Huntly Bauxite Mine – WQMS Data Review

March 2025

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Contents

1. Executive Summary

This report, prepared by RARE Environmental Pty Ltd and SciDev Pty Ltd for Alcoa, provides an analysis of turbidity data collected from Water Quality Monitoring Systems (WQMSs) deployed at the Huntly bauxite mining operations during March 2025. The primary objective of this analysis was to evaluate the quality of the data, identify potential "true" turbidity exceedance events, and support Alcoa's compliance reporting obligations under Schedule 1, Division 2, Clause 6 of the **Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023**.

The analysis focused on identifying and classifying turbidity events where levels exceeded 25 nephelometric turbidity units (NTU) for at least one hour. Events were categorized as "true" or "false" based on Alcoa's **Turbidity Event Classification Guidelines**, which distinguish actual turbidity increases (true events) from false readings caused by environmental factors such as debris, air bubbles, or fluctuating water levels.

Key findings include:

- **True Events**: Zero "true" turbidity exceedance events were identified.
- **Further Investigation**: Zero event's were flagged for further investigation.
- **False Events**: Sixty-two 'false' events were identified, primarily attributed to factors such as debris accumulation, sensor obstructions, and water turbulence.
- **Excluded Units**: Twenty-nine WQMS units were excluded from the analysis due to invalid data caused by equipment faults or environmental interference.

The report also highlights periods of missing data, which occurred due to system logoffs, equipment faults, or unplanned shutdowns. These gaps are detailed in the report to ensure transparency in data handling.

2. Scope

RARE Environmental Pty Ltd and SciDev Pty Ltd were engaged by Alcoa to analyse turbidity data collected from the Huntly Water Quality Monitoring Systems (WQMSs). The primary objective of this engagement is to assess the quality of the collected data and identify potential "true" turbidity events. This analysis supports Alcoa's reporting obligations under *Schedule 1, Division 2, Clause 6 of the Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023*.

3. Introduction

3.1. Background

Alcoa of Australia Ltd (Alcoa) operates two bauxite mines, Huntly and Willowdale, approximately 100 km southeast of Perth, Western Australia. These mining operations are subject to environmental controls mandated by the *Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023*.

Under this Exemption Order, Alcoa is required to implement drainage control measures and monitor effectiveness in water bodies within and downstream of mining operations. Turbidity, a critical water quality parameter, is monitored using Water Quality Monitoring Systems (WQMSs), to detect deviations and identify high-turbidity events.

Alcoa is obligated to report monthly on-stream turbidity, including the identification and classification of any "true" high-turbidity exceedance events. (Refer to Appendix B for the site map showing WQMS locations.)

3.2. Monitoring requirements

Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023 specifies that a drainage incident occurs when:

> *a) runoff from a disturbance area enters the surrounding environment, resulting in surface water turbidity of at least 25 NTU for a duration of at least one hour; or*
>
> *b) a discharge from containment infrastructure includes, or may include, environmentally hazardous material.*

Trigger levels for drainage incidents are outlined in *Schedule 1* of the Exemption Order. To meet these requirements, Alcoa has developed "Turbidity Event Classification Guidelines" which define a true turbidity exceedance event as a WQMS recording turbidity levels of at least 25 NTU for a period exceeding one hour.

3.3. Water Quality Management Systems (WQMSs)

During the March 2025 monitoring period, forty-four WQMS units were deployed to monitor turbidity levels in streams subject to surface water runoff within and downstream of Huntly mining operations.

Each WQMS unit consists of the following components:

Aquas SMR10 Turbidity Probe

> Positioned at a 90-degree angle to water flow, each probe is equipped with an automatic lens wiper and a guard to protect against larger debris.

Data Taker DT82 Logger

> Records data locally every 6 seconds, with 6-minute averages transmitted via IoT-enabled modems to a cloud-based platform.

Float Switch

Detects whether the sensor is submerged, or the stream is dry.

3.4. Purpose

This report aims to analyse turbidity data collected during March2025, focusing on the identification and classification of "true" turbidity exceedance events based on Alcoa's Turbidity Event Classification Guidelines.

3.5. Exclusions

This report is not intended as:

- An assessment of the WQMS network or Alcoa's compliance with relevant legislation and requirements.
- An evaluation of the suitability of the trigger levels or event classification procedures adopted by Alcoa.

3.6. Abbreviations

	Term
IoT	Internet of Things
NTU	Nephelometric Turbidity Units
WQMS	Water Quality Management System

4. Methodology

4.1. WQMS Locations

A site map showing the WQMSs locations is provided in Appendix B.

4.2. Data Review

Data recorded by the WQMS Units was reviewed and potential events where turbidity levels exceeded 25 NTU for at least one hour. Each potential event was categorised as either 'true 'or 'false'.

4.2.1. True Turbidity Exceedance Events

These events are caused by an actual increase in stream turbidity. Per Alcoa's "Turbidity Event Classification Guidelines" true exceedance events typically exhibit:

- A sharp, sudden incline in turbidity levels.
- A return to baseline turbidity levels in a pattern resembling a normal (Gaussian) distribution.

Figure 1 Typical 'true' exceedance event showing the sharp incline and gradual return to background levels.

4.2.2. False Turbidity Exceedance Events

These events are caused by factors unrelated to actual turbidity increase, such as:

- Organic debris (e.g., leaves, sticks, algae) obstructing the sensor
- Air bubbles or water turbulence near the sensor
- Fluctuating water levels intermittently covering and uncover the sensor lens.

False events typically exhibit sharp inclines and declines without the characteristic bell curve shape of true events.

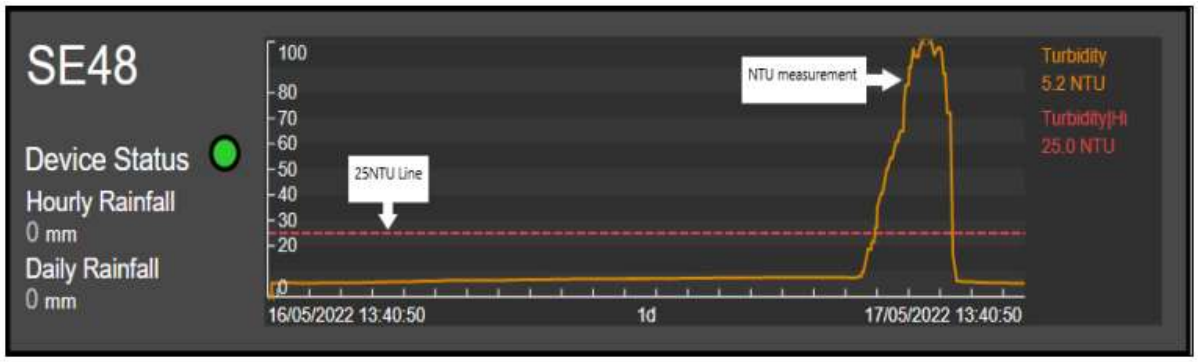


Figure 2 Typical 'false' exceedance event showing both a sharp incline and decline

4.2.3. Missing Data

Missing data occurs when a WQMS unit fails to record information, this can occur from unexpected system logoffs, equipment faults, or unplanned shutdowns.

5. Results and Discussion

5.1. Events

Table 1 provides a summary of identified events. Table 2 offers detailed information about each event.

Table 1 Events Summary

Category	# of events
Flagged for further investigation	0
False	62

Table 2 Events Details

Event ID	WQMS ID	Event Category	Start	End	Duration	Peak Turbidity (NTU)	Average Turbidity (NTU)
HUN-2503-001	ND06T	'False'	1/03/2025 0:00	1/03/2025 10:00	9 hr, 59 min	323.43	77.13
HUN-2503-002	ND06T	'False'	6/03/2025 17:30	7/03/2025 0:42	7 hr, 12 min	111.42	86.74
HUN-2503-003	ND06T	'False'	17/03/2025 17:36	17/03/2025 21:48	4 hr, 12 min	96.81	71.91
HUN-2503-004	ND06T	'False'	18/03/2025 15:54	18/03/2025 19:00	3 hr, 5 min	100.60	59.61
HUN-2503-005	ND06T	'False'	18/03/2025 20:18	18/03/2025 23:36	3 hr, 18 min	104.63	71.96
HUN-2503-006	ND06T	'False'	19/03/2025 18:48	19/03/2025 20:30	1 hr, 42 min	114.57	43.04
HUN-2503-007	ND06T	'False'	20/03/2025 16:12	20/03/2025 18:18	2 hr, 6 min	104.30	62.47
HUN-2503-008	ND06T	'False'	20/03/2025 21:18	21/03/2025 0:48	3 hr, 29 min	603.07	87.50
HUN-2503-009	ND06T	'False'	21/03/2025 15:06	21/03/2025 16:36	1 hr, 30 min	104.09	68.17
HUN-2503-010	ND06T	'False'	22/03/2025 0:24	22/03/2025 2:54	2 hr, 29 min	111.72	76.13
HUN-2503-011	ND06T	'False'	22/03/2025 13:36	22/03/2025 14:54	1 hr, 17 min	104.26	69.49
HUN-2503-012	ND06T	'False'	23/03/2025 1:54	23/03/2025 4:06	2 hr, 11 min	302.02	118.74
HUN-2503-013	ND06T	'False'	23/03/2025 14:06	23/03/2025 15:30	1 hr, 23 min	103.75	69.07
HUN-2503-014	ND06T	'False'	24/03/2025 3:06	24/03/2025 6:00	2 hr, 54 min	336.32	83.37
HUN-2503-015	ND06T	'False'	24/03/2025 12:12	24/03/2025 13:30	1 hr, 18 min	101.26	69.57
HUN-2503-016	ND06T	'False'	25/03/2025 4:36	25/03/2025 7:12	2 hr, 36 min	110.44	76.74

