

Huntly Bauxite Mine – Water Quality Monitoring System Data Review

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1. Introduction

1.1. Purpose

RARE Environmental Pty Ltd (RARE) was engaged by SciDev Pty Ltd (SciDev) to analyse and comment on raw turbidity monitoring data collected by their Water Quality Monitoring Systems (WQMSs) under Section 6 of the Environmental Protection Act 1986 at the Huntly Bauxite Mine, owned and operated by Alcoa of Australia Limited (Alcoa). Stream turbidity monitoring is a core regulatory requirement stipulated as part of Alcoa's approvals and operating framework. The data for this reporting period was collected in September of 2024.

This report has been prepared to assess the quality of data provided and identify potential drainage incidents ('true' events) per the procedure detailed below within that data. Where possible recommendations are made for either WQMS network upgrades or further investigation of events identified within the data. This report should not be considered an assessment of the WQMS network and/or Alcoa's compliance to relevant legislation and requirements, nor should it be considered an assessment of the suitability of the adopted trigger level and event classification procedure.

1.2. Context

Data from each location has been collected and compared against the drainage incident trigger level outlined in the *Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023* Schedule 1 Division 2 Cl. 6. Trigger events have then been assessed against Alcoa's turbidity event classification guidelines to determine whether the event is true, i.e. caused by stream turbidity, or false, i.e. caused by stream debris, algae or other. For the purpose of this report a turbidity event is an event where turbidity levels, measured by a WQMS, are at least 25 nephelometric turbidity units (NTU) for a period of at least 1 hour.

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

1.3. Monitoring Requirements

Under Schedule 1, Division 2 ("Controls on activities"), of the *Environmental Protection (Darling Range Bauxite Mining Proposals) Exemption Order 2023* a drainage incident is defined as:

- a) a runoff from a disturbance area to the surrounding environment of surface water that has a turbidity of at least 25 nephelometric turbidity units for a period of at least 1 hour; or
- b) a discharge from containment infrastructure that includes or may include environmentally hazardous material;

1.4. Water Quality Monitoring System (WQMS)

At the Huntly site, for this reporting period, 41 (forty-one) WQMSs have been installed in streams within or downstream of mining operations to monitor stream turbidity levels. Each turbidity monitoring station is fitted with an Aquas SMR10 turbidity probe. The Aquas probes are placed directly in the streams, mounted at 90 degrees to the flow of water. Each sensor has a guard to protect the lens from larger debris and the units are fitted with a lens screen wiper. Note: disruptions or errant readings can occur with smaller pieces of debris (leaves etc.).

Data is collected via a Data Taker DT82 logger. Data from each logger is linked to an IOT data modem to transmit to a cloud-based platform. Data is logged locally in 6 second intervals with a 6-minute average pushed into the cloud-based platform. A float switch or cell indicates sensor immersion or a dry stream.

1.5. Data Review & Event Classification Process

Data produced by the WQMSs is reviewed by RARE per the following procedure and in consultation with SciDev. This allows for the identification of true events that require investigation to determine whether the mining operations may have contributed to the elevated turbidity levels, and false events.

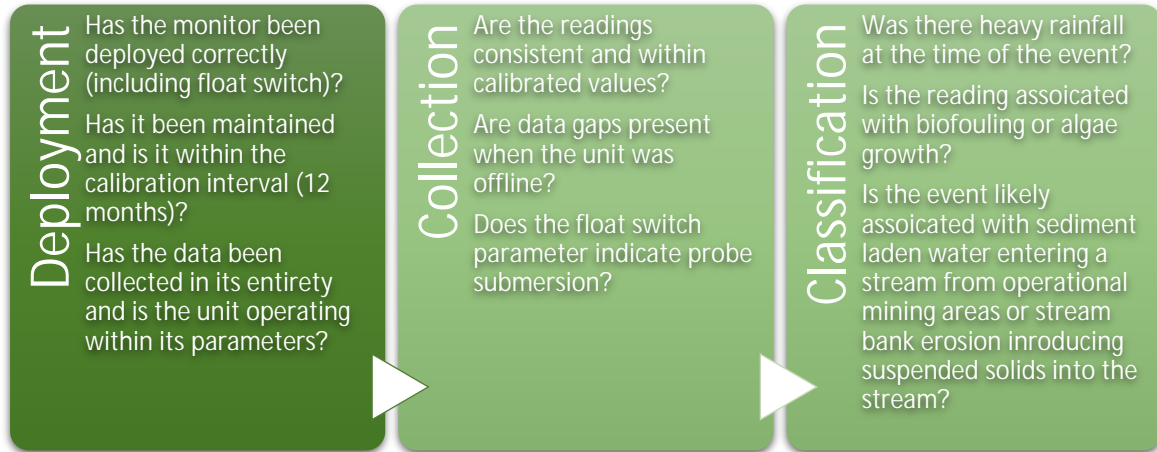


Figure 1: Data Review & Event Classification Process

The process considers the physical aspects of the WQMS deployment, the data collection by that monitor and finally classification of the events identified in that data. Classification of events is per Alcoa’s procedure to identify events as true or false.

A ‘true’ stream turbidity exceedance event that is caused by an actual increase in stream water turbidity. Alcoa has identified that ‘true’ turbidity exceedance events typically show a sharp turbidity incline before gradually trailing off as the stream turbidity level returns to background.



Figure 2: Typical ‘true’ exceedance event showing the sharp incline and gradually return to background levels.

‘False’ stream turbidity exceedance events are caused by factors other than an actual increase in stream water turbidity (i.e. organic debris covering the monitor such as sticks/leaves/algae, stream water turbulence or air bubbles and fluctuating water levels that intermittently cover the monitor lens and then recede). Alcoa has identified that ‘false’ turbidity exceedance events typically illustrate sharp inclines and declines for turbidity when the data is graphed over time and lack the distinctive ‘bell curve’ shape that is associated with ‘true’ turbidity exceedance events.

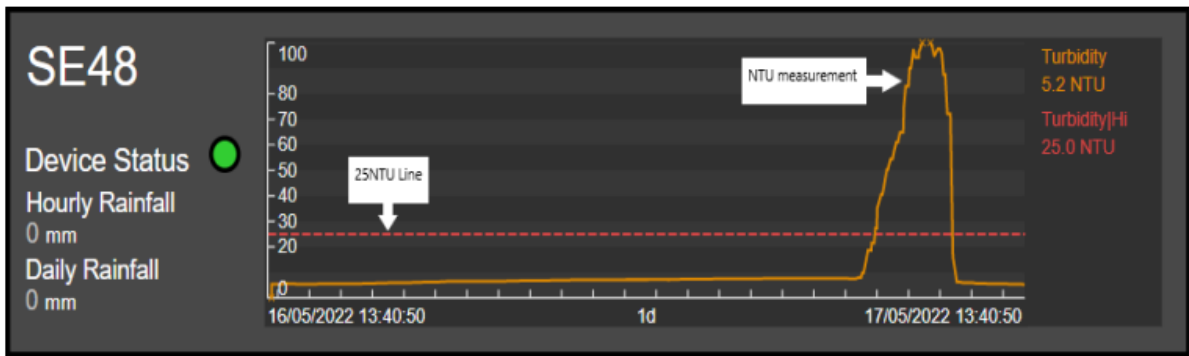


Figure 3: Typical ‘false’ exceedance event showing both a sharp incline and decline.

Any ‘true’ events identified in this report have been listed in Section 3.

2. WQMS Data Review

For the reporting period of September 2024, 276,173 data points were collected by 41 (forty-one) WQMSs across the Huntly site. From this data a total of 165 (one hundred and sixty-five) events were flagged where turbidity levels above 25 NTU were held for an hour or more. The following sections review this data, beginning with the deployment and operation of the WQMSs.

2.1. Deployment & Collection

From the data provided there were several units producing erroneous results, marked by spikes and/or non-sensical peaks.

RARE have identified WQMSs in Table 1 that require review in regards erroneous data. SciDev confirmed that the data generated by these units is invalid and has therefore been excluded from further analysis.

An additional 8 (eight) monitors have been included in September. Monitor SE03INV2 was installed on 17/09/2024, SE03INV1 and SE03INV2 was installed on 19/09/2024 as temporary investigation monitors due to a faulty sensor on SE03T. Monitors SE22T, SE23T, SE24T, SE25T, SE26T were included for contingency mining area base line data.

Monitor ND04T is not included under Section 6.

Excluding the data from these units leaves 24 (twenty-four) potential turbidity events during the reporting period across 14 (fourteen) units as discussed in the following section.

Table 1: WQMS Requiring Review

Unit	Dates	SciDev Comment
DB02T	September 16 th to 17 th (2 events)	Data trend indicates false event, gradual incline and sharp decline. Site inspected on 18/09/2024, stream clear and flowing, water level starting to drop. Sensor slightly impacted by algae, turbidity reading on arrival 2.7NTU which dropped to 1.3NTU after lens cleaning. Sensor is heavily impacted by vegetation growing on the stream bank. Event likely caused by debris caught around the sensor.
SE01T	September 1 st (2 events)	Manual data download due to turbidity exceedance event. Site was inspected on 15/09/2024 and cleaned sensor. Sensor sitting at the bottom of stream bed, impacted by debris. Installed sensor back in stream, forest track eroded and water upwelling from track into the creek line. Stream is flowing and clear, this is a FALSE event and could be a trigger from debris. No rainfall recorded and on evidence of mining activity found. Monitor was reading False NTU of -1636363200.000 on departure.
SE02T	September 4 th to 28 th (16 events)	Sensor is reading high, incorrect values. This issue was previously repaired on 4/07/2024 however sensor again reading high values from 4/09/2024 to 1/10/2024. Site was inspected regularly during this period, stream clear and no visible mining sediment within the stream bed. Sensor has been calibrated and values will be monitored.
SE03INV3	September 20 th to October 1 st (2 events)	Site inspected on 22/09/2024, stream clear and sensor clean. Sensor is reading incorrectly, maintenance contractor to attend.
SE03T	September 11 th	Field visit on the 14/09/2024 indicated stream level had dropped, and the stream bed and sensor was impacted by Algae build up. Issue with remote comms to monitor. No rainfall event had occurred to trigger field inspection/download prior.
SE06T	September 25 th to 26 th (2 events)	Inspection on 26/09/2024 found the stream shallow and the sensor face impacted by stream sediment and debris. On arrival the NTU was 396.26. Post clean of sensor and returning to the stream the NTU reduced to 0.5660 indicating false event due to sediment and organic debris impacting sensor data.

SE11T	September 23 rd to 26 th (4 events)	Site inspected on 26/09/2024. Stream level drop, sensor out of water
SE15T	August 28 th to September 11 th (2 events)	Sensor is impacted by debris and cannot be accessed due to deep stream channel. Additional sensor has been installed
SE15T	September 18 th (3 events)	Site inspected on 18/09/2024, sensor impacted by debris
SE15T	September 20 th to 22 nd (7 events)	Site inspected on the 27/09/2024 and manually downloaded data. Stream is clear and flowing, sensor impacted by stream bed and debris. Stream water level dropped thereby impacting sensor and possibly triggering a FALSE turbidity event. Cleaned sensor and installed back into stream.
SE34T	September 18 th to 20 th (2 events)	Stream level drop, sensor out of water
SE48T	September 17 th	Site inspected on 18/09/2024. Stream level drop, sensor out of water.
SE51T	September 11 th to 30 th (89 events)	Manual data download. This monitor has a fault and SciDev will attend site to inspect the monitor and fix the ongoing issue. Stream is clear and flowing. NTU reading 883.95 post clean. Probe fault, lens auto-wipe malfunction. Wiper rotating and stopping on the lens.
SE61T	September 1 st to 5 th (5 events)	Data trend indicates a False event with no rainfall recorded. Stream is clear and flowing but sensor sitting above stream, could trigger NTU exceedance. Very heavy build-up of algae present on sensor. Cleaned sensor but couldn't get the red concentrate off the sensor. This maybe as a result of high iron (Fe) concentrate in stream, reacting with air molecules.
SE61T	September 11 th to 12 th	Manual data download due to NTU exceedance on Pi vision on the 12/09/2024. Stream is flowing and clear, NTU reading 281.20 on arrival. Sensor sitting above stream water level, with water flow pressure can trigger NTU level. Sensor is heavily discoloured due to high Iron (FE)concentrate in water reacting with air. Cleaned sensor and installed back in stream. NTU reading dropped to 7.046 post clean.
SE61T	September 24 th to 25 th	Site inspected on 25/09/2024, sensor sitting in the stream bed. Sensor is heavily stained, and lens cannot be cleaned. Scheduled for replacement.
SN07T	September 2 nd	Data trend suggests false data outside of rainfall. Sensor had fallen out of flow cell into sediment - field inspection on the 02/09/2024.

2.2. Classification

Analysing the data collected outside of the above periods leaves 24 (twenty-four) potential turbidity events during the reporting period across 14 (fourteen) units as summarised in Table 2. For this reporting period there were 3 (three) ‘true’ turbidity events identified. Refer to the following section for analysis.

Table 2: Turbidity events summary

Date	Huntley WQMS Data -September2024 - Events with turbidity > 25 NTU for an hour or more																					
	DB01T	DB02T	FPWR1	ND06T	ND07T	ND12T	ND13T	ND14T	PD01T	SE01T	SE02T	SE03IN V1	SE03IN V2	SE03IN V3	SE03T	SE05T	SE06T	SE07T	SE08T	SE09T	SE10T	
1/09/2024																						
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27/09/2024				1																		
28/09/2024																						
29/09/2024																						
30/09/2024																						

Note: Grey cells indicate data has been excluded. False events have been annotated by black bold text. True events for further investigation are annotated by red bold text. See following section for analysis.

