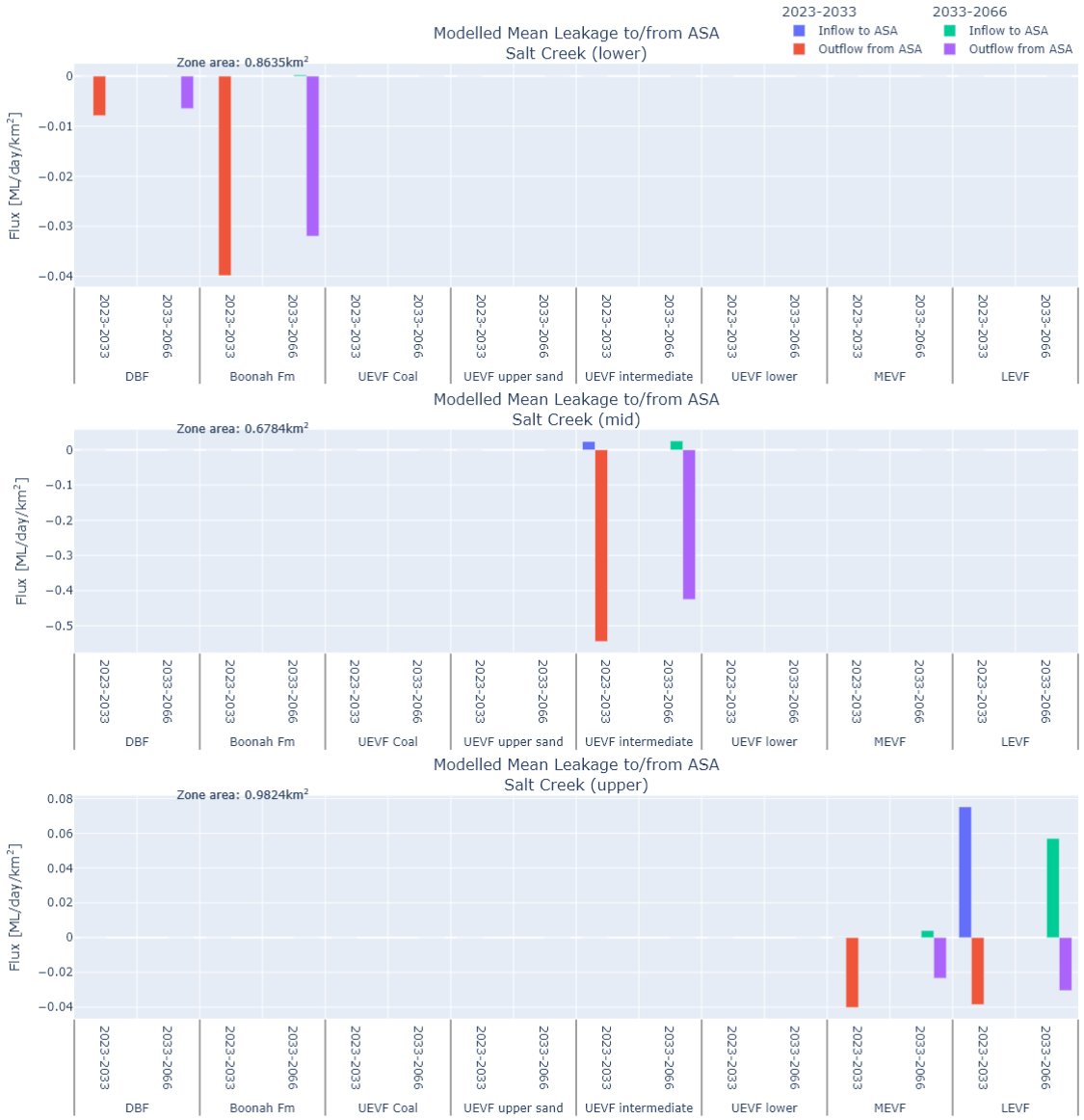

Salt Creek (upper) Modelled ASA
Mean Leakage 2023-2033 and 2033-2066
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 0.9824km²
Flux [ML/day/km²]
0.08
0.06
0.04
0.02
0
−0.02
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF


Modelled Mean Leakage to/from ASA
Anglesea River ds Salt Creek
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Zone area: 1.068km²
Flux [ML/day/km²]
0
−0.005
−0.01
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

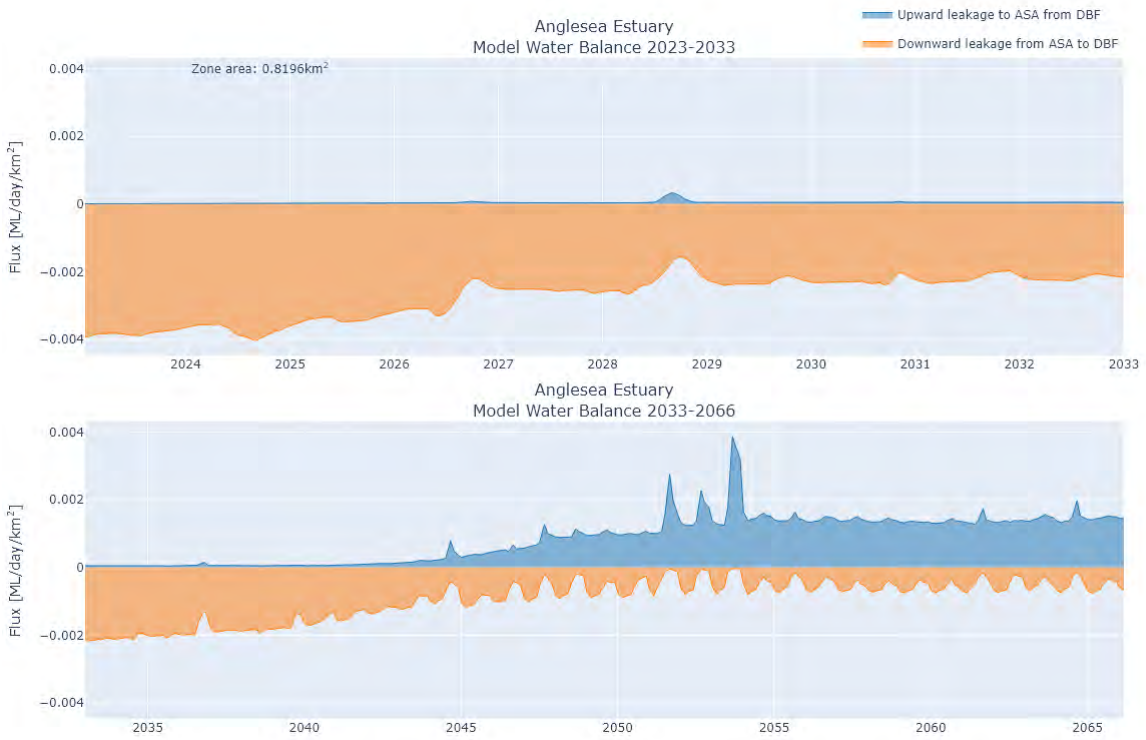

Modelled Mean Leakage to/from ASA
Anglesea River (lower-mid)
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.02
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

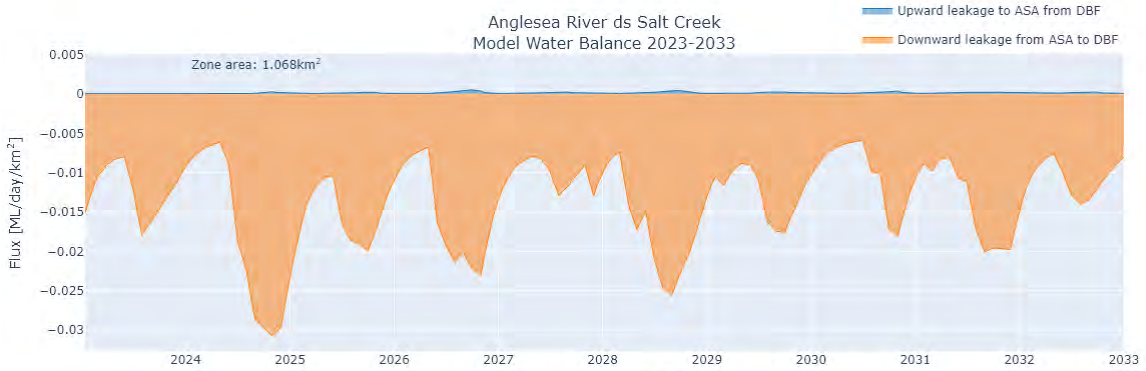

Modelled Mean Leakage to/from ASA
Anglesea River (mid)
Zone area: 2.628km²
Flux [ML/day/km²]
0.4
0.3
0.2
0.1
0
−0.1
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

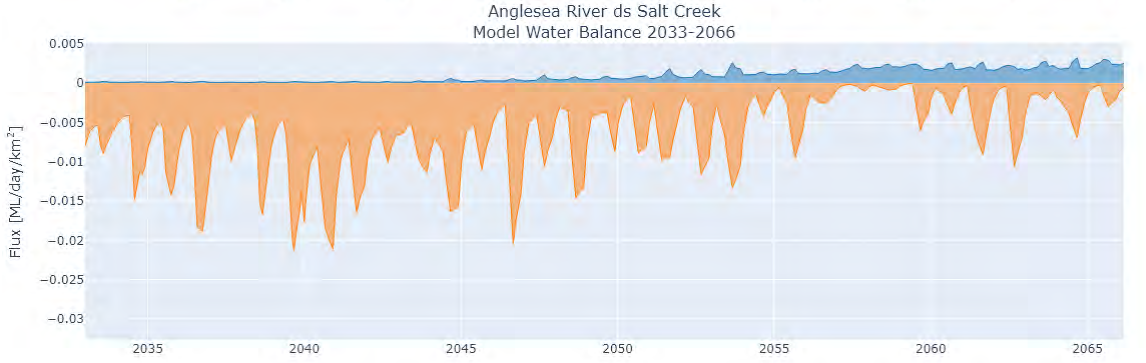

Modelled Mean Leakage to/from ASA
Anglesea River (upper)
Zone area: 0.3505km²
Flux [ML/day/km²]
0.2
0.1
0
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

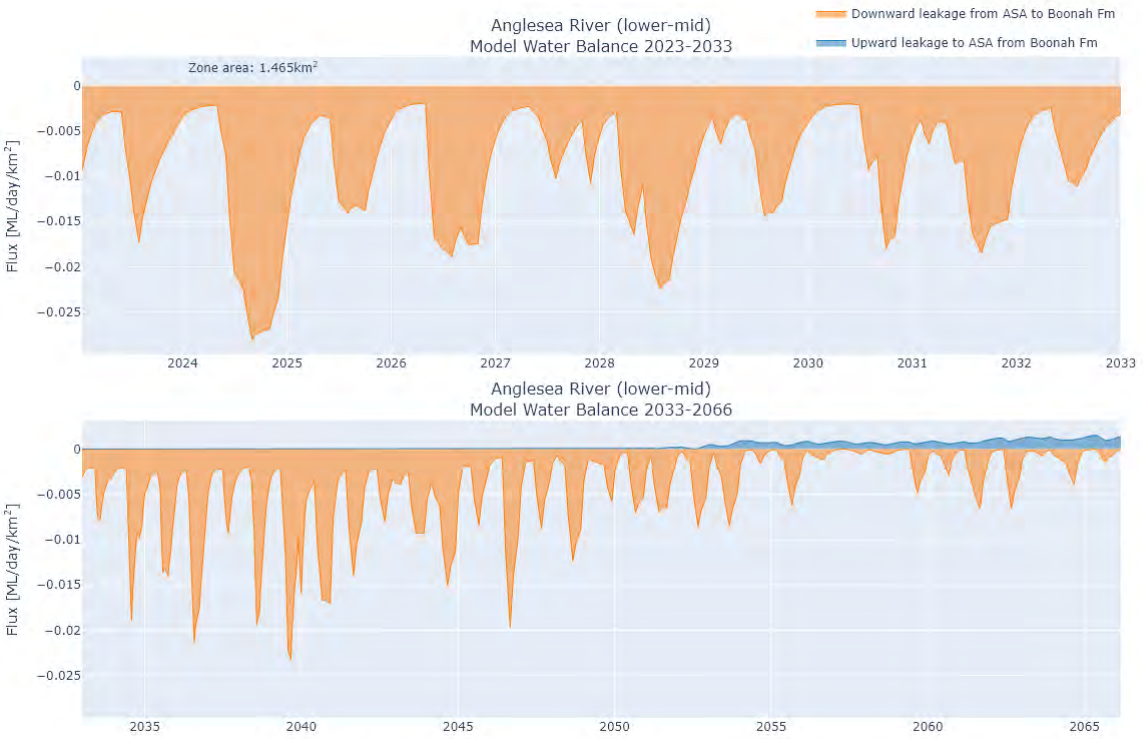

2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Modelled Mean Leakage to/from ASA
Salt Creek (lower)
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
Modelled Mean Leakage to/from ASA
Salt Creek (mid)
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.1
−0.2
−0.3
−0.4
−0.5
Modelled Mean Leakage to/from ASA
Salt Creek (upper)
Zone area: 0.9824km²
Flux [ML/day/km²]
0.08
0.06
0.04
0.02
0
−0.02
−0.04
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF

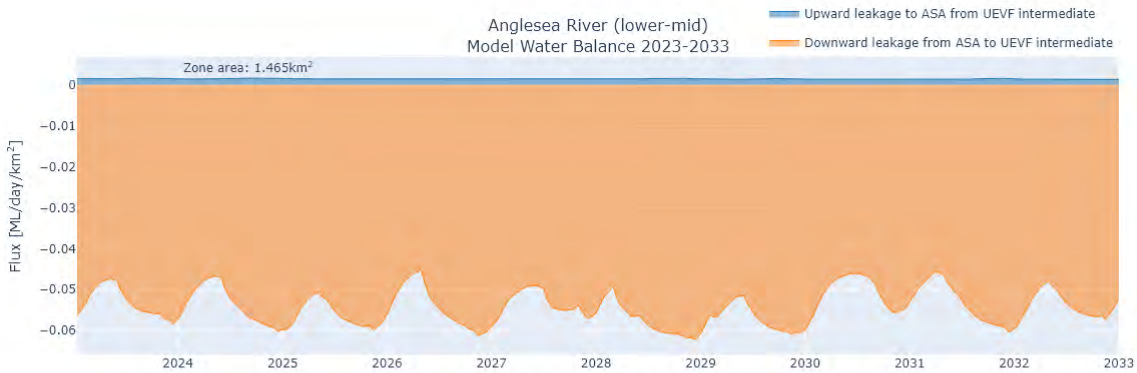
Timeseries ASA leakage to the various underlying HGUs for specified stream reaches (one plot each)

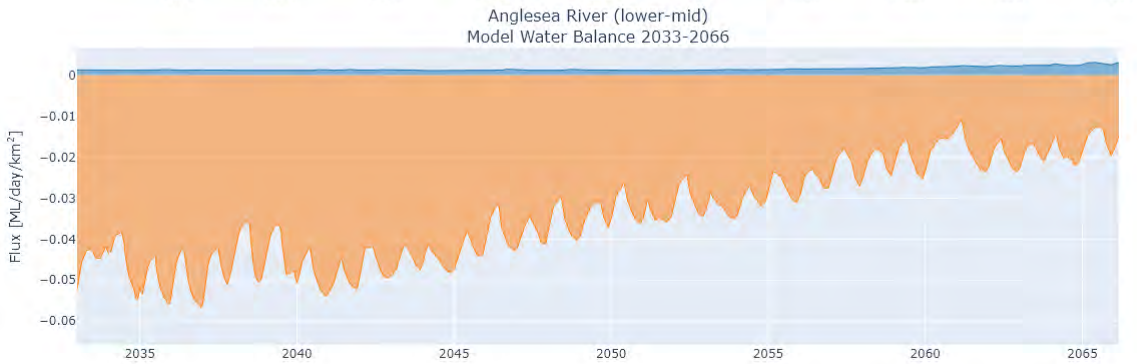


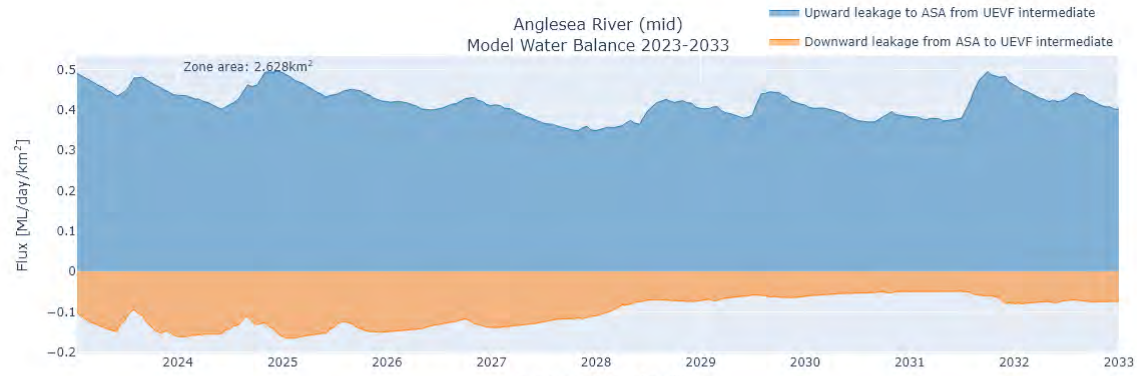


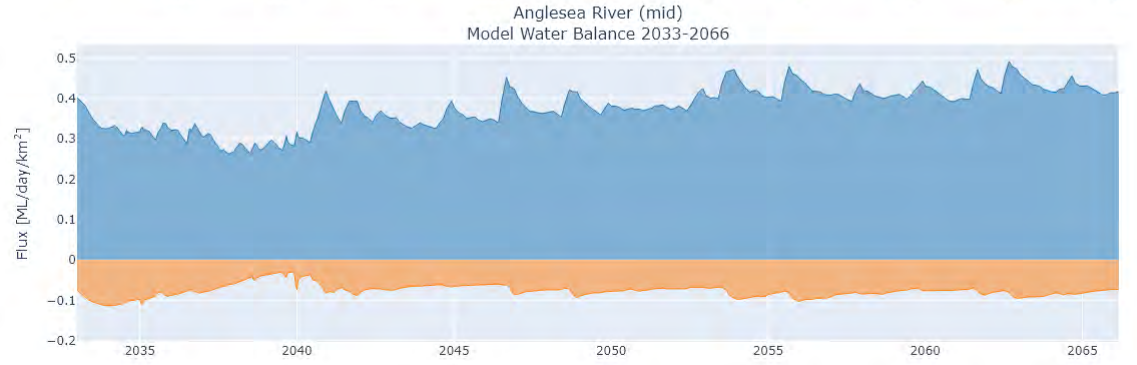


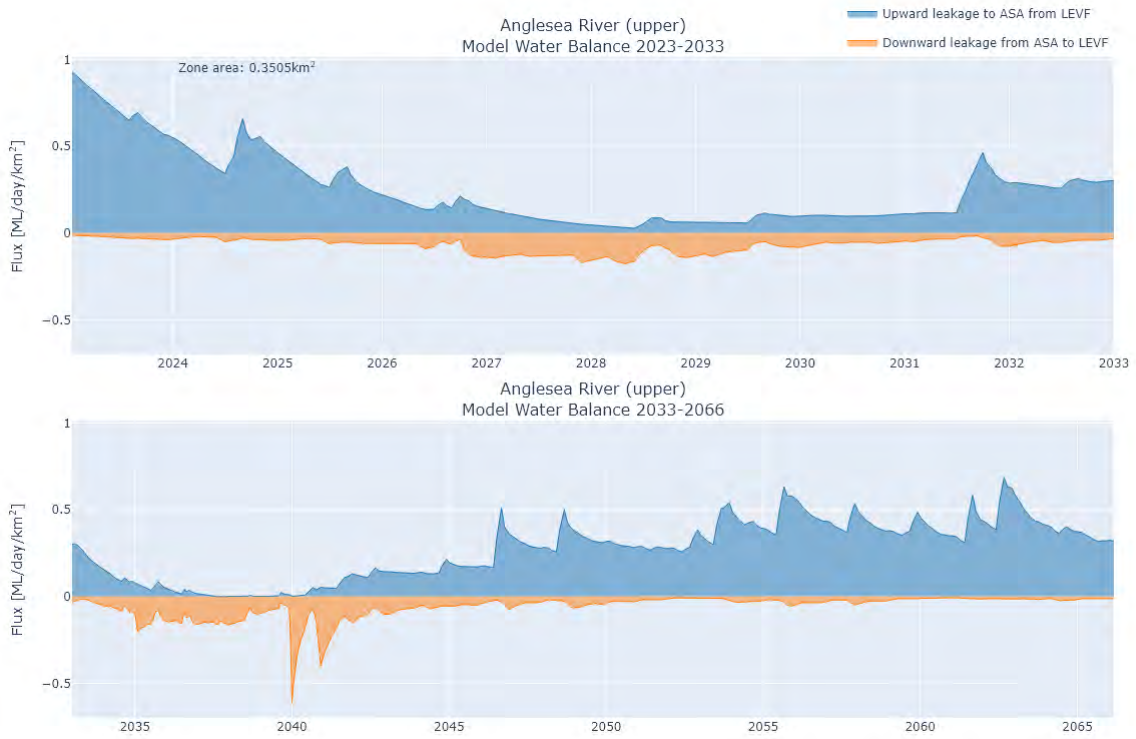

Anglesea River (lower-mid)
Model Water Balance 2023-2033
Downward leakage from ASA to Boonah Fm
Upward leakage to ASA from Boonah Fm
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Anglesea River (lower-mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.005
−0.01
−0.015
−0.02
−0.025
2035
2040
2045
2050
2055
2060
2065

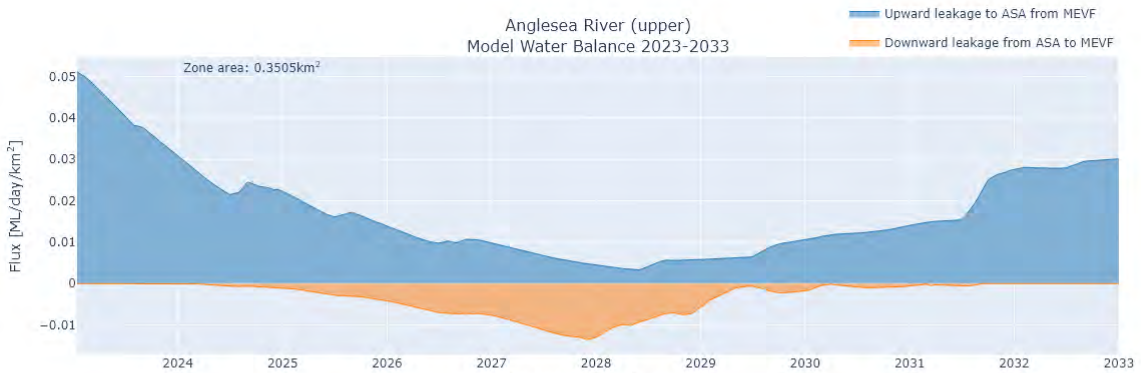

Anglesea River (lower-mid)
Model Water Balance 2023-2033
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 1.465km²
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

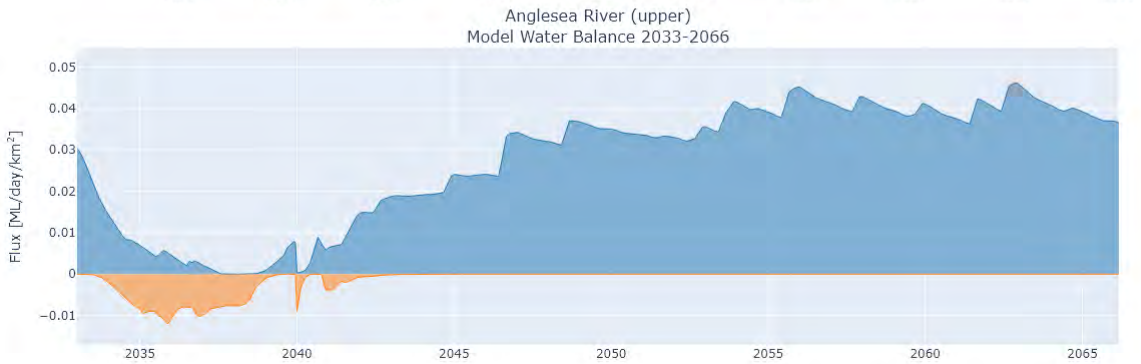

Anglesea River (lower-mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.01
−0.02
−0.03
−0.04
−0.05
−0.06
2035
2040
2045
2050
2055
2060
2065

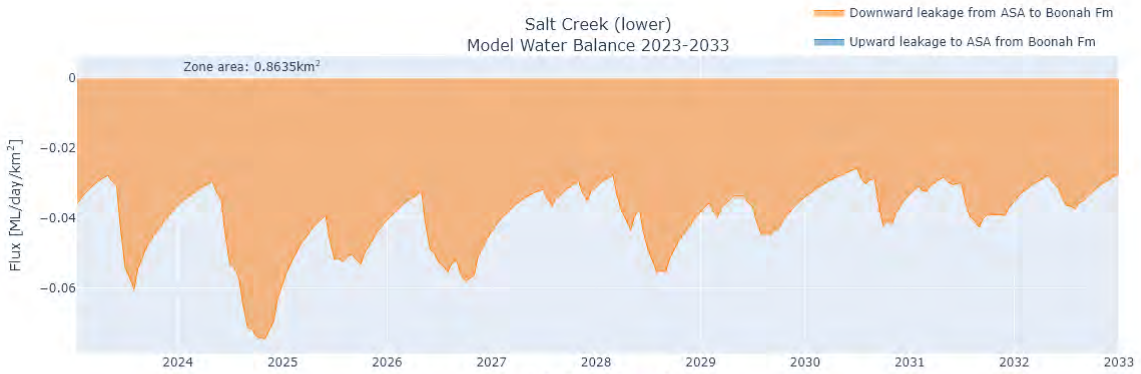

Anglesea River (mid)
Model Water Balance 2023-2033
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 2.628km²
Flux [ML/day/km²]
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

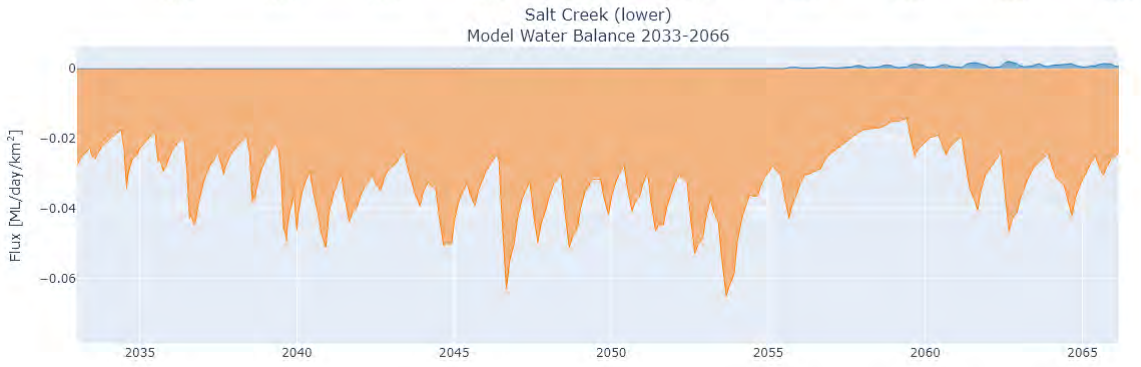

Anglesea River (mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
2035
2040
2045
2050
2055
2060
2065

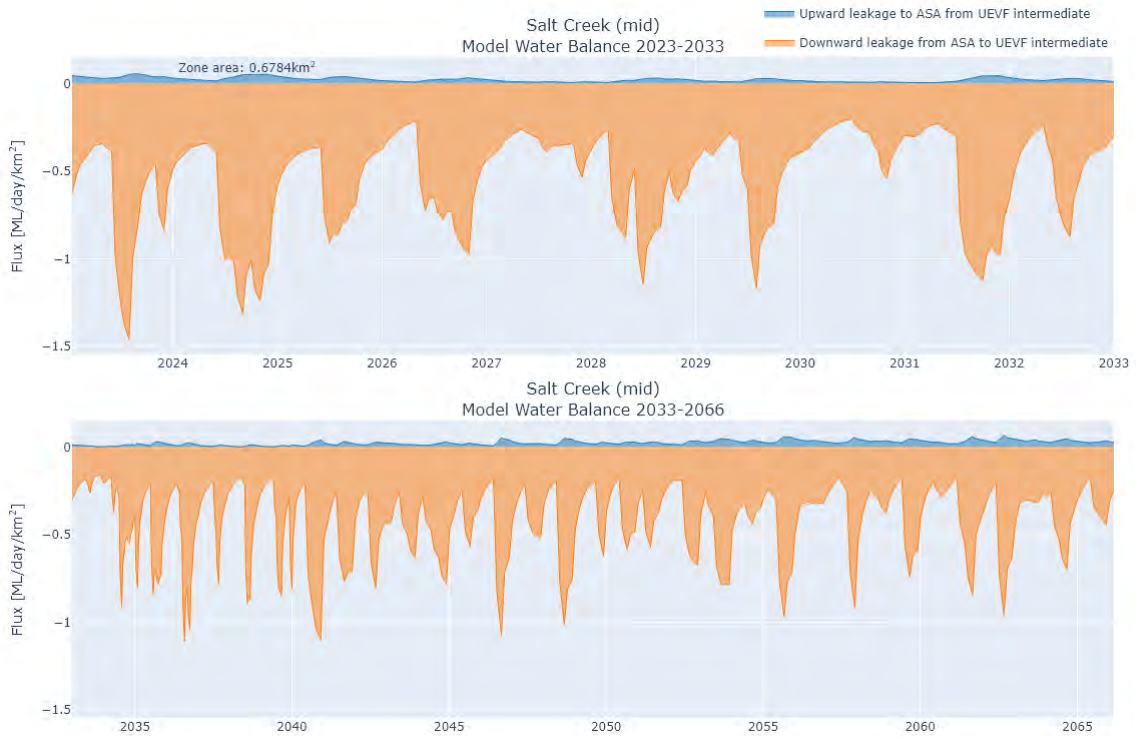

Anglesea River (upper)
Model Water Balance 2023-2033
Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Zone area: 0.3505km²
Flux [ML/day/km²]
1
0.5
0
−0.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Anglesea River (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
1
0.5
0
−0.5
2035
2040
2045
2050
2055
2060
2065

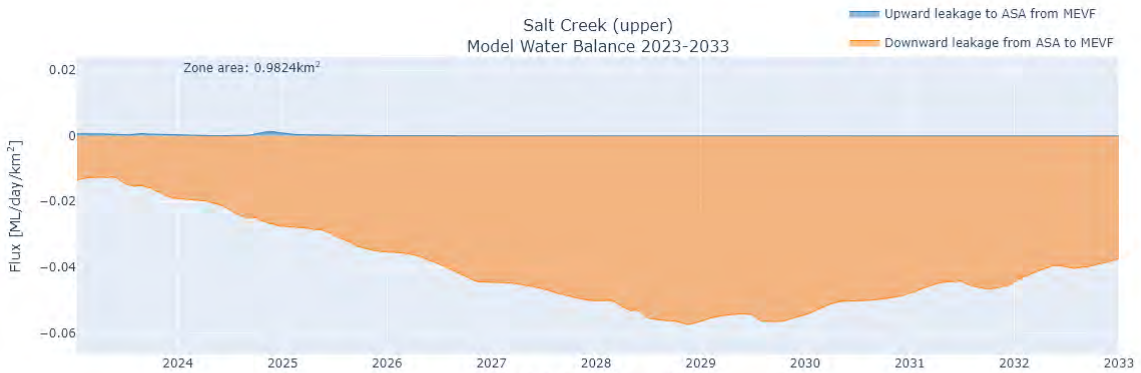

Anglesea River (upper)
Model Water Balance 2023-2033
Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Zone area: 0.3505km²
Flux [ML/day/km²]
0.05
0.04
0.03
0.02
0.01
0
−0.01
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