Event ID	WQMS ID	Event Category	Start	End	Duration	Peak Turbidity (NTU)	Average Turbidity (NTU)
HUN-2503-017	ND06T	'False'	25/03/2025 11:06	25/03/2025 12:36	1 hr, 29 min	102.89	68.47
HUN-2503-018	ND06T	'False'	26/03/2025 8:18	26/03/2025 11:18	3 hr, 0 min	86.47	64.09
HUN-2503-019	ND07T	'False'	1/03/2025 0:00	1/03/2025 9:12	9 hr, 11 min	762.35	196.49
HUN-2503-020	ND07T	'False'	1/03/2025 15:36	3/03/2025 8:30	1 d, 16 hr, 53 min	689.23	172.00
HUN-2503-021	ND07T	'False'	5/03/2025 17:54	13/03/2025 19:24	8 d, 1 hr, 29 min	1174.50	158.48
HUN-2503-022	ND07T	'False'	29/03/2025 18:36	31/03/2025 19:53	2 d, 1 hr, 17 min	190.09	149.85
HUN-2503-023	PD01T	'False'	12/03/2025 1:18	13/03/2025 9:00	1 d, 7 hr, 42 min	393.47	107.13
HUN-2503-024	SE02T	'False'	1/03/2025 0:00	1/03/2025 12:24	12 hr, 24 min	109.97	93.85
HUN-2503-025	SE02T	'False'	5/03/2025 1:30	13/03/2025 11:24	8 d, 9 hr, 54 min	1234.93	568.34
HUN-2503-026	SE02T	'False'	17/03/2025 3:42	20/03/2025 10:48	3 d, 7 hr, 6 min	839.04	320.35
HUN-2503-027	SE02T	'False'	25/03/2025 1:59	27/03/2025 10:15	2 d, 8 hr, 16 min	281.14	134.55
HUN-2503-028	SE02T	'False'	27/03/2025 12:34	27/03/2025 15:06	2 hr, 31 min	4000.00	685.40
HUN-2503-029	SE02T	'False'	30/03/2025 8:27	31/03/2025 23:57	1 d, 15 hr, 29 min	307.70	139.15
HUN-2503-030	SE03INV2	'False'	10/03/2025 17:12	17/03/2025 15:18	6 d, 22 hr, 6 min	367.77	181.64
HUN-2503-031	SE03INV2	'False'	23/03/2025 4:54	29/03/2025 14:36	6 d, 9 hr, 42 min	1386.05	518.56
HUN-2503-032	SE03T	'False'	6/03/2025 19:17	6/03/2025 20:54	1 hr, 37 min	109.16	70.00
HUN-2503-033	SE03T	'False'	25/03/2025 20:15	25/03/2025 22:34	2 hr, 19 min	105.54	69.64
HUN-2503-034	SE03T	'False'	26/03/2025 18:52	26/03/2025 20:29	1 hr, 36 min	107.04	70.73
HUN-2503-035	SE03T	'False'	27/03/2025 17:04	27/03/2025 18:23	1 hr, 18 min	109.21	66.60
HUN-2503-036	SE03T	'False'	29/03/2025 17:42	29/03/2025 19:13	1 hr, 30 min	108.62	67.70
HUN-2503-037	SE03T	'False'	30/03/2025 17:38	30/03/2025 19:58	2 hr, 19 min	108.41	68.21
HUN-2503-038	SE03T	'False'	31/03/2025 18:41	31/03/2025 20:42	2 hr, 1 min	107.64	63.57
HUN-2503-039	SE05T	'False'	10/03/2025 20:12	10/03/2025 22:18	2 hr, 5 min	41.98	33.37

Event ID	WQMS ID	Event Category	Start	End	Duration	Peak Turbidity (NTU)	Average Turbidity (NTU)
HUN-2503-040	SE05T	'False'	11/03/2025 11:42	13/03/2025 9:42	1 d, 21 hr, 59 min	827.40	434.78
HUN-2503-041	SE05T	'False'	20/03/2025 4:12	23/03/2025 21:18	3 d, 17 hr, 5 min	660.66	194.33
HUN-2503-042	SE06T	'False'	5/03/2025 1:48	5/03/2025 11:12	9 hr, 23 min	115.05	32.29
HUN-2503-043	SE06T	'False'	5/03/2025 13:24	11/03/2025 9:54	5 d, 20 hr, 30 min	1296.13	410.96
HUN-2503-044	SE06T	'False'	12/03/2025 15:24	12/03/2025 16:48	1 hr, 24 min	110.92	68.57
HUN-2503-045	SE06T	'False'	17/03/2025 21:42	22/03/2025 10:00	4 d, 14 hr, 3 min	382.30	126.69
HUN-2503-046	SE06T	'False'	22/03/2025 10:30	22/03/2025 13:24	2 hr, 54 min	244.88	189.41
HUN-2503-047	SE06T	'False'	24/03/2025 7:12	29/03/2025 12:14	5 d, 5 hr, 2 min	1050.06	197.62
HUN-2503-048	SE52T	'False'	1/03/2025 2:37	1/03/2025 3:44	1 hr, 7 min	115.43	74.63
HUN-2503-049	SE52T	'False'	3/03/2025 18:52	3/03/2025 20:41	1 hr, 49 min	97.79	68.44
HUN-2503-050	SE52T	'False'	3/03/2025 23:12	4/03/2025 0:25	1 hr, 13 min	94.43	63.54
HUN-2503-051	SE52T	'False'	7/03/2025 17:37	7/03/2025 18:43	1 hr, 6 min	163.65	104.46
HUN-2503-052	SE52T	'False'	10/03/2025 22:29	11/03/2025 1:00	2 hr, 31 min	99.15	70.45
HUN-2503-053	SE52T	'False'	11/03/2025 20:54	12/03/2025 0:51	3 hr, 57 min	147.21	88.13
HUN-2503-054	SE52T	'False'	26/03/2025 19:40	26/03/2025 21:05	1 hr, 24 min	88.92	60.40
HUN-2503-055	SE52T	'False'	31/03/2025 15:50	31/03/2025 16:51	1 hr, 0 min	1242.86	498.83
HUN-2503-056	SE59T	'False'	5/03/2025 0:20	5/03/2025 1:39	1 hr, 19 min	378.07	188.07
HUN-2503-057	SE59T	'False'	9/03/2025 4:21	9/03/2025 5:27	1 hr, 6 min	53.19	41.98
HUN-2503-058	SE61T	'False'	1/03/2025 0:00	1/03/2025 3:06	3 hr, 5 min	26.18	26.08
HUN-2503-059	SE61T	'False'	1/03/2025 3:24	1/03/2025 11:00	7 hr, 35 min	93.51	27.83
HUN-2503-060	SE61T	'False'	13/03/2025 13:06	14/03/2025 2:18	13 hr, 12 min	36.24	30.26
HUN-2503-061	SE61T	'False'	24/03/2025 19:18	25/03/2025 16:18	21 hr, 0 min	49.37	39.59
HUN-2503-062	SE61T	'False'	29/03/2025 15:00	31/03/2025 23:54	2 d, 8 hr, 54 min	142.81	63.31

* End date and time provided by Alcoa

5.2. Additional Investigation

Zero events were flagged for additional investigation.

5.3. True Event(s)

Zero 'True' turbidity events were identified during the reporting period.

5.4. False Event(s)

Sixty-two 'False' events were identified during the reporting period. Rationale on potential causes is summarised below.

Table 3 False Events Rationale

Event ID	Monitor ID	Rationale	Field Notes
HUN-2503-001	ND06T	This event is marked by sporadic peaks. This is indicative of a false event	Site inspected on 14/03/2025. Stream is very shallow and sensor is intermittently impacted by stream bed sediment.
HUN-2503-002	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-003	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-004	ND06T	This event is marked by sporadic peaks. This is indicative of a false event	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-005	ND06T	This event is marked by sporadic peaks. This is indicative of a false event	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-006	ND06T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-007	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-008	ND06T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-009	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-010	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.