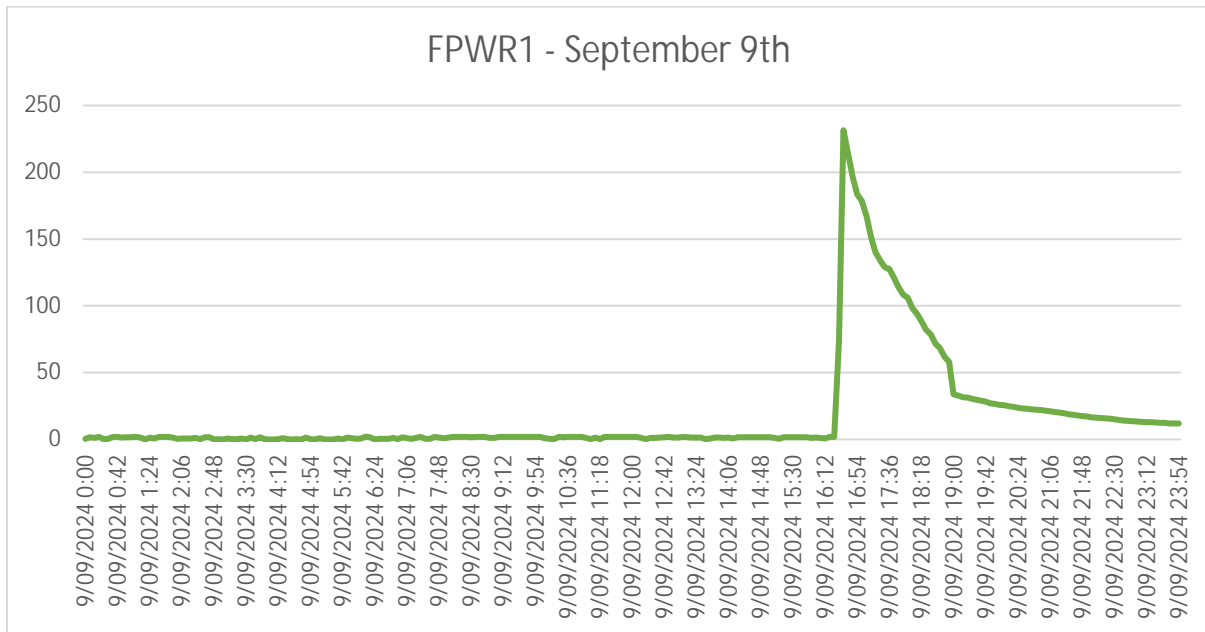
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Date	Huntly WQMS Data – September 2024 - Events with turbidity > 25 NTU for an hour or more																			
	SE11T	SE12INV	SE12T	SE15T	SE22T	SE23T	SE24T	SE25T	SE26T	SE34T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE60T	SE61T	SE62T	SN07T
1/09/2024		1																		
2/09/2024		1																		
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30/09/2024																				

Note: Grey cells indicate data has been excluded. False events have been annotated by black bold text. True events for further investigation are annotated by red bold text. See following section for analysis.

2.2.1. FPWR1 Potential Turbidity Events

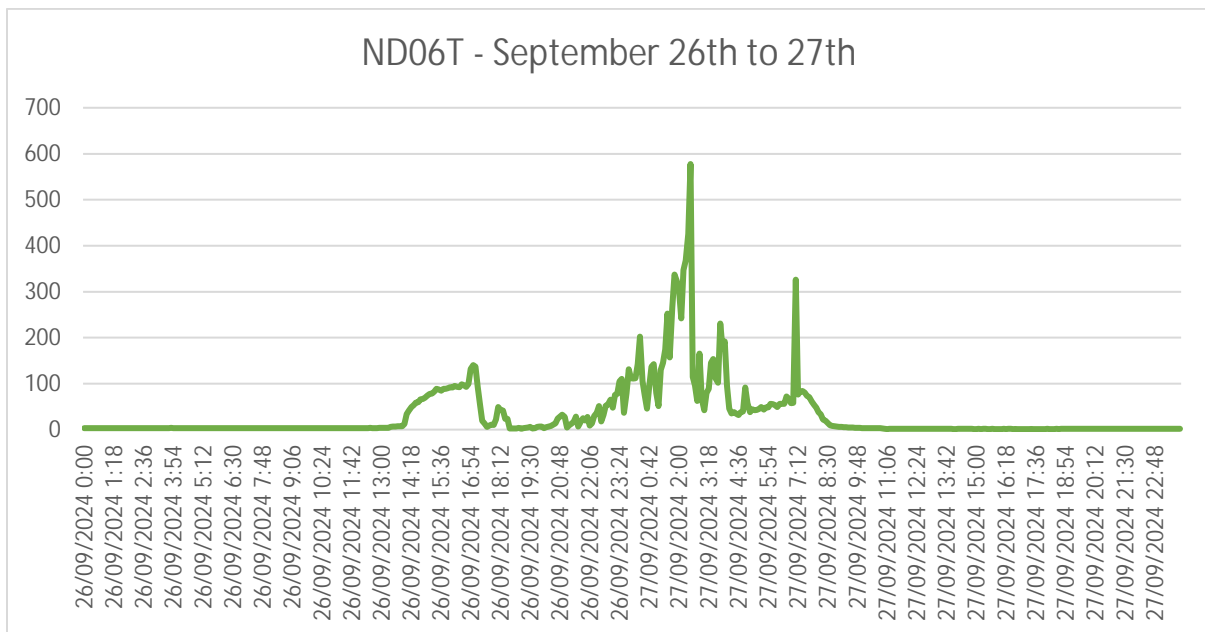
Chart(s) for data flagged at monitor FPWR1 are shown below for the potential events identified in the reporting period.



This event is marked by a sharp incline and gradual return to background levels indicative of a ‘true’ event, flagged for further investigation.

2.2.2. ND06T Potential Turbidity Events

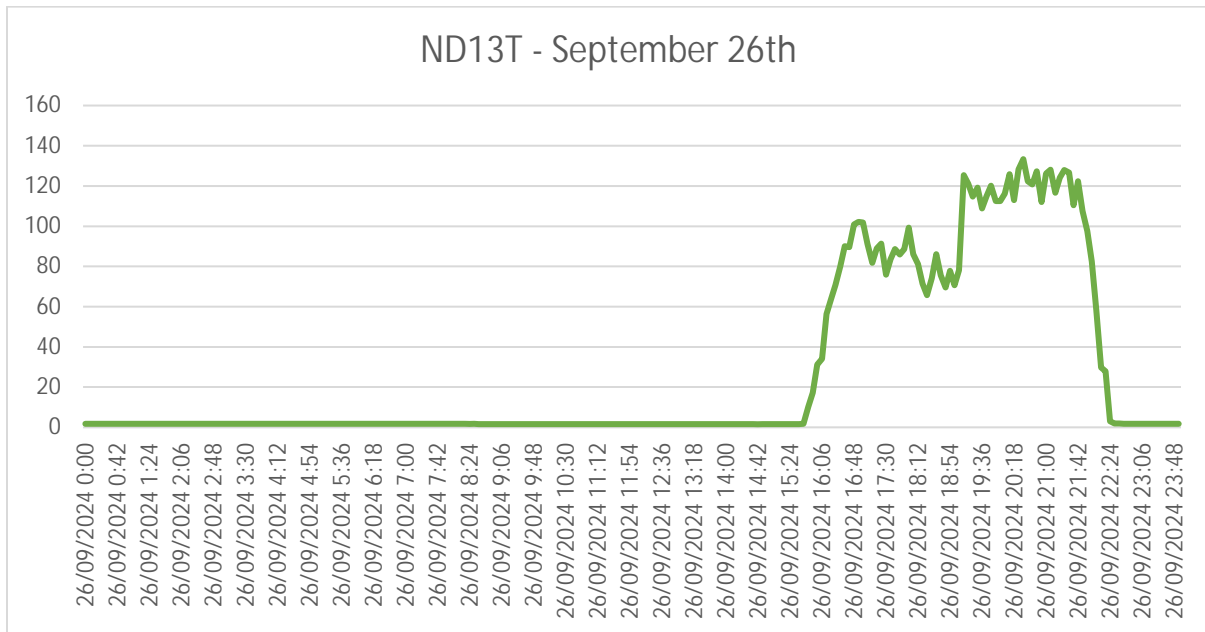
Chart(s) for data flagged at monitor ND06T are shown below for the potential events identified in the reporting period.



These events are marked by sporadic peaks, indicative of a ‘false’ event.

2.2.3. ND13T Potential Turbidity Events

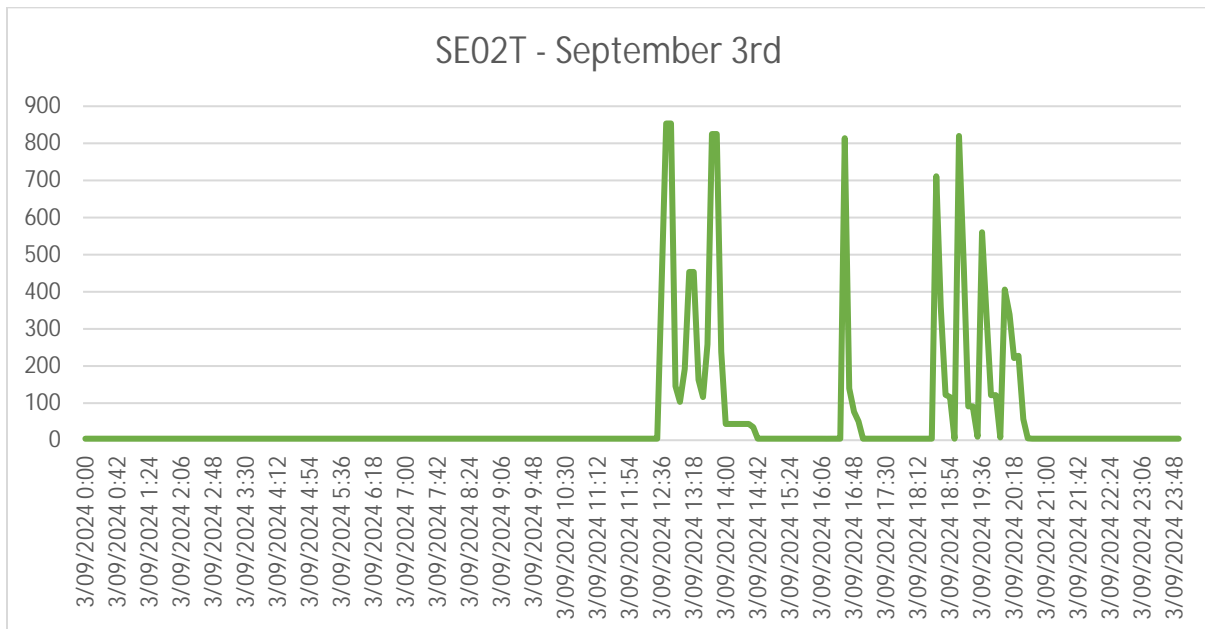
Chart(s) for data flagged at monitor ND13T are shown below for the potential events identified in the reporting period.



This event is marked by a sharp incline and decline, indicative of a 'false' event.

2.2.4. SE02T Potential Turbidity Events

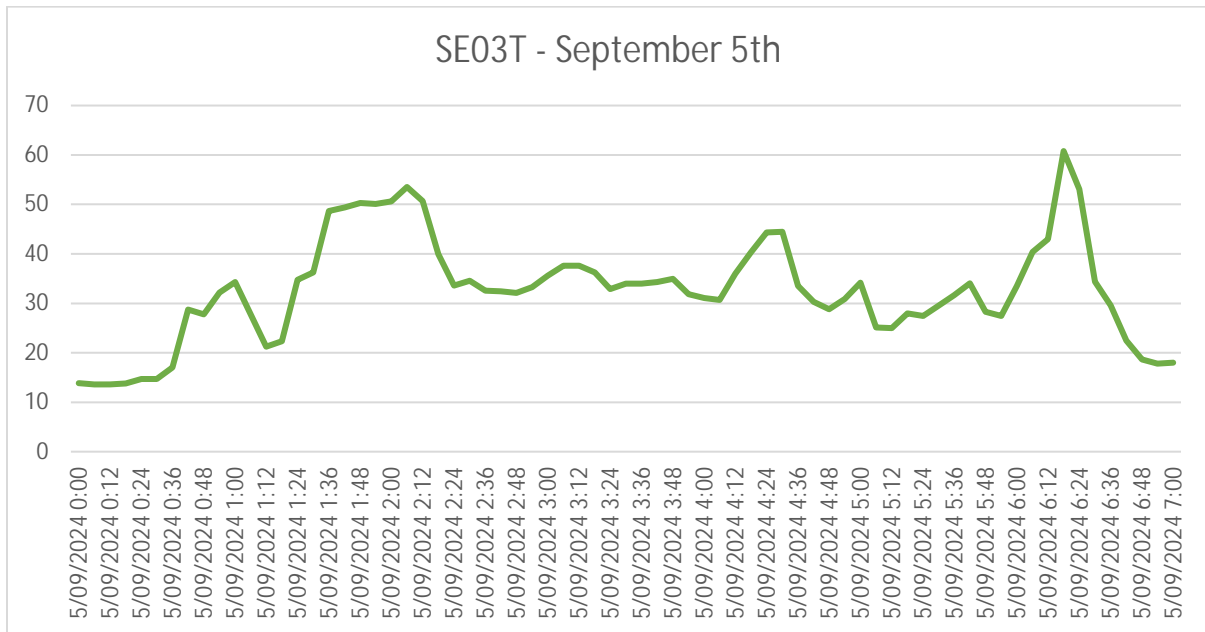
Chart(s) for data flagged at monitor SE02T are shown below for the potential events identified in the reporting period.



This event is marked by sporadic peaks, indicative of a 'false' event.

2.2.5. SE03T Potential Turbidity Events

Chart(s) for data flagged at monitor SE03T are shown below for the potential events identified in the reporting period.



This even has been marked as true events as per Alcoa investigation.