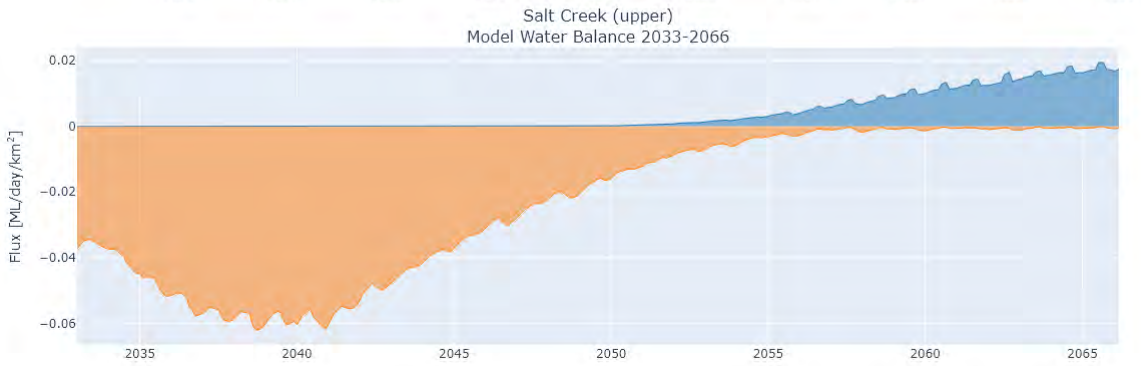

Anglesea River (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.05
0.04
0.03
0.02
0.01
0
−0.01
2035
2040
2045
2050
2055
2060
2065

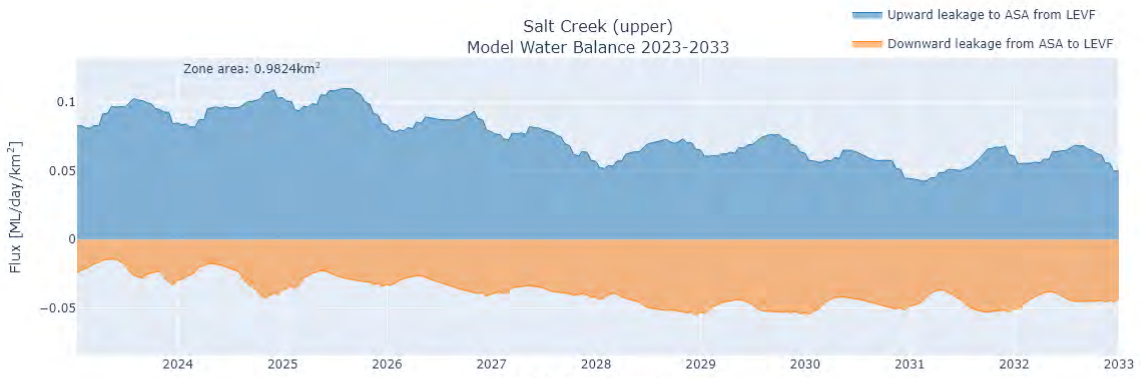

Salt Creek (lower)
Model Water Balance 2023-2033
Downward leakage from ASA to Boonah Fm
Upward leakage to ASA from Boonah Fm
Zone area: 0.8635km²
Flux [ML/day/km²]
0
−0.02
−0.04
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

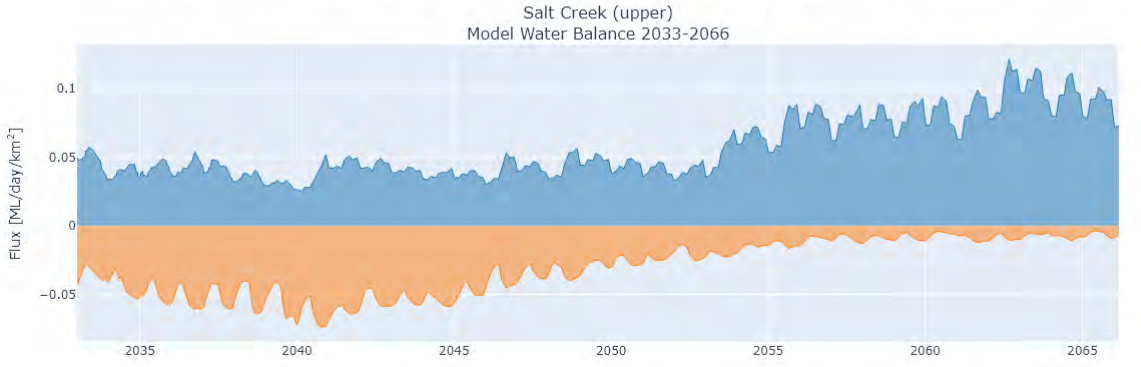

Salt Creek (lower)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.02
−0.04
−0.06
2035
2040
2045
2050
2055
2060
2065


Salt Creek (mid)
Model Water Balance 2023-2033
Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Zone area: 0.6784km²
Flux [ML/day/km²]
0
−0.5
−1
−1.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Salt Creek (mid)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0
−0.5
−1
−1.5
2035
2040
2045
2050
2055
2060
2065

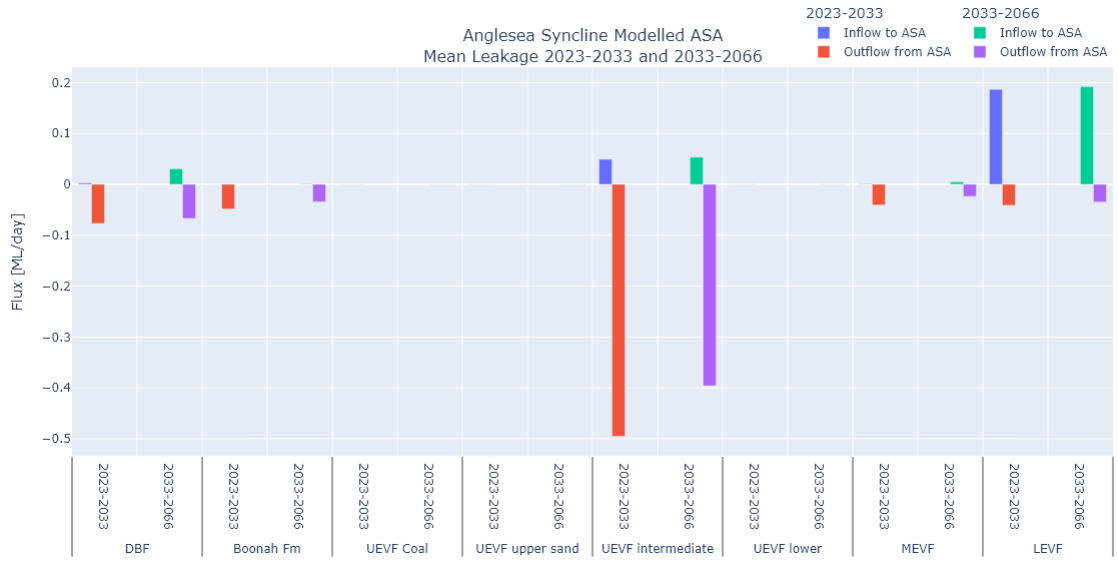

Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Salt Creek (upper)
Model Water Balance 2023-2033
Zone area: 0.9824km²
Flux [ML/day/km²]
0.02
0
−0.02
−0.04
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

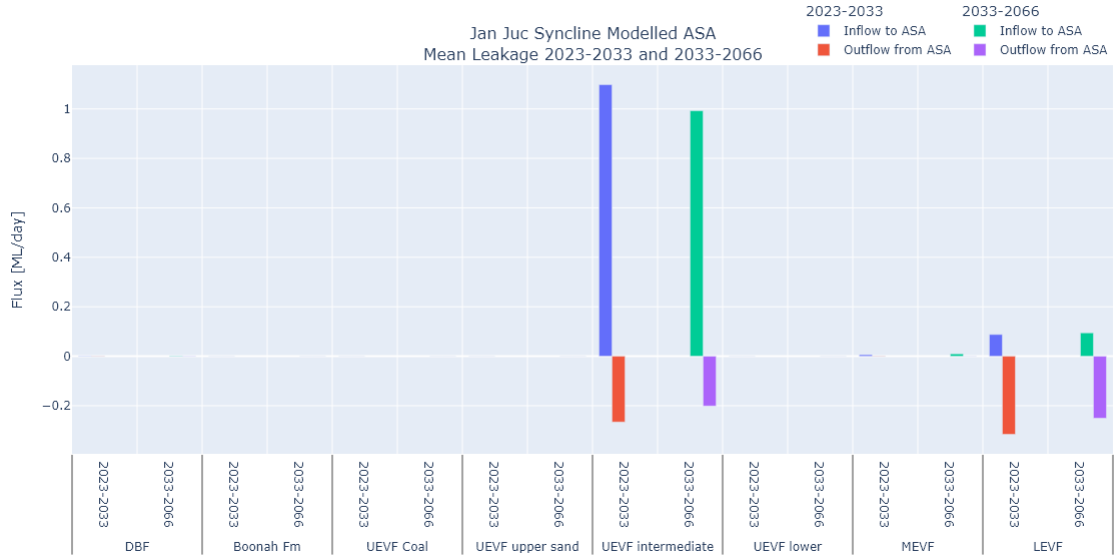

Salt Creek (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.02
0
−0.02
−0.04
−0.06
2035
2040
2045
2050
2055
2060
2065

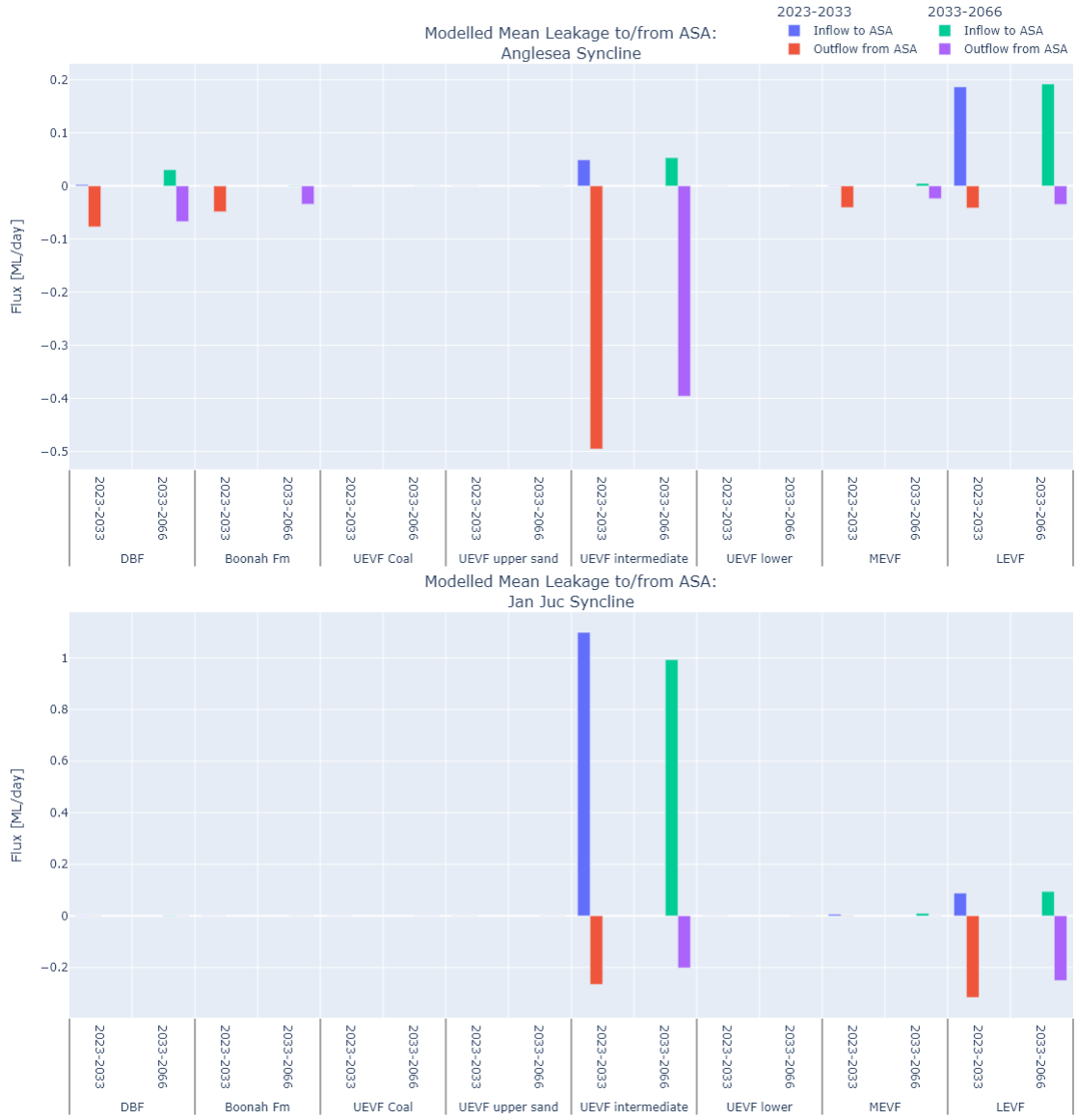

Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Salt Creek (upper)
Model Water Balance 2023-2033
Zone area: 0.9824km²
Flux [ML/day/km²]
0.1
0.05
0
−0.05
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033


Salt Creek (upper)
Model Water Balance 2033-2066
Flux [ML/day/km²]
0.1
0.05
0
−0.05
2035
2040
2045
2050
2055
2060
2065

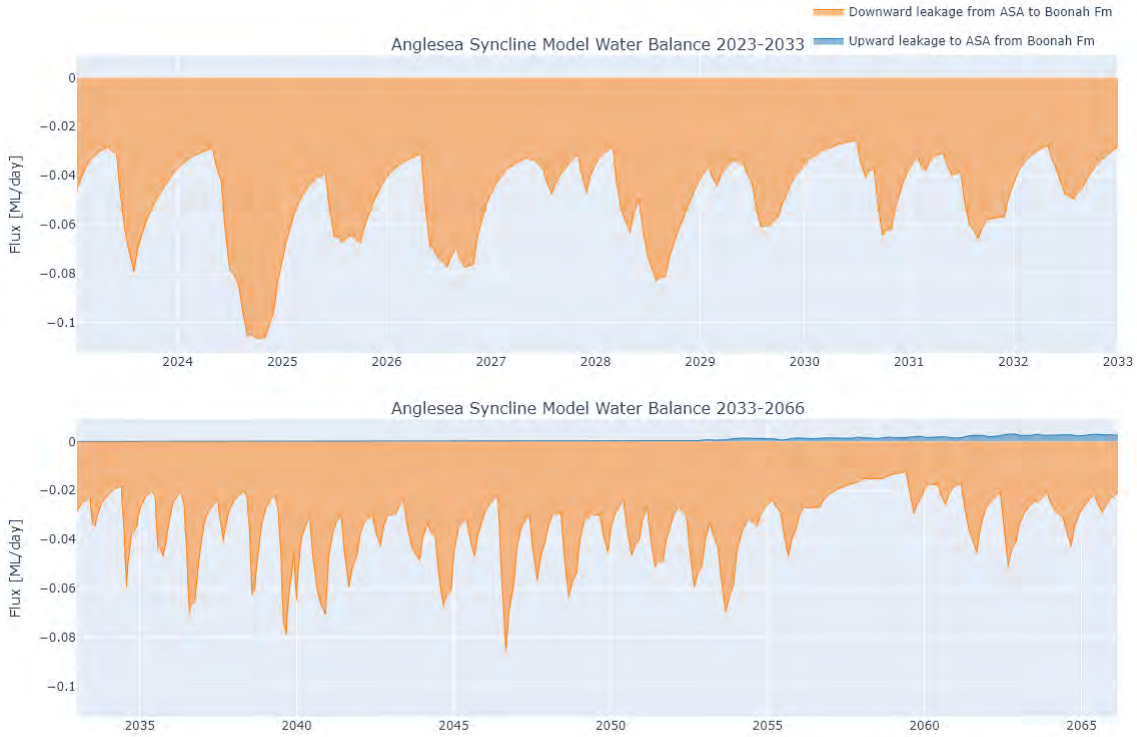
Mean ASA leakage to the various underlying HGUs for each of the Anglesea and Jan Juc Synclines (on plot each) and Single plot showing both syncline charts of mean ASA leakage per HGU.

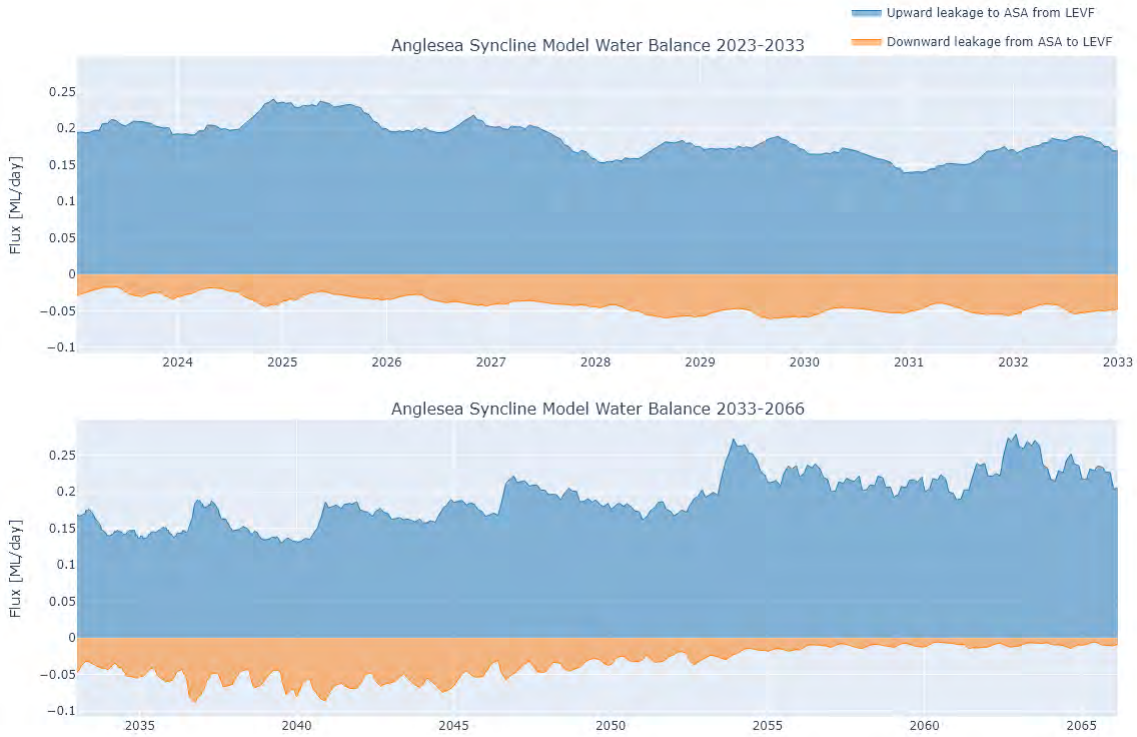


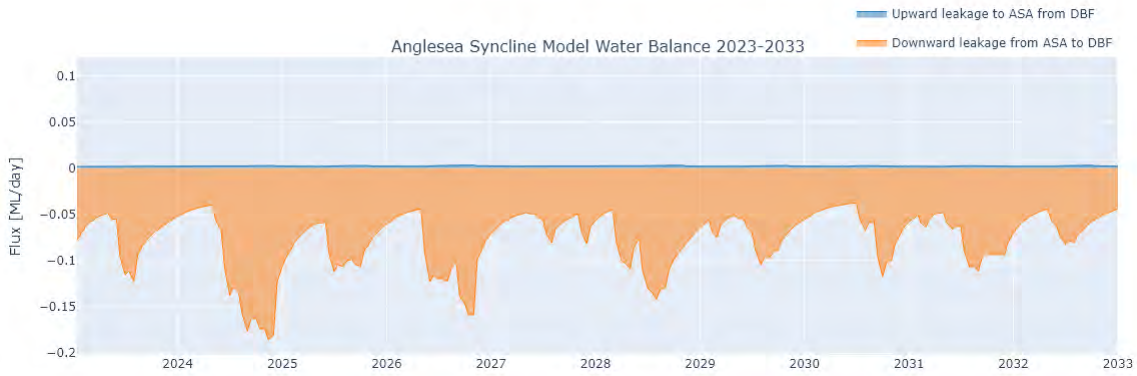


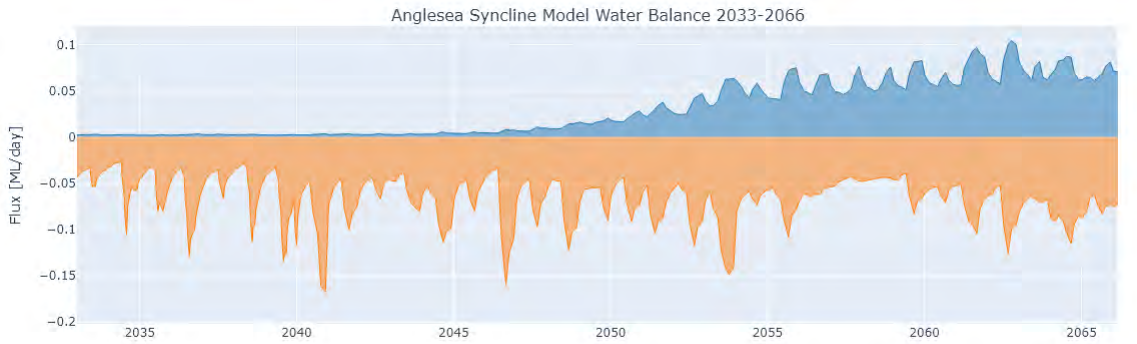

Modelled Mean Leakage to/from ASA:
Anglesea Syncline
2023-2033
Inflow to ASA
Outflow from ASA
2033-2066
Inflow to ASA
Outflow from ASA
Flux [ML/day]
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
2023-2033
2033-2066
DBF
Boonah Fm
UEVF Coal
UEVF upper sand
UEVF intermediate
UEVF lower
MEVF
LEVF
Modelled Mean Leakage to/from ASA:
Jan Juc Syncline
Flux [ML/day]
1
0.8
0.6
0.4
0.2
0
−0.2

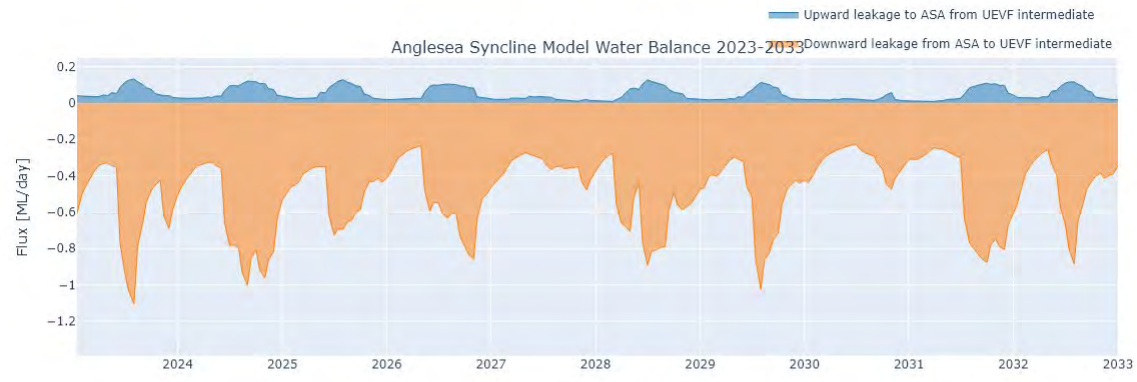
Timeseries ASA leakage per HGU, for each of the Jan Juc and Anglesea Synclines.

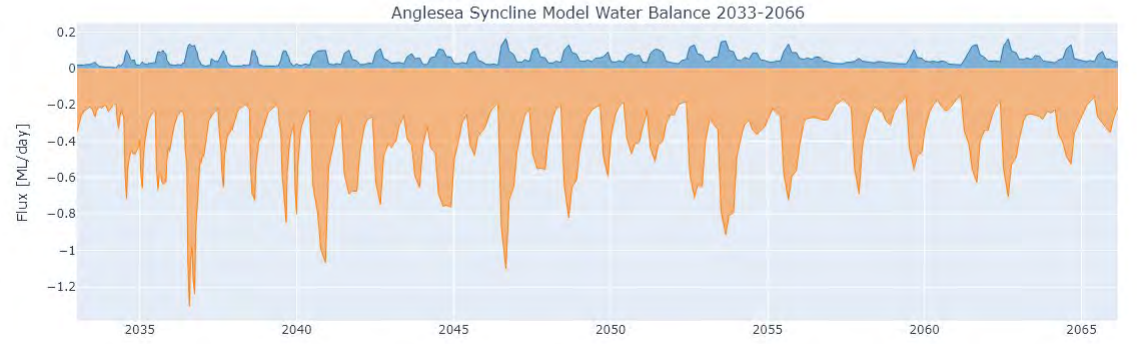


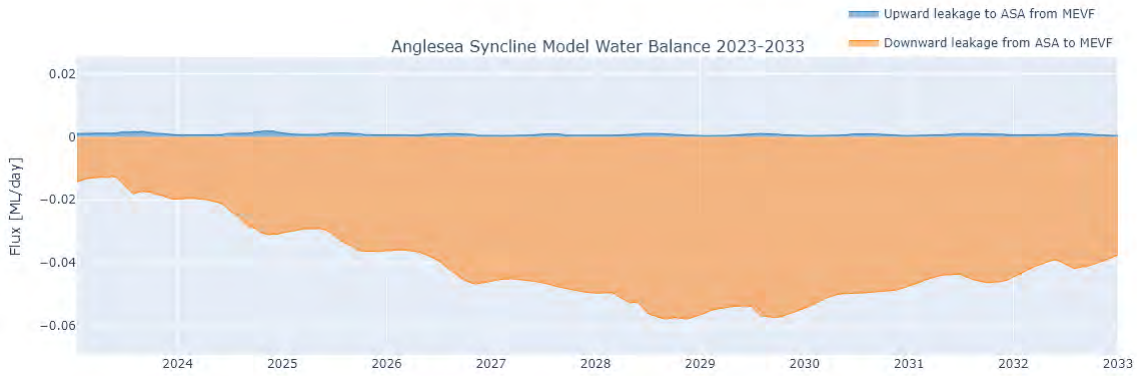


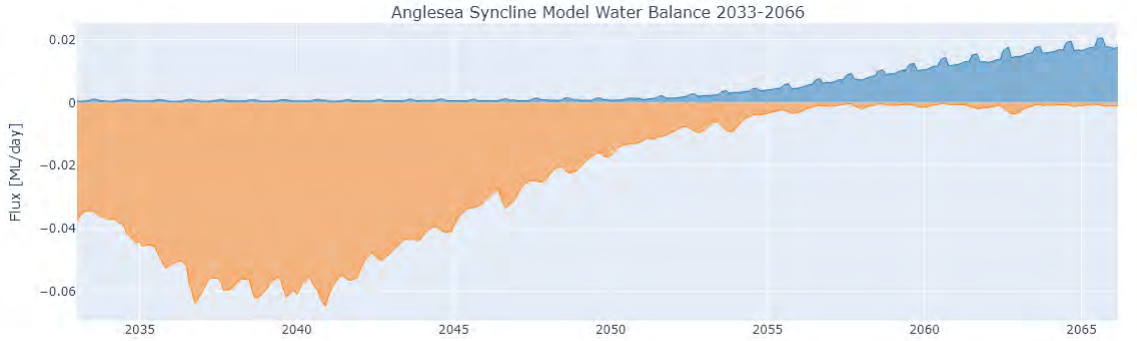

Upward leakage to ASA from DBF
Downward leakage from ASA to DBF
Anglesea Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

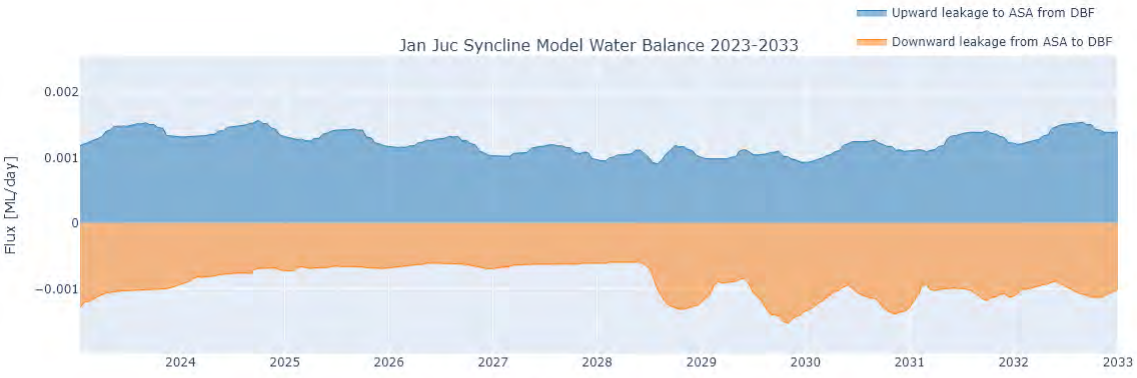

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.1
0.05
0
−0.05
−0.1
−0.15
−0.2
2035
2040
2045
2050
2055
2060
2065

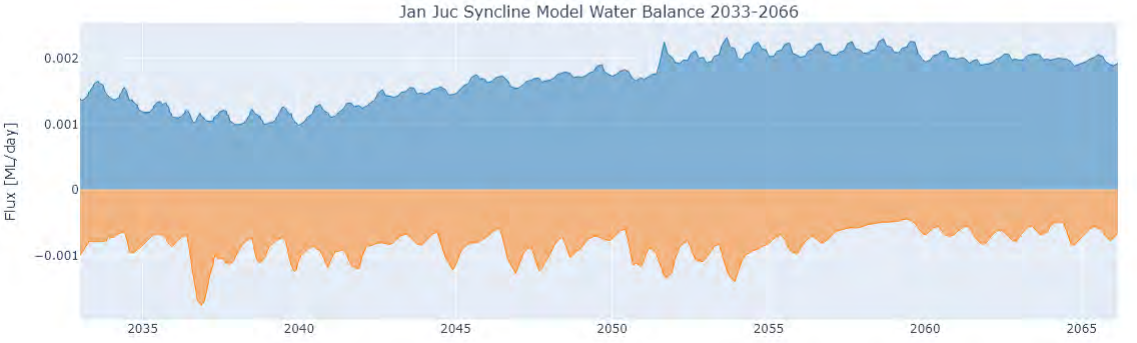

Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Anglesea Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

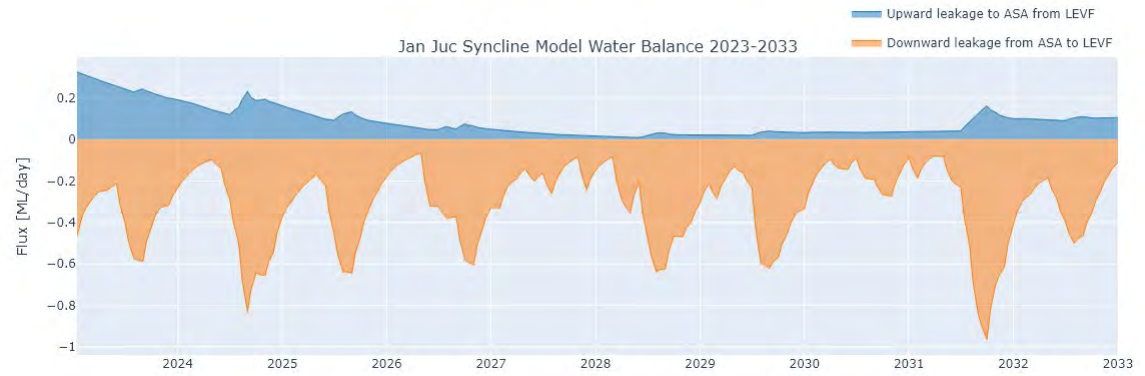

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
2035
2040
2045
2050
2055
2060
2065

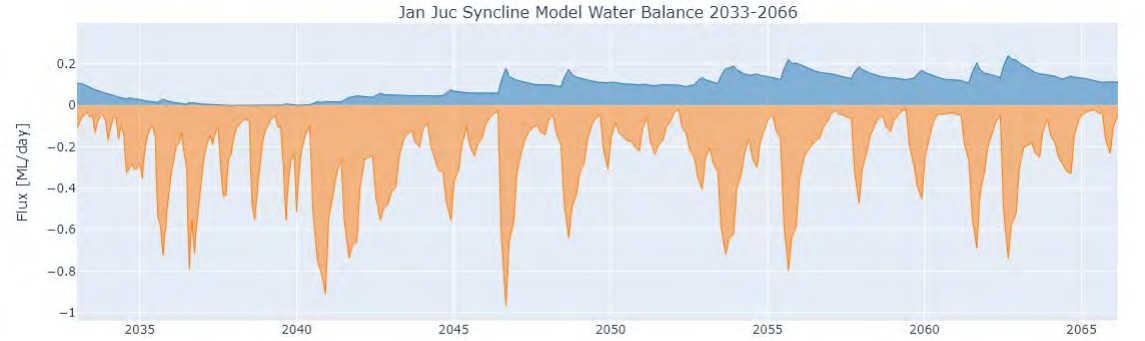

Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Anglesea Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.02
0
−0.02
−0.04
−0.06
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

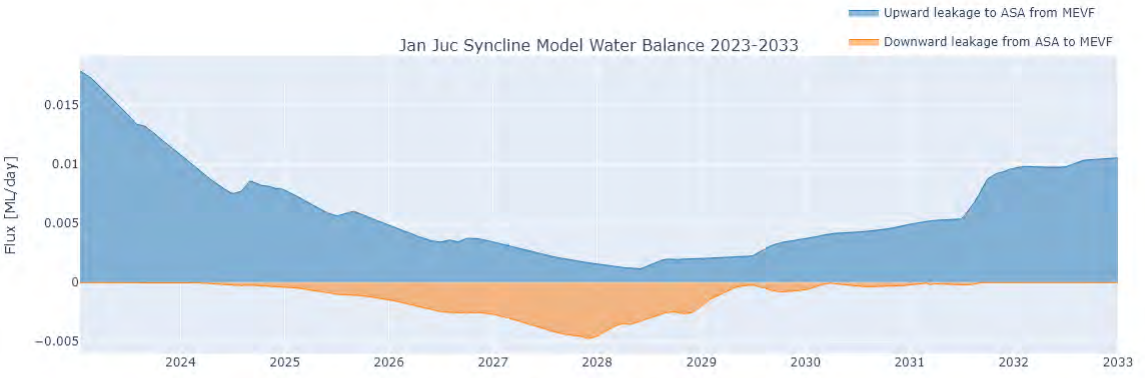

Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.02
0
−0.02
−0.04
−0.06
2035
2040
2045
2050
2055
2060
2065

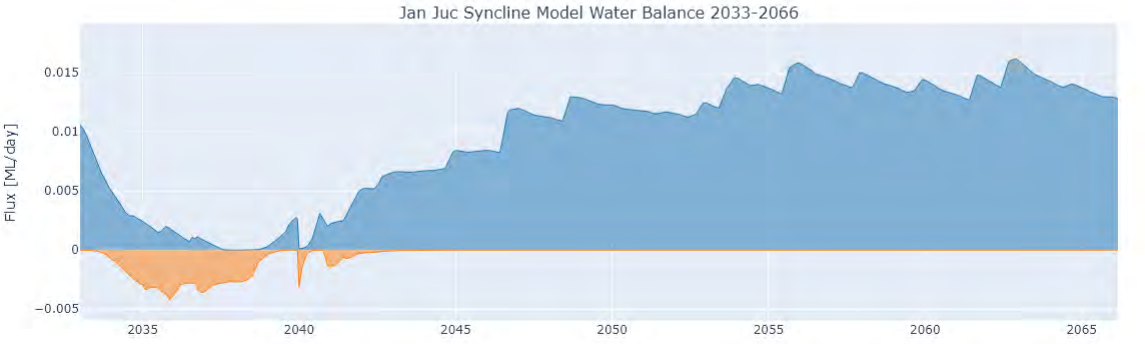

Upward leakage to ASA from DBF
Downward leakage from ASA to DBF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.002
0.001
0
−0.001
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033


Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.002
0.001
0
−0.001
2035
2040
2045
2050
2055
2060
2065


Upward leakage to ASA from LEVF
Downward leakage from ASA to LEVF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033


Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
2035
2040
2045
2050
2055
2060
2065


Upward leakage to ASA from MEVF
Downward leakage from ASA to MEVF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
0.015
0.01
0.005
0
−0.005
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033


Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
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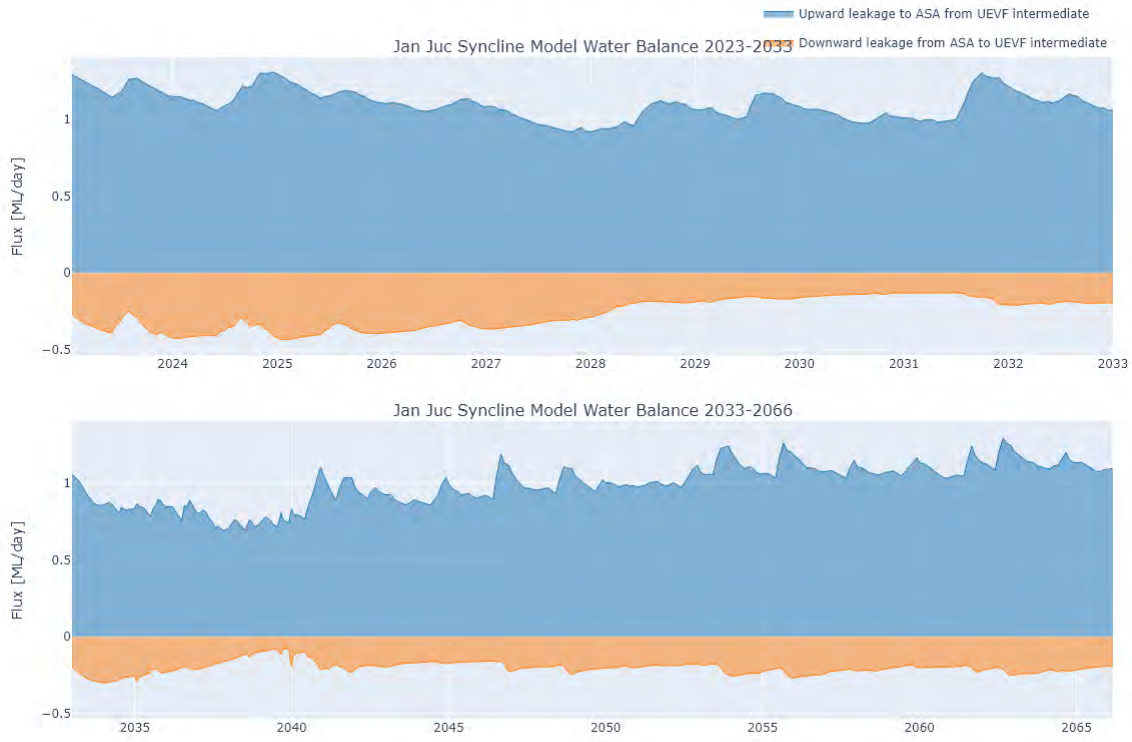
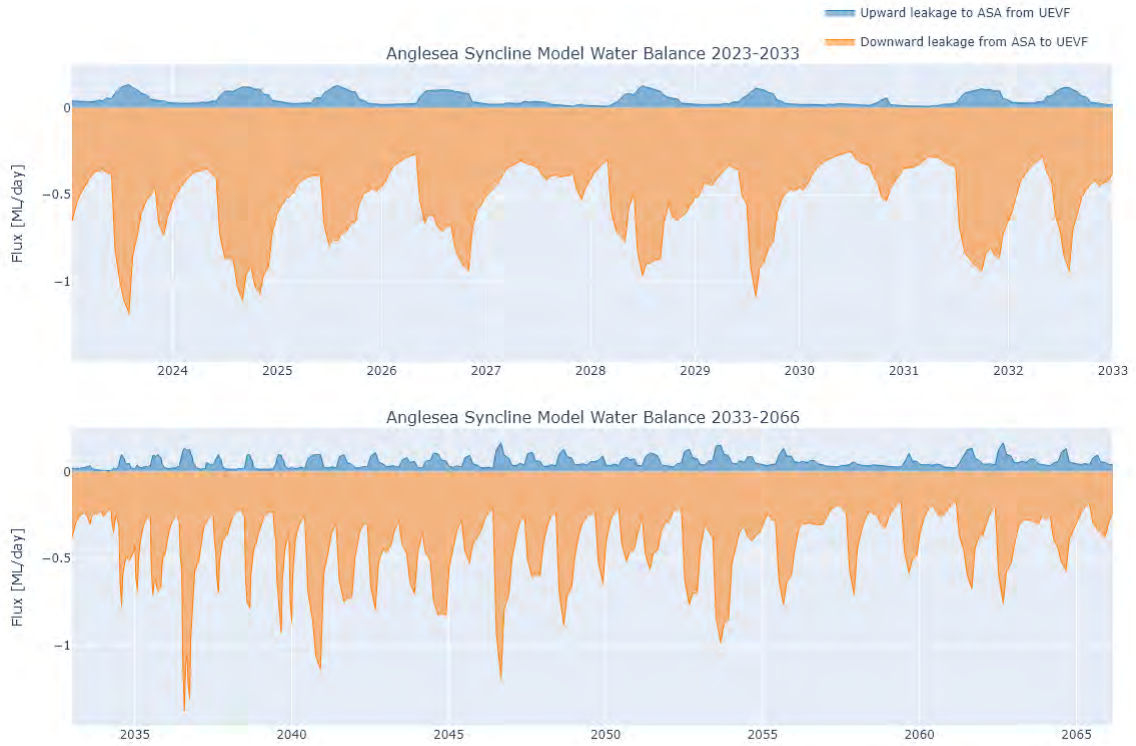
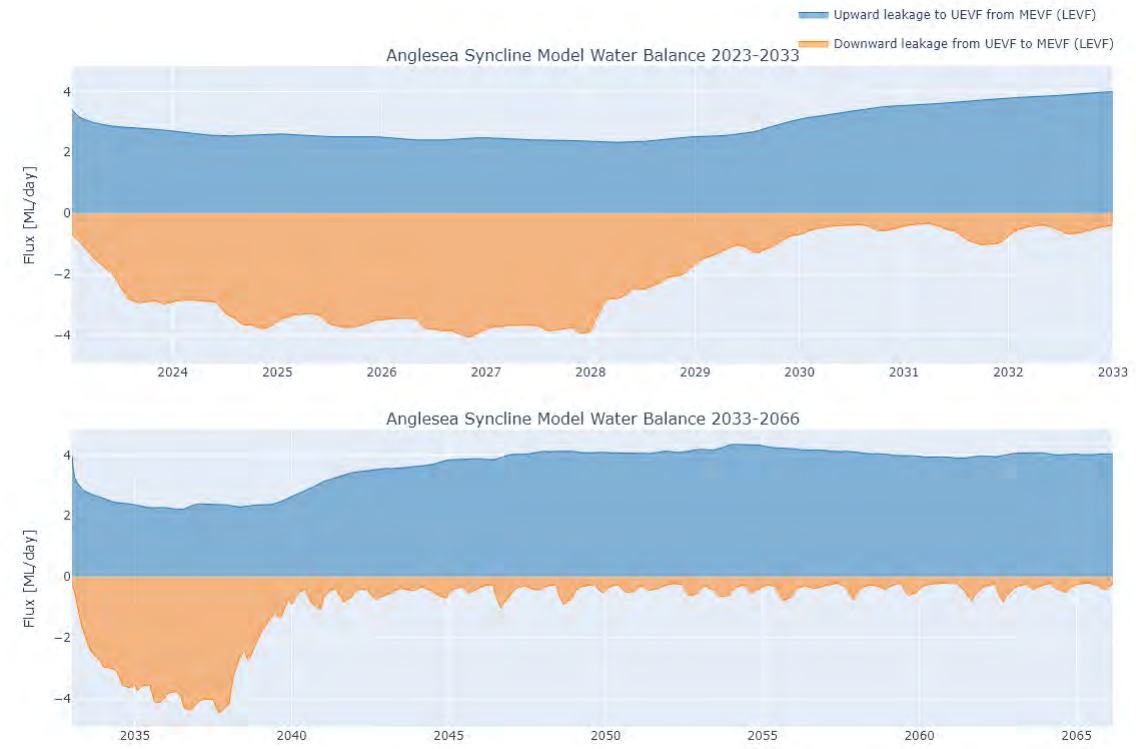
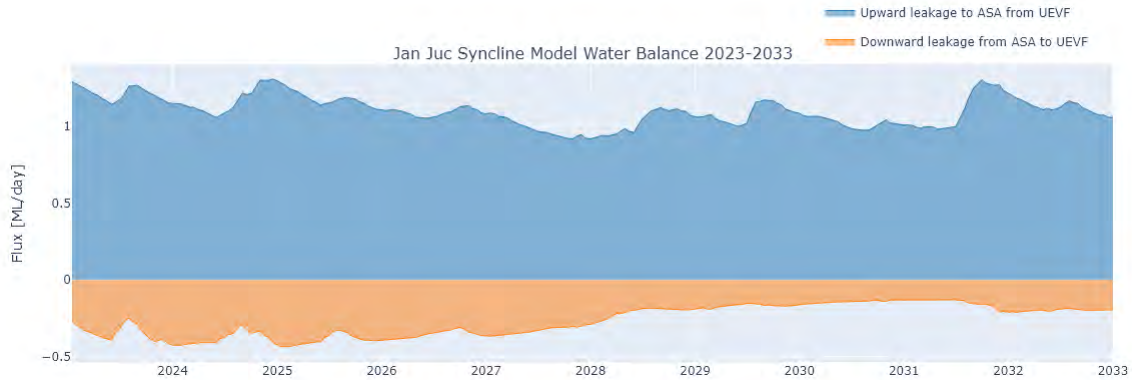
0.01
0.005
0
−0.005
2035
2040
2045
2050
2055
2060
2065

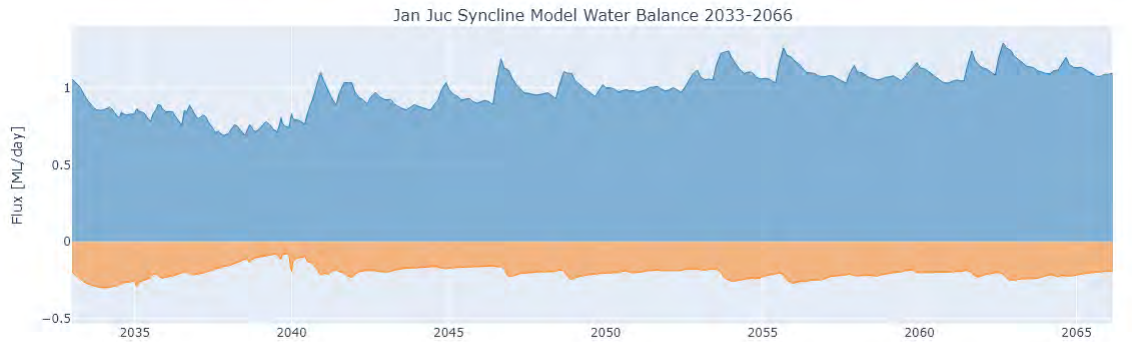

Upward leakage to ASA from UEVF intermediate
Downward leakage from ASA to UEVF intermediate
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
1
0.5
0
−0.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
1
0.5
0
−0.5
2035
2040
2045
2050
2055
2060
2065

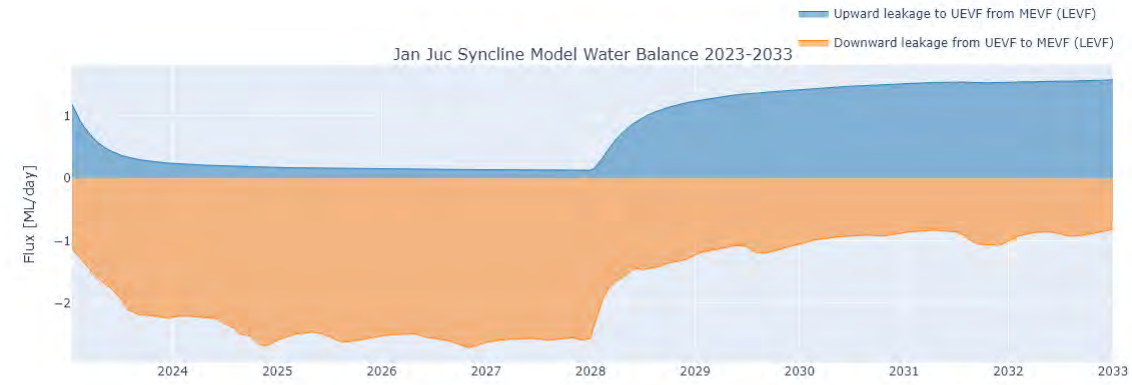
ASA-UEVF inter-aquifer flow by HGU (anglesea/jan juc synclines)

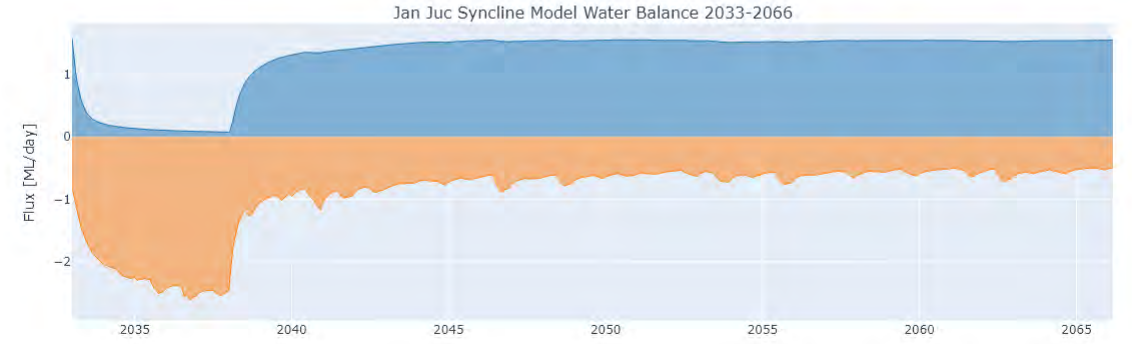




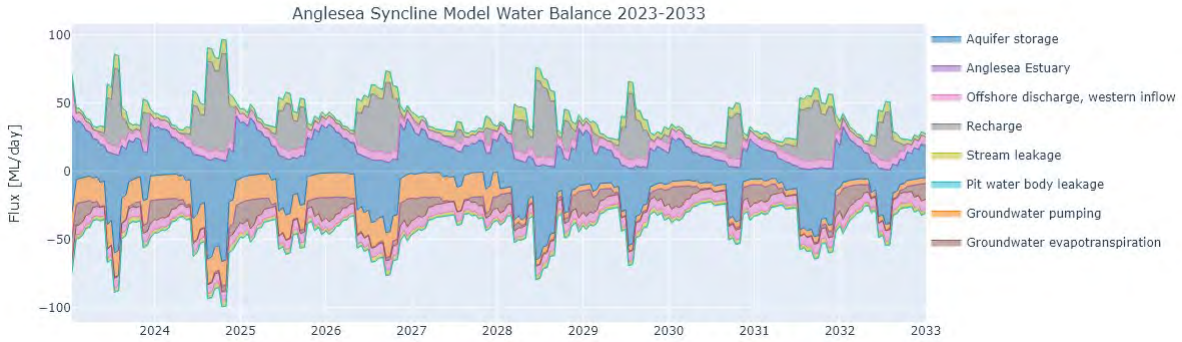

Upward leakage to ASA from UEVF
Downward leakage from ASA to UEVF
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
1
0.5
0
−0.5
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

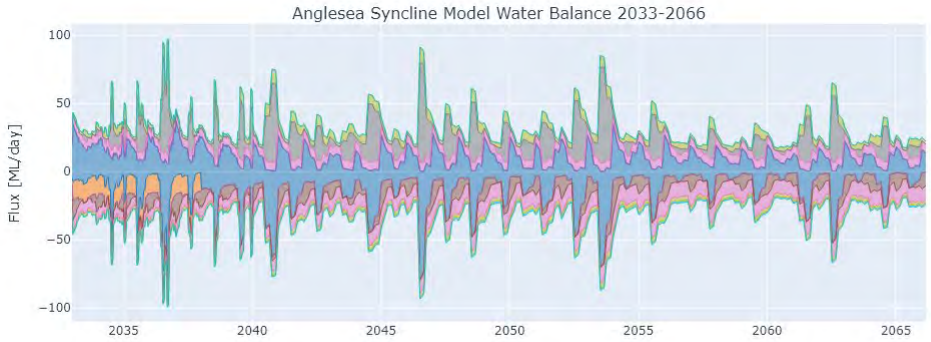

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
1
0.5
0
−0.5
2035
2040
2045
2050
2055
2060
2065

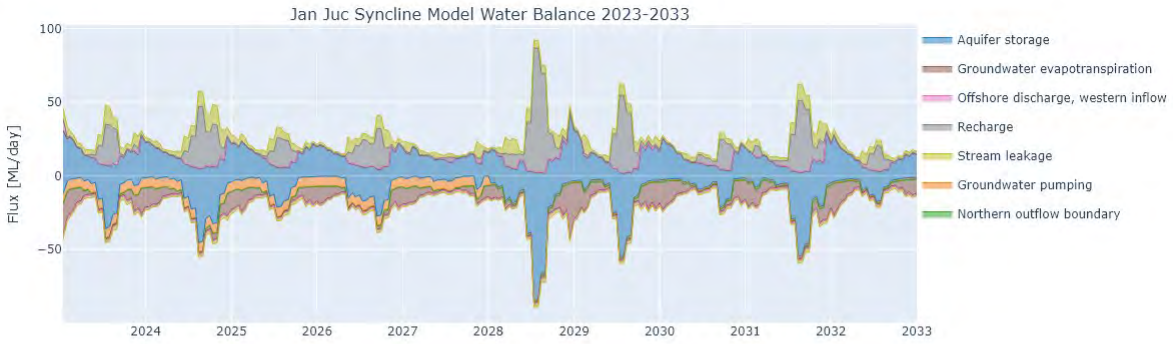

Upward leakage to UEVF from MEVF (LEVF)
Downward leakage from UEVF to MEVF (LEVF)
Jan Juc Syncline Model Water Balance 2023-2033
Flux [ML/day]
1
0
−1
−2
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033

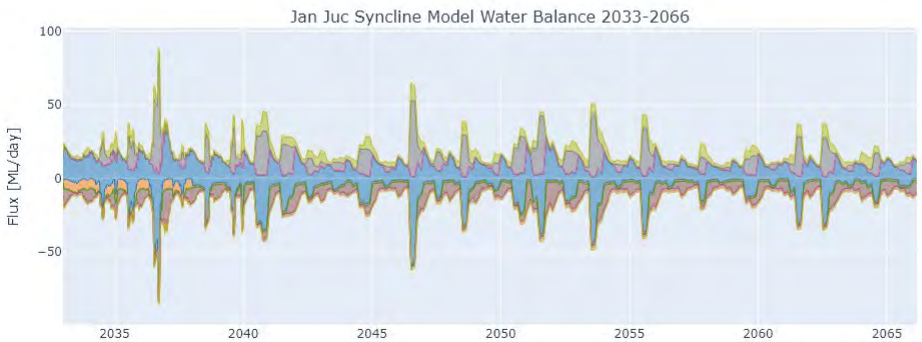

Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
1
0
−1
−2
2035
2040
2045
2050
2055
2060
2065

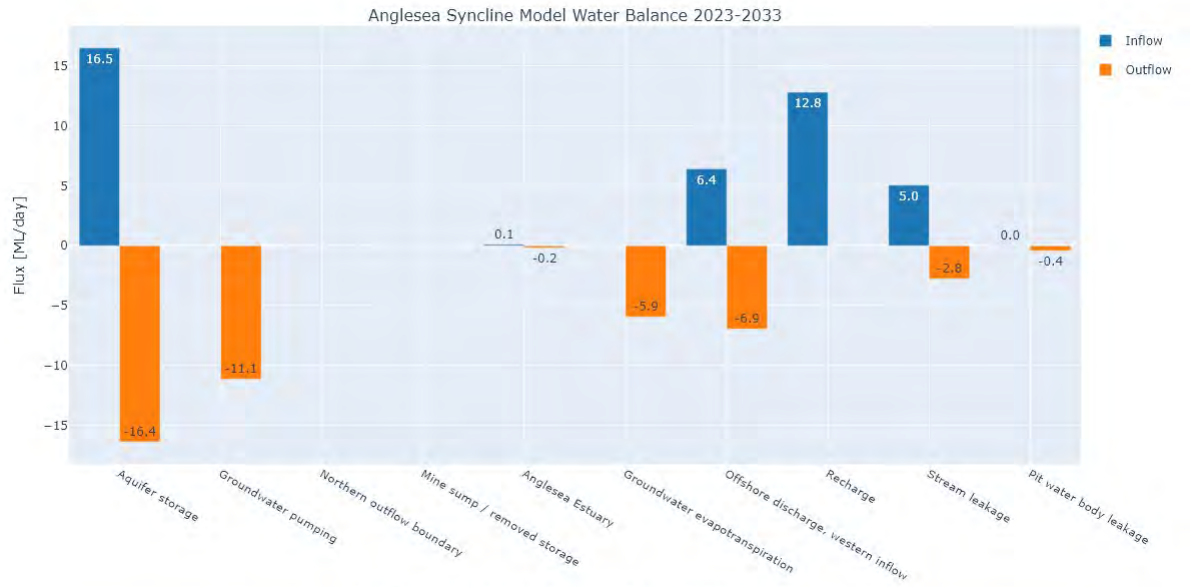
Water balance flow components for all layers as a whole (anglesea and jan juc syncline)

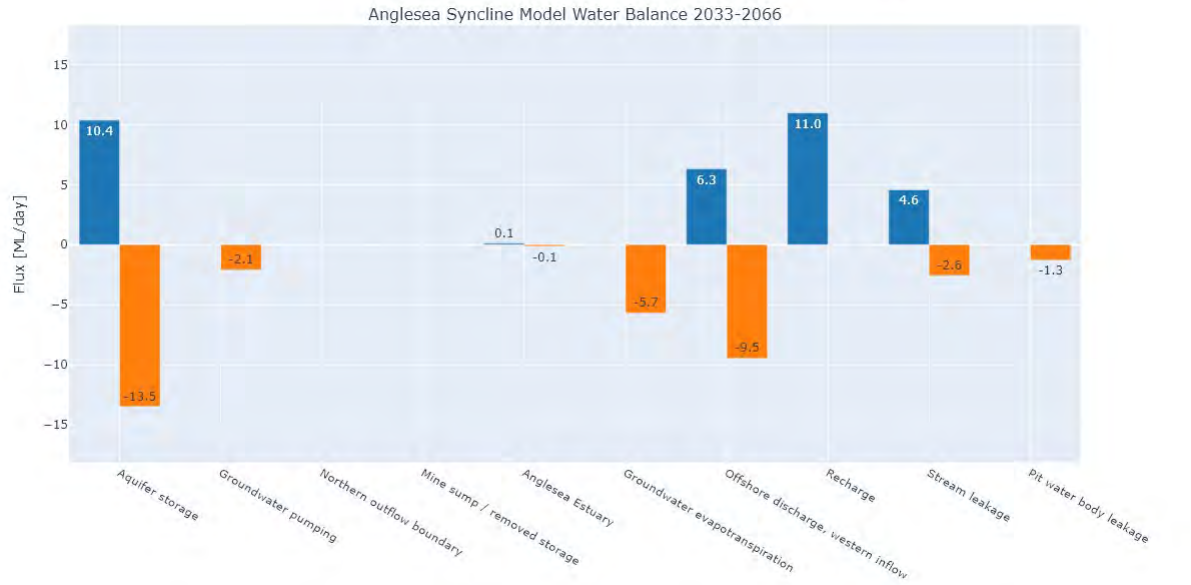


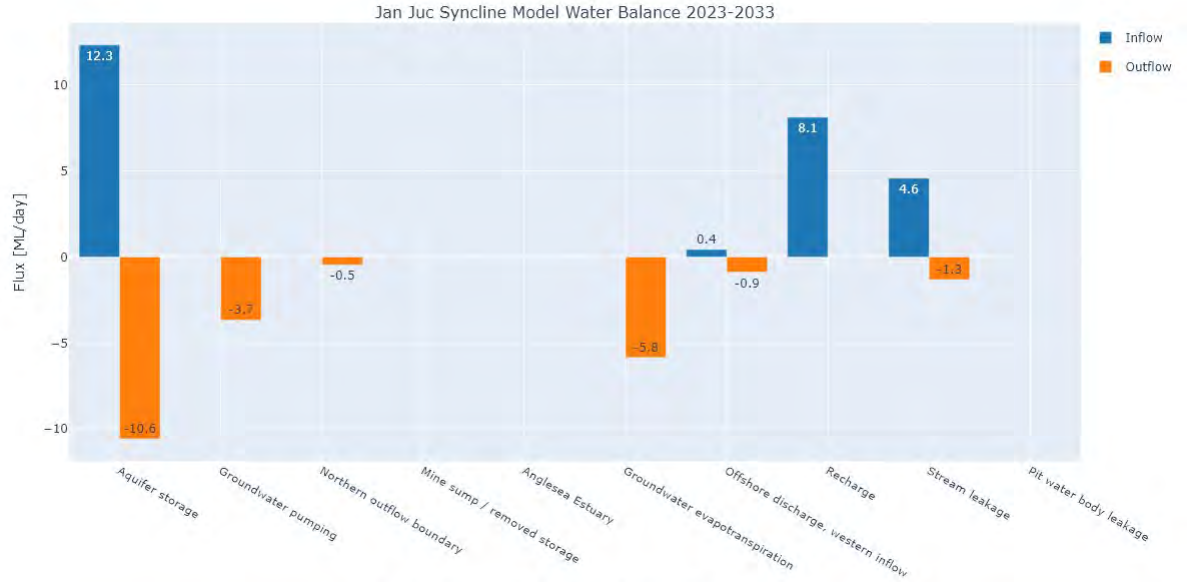


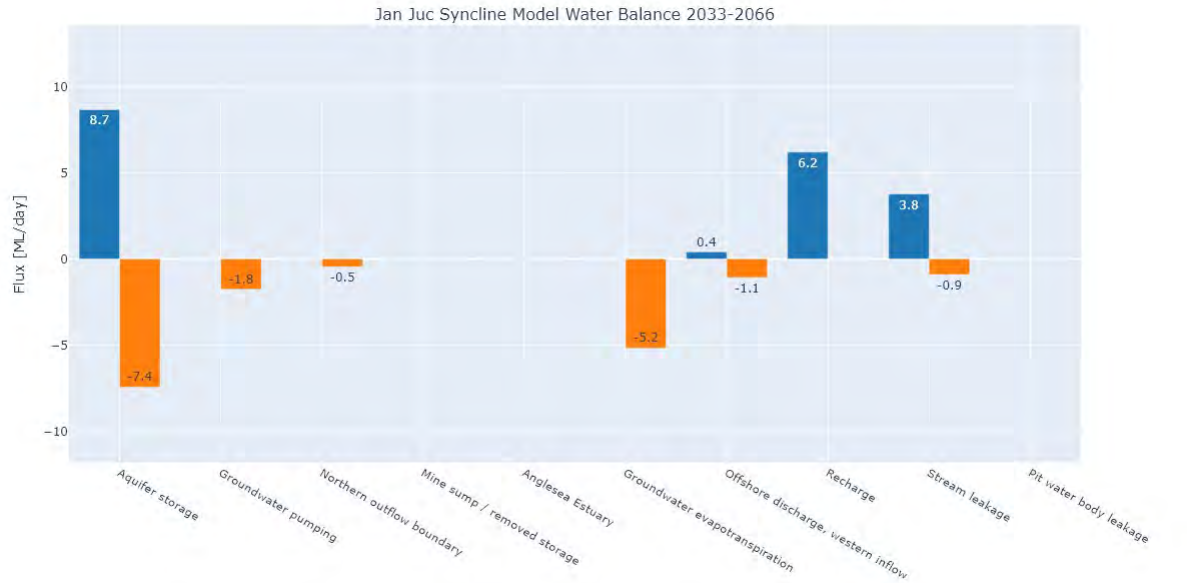




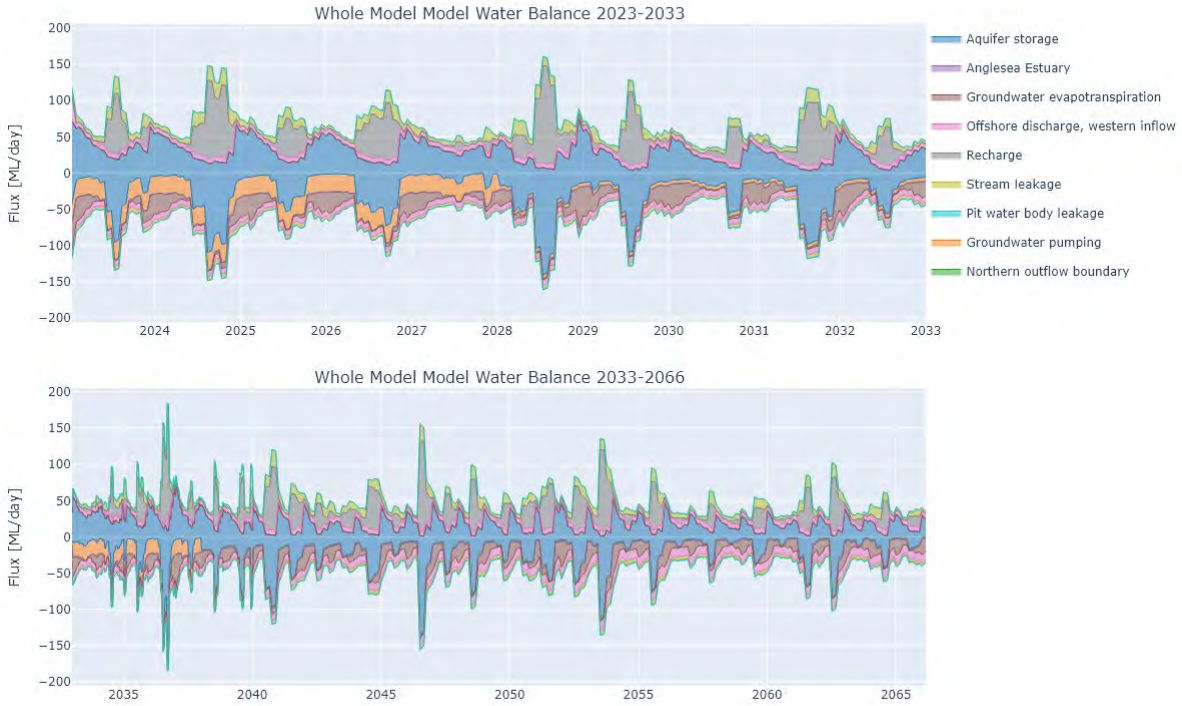

Anglesea Syncline Model Water Balance 2023-2033
Inflow
Outflow
Flux [ML/day]
16.5
-16.4
-11.1
0.1
-0.2
-5.9
6.4
-6.9
12.8
5.0
-2.8
0.0
-0.4
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage


Anglesea Syncline Model Water Balance 2033-2066
Flux [ML/day]
10.4
-13.5
-2.1
0.1
-0.1
-5.7
6.3
-9.5
11.0
4.6
-2.6
-1.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

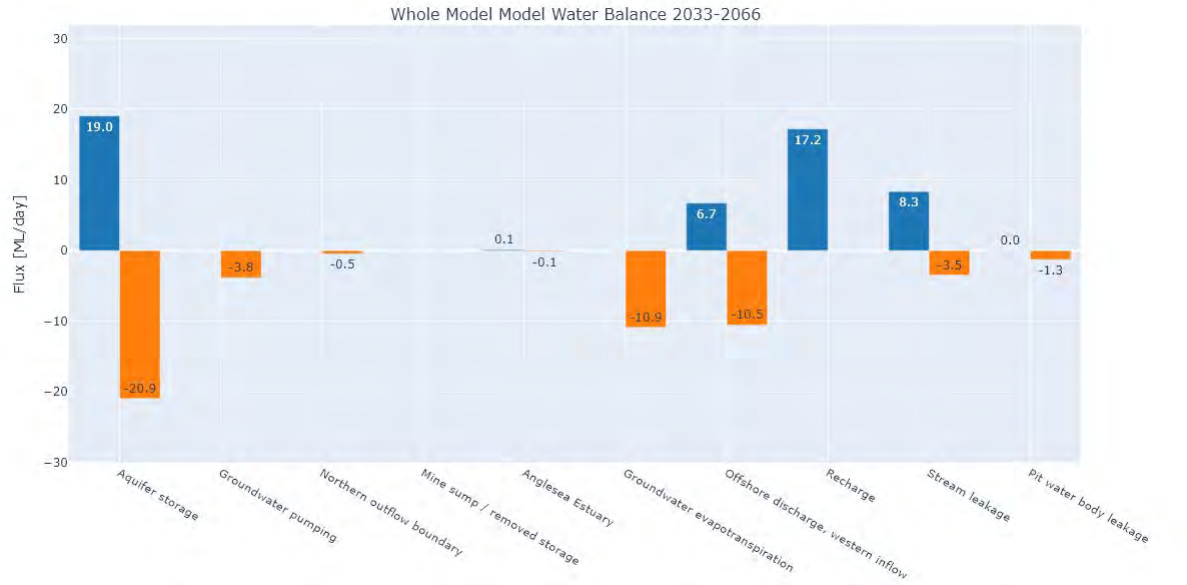

Jan Juc Syncline Model Water Balance 2023-2033
Inflow
Outflow
Flux [ML/day]
12.3
-10.6
-3.7
-0.5
-5.8
0.4
-0.9
8.1
4.6
-1.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage


Jan Juc Syncline Model Water Balance 2033-2066
Flux [ML/day]
8.7
-7.4
-1.8
-0.5
-5.2
0.4
-1.1
6.2
3.8
-0.9
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

Water balance flow components for all layers as a whole (over full model domain)



Whole Model Model Water Balance 2023-2033
Inflow
Outflow
Flux [ML/day]
30
20
10
0
−10
−20
−30
28.8
-26.9
-14.8
-0.5
0.1
-0.2
-11.8
6.8
-7.8
20.9
9.6
-4.1
0.0
-0.4
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage


Whole Model Model Water Balance 2033-2066
Flux [ML/day]
30
20
10
0
−10
−20
−30
19.0
-20.9
-3.8
-0.5
0.1
-0.1
-10.9
6.7
-10.5
17.2
8.3
-3.5
0.0
-1.3
Aquifer storage
Groundwater pumping
Northern outflow boundary
Mine sump / removed storage
Anglesea Estuary
Groundwater evapotranspiration
Offshore discharge, western inflow
Recharge
Stream leakage
Pit water body leakage

Appendix G Quarterly Reporting Template

Mine Groundwater Monitoring

QUARTERLY UPDATE NOVEMBER 2024

This quarterly update provides a status of groundwater levels for key monitoring bores, including any groundwater extraction from the Upper Eastern View Formation (UEVF) aquifer, for the Anglesea Mine.

Note that the groundwater pumping test commenced on 13 May 2021, and was completed on 8 December 2021. No groundwater has been extracted since.

In summary:

- This report provides the quarterly update based on the November groundwater monitoring event data collection on 14 November 2024.
- No water was extracted during this period and total rainfall for the three-month period 12 August to 14 November was 147.4 mm. Note that rainfall in the previous quarter 8 May to 12 August was 123.6 mm.
- As of 10 October 2024, the water level was RL -15.40 which represents approx. 19.3% of the proposed full volume of the waterbody. (Relative level, or RL, is the water level in metres below sea level.).
- No water has been extracted since 8 December 2021, and the groundwater level in the lower part of the UEVF has returned to its pre-test level. Refer to Graph 1.
- There is no change to groundwater level behaviour in the upper part of the UEVF aquifer which is gradually increasing (refer Graph 2), or the unconfined shallow Demons Bluff Group (DBG) and Perched Water Table (PWT) aquifers which are responding to natural climate variations (refer Graph 3).
- Groundwater levels at unconfined shallow wells MW33 and MW64 have showed a steady decline due to lower-than-average rainfall recorded in the region from November 2022 to August 2024.
- Water quality observations of note:
    - General mine water body quality is stable and consistent with historical events.
    - pH is decreasing at DBG MB6. Figure 27 suggests groundwater at this location is has not reached an equilibrium. At this location, the current direction of groundwater flow is towards the mine water body.
    - TDS is increasing at DBG MB4. This appears to be driven by an increase in chloride (Figure 28). At this location, the current direction of groundwater flow is towards the mine water body.
- Note: Following the November 2022 groundwater monitoring event, two data loggers were identified to be replaced (WB4 and MW37). Following deployment of these dataloggers, all datalogger reference points were updated following the groundwater monitoring event (GME). This highlighted that some dataloggers exhibited “data drift”. As a result, following the February 2023 GME, all data was referenced against manual gauging data and where required (namely UEVF MB 1, 2, 4 and 6), data was normalised to correct data drift.
- The data logger in UEVF MB2 failed and was replaced on the 21 November 2023. Following deployment of the new datalogger, a new reference point has been established.

- The datalogger in DBG MB04 failed and was replaced on the 9 May 2024. Datalogger data is not available for the period 20 February to 8 May 2024.
- The datalogger in WB12 and WB14 could not be downloaded on the 13 August 2024. Datalogger data is not available for the period 8 May 2024 to 14 November 2024. The dataloggers in these two bores were replaced on 14 November 2024.
- From November to December 2022 groundwater levels at SOBN 116459 declined, which coincided when Barwon Water were undertaking a pumping test from the LEVF. Groundwater levels have increased by approximately 2.0 m since the cessation of the Barwon Water pumping test.

Background

The groundwater pumping test commenced on 13 May 2021 and was completed on 8 December 2021.

The test was run in accordance with the licence.

A total of 671.9ML was extracted during the pumping test, representing approximately 44% of the licensed volume.

Specialist consultants are now collating, analysing and validating the data collected during stage one to determine a sustainable pumping rate.

Monthly reviews were conducted with the Co-regulator Technical Working Group (inclusive of Alcoa, Southern Rural Water, DELWP, EPA Victoria, Earth Resources Regulation, Barwon Water and Corangamite Catchment Management Authority).

The data will also facilitate the calibration of the updated 'Anglesea Groundwater Model' being developed in close conjunction with Barwon Water. The model is being independently peer reviewed by a Technical Review Panel established by DELWP and will further inform any proposed long-term licence amendment.

The groundwater pumping test was underpinned by a comprehensive water monitoring plan approved by Southern Rural Water. The plan ensured the groundwater extraction did not threaten groundwater dependent ecosystems that may connect to the aquifer underlying and surrounding the mine, or adversely impact any other users.

Water extraction rates, groundwater levels and quality, and the waterbody level were closely monitored by a specialist consultant. Results were reported monthly to the co-regulator technical working group (inclusive of Alcoa, Southern Rural Water, Department Environment Land Water and Planning, EPA Victoria, Earth Resources Regulation, Barwon Water and CCMA) for review, and an update published for the community.

To monitor groundwater levels and quality during the pumping test, 28 bores have been selected with 12 of those also nominated as trigger bores. The location of the trigger and other monitoring bores are shown in Figure 1 below.

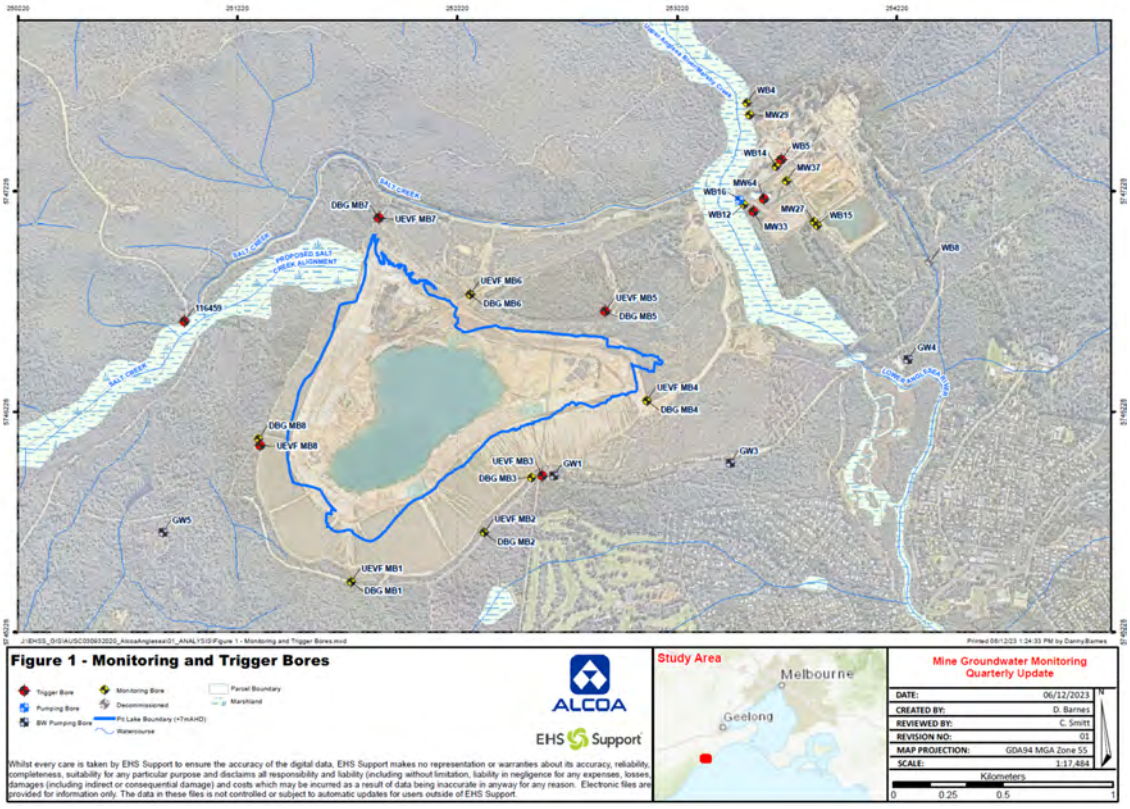


Figure 1: *Trigger and other monitoring bore locations.*

Each of the trigger bores has defined water level and/or water quality thresholds, known as triggers, and defined response actions if a trigger is met. The triggers and responses, known as trigger rules, were developed in consultation with a specialist consultant and Southern Rural Water.

Each trigger has been set at a conservatively low level to ensure we are alerted early, and, if necessary, able to act quickly during the pumping test to prevent damage to groundwater dependent ecosystems. In total there are five separate trigger rules, with these applying in various combinations to the 12 trigger bores. Each trigger rule has different responses ranging from additional monitoring to reducing the pumping rate.

Data from key Barwon Water monitoring bores in the vicinity is also included in the water monitoring plan for analysis. This data is provided by Barwon Water.

Extraction rates

Month	Volume extracted (ML)	Maximum daily volume extracted (ML)	Total volume extracted to date (ML)
May 2021 (from 13/5)	53.6 ML	3.45ML	53.6 ML
June 2021	118.3ML	4.32ML	171.9ML
July 2021	132.6ML	4.32ML	304.5ML
August 2021	105.1ML	4.32ML	409.6ML
September 2021	61.5ML*	3.45ML	471.1ML
October 2021	74.0ML*	3.45ML	569.0ML
November 2021	101.1ML	3.45ML	645.2ML
December 2021	26.7ML	3.45ML	671.9ML
January 2022	0ML	0ML	671.9ML
February 2022	0ML	0ML	671.9ML
March 2022	0ML	0ML	671.9ML
April 2022	0ML	0ML	671.9ML
May 2022	0ML	0ML	671.9ML
June 2022	0ML	0ML	671.9ML
July 2022	0ML	0ML	671.9ML
August 2022	0ML	0ML	671.9ML
September 2022	0ML	0ML	671.9ML
October 2022	0ML	0ML	671.9ML
November 2022	0ML	0ML	671.9ML
December 2022	0ML	0ML	671.9ML
January 2023	0ML	0ML	671.9ML
February 2023	0ML	0ML	671.9ML
March 2023	0ML	0ML	671.9ML
April 2023	0ML	0ML	671.9ML
May 2023	0ML	0ML	671.9ML
June 2023	0ML	0ML	671.9ML
July 2023	0ML	0ML	671.9ML
August 2023	0ML	0ML	671.9ML
November 2023	0ML	0ML	671.9ML
December 2023	0ML	0ML	671.9ML
January 2024	0ML	0ML	671.9ML
February 2024	0ML	0ML	671.9ML
March 2024	0ML	0ML	671.9ML
April 2024	0ML	0ML	671.9ML
May 2024	0ML	0ML	671.9ML
June 2024	0ML	0ML	671.9ML
July 2024	0ML	0ML	671.9ML
August 2024	0ML	0ML	671.9ML
September 2024	0ML	0ML	671.9ML
October 2024	0ML	0ML	671.9ML

November 2024	0ML	0ML	671.9ML

Note: SRW License allows a maximum daily limit of 5.18ML, and total extracted volume limit of 1500ML.
*Due to equipment reliability issue, a lower volume was extracted.

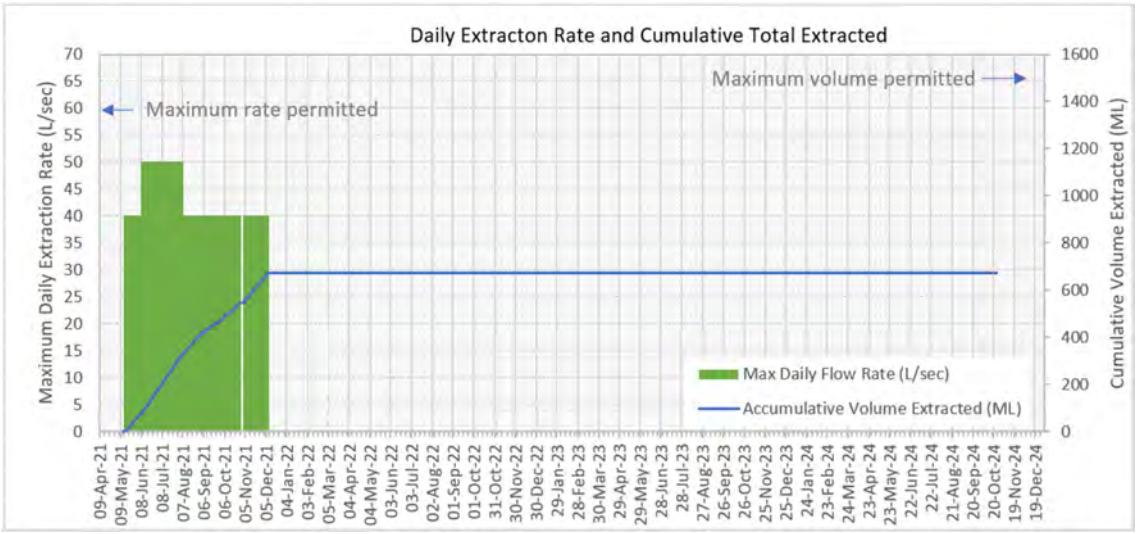


Figure 2: Daily extraction rate and cumulative total extracted.

Waterbody level

Date	Waterbody level RL (m)	Waterbody % Full	Month/Year	Monthly Rainfall (Aireys Inlet) (mm)	Monthly Rainfall (Alcoa Gauging Station Anglesea) (mm)
26 April 2021	-20.93m	10.3%	April 2021	23.8	23.8
24 May 2021	-20.42m	11.1%	May 2021	163.2	96.9
21 June 2021	-19.93m	11.8%	June 2021	65.8	52.8
19 July 2021	-19.41m	12.5%	July 2021	84.6	56.3
30 Aug 2021	-18.64m	13.7%	August 2021	29.6	25.3
27 Sept 2021	-18.46m	14.0%	September 2021	57.4	54.7
25 Oct 2021	-18.06m	14.6%	October 2021	103.0	106.3
22 Nov 2021	-17.72m	15.2%	November 2021	43.4	47.7
8 Dec 2021	-17.62m	15.4%	December 2021	21.0	21.7
17 Jan 2022	-17.87m	15.2%	January 2022	129.8	121.5
21 Feb 2022	-17.46m	15.6%	February 2022	3.8	2.6
21 Mar 2022	-17.40m	15.7%	March 2022	61.4	45.2
26 April 2022	-17.41m	15.7%	April 2022	32.2	47.3
23 May 2022	-17.39m	15.7%	May 2022	12.4	11.1
20 June 2022	-17.28m	15.9%	June 2022	Not Reported	60.5
18 July 2022	-17.21m	16.0%	July 2022	Not Reported	51.8
16 August 2022	-17.06m	16.3%	August 2022	Not Reported	62.7
19 September 2022	-16.93m	16.6%	September 2022	56.8	43.6
18 October 2022	-16.67m	17.0%	October 2022	169.4	155.7
22 November 2022	-16.26m	17.8%	November 2022	99.4	105.5
19 December 2022	-16.35m	17.7%	December 2022	25.8	20.6
16 January 2023	-16.36m	17.7%	January 2023	51.6	24.6
24 February 2023	-16.49m	17.4%	February 2023	23.4	13.5
			March 2023	19.4	16.7
5 April 2023	-16.41m	17.6%	April 2023	31.0	70.3
			May 2023	53.4	40.0
5 June 2023	-16.27m	17.8%	June 2023	67.0	68.6
			July 2023	27.0	27.6
7 August 2023	-16.03m	18.1%	August 2023	22.2	10.7
			September 2023	10.2	9.8
9 October 2023	-15.95m	18.3%	October 2023	42.4	39.7
			November 2023	34.0	33.6
5 December 2023	-15.87	18.4%	December 2023	87.0	60.7
			January 2024	53.2	38.6
12 February 2024	-15.87	18.4%	February 2024	7.6	1.8
			March 2024	2.4	5.3
3 April 2024	-15.92	18.4%	April 2024	49.6	39.6
			May 2024	30.2	30.2
3 June 2024	-15.82	18.5%	June 2024	36.6	25.0

			July 2024	58	53.9
5 August 2024	-15.61	18.9%	August 2024	29.4	28.0
			September 2024	66.8	54.9
8 October 2024	-15.40	19.3%*	October 2024	48.8	48.8
			November	21.6	19.9

*Total estimated volume of the water body is 17,600ML (17.6GL) at RL 5.0m (based on latest bathymetry survey from Berry and Whyte, June 2024).

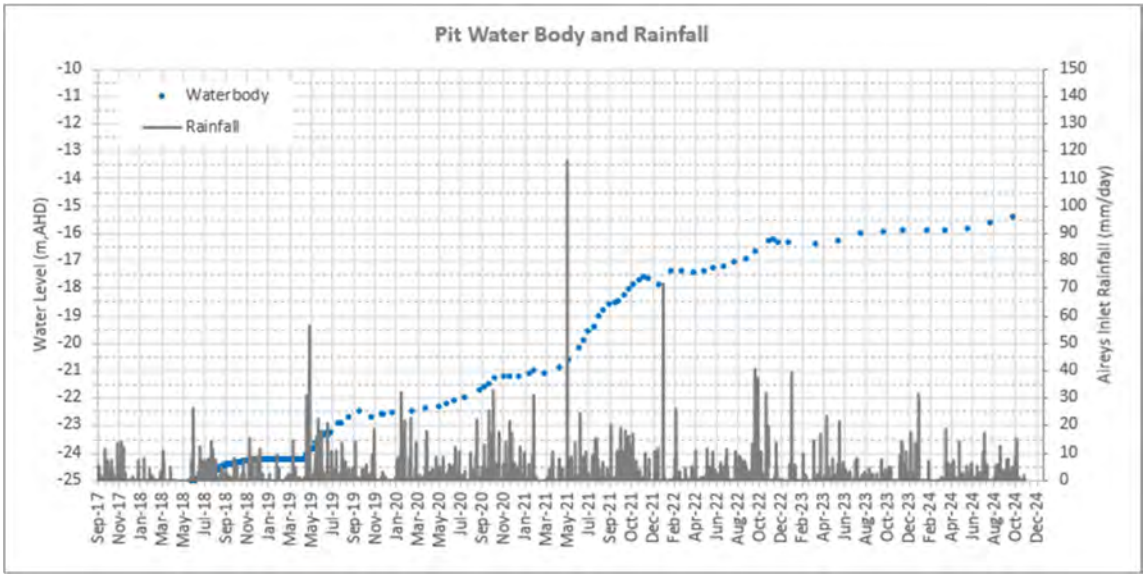


Figure 3: Pit waterbody level and rainfall

Groundwater level monitoring and trigger status

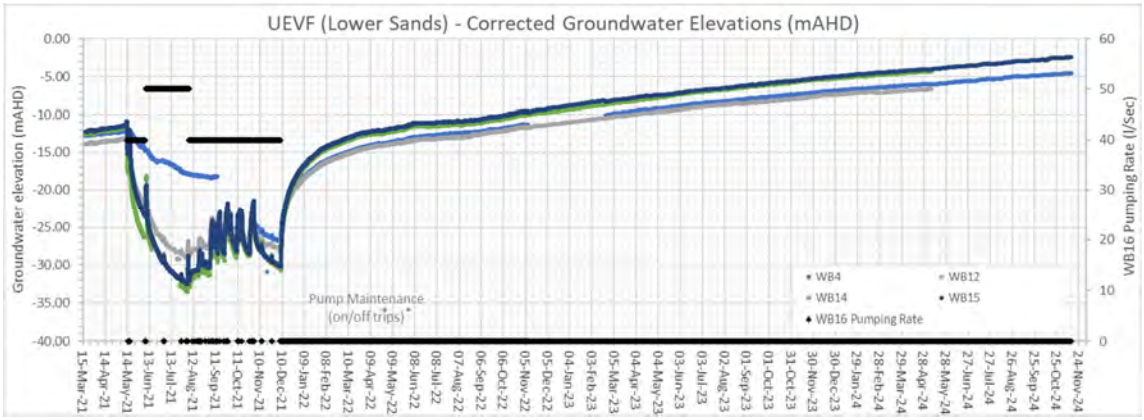
Although Alcoa did not pump during this reporting period, we continue to monitor the bores quarterly.

Bore	Overall status	Action / Comment
UEVF WB14	No trigger reached	Continue to monitor
UEVF SOB 116459	No trigger reached	Continue to monitor
UEVF MB3	No trigger reached	Continue to monitor
UEVF MB5	No trigger reached	Continue to monitor
UEVF MB7	No trigger reached	Continue to monitor
UEVF MB8	No trigger reached	Continue to monitor
DBG MB3	No trigger reached	Continue to monitor
DBG MB5	No trigger reached	Continue to monitor
DBG MB7	No trigger reached	Continue to monitor
DBG MB8	No trigger reached	Continue to monitor
PWT MW33	No trigger reached	Continue to monitor
PWT MW64	No trigger reached	Continue to monitor

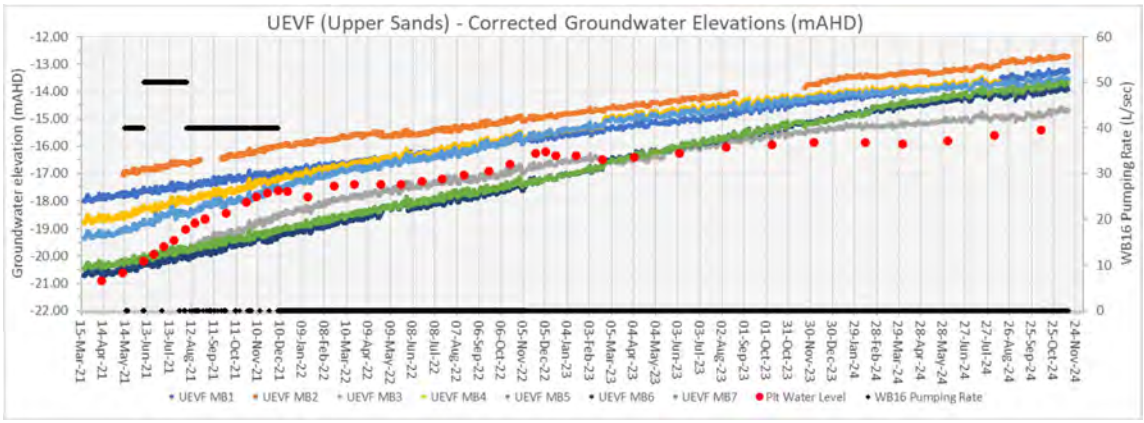
Current Key Data

Below (page 9) are graphical representations of some of the key data since stage one of the pumping test concluded on 8 December 2021.

- Graph 1 shows that the groundwater levels in the lower part of the UEVF (180 metres to 250 metres below the surface) have recovered as expected.
- Graph 2 shows that groundwater levels in the upper part of the UEVF aquifer, located at depths varying between 40 metres and 140 metres below the surface, show no impact of pumping test and continue to gradually increase in pressure.
- Graph 3 importantly shows the shallowest aquifers, Demons Bluff Formation (DBF) and Perched Water Table (PWT), located 5 metres to 50 metres below the surface and closest to the Anglesea River system, are responding only to natural climate variations and have shown no impact as a result of the pumping test.

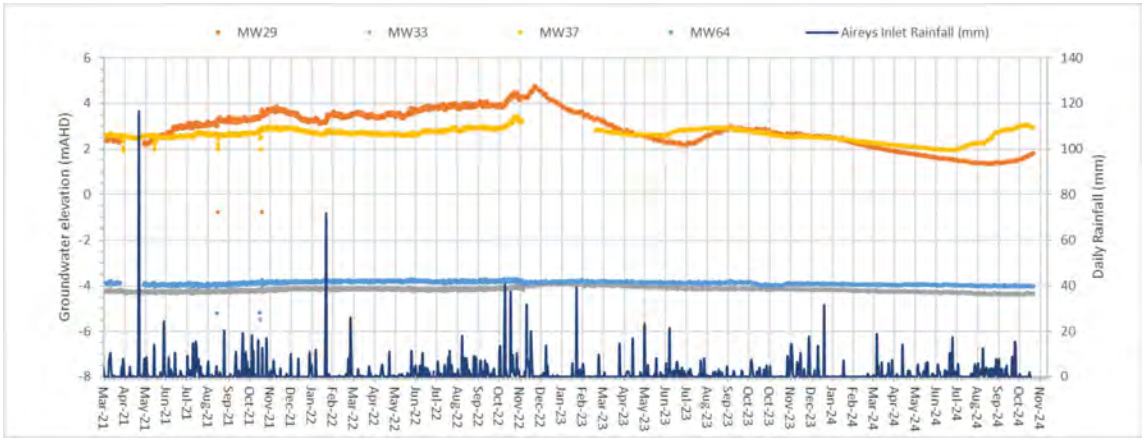


Graph 1: Groundwater level (pressure) trends for the lower part of the UEVF aquifer (approximately 200m depth) show declines as modelled. Note: Datalogger re-deployed in WB04 on 20 February 2023. No data between November 2022 and February 2023. The datalogger in WB12 and WB14 could not be downloaded on the 13 August 2024. Datalogger data is not available for the period 8 May 2024 to 14 November 2024.



Graph 2: Groundwater level (pressure) trends for the upper part of the UEVF aquifer (approximately 40m to 140m depth) show no impact of pumping.

Data logger failed in UEVF MB2 and data could not be retrieved from August to November 2023.



Graph 3: Groundwater level trends in the DBG / PWT aquifer (approximately 5m to 50m depth) shows no response to the pumping test. Datalogger re-deployed in MW37 on 20 February. No data between November 2022 and February 2023.

Barwon Water Anglesea borefield monitoring data

For more information on the Anglesea borefield and the monthly updates please see the Barwon Water website.

Appendices

The data in this monthly report includes all data up to the most recent groundwater data collection, on 14 November 2024.

Note: Bores DBG MB01, DBG MB02, DBG MB03, DBG MB05, DBG MB07 and DBG MB08 are not shown on the graphs in the section below as these bores are currently dry and have no historical water level.

Bores DBG MB04 and DBG MB06 are saturated.

Key Considerations

In addition to the trigger level assessment, **Table 1** provides general comments, where appropriate, based on review of the water level and water quality results to date for the following Figures and Tables where appropriate.

Any new recommendations for TWG consideration are underlined within the table; there are no new recommendations.

Table 1: General comments based on a review of the water level and quality data to date.