Event ID	Monitor ID	Rationale	Field Notes
HUN-2503-011	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-012	ND06T	This event is marked by a gradual increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-013	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-014	ND06T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-015	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-016	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-017	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-018	ND06T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on the 1/04/2025, sensor was out of the water and stream was very shallow. Sensor was positioned into water but will likely be impacted by sediment due to the shallow stream.
HUN-2503-019	ND07T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspection on 03/03/2025. Stream stagnant and ponding. Sensor was above water. No rainfall in last 24 hours prior.
HUN-2503-020	ND07T	This event is marked by a rapid increase and a rapid decrease in turbidity with	Site inspection on 15/03/2025. Stream is stagnant and ponded.

Event ID	Monitor ID	Rationale	Field Notes
		sporadic peaks. This is indicative of a false event.	
HUN-2503-021	ND07T	This event is marked by a rapid increase and a rapid decrease in turbidity with sporadic peaks. This is indicative of a false event.	Site inspection on 15/03/2025. Stream is stagnant and ponded.
HUN-2503-022	ND07T	This event is marked by a rapid increase and a rapid decrease in turbidity with sporadic peaks. This is indicative of a false event.	Site inspection on 15/03/2025. Stream is stagnant and ponded.
HUN-2503-023	PD01T	This event is marked by a gradual increase and a rapid decrease in turbidity with sporadic peaks. This is indicative of a false event.	Site visited on 13/03/2025. Stream very low and impacted by leaf litter and vegetation. Data trend indicates a false event. NTU on arrival was 189.1631 and post clean reduced to 1.2847 NTU.
HUN-2503-024	SE02T	This event is marked by a rapid increase in turbidity with a sustained flat line peak. This is indicative of a false event.	Site inspected on 13/03/2025. Stream is low and heavily impacted by red algae. Data trend indicates false event. NTU on arrival 1236.2722, post clean 3.3581 NTU.
HUN-2503-025	SE02T	This event is marked by a gradual increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected on 20/03/2025. Stream low and heavily impacted by algae. Data trend indicates false event. NTU on arrival 517.4222, post clean 4.927264.
HUN-2503-026	SE02T	This event is marked by a gradual increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected 4/04/2025. Stream low and heavily impacted by algae. Data trend indicates false event.
HUN-2503-027	SE02T	This event is marked by a rapid increase in turbidity with a sustained flat line peak. This is indicative of a false event.	Site inspected 4/04/2025. Stream low and heavily impacted by algae. Data trend indicates false event.
HUN-2503-028	SE02T	This event is marked by a rapid increase in turbidity with a sustained flat line peak. This is indicative of a false event.	Site inspected 4/04/2025. Stream low and heavily impacted by algae. Data trend indicates false event.

Event ID	Monitor ID	Rationale	Field Notes
HUN-2503-029	SE02T	This event is marked by a gradual increase with sporadic peaks. This is indicative of a false event.	Site inspected 4/04/2025. Stream low and heavily impacted by algae. Data trend indicates false event.
HUN-2503-030	SE03INV2	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on the 17/03/2025, stream is very low and impacted by red algae and staining. Organic debris in stream.
HUN-2503-031	SE03INV2	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on the 29/03/2025. Stream bed and sensor heavily impacted by red algae. Cleaned sensor and returned into stream. Float has one broken wire and also needs picket - added to Scidev work list.
HUN-2503-032	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.
HUN-2503-033	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.
HUN-2503-034	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.
HUN-2503-035	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.
HUN-2503-036	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.
HUN-2503-037	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.
HUN-2503-038	SE03T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited 05/03. Stream clear and flowing with algae present.

Event ID	Monitor ID	Rationale	Field Notes
HUN-2503-039	SE05T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site inspected on 13/03/2025. Stream is low and heavily impacted by red algae. NTU on arrival 367.3241, post clean 2.9980 NTU. Data trend indicates false event.
HUN-2503-040	SE05T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected on 13/03/2025. Stream is low and heavily impacted by red algae. NTU on arrival 367.3241, post clean 2.9980 NTU. Data trend indicates false event.
HUN-2503-041	SE05T	This event is marked by a gradual increase and a rapid decrease in turbidity. This is indicative of a false event.	Site inspected 29/03. Float = 1; Temp = 33.506; Stream low, clear and flowing. Stream impacted by red algae. Cleaned sensor and returned into stream. Data trend indicates a false event. No rain proceeding false event.
HUN-2503-042	SE06T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 13/03/2025. Stream is very shallow and sensor is impacted by stream bed sediment and organic matter. Data trend indicates false event. NTU on arrival 45.1139, post clean 0.6754.
HUN-2503-043	SE06T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 13/03/2025. Stream is very shallow and sensor is impacted by stream bed sediment and organic matter. Data trend indicates false event. NTU on arrival 45.1139, post clean 0.6754.
HUN-2503-044	SE06T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 13/03/2025. Stream is very shallow and sensor is impacted by stream bed sediment and organic matter. Data trend indicates false event. NTU on arrival 45.1139, post clean 0.6754.
HUN-2503-045	SE06T	This event is marked by a gradual increase and a rapid decrease in turbidity. This is indicative of a false event.	Site visited on 13/03/2025. Stream is very shallow and sensor is impacted by stream bed sediment and organic matter. Data trend indicates false event. NTU on arrival 45.1139, post clean 0.6754.
HUN-2503-046	SE06T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site visited on 29/03/2025. Float = 0; Temp = 34.415; Sensor above the stream on arrival. Stream is very shallow, clear and flowing. Sensor is being impacted by stream bed sediment and vegetation. Cleaned sensor and returned into stream. NTU on arrival 222.0977, post clean 0.8367 NTU.
HUN-2503-047	SE06T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 29/03/2025. Float = 0; Temp = 34.415; Sensor above the stream on arrival. Stream is very shallow, clear and flowing. Sensor is being impacted by stream bed sediment and vegetation.

Event ID	Monitor ID	Rationale	Field Notes
			Cleaned sensor and returned into stream. NTU on arrival 222.0977, post clean 0.8367 NTU.
HUN-2503-048	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on 29/03/2025. Float = 0; Temp = 34.415; Sensor above the stream on arrival. Stream is very shallow, clear and flowing. Sensor is being impacted by stream bed sediment and vegetation. Cleaned sensor and returned into stream. NTU on arrival 222.0977, post clean 0.8367 NTU.
HUN-2503-049	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on 03/03/2025, stream is very low with green algae & leaf litter noted on the stream bed and impacting sensor. Data trend indicates false event likely caused by algae and organic debris impact.
HUN-2503-050	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on 15/03/2025, stream is very low with algae & organic debris noted on the stream bed and impacting sensor. Data trend indicates false event. Likely caused by algae and organic debris impact.
HUN-2503-051	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on 15/03/2025, stream is very low with algae & organic debris noted on the stream bed and impacting sensor. Data trend indicates false event. Likely caused by algae and organic debris impact.
HUN-2503-052	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on 15/03/2025, stream is very low with algae & organic debris noted on the stream bed and impacting sensor. Data trend indicates false event. Likely caused by algae and organic debris impact.
HUN-2503-053	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity with multiple peaks. This is indicative of a false event.	Site visited on 15/03/2025, stream is very low with algae & organic debris noted on the stream bed and impacting sensor. Data trend indicates false event. Likely caused by algae and organic debris impact.
HUN-2503-054	SE52T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on 15/03/2025, stream is very low with algae & organic debris noted on the stream bed and impacting sensor. Data trend

Event ID	Monitor ID	Rationale	Field Notes
			indicates false event. Likely caused by algae and organic debris impact.
HUN-2503-055	SE52T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	No rain leading up to false event. Site visited on 15/03/2025, stream is very low with algae & organic debris noted on the stream bed and impacting sensor. Data trend indicates false event. Likely caused by algae and organic debris impact.
HUN-2503-056	SE59T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 15/03/2025, stream is clear and flowing. Extensive evidence of pig activity in the stream and both stream banks around the sensor. Data trend indicates a false event.
HUN-2503-057	SE59T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 15/03/2025, stream is clear and flowing. Extensive evidence of pig activity in the stream and both stream banks around the sensor. Data trend indicates a false event.
HUN-2503-058	SE61T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on 01/03/25, stream clear and flowing. Sensor and stream bed heavily burdened by algae. NTU on arrival 26.2069 and post clean NTU 15.3186.
HUN-2503-059	SE61T	This event is marked by a rapid increase and a rapid decrease in turbidity. This is indicative of a false event.	Site visited on 01/03/25, stream clear and flowing. Sensor and stream bed heavily burdened by algae. NTU on arrival 26.2069 and post clean NTU 15.3186.
HUN-2503-060	SE61T	This event is marked by sporadic peaks. This is indicative of a false event	Site visited on the 17/03/2025, stream appears clear but sensor and stream heavily impacted be algae. NTU was 22 on arrival and dropped to 4.1 after clean.
HUN-2503-061	SE61T	This event is marked by a gradual increase and a gradual decrease in turbidity. This is indicative of a false event.	Site visited on the 05/04/2025. Sensor and stream bed heavily impacted by algae. NTU was 22.43 on arrival, post clean dropped to 2.28
HUN-2503-062	SE61T	This event is marked by a gradual increase in turbidity. This is indicative of a false event.	Site visited on the 05/04/2025. Sensor and stream bed heavily impacted by algae. NTU was 22.43 on arrival, post clean dropped to 2.28

5.5. Excluded WQMS Units

Twenty-nine WQMS Units were excluded from analysis due to erroneous data. Alcoa confirmed the invalidity of data recorded from these units and provided commentary on the condition of each.

Table 4 Excluded WQMS Units

Unit	Dates	SciDev Comment
DB01T	01/03/2025-31/03/2025	Stream dry as of 3/01/2025
DB02T	01/03/2025-31/03/2025	Stream dry as of 15/02/2025
FPWR1	01/03/2025-31/03/2025	Stream dry as of 1/01/2025. Monitor offline due to fault.
ND04T	01/03/2025-31/03/2025	Stream dry as of 1/01/2025
ND12T	01/03/2025-31/03/2025	Stream dry as of 21/12/2025
ND13T	01/03/2025-31/03/2025	Stream dry as of 16/01/2025
PD02T	01/03/2025-31/03/2025	No Data Available
PD03T	01/03/2025-31/03/2025	No Data Available
SE01T	01/03/2025-31/03/2025	Stream dry as of 4/01/2025
SE03INV3	01/03/2025-31/03/2025	Stream dry as of 28/11/2025.
SE07T	01/03/2025-31/03/2025	Stream dry as of 28/11/2025
SE08T	01/03/2025-31/03/2025	Stream dry as of 31/01/2025
SE09T	01/03/2025-31/03/2025	Stream dry as of 5/01/2025
SE10T	01/03/2025-31/03/2025	Stream dry as of 5/01/2025
SE11T	01/03/2025-31/03/2025	Stream dry as of 28/10/2025
SE12INV	01/03/2025-31/03/2025	Stream dry as of 5/11/2025
SE12T	01/03/2025-31/03/2025	Stream dry as of 8/12/2025
SE15T	01/03/2025-31/03/2025	Stream dry as of 16/11/2025
SE22T	01/03/2025-31/03/2025	Stream dry as of 14/12/2025
SE23T	01/03/2025-31/03/2025	Stream dry as of 15/10/2025
SE24T	01/03/2025-31/03/2025	Stream dry as of 2/11/2025
SE25T	01/03/2025-31/03/2025	Stream dry as of 2/11/2025
SE26T	01/03/2025-31/03/2025	Stream dry as of 15/10/2025
SE34T	01/03/2025-31/03/2025	Stream dry as of 28/12/2025
SE36T	01/03/2025-31/03/2025	Stream dry as of 5/01/2025
SE48T	01/03/2025-31/03/2025	Stream dry as of 23/12/2025
SE60T	01/03/2025-31/03/2025	Stream dry as of 5/12/2025
SE62T	01/03/2025-31/03/2025	Stream dry as of 28/12/2025
SN07T	01/03/2025-31/03/2025	Stream dry as of 26/01/2025

5.6. Missing Data

Periods of missing data are detailed in Table 5.

Table 5 Missing Data Summary

Missing Data ID	Unit	Start	End	Comments
MD-2503-001	ND14T	1/03/2025 17:10	3/03/2025 10:40	No Field Note Available
MD-2503-002	ND14T	3/03/2025 17:15	3/03/2025 18:32	No Field Note Available
MD-2503-003	ND14T	7/03/2025 10:43	7/03/2025 13:20	No Field Note Available

MD-2503-004	ND14T	8/03/2025 18:43	9/03/2025 6:26	No Field Note Available
MD-2503-005	SE02T	24/03/2025 10:21	24/03/2025 15:04	No Field Note Available
MD-2503-006	SE06T	17/03/2025 16:54	17/03/2025 21:42	No Field Note Available
MD-2503-007	SE51T	29/03/2025 3:25	29/03/2025 8:15	No Field Note Available
MD-2503-008	SE52T	16/03/2025 8:53	16/03/2025 13:43	No Field Note Available
MD-2503-009	SE53T	23/03/2025 11:10	23/03/2025 15:57	No Field Note Available
MD-2503-010	SE59T	12/03/2025 6:36	12/03/2025 11:23	No Field Note Available

6. Appendices

Appendix A. Huntly Raw WQMS Data

Date	Huntly WQMS Data - March2025 - Events with turbidity > 25 NTU for an hour or more																
	DB01T	DB02T	FPWR1	ND04T	ND06T	ND07T	ND12T	ND13T	ND14T	PD01T	SE01T	SE02T	SE03T	SE05T	SE06T	SE07T	SE08T
1/03/2025					**1**	**2**						**1**					
2/03/2025																	
3/03/2025																	
4/03/2025																	
5/03/2025						**1**						**1**			**1**		
6/03/2025													**1**				
7/03/2025					**1**												
8/03/2025																	
9/03/2025																	
10/03/2025														**1**			
11/03/2025														**1**			
12/03/2025										**1**					**1**		
13/03/2025																	
14/03/2025																	
15/03/2025																	
16/03/2025																	
17/03/2025					**1**							**1**			**1**		
18/03/2025					**2**												
19/03/2025					**1**												
20/03/2025					**2**												
21/03/2025					**1**									**1**			
22/03/2025					**2**										**1**		
23/03/2025					**2**												
24/03/2025					**2**										**1**		
25/03/2025					**2**							**1**	**1**				
26/03/2025					**1**								**1**				
27/03/2025												**1**	**1**				
28/03/2025																	
29/03/2025						**1**							**1**				
30/03/2025												**1**	**1**				
31/03/2025													**1**				

Note: False events have been annotated by **black** bold text. True events for further investigation are annotated by **red** bold text

Date	Huntly WQMS Data -March2025 - Events with turbidity > 25 NTU for an hour or more																
	SE09T	SE10T	SE11T	SE12T	SE12INV	SE15T	SE34T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE60T	SE61T	SE62T	SN07T
1/03/2025											**1**				**2**		
2/03/2025																	
3/03/2025											**2**						
4/03/2025																	
5/03/2025													**1**				
6/03/2025																	
7/03/2025											**1**						
8/03/2025																	
9/03/2025													**1**				
10/03/2025											**1**						
11/03/2025											**1**						
12/03/2025																	
13/03/2025															**1**		
14/03/2025																	
15/03/2025																	
16/03/2025																	
17/03/2025																	
18/03/2025																	
19/03/2025																	
20/03/2025																	
21/03/2025																	
22/03/2025																	
23/03/2025																	
24/03/2025															**1**		
25/03/2025																	
26/03/2025											**1**						
27/03/2025																	
28/03/2025																	
29/03/2025															**1**		
30/03/2025																	
31/03/2025											**1**						

Note: False events have been annotated by **black** bold text. True events for further investigation are annotated by **red** bold text

Date	Huntly WQMS Data - March2025 - Events with turbidity > 25 NTU for an hour or more																
	SE03INV2	SE22T	SE23T	SE25T	SE24T	SE03INV1	SE03INV3	SE24T									
1/03/2025																	
2/03/2025																	
3/03/2025																	
4/03/2025																	
5/03/2025																	
6/03/2025																	
7/03/2025																	
8/03/2025																	
9/03/2025																	
10/03/2025	**1**																
11/03/2025																	
12/03/2025																	
13/03/2025																	
14/03/2025																	
15/03/2025																	
16/03/2025																	
17/03/2025																	
18/03/2025																	
19/03/2025																	
20/03/2025																	
21/03/2025																	
22/03/2025																	
23/03/2025	**1**																
24/03/2025																	
25/03/2025																	
26/03/2025																	
27/03/2025																	
28/03/2025																	
29/03/2025																	
30/03/2025																	
31/03/2025																	