2.2.6. SE09T Potential Turbidity Events

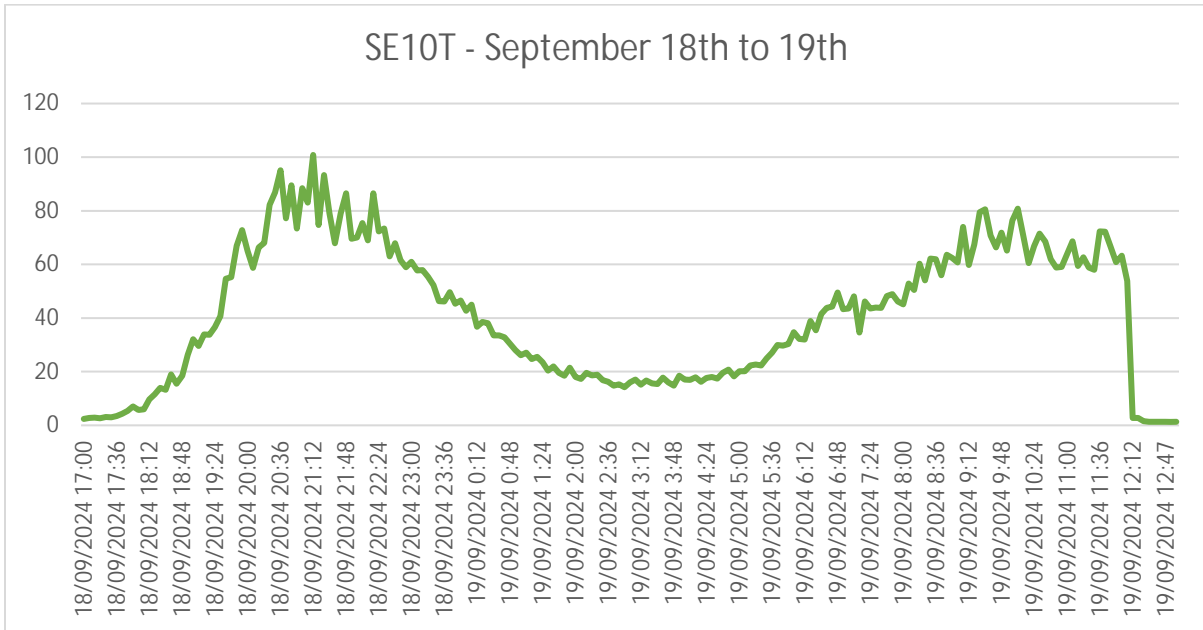
Chart(s) for data flagged at monitor SE09T are shown below for the potential events identified in the reporting period.



These events are marked by sporadic peaks, indicative of a 'false' event.

2.2.7. SE10T Potential Turbidity Events

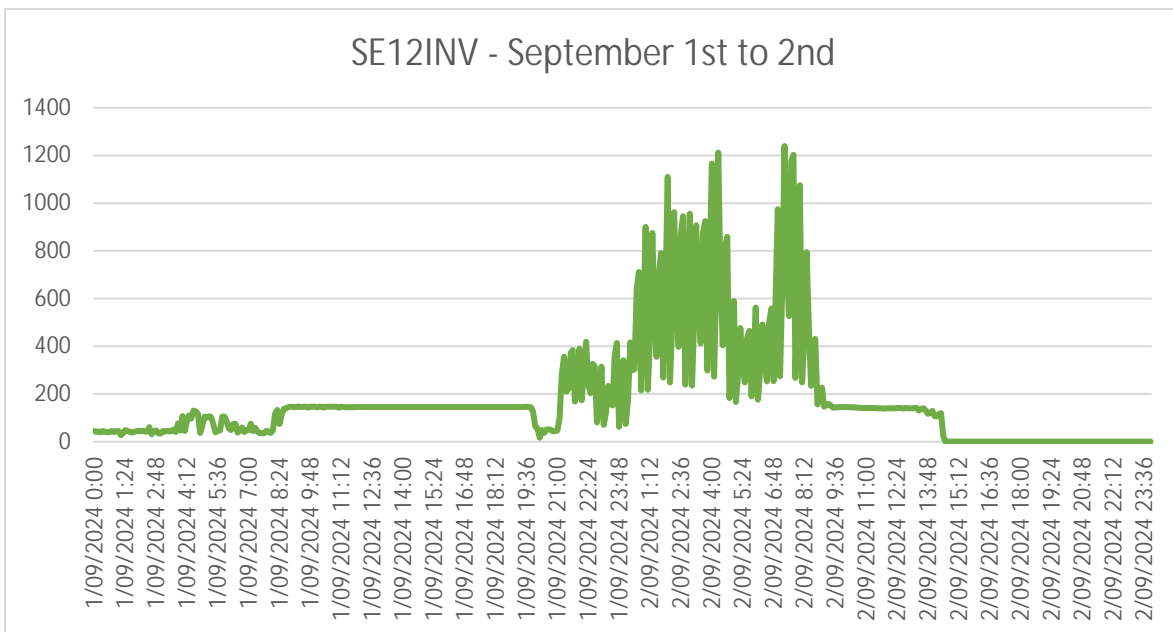
Chart(s) for data flagged at monitor SE10T are shown below for the potential events identified in the reporting period.



This event is marked by a sharp decline, indicative of a ‘false’ event

2.2.8. SE12INV Potential Turbidity Events

Chart(s) for data flagged at monitor SE12INV are shown below for the potential events identified in the reporting period.



These events are marked by sporadic peaks, indicative of a ‘false’ event.

2.2.9. SE12T Potential Turbidity Events

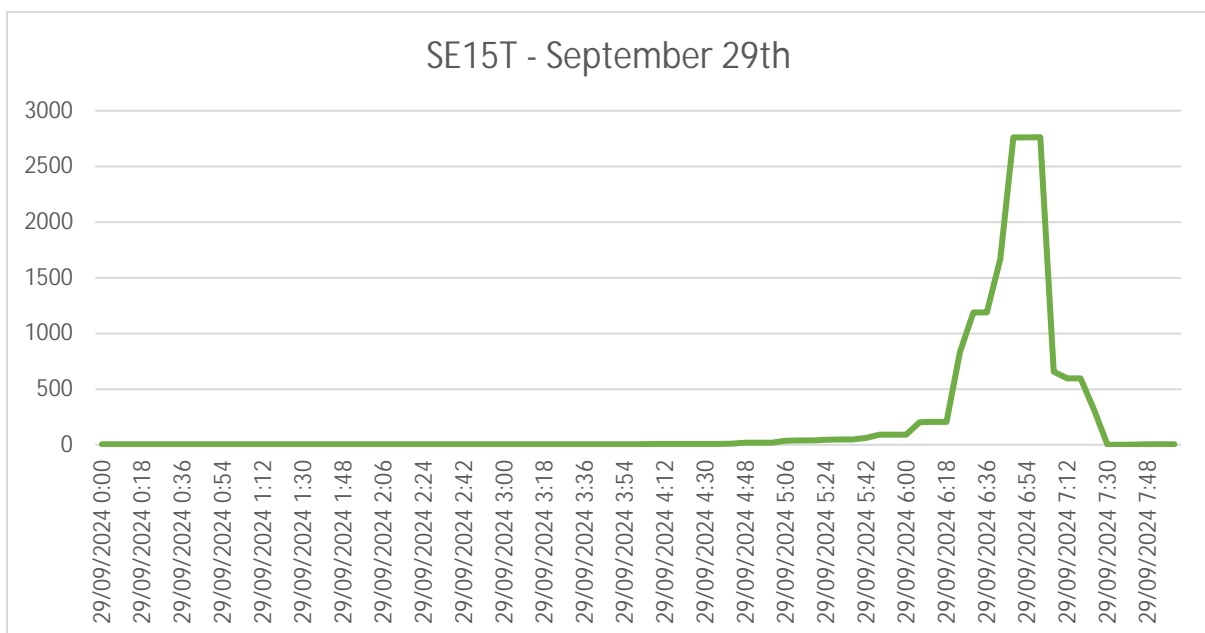
Chart(s) for data flagged at monitor SE12T are shown below for the potential events identified in the reporting period.



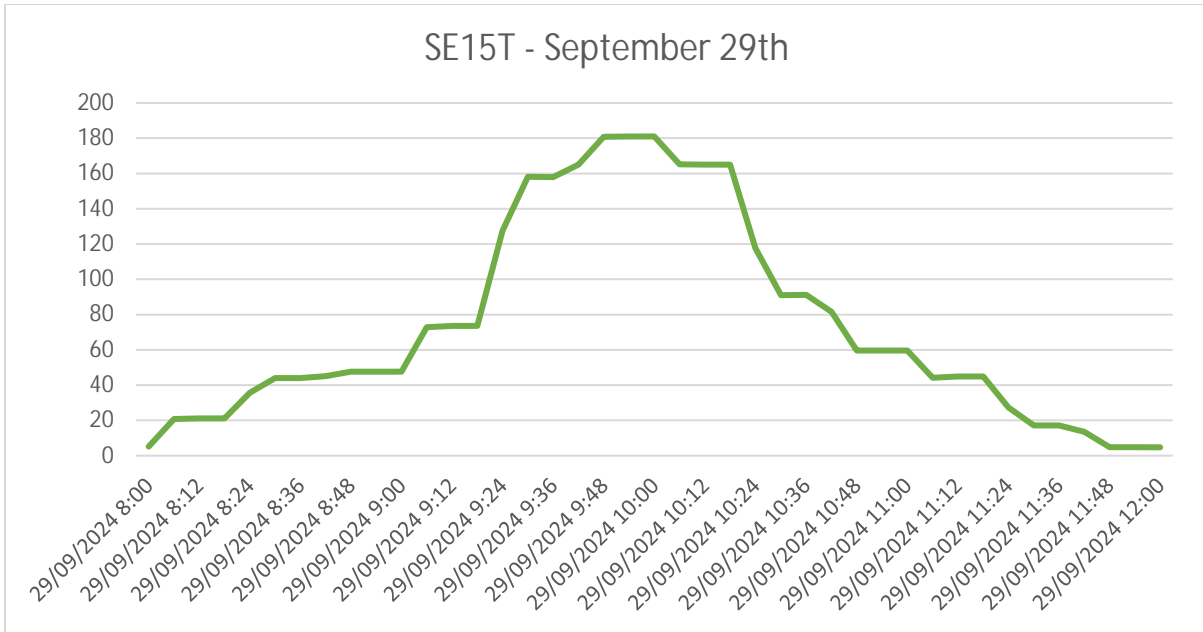
This event is marked by a sharp incline and decline, indicative of a 'false' event.

2.2.10. SE15T Potential Turbidity Events

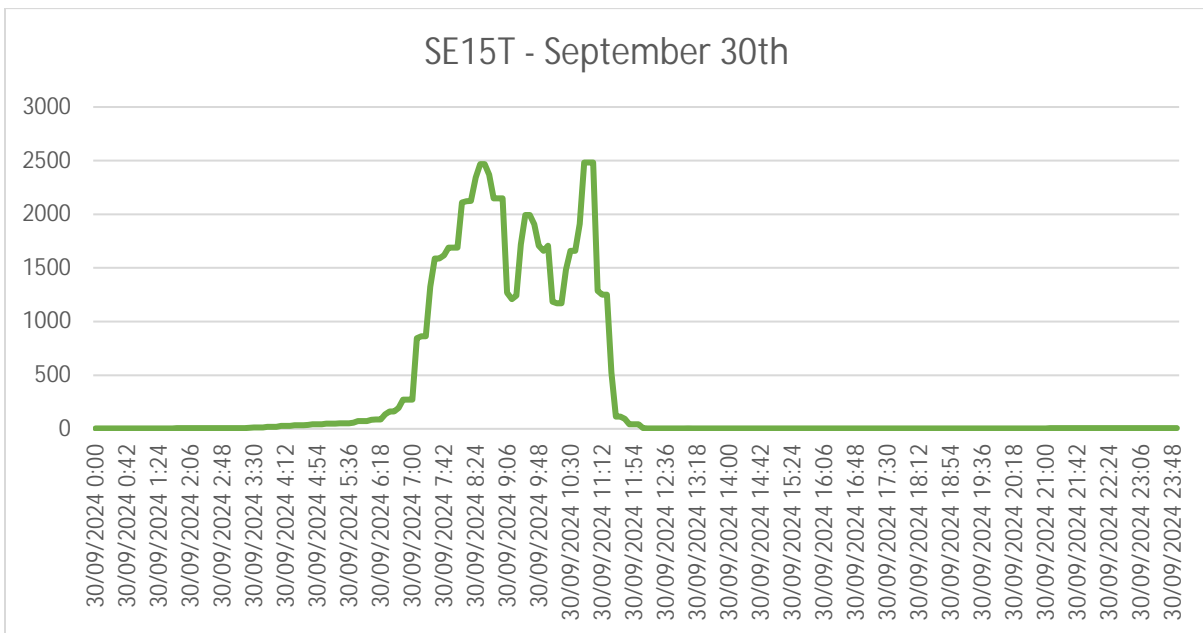
Chart(s) for data flagged at monitor SE15T are shown below for the potential events identified in the reporting period.



This event is marked by a sharp incline and decline, indicative of a 'false' event.