Figure / Table Reference	Bore ID	Comment	Action / Investigation Findings
Figure 4	WB4	The drawdown is as expected however as reported in previous reports the nature of the drawdown response continues to appear "dampened" when compared to others. This could be as a result of several hypothesis listed in previous months. As part of the Bore Assessment Program (BAP), the datalogger was removed on June 20 to allow wireline (geophysical) logging and downhole camera inspection. The re-sleaved WB4 will form part of the monitoring program moving forward with the datalogger re-deployed on November 5.	In 1977, this well was repaired by re-sleaving with an 8-inch casing. As part of the BAP, the drilling contractor advanced down through the bore annulus to 195m. A geophysics survey was completed and the screened intervals were confirmed at 117-120 m, 161-164m, 176-182m. It is likely that other screened intervals were installed but these could not be confirmed by the geophysics survey. The re-drilling of the bore as part of the BAP was successful. A decision was made to re-sleave WB4. Lithological information and geophysical logs were reviewed to enable a suitable design. The following bore design summary is provided: • 50mm diameter screen and casing • Screen intervals at 117-120m, 161-164m, 176-182m, 191-194m. The casing was perforated at 192.5m • Fibre-glass casing was used from 0-117m • Stainless steel screens and blank casing were used from 117-195m • A sump was installed from 194-195m. The groundwater response observed since this bore was repaired now exhibits behaviour expected of this bore.
Figure 4	WB12	As reported previously, the drawdown is smaller than expected. WB12 is the closest bore to the pumping bore	As part of the BAP, the drilling contractor has identified a number of integrity issues with this bore: • Collapsed casing at 90m;

Figure / Table Reference	Bore ID	Comment	Action / Investigation Findings
		(WB16; 28m away) and does not show the greatest drawdown. This is observed at WB14 which is 288m from WB16. This could be as a result of several hypothesis listed in previous months.	• Damage to the casing (large holes) between 107m and 117m. • Significant debris throughout with a large obstruction at 193m. • Screens blocked by silt / sediment and likely iron bacteria. At this stage WB12 forms part of the monitoring network. Following pump shut down and the collection of recovery data, further analysis will be undertaken to assess the response in WB12. Depending on the outcomes of the data analysis, WB12 may be: • Rectified by re-sleaving the casing issues, removing the obstruction at depth and cleaning the screened intervals; or • Decommissioned. Note any decommissioning will not be undertaken whilst the pump test is active.
Figure 4 **Figure 5**	WB16	The extraction pump within WB16 has recorded a number trips resulting in a number of restarts. The ongoing intermittent fault continues to be investigated and appears to be related to the diesel generator providing power to the pump. This is not expected to impact the overall objective of the pumping test.	All equipment items have been recently serviced and inspected by the original equipment manufacturers. A number of generator components have been changed out or modified. Investigations continue through Sept and Oct and the intermittent issue was rectified, allowing for uninterrupted (other than refuelling) operation through November to the end of Stage 1 on December 8.
Figure 7	UEVF MB8	As reported previously UEVF MB8 exhibits a pressure ~20m higher than UEVF bores MB1 to MB7. The upper sands seen within UEVF MB1 to MB7 are not present at UEVF MB8. In addition, the water chemistry of this bore is considerably different to the other near mine water body bores. For background, this bore was developed at <1L/sec for ~48 hours (air lift). Water quality stabilised after 3.5 hours with stabilised water quality reported as pH 9.59 and EC 1373 µS/cm which is typical of water within coal formations. However, the pH and TDS from the May and June sampling was considerably higher than during bore development.	The higher groundwater levels seen in this bore are likely representative of the confining coal and clay which the bore is screened. These levels are also similar to the pressures seen in the decommissioned piezometers historically installed along the south wall (refer Figure 4-5 of the Monitoring Plan). This bore is no longer used to report for groundwater quality.
Figure 12	SOB 116459	Trigger level 3 was briefly reached once for a total of 2 days	Notwithstanding that Alcoa Stage one pumping ceased on 8 December 2021, an investigation trigger was reached

Figure / Table Reference	Bore ID	Comment	Action / Investigation Findings
		in the month before recovering above the level.	for one of the 12 nominated trigger bores with SOB 116459 trigger briefly exceeded during the period. Prior to stage two commencing, this trigger level will be reviewed with the TWG. A review of previous trigger rule 3 exceedances was included in the December TWG report, including that the trigger being reached is believed to be as a result of multiple factors including climate, bore condition and also potentially the pumping test. Recovery data will continue to be monitored.
Figure 13	UEVF MB3	UEVF MB03 is the deepest bore in the UEVF series. UEVF MB03 is the closest bore to the mine sump. As the mine pit water body fills, the delayed water level response observed is likely due to the compressibility of the aquifer. The other UEVF bores are located at a distance from the mine sump where the delayed response is not observed.	Continue to monitor quarterly.
Figure 18 and Figure 27	DBG MB6	The pH at DBG MB6 ranged between 4.28 and 7 from February 2021 to November 2024. Over the last 12 months, pH has declined from 6.02 to 4.28. The TDS has remained constant at around 2,500 mg/L since monitoring commenced in April 2021. The pH change may be associated with mineral dissolution in the backfilled overburden, however the change is unknown at this stage. The mine pit water level is currently below the water level in the backfilled overburden. The groundwater flow direction is still towards the mine pit.	Continue to monitor quarterly.
Figure 18	Mine Water Body	The pH in the Mine Water Body ranged between 3.4 to 4.2 from February 2023 to November 2024. The pH recorded in November 2024 was 3.44 which is consistent with past observations. The TDS has remained constant at around 1,600 mg/L since monitoring commenced in April 2021.	Continue to monitor quarterly.
Figure 18 and Figure 28	DBG MB04	Since February 2023, TDS has increased from 2,140 to 4,000 mg/L. Figure 28 suggests this increase is driven by an increase in chloride.	Continue to monitor quarterly.

Figure / Table Reference	Bore ID	Comment	Action / Investigation Findings
Figure 8, 16 and 17	MW29, MW33, MW37 and MW64	Continual falling groundwater levels are observed in these shallow screened well as a result of lower than average rainfall. This supports our conceptual understanding of water level behaviour in this area which is strongly related to rainfall and evapotranspiration.	Continue to monitor quarterly.

Table Notes: **m** = metres **L** = Litre **cm** = centimetres **µS/cm** = microsiemen per centimetre

Monitoring bore hydrographs (entire network)

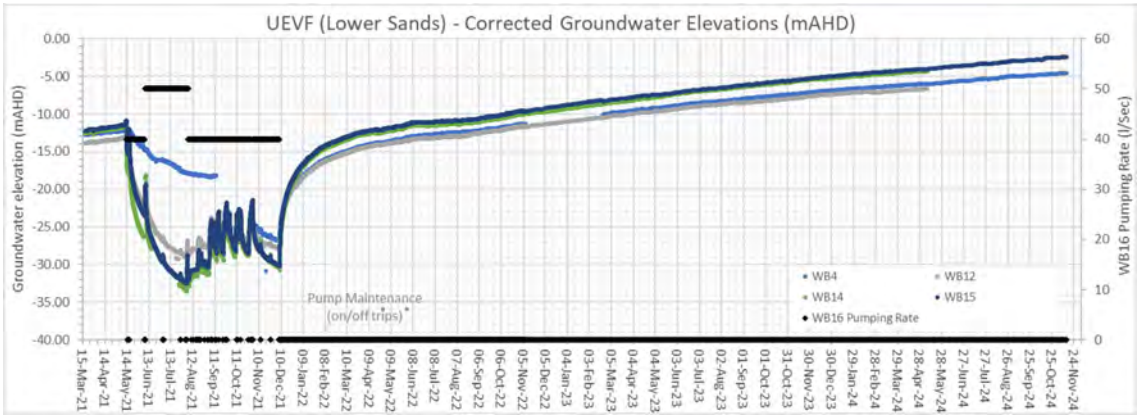


Figure 4: Shows the groundwater elevation trends for the lower zone/sands of the UEVF aquifer.

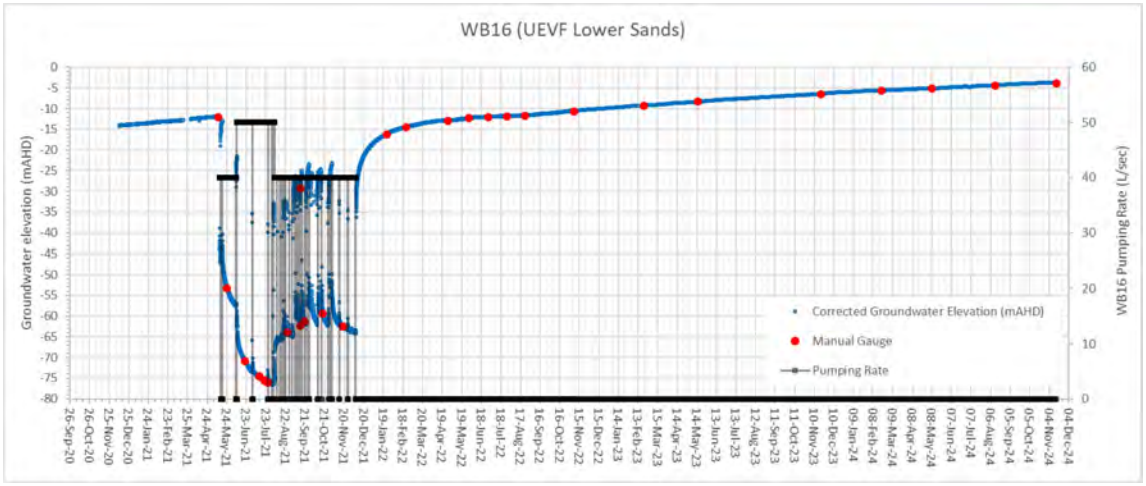


Figure 5: Shows the groundwater elevation trends in the pumping bore (WB16).

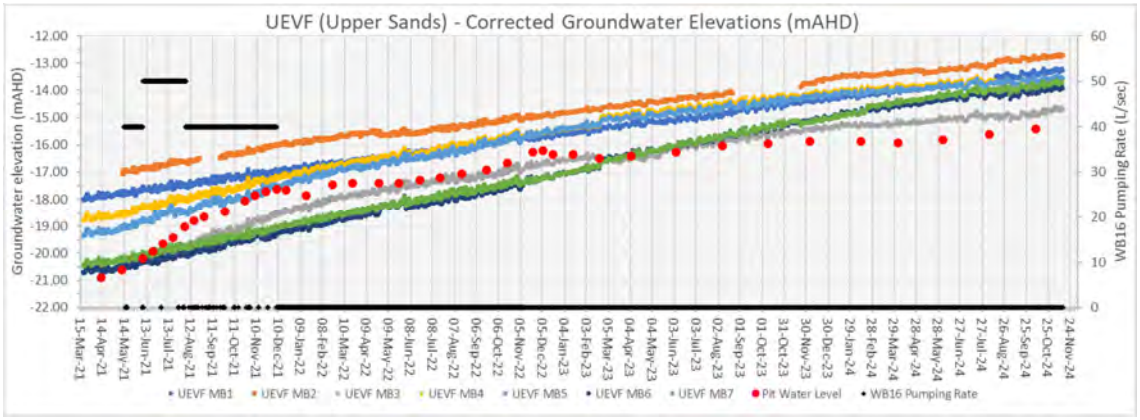


Figure 6: Shows the groundwater elevation trends for the upper part of the UEVF aquifer (and pit waterbody level for comparison). Note: From November 2022, the logging frequency changes from hourly to daily.

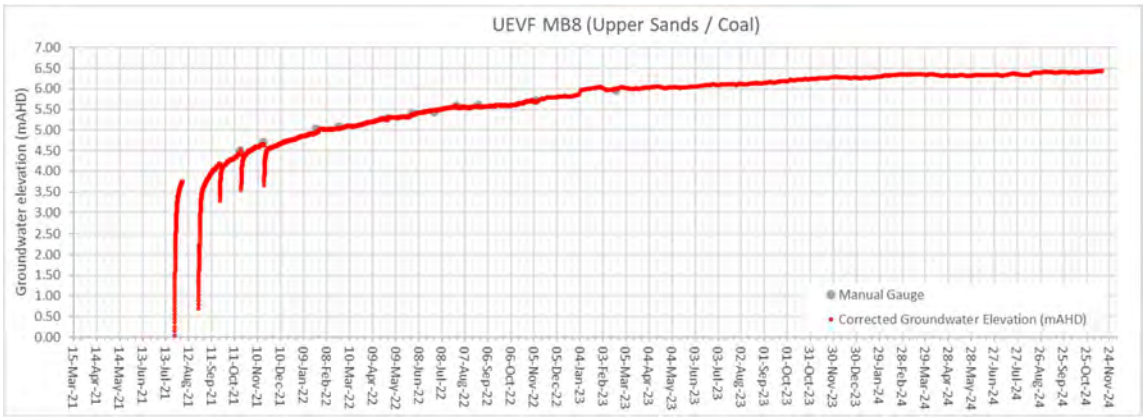


Figure 7: Shows the groundwater elevation trends for UEVF MB8 screened in the Coal within upper part of the UEVF. Note: From November 2022, the logging frequency changes from hourly to daily.

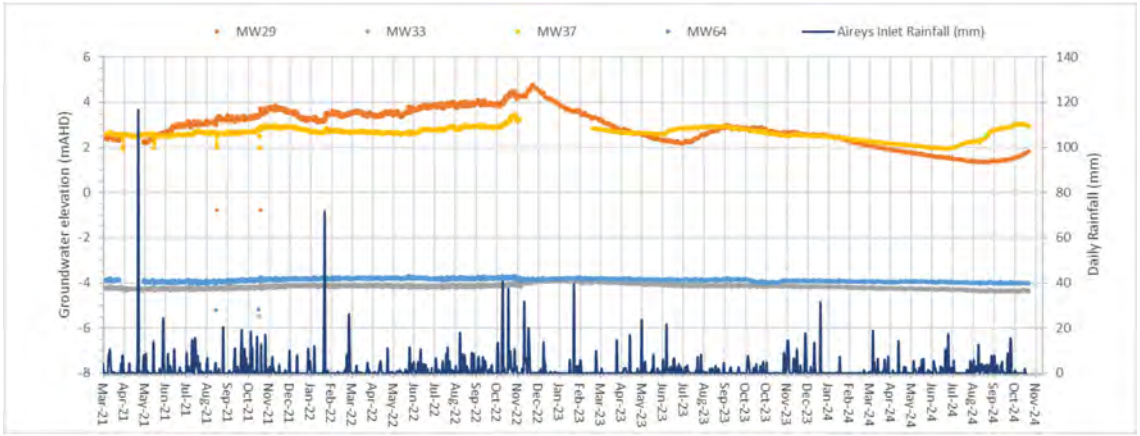


Figure 8: Shows the groundwater elevation trends for the unconfined (shallow) aquifers (DBG / PWT). Note: From November 2022, the logging frequency changes from hourly to daily.

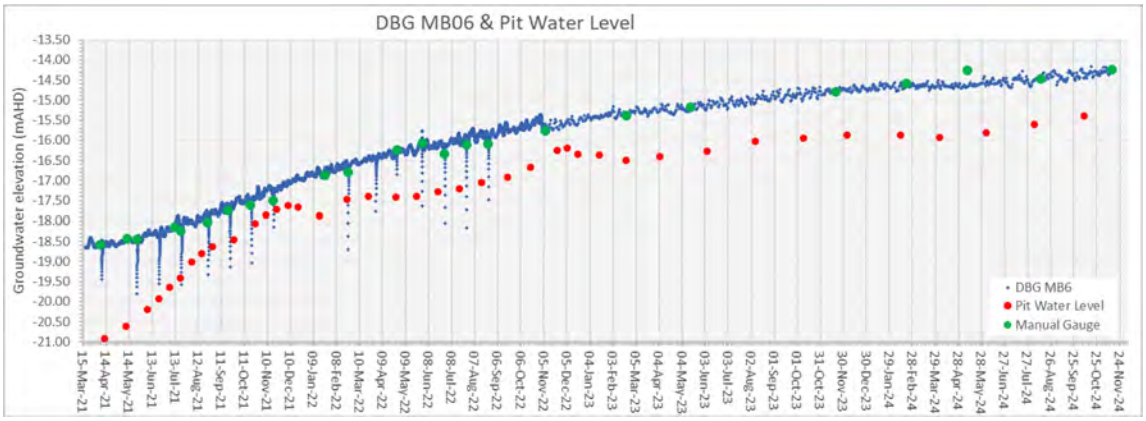


Figure 9: Shows the groundwater elevation trends for the DBG aquifer (and pit waterbody level for comparison). Note: From November 2022, the logging frequency changes from hourly to daily.

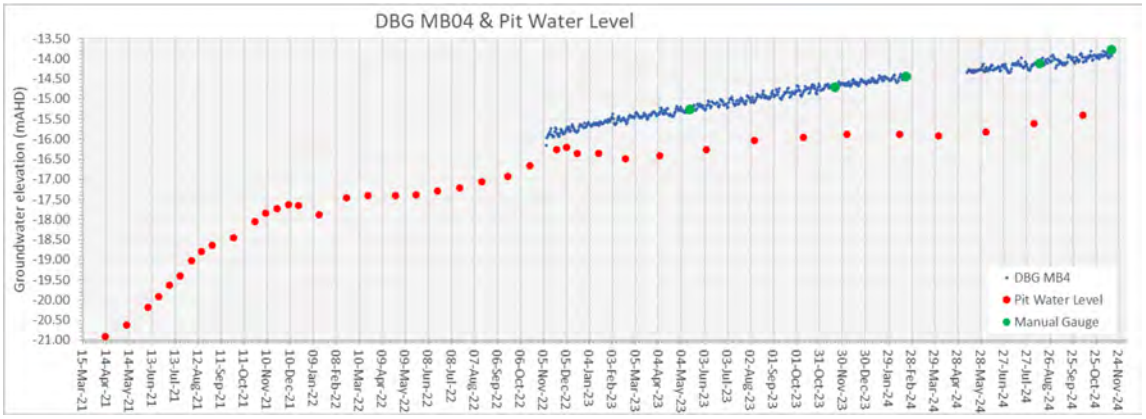


Figure 10: Shows the groundwater elevation trends for the DBG aquifer (and pit waterbody level for comparison) at DBG MB04. Note that before November 2022 this bore was dry. Note from 20 February to 8 May 2024, the datalogger malfunctioned and no data is available.

Monitoring bore hydrographs (trigger bores)

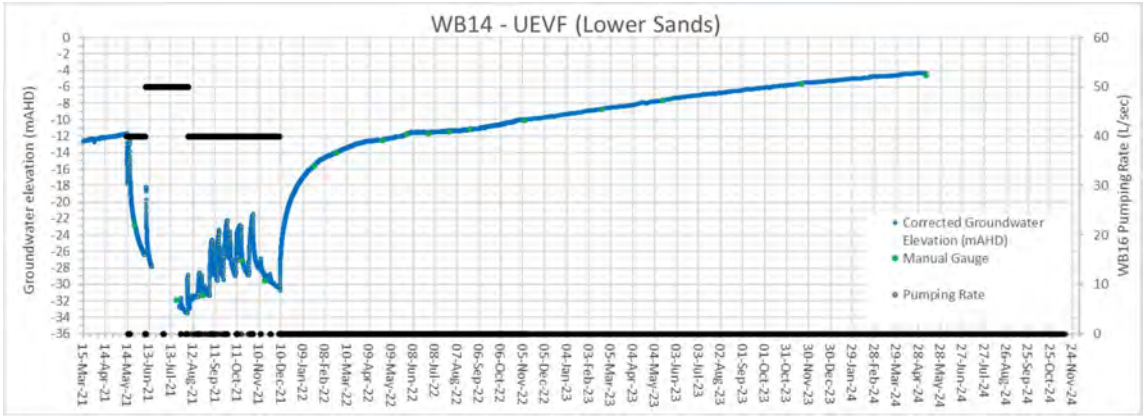


Figure 11: Shows the groundwater elevation history in trigger bore WB14. Note: From November 2022, the logging frequency changes from hourly to daily.

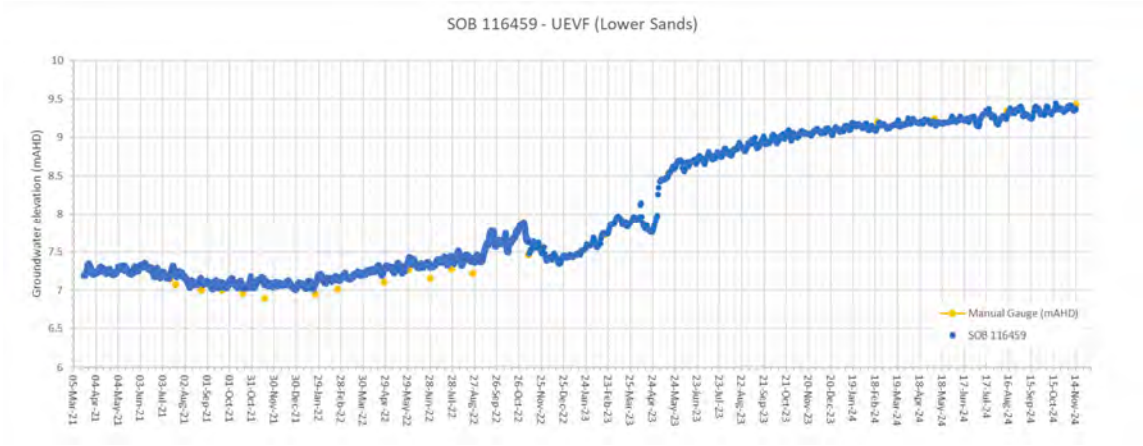


Figure 12: Shows the groundwater elevation history in trigger bore SOBN 116459. Note: From November 2022, the logging frequency changes from hourly to daily.

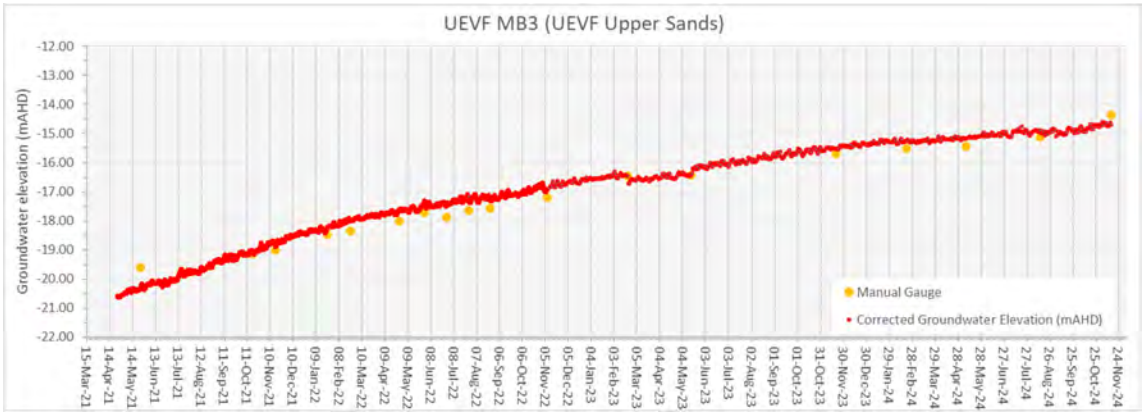


Figure 13: Shows the groundwater elevation history in trigger bore UEVF MB3. Note: From November 2022, the logging frequency changes from hourly to daily.

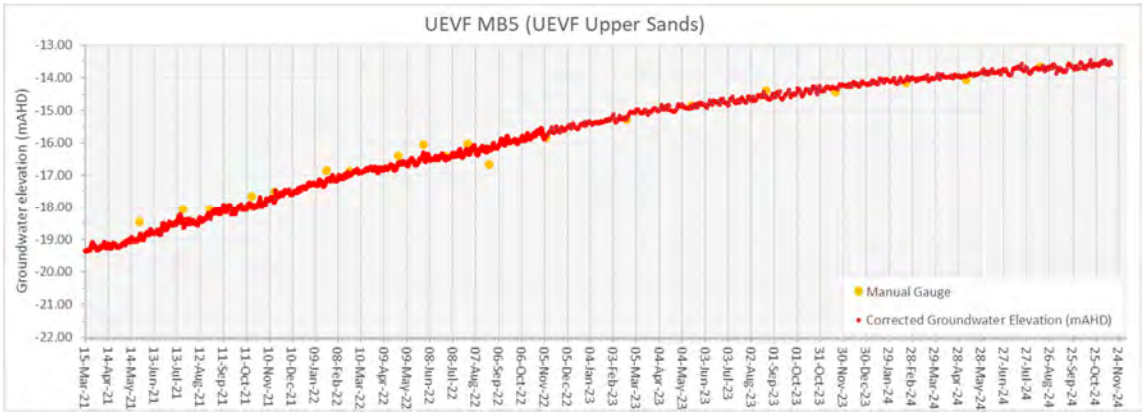


Figure 14: Shows the groundwater elevation history in trigger bore UEVF MB5. Note: From November 2022, the logging frequency changes from hourly to daily.

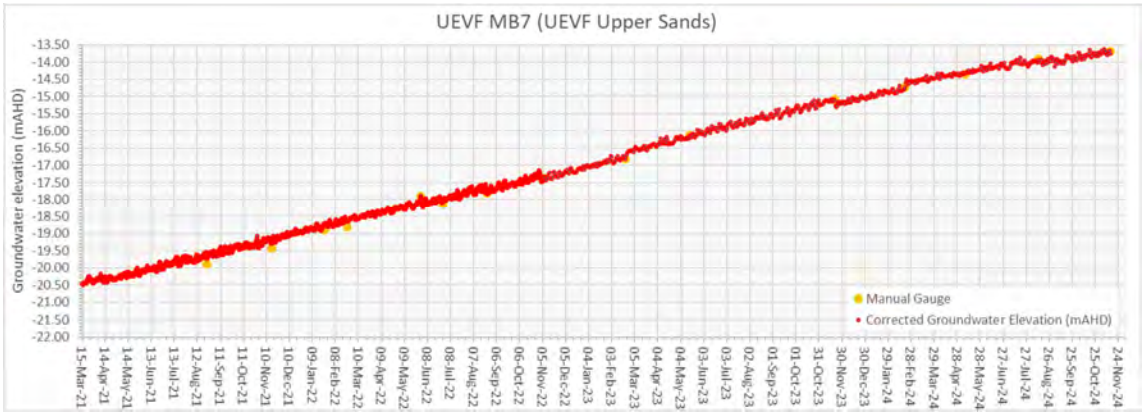


Figure 15: Shows the groundwater elevation history in trigger bore UEVF MB7. Note: From November 2022, the logging frequency changes from hourly to daily.

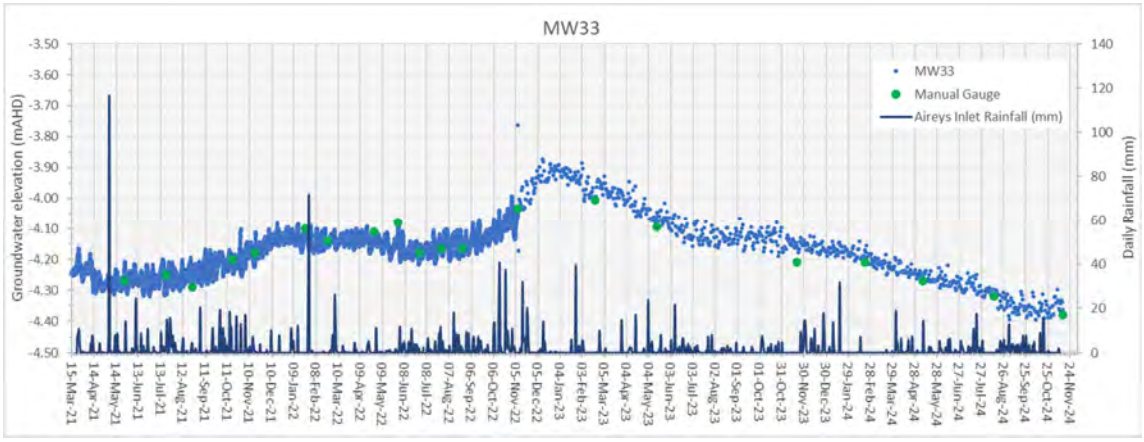


Figure 16: Shows the groundwater elevation history in trigger bore MW33. Note: From November 2022, the logging frequency changes from hourly to daily.

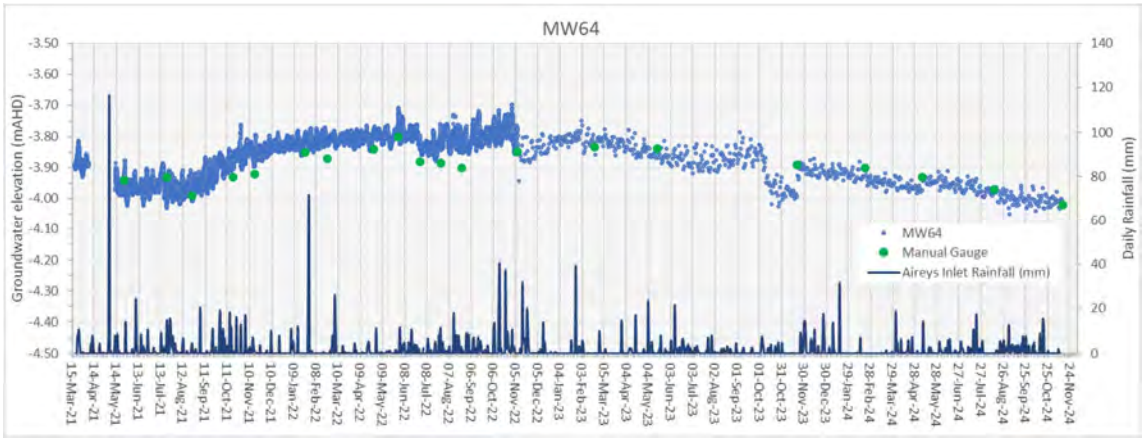


Figure 17 Shows the groundwater elevation history in trigger bore MW64. Note: From November 2022, the logging frequency changes from hourly to daily.

Water Quality Results

Table 2 presents the TDS and pH results from sampling undertaken on 14 November 2024 for each bore where water was above the well screen and where it was a part of the GME. **Figure 18** presents the TDS and pH plots for monthly GMEs.

Figures 19 – 26 present piper plots for the monthly GMEs (April 2021 to November 2024). The results indicate groundwater, and mine water are similar by water type and mostly dominated by calcium sulfate and sodium chloride. Groundwater from DBG MB4 and DBG MB6 is sodium chloride dominant. **Figure 29** presents trend of TDS and chloride/bromide ratios. The results indicate there is no evidence of groundwater mixing.

Table 2 Water quality data from sampling undertaken in November 2024.

Sample Location	TDS (mg/L)	pH
MINEWATER BODY	1740	3.44
DBG MB4	4000	4.43
DBG MB6	2630	4.28

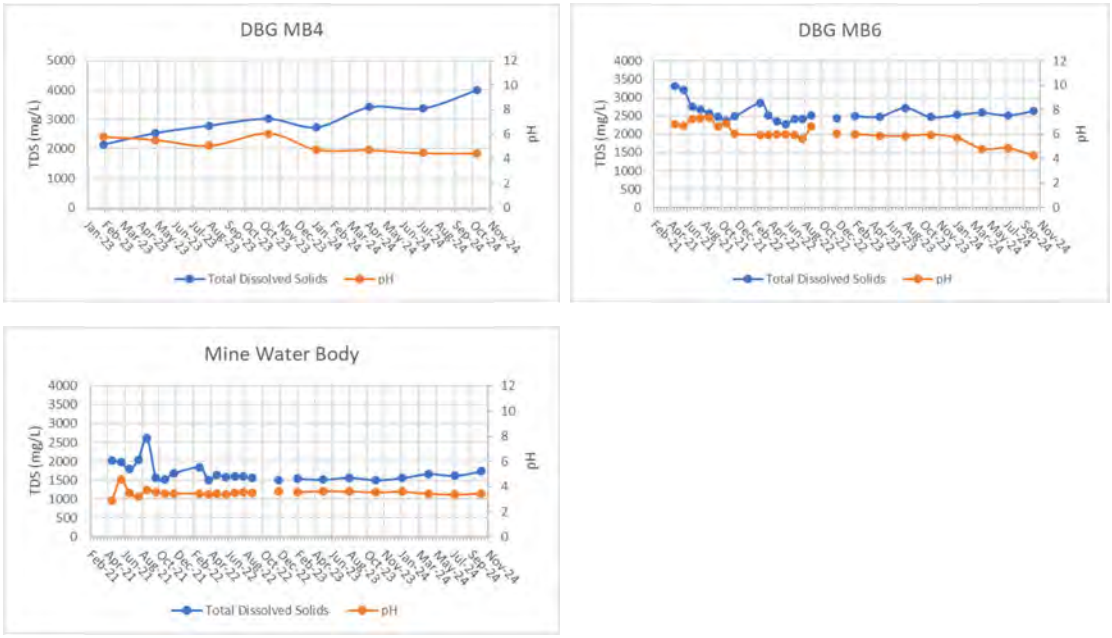


Figure 18 TDS and pH plots for DBG MB4, DBG MB6 and the Mine Water Body (April 2021 to November 2024).

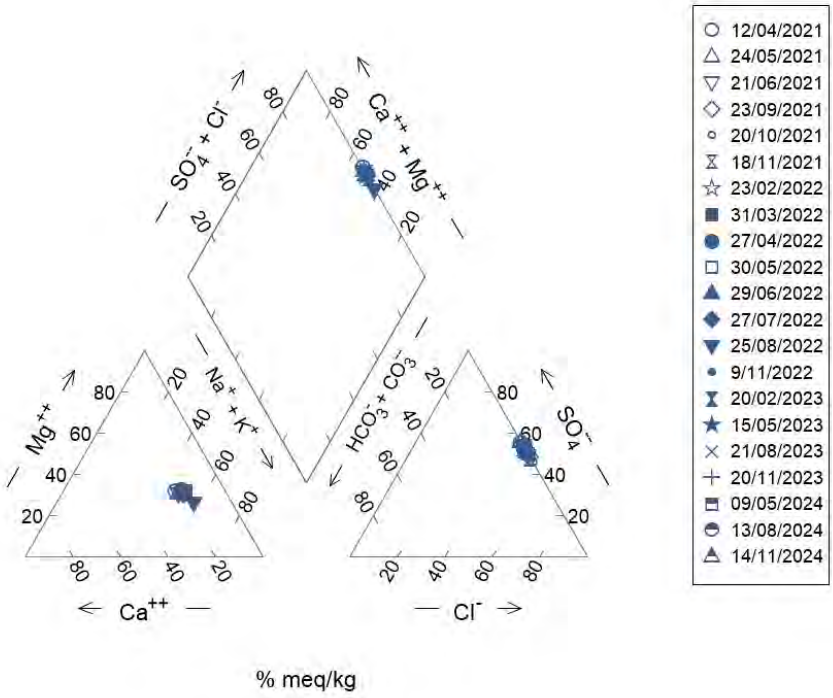


Figure 19 Piper diagrams for the Mine Water Body (April 2021 to November 2024).

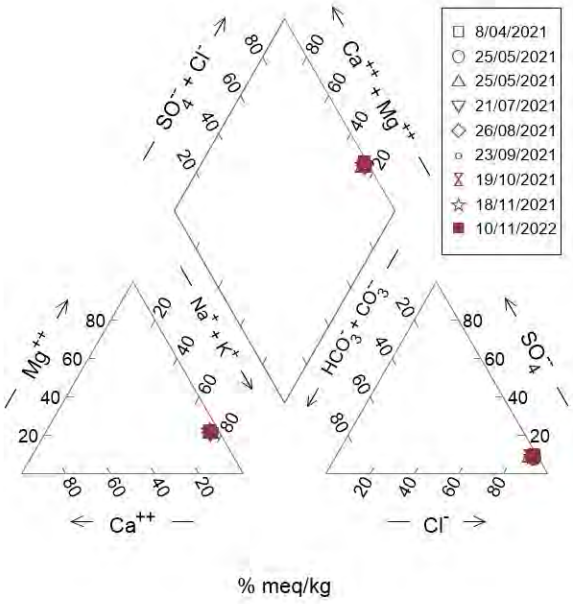


Figure 20 Piper diagrams for UEVF MB1 (April 2021 to November 2022).

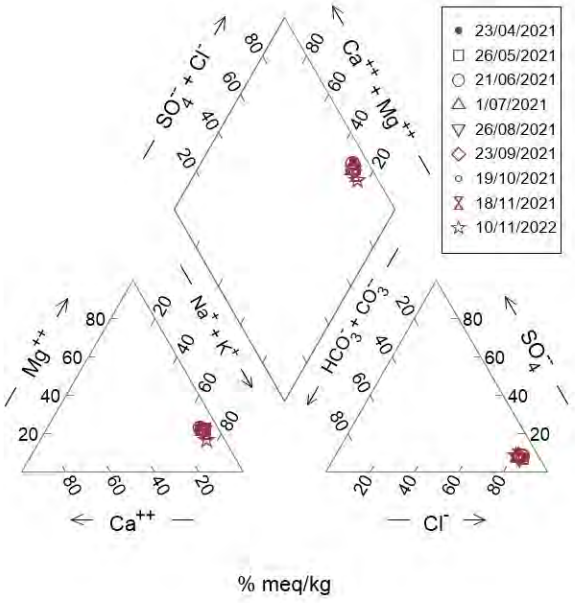


Figure 21 Piper diagrams for UEVF MB2 (April 2021 to November 2022).

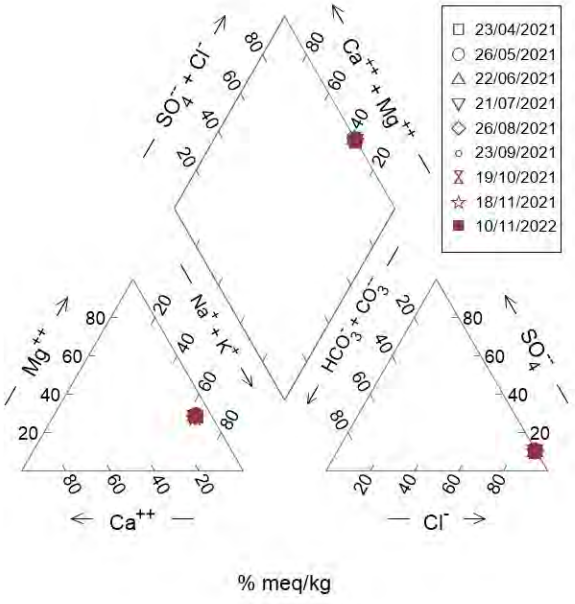


Figure 222 Piper diagrams UEVF MB3 (April 2021 to November 2022).

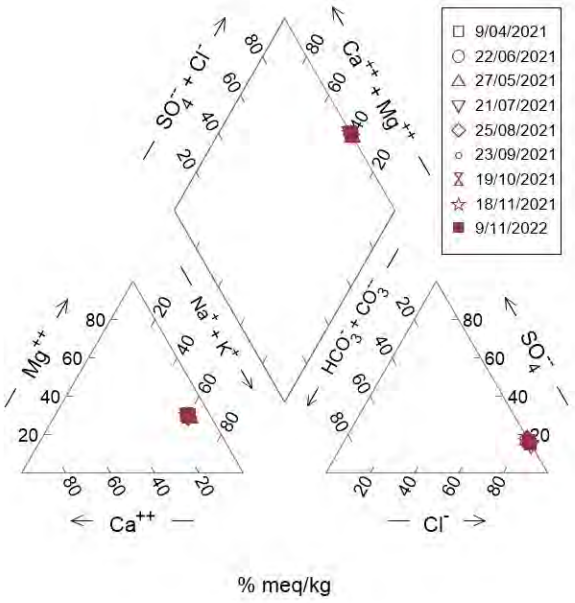


Figure 23 Piper diagrams for UEVF MB4 (April 2021 to November 2022).

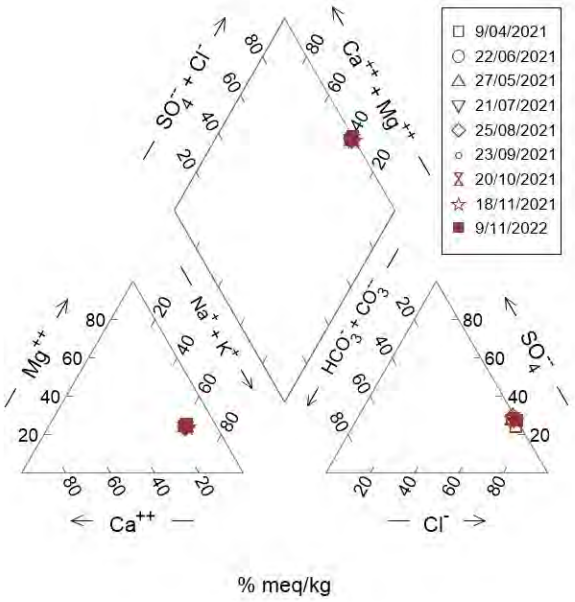


Figure 24 Piper diagrams for UEVF MB5 (April 2021 to November 2022).

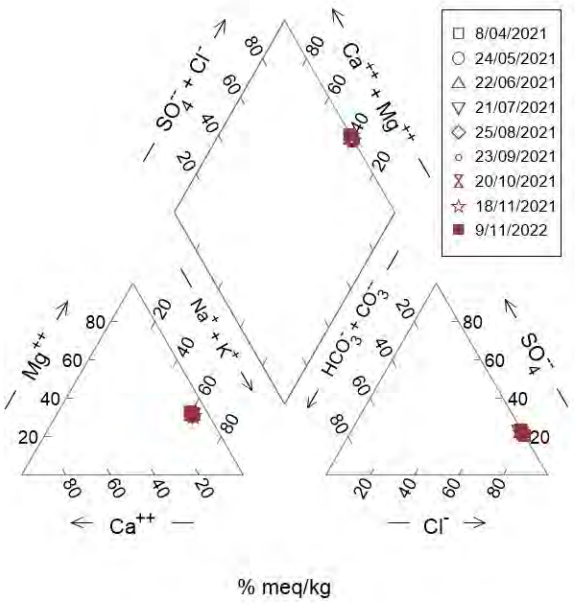


Figure 25 Piper diagrams for UEVF MB6 (April 2021 to November 2022).

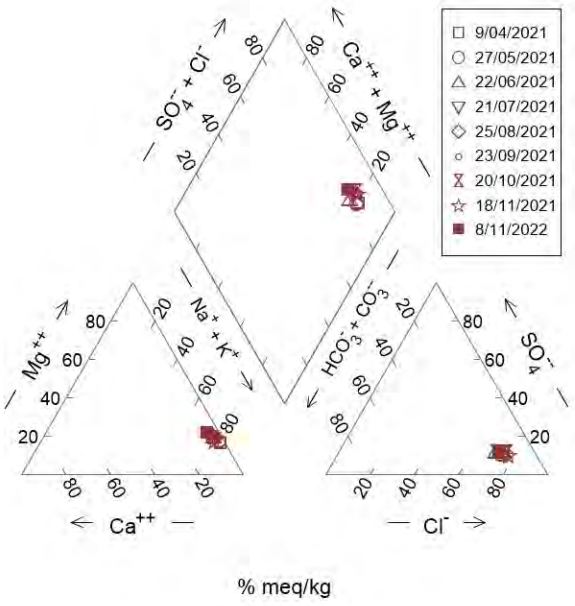


Figure 26 Piper diagrams for UEVF MB7 (April 2021 to November 2022).

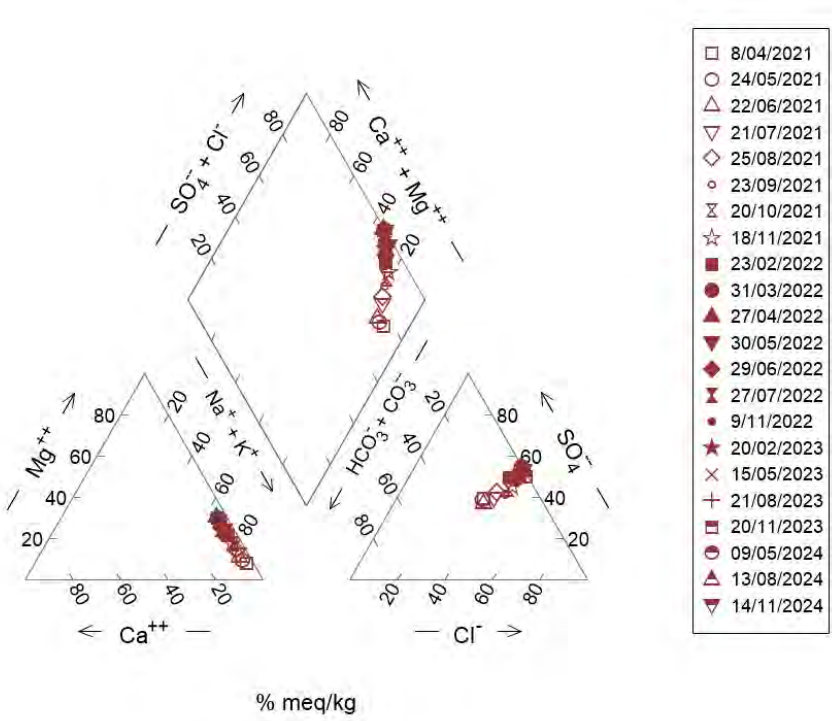


Figure 27 Piper diagrams for DGB MB06 (April 2021 to November 2024).

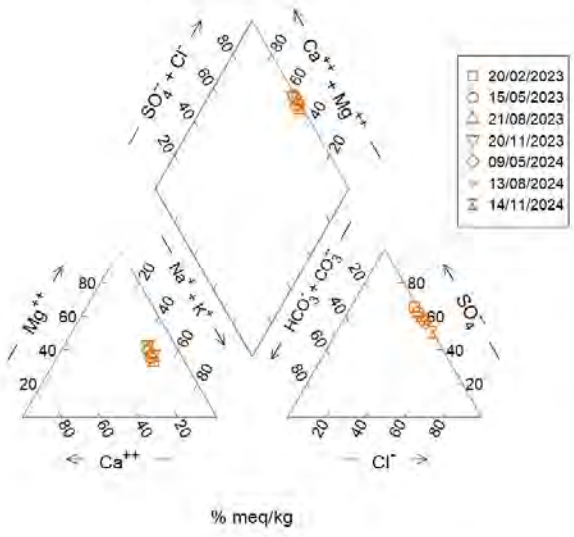
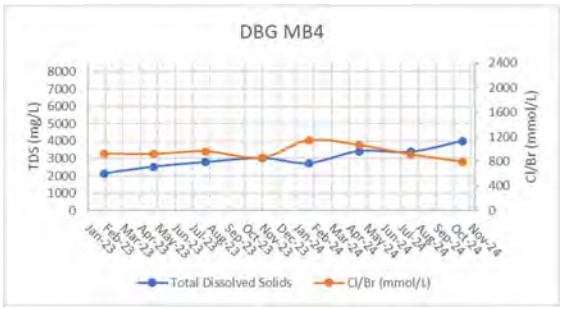
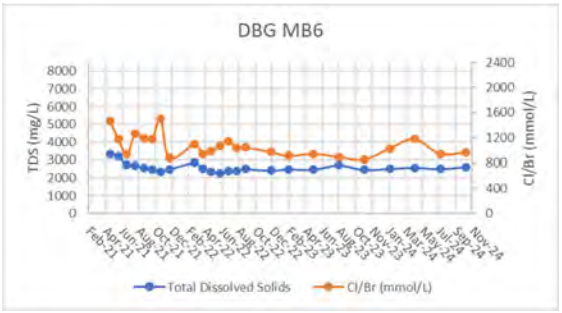
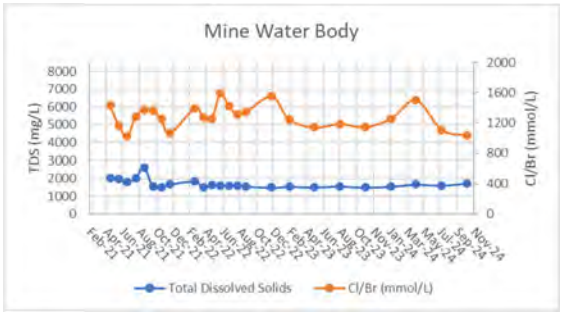
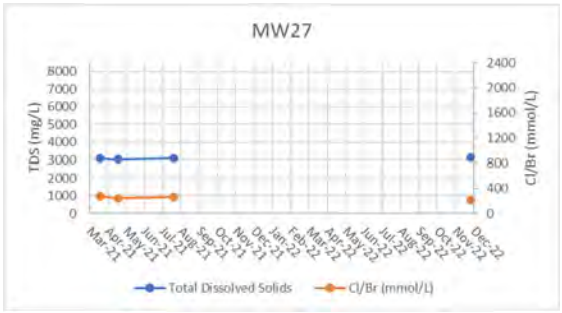


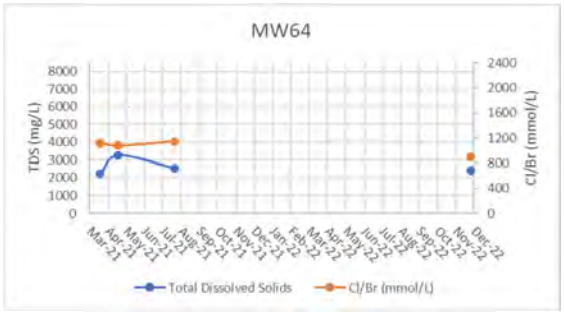
Figure 28 Piper diagrams for DGB MB04 (February 2023 to November 2024).

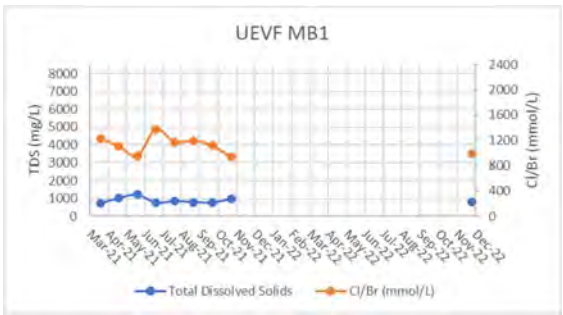


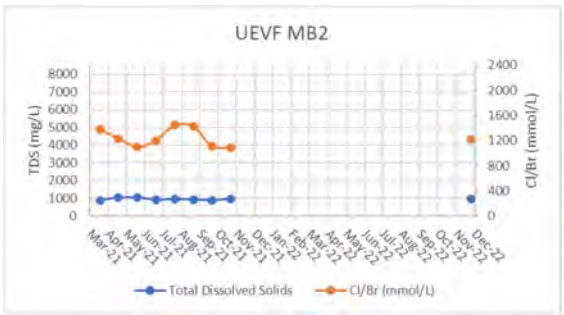


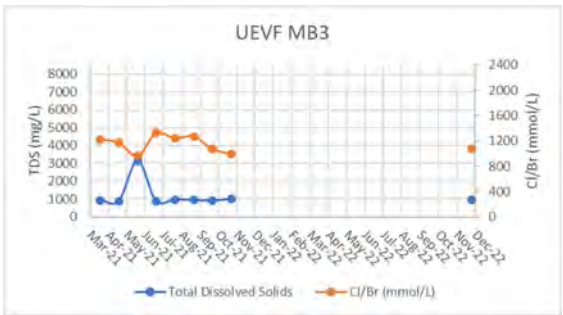












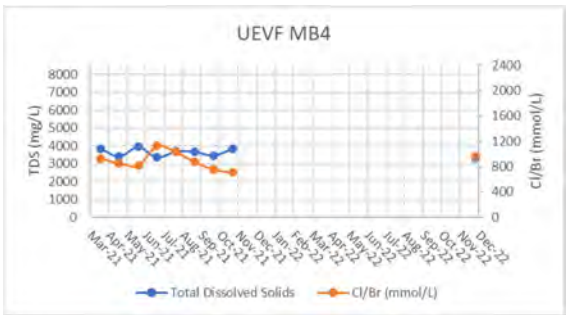


Figure 29 Trend of TDS and Chloride/Bromide Ratio (continued overleaf).

Figure 30 (continued) Trend of TDS and Chloride/Bromide Ratio.

Appendix H Community Engagement Report

Alcoa

Alcoa Anglesea

Community Engagement Report

A summary of the feedback Alcoa received from open house sessions related to a potential mine water filling strategy

Published July 2024

Alcoa acknowledges Wadawurrung People as the Traditional Owners of the land where we operate and we pay our respects to their Elders past, present and emerging.

Kuarka Dorla Dja, (Anglesea) is a place where Wadawurrung ancestors came to fish for mullet.

Bounded by intricate waterways flowing out to the Warri (salt water), sand dunes steeped in heritage, and the high point of country the Anglesea Heathlands, where the Mirri (sun) rises on the Warri (salt water) and sets across the heath.

We acknowledge Bunjil as the Creator Spirit, who continues to watch over the land and guide us all on our journey and responsibility to heal country.

*Artwork © Billy-Jay O'Toole, '**Kuarka Dorla Dja**', 2023.*

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Executive summary

Between 23 and 25 May 2024, Alcoa hosted three open house sessions in Anglesea, providing opportunity for local community members to learn about the company's potential plans to fill its mine pit with groundwater, and hear the latest on rehabilitation of the former mine and power station sites.

The sessions were part of a comprehensive community engagement initiative, which leveraged a number of communication channels to generate community awareness and attendance. In total, 102 members of the local community dropped in to the sessions, seizing the opportunity to discuss the technical findings with Alcoa representatives and their technical experts, demonstrating strong community interest.

The feedback collected was mostly positive in nature, with 88 per cent of attendees feeling more informed about the Anglesea Mine Rehabilitation and Closure Plan and 86 per cent feeling better informed about the viable options for filling the mine pit.

Sentiment analysis of the feedback collected revealed approximately 14 per cent of responses were negative, with the majority neutral (54 per cent) or positive (32 per cent).

While some attendees provided feedback about the technical nature of the information presented, the majority of attendees reported that they appreciated the detailed technical information and valued the opportunity to engage directly with Alcoa's team.

Positive comments highlighted the sessions' informative nature, the professionalism of the presentation, and the accessibility of the representatives.

Many attendees expressed support for Alcoa's efforts and a desire to stay informed about the next steps, and also expressed an interest in site tours.

Introduction

After 46 years of operation, Alcoa's Anglesea Power Station and Coal Mine was permanently closed in August, 2015.

Following extensive consultation with the community, Alcoa published the draft Anglesea Mine Rehabilitation and Closure Plan in 2017, underpinned by key geotechnical, hydrological and vegetation technical studies undertaken by experienced consultants.

Since then, major earthworks and revegetation activities completed in 2020 have delivered a safe, stable and sustainable landform, which will require ongoing monitoring and maintenance over the next decade.

Alcoa have a regulatory obligation to deliver the final Anglesea Mine Rehabilitation and Closure Plan, and in order to achieve this an approved strategy to fill and maintain the mine pit with water is required.

A range of potential options to support filling the mine pit in a timely manner have been investigated and of these, the only two currently feasible options are the use of groundwater from the Upper Eastern View Formation (UEVF) which would see the mine pit filled in seven to 10 years, or natural fill which is estimated to take approximately 50 years.

Mine water filling strategy

Approximately 18 gigalitres of water is needed to fill the mine pit. As at April 2024, there is approximately three gigalitres of water present.

Alcoa's preferred option is to fill the mine pit over seven to 10 years, achieved through supplementing natural filling of the mine with a combination of UEVF groundwater and potential peak flows from Salt Creek. Note: the current focus is the potential use of UEVF groundwater, with potential peak flows from Salt Creek not currently being explored.

Extensive technical work undertaken over more than three years has not identified any adverse impact on groundwater dependent ecosystems, including the Anglesea River.

Alcoa understands the community's interest in the Alcoa site, and has continued to actively engage with the Anglesea community and key stakeholders.

This report outlines the feedback Alcoa received during the open house sessions related the potential use of UEVF groundwater to support the mine water filling strategy.

A copy of the information boards displayed at the open house sessions are provided within Appendix 1.

The journey to now

2016 | Shared vision

Community engagement undertaken to capture the community's views and aspirations for future land uses.

Considerate of the feedback, the shared vision including five guiding principles were developed to inform development of the draft Anglesea Mine Rehabilitation and Closure Plan.

2017 | Draft Mine Rehabilitation and Closure Plan

The shared vision was incorporated into the draft Anglesea Mine Rehabilitation and Closure Plan, which was then presented to the community.

The feedback revealed high levels of support for the plan, including for the re-profiling of slopes, re-vegetation with native species, and the creation of a large water body.

Considerate of the feedback, the draft Anglesea Mine Rehabilitation and Closure Plan was submitted to the Victorian Government in September 2017.

2018 - 2020

Major earthworks program and vegetation strategy deliverables of the draft Anglesea Mine Rehabilitation and Closure Plan were implemented and delivered a safe, stable and sustainable landform.

A number of potential mine water filling options were explored during this period including recycled water, seawater, and the use of the deeper LEVF aquifer – each ultimately determined to be unfeasible for a variety of reasons.

2021 - 2024

Extensive technical work undertaken to explore the possibility of using UEVF groundwater to fill the mine pit as part of the mine water filling strategy.

This included analysing historical groundwater behaviour, review of independent historical studies, comprehensive geological studies, a 2021 groundwater pumping test with active regulatory oversight, and development of the Anglesea regional groundwater model in collaboration with Barwon Water.

May 2024

With the technical work nearing completion, the local community were invited to discuss the resultant findings and share their feedback on the potential strategy to fill the mine pit.

Community engagement snapshot

A total of 102 community members dropped in to one of three, two-hour sessions hosted at the Anglesea Bowling Club, with many spending a significant period of time reading the information boards displayed around the room and conversing with Alcoa representatives and their technical experts.

Session dates, times and attendee breakdown:

Thursday 23 May
4:00pm to 6:00pm

24

Friday 24 May
10:00am to 12:00pm

16

Saturday 25 May
10:00am to 12:00pm

62

How the sessions were advertised

A multi-channel approach was adopted to inform the community and stakeholders about the open house sessions. Copies of the advertising collateral are provided within Appendix 2.

979

email invitations to individual Alcoa database subscribers.

507

visits to a dedicated web page advertising open house sessions and featuring FAQs.

Three

event listings on the Surf Coast Shire's website event calendar.

One

advertorial in the Surf Coast Times.

One

editorial in the Armstrong Creek Times, resulting from an Alcoa issued media release.

Multiple direct outreaches

to local community and interest groups, resulting in numerous Facebook posts and a dedicated Anglesea Community Network newsflash (e-newsletter).

Multiple direct outreaches

to key stakeholders including local and state government representatives, authorities, and regulators and ongoing engagement with the Wadawurrung Traditional Owners group.

One

off-page Facebook and Instagram campaign - high level results displayed to the right.

A full breakdown of the campaign content and results is provided within Appendix 3.

Metric	Results
Reach *Number of accounts/users who saw content at least once*	3,819
Frequency *The average number of times each account saw the ads*	2.8
Impressions *Number of times the ads were on screen*	13,945
All Clicks *The number of clicks, taps or swipes on the ads*	103
Link Clicks *The number of clicks, taps or swipes within the ad that led to the dedicated website*	32
Engagements *Number of actions people took involving the ad.*	732

Feedback summary

Alcoa engaged independent communications agency, Keep Left, to capture community feedback throughout the sessions via a simple questionnaire - comprising three questions.

Prior to leaving the sessions, community members were invited to provide feedback, by completing the questionnaire themselves, or verbally while one of the two Keep Left representatives recorded the response.

Of the 102 attendees, more than half (65) chose to provide feedback.

The following data analysis aims to summarise the feedback provided, including categorisation of common themes and sentiment.

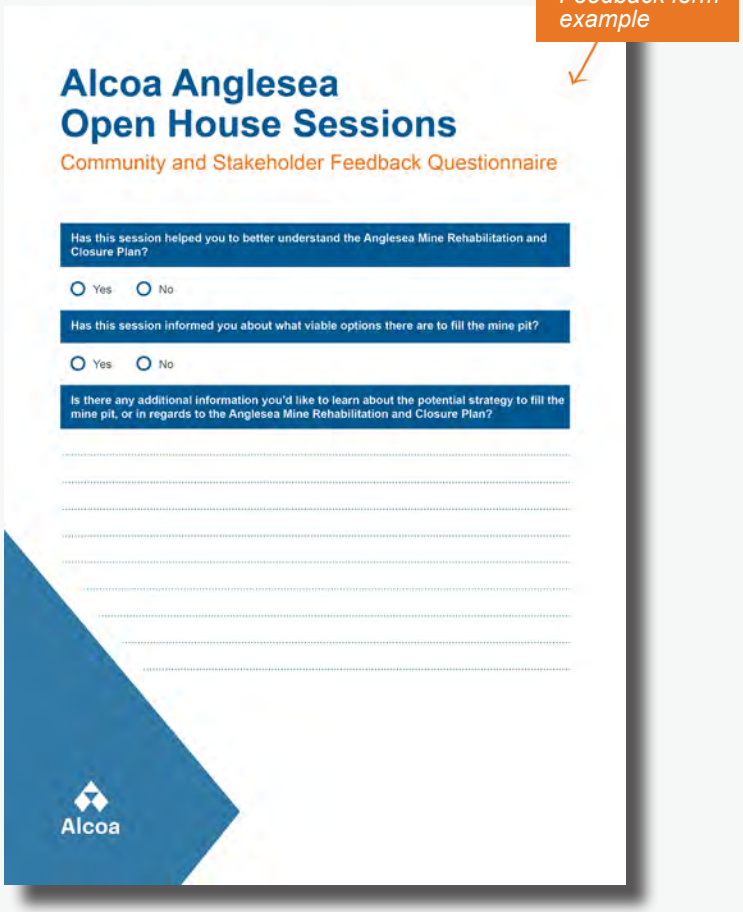
A copy of the completed feedback forms are provided within Appendix 4.

Considerations when reading this report

Several factors influenced the gathering and analysis of the quantitative data and qualitative feedback and should be considered before reading. These include:

- The information presented in this report was collected from voluntary feedback and therefore the sample is not necessarily statistically representative of Anglesea population.
- The collation and analysis of data has been undertaken by Keep Left.
- The comments referenced within this report are often a direct quotation of feedback provided by respondents within their feedback. The accuracy of content provided within this feedback has not been assessed, and therefore should not necessarily be viewed as a statement of fact, but rather a representation of the opinions and perceptions of respondents.
- Feedback quoted in this report may have been edited to correct spelling and grammar to aid readability. Care has been taken not to change the sentiment, tone or context.

Feedback form example



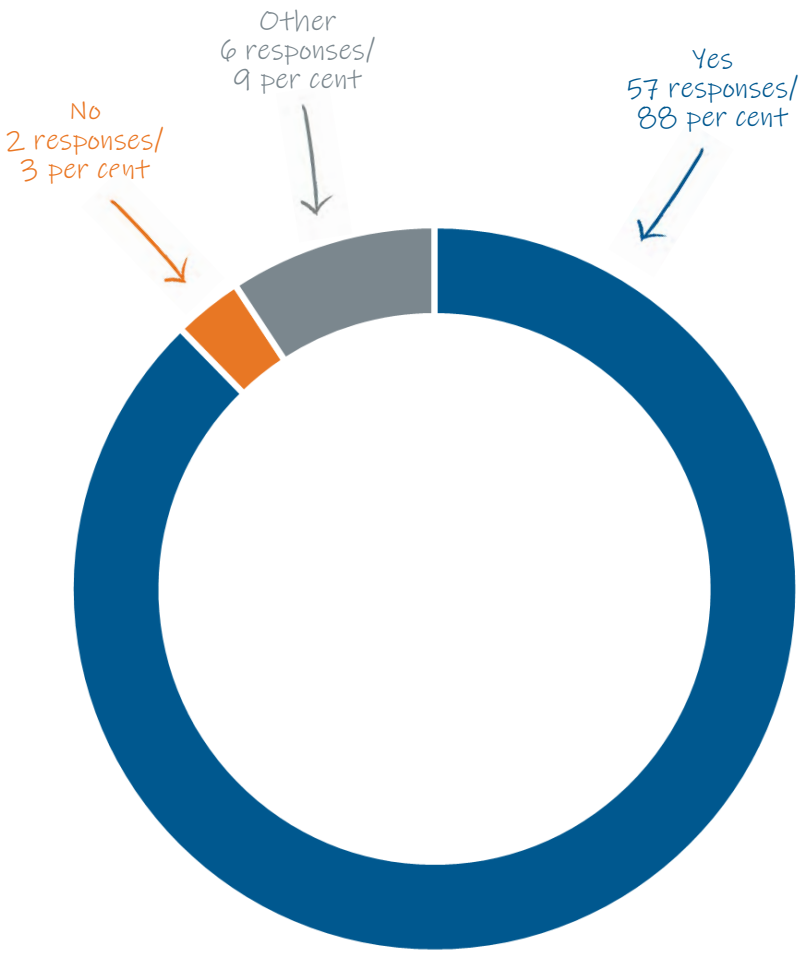
Question one

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No

Insights

- The vast majority (88 per cent) of attendees responded ***yes***
- Some respondents (9 per cent) didn't provide a clear response or made an alternative option, such as ***maybe*** - for the purpose of this analysis, these have been categorised as ***other***
- Only two attendees (3 per cent) responded ***no***



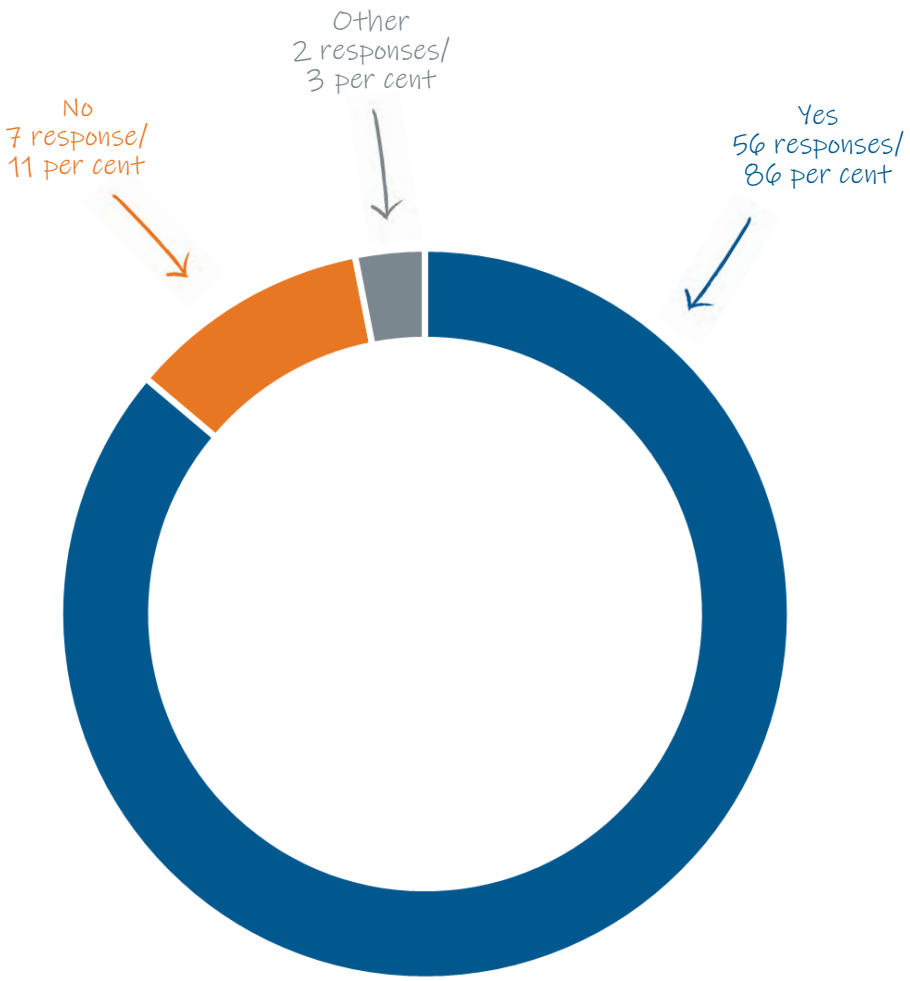
Question two

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ○ No

Insights

- The vast majority (86 per cent) of attendees responded ***yes***
- Seven respondents (11 per cent) responded ***no***
- While two were categorised as ***other***



Question three

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Insights

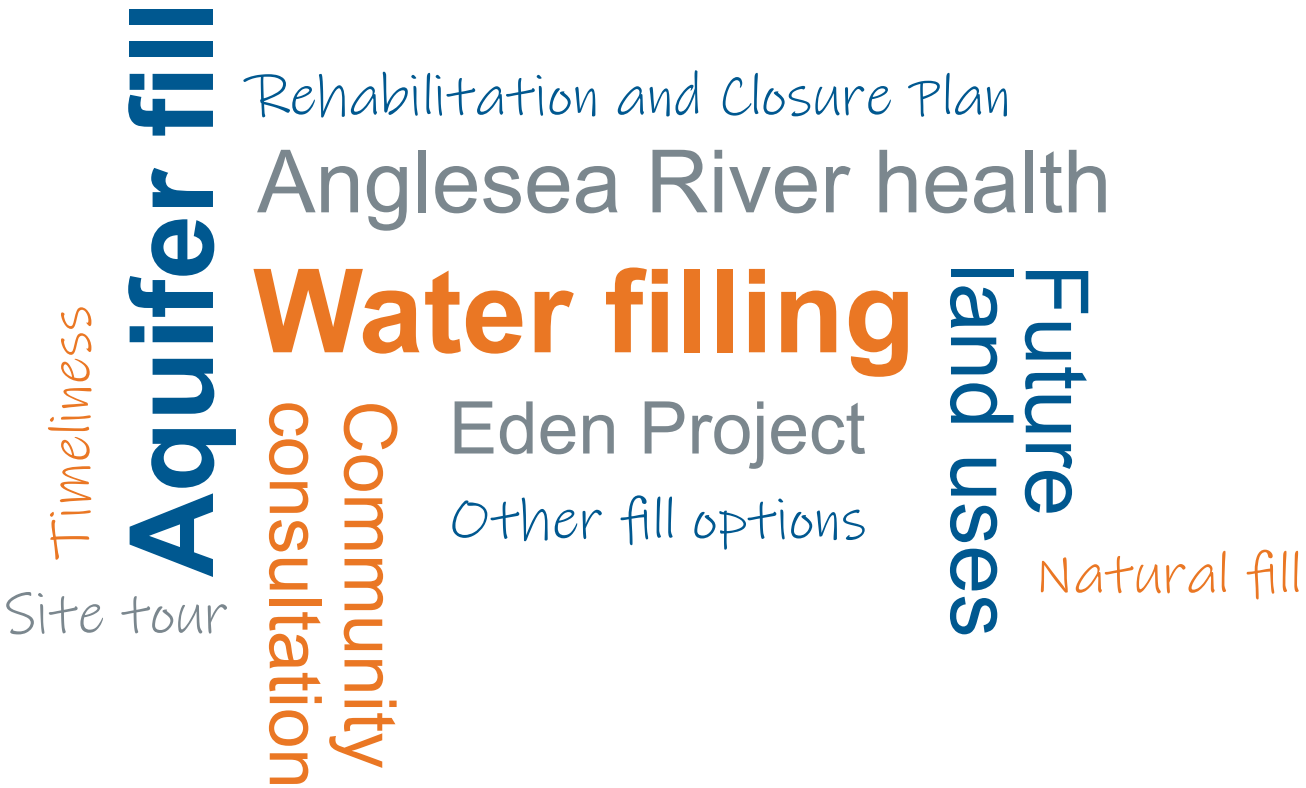
The nature of this question prompted respondents to say what ***additional*** information they would like regarding the mine water filling strategy and broader Anglesea Mine Rehabilitation and Closure Plan, whilst also providing opportunity for general comments or feedback.

While some respondents directly answered this question by specifying the exact information that they would like, many others used the free text field as an opportunity to provide their views and opinions about the project.

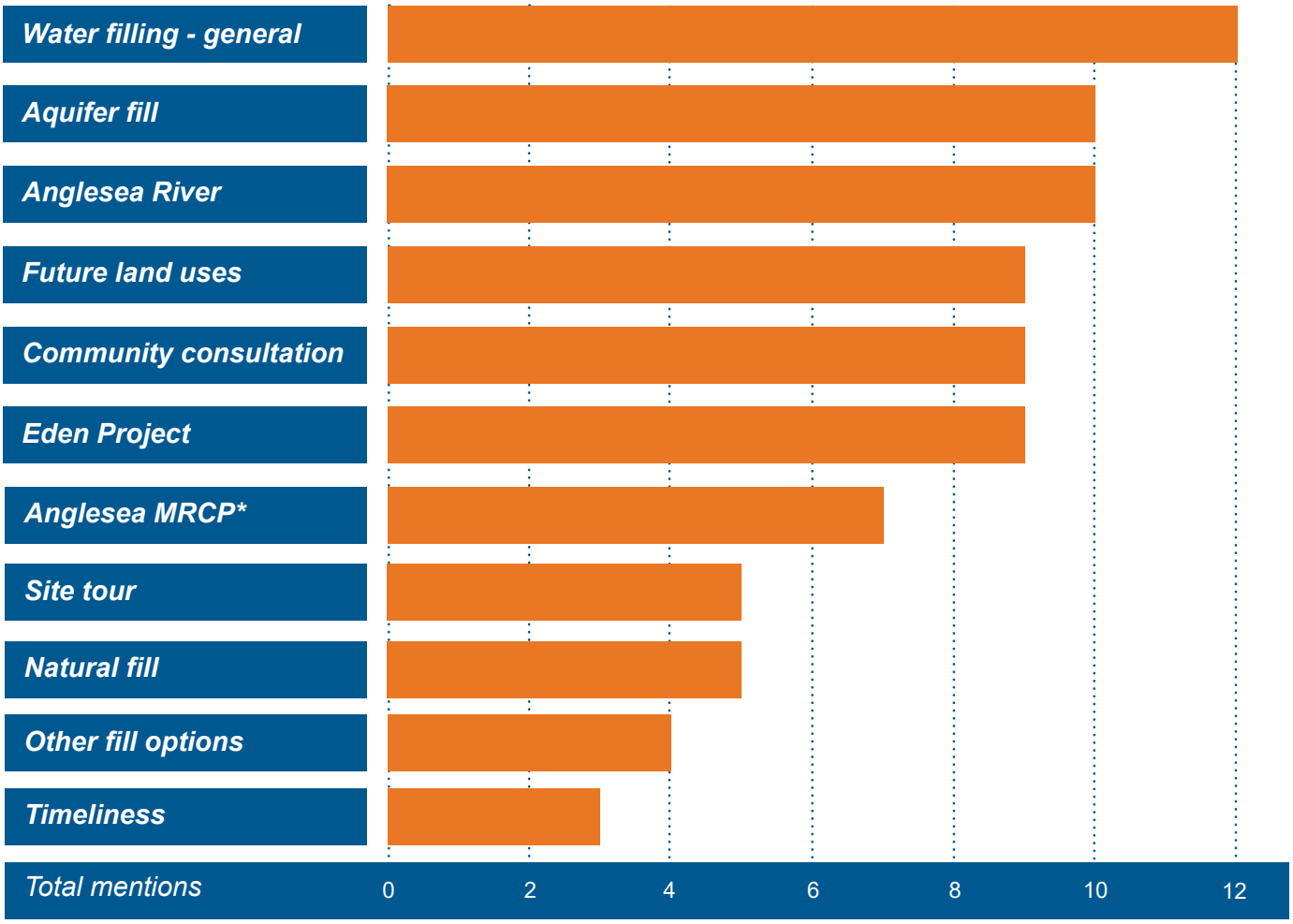
Given the level of detail provided by respondents to this question, Keep Left has undertaken some additional analysis to assess sentiment and categorise the most common themes.

Most responses to the question referenced multiple topics or themes. As a result, most individual feedback forms were tagged as addressing multiple categories.

Only two respondents chose not to respond to this question at all.



Feedback themes



*Mine Rehabilitation and Closure Plan

Water filling

The mine water filling strategy was the most common theme of feedback for question three, which is unsurprising given the topic was the focus of information provided at the open house sessions, and the subject of most discussions. Comments collected were categorised as being either general in nature (***Water filling - general***), or as indicating a preference for an ***aquifer fill*** or ***natural fill***. Comments about water filling were often connected to commentary around local waterways, which were categorised as ***Anglesea River***.

Examples of water related feedback include:

> *"How can we fill it quicker. Found it fascinating how much water there it under there. If people understand how much water there is underground it will help them understand."*
>
> *"Recycled water and sewerage. What is the quality of the water from the Anglesea sewerage plant, couldn't that be used?"*
>
> *"There is a lot to digest, lots of good information. Not convinced about aquifer but appreciate being able to talk about option, with teams."*
>
> *"Happy with the info about the river history."*
>
> *"For someone who doesn't understand water it was well presented with helpful people around."*

Information detail and complexity

A high-level of detailed information was provided about pumping tests, groundwater, aquifers, hydrology and geology at the sessions. This was supported by explanations from Alcoa representatives and their technical experts.

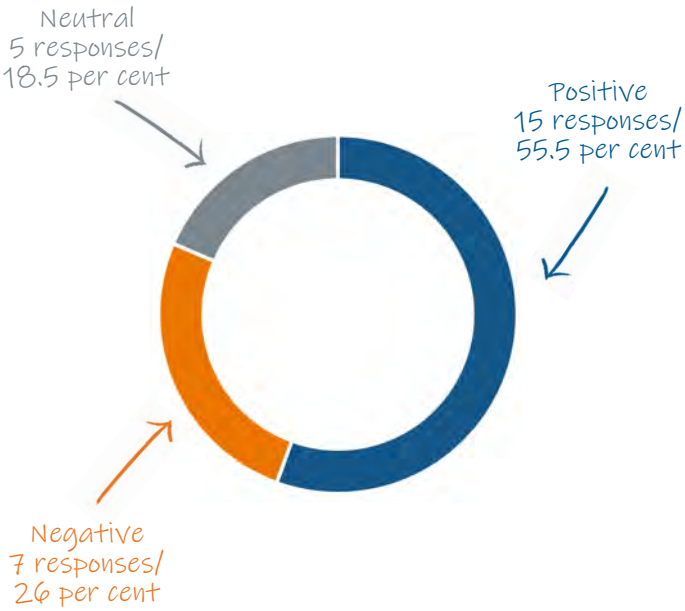
Many respondents expressed appreciation about the level of detail provided, which was reflective in many attendees spending a considerable amount of time digesting the information and chatting with representatives.

There were also a number of comments from attendees expressing a feeling that there was too much information provided and that it was too technical in nature, despite Alcoa's attempt to explain what by its very nature, is a complex and technical project.

Given many respondents had feedback about the level of detailed information provided, this was assessed as a sub-category.

Examples of the differing opinions regarding information complexity include:

> *"Graphs were too technical, graphs need to be better explained, also labelled…would like to see more progression and plans moving forward."*
>
> *"Well presented - for someone that doesn't understand water it was well presented and helpful people around."*



Given the majority of feedback regarding information complexity was categorised as either positive or neutral, it is reasonable to assess that Alcoa did a good job of presenting the community with a significant amount of information, in a way that enabled attendees to be able to make their own assessments.

Presenting all of the research data, while also seeking to educate attendees about this complex project is a challenge, and it's reasonable to err on the side of providing more information, than to not present all of the detail and facts.

Future land uses

Respondents seeking more information about future land uses, including the Eden Project for Anglesea concept and broader Anglesea Mine Rehabilitation and Closure Plan (MRCP), were the next most common feedback themes.

Examples of future land use related feedback include:

> *"Interested in Eden Project or if there are viable alternatives. Also interested in what progress to make sure water is provided and has the right impact. Also, why do you want water, not soil?"*
>
> *"Not at this stage. Will there be a block of land for housing? Interested in Eden Project."*
>
> *"Displays really good - balance of technical and well explained. Good doing three sessions to inform community."*
>
> *"I'd like to get an update on Eden Project and in regard to the filling."*
>
> *"Good overall - would like more info on Eden Project update."*

Other

Other feedback included requests to participate in tours of the former mine site, to see the rehabilitation activities first hand, or were more general about the overall consultation process.

Examples include:

> *"I would love to participate in a site tour."*
>
> *"Looking forward to a tour of the area."*
>
> *"Where is Torquay's storm water going to go? Would be good to do tours & have a better understanding and information Get the kids involved a teach them about the aquifer."*
>
> *'Thinks session is good - important to engage the community. Fantastic to have the team that actually work on the project here - especially Chris for technical details. Wants to do a tour overall supportive."*

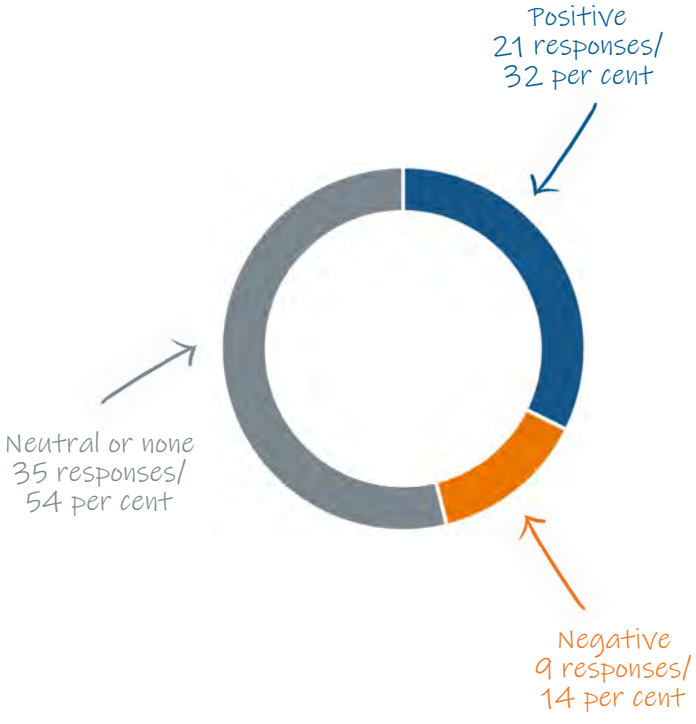
Sentiment analysis

In terms of sentiment, the majority of feedback (56 per cent) was assessed as being either neutral in tone, or that no sentiment could be gleaned from the respondent.

Many of these were responding to the question as it was intended, simply providing areas where more feedback would be appreciated.

Examples of neutral feedback include:

> *"I'm already informed as a member of the River Advisory Council and Angair, but it's an opportunity to see all the detail as I attend a lot of community information sessions."*
>
> *"Much more technical than I thought it would be. I would like to see more of a timeline and progression too."*
>
> *"I feel like you guys know more about this than I do and I'm a local. I'm just interested to see what's happening."*



Just under a third (32 per cent) of respondent feedback was assessed as being positive in nature.

Examples of positive feedback include:

> *"As Mr. Nike says, "Just do it"."*
>
> *"Opportunities galore. Well-presented and supported."*
>
> *"People seem very knowledgeable."*
>
> *"Over the years since the mid-1960s I have supported everything Alcoa has done for the town. From employment of locals to support of almost all locals around town clubs and organisations in the form of donations. Their commitment to rehabilitation of the mine site to demolition of power station and the ongoing attention to water mine filling, reshaping the mine and monitoring the nature drainage has been commendable."*

Feedback from nine respondents (14 per cent) was assessed as being negative in nature.

Examples of negative feedback include:

> *"Doesn't understand why Alcoa wants to 'fill so quickly'. Don't like Eden Project, doesn't want it to be turned into hotels and conference centres. No benefits for Anglesea Community."*
>
> *"The information provided was relatively complex and would require further examination to fully understand Alcoa Arguments. Too much information - too little time. I am most concerned that Alcoa is suggesting that climate change is a major driver of reduced flows and acidity in the Anglesea River without considering the impact of the mine void (and cone of depression on the river."*

Post-it board

Attendees were invited to provide additional feedback on post-it notes to be placed on a board for others to see.

Only a few attendees chose to provide feedback on the board. However, Keep Left took a selection of quotes provided in early feedback forms to write up on the board to encourage more respondents.

General observations

While not captured in the feedback collected, a number of general and positive observations were noted during conversations Alcoa representatives and technical experts had with attendees.

These observations touched on topics such as Coalmine Road access, freehold land, affordable housing options and the suitability of the Anglesea Sewage Treatment Plant for filling the mine pit.

Digitised version of the feedback board

Conclusion

Thanks is extended to all of the community members who took the time to drop in to a session and hear firsthand how the technical work is informing Alcoa.

Throughout the sessions, Alcoa representatives and technical experts engaged in numerous constructive conversations with individuals who showed genuine interest in the work being undertaken.

Many were equally as appreciative of the opportunity to be informed, with positive comments highlighting the sessions' informative nature, the professionalism of the presentation, and the accessibility of the representatives.

This notion also aligns with the majority sentiment gleaned from the feedback forms and from the data analysed.

A summary of all the feedback collected during the open house sessions is detailed below:

- 88 per cent of feedback received indicated that attendees felt they better understood the draft Anglesea Mine Rehabilitation and Closure Plan
- 86 per cent of the feedback received indicated that attendees felt informed about what viable options there are to fill the mine pit
- The majority of feedback (56 per cent) was assessed as being either neutral in tone, or that no sentiment could be gleaned from the respondent, while 32 per cent was positive and 14 per cent negative
- Community members remain interested in a variety of other aspects related to the future of the site

Stay informed and involved

Sign up to Alcoa's email mailing list by scanning the QR code below or by emailing **angleseaps@alcoa.com.au**.

To contact the team directly, reach out via **angleseaps@alcoa.com.au**.

To learn more about Alcoa's work, visit **alcoa.com/australia/en/anglesea**.

Scan me

Alcoa

Alcoa Anglesea

205 Coalmine Road, Anglesea VIC 3230
angleseaps@alcoa.com.au
www.alcoa.com/australia/anglesea

Alcoa

Alcoa Anglesea

Community Engagement Report Appendices

Published July 2024

Appendix 1 | Information boards

Welcome

Alcoa acknowledges Wadawurrung People as the Traditional Owners of the land where we operate and we pay our respects to their Elders past, present and emerging.

Kuarka Dorla Dja, (Anglesea) is a place where Wadawurrung ancestors came to fish for mullet.

Bounded by intricate waterways flowing out to the Warri (salt water), sand dunes steeped in heritage, and the high point of country the Anglesea Heathlands, where the Mirri (sun) rises on the Warri (salt water) and sets across the heath.

We acknowledge Bunjil as the Creator Spirit, who continues to watch over the land and guide us all on our journey and responsibility to heal country.

*Artwork © Billy-Jay O'Toole, '**Kuarka Dorla Dja**', 2023.*

Alcoa

Mine Rehabilitation and Closure Plan

Delivering a space for community

Alcoa have a regulatory obligation to deliver the final Anglesea Mine Rehabilitation and Closure Plan.

Major earthworks and revegetation activities completed in 2020, have delivered a safe, stable and sustainable landform, which will require ongoing monitoring and maintenance over the next decade.

The key remaining aspect of the Plan is an approved strategy to fill and maintain the mine pit with water.

A range of potential options to support filling the mine pit in a timely manner have been investigated and of these, the only two currently feasible options are the use of groundwater from the Upper Eastern View Formation (UEVF) which would see the mine pit filled in seven to 10 years, or natural fill.

Options considered

- UEVF groundwater - Alcoa licence
  LEVF groundwater - Barwon Water licence
- Recycled water - Breamlea treatment plant
- Natural fill - estimated to take approximately 50 years
- Seawater and/or desalination
- Salt Creek restoration

Post completion of earthworks and revegetation 2022

Alcoa

Legend
1. Native grassland slope
2. Native dryland / wetland vegetation / rocks
3. Rediverted Salt Creek
4. Outlet to Anglesea River
5. Historical rehabilitation areas
6. Proposed areas for alternative uses
7. Proposed access route
Alcoa of Australia Freehold
WATER BODY
Anglesea Heath
Peregrine Track
Salt Creek
Bald Hills Rd
Anglesea River
Alcoa of Australia Freehold
Coalmine Road
Messmate Track
Coalmine Rd
Anglesea Golf Club
N
0m
50m
100m
250m
500m

Mine Water Filling Strategy

Approximately **18 gigalitres** of water is needed to fill the mine pit. As at April 2024, there is approximately **three gigalitres** of water present.

Alcoa's preferred option is to fill the mine pit over seven to 10 years, achieved through supplementing natural filling of the mine with a combination of UEVF groundwater and potential peak flows from Salt Creek. Extensive technical work undertaken over more than three years has not identified any adverse impact on groundwater dependent ecosystems, including the Anglesea River.

Why water?

Creating a water body supports:

- Benefits to the environment, the regional economy and the community from the future land use of the rehabilitated landscape
- A critical fire break to minimise fire risk to the Anglesea township
- Geotechnical stability through the weight of water at the base of the mine

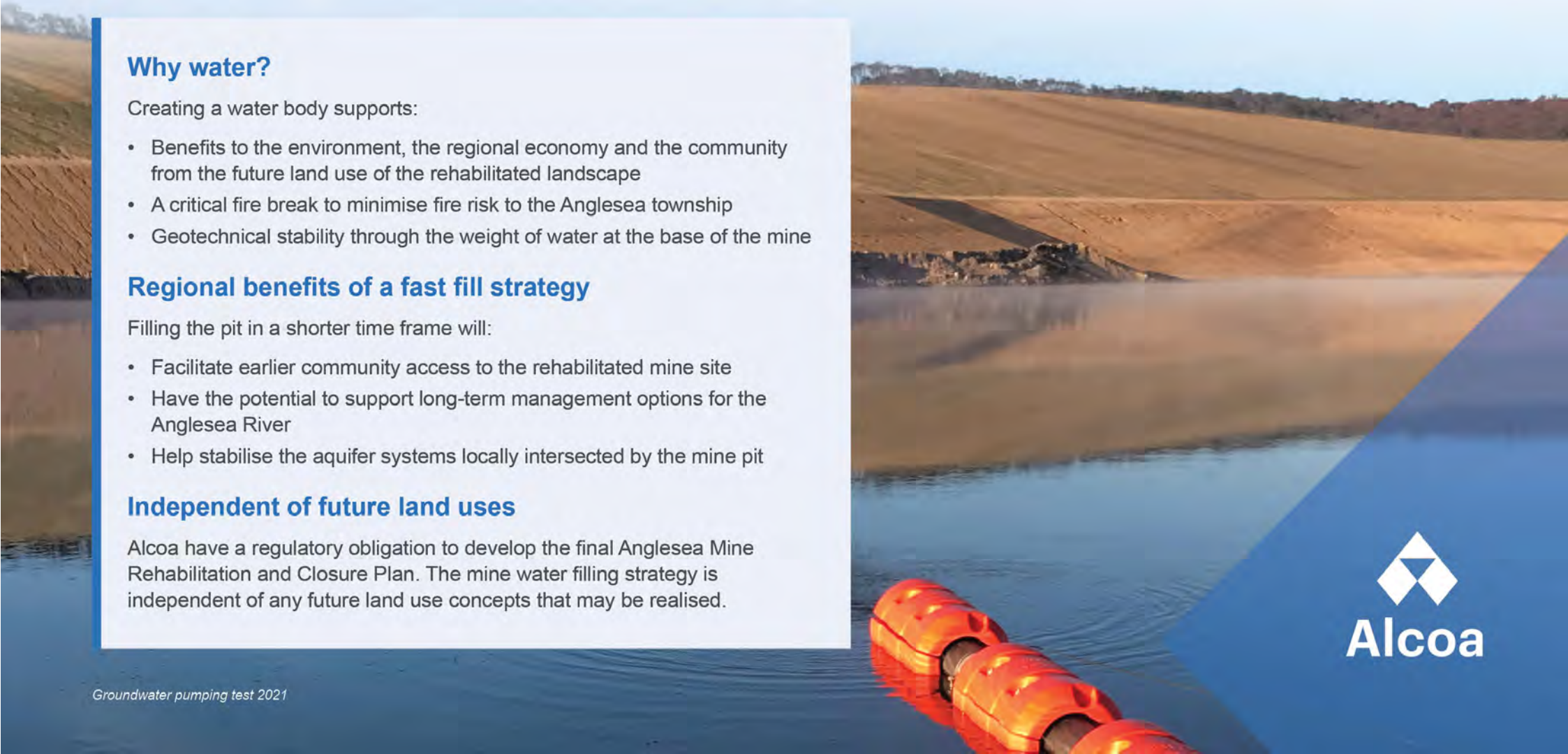
Regional benefits of a fast fill strategy

Filling the pit in a shorter time frame will:

- Facilitate earlier community access to the rehabilitated mine site
- Have the potential to support long-term management options for the Anglesea River
- Help stabilise the aquifer systems locally intersected by the mine pit

Independent of future land uses

Alcoa have a regulatory obligation to develop the final Anglesea Mine Rehabilitation and Closure Plan. The mine water filling strategy is independent of any future land use concepts that may be realised.



Groundwater pumping test 2021

Alcoa

What's below the surface?

Understanding the hydrogeology

Different layers of geology impact the interaction between groundwater and surface water.

The Upper Eastern View Formation (UEVF) hosts multiple sub-aquifers, located either in the upper section (upper sands) or lower sections (lower sands).

Separating the upper and lower sub-aquifers are multiple low permeability layers of coals and sandy clays.

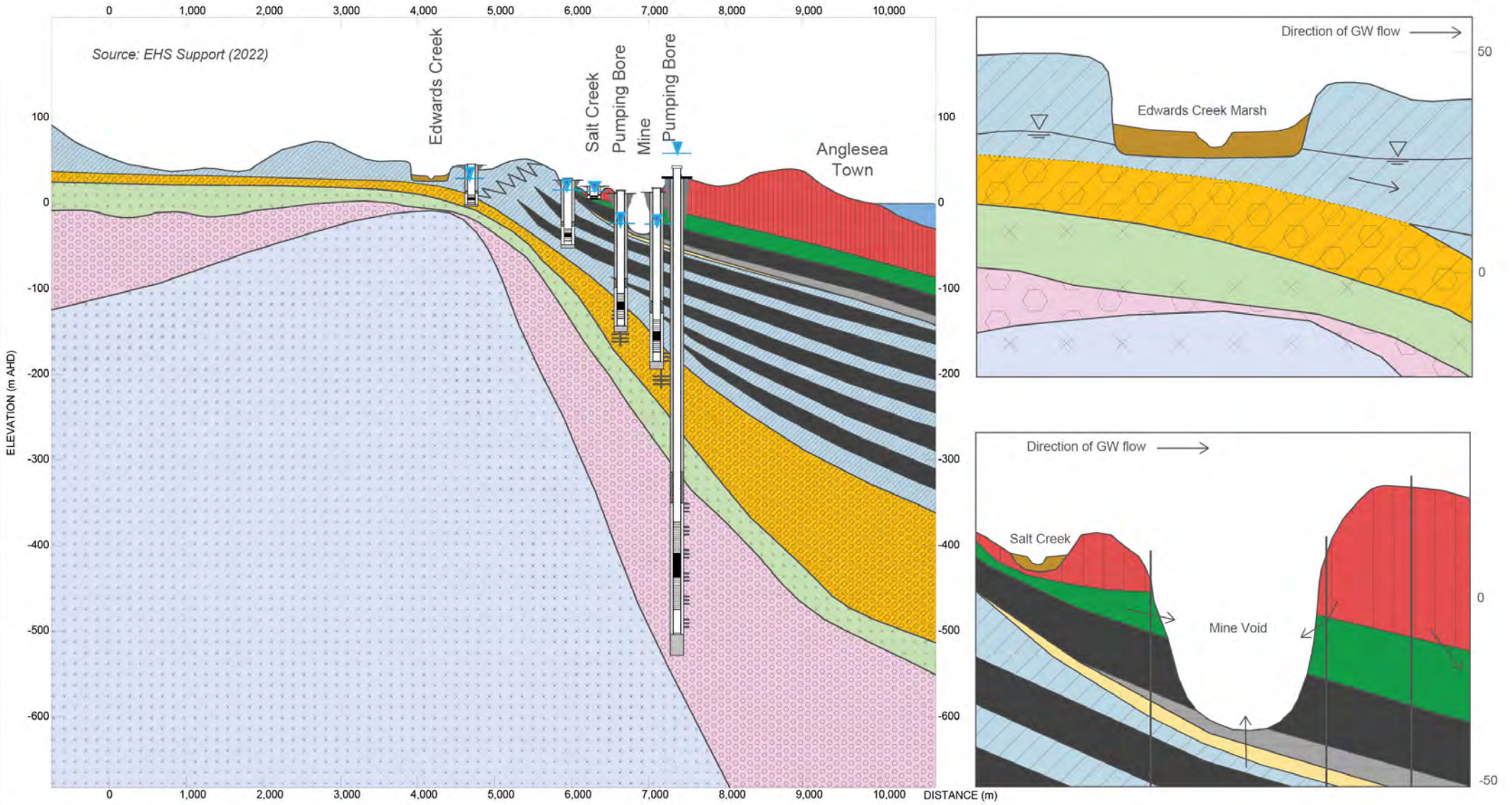
The permeabilities of these layers are typically equivalent to EPA specified landfill liner requirements.

Water pressure is higher in the saturated low permeability layers of coals and clays compared to the upper and lower sands – which indicates a degree of disconnectivity.

Clay also lines the base of the creek systems, inhibiting surface and groundwater interaction.

Alcoa

Surface water drain engineered in top soil revegetation



MATERIAL GRAPHIC

- Clayey Gravel
- Clayey Sand
- Well-graded Sand
- Siltstone
- Silt

GEOLOGY UNIT 1

- Channel Alluvial
- Upper Eastern View Formation (Coal Seam)
- Upper Eastern View Formation (Intermediate)
- Lower Eastern View Formation
- Demons Bluff Group
- Upper Eastern View Formation (Basal Clay)
- Upper Eastern View Formation (Lower Sands)
- Torquay Group
- Boonah Formation
- Upper Eastern View Formation (Upper Sands)
- Middle Eastern View Formation

H 1:20000
0 1000m 2000m
V 1:1800
0 50 100 150 200 250m
Coord.System: MGA94 Zone 55 Height Datum: AHD

EHS Support

TITLE

Alcoa of Australia Limited
Anglesea
Alcoa Anglesea Mine and Power Station

DRAWN	DATE	25/11/2021
CHECKED	DATE	25/11/2021
SCALE H 1:20000 V 1:1800		A3
PROJECT No AUS##C03093_2020	FIGURE No	

Exploring historical groundwater behaviour

What story does history tell?

Groundwater pressures in the lower sands of the UEVF have ranged between -90 to 0 mAHD. Since the 1990s when shallow aquifer monitoring began, this lower aquifer depressurisation has not impacted the shallow aquifers' water table, indicating the 'cone of depression' is confined to the pumped aquifer.

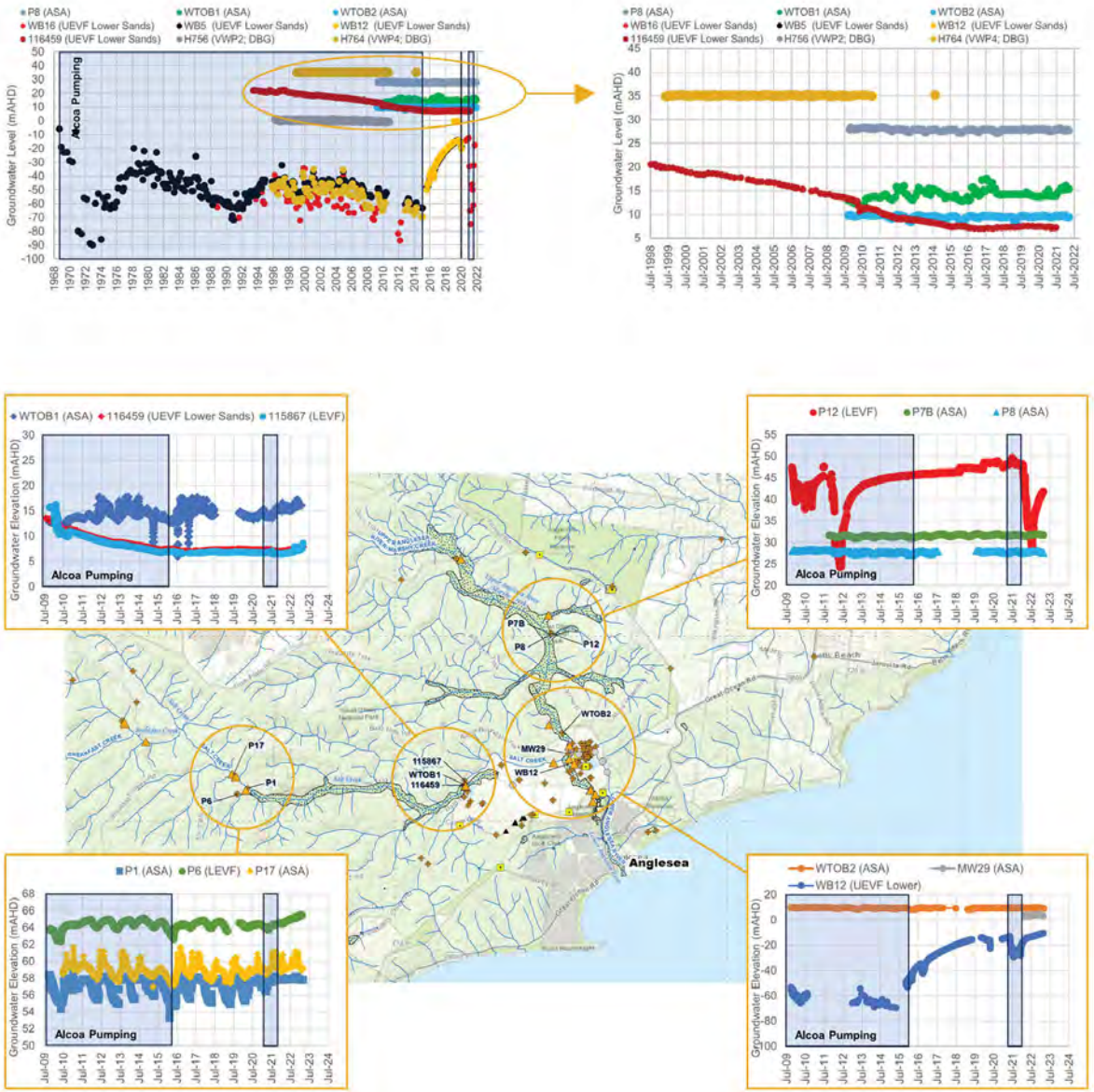
Groundwater levels in the alluvial swamp aquifer (ASA) respond closely to seasonal rainfall - declining when the proceeding months are low in rainfall and/or evapotranspiration is high.

Groundwater trends in the ASA behaves similarly regardless if the UEVF potentiometric surface or 'cone of depression' is higher or lower than the water table in the ASA.

For example:

P8 (screened in the ASA with potential gaining conditions) experiences similar behaviors as WTOB2 (screened in the ASA with potential losing conditions).

This indicates that at these locations, the base of the ASA is relatively impermeable with the clay layer retarding vertical water movement. Rather climatic conditions such as rainfall and evapotranspiration control water level behaviour and consequently, timing of surface water flow.



Groundwater pumping test

In 2021 Alcoa undertook a groundwater pumping test on the UEVF aquifer to help determine if UEVF groundwater could be used to fill the mine pit.

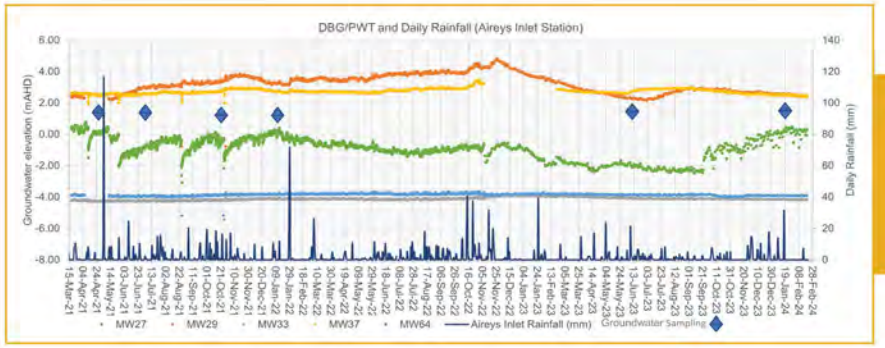
The test was undertaken by expert hydrogeologists between May and December 2021, with oversight by a Victorian government co-regulator technical working group. A total of 671.9ML was extracted during the test period.

What did the results demonstrate?

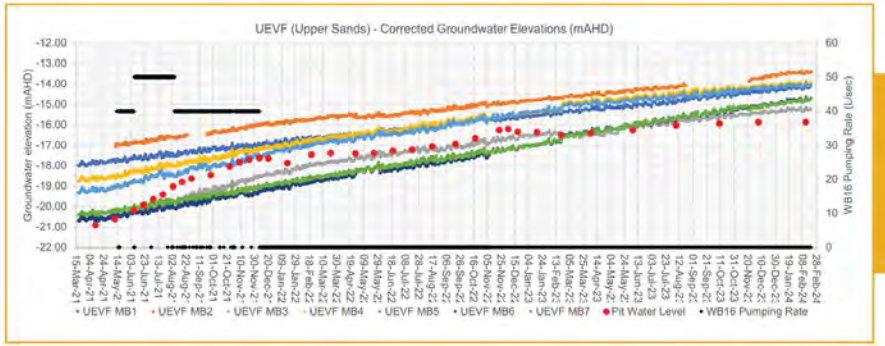
Science-based data collected throughout the process revealed groundwater dependent ecosystems, including the Anglesea River were not adversely impacted as a result of the pumping.

While the groundwater pressure reduced as expected in the UEVF lower sands, there was no impact in the UEVF upper sands or the shallow aquifer systems.

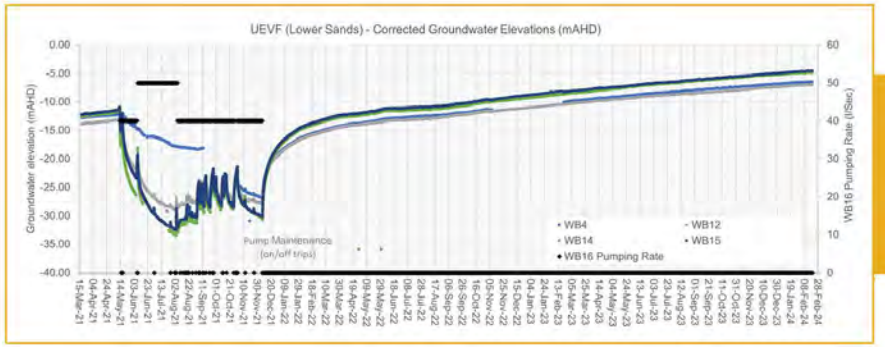
WB16 pumping bore | UEVF/DBG monitoring bore | Discharge location



Groundwater level trends in the DBG/PWT aquifer (5-50m) shows response only to natural climate variations and no impact of pumping



Groundwater level (pressure) trends for the upper part of the UEVF aquifer (40-140m) show no impact of pumping



Groundwater level (pressure) trends for the lower part of the UEVF aquifer (200m) show declines as modelled

Groundwater Model

What is it?

The model allows Alcoa to examine how groundwater systems respond to different stressors and predict what may occur under future climate conditions. It is a mathematical estimation of how groundwater flows through rocks and sediments, and provides a forecast range of estimates (called uncertainty) based on running the model hundreds of times using different realistic parameters.

The model was reviewed by the Inter-Agency Group comprising DEECA, SRW and DJPR-ERR, and was supported by a Technical Review Panel consisting of independent experts from a wide range of disciplines including geology, hydrogeology, modelling, geochemistry, and ecology.

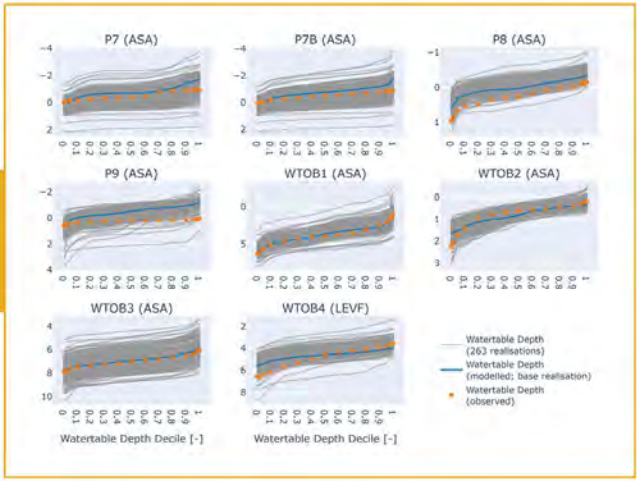
Initial modelling suggests there is a low risk of adverse impacts to groundwater dependent ecosystems, including the Anglesea River.

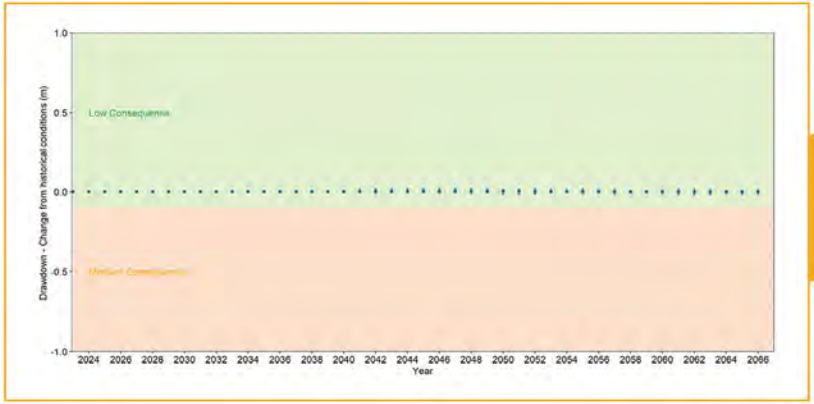
The model is one of many tools including the hydrogeological model, actual historical data, independent technical studies and groundwater pumping tests, used to help understand potential risks to groundwater dependent ecosystems, including the Anglesea River.

The model has been developed using:

- Data from more than 140 groundwater monitoring bores
- Data from six stream gauges
- Findings from historic and recent pumping tests
- Long-term climate data
- Recovery data obtained since Alcoa ceased pumping in 2016

Example of model calibration at observation bores





Groundwater level impact (WTOB1 - ASA)

What a potential application might look like

Mine water filling strategy figures

Alcoa are considering applying for a licence amendment with Southern Rural Water for the extraction of up to 1.5 gigalitres per year, for approximately 10 years.

Applying the precautionary principal, this is a conservative approach, being less than 40 per cent of the historical extraction rate.

Mitigating risk

Alcoa would expect any future licence to have specific volume and extraction limits, and a variety of stringent and standard conditions.

To further mitigate any risk to the environment, as part of any application Alcoa would also propose an adaptive management approach which would include:

- A documented water management and monitoring plan
- Ongoing, comprehensive monitoring of all available bores across all aquifers
- Multiple bores (~30) in various aquifers selected as dedicated monitoring and/or trigger bores
- Nominated trigger bores with defined water level and/or water quality triggers and contingency actions (including cessation of extraction) in the event of a trigger exceedance
- Sharing of monitoring results with community and relevant stakeholders

Monitoring infrastructure

2021 pumping test monitoring and trigger bores

View of the mine pit across completed top soil revegetation works

Alcoa's understanding of the river

Anglesea River was originally named Swampy Creek, and was changed in 1884 so as to not discourage tourists from the area[1].

Salt Creek and Marshy Creek are historically ephemeral waterways - meaning they do not flow all year round, only when the prevailing conditions allow.

Anglesea River has historically seen periods of sustained low flows, including pre-Alcoa in the 1930s and 1950s[1].

Both Anglesea River catchments have high levels of naturally occurring acid sulphate soils[2].

The lower Anglesea River appears to have historically acted in a more estuarine fashion than it does today.

In the mid-1960s Alcoa diverted the last two kilometres of Salt Creek around the mine into a clay and concrete lined diversion channel.

During operation Alcoa extracted up to 4 gigalitres per annum and discharged approximately 4.5 ML/day of pH 7 to 8 water into the Anglesea River. During low flow periods, this constituted a major portion, if not 100 per cent of flow inputs to the estuary.

There is an absence of continuous, historical actual river flow and water quality data, and little to no data before 1969.

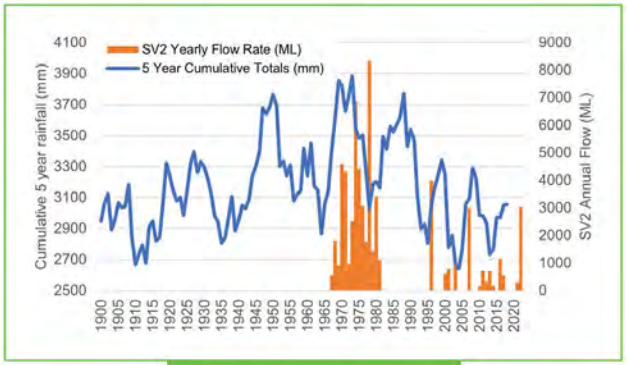
There has been numerous historical attempts to sandbag the mouth of the river, including the creation of a weir wall in 1975, 'to keep the river at a constant level'.

Coogoorah Park was created in 1983 as part of the lower Anglesea River, increasing its volume and adding a potential acid sulphate risk.

The region is going through a long-term drying cycle, using the annual rainfall/deficit versus the long-term average rainfall.

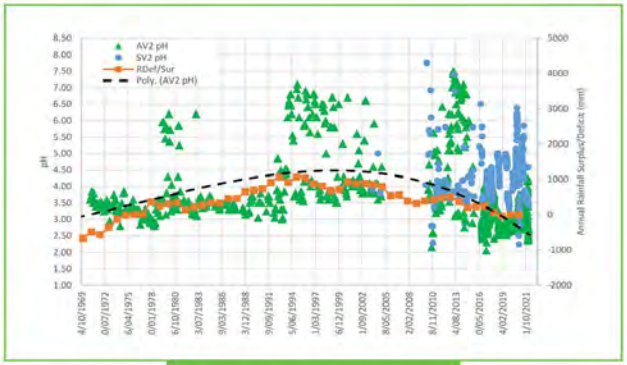
Two of the three driest five-year periods in the last century have occurred since 2006, and the two wettest five-year periods in the 1970s[3].

River flow is not just about how much rainfall, but also about when it rains and the prevailing conditions.



Rainfall and surface water relationship

Annual rainfall surplus/deficit[3]



AV2 pH data from 1969

[1]Prue and Graeme Weber (2010), The Grand Challenge: A History of the Anglesea Recreation and Sports Club 1911 – 2010. [2]Wong (2020), Monash University. [3]Queensland Government, SILO database, https://www.longpaddock.qld.gov.au/silo/.

Appendix 2 | Advertising collateral

Surf Coast Times advertorial

Published Friday 17 May 2024.

Our work exploring the possibility of using groundwater to fill the mine pit within the next decade is nearing completion.

Community members are invited to drop-in to one of three open house sessions, to learn more about the findings from members of our team and technical experts.

The feedback collected during the sessions will be considered when determining if we submit a formal groundwater licence amendment application with Southern Rural Water.

Anglesea Bowling Club | 15 Cameron Road, Anglesea

Thursday 23 May	Friday 24 May	Saturday 25 May
4:00pm to 6:00pm	10:00am to 12:00pm	10:00am to 12:00pm

No registration required. Community members are welcome to come and go as they please throughout the time slot.

To contact the team, reach out via angleseaps@alcoa.com.au.

To learn more about our work, scan the QR code.

Event flyer

Published Friday 17 May 2024.

Alcoa Anglesea Open House Sessions

Our work exploring the possibility of using groundwater to fill the mine pit within the next decade is nearing completion.

Community members are invited to drop-in to one of three open house sessions, to learn more about the findings from members of our team and technical experts.

The feedback collected during the sessions will be considered when determining if we submit a formal groundwater licence amendment application with Southern Rural Water.

Anglesea Bowling Club | 15 Cameron Road, Anglesea

Thursday 23 May	Friday 24 May	Saturday 25 May
4:00pm - 6:00pm	10:00am - 12:00pm	10:00am - 12:00pm

No registration required. Community members are welcome to come and go as they please throughout the two-hour time slot.

Email invitations

Sent to 979 individual Alcoa database subscribers.

Email copy:

Alcoa will host three open house sessions in Anglesea this month, inviting local community members to hear the latest update on rehabilitation of the former mine and power station sites, and learn about a potential strategy to fill the mine pit.

Click the image below to find out more about the sessions being held on Thursday 23, Friday 24 and Saturday 25 May.

Image link: https://sway.cloud.microsoft/qieBQ1ohsjXPvUWs?ref=Link.

If you no longer wish to receive communication material from Alcoa Anglesea, reply unsubscribe to this email.

Note: Click on the link to visit the dedicated web page visited by 507 individuals.

Appendix 3 | Facebook and Instagram campaign

Off-Page Social Media Campaign

Overview

Objective: deliver an off-page targeted social media campaign to drive awareness about the three upcoming open-house community information sessions being hosted in Anglesea over May and June:

- **Campaign objective**: increase awareness about the information sessions
- **Conversation location**: https://sway.cloud.microsoft/qieBQ1ohsjXPvUWs?ref=Link
- **Channels and delivery**: deliver across two channels: Alcoa Australia Facebook and Instagram
- Campaign to target selected postcodes from Friday 17 May – Friday 24 May

Creative: 3 x animated ads utilising brand campaign imagery

- Water pump imagery
- West wall imagery
- Aerial imagery
- Animated graphics designed to suit all required ad specs for multi-platform ad delivery including feed ads, story/reel ads and right column graphics

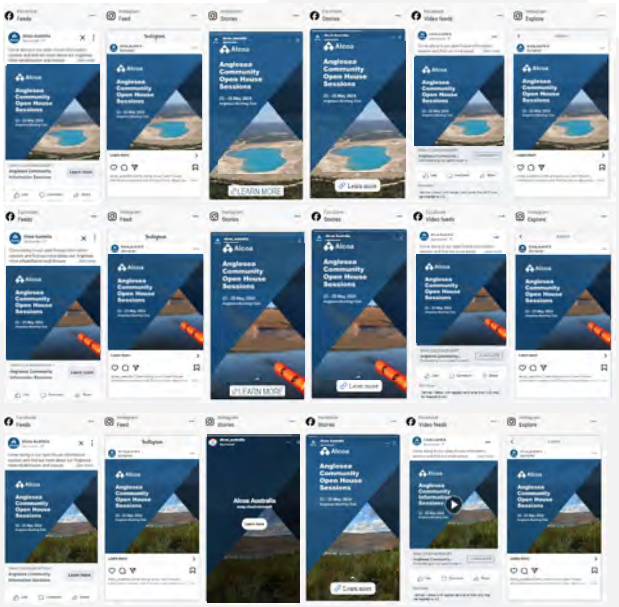
Audience: Targeting Anglesea postcode

- Anglesea 3230 and Aireys Inlet 3231

Content placement

Social media touchpoints and opportunities

- **Each advert to be displayed in 21 placements across:**
  - Facebook feeds
  - Instagram feeds
  - Facebook marketplace
  - Facebook video feeds
  - Instagram explore
  - Instagram explore home
  - Facebook Business explore
  - Instagram stories
  - Facebook stories
  - Instagram reels
  - Facebook reels
  - Facebook in-stream for Videos
  - Facebook Ads on Facebook Reels
  - Instagram Ads on Instagram Reels
  - Facebook Search results
  - Instagram Search results
  - Audience Network: native, banner and interstitial (apps and sites)



Ad results - summary

Off-page campaign performance overview

- The off-page campaign had a performance target to ensure it met the main goal of boosting awareness of Alcoa's Anglesea Community Open Sessions:
  - **Performance goal**: maximising total reach and number of impressions of ads
- The campaign, made up of three ad sets targeting the specified postcodes Anglesea 3230 and Aireys Inlet 3231

- In total, the campaign received close to 14,000 impressions, and reached an audience of just over 3,800. This a strong result considering the total audience size of the campaign sit within 5,000 – 5,300.

METRIC	RESULTS
Reach *Number of accounts/users who saw content at least once.*	3,819
Frequency *The average number of times each account saw your ad.*	2.8
Impressions *Number of times your ads were on screen.*	13,945
All Clicks *The number of clicks, taps or swipes on your ads.*	103
Link Clicks *The number of clicks, taps or swipes within the ad that led to advertiser-specified destinations*	32
Engagements *Number of actions people take involving ad.*	732

Ad results - audience

Off-page campaign gender breakdown

Gender breakdown

	Reach	Impressions	Engagements
Male	2,100	7,810	395
Female	1,681	5,996	330
Uncategorised	38	139	7

Age breakdown

	Reach	Impressions	Engagements
18-24	840	3,207	102
25-34	954	3,765	95
35-44	575	1952	124
45-54	458	1813	118
55-64	496	1674	117
65+	496	1534	176

Findings

- The campaign was well-received by both the male and female audiences. The budget optimsation tool prompted an increase in budget allocation to the male-owned accounts to effectively hit the 'reach' targets set for this campaign
- Findings are a true reflection of current Facebook user statistics (as of January 2024 via Statistica) with men between the ages of 25 and 34 years making up the largest audience (20%)
- Interesting to note that users between the ages of 25 and 34 saw the campaign the most but those in the 65+ age bracket were the most engaged. This reflects the Australian Bureau of Statistics population census results of Anglesea that details people between the ages of 60 to 80 make up the largest portion

https://abs.gov.au/census/find-census-data/quickstats/2021/SAL20046

Appendix 4 | Completed feedback forms

Names and identifying information have been redacted for privacy purposes.

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- What will happen to the freehold land.

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

① Despite the huge effort obviously made it is still difficult for even informed locals to understand.

② The complexities & variables are huge

③ I believe most residents who bother to come really want to know only "how can we have our river back to health". Alcoa seems keen this to be ongoing as the river is a separate issue from the filling of the pit.

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No A little.

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ☑ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

[redacted] I found the information well presented but difficult to understand as it is very complex and a lot to take in.
I'll read up and try to absorb the information
(I took photo's)

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Opportunities galore, well presented & supported.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [x] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

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Alcoa

Alcoa Anglesea Open House Sessions

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Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Maybe access to the list of plants being used for revegetation - of interest to Gordon students.

Love to see more before / after images as I think you are doing a great job!

Alcoa

Alcoa Anglesea Open House Sessions

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Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Potential uses for the site post closure & filling of mine pit. Alcoa/Government plans for utilisation post fill.
- How could ~~ex~~ local education providers be involved along the way. Opportunities for collaboration or tours/visits.

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

(●) Yes ( ) No

Has this session informed you about what viable options there are to fill the mine pit?

(●) Yes ( ) No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

No feedback but verbatim:
"I feel like you guys know more about this than I do and I'm a local." "I'm just interested to see what's happening."

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Would like to stay in touch
- Well presented

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

No more than you are providing.
Thank you.

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

No.

Over the years since the mid 1960's I have supported everything Alcoa has done for the town. From employment of locals to support of almost all local clubs and organisations around town in the form of donations. Their commitment to rehabilitation of the mine site to demolition of power station and the ongoing attention to water mine filling, reshaping the mine and mountaining the nature drainage has been commendable.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Happy with the info about the river highway.

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

How will you manage to convince the many different groups of residents to allow this? There appears to be a number of groups opposing any change! Each group has a different opinion on water issues - many ill informed.

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

The Session is most informative and gave insight into viable future options. The Staff are open to question and have the knowledge needed to help the public understand the history and the future of the mine in Anglesea.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

(✓) Yes ( ) No

Has this session informed you about what viable options there are to fill the mine pit?

( ) Yes (✓) No Insufficient info about options.

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Overall, very clearly presented.
Thanks.

"It's far more complex than I can understand"

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ☒ No not sure there were many other viable others

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Just a viable option - the professional expertise has said this will be the best to benefit.
- Interested in Eden Project or if there are viable alternatives.
- What progress to make sure water is provided that has the right input.
- Why do you want water - not soil.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

(X) Yes ( ) No

Has this session informed you about what viable options there are to fill the mine pit?

(X) Yes ( ) No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Not at this stage
- block of land for housing.
- Interested in Eden Project.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

(X) Yes ( ) No

Has this session informed you about what viable options there are to fill the mine pit?

(X) Yes ( ) No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Displays really good - balance of technical + well explained.

- Good doing three sessions to get buy in from community.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Why do we need to fill it up?"

"If there is a good reason, it seems like water already creates the geostability"

"We may not understand future impacts" "risky"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Surf Coast Times article prompted visit

"Biggest concern is the river, used to be able to catch a fish with the kids now it's dead"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"People seem very knowledgable"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- "How can we fill it quicker"
- Found it so fascinating how much water there is under here.
- If people understand how much water there is underground it will help them understand.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Preferred option is natural filling.
Alcoa doing a good job.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Not at this stage.

"Very informative"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No to an extent

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

I would love to participate in a site tour.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

(●) Yes ( ) No

Has this session informed you about what viable options there are to fill the mine pit?

(●) Yes ( ) No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Looking forward to a tour of Thearca

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Update on Eden's progress & interest

"As Mr. Nike says, 'Just do it.'"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Yes I would like more information on filling the mine pit and the risks involved.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Two options - natural or not.
I thought you had finalised plans.

- Not sure why you're so anxious about filling it with water.
- See the advantages for fire
- The Anglesea river is in quite a dire situation.
- "My preference would be to let it fill naturally."

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Recycled water + Sewerage. - Quality of the water from the Anglesea sewage plant. Could that be used.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Much more technical than I thought it would be"

"Would like to see more of a timeline.... would like to see more progression too."

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

No -

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Where in the plan it says it needs to be filled. Is it mandatory and walk away

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Alcoa's plan filling with overburden from work - fish + pigs on all 3.

- In relation to the environmental impact assessment of "Galcappa" + Anglesea river health - the interaction of all three.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Good overall
- More interested in the Eden Project

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Also Good overall
- Would like more info on Eden Project update

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No "to a degree quite technical"

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ☑ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"greater understanding, simpler language"
"corporate speak"
"interested in the certification of the river" - also the general health of it
"communication has felt a bit convoluted"
"would like to know more about the Eden Project, we know its not going to be as good, we also want to know how it would impact the community e.g housing, traffic, roads, environment."
"how is putting the water in there going to rehabilitate it the land which has been so degredated"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Via GIS

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Interested in the use of the land

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- No - A bit too complex

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No – already knows about plans

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ○ No – doesn't agree with it

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"doesn't understand why Alcoa wants to fill so quickly"

"don't like Eden Project, doesn't want it to be turned into hotels & conference centres"

"no benefits for Anglesea Community"

* didn't look at boards, Rach

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ⊘ No

Has this session informed you about what viable options there are to fill the mine pit?

⊘ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

the aquifer should only be used again if there is NO RISK, rather than Low RISK of adverse impacts on the river.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No – already informed

Has this session informed you about what viable options there are to fill the mine pit?

✓ Yes ○ No opportunity to see all the detail

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"attends a lot community information sessions"

"to understand the data is something we'd like but we'd need an ~~engineer~~ engineer but it's difficult"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Concerned that nobody can guarantee the impacts ~~[illegible]~~ of the groundwater extraction"

"Why not let nature fix it up, if it rains it will fill"

"Can't see a problem with the mine taking a long time"

"I've never read anything solid about the Eden project - all seems a bit 'hollywood'."

Alcoa

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Did consider pump hydro.
- Cooling pond power station - does need a huge drop.
- Has anyone considered building a hedonic sanctuary.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

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Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes X ○ No Maybe

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes X ○ No – Maybe. Don't understand other than Alcoa's position.

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

– Would need to understand what I do and don't know

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Appreciative of today's session, the community is very concerned about the health of the river, how well the flow in impact it?"

Alcoa

Alcoa Anglesea Open House Sessions

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Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- No not really
- Interested in the long-term use of the site
integrity to withstand the erosion of the soil

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- 1970 book - Plans for after the site closed - potential water park.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Graphs were too technical, graphs need to be better explained" ← also labelled

"Would like to see more progression & plans moving forward"

note: seemed hesitant about plans

Alcoa

S1

Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Well presented
- for someone that doesn't understand water it was well presented and helpful people around.
- No

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Terrific session"

"Concerned about using good water that we can't use during something like a drought"

"Water is a precious commodity"

"I'm not anti-Alcoa, but it doesn't change my mind that the long way is the best way, I don't care if it takes 50 years!"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No "a little bit"

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Where is Torquay's storm water going to go"

"Would be good to do tours & have a better understanding, more informative"

"get the kids involved & teach them about aquifer" — educational

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

(✓) Yes ( ) No already informed

Has this session informed you about what viable options there are to fill the mine pit?

( ) Yes (✓) No would like to see more recent modelling

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Feels like a lot of people have other plans of their mind, e.g. cost of living, accomadation, climate change

"damge is done, I'm only here because I care about the river"

"concentrated sulphar fall-out in the mine"

*Feels there has been a lack of responsibility on behalf of many parties, including government

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

Came for friends of Anglesea, local, came out of interest

"wants to understand the view a bit better"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☒ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☒ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Love maps - so interesting to see the layout

- Questions were answered well

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ⊗ No

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ⊗ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Feel not well equipped to understand. "I think I'm too
- Why not just let it fill naturally stupid to understand"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"Thinks session is good - important to engage the community"

"Fantastic to have the team that actually works on the project here - especially Chris" → for technical details

& wants to do a tour, overall supportive

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

☑ Yes ○ No already knowledgable

Has this session informed you about what viable options there are to fill the mine pit?

☑ Yes ○ No but feels better understanding now

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

"the session has fulfilled its brief"

"feels that many community members struggle to have opinions on issues impacting locals"

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

- [x] Yes
- [ ] No

Has this session informed you about what viable options there are to fill the mine pit?

- [x] Yes
- [ ] No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

- Information about the soil remediation.

Alcoa

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Alcoa Anglesea Open House Session

Community and Stakeholder Feedback C

Has this session helped you to better understand the Anglesea Min Closure Plan?

⊘ Yes ○ No

Has this session informed you about what viable options there are

⊘ Yes ○ No

Is there any additional information you'd like to learn about the pote mine pit, or in regards to the Anglesea Mine Rehabilitation and Clos

- Nothing else - was interested in the overall plan.
-
-
-
-
-

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Alcoa Anglesea Open House Session

Community and Stakeholder Feedback C

Has this session helped you to better understand the Anglesea Min Closure Plan?

☑ Yes ○ No

Has this session informed you about what viable options there are

☑ Yes ○ No

Is there any additional information you'd like to learn about the pote mine pit, or in regards to the Anglesea Mine Rehabilitation and Clos

"there is a lot to digest, lots of good information"

"not convinced about aquifer, but appreciates being able to talk about options with teams"

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Alcoa Anglesea Open House Session

Community and Stakeholder Feedback C

Has this session helped you to better understand the Anglesea Min Closure Plan?

☑ Yes ○ No already knowledgable

Has this session informed you about what viable options there are

☑ Yes ○ No

Is there any additional information you'd like to learn about the pote mine pit, or in regards to the Anglesea Mine Rehabilitation and Clos

- wanting to speak to Warren about specific q's

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No ?

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ⊘ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

(1) The presentation of information was very complex and difficult to understand, even as an experienced scientist, so probably quite inaccessible to a lay person.

(2) The hydrogeologist hired by Alcoa is pushing the climate change argument for the state of the river which is unsubstantiated.

(3) Warren Sharpe stated that there was no engineering advantage in rapidly filling the mine void, so on this basis should be left, rather than further depleting the aquifer.

Alcoa

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Alcoa Anglesea Open House Sessions

Community and Stakeholder Feedback Questionnaire

Has this session helped you to better understand the Anglesea Mine Rehabilitation and Closure Plan?

○ Yes ○ No ⊗ A little bit

Has this session informed you about what viable options there are to fill the mine pit?

○ Yes ⊗ No

Is there any additional information you'd like to learn about the potential strategy to fill the mine pit, or in regards to the Anglesea Mine Rehabilitation and Closure Plan?

The information provided was relatively complex and would require further examination to fully understand Alcoa's arguments - too much information - too little time. I am most concerned that Alcoa is suggesting that climate change is the major driver of reduced flows and acidity in the Anglesea River, without considering the impact of the mine void (and cone of depression) on the river.

Our major concern as residents is that pumping may lead to further depletion of the overlying river catchment.

There is certainly no benefit to the river and catchment by Alcoa pumping water from the VEA, the argument that rapid filling of the void will be of environmental value to the area is spurious, as it will not provide any ecological benefits at all.

Even Warren Sharpe also [illegible] indicated that rapid filling of the void is not necessary from an engineering perspective as the walls are stable.

I feel that it environmentally irresponsible of alcoa to resume pumping from the VEA rather than allowing the aquifer to replenish and reach its natural levels

I see no point in pumping to fill an un-natural, toxic, acidic ditch.

Alcoa

Alcoa Anglesea

205 Coalmine Road, Anglesea VIC 3230
angleseaps@alcoa.com.au
www.alcoa.com/australia/anglesea