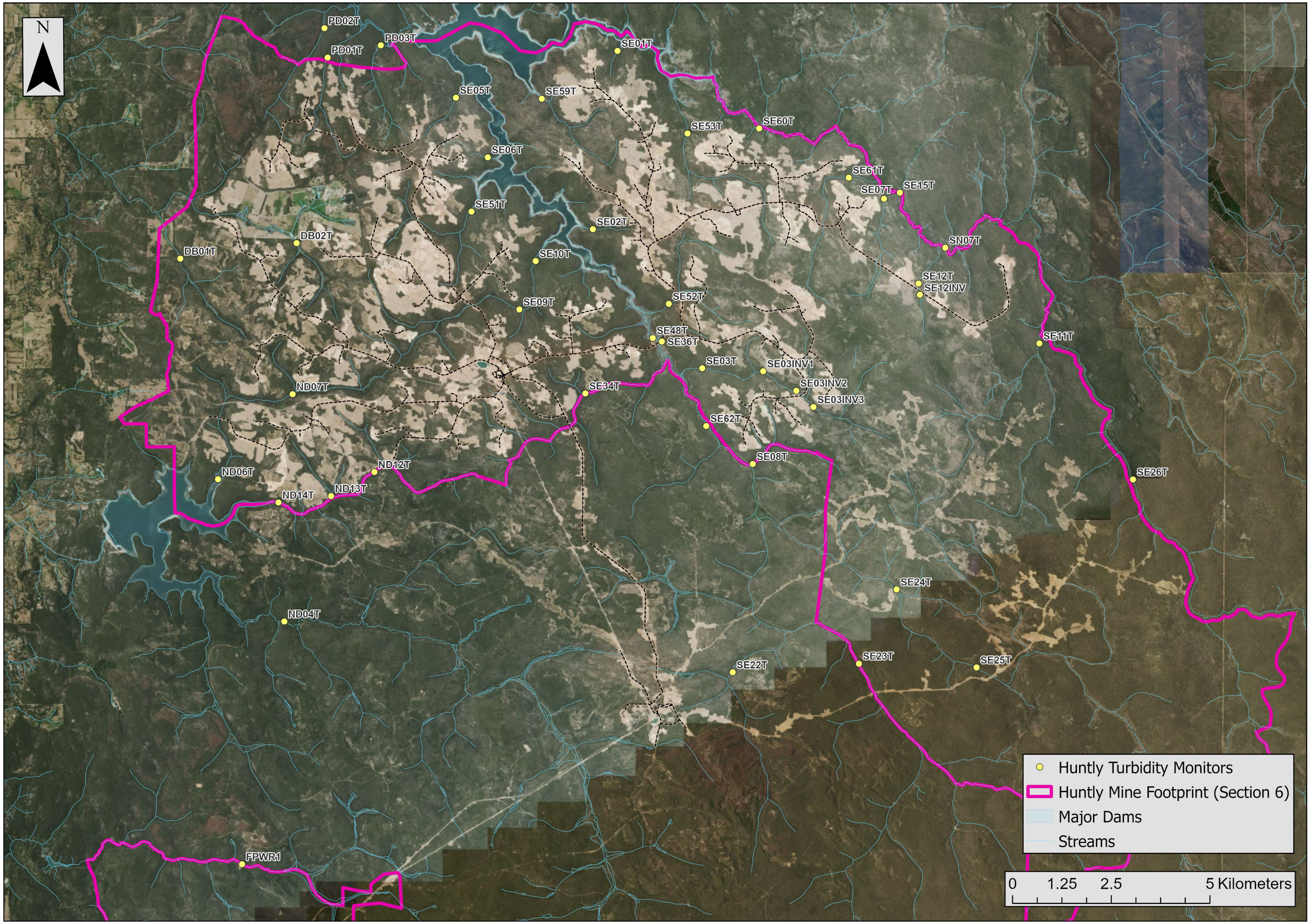
Note: False events have been annotated by **black** bold text. True events for further investigation are annotated by **red** bold text

Date	Huntly WQMS Data - March2025 - Turbidity (Daily Average, NTU)																
	DB01T	DB02T	FPWR1	ND04T	ND06T	ND07T	ND12T	ND13T	ND14T	PD01T	SE01T	SE02T	SE03T	SE05T	SE06T	SE07T	SE08T
1/03/2025					34.29	141.43			0.91	1.79			2.91	6.11	3.93		
2/03/2025					4.04	164.41				2.54		3.69	4.03	5.79	10.21		
3/03/2025					5.51	66.60			0.75	3.96		4.96	4.11	8.02	7.24		
4/03/2025					3.63	5.08			29.53	1.90		13.99	3.80	5.08	9.62		
5/03/2025					3.92	61.46			0.84	1.60		41.94	4.66	6.32	33.90		
6/03/2025					28.19	147.77			0.89	1.38		107.35	11.07	13.55	84.97		
7/03/2025					7.38	148.44			0.92	1.49		244.15	6.05	6.41	162.37		
8/03/2025					4.44	154.57			0.92	1.92		417.58	4.43	6.20	487.54		
9/03/2025					4.40	164.00			0.94	3.96		605.81	5.15	5.81	858.14		
10/03/2025					3.57	159.97			0.90	6.64		779.19	5.27	12.06	596.65		
11/03/2025					3.82	151.54			1.06	13.79		944.29	5.63	80.46	207.28		
12/03/2025					3.38	152.08			0.96	85.83		1077.94	6.20	511.74	16.99		
13/03/2025					4.10	142.07			1.30	58.20		569.64	5.77		6.56		
14/03/2025					2.85	1.40			1.42	1.84		3.07	2.79	5.16	0.85		
15/03/2025					1.24	0.99			1.04	1.73		3.37	3.50	3.62	2.26		
16/03/2025					1.87	1.44			0.96	2.32		9.55	2.84	4.04	8.08		
17/03/2025					15.02	1.92			1.05	2.14		55.14	3.14	4.00	18.11		
18/03/2025					20.51	2.41			1.02	2.30		238.80	3.52	4.82	40.27		
19/03/2025					5.85	1.81			0.98	2.59		438.75	3.83	12.84	71.67		
20/03/2025					19.79	3.02			1.02	2.34		332.35	7.14	55.93	122.36		
21/03/2025					9.31	3.42			1.05	2.22		6.50	4.10	170.35	194.89		
22/03/2025					14.90	2.65			0.95	2.81		7.59	4.20	241.08	167.74		
23/03/2025					18.45	1.90			0.98	2.13		9.35	4.20	259.75	8.07		
24/03/2025					17.84	2.08			7.93	2.10		14.01	4.85	4.93	43.81		
25/03/2025					16.87	1.29			1.07	2.39		47.57	10.74	10.48	139.44		
26/03/2025					12.57	1.05			1.38	2.21		160.46	8.85	8.18	194.82		
27/03/2025					5.95	1.24			1.61	2.36			7.94	4.57	253.39		
28/03/2025					8.30	2.96			1.44	3.18		3.12	8.36	4.18	302.74		
29/03/2025					7.25	59.66			1.21	3.55		4.87	8.86	3.04	102.51		
30/03/2025					9.18	154.14			30.99			48.26	11.57	4.41	0.66		
31/03/2025					7.89	137.05			2.42			186.82	9.92	7.03	0.87		

Date	Huntly WQMS Data - March2025 - Turbidity (Daily Average, NTU)																
	SE09T	SE10T	SE11T	SE12T	SE12INV	SE15T	SE34T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE60T	SE61T	SE62T	SN07T
1/03/2025										0.27	9.68	0.10	10.13		21.32		
2/03/2025										0.07	7.50	0.53	8.56		16.74		
3/03/2025										0.20	12.12	0.34	8.65		17.69		
4/03/2025										0.16	1.78	0.15	5.59		18.59		
5/03/2025										0.03	4.55	0.33	13.72		19.38		
6/03/2025										0.02	7.01	0.52	3.48		20.07		
7/03/2025										0.25	9.30	0.26	4.41		20.92		
8/03/2025										0.10	3.08	0.08	7.15		22.10		
9/03/2025										0.11	0.58	0.04	12.06		22.76		
10/03/2025										0.09	5.18	0.06	4.73		23.02		
11/03/2025										0.13	18.01	0.27	5.24		23.38		
12/03/2025										0.12	5.09	0.48	5.75		23.81		
13/03/2025										0.41	4.27	1.01	6.85		27.27		
14/03/2025										0.63	4.58	0.64	7.59		22.78		
15/03/2025										0.09	2.50	0.75	4.80		22.18		
16/03/2025										0.10	0.31	0.79	3.91		22.56		
17/03/2025										0.07	0.32	0.65	3.84		14.22		
18/03/2025										0.10	0.32	1.14	4.23		4.22		
19/03/2025										0.09	0.36	0.90	4.55		5.11		
20/03/2025										0.15	0.50	0.72	4.90		3.79		
21/03/2025										0.10	0.57	0.64	5.25		1.96		
22/03/2025										0.10	0.40	0.54	5.59		2.22		
23/03/2025										0.10	0.49	0.86	6.17		4.10		
24/03/2025										0.10	0.48	0.62	6.81		17.40		
25/03/2025										0.09	1.05	0.53	7.69		31.27		
26/03/2025										0.27	5.36	0.60	8.41		7.87		
27/03/2025										0.13	4.41	0.56	9.94		11.84		
28/03/2025										0.23	10.65	0.52	11.70		9.40		
29/03/2025										0.10	5.47	0.64	13.56		22.67		
30/03/2025										0.15	8.60	0.78	13.69		42.42		
31/03/2025										1.06	30.09	0.35	13.32		95.69		

Date	Huntly WQMS Data - March2025 - Turbidity (Daily Average, NTU)																	
	SE03INV2	SE22T	SE23T	SE25T	SE24T	SE03INV1	SE03INV3	SE24T										
1/03/2025	9.87					2.65												
2/03/2025	1.53					2.27												
3/03/2025	1.63					4.15												
4/03/2025	1.88					2.31												
5/03/2025	2.32					2.40												
6/03/2025	2.50					2.40												
7/03/2025	3.16					2.53												
8/03/2025	4.00					2.72												
9/03/2025	5.39					2.85												
10/03/2025	20.29					2.87												
11/03/2025	46.15					3.02												
12/03/2025	231.33					3.12												
13/03/2025	254.30					9.64												
14/03/2025	330.61					3.37												
15/03/2025	151.82					2.89												
16/03/2025	127.36					2.87												
17/03/2025	109.48					2.98												
18/03/2025	1.72					3.10												
19/03/2025	1.97					3.20												
20/03/2025	2.86					3.27												
21/03/2025	6.15					3.42												
22/03/2025	12.18					3.51												
23/03/2025	33.75					4.12												
24/03/2025	63.03					3.87												
25/03/2025	245.83					4.56												
26/03/2025	415.64					4.27												
27/03/2025	539.36					30.50												
28/03/2025	1190.40					4.68												
29/03/2025	839.96					4.35												
30/03/2025	1.46					2.42												
31/03/2025	1.70					2.35												

Appendix B. Huntly WQMS Locations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PD03T
PD01T
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SE51T
SE02T
DB02T
DB01T
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SN07T
SE12T
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SE52T
SE09T
SE48T
SE36T
SE11T
SE03T
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SE03INV2
SE03INV3
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SE62T
SE08T
ND12T
ND06T
ND13T
ND14T
SE26T
SE24T
ND04T
SE23T
SE25T
SE22T
FPWR1
Huntly Turbidity Monitors
Huntly Mine Footprint (Section 6)
Major Dams
Streams
0
1.25
2.5
5 Kilometers

Appendix C. WQMS General Arrangement

ANTENNA

SOLAR PANEL

DATA TRANSMISSION TO IOT

DATA OUTLET

POWER INLET

40 X 60 MM CABLE DUCT

20 AMP MPPT
SOLAR CHARGER

40 X 60 MM CABLE DUCT

SIERRA WIRELESS FX30

40 X 60 MM CABLE DUCT

12 V, 120 AH LI-ION BATTERY

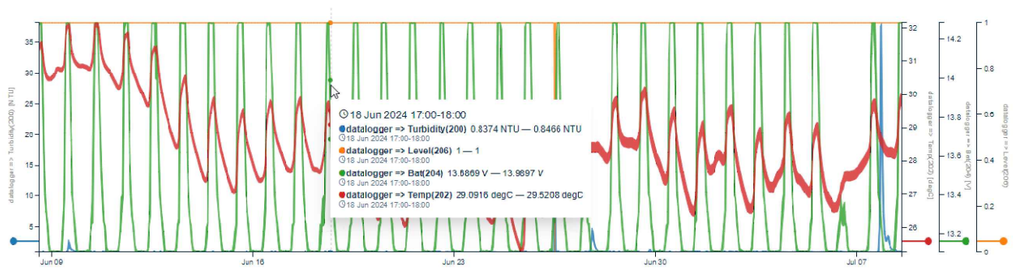
DATA INLET

SENSOR

STREAM DRY

SENSOR

STREAM FLOWING



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TITLE
IOT TURBIDITY MONITORING STATION
SITE LAYOUT
GENERAL ARRANGEMENT

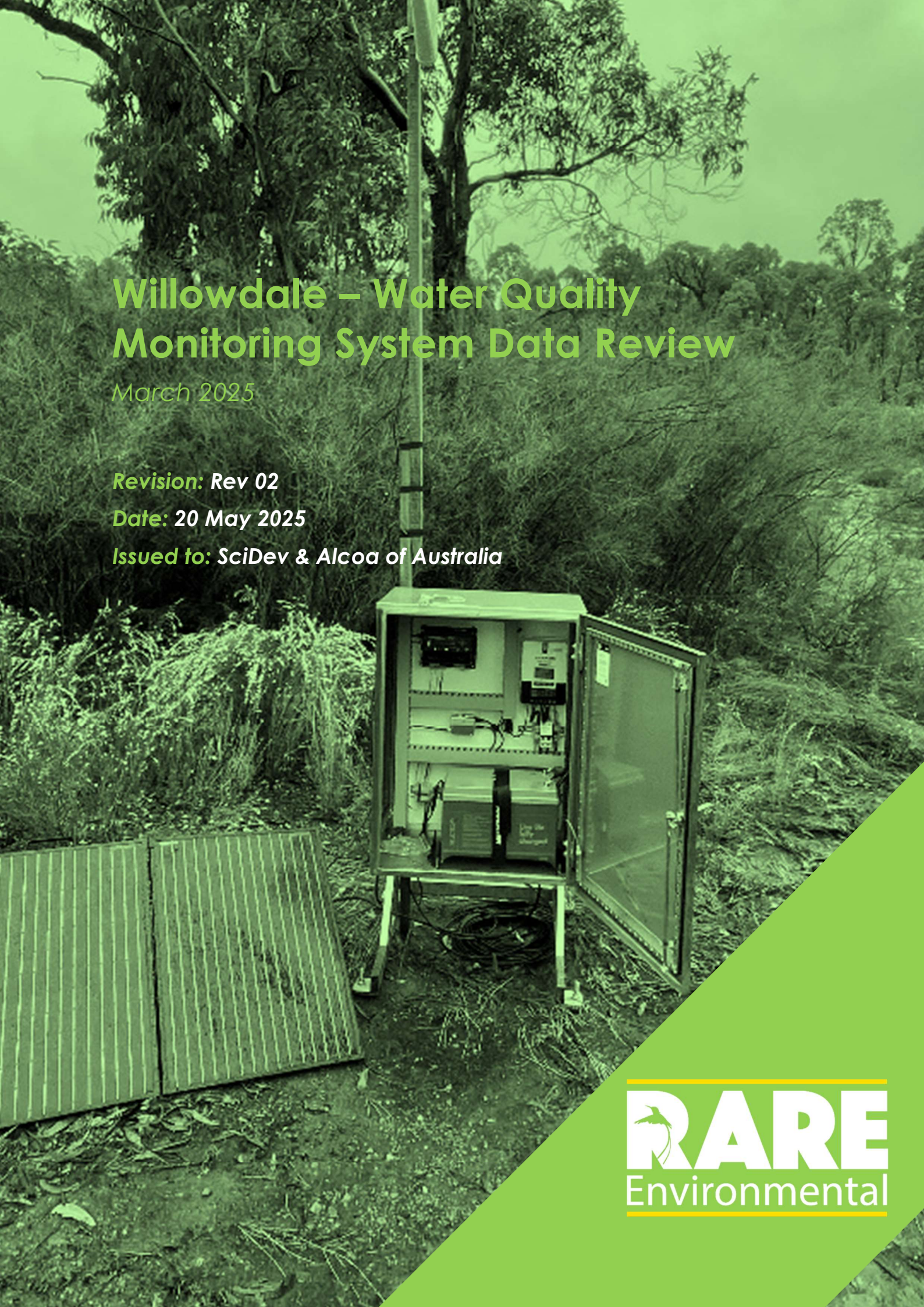
SHEET 1 OF 2

SCALE NTS OR AS SHOWN

DRAWING NO.
HI0090 - ALCOA WQMS

SHEET SIZE
A3

REV.
1



Willowdale – Water Quality Monitoring System Data Review

March 2025

Revision: ***Rev 02***

Date: ***20 May 2025***

Issued to: ***SciDev & Alcoa of Australia***

RARE Environmental

Document Control

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Document No	RP24050 WDL WQMS Data Review - March 2025
Project Name	WQ Data Processing
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Document History and Status						
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01	02/05/25	Issued to client	MM	GD	GD	Alcoa
02	20/05/25	Amended with comments	MM	GD	GD	Alcoa

Report Sign Off					
Report Version	02				
Prepared by		Technical Review		Approved for Issue	
Michael Minter		Georgia Duffy		Georgia Duffy	
Name	Michael Minter	Name	Georgia Duffy	Name	Georgia Duffy
Position	Env. Engineer	Position	Chemical Engineer	Position	Chemical Engineer
Date	20/05/25	Date	20/05/25	Date	20/05/25

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Contents

1. Executive Summary

This report, prepared by RARE Environmental Pty Ltd and SciDev Pty Ltd for Alcoa, provides an analysis of turbidity data collected from Water Quality Monitoring Systems (WQMSs) deployed at the Willowdale bauxite mining operations during March 2025. The primary objective of this analysis was to evaluate the quality of the data, identify potential "true" turbidity exceedance events, and support Alcoa's compliance reporting obligations under Schedule 1, Division 2, Clause 6 of the **Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023**.

The analysis focused on identifying and classifying turbidity events where levels exceeded 25 nephelometric turbidity units (NTU) for at least one hour. Events were categorized as "true" or "false" based on Alcoa's **Turbidity Event Classification Guidelines**, which distinguish actual turbidity increases (true events) from false readings caused by environmental factors such as debris, air bubbles, or fluctuating water levels.

Key findings include:

- **True Events**: Zero "true" turbidity exceedance events were identified.
- **Further Investigation**: Zero events were flagged for further investigation.
- **False Events**: One 'false' events was identified, primarily attributed to factors such as debris accumulation, sensor obstructions, and water turbulence.
- **Excluded Units**: Two WQMS units were excluded from the analysis due to invalid data caused by equipment faults or environmental interference.

The report also highlights periods of missing data, which occurred due to system logoffs, equipment faults, or unplanned shutdowns. These gaps are detailed in the report to ensure transparency in data handling.

2. Scope

RARE Environmental Pty Ltd and SciDev Pty Ltd were engaged by Alcoa to analyse turbidity data collected from the Willowdale Water Quality Monitoring Systems (WQMSs). The primary objective of this engagement is to assess the quality of the collected data and identify potential "true" turbidity events. This analysis supports Alcoa's reporting obligations under *Schedule 1, Division 2, Clause 6 of the Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023*.

3. Introduction

3.1. Background

Alcoa of Australia Ltd (Alcoa) operates two bauxite mines, Huntly and Willowdale, approximately 100 km southeast of Perth, Western Australia. These mining operations are subject to environmental controls mandated by the *Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023*.

Under this Exemption Order, Alcoa is required to implement drainage control measures and monitor effectiveness in water bodies within and downstream of mining operations. Turbidity, a critical water quality parameter, is monitored using Water Quality Monitoring Systems (WQMSs), to detect deviations and identify high-turbidity events.

Alcoa is obligated to report monthly on-stream turbidity, including the identification and classification of any “true” high-turbidity exceedance events. (Refer to Appendix B for the site map showing WQMS locations.)

3.2. Monitoring requirements

Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023 specifies that a drainage incident occurs when:

> *a) runoff from a disturbance area enters the surrounding environment, resulting in surface water turbidity of at least 25 NTU for a duration of at least one hour; or*
>
> *b) a discharge from containment infrastructure includes, or may include, environmentally hazardous material.*

Trigger levels for drainage incidents are outlined in *Schedule 1* of the Exemption Order. To meet these requirements, Alcoa has developed "Turbidity Event Classification Guidelines" which define a true turbidity exceedance event as a WQMS recording turbidity levels of at least 25 NTU for a period exceeding one hour.

3.3. Water Quality Management Systems (WQMSs)

During the March 2025 monitoring period, 4 Turbidity units were deployed in section 6 areas to monitor turbidity levels in streams subject to surface water runoff within and downstream of Willowdale mining operations.

Each WQMS unit consists of the following components:

Aquas SMR10 Turbidity Probe

> Positioned at a 90-degree angle to water flow, each probe is equipped with an automatic lens wiper and a guard to protect against larger debris.

Data Taker DT82 Logger

> Records data locally every 6 seconds, with 6-minute averages transmitted via IoT-enabled modems to a cloud-based platform.

Float Switch

Detects whether the sensor is submerged, or the stream is dry.

3.4. Purpose

This report aims to analyse turbidity data collected during March 2025, focusing on the identification and classification of "true" turbidity exceedance events based on Alcoa's Turbidity Event Classification Guidelines.

3.5. Exclusions

This report is not intended as:

- An assessment of the WQMS network or Alcoa's compliance with relevant legislation and requirements.
- An evaluation of the suitability of the trigger levels or event classification procedures adopted by Alcoa.

3.6. Abbreviations

	Term
IoT	Internet of Things
NTU	Nephelometric Turbidity Units
WQMS	Water Quality Management System

4. Methodology

4.1. WQMS Locations

A site map showing the WQMSs locations is provided in Appendix B.

4.2. Data Review

Data recorded by the WQMS Units was reviewed and potential events where turbidity levels exceeded 25 NTU for at least one hour. Each potential event was categorised as either 'true 'or 'false'.

4.2.1. True Turbidity Exceedance Events

These events are caused by an actual increase in stream turbidity. Per Alcoa's "Turbidity Event Classification Guidelines" true exceedance events typically exhibit:

- A sharp, sudden incline in turbidity levels.
- A return to baseline turbidity levels in a pattern resembling a normal (Gaussian) distribution.

Figure 1 Typical 'true' exceedance event showing the sharp incline and gradual return to background levels.

4.2.2. False Turbidity Exceedance Events

These events are caused by factors unrelated to actual turbidity increase, such as:

- Organic debris (e.g., leaves, sticks, algae) obstructing the sensor
- Air bubbles or water turbulence near the sensor
- Fluctuating water levels intermittently covering and uncover the sensor lens.

False events typically exhibit sharp inclines and declines without the characteristic bell curve shape of true events.

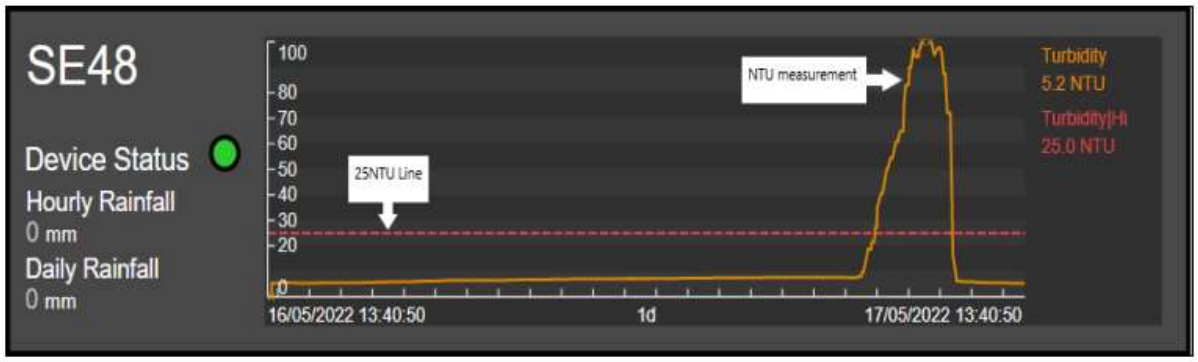


Figure 2 Typical 'false' exceedance event showing both a sharp incline and decline

4.2.3. Missing Data

Missing data occurs when a WQMS unit fails to record information, this can occur from unexpected system logoffs, equipment faults, or unplanned shutdowns.

5. Results and Discussion

5.1. Events

Table 1 provides a summary of identified events. Table 2 offers detailed information about each event.

Table 1 Events Summary

Category	# of events
Flagged for further investigation	0
False	1

Table 2 Events Details

Event ID	WQMS ID	Event Category	Start	End	Duration	Peak Turbidity (NTU)	Average Turbidity (NTU)
WDL-2503-001	RHB2	'False'	16/03/2025 18:54	25/03/2025 14:06	8 d, 19 hrs, 12 mins	920.40	102.06

5.2. Additional Investigation

Zero events were identified for further investigation.

5.3. True Event(s)

Zero potential 'true' turbidity events were identified during the reporting period.

5.4. False Event(s)

One 'false' events were identified during the reporting period. Rationale on potential causes is summarised below.

Table 3 False Events Rationale

Event ID	Monitor ID	Rationale	Field Notes
WDL-2503-001	RHB2	This event is marked by a gradual increase with multiple peaks. This is indicative of a false event.	Stream inspected on 11/04/2025. No signs of turbid water or sediment deposition. There was some residue build up on the sensor lens and the probe cable. Probe cleaned and returned to stream. Connection issue resolved. 0.2mm rain received in preceding 24 hours. Event classified as a false event.

5.5. Excluded WQMS Units

Two WQMS Units were excluded from analysis due to erroneous data. Alcoa confirmed the invalidity of data recorded from these units and provided commentary on the condition of each.

Table 4 Excluded WQMS Units

Unit	Dates	Alcoa Comment
HV07	01/02/2025-31/03/2025	Stream dry, probe installed in a bucket of deionised water for protection
HV49T	01/02/2025-31/02/2025	Stream dry, probe installed in a bucket of deionised water for protection

5.6. Missing Data

Periods of missing data are detailed in Table 5.

Table 5 Missing Data Summary

Missing Data ID	Unit	Start	End	Comments
MD-2502-02	RHB2	09/03/2025	9/03/2025	System fault – no usable data recorded for 9 hours.
MD-2502-03	RHB2	13/03/2025	13/03/2025	System fault – no usable data recorded for 7 hours.
MD-2502-04	RHB2	14/03/2025	14/03/2025	System fault – no usable data recorded for 14 hours.
MD-2502-01	RHB2	25/03/2025	31/03/2025	System Fault - no usable data recorded from 25/03/2025.
MD-2502-05	RHB3	28/03/2025	31/03/2025	Battery failure due to stolen solar equipment. No usable data recorded from 28/03/2025

6. Appendices

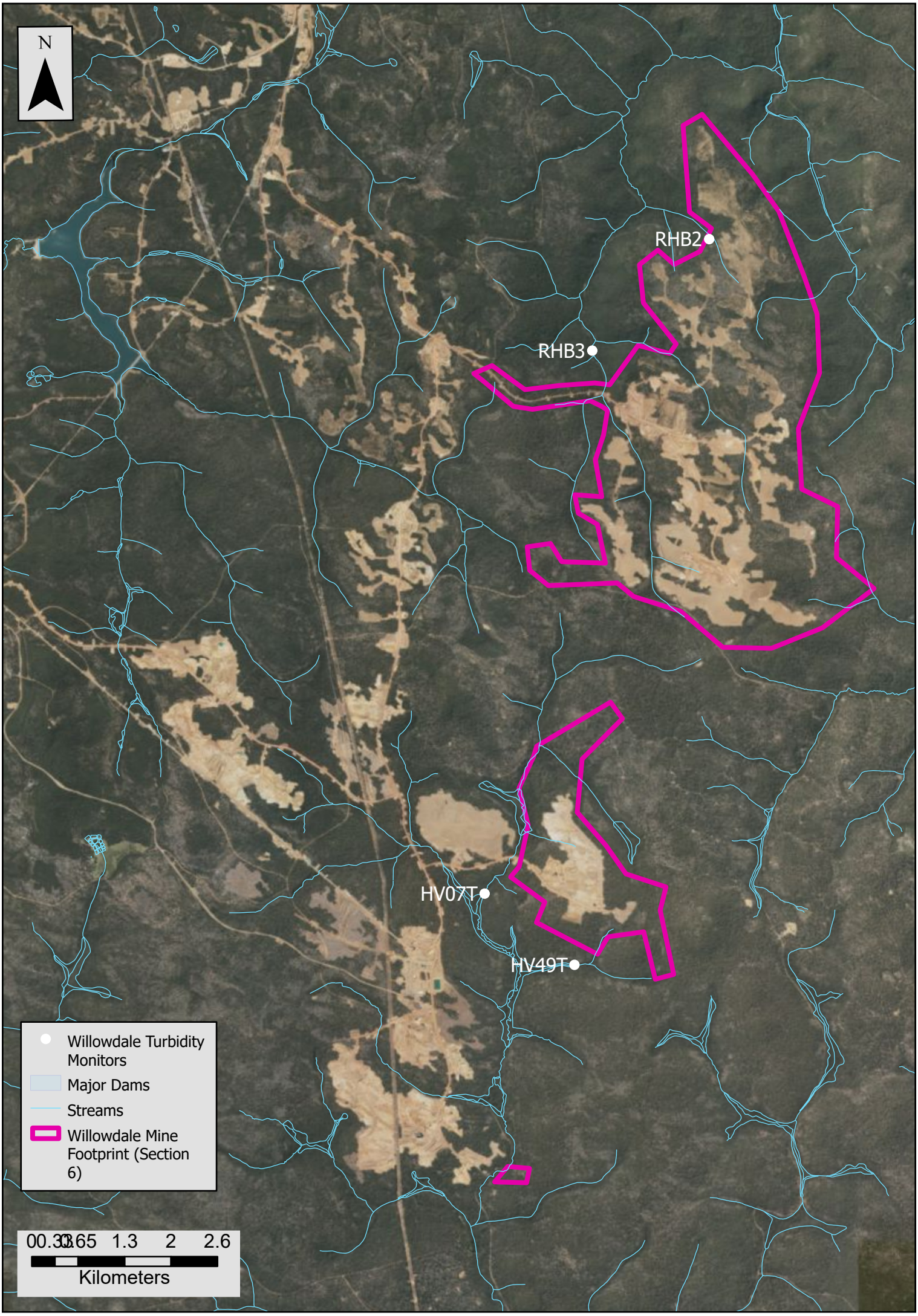
Appendix A. Willowdale Raw WQMS Data

Date	Willowdale WQMS Data - March 2025 - Events with turbidity > 25 NTU for an hour or more			
	HV07T	HV49T	RHB2	RHB3
1/03/2025				
2/03/2025				
3/03/2025				
4/03/2025				
5/03/2025				
6/03/2025				
7/03/2025				
8/03/2025				
9/03/2025				
10/03/2025				
11/03/2025				
12/03/2025				
13/03/2025				
14/03/2025				
15/03/2025				
16/03/2025			**1**	
17/03/2025				
18/03/2025				
19/03/2025				
20/03/2025				
21/03/2025				
22/03/2025				
23/03/2025				
24/03/2025				
25/03/2025				
26/03/2025				
27/03/2025				
28/03/2025				
29/03/2025				
30/03/2025				
31/03/2025				

Date	Willowdale WQMS Data - March 2025 – Daily Average Turbidity (NTU)			
	HV07T	HV49T	RHB2	RHB3
1/03/2025			10.23	0.41
2/03/2025			10.25	0.43
3/03/2025			10.31	0.43
4/03/2025			10.23	0.43
5/03/2025			10.03	0.46
6/03/2025			9.67	0.47
7/03/2025			10.49	0.45
8/03/2025			7.82	0.43
9/03/2025			7.51	0.44
10/03/2025			7.74	0.47
11/03/2025			6.18	0.48
12/03/2025			7.43	0.45
13/03/2025			11.24	0.46
14/03/2025			18.21	0.43
15/03/2025			20.80	0.39
16/03/2025			23.27	0.40
17/03/2025			30.59	0.42
18/03/2025			40.44	0.43
19/03/2025			49.20	0.43
20/03/2025			57.01	0.50
21/03/2025			60.75	0.52
22/03/2025			67.49	0.47
23/03/2025			77.94	0.44
24/03/2025			86.20	0.45
25/03/2025				0.46
26/03/2025				0.45
27/03/2025				0.46
28/03/2025				0.46
29/03/2025				
30/03/2025				
31/03/2025				

* - Adjusted average with sensor fault data removed

Appendix B. Willowdale WQMS Locations


N
RHB2
RHB3
HV07T
HV49T
Willowdale Turbidity Monitors
Major Dams
Streams
Willowdale Mine Footprint (Section 6)
0 0.33 0.65 1.3 2 2.6
Kilometers

Appendix C. WQMS General Arrangement

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DATA TRANSMISSION TO IOT

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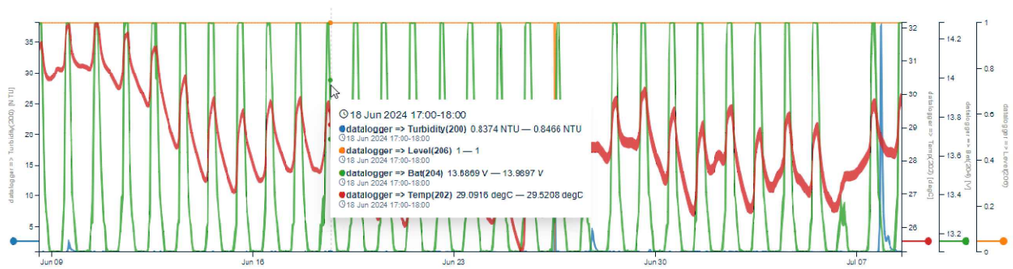
SENSOR

STREAM FLOWING



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TITLE
IOT TURBIDITY MONITORING STATION
SITE LAYOUT
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SHEET 1 OF 2

SCALE NTS OR AS SHOWN

DRAWING NO.
HI0090 - ALCOA WQMS

SHEET SIZE
A3

REV.
1