Appendix 17 – 'Wittwer 8' Example Application of the WA Mining and Haul Road Drainage Design Manual

Wittwer 8 Notice Area D112/23 Case Study

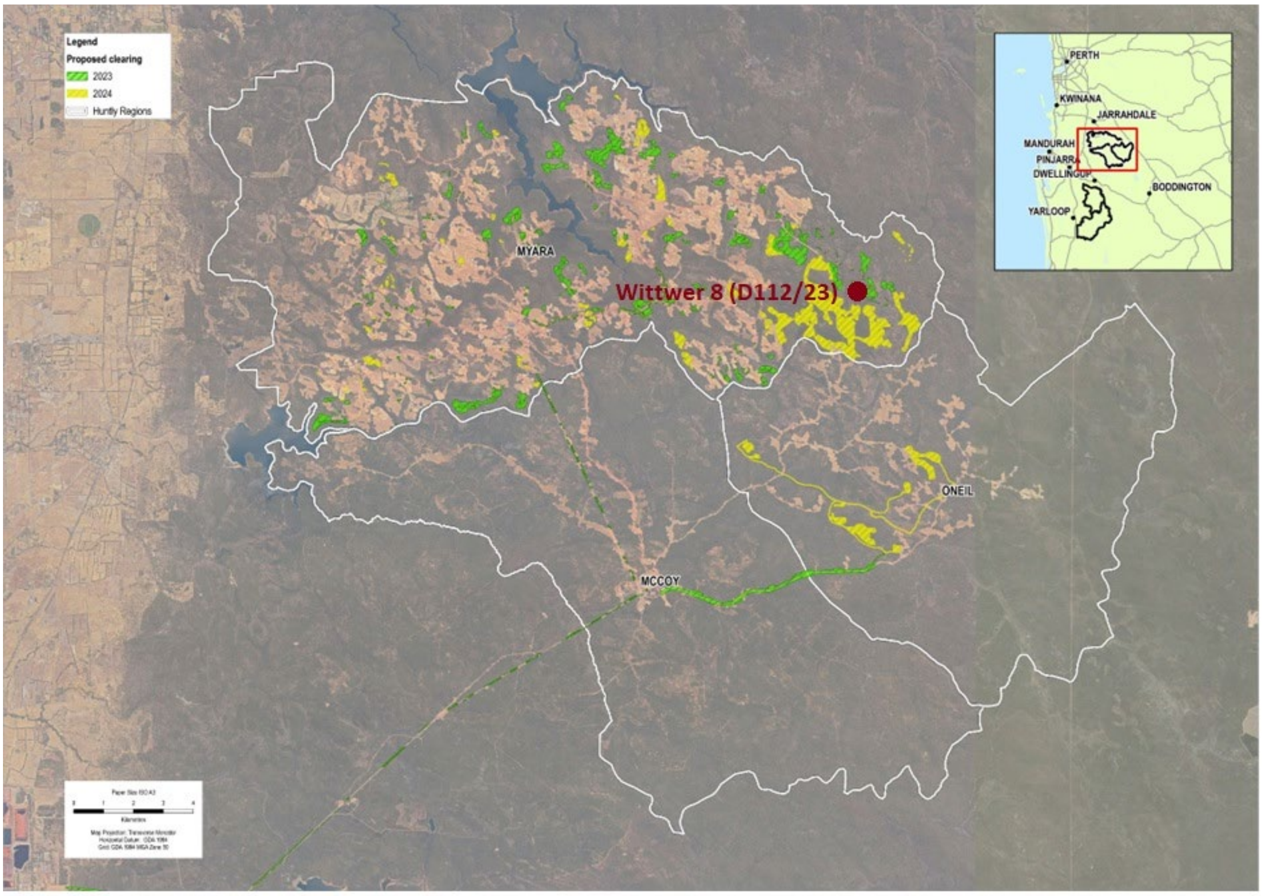
The Wittwer 8 Notice Area D112/23 (Figure 1) is presented here as case study with respect to improved and rationalised drainage control associated with the WA Mining and Haul Road Drainage Design Manual (the Manual).

Drainage Control Management Plan (DCMP) D112/23 is provided within Appendix A for reference. This Case Study expands on the information within the D112/23 DCMP and provides detailed explanation of the application of the WA Mining and Haul Road Drainage Manual.

Wittwer 8 D112/23 notice area forms part of the proposed 24 month mine plan within the 2023-2027 MMP and is also nominated as an area for FCA 2023a endorsement. It has the following base characteristics that make it suitable for the purpose of a case study:

- impacted by areas of slope > 16%
- located in an area that has not previously been cleared, and therefore is not subject to historical clearing-induced groundwater rise

Figure 1: Huntly Proposed 24 month clearing plan, showing Wittwer 8 D112/23 location



WA Mining and Haul Road Drainage Design Manual Recap

The WA Mining and Haul Road Drainage Design Manual, (the Manual) has been updated from past versions with the original 1990 Minesite Drainage Book (MDB) prepared by J. T. Croton of Water and Environmental Consultants for Alcoa of Australia, as a guide to design of drainage facilities to serve the mine and its haul roads.

Risk-based or failure mode-based items that have been included within the Alcoa drainage design approach and the Manual, including:

- Storage capacity effectiveness water balance modelling relative to Dwellingup 1980 to 2021 daily rainfall record for a range of infiltration rates and design event storage capacities to support the 1% AEP 24-hour design event storage and 24mm/day infiltration rate basis of design. Appendix 7 provides the detailed case study water balance modelling which shows the application of these two parameters are predicted to contain >99% of cleared mining area catchment runoff and direct rainfall relative to Dwellingup weather station daily rainfall record from 1980 to 2021
- Storage capacity sedimentation modelling to support the 15% factor of safety storage capacity inclusion (in addition to 1% AEP 24-hour design event storage)
- Spillway design for mine pit storage structures including downslope assessment of controlled release water velocity and control measures and turbidity monitoring
- The inclusion of groundwater aspects including groundwater interaction and current infiltration estimates
- Planning drainage capacity assessment for prioritising active management of sumps based on their capacity, to prioritise those sumps with minimum requirement capacity storage volume

In the process of the Manual update, detailed consultation was sought from independent advisors Dr John Ruprecht and Peter Dundon on the following key items of the Manual update:

- Mining and haul road Basis of Design, including tabulated assumptions covering design capacity, area, slope sedimentation, runoff, freeboard, spillway, trigger actions
- Mining spillway design, including methodology and rationale
- Mining storage water balance scenario modelling.

Wittwer 8 D112_23 Design Process

The mine pit drainage design for Wittwer 8 has been developed as per the Manual and identifies the key drainage design elements applied to the development of the mine plan for this region, being:

1) storage containment design; and

2) spillway design.

The storage containment design utilises pit floor flow path modelling to derive discrete sub-catchment areas within the mine area (Figure 2 below) to derive sub-catchment area and applies the selected storage design assumptions:

- Storage feature capacity 1% AEP 24-hour plus 15% factor of safety volume to account for sedimentation within storage containment feature
- Infiltration rate 24mm/day

Figure 2. Surface Water Control Flow Path and Storage Model

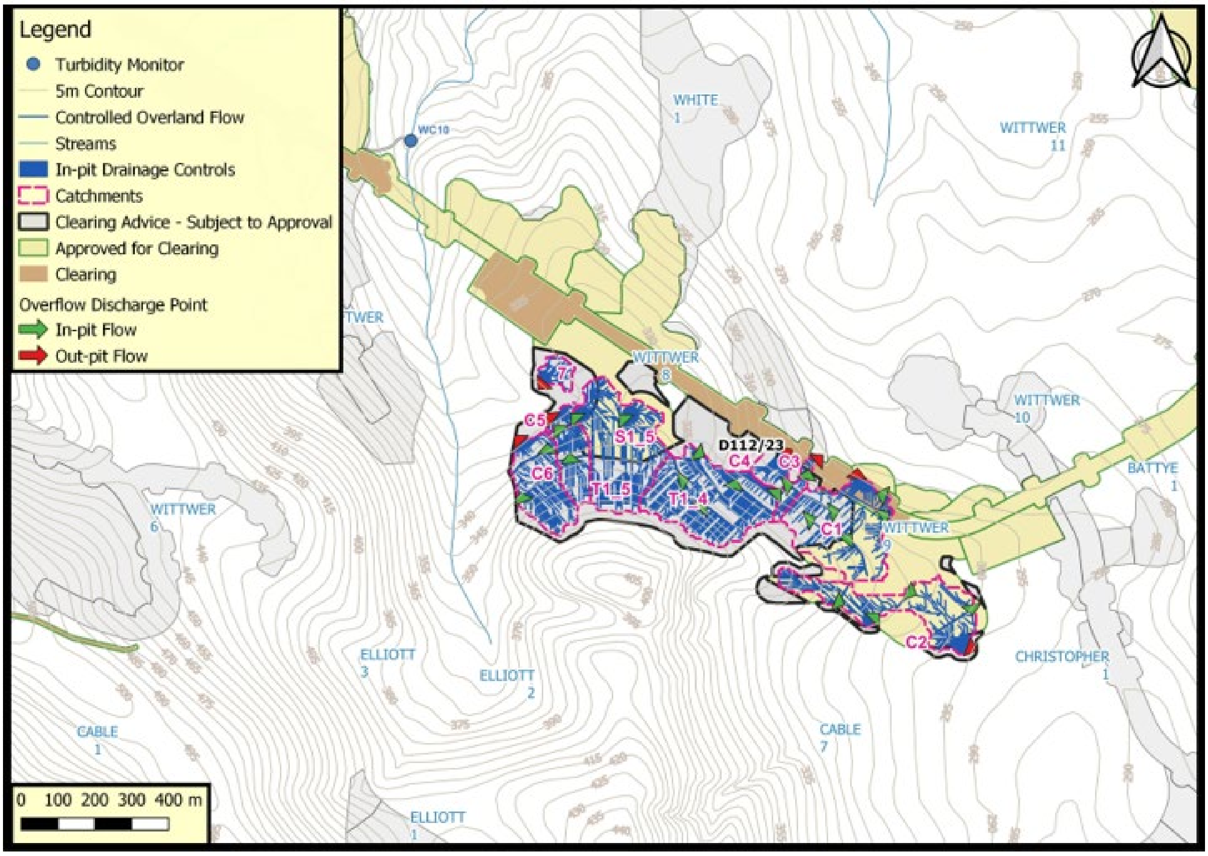


Table 1 below outlines the mining area catchment surface area calculation, which is used to derive the required surface water containment volume using the WA Mining and Haul Road Drainage Design Manual, Section 3 Basis of Drainage Control Design parameters. A 100% capacity ratio signifies the designed containment meets design requirements. A >100% capacity ratio signifies the mined-out pit geometry exceeds the design requirements.

Table 1. Storage Model Water Capacity Details

Catchment ID	Catchment Area (ha)*	Required Containment (m^3)	Designed Containment (m^3)	Capacity Ratio (%)*
7	0.66	917	1066	116.25
C1	5.83	8104	8197	101.15
C2	4.66	6477	6674	103.04
C3	0.68	945	1503	159.05
C4	0.88	1223	1727	141.21
C5	0.37	514	557	108.37
C6	3.12	4337	4592	105.88
S1_5	6.00	8340	8404	100.77
T1_4	6.14	8535	8952	104.89
T1_5	1.73	2405	2589	107.65

* A capacity ratio of 100% or more indicates the pit exceeds the required catchment for a 1% AEP 24-hr rainfall event plus 15%, included as a factor of safety.

Each catchment area exhibits an engineered overflow point to prevent catastrophic containment failure in the event design parameters and contingency controls are exceeded. Engineered overflow locations(s) are also illustrated in Figure 3.

Spillways have been designed in accordance with the WA Mining and Haul Road Drainage Design Manual, Section 4.4 Controlled Release from Pits and Section 3.3 Runoff Estimation. Outputs from the assessment are shown in Table 2 and spillway release flow paths are shown in Figure 3 below. Preliminary spillway design characterises key elements of the design being:

1) terminal spillway type (“cap rock”, which is preferred, or “engineered embankment”)

2) the associated spillway width to achieve low water flow velocity and freeboard requirements; and

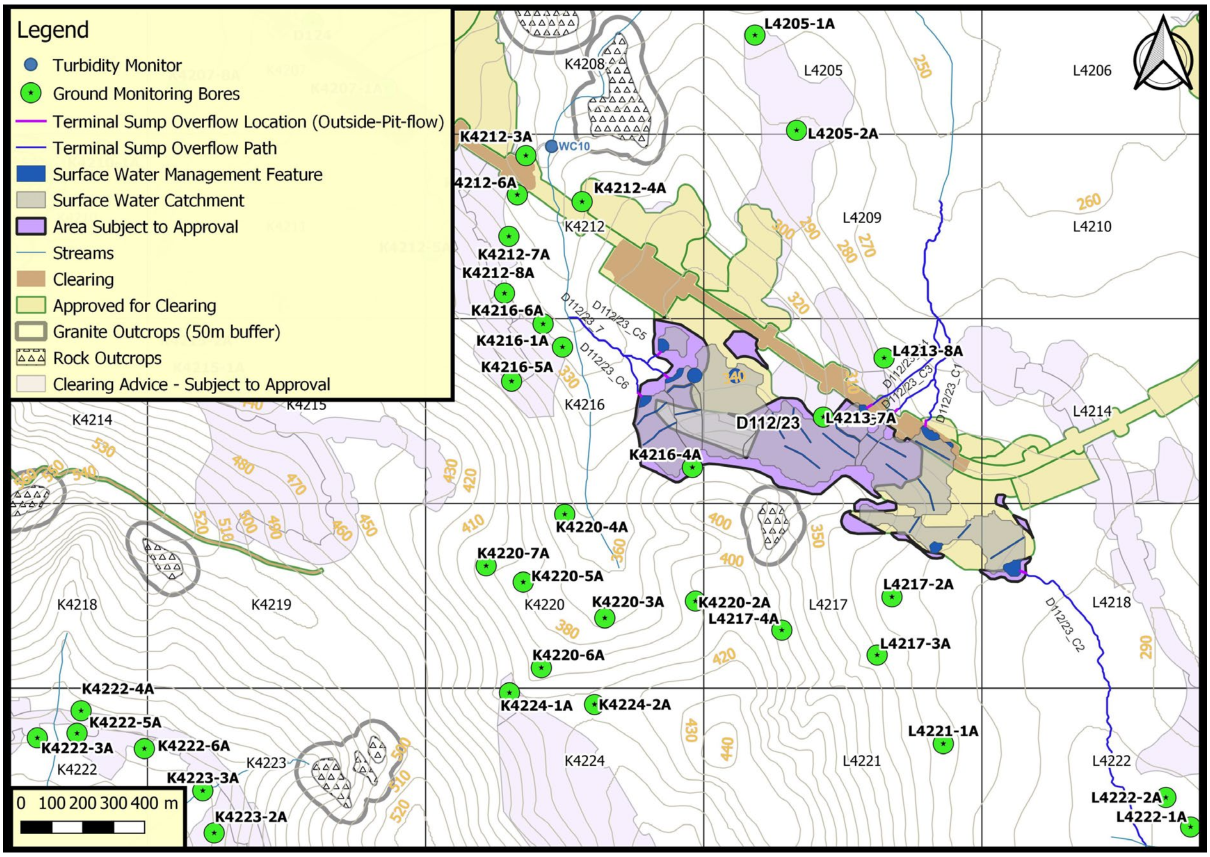
3) downslope flow path characteristics in the event of low likelihood cyclonic event or event not represented within the Dwellingup rainfall station 1980 to 2021 daily rainfall record.

Table 2: Spillway design assessment

Terminal overflow ID	Terminal Spillway type	Spillway Width (m)[1]	Flowpath distance to Nearest Receptor (m)	Average Downstream slope (%)	Receiving environment
D112/23_C1	Cap Rock	15.0	829.0	6.23	Forest
D112/23_C2	Cap Rock	15.0	1117.0	4.45	Forest
D112/23_C3	Cap Rock	5.0	827.0	6.79	Forest
D112/23_C4	Cap Rock	15.0	834.0	7.04	Infrastructure
D112/23_7	Cap Rock	5.0	365.0	6.54	Forest
D112/23_C5	Cap Rock	20.0	378.0	6.68	Forest
D112/23_C6	Cap Rock	15.0	371.0	6.93	Forest

The receiving environment for most designed outlets comprises uncleared forest with an average slope of between 4 and 7%. Using the average slope versus velocity figure in section 3.3.3 of the WA Mining and Haul Road Drainage Design Manual, which estimates velocity for shallow water flow, overland flow in this area should have an average velocity of around between 0.2 m/s and 1.1 m/s. The remaining outlet drains into infrastructure areas, with an average slope of 7%. This is expected to lead to an average velocity of around 1.1 m/s. In the unlikely event that a storm event more severe than a 1% AEP 24-hour rainfall event occurs, flow over the spillway is estimated to have a low velocity, which will limit erosion and sedimentation.

Figure 3: Spillway Release Flow Path and Receiving Environment



The assessment of downslope water quality monitoring adequacy takes into consideration the mine pit storage containment volume and location. Specifically, the mine pit storage volume resultant from lower slope pit design geometry relative to the manual prescribed minimum mine pit storage volume (which predicts to contain >99% mine pit catchment rainfall runoff volume). A mine pit storage volume resultant from lower slope pit design geometry that equates to approximately 135% or greater of the manual prescribed minimum storage, assuming 24mm/day infiltration rate, is predicted to contain 100% of the mine pit catchment rainfall runoff based upon 1980 to 2021 Dwellingup daily rainfall record[1]. Given the range of calculated capacity ratio for D112_23 (Table 2) is above 100% and the existing turbidity monitor locations are considered adequate to support accurate monitoring of performance, no additional specific turbidity monitoring is deemed necessary.

[1] this relates to the Manual mine pit water balance modelling scenario number six (6) whereby 1% AEP 72 hour storage design rainfall and 24mm/day were evaluated with zero percentage rainfall runoff.

Supporting Controls for All Mining Areas

Increased stream zone (riparian vegetation) setbacks.

Alcoa has further implemented an additional layer of control for the management of catchment water quality relative to low likelihood rainfall storm events or series. All pit designs will now respect a minimum setback of 100m from the edge of mapped stream zone (riparian) vegetation to the edge of any mine pit. This design change ensures that an undisturbed forest buffer is retained between mining activities and any stream. A literature review commissioned by Alcoa and undertaken by Richard Silberstein, *The impact of land use change on sediment mobilisation and stream turbidity: a review*, (Silberstein, December 2022), further confirmed that the mitigating effect of riparian zone buffers, bank revegetation and stream channel vegetation on erosion and turbidity is well documented and highly successful in reducing sediment mobilisation and stream turbidity. Further to this, Borg et al. (1987a; 1987b) undertook one of the most comprehensive studies of the impact of logging on stream flow and water quality in south-west WA. They found that during the period of logging, and for up to 4 years thereafter stream turbidity and sediment load increased only in catchments that did not have a 30-100 metre riparian stream buffer and were harvested in winter.

Adaptive Water Handling

Alcoa is developing mine site wide water handling plan that will be updated and maintained to include consideration of each pit within the mine plan, prioritised by the range of individual mine pit storage volume capacities.

Conclusion

This information shows that the principles of the Manual have been followed in the design of notice area D112_23. The Manual is derived from risk-based or failure mode-based associated with catchment runoff water quality management. The Darling Range hydrology is well understood system and therefore any missing failure modes or management control inadequacy against failure modes are easily discussed to achieve agreed drainage control design.

References

[Borg, H., King, P.D. and Loh, I.C., 1987a. Stream and ground water response to logging and subsequent regeneration in the southern forest of Western Australia: interim results from paired catchment studies. WH 34, Water Authority of Western Australia, Water Resources Directorate, Surface Water Branch, Perth, W.A.]

[Borg, H., Stoneman, G.L. and Ward, C.G., 1987b. Stream and ground water response to logging and subsequent regeneration in the southern forest of Western Australia: Results from four catchments. Technical Report 16.]

[Silberstein 2022 *The impact of land use change on sediment mobilisation and stream turbidity: a review]*

Appendix A – DCMP D112/23

Drainage Control Management Plan (D112/23)

1. Scope

Alcoa's Mining and Management Program (MMP) annual submission enables governing bodies and stakeholders to assess Alcoa's plan for operations at Huntly and Willowdale mines based on proposed clearing areas for mine site infrastructure. Additional endorsement of Alcoa's proposed clearing occurs via the submission of Forest Clearing Advice (FCA) and, where relevant, associated Drainage Control Management Plan (DCMP).

This DCMP provides an overview of drainage designs and outcomes from the application of the WA Mining and Haul Road Drainage Design Manual, including details of surface water storage and management, groundwater separation within pit development, operations and rehabilitation.

DCMPs are developed for discrete clearing areas uniquely identified as Alcoa Notice Areas. In the case of this DCMP, multiple Notice Areas are grouped together based on their sub-catchment, terrain and general consolidation considerations. This is so individual Notice Area specific surface water and groundwater assessments can still be completed while minimising the number of DCMPs generated for the FCA review.

2. Location/Area Identification

This DCMP includes the Notice Areas listed in Table 1 and illustrated in Figure 1. It also includes details relating to the proposed and approved clearing areas and turbidity monitors for each Notice Area.

Figure 1: Notice Areas General Arrangement and Slope Overview

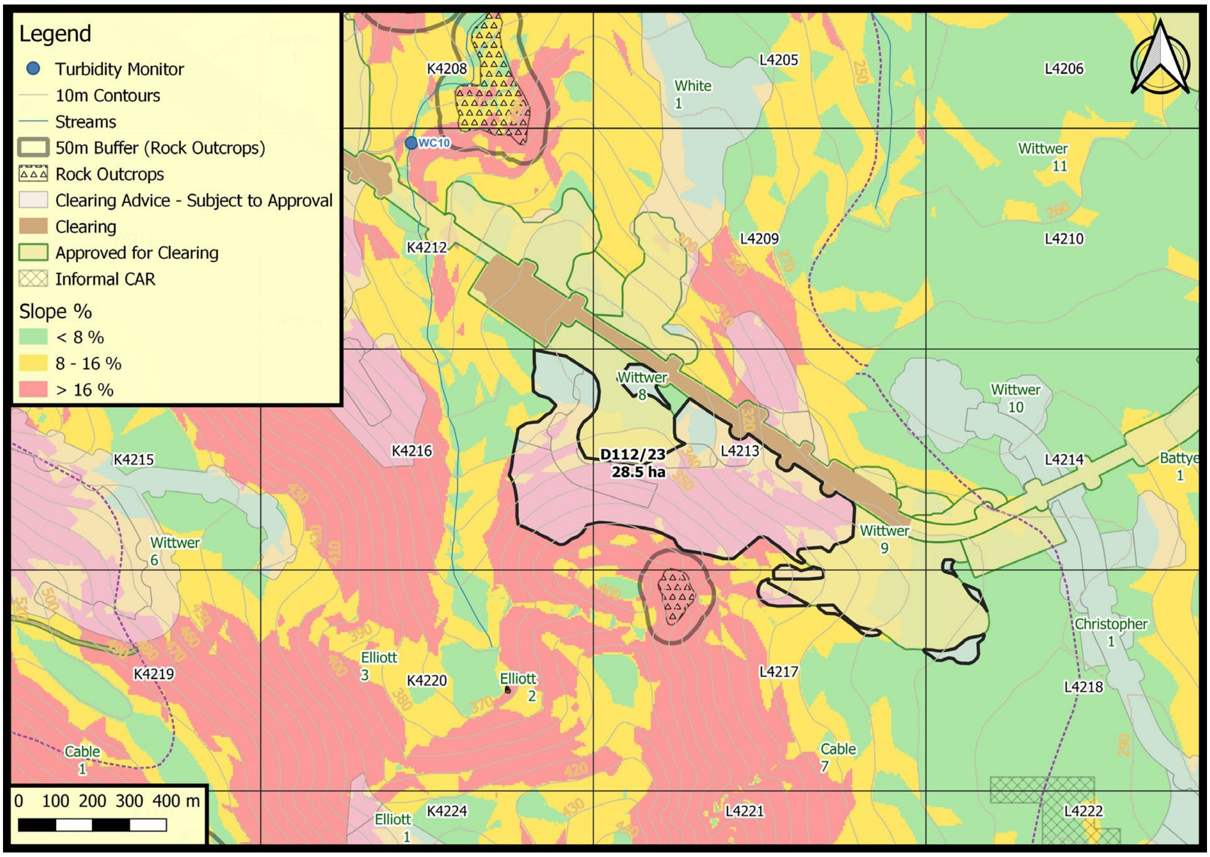


Table1: Notice Area Details

Notice Area Number	Clearing Purpose	Catchment	Sub-catchment	Downstream Turbidity Monitor ID and Status
D112/23	Ore, Stockpile, Haul	Serpentine Dam	Serpentine River 50, 55, 56	WC10 Installed

3. Pit Development Drainage Risk Assessment

The Alcoa Drainage Protection Slot (DPS) and Woody Windrow assessment identifies locations to encourage surface water infiltration via voids created by blasting. Each DPS will be installed as early as possible in the clearing process to provide drainage protection. Every DPS installed will provide a minimum retention capacity of a 1% 24 hour AEP.

Table 2: Notice Area Control Trigger Assessment

Risk Ranking		Location	Proximity to Stream* or Reservoir	Slope	Area Size
0	Mining Exclusion Area	☐ OCA1	☐ 1st & 2nd order streams: - 20m from edge of stream zone. 3rd order + streams (outside OCA2): - 30m beyond stream zone vegetation. 1,000m upstream of TWL of PDWSA reservoirs: - 50m beyond stream zone vegetation.	NA	NA
1	High	☑ RPZ or Serpentine Pipehead catchment	☑ <200m beyond stream zone vegetation or reservoir TWL	☑ >16%	☑ >5ha
2	Moderate	☐ - Proclaimed catchment - Off-site environmentally sensitive surface water catchment or private drinking water supply	☐ 200-500m beyond stream zone vegetation or reservoir TWL	☐ 8-16%	☐ 1-5ha
3	Low	☐ Off-site surface water catchment, non-environmentally sensitive	☐ 500-1,000m beyond stream zone vegetation or reservoir TWL	☐ <8%	☐ <1ha
4	Insignificant	☐ On-site water catchment	☐ >1,000m beyond stream zone vegetation or reservoir TWL	☐ NA	☐

Table 3: Drainage Control Assessment Requirements Identification Reference

Drainage Control	Aspects for Rating	Rating	Required Action	Final Rating	Control Required
Woody Windrows	A +B + C	3-5	Woody Windrows required	3	☑ Required
		5+	Woody Windrows not required		☐ Not Required
DPS Assessment	B + C + D	3-10	DPS assessment required	3	☑ DPS assessment required
		>10	DPS assessment not required		☐ DPS not required
Groundwater and Regolith Assessment	All areas				
Surface Water Control Plan	All areas				
Rehabilitation Execution	All areas				

Figure 2: Drainage Protection Slots General Arrangement

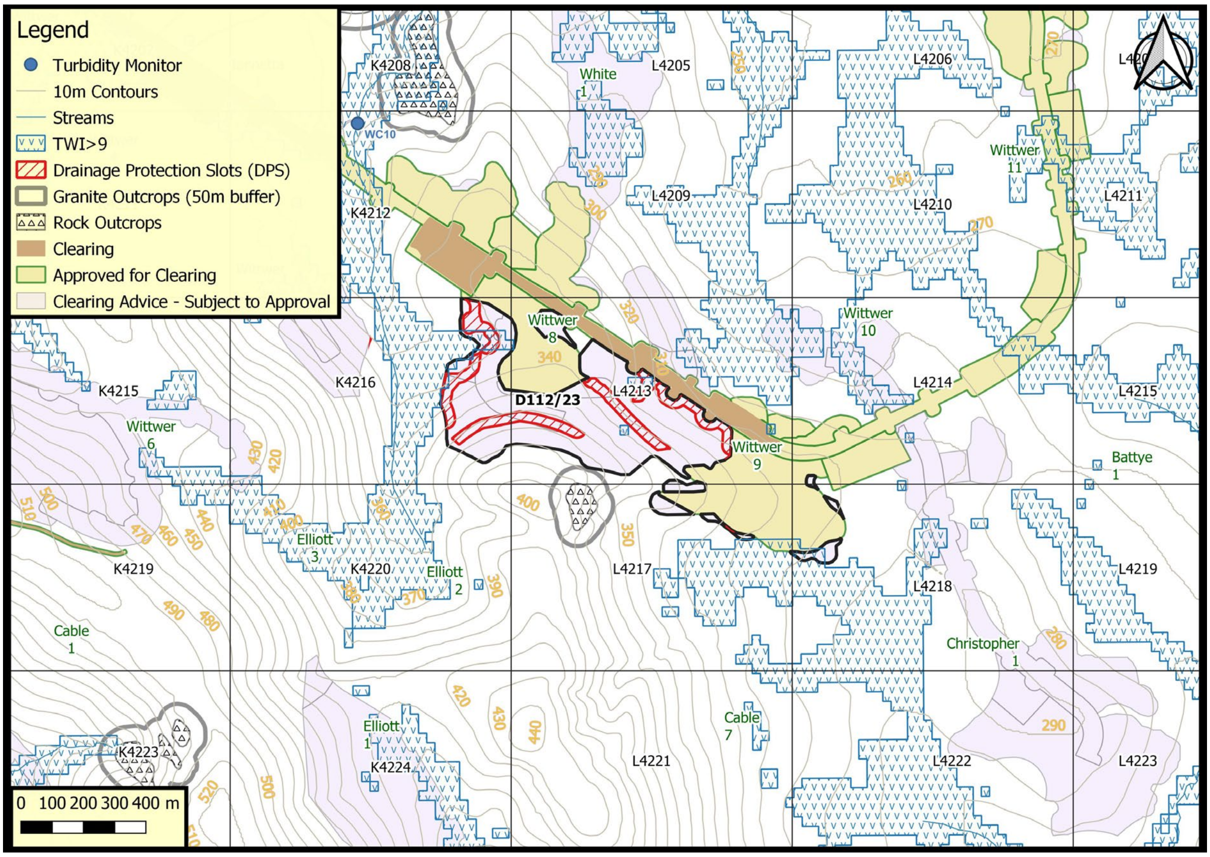


Table 4: Drainage Protection Slot Assessment

Drainage Protection Slot Alcoa ID: Wittwer8_WS08				
Risk Category	Proximity to Stream*	Slope	Catchment size	Upslope run length
1	☐ <200m	☐ >16%	☐ >5ha	☐ >250m**
2	☑ 200m – 500m	☐ 8 – 16%	☑ 1 – 5ha	☑ 80m – 250m
3	☐ >500m	☑ <8%	☐ <1ha	☐ <80m
DBF Downslope		☐ Yes – DPS required		☑ No
Rating (sum of above columns)			Inspection schedule	
☐ 4 – 7 High – DPS Required			Monthly	
☑ 8 – 9 Moderate – DPS Required			Quarterly	
☐ >10 Low – DPS not required unless Dieback Free (DBF) downslope			6-monthly	

Drainage Protection Slot Alcoa ID: Wittwer8_WS09				
Risk Category	Proximity to Stream*	Slope	Catchment size	Upslope run length
1	☐ <200m	☑ >16%	☐ >5ha	☐ >250m**
2	☑ 200m – 500m	☐ 8 – 16%	☑ 1 – 5ha	☑ 80m – 250m
3	☐ >500m	☐ <8%	☐ <1ha	☐ <80m
DBF Downslope		☐ Yes – DPS required		☑ No
Rating (sum of above columns)			Inspection schedule	
☑ 4 – 7 High – DPS Required			Monthly	
☐ 8 – 9 Moderate – DPS Required			Quarterly	
☐ >10 Low – DPS not required unless Dieback Free (DBF) downslope			6-monthly	

Drainage Protection Slot Alcoa ID: Wittwer8_WS10				
Risk Category	Proximity to Stream*	Slope	Catchment size	Upslope run length
1	☐ <200m	☑ >16%	☑ >5ha	☐ >250m**
2	☐ 200m – 500m	☐ 8 – 16%	☐ 1 – 5ha	☑ 80m – 250m
3	☑ > 500	☐ <8%	☐ <1ha	☐ <80m
DBF Downslope		☐ Yes – DPS required		☑ No
Rating (sum of above columns)			Inspection schedule	
☑ 4 – 7 High – DPS Required			Monthly	
☐ 8 – 9 Moderate – DPS Required			Quarterly	
☐ >10 Low – DPS not required unless Dieback Free (DBF) downslope			6-monthly	

Drainage Protection Slot Alcoa ID: Wittwer8_WS11				
Risk Category	Proximity to Stream*	Slope	Catchment size	Upslope run length
1	☐ <200m	☑ >16%	☑ >5ha	☐ >250m**
2	☐ 200m – 500m	☐ 8 – 16%	☐ 1 – 5ha	☑ 80m – 250m
3	☑ > 500	☐ <8%	☐ <1ha	☐ <80m
DBF Downslope		☐ Yes – DPS required		☑ No
Rating (sum of above columns)			Inspection schedule	
☑ 4 – 7 High – DPS Required			Monthly	
☐ 8 – 9 Moderate – DPS Required			Quarterly	
☐ >10 Low – DPS not required unless Dieback Free (DBF) downslope			6-monthly	

<table>
<tr><th colspan="5">Drainage Protection Slot Alcoa ID: Wittwer8_WS12</th></tr>
<tr><th>Risk Category</th><th>Proximity to Stream*</th><th>Slope</th><th>Catchment size</th><th>Upslope run length</th></tr>
<tr><td>1</td><td>☐ <200m</td><td>☑ >16%</td><td>☐ >5ha</td><td>☐ >250m**</td></tr>
<tr><td>2</td><td>☐ 200m – 500m</td><td>☐ 8 – 16%</td><td>☑ 1 – 5ha</td><td>☑ 80m – 250m</td></tr>
<tr><td>3</td><td>☑ > 500</td><td>☐ <8%</td><td>☐ <1ha</td><td>☐ <80m</td></tr>
<tr><th colspan="2">DBF Downslope</th><td colspan="2">☐ Yes – DPS required</td><td>☑ No</td></tr>
<tr><th colspan="3">Rating (sum of above columns)</th><th colspan="2">Inspection schedule</th></tr>
<tr><td colspan="3">☐ 4 – 7 High – DPS Required</td><td colspan="2">Monthly</td></tr>
<tr><td colspan="3">☑ 8 – 9 Moderate – DPS Required</td><td colspan="2">Quarterly</td></tr>
<tr><td colspan="3">☐ >10 Low – DPS not required unless Dieback Free (DBF) downslope</td><td colspan="2">6-monthly</td></tr>
<tr><th colspan="5">Drainage Protection Slot Alcoa ID: Wittwer8_WS07</th></tr>
<tr><th>Risk Category</th><th>Proximity to Stream*</th><th>Slope</th><th>Catchment size</th><th>Upslope run length</th></tr>
<tr><td>1</td><td>☐ <200m</td><td>☐ >16%</td><td>☐ >5ha</td><td>☐ >250m**</td></tr>
<tr><td>2</td><td>☐ 200m – 500m</td><td>☑ 8° – 16%</td><td>☑ 1 – 5ha</td><td>☑ 80m – 250m</td></tr>
<tr><td>3</td><td>☑ > 500</td><td>☐ <8%</td><td>☐ <1ha</td><td>☐ <80m</td></tr>
<tr><th colspan="2">DBF Downslope</th><td colspan="2">☐ Yes – DPS required</td><td>☑ No</td></tr>
<tr><th colspan="3">Rating (sum of above columns)</th><th colspan="2">Inspection schedule</th></tr>
<tr><td colspan="3">☐ 4 – 7 High – DPS Required</td><td colspan="2">Monthly</td></tr>
<tr><td colspan="3">☑ 8 – 9 Moderate – DPS Required</td><td colspan="2">Quarterly</td></tr>
<tr><td colspan="3">☐ >10 Low – DPS not required unless Dieback Free (DBF) downslope</td><td colspan="2">6-monthly</td></tr>
</table>

* Includes stream zone vegetation, or where stream zone vegetation is not present the grade changes define water flow channels or, if no grade changes, the centre of the stream channel. Includes Reservoir TWL.

** Requires a minimum 3-row mid-slope DPS to break up the catchment.

4. Storage Volume and Water Balance

Catchments were identified using the post-mining pit floor and flow path modelling, as shown in Figure 3.

Figure 3: Surface Water Control Flow Path and Storage Model

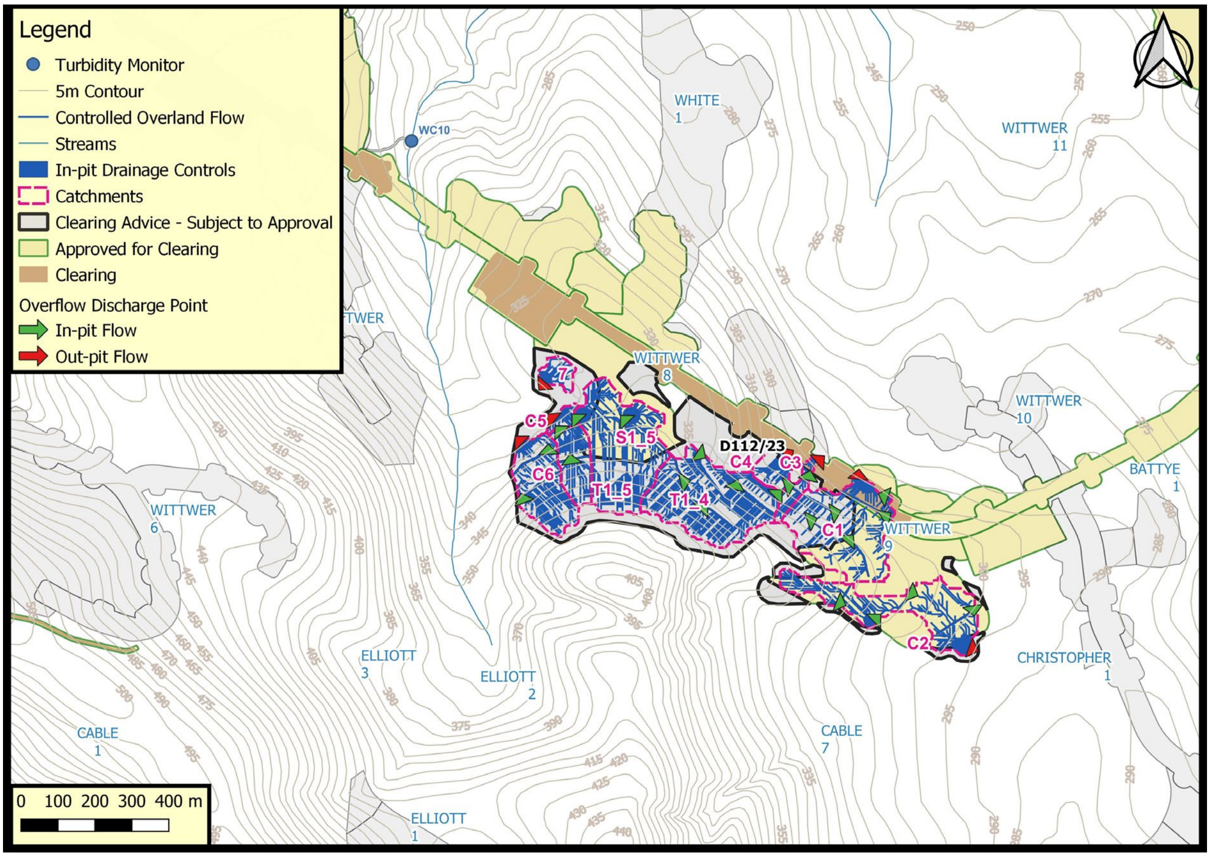


Table 5 outlines the in-pit catchment surface area calculation, which is used to derive the required surface water containment volume using the WA Mining and Haul Road Drainage Design Manual, Section 3 Basis of Drainage Control Design parameters. The designed containment volumes characterise the storage capacity within each in-pit catchment to meet the desired objective, and include the projected design rainfall event plus a 15% safety factor. A 100% capacity ratio signifies the designed containment meets design requirements. A >100% capacity ratio signifies the mined-out pit geometry exceeds the design requirements.

Each catchment area exhibits an engineered overflow point to prevent catastrophic containment failure in the event design parameters and contingency controls are exceeded. Engineered overflow locations(s) are also provided in Figure 4.

Table 5: Storage Model Water Capacity Details

Catchment ID	Catchment Area (ha)*	Required Containment (m^3)	Designed Containment (m^3)	Capacity Ratio (%)*
7	0.66	917	1066	116.25
C1	5.83	8104	8197	101.15
C2	4.66	6477	6674	103.04
C3	0.68	945	1503	159.05
C4	0.88	1223	1727	141.21
C5	0.37	514	557	108.37
C6	3.12	4337	4592	105.88
S1_5	6.00	8340	8404	100.77
T1_4	6.14	8535	8952	104.89
T1_5	1.73	2405	2589	107.65

* A capacity ratio of 100% or more indicates the pit exceeds the required catchment for a 1% AEP 24-hr rainfall event plus 15%, included as a factor of safety.

5. Terminal Sump Spillway and Downstream Analysis

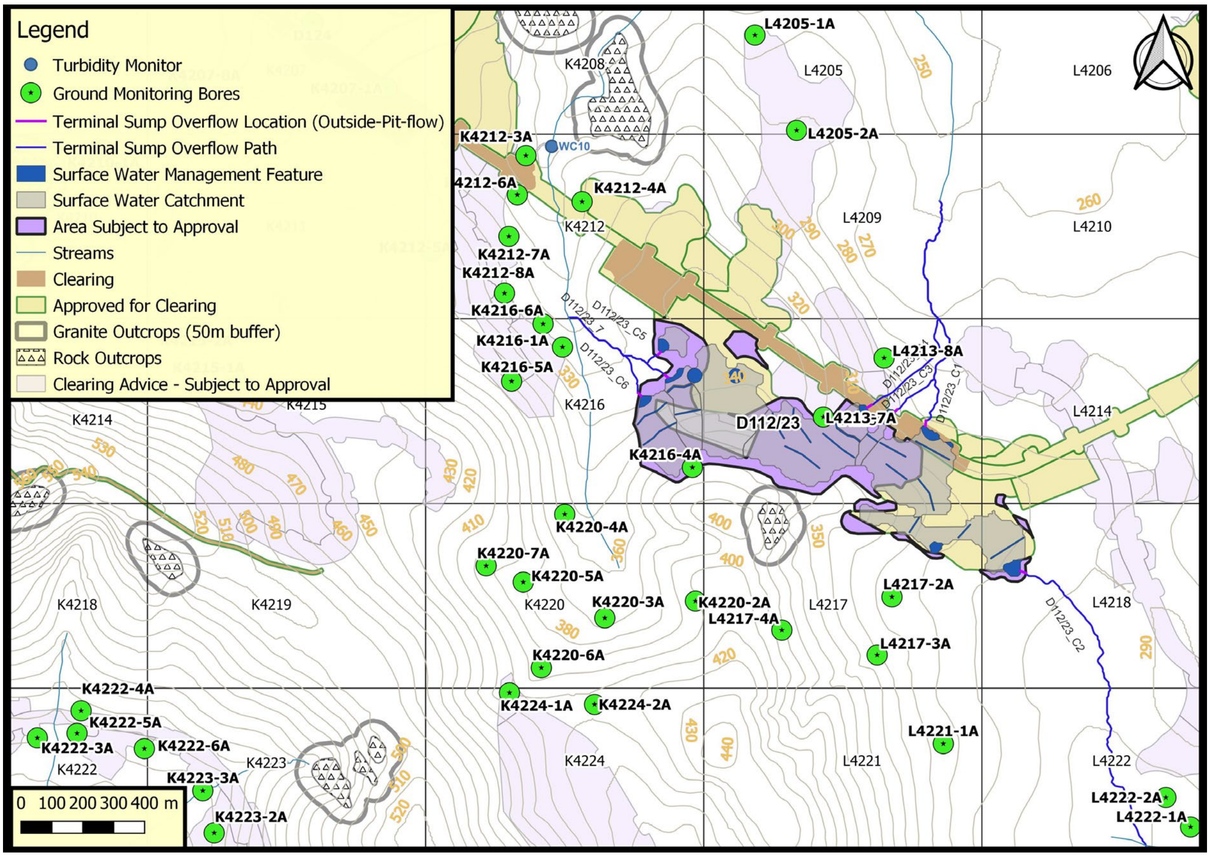
Spillways have been designed in accordance with the WA Mining and Haul Road Drainage Design Manual, Section 4.4 Controlled Release from Pits and Section 3.3 Runoff Estimation. Outputs from the assessment are shown in Table 6 and spillway release flow paths are shown in Figure 4 below:

Table 6: Spillway design assessment

Terminal overflow ID	Terminal Spillway type	Spillway Width (m)[1]	Flowpath distance to Nearest Receptor (m)	Average Downstream slope (%)	Receiving environment
D112/23_C1	Cap Rock	15.0	829.0	6.23	Forest
D112/23_C2	Cap Rock	15.0	1117.0	4.45	Forest
D112/23_C3	Cap Rock	5.0	827.0	6.79	Forest
D112/23_C4	Cap Rock	15.0	834.0	7.04	Infrastructure
D112/23_7	Cap Rock	5.0	365.0	6.54	Forest
D112/23_C5	Cap Rock	20.0	378.0	6.68	Forest
D112/23_C6	Cap Rock	15.0	371.0	6.93	Forest

[1] Spillway geometry calculated in accordance with Section 5.4 of the WA Mining and Haul Road Drainage Manual.

Figure 4: Spillway Release Flow Path and Receiving Environment



The receiving environment for most designed outlets comprises uncleared forest with an average slope of between 4 and 7%. Using the average slope versus velocity figure in section 3.3.3 of the WA Mining and Haul Road Drainage Design Manual, which estimates velocity for shallow water flow, overland flow in this area should have an average velocity of around between 0.2 m/s and 1.1 m/s. The remaining outlet drains into infrastructure areas, with an average slope of 7%. As per the above diagram, this should lead to an average velocity of around 1.1 m/s. In the unlikely event that a storm event more severe than a 1% AEP 24-hour rainfall event occurs, flow over the spillway is estimated to have a low velocity, which will limit erosion and sedimentation.

6. Groundwater Management

Groundwater was assessed using the vertical distance between depth of mining and estimated groundwater levels as a primary criterion. A geological model was developed using geological data obtained from mineral resource investigations and from observations in previous mining areas. The geological model was used to inform the hydrogeology of the new mining and surrounding areas. Depth to groundwater and seasonal fluctuations in groundwater were evaluated through analysis of existing groundwater monitoring bore data and depth to groundwater was extrapolated between bores to form an estimate of groundwater levels in the geological profile.

Three piezometers were installed, within and adjacent to the Notice Areas of varying depth from 26.09 metres below ground level (mbgl) to 30.13 mbgl (Table 7). Analysis of the corresponding construction reports and drill hole logs confirm that drilling stopped in several bores in the mined area/notice area between 9.80 and 20.10 mbgl due to refusal (possibly bedrock). Evaluation of bore records in other monitoring and all exploration bores within the Notice Area confirmed regolith above the water table extended from to 15.59 to 16.88 mgbl with one bore recording dry conditions.

Hydrogeological transects were developed for representative sections (for example, from tops of hills to low points in valleys) to illustrate and compare the proposed depth of mining and depth to the groundwater. The transects are representative of pit depths and depths to groundwater and include the likely worst case scenarios (that is, deepest pits and shallower groundwater). Figure 6 and Figure 7 illustrates the individual transects.

Table 7: Piezometer Monitoring

Site	Sample Date (mm/yyyy)	Surface RL (mAHD)	End of Hole (mbgl)	Depth to Water (mbgl)	Groundwater Level (mAHD)	Drilled to Refusal[1,2]	Predicted Max GWL (mbgl)[3]
K4216-4A	10/2022	377.44	30.13	Dry	N/A	No	N/A
L4213-7A	10/2022	321.23	26.36	15.59	305.64	No	N/A
L4213-8A	10/2022	287.98	26.09	16.88	271.10	No	N/A
K42125001	04/2022	314.269	15.50	N/A	N/A	Yes	N/A
K42125002	04/2022	326.511	9.80	N/A	N/A	Yes	N/A
K42125003	04/2022	329.959	10.80	N/A	N/A	Yes	N/A
L42095000	04/2022	307.54	14.50	N/A	N/A	Yes	N/A
L42095001	04/2022	329.32	10.70	N/A	N/A	Yes	N/A
L42135000	04/2022	309.51	17.80	N/A	N/A	Yes	N/A
L42145001	04/2022	300.95	20.10	N/A	N/A	Yes	N/A
L42175000	04/2022	306.42	14.00	N/A	N/A	Yes	N/A
L42175001	04/2022	321.88	19.10	N/A	N/A	Yes	N/A
L42175002	04/2022	335.21	21.20	N/A	N/A	Yes	N/A

[1] 'Drill to Refusal' is the drill rig drilling its maximum achievable depth where refusal is defined as: the drill rods reach impenetrable granitic or doleritic bedrock, soil sample is too wet to retrieve, or the drill rig drills its maximum depth of approximately 20m.

[2] 'Drill to refusal' holes were purpose drilled to prove depth of regolith only.

[3] Predicted groundwater levels were developed under recommendation from the Department of Water and Environmental Regulation (DWER) and the Water Corporation (WC). The goal being to model the maximum seasonal rise from the maximum depth of the groundwater below surface level (depth to water) to the shallowest (depth to water) within a hydrological year (for 3 annual rainfall scenarios). Monitoring undertaken in October / November represent groundwater depths nearing seasonal maximums and are therefore not modelled.

Figure 5: Hydrogeological Transects Overview

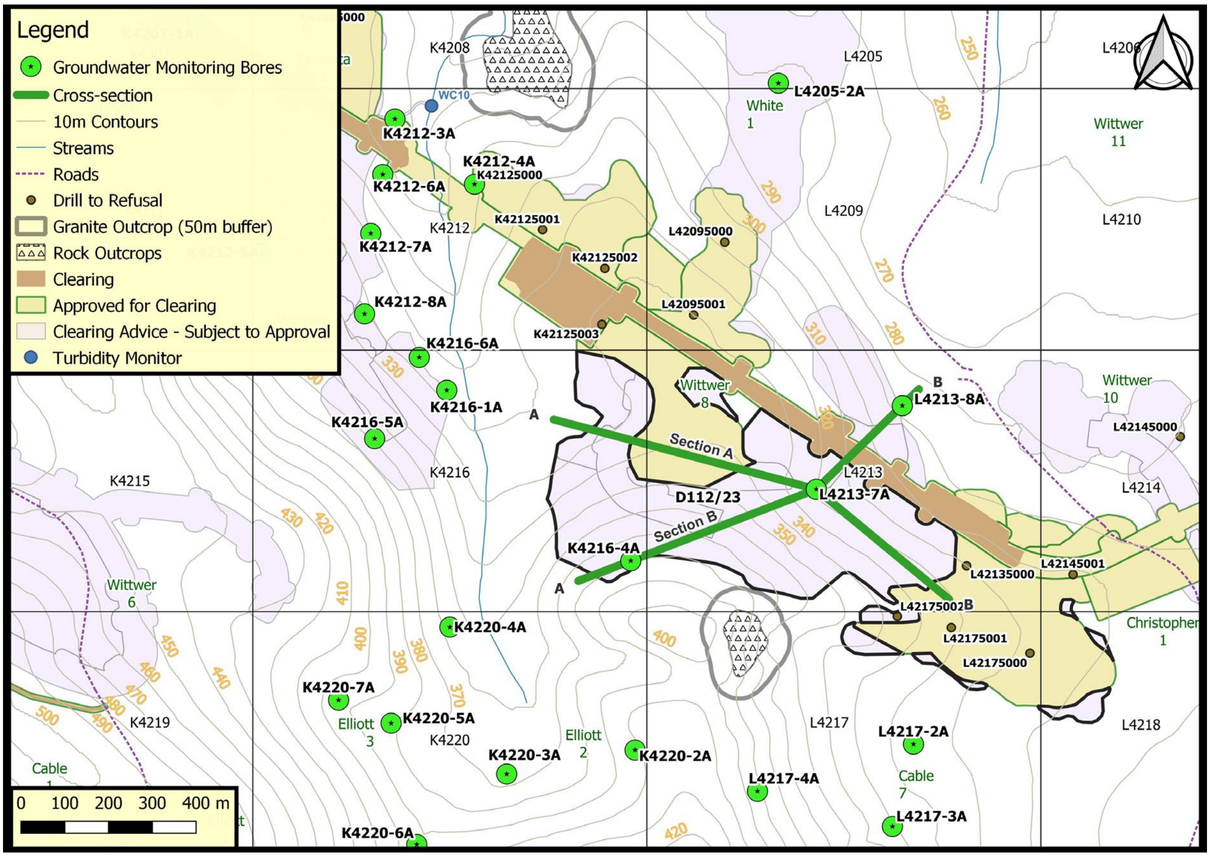


Figure 6: Cross-sections

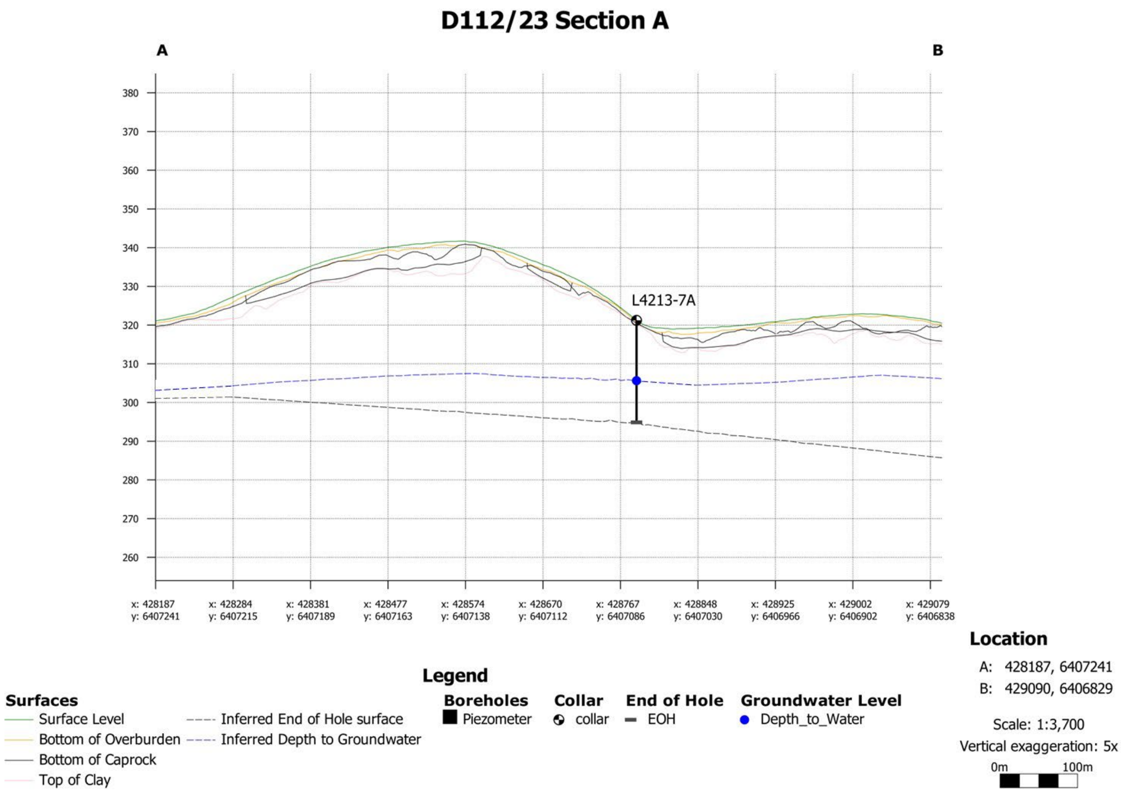
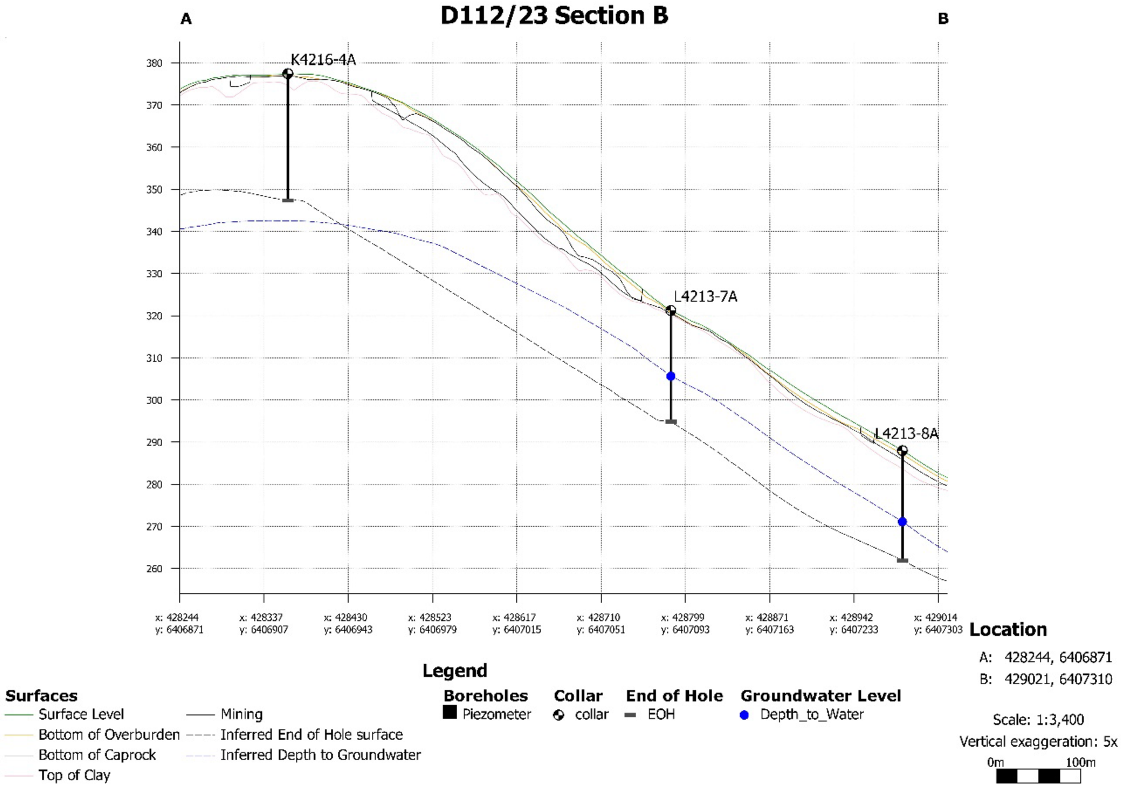


Figure 7: Cross-sections



6.1. Notice Area Groundwater Management

Based on the groundwater monitoring results as shown in Table 7, which include those representing likely worst-case scenarios, the transects show that pit depths in proposed notice areas maintain a 3-metre separation between the proposed mine pit floor and groundwater (Figure 6 and Figure 7). This is the case for all transects. The distance between estimated groundwater levels and the depth of mining is generally greater than 15 metres providing a substantial buffer well above the likely margin of error of the assessments, and to account for unlikely or unforeseen localised anomalies in the groundwater system. The results of the assessment are consistent with historical observations from mining operation geologists / hydrogeologists and are consistent with the expectations of hydrogeologists.

Assessment of the localised hydrogeology using exploration geological and groundwater monitoring data from three bores at varying elevations across the site have confirmed that approximate depth to groundwater is between 15.59 to 16.88 mgbl (inferred groundwater table) with one bore recording dry conditions. (Figure 6 to Figure 7). It's considered highly unlikely that based on the currently proposed pit shells for the new notice areas that the water table will be within 3m of the base of mining during the wet or dry season.

7. Conclusion

Hydrology characterisation and storage facility design has been completed according to the WA Mining and Haul Road Drainage Design Manual, including agreed design rainfall data, runoff estimation inputs taking account of sedimentation and design freeboard to derive the drainage facility design storage volume.

Contingency measure design includes drainage facility-controlled overflow point design to prevent storage facility hydraulic failure if a lower probability rainfall event occurs which exceeds the design rainfall, or if there are unexpected hydrological conditions unaccounted for in the design process (i.e., interception of sub-surface flow pathways).