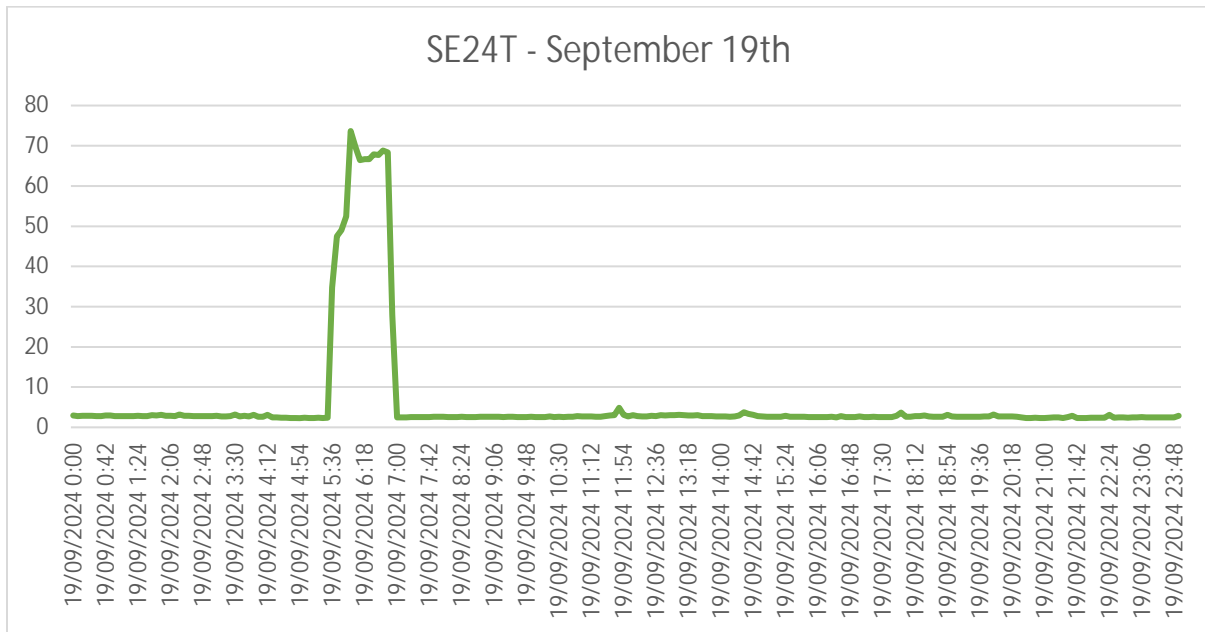
This event is marked by a rapid increase and decrease, indicative of a 'false' event.



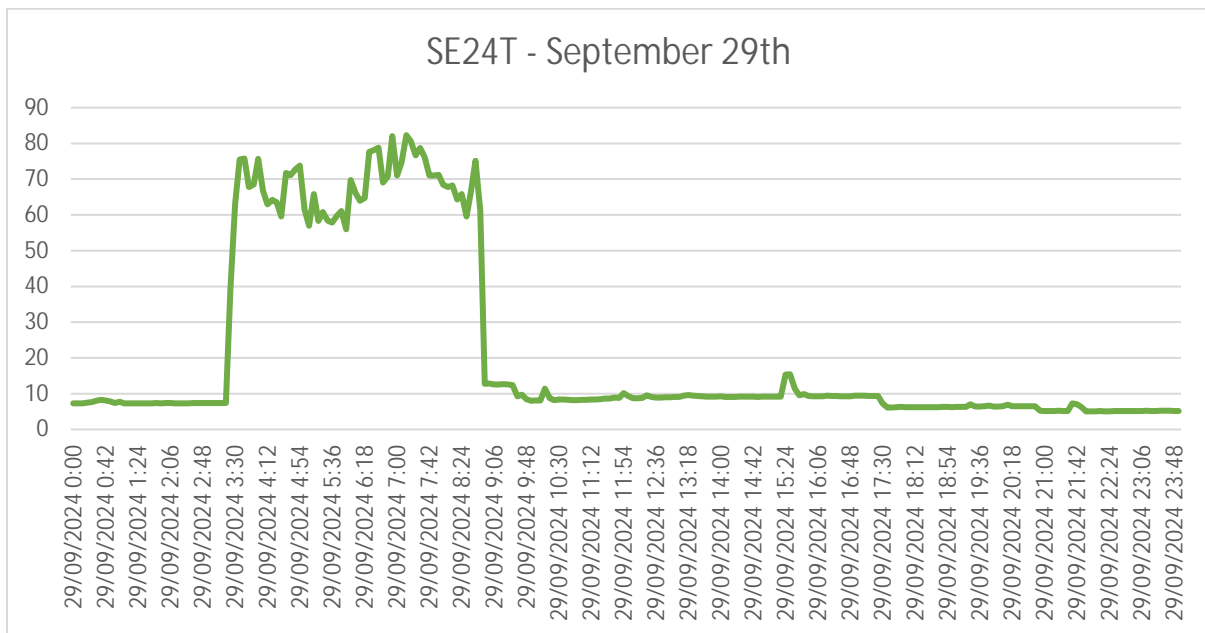
This event is marked by a sharp incline and decline, indicative of a 'false' event.

2.2.11. SE24T Potential Turbidity Events

Chart(s) for data flagged at monitor SE24T are shown below for the potential events identified in the reporting period.



This event is marked by a sharp incline and decline, indicative of a 'false' event.



This event is marked by a sharp incline and decline, indicative of a 'false' event.

2.2.12. SE26T Potential Turbidity Events

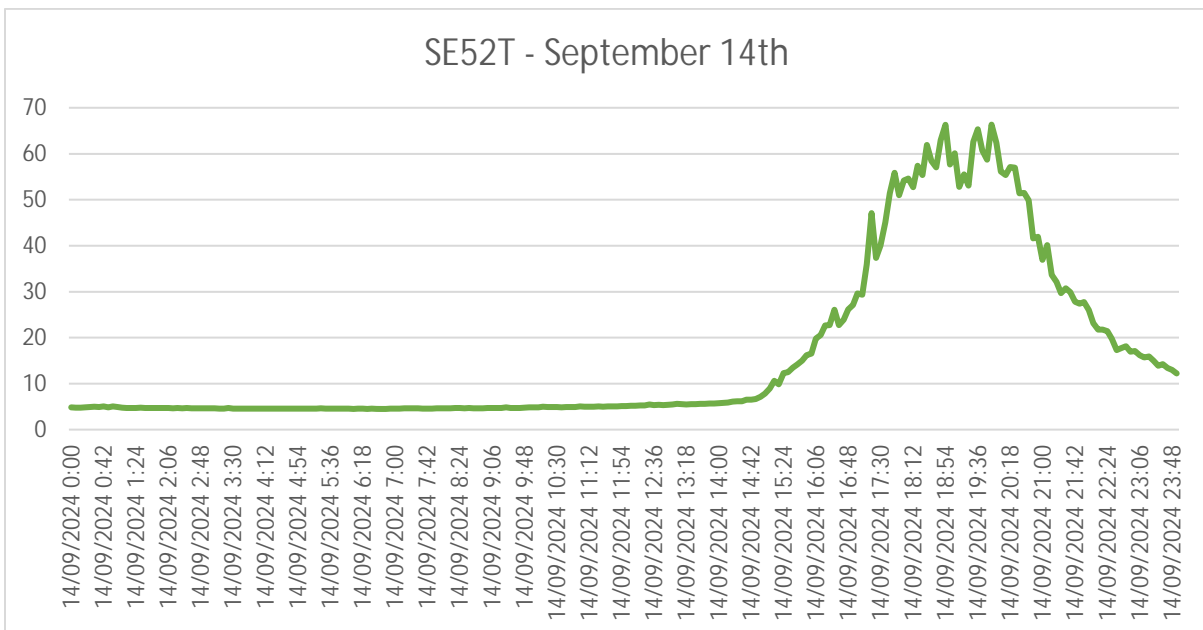
Chart(s) for data flagged at monitor SE26T are shown below for the potential events identified in the reporting period.



These events are marked by sporadic peaks, indicative of a 'false' event.

2.2.13. SE52T Potential Turbidity Events

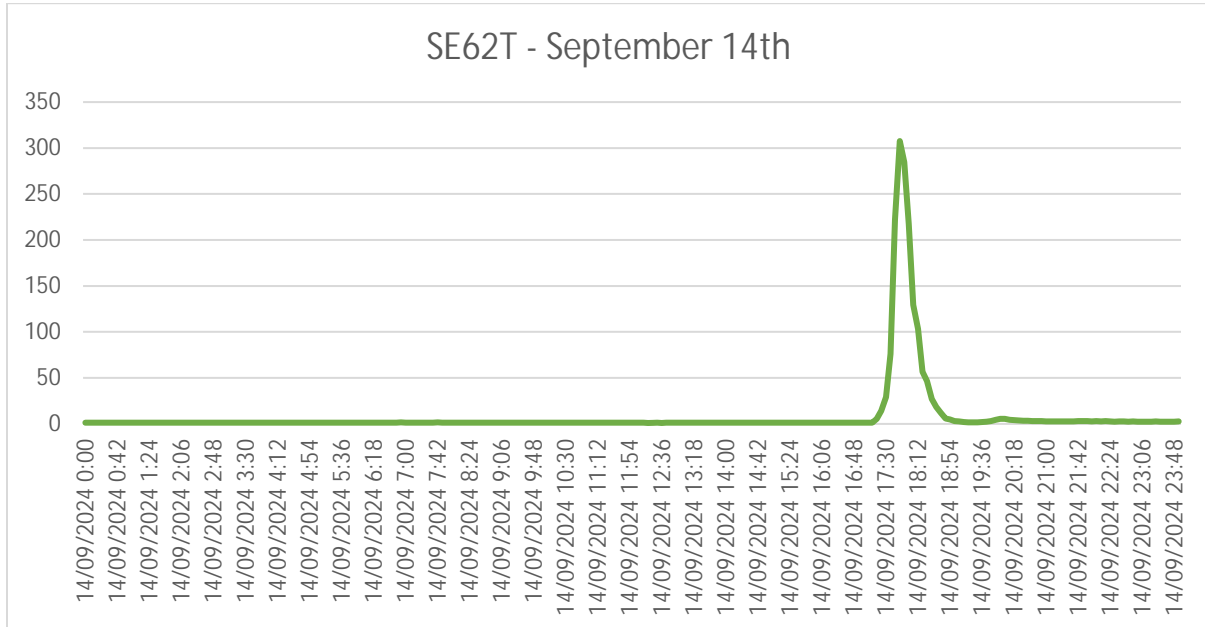
Chart(s) for data flagged at monitor SE52T are shown below for the potential events identified in the reporting period.



These events are marked by gradual inclines and gradual return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.14. SE62T Potential Turbidity Events

Chart(s) for data flagged at monitor SE62T are shown below for the potential events identified in the reporting period.



This event is marked by a sharp incline and decline, indicative of a ‘false’ event.

2.3. True Turbidity Events

For this reporting period, 3 (three) potential drainage or ‘true’ incidents were identified for further investigation.

Table 3: True Turbidity Events

Event ID	Monitor	Date(s)	Start Time	End Time	Duration	Peak Turbidity (NTU)
HUN-2409-001	FPWR1	09/09/2024	4:30:00 PM	8:06:00 PM	3hrs 36min	231.51
HUN-2409-002	SE03T	05/09/2024	1:24:00 AM	6:36:00 AM	5hrs 16min	60.79
HUN-2409-003	SE52T	14/09/2024	16:48:00 PM	22:00:00 PM	5hrs 12min	66.33

2.4. Investigation Outcomes

SciDev provided the following in regards to the identified ‘true’ events.

Table 4: Investigation Outcomes

Event ID	Event Classification	Alcoa Investigation
HUN-2409-001	-	<i>Data trend indicates false event, turbidity values spike from 1.8NTU to 73.9NTU within 6 minutes, followed by a gradual decline.</i>
HUN-2409-002	Non-Mining Related	<i>Catchment inspection commenced on 5/09/2024. During the initial assessment, Alcoa identified that surface water had flowed approximately 6 metres from the Downes 12 rehabilitation area and into the adjacent forest. Whilst this resulted in minor sediment deposition within the immediate vicinity, the observed area of impact is approximately 60 metre upslope of the nearest stream, and did not intersect any stream or stream zone vegetation. Further investigation of the catchment identified erosion from two forest tracks, located approximately 1.8km and 2km upstream of SE03 turbidity monitor. Additionally, surface erosion of the Blacklock Haul Road embankment was observed adjacent to the haul road stream crossing. All three sources have potentially contributed to the SE03 turbidity monitor exceedance. Alcoa has deployed three temporary turbidity monitors into the SE03 catchment, to inform further investigation into the sources of stream turbidity.</i>
HUN-2409-003	-	<i>Manual data download. Stream is clear and flowing. Cleaned sensor and installed back in stream. Stream water level is low and sensor sitting at the top of stream. No evidence of mining activity found, this is a false turbidity event. We haven't had any rain event and no further action required for this investigation.</i>

3. Recommendations

3.1. WQMS Network

RARE recommends:

- WQMSs include a flow switch or similar mechanism to detect when the stream is dry if they haven't been fitted with one.
- Perform routine maintenance on all units to ensure their correct operation.
- Continue monitoring Biochemical Oxygen Demand levels at SE61T.

4. Raw WQMS Data

Date	Huntley WQMS Data – September 2024 - Events with turbidity > 25 NTU for an hour or more																				
	DB01T	DB02T	FPWR1	ND06T	ND07T	ND12T	ND13T	ND14T	PD01T	SE01T	SE02T	SE03IN V1	SE03IN V2	SE03IN V3	SE03T	SE05T	SE06T	SE07T	SE08T	SE09T	SE10T
1/09/2024										2											
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16/09/2024		1									1										
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19/09/2024											2										2
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27/09/2024				1							2										
28/09/2024											2										
29/09/2024																					
30/09/2024														1							

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

Huntly Bauxite Mine – Water Quality Monitoring System Data Review

Date	Huntley WQMS Data -September 2024 - Events with turbidity > 25 NTU for an hour or more																				
	SE11T	SE12IN V	SE12T	SE15T	SE22T	SE23T	SE24T	SE25T	SE26T	SE34T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE60T	SE61T	SE62T	SN07T	
1/09/2024		1																		3	
2/09/2024		1																		1	1
3/09/2024																					
4/09/2024																					
5/09/2024																				1	
6/09/2024																					
7/09/2024																					
8/09/2024																					
9/09/2024				1																	
10/09/2024				1																	
11/09/2024				1																	
12/09/2024																				1	
13/09/2024																					
14/09/2024														1						1	
15/09/2024																					
16/09/2024									3				2								
17/09/2024												1	6								
18/09/2024			1	3									4								
19/09/2024							1			1			3								
20/09/2024				2						1			8								
21/09/2024				3									4								
22/09/2024				2									3								
23/09/2024													9								
24/09/2024	2												7								
25/09/2024	1												3							1	
26/09/2024	1												5								
27/09/2024													5								
28/09/2024													6								
29/09/2024				2			1						11								
30/09/2024				1									13								

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

Huntly Bauxite Mine – Water Quality Monitoring System Data Review

Date	Huntley WQMS Data – September 2024 - Events with turbidity > 25 NTU for an hour or more																				
	DB01T	DB02T	FPWR1	ND06T	ND07T	ND12T	ND13T	ND14T	PD01T	SE01T	SE02T	SE03IN V1	SE03IN V2	SE03IN V3	SE03T	SE05T	SE06T	SE07T	SE08T	SE09T	SE10T
1/09/2024	0.9	1.4	1.4	1.0	0.9	2.7	1.1	0.8	5.2	56.6	4.3				5.6	3.9	0.8	1.9	1.1	1.0	1.3
2/09/2024	0.9	1.4	1.4	1.0	0.9	2.2	1.5	0.8	5.2	23.1	14.5				5.4	3.7	1.3	2.0	1.2	1.0	1.3
3/09/2024	0.9	1.4	2.1	1.1	1.0	2.2	1.8	0.8	5.2	3.7	55.4				5.5	3.7	0.9	1.9	1.1	1.0	1.4
4/09/2024	0.9	1.8	1.3	1.3	1.1	2.4	1.7	1.1	7.1	2.0	34.7				13.3	7.5	1.9	1.9	1.1	1.0	1.5
5/09/2024	1.6	2.0	0.8	1.4	1.2	2.7	1.5	1.0	7.4	1.3	38.1				17.6	5.8	2.4	1.9	1.2	1.3	1.8
6/09/2024	1.0	1.4	1.2	0.9	1.0	2.5	1.2	0.8	5.3	1.0	32.2				7.0	4.2	1.0	1.9	2.3	1.0	1.5
7/09/2024	0.9	1.4	1.3	0.8	1.0	2.9	1.3	0.8	5.6	0.8	27.2				5.0	4.2	0.9	1.9	1.1	1.0	1.4
8/09/2024	0.9	1.6	1.0	0.8	1.3	2.4	1.3	0.8	5.3	0.7	24.9				4.2	4.7	1.0	1.9	22.3	1.0	1.4
9/09/2024	0.9	1.4	17.6	0.8	1.0	2.3	2.3	0.8	5.4	0.7	24.2				4.2	5.5	1.1	1.9	1.1	1.0	1.4
10/09/2024	0.9	1.4	4.4	0.8	1.0	2.3	1.4	0.8	5.8	0.6	23.6				5.1	6.0	1.2	1.9	1.1	1.0	1.4
11/09/2024	0.9	1.4	2.8	0.8	1.0	2.2	1.7	0.8	6.0	0.6	22.7				10.0	6.6	1.4	117.1	1.1	21.9	1.4
12/09/2024	0.9	1.4	2.9	0.9	1.0	2.3	1.6	0.8	5.8	0.5	17.7				5.2	7.3	1.3	322.0	1.1	22.9	1.4
13/09/2024	0.9	1.4	2.8	0.9	1.1	2.6	1.6	0.8	5.8	1.1	21.8				4.1	7.3	2.2	404.9	1.1	2.0	1.4
14/09/2024	0.9	1.5	2.7	1.0	1.1	2.3	1.7	0.9	5.9	0.9	29.3				5.0	7.6	1.5	318.1	1.0	3.5	1.4
15/09/2024	0.9	2.7	3.0	1.0	1.1	2.4	1.7	0.9	6.3	9.7	27.2				3.4	7.9	1.0	363.8	1.0	5.4	1.5
16/09/2024	0.9	16.3	3.0	1.1	1.2	2.3	1.7	1.0	6.1		28.7				3.3	7.4	1.1	320.9	1.1	5.1	1.6
17/09/2024	1.0	12.2	2.3	1.2	1.4	2.3	2.8	0.9			24.8		2.7		3.3	7.6	1.2	284.1	1.6	3.0	1.7
18/09/2024	0.9	3.4	1.1	1.4	0.9	2.3	1.7	1.0			24.9				3.3	8.3	1.9	410.2	1.6	2.9	18.2
19/09/2024	0.9	1.4	1.1	1.4	1.0	2.4	1.7	1.1			24.4	2.2	2.9	0.0	3.4	7.1	5.1	382.6	1.2	2.1	37.9
20/09/2024	1.0	1.4	0.3	1.4	2.0	2.5	1.7	1.0			23.8	2.2	3.0	1.6	3.1	4.3	11.7	450.1	3.4	1.5	10.9
21/09/2024	1.0	3.8	0.1	1.6	5.0	2.3	1.8	1.0			22.9	2.2	3.1	65.3	2.9	4.4	17.7	397.3	1.6	1.0	2.9
22/09/2024	1.0	1.4	0.8	1.7	6.6	2.3	2.3	1.1			22.7	2.1	3.0	271.0	2.9	4.4	8.7	350.5	2.3	1.0	1.3
23/09/2024	1.0	21.4	0.7	1.8	7.4	2.3	1.7	1.0			23.5	2.1	2.9	264.7	3.0	4.6	6.5	358.2	1.1	1.0	1.3
24/09/2024	1.0	1.4	0.5	2.0	3.4	2.2	1.7	1.1			23.9	2.1	2.9	233.1	3.2	5.1	9.2	259.9	1.1	1.0	1.3
25/09/2024	1.2	1.4	0.1	2.8	2.3	2.3	1.7	1.5			49.7	28.3	3.1	232.9	3.1	5.1	73.2	245.2	1.1	1.0	1.3
26/09/2024	7.8	1.4	0.2	19.3	1.4	2.2	26.6	1.2			24.5	2.0	2.9	222.4	3.1	5.1	197.1	219.3	1.0	1.1	1.3
27/09/2024	1.9	1.5	0.7	43.8	0.8	1.9	1.4	1.5			26.9	2.4	3.2	250.0	4.0	6.2	1.0	430.9	29.3	1.0	1.3
28/09/2024	0.9	1.5	1.1	1.4	1.0	1.5	1.1	0.9			24.2	2.1	3.5	290.2	3.0	5.1	2.4	398.1	1.1	1.3	1.3
29/09/2024	0.9	1.7	1.1	1.4	0.9	1.5	1.1	0.9			9.2	2.1	3.5	238.1	2.9	6.8	1.4	358.9	1.1	1.0	1.4
30/09/2024	0.9	11.6	1.1	1.6	1.1	3.7	1.1	1.0			9.3	2.1	3.5	216.7	3.0	5.1	1.5	464.3	1.1	1.0	2.4

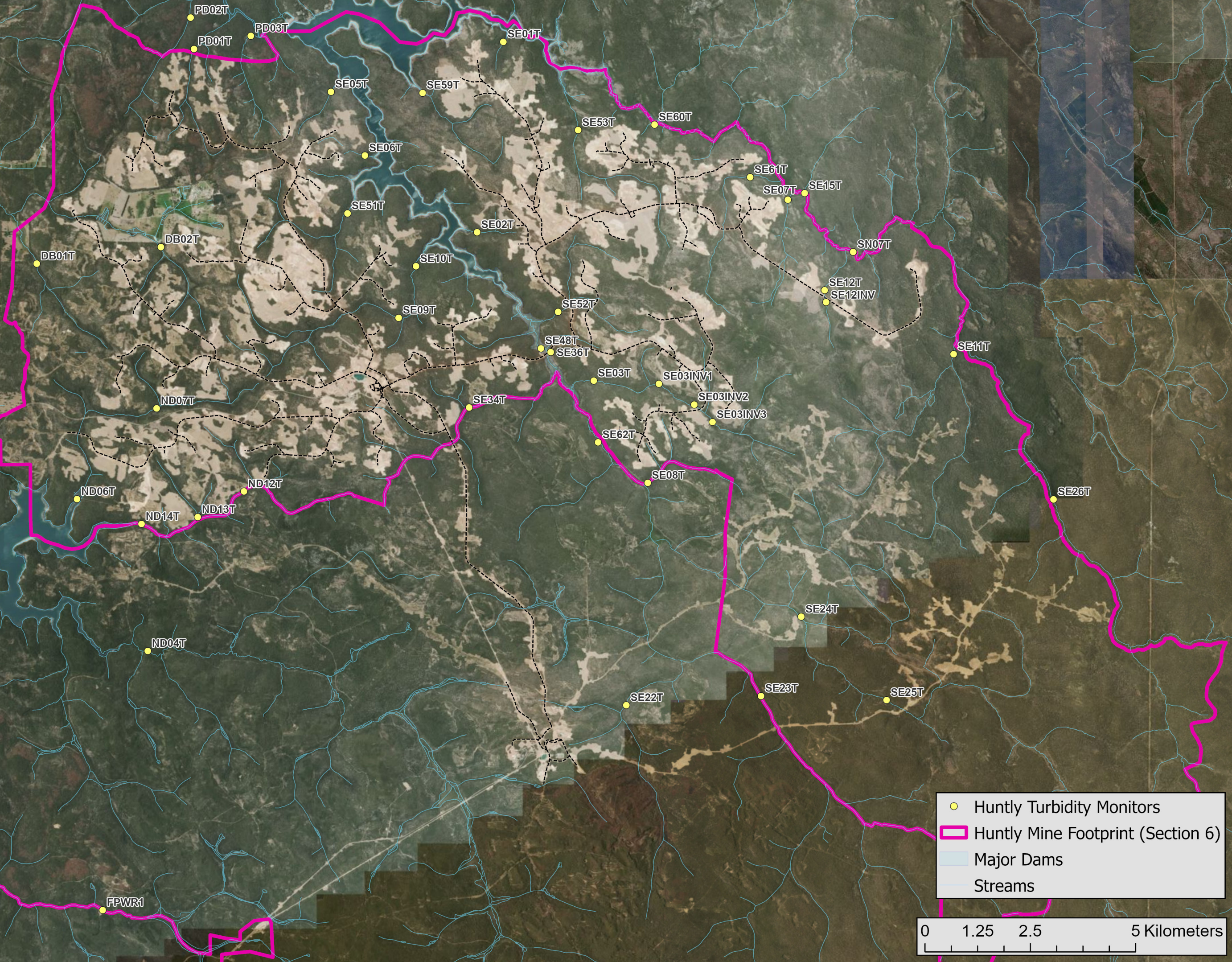
Note: Daily averages above 25 NTU have been annotated by black bold text. Daily averages inclusive of with true events for further investigation are annotated by red bold text. Grey shading indicates no data available for that day at that unit.

Huntly Bauxite Mine – Water Quality Monitoring System Data Review

Date	Huntley WQMS Data -September 2024 - Events with turbidity > 25 NTU for an hour or more																			
	SE11T	SE12IN V	SE12T	SE15T	SE22T	SE23T	SE24T	SE25T	SE26T	SE34T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE60T	SE61T	SE62T	SN07T
1/09/2024	0.4	121.6	4.5	81.7	0.8	2.2	2.3	2.5		1.0	6.5	2.7	56.7	2.6	1.1	4.4	1.2	37.2	1.3	16.2
2/09/2024	0.4	238.8	5.3	79.9	0.8	2.2	2.1	2.4		1.0	1.2	2.7	58.8	2.2	1.1	4.0	1.2	39.4	1.2	26.8
3/09/2024	0.4	0.3	7.7	88.2	0.8	2.2	4.4	2.2	2.8	1.0	4.5	3.0	120.5	1.7	1.2	4.2	1.1	10.0	1.2	2.1
4/09/2024	4.2	7.3	10.0	98.5	0.9	2.6	4.8	3.1	2.9	1.1	1.9	3.6	63.4	6.2	3.3	7.9	1.1	17.6	1.3	2.2
5/09/2024	3.0	4.8	9.9	132.2	0.8	2.9	2.4	3.9	3.7	1.2	2.8	3.6	70.4	9.3	5.0	9.0	2.5	57.1	1.7	3.2
6/09/2024	0.6	0.6	2.9	161.7	0.8	2.4	2.5	3.2	5.5	1.1	1.7	3.3	76.4	5.5	0.9	4.9	2.2	8.9	2.0	3.8
7/09/2024	0.1	0.7	3.1	201.6	0.8	2.0	2.3	2.9	5.2	1.2	5.1	3.0	112.5	4.9	0.4	4.5	2.3	7.3	1.7	4.1
8/09/2024	0.1	0.8	3.1	96.8	0.8	1.9	2.1	2.7	4.5	1.2	6.0	2.9	146.2	4.6	0.3	4.5	2.0	7.0	1.5	3.5
9/09/2024	0.2	0.8	3.1	42.9	0.9	1.8	2.0	2.3	4.2	1.3	5.6	2.8	131.3	3.7	0.2	4.5	28.5	7.7	1.4	3.0
10/09/2024	0.2	0.8	3.0	42.2	1.3	1.8	3.2	2.0	4.1	1.3	3.8	19.8	127.4	2.9	0.2	4.3	1.3	12.9	1.3	2.8
11/09/2024	0.2	0.7	3.1	24.2	2.1	1.9	2.2	2.2	3.7	1.4	1.2	2.7	314.9	2.6	0.3	4.4	1.6	40.5	1.2	2.7
12/09/2024	0.2	0.8	3.1	4.3	1.9	1.9	2.2	1.8	3.0	1.3	6.1	2.8	546.0	3.0	0.3	4.6	26.1	70.4	1.2	2.7
13/09/2024	0.2	0.5	3.3	4.3	1.7	1.9	2.2	1.6	2.8	1.5	1.1	2.9	611.6	3.4	0.4	4.9	1.2	7.3	1.3	2.7
14/09/2024	0.2	0.5	3.2	4.5	2.8	1.9	2.4	1.6	2.6	4.6	4.6	2.9	531.8	16.0	0.5	5.1	1.2	7.5	8.0	2.7
15/09/2024	0.2	0.6	3.1	4.6	1.2	1.9	3.1	2.6	2.6	1.4	1.2	2.9	574.4	3.4	0.5	5.3	1.2	9.0	1.6	2.7
16/09/2024	0.2	0.6	3.3	5.0	0.8	2.0	3.7	8.3	216.5	3.0	1.1	3.6	510.9	0.8	0.4	5.5	1.1	8.8	1.1	2.9
17/09/2024	0.2	0.6	175.7	6.0	0.8	2.3	3.2	2.2	8.2	1.9	1.1	17.0	491.1	1.0	0.4	5.8	1.1	7.1	1.1	2.8
18/09/2024	0.2	0.7	214.1	120.0	0.8	2.6	4.1	1.6	4.0	19.5	1.0	3.0	463.8	1.0	0.5	6.0	1.1	7.1	1.1	2.8
19/09/2024	0.2	0.8	20.9	4.0	0.8	3.1	6.0	1.4	4.4	46.9	1.0	2.3	462.5	0.7	0.6	6.3	1.7	7.2	1.1	2.8
20/09/2024	0.3	0.8	33.8	251.4	0.8	3.2	3.6	1.5	6.9	29.7	1.0	2.4	429.5	0.7	0.5	7.2	1.1	7.1	1.2	3.0
21/09/2024	0.4	0.8	22.3	167.2	0.8	4.7	4.3	1.5	6.9	14.7	1.0	2.6	427.4	0.8	0.5	6.3	1.1	6.7	1.2	3.1
22/09/2024	1.3	0.7	18.7	99.5	0.8	5.4	6.0	1.5	7.1	11.2	0.9	2.5	424.4	0.8	0.5	6.2	1.0	7.2	1.2	3.1
23/09/2024	16.6	0.7	18.2	5.9	0.8	6.2	8.5	1.3	7.0	6.5	0.9	2.5	415.4	0.8	0.5	6.5	1.1	10.3	1.2	3.1
24/09/2024	20.2	0.8	19.1	5.0	0.8	5.9	6.2	1.4	7.0	0.8	1.1	4.0	423.3	0.8	0.6	7.5	1.0	17.8	1.3	3.1
25/09/2024	39.7	0.8	19.3	6.3	0.8	7.0	7.8	1.4	7.0	0.8	3.9	2.5	369.7	0.7	0.5	8.0	1.0	40.2	1.3	3.0
26/09/2024	32.4	0.7	29.8	7.0	0.8	7.0	8.7	1.4	7.2	0.8	1.2	2.5	377.5	0.9	0.6	6.8	1.0	6.6	1.3	3.0
27/09/2024	0.4	0.8	18.7	6.3	0.8	7.0	10.1	1.7	7.1	0.8	0.8	2.5	315.0	3.4	0.7	8.1	1.8	6.3	1.3	2.9
28/09/2024	0.4	0.8	20.1	4.3	0.9	7.0	9.5	1.6	6.4	0.8	0.9	2.5	354.1	4.7	0.5	8.1	3.0	4.9	1.4	3.0
29/09/2024	0.6	0.8	21.1	85.1	0.9	7.0	21.7	1.9	7.2	0.8	0.8	2.5	413.7	5.5	0.4	8.0	1.4	4.7	1.3	3.0
30/09/2024	0.3	0.8	22.4	327.6	0.9	8.1	5.8	1.9	7.3	0.8	1.1	2.5	403.2	6.3	0.4	8.4	1.1	4.8	1.4	2.8

Note: Daily averages above 25 NTU have been annotated by black bold text. Daily averages inclusive of with true events for further investigation are annotated by red bold text. Grey shading indicates no data available for that day at that unit.

Appendix A. Huntly WQMS Locations



-  Huntly Turbidity Monitors
-  Huntly Mine Footprint (Section 6)
-  Major Dams
-  Streams



FPWR1

ND04T

ND06T

ND07T

DB01T

DB02T

ND13T

ND14T

ND12T

SE51T

SE09T

SE10T

SE34T

SE48T

SE36T

SE03T

SE62T

SE22T

SE08T

SE23T

SE24T

SE25T

SE61T

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SE15T

SN07T

SE12T

SE12INV

SE11T

SE26T

SE01T

SE59T

SE53T

SE60T

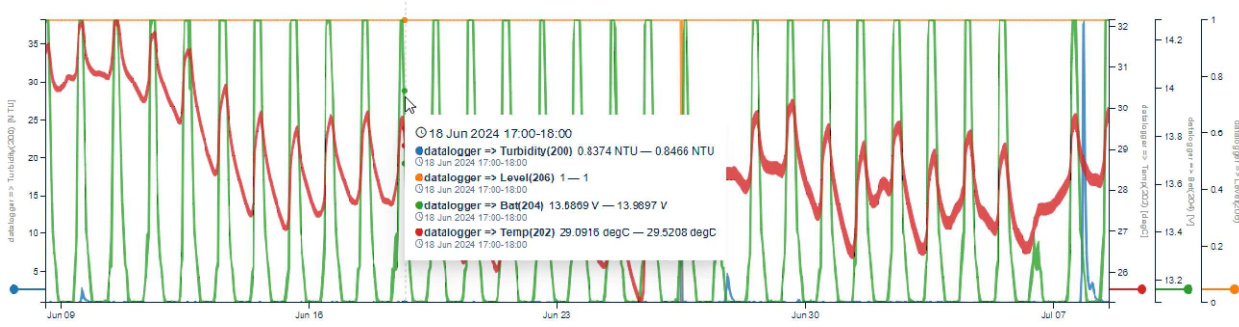
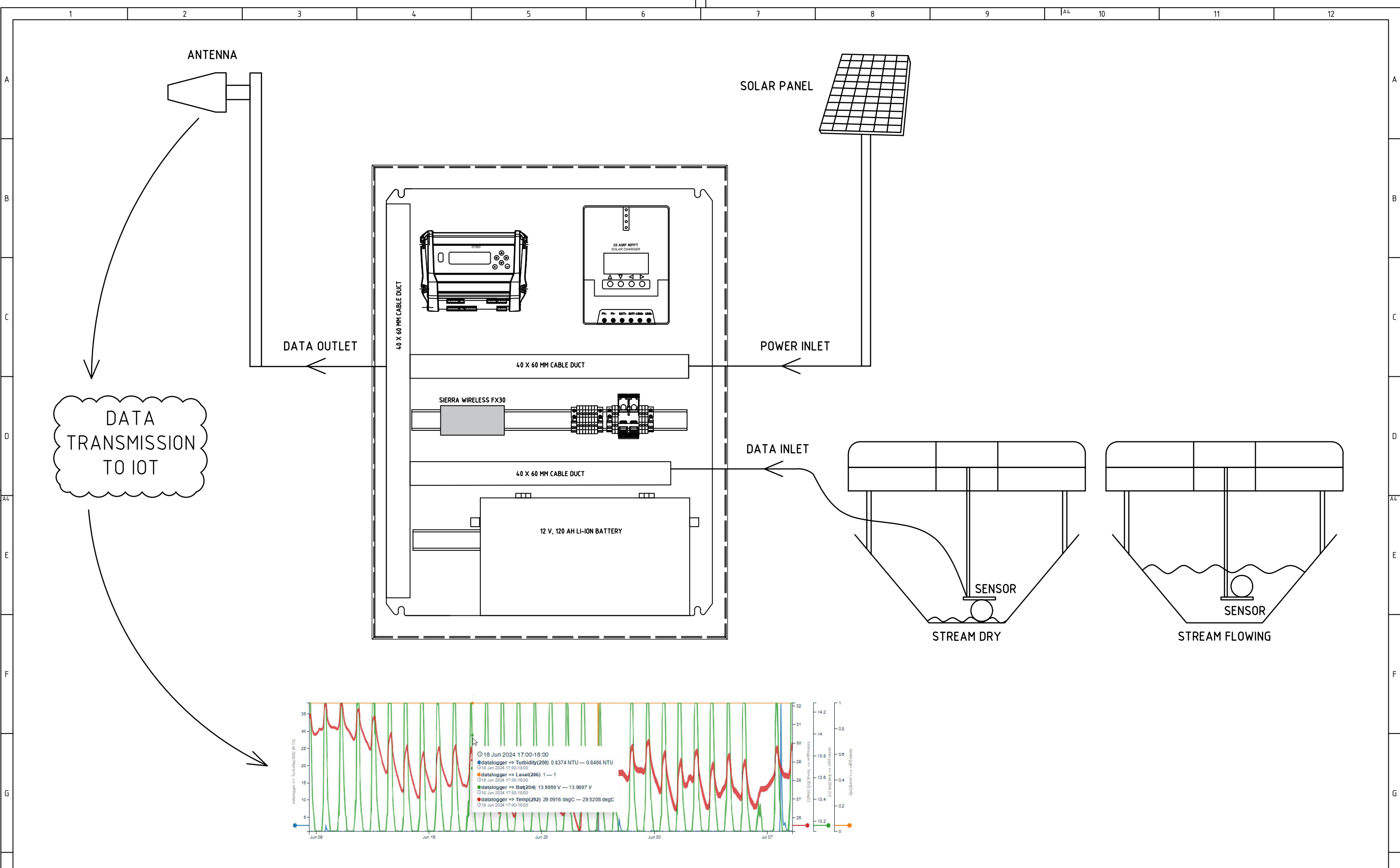
SE05T

PD03T

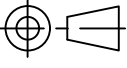
PD01T

PD02T

Appendix B. WQMS General Arrangement




REV.	REMARKS	DATE	DESIGNED	DRAWN	CHECKED	APPROVED	REFERENCE DRAWINGS
0	ISSUE FOR APPROVAL	05.07.2024	A.K.	S.A.	A.K.	A.K.	


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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 Mine – Water Quality Monitoring System Data Review

September 2024

Revision: 02

Date: 26 November 2024

Client: SciDev Pty Ltd

Issued to: SciDev & Alcoa of Australia



RARE
Environmental

Document Control

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Project Name	SciDev WQ Data Processing
Project Number	RP24050
Client	SciDev
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Revision	Date	Description	Prepared	Reviewed	Approved	Issued to
01	15/11/24	For internal review	SM	CR	CR	SciDev
02	26/11/24	Update PTM01 ID	SM	CR	CR	Scidev

Report Sign Off					
Report Version		01			
Prepared by		Technical Review		Approved for Issue	
					
Name	Sarah Mathew	Name	Chris Redford	Name	Chris Redford
Position	Env. Scientist	Position	Env. Scientist	Position	Env. Scientist
Date	26/11/2024	Date	26/11/2024	Date	26/11/2024

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1. Introduction

1.1. Purpose

RARE Environmental Pty Ltd (RARE) was engaged by SciDev Pty Ltd (SciDev) to analyse and comment on raw turbidity monitoring data collected by their Water Quality Monitoring Systems (WQMSs), at the Willowdale Mine, owned and operated by Alcoa of Australia Limited (Alcoa). Stream turbidity monitoring is a core regulatory requirement stipulated as part of Alcoa’s approvals and operating framework. The data for this reporting period was collected in September of 2024 from monitors under Section 6.

This report has been prepared to assess the quality of data provided and identify potential drainage incidents (‘true’ events) per the procedure detailed below within that data. Where possible recommendations are made for either WQMS network upgrades or further investigation of events identified within the data. This report should not be considered an assessment of the WQMS network and/or Alcoa’s compliance to relevant legislation and requirements, nor should it be considered an assessment of the suitability of the adopted trigger level and event classification procedure.

1.2. Context

Data from each location has been collected and compared against the drainage incident trigger level outlined in the *Environmental Protection (Darling Range Bauxite Mining Proposal) Exemption Order 2023* Schedule 1 Division 2 Cl. 6. Trigger events have then been assessed against Alcoa’s turbidity event classification guidelines to determine whether the event is true, i.e. caused by stream turbidity, or false, i.e. caused by stream debris, algae or other. For the purpose of this report a turbidity event is an event where turbidity levels, measured by a WQMS, are at least 25 nephelometric turbidity units (NTU) for a period of at least 1 hour.

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

1.3. Monitoring Requirements

Under Schedule 1, Division 2 (“Controls on activities”), of the *Environmental Protection (Darling Range Bauxite Mining Proposals) Exemption Order 2023* a drainage incident is defined as:

- a) a runoff from a disturbance area to the surrounding environment of surface water that has a turbidity of at least 25 nephelometric turbidity units for a period of at least 1 hour; or
- b) a discharge from containment infrastructure that includes or may include environmentally hazardous material;

1.4. Water Quality Monitoring System (WQMS)

At the Willowdale site, for this reporting period, 4 (four) active WQMSs have been installed as per Section 6, in streams within or downstream of mining operations to monitor stream turbidity levels. Each turbidity monitoring station is fitted with an Aquas SMR10 turbidity probe. The Aquas probes are placed directly in the streams, mounted at 90 degrees to the flow of water. Each sensor has a guard to protect the lens from larger debris and the units are fitted with a lens screen wiper. Note: disruptions or errant readings can occur with smaller pieces of debris (leaves etc.).

Data is collected via a Data Taker DT82 logger. Data from each logger is linked to an IOT data modem to transmit to a cloud-based platform. Data is logged locally in 6 second intervals with a 6-minute average pushed into the cloud-based platform. A float switch or cell indicates sensor immersion or a dry stream.

1.5. Data Review & Event Classification Process

Data produced by the WQMSs is reviewed by RARE per the following procedure and in consultation with SciDev. This allows for the identification of true events that require investigation to determine whether the mining operations may have contributed to the elevated turbidity levels, and false events.

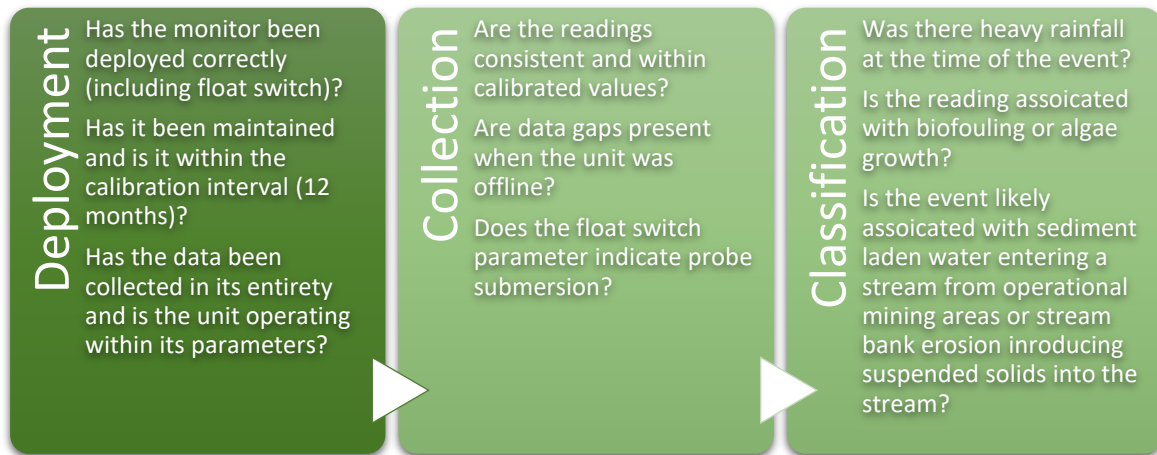


Figure 1: Data Review & Event Classification Process

The process considers the physical aspects of the WQMS deployment, the data collection by that monitor and finally classification of the events identified in that data. Classification of events is per Alcoa’s procedure to identify events as true or false.

A ‘true’ stream turbidity exceedance event that is caused by an actual increase in stream water turbidity. Alcoa has identified that ‘true’ turbidity exceedance events typically show a sharp turbidity incline before gradually trailing off as the stream turbidity level returns to background.



Figure 2: Typical ‘true’ exceedance event showing the sharp incline and gradually return to background levels.

‘False’ stream turbidity exceedance events are caused by factors other than an actual increase in stream water turbidity (i.e. organic debris covering the monitor such as sticks/leaves/algae, stream water turbulence or air bubbles and fluctuating water levels that intermittently cover the monitor lens and then recede). Alcoa has identified that ‘false’ turbidity exceedance events typically illustrate sharp inclines and declines for turbidity when the data is graphed over time and lack the distinctive ‘bell curve’ shape that is associated with ‘true’ turbidity exceedance events.

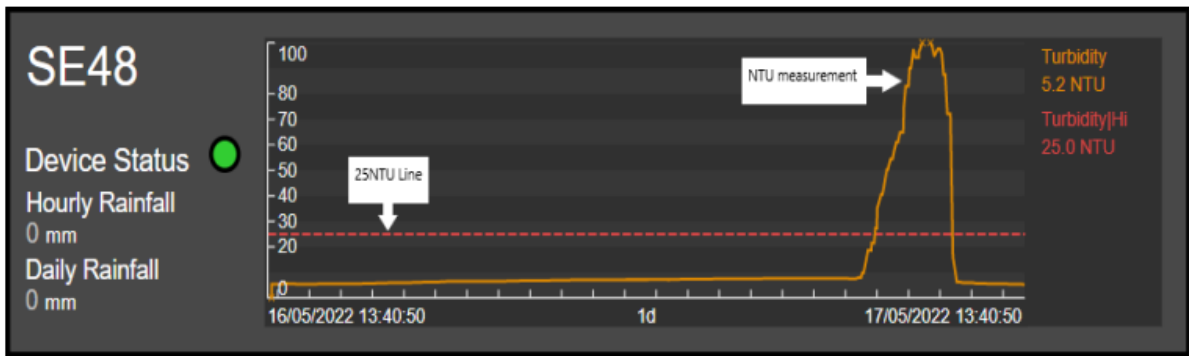


Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

Any 'true' events identified in this report have been listed in **Section 3**.

2. WQMS Data Review

For the reporting period of September 2024, 28,678 data points were collected by 4 (four) active WQMSs across the Willowdale site. From this data a total of 9 (nine) events were flagged where turbidity levels above 25 NTU were held for an hour or more. The following sections review this data, beginning with the deployment and operation of the WQMSs.

2.1. Deployment & Collection

No erroneous data has been identified by RARE during the month of September.

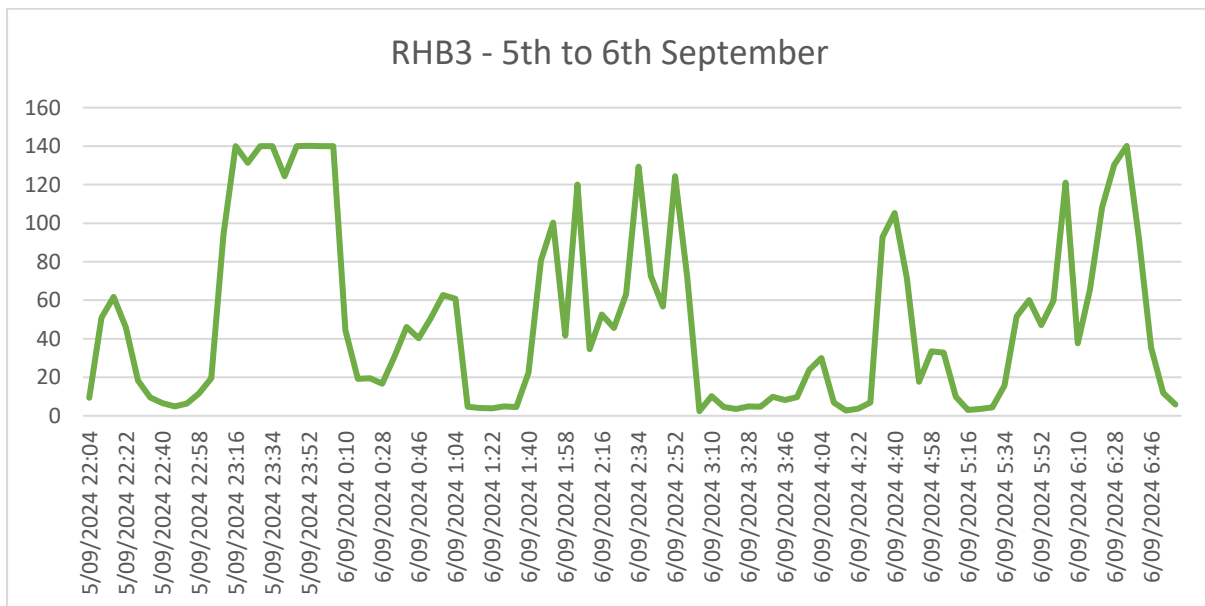
2.2. Classification

Analysing the data collected outside of the above periods leaves 9 (nine) potential turbidity events during the reporting period across 2 (two) units – RHB2 and RHB3.

For this reporting period there were no ‘true’ turbidity events identified. Refer to the following section for analysis.

2.2.1. RHB3 Potential Turbidity Events

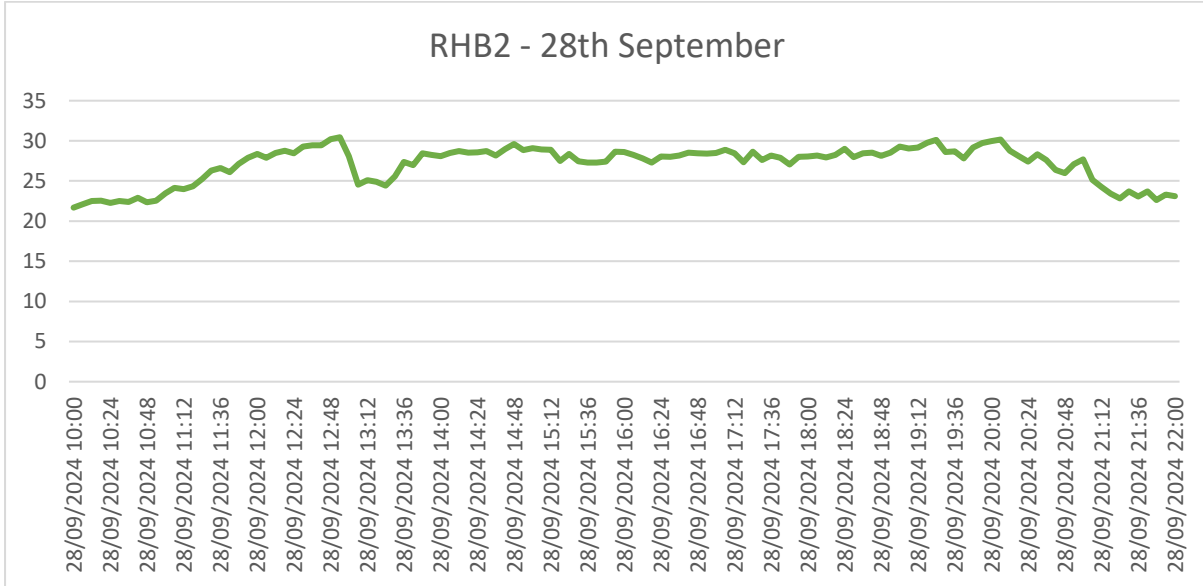
Chart(s) for data flagged at monitor RHB3 are shown below for the potential events identified in the reporting period.



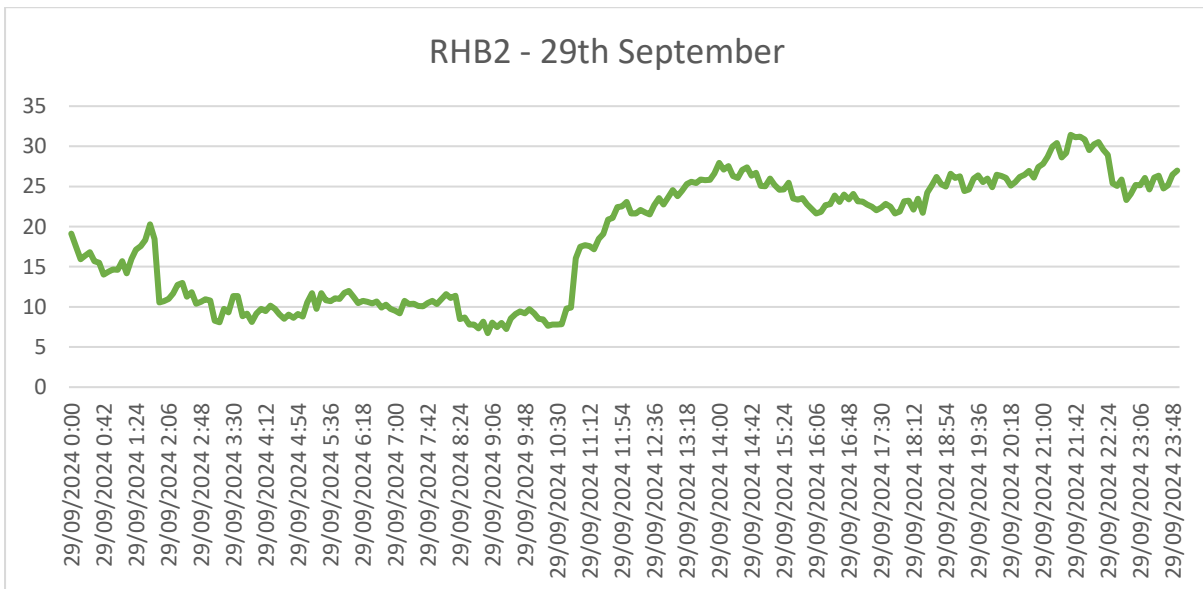
This event is marked by sporadic peaks, indicative of a ‘false’ event.

2.2.2. RHB2 Potential Turbidity Events

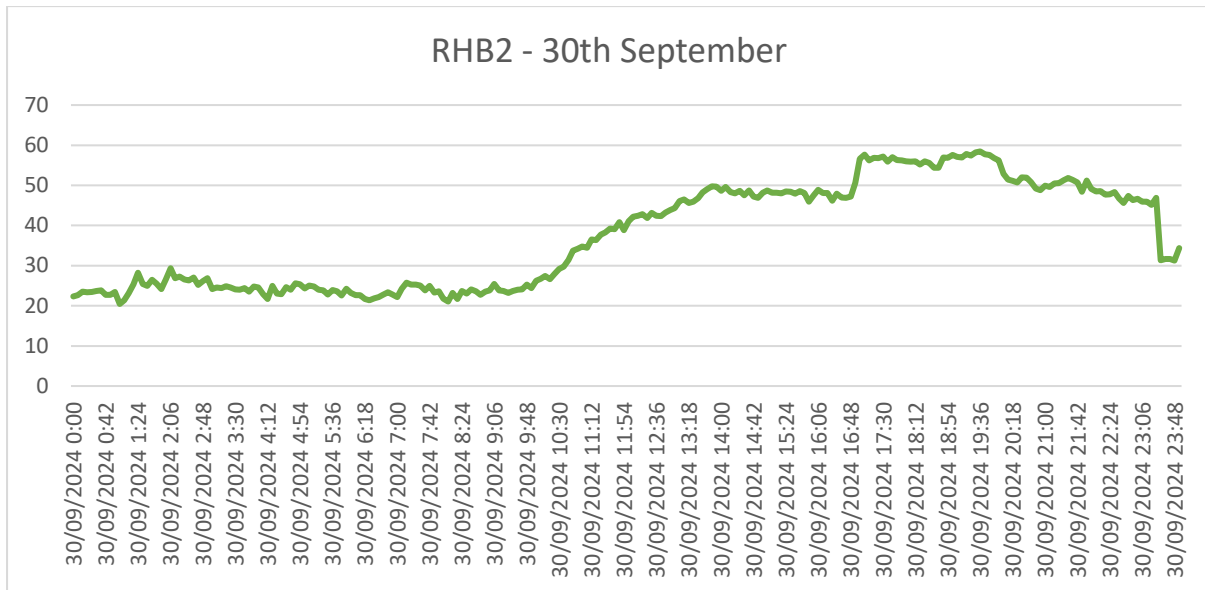
Chart(s) for data flagged at monitor RHB2 are shown below for the potential events identified in the reporting period.



This event is marked by gradual increases and decreases, indicative of a ‘false’ event.



This event is marked by sharp increases and sharp decreases, indicative of a ‘false’ event.



This event is marked by a gradual increase and sharp decrease, indicative of a ‘false’ event.

2.3. True Turbidity Events

For this reporting period, no potential drainage or ‘true’ incidents were identified for further investigation.

3. Recommendations

3.1. WQMS Network

RARE recommends:

- Perform a maintenance and deployment review of all units to ensure their correct operation.

4. Raw WQMS Data

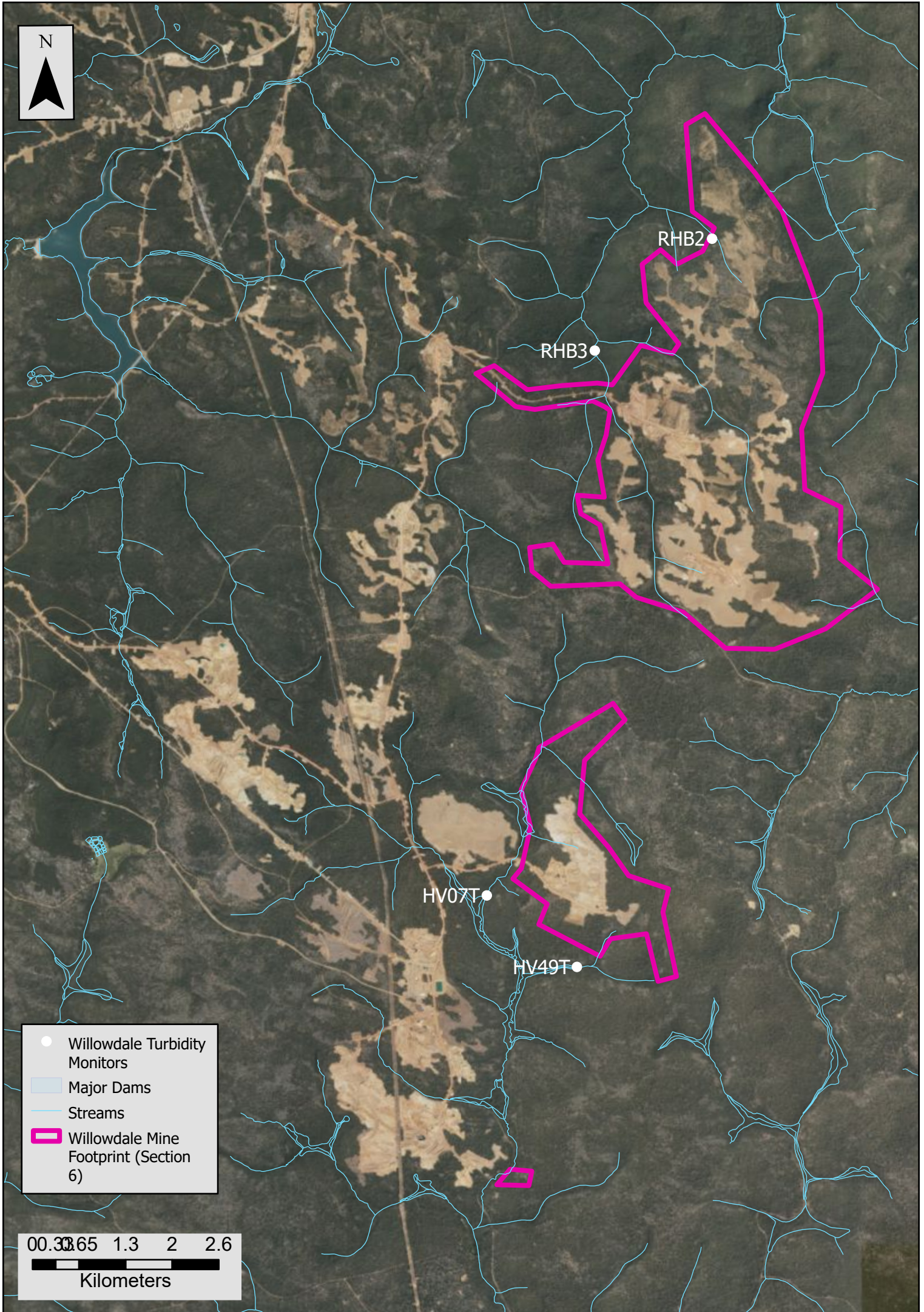
Date	Willowdale WQMS Data – September 2024 - Events with turbidity > 25 NTU for an hour or more			
	HV07	HV49T	RHB2	RHB3
1/09/2024				
2/09/2024				
3/09/2024				
4/09/2024				
5/09/2024				
6/09/2024				3
7/09/2024				
8/09/2024				
9/09/2024				
10/09/2024				
11/09/2024				
12/09/2024				
13/09/2024				
14/09/2024				
15/09/2024				
16/09/2024				
17/09/2024				
18/09/2024				
19/09/2024				
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21/09/2024				
22/09/2024				
23/09/2024				
24/09/2024				
25/09/2024				
26/09/2024				
27/09/2024				
28/09/2024			2	
29/09/2024			2	
30/09/2024			2	

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

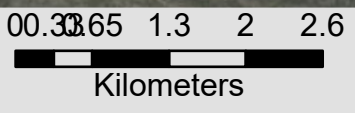
Date	Willowdale WQMS Data – September 2024 - Turbidity (Daily Average, NTU)			
	HV07	HV49T	RHB2	RHB3
1/09/2024	1.1	1.2	1.5	1.7
2/09/2024	0.9	1.2	1.4	1.4
3/09/2024	1.7	1.2	1.5	1.3
4/09/2024	0.9	1.2	2.3	13.2
5/09/2024	1.0	1.2	2.5	14.8
6/09/2024	1.1	1.2	1.4	37.8
7/09/2024	0.9	1.2	0.7	12.6
8/09/2024	0.9	1.2	0.1	9.3
9/09/2024	0.9	1.3	0.0	6.3
10/09/2024	0.9	1.3	0.1	2.0
11/09/2024	0.9	1.3	0.0	1.6
12/09/2024	0.9	1.3	0.1	1.6
13/09/2024	0.9	1.2	1.9	2.0
14/09/2024	1.0	1.1	2.2	1.5
15/09/2024	0.9	1.1	2.2	1.4
16/09/2024	1.0	1.1	2.3	1.5
17/09/2024	1.2	1.2	2.2	1.4
18/09/2024	0.9	1.3	2.2	1.4
19/09/2024	0.9	1.3	2.4	1.4
20/09/2024	1.0	1.3	2.5	1.4
21/09/2024	1.0	1.3	2.3	1.4
22/09/2024	1.2	1.2	2.3	1.4
23/09/2024	1.0	1.2	2.4	1.5
24/09/2024	0.9	1.2	3.7	1.5
25/09/2024	1.3	1.1	3.5	1.4
26/09/2024	0.9	1.1	6.6	1.4
27/09/2024	1.0	1.3	7.7	2.0
28/09/2024	1.4	1.2	22.6	1.4
29/09/2024	0.9	1.1	18.5	1.3
30/09/2024	0.9	1.2	37.5	1.3

Note: Daily averages above 25 NTU have been annotated by **black** bold text. Daily averages inclusive of with true events for further investigation are annotated by **red** bold text. Grey shading indicates no data available for that day at that unit.

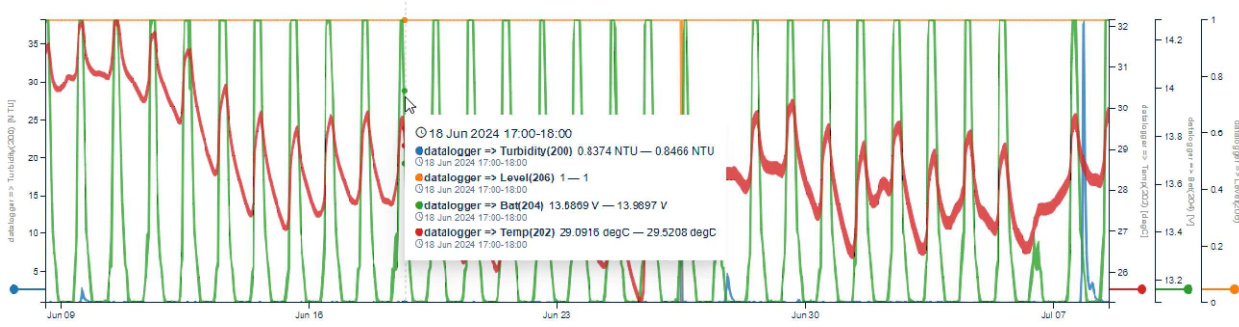
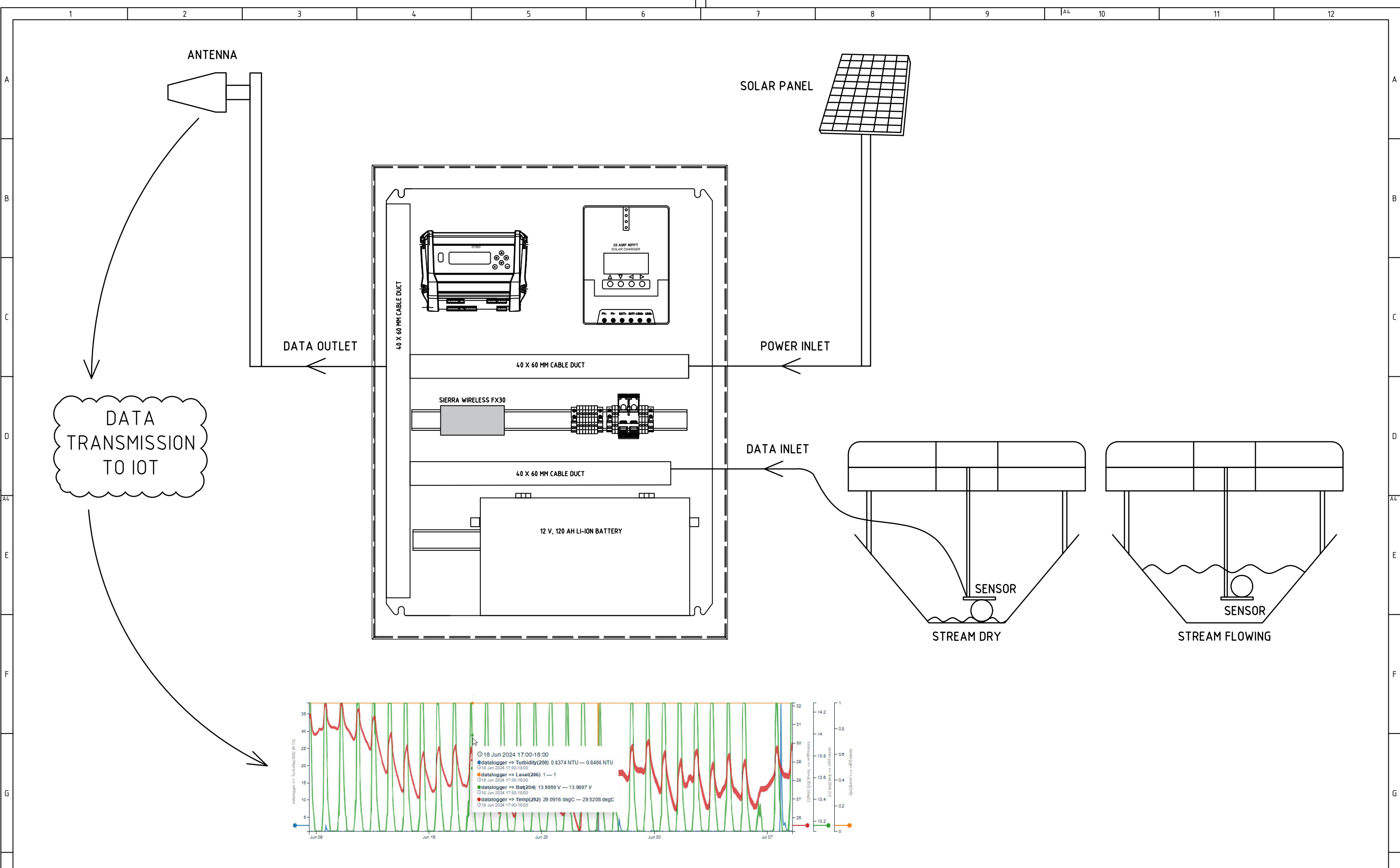
Appendix A. Willowdale WQMS Locations



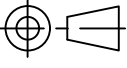
- Willowdale Turbidity Monitors
- Major Dams
- Streams
- ▭ Willowdale Mine Footprint (Section 6)



Appendix B. WQMS General Arrangement



REV.	REMARKS	DATE	DESIGNED	DRAWN	CHECKED	APPROVED	REFERENCE DRAWINGS
0	ISSUE FOR APPROVAL	05.07.2024	A.K.	S.A.	A.K.	A.K.	


 ALL DIMENSIONS IN MILLIMETRES UNO.
 LEVELS ARE IN METRES ON AHD UNO.
 DO NOT SCALE DRAWING
 IF IN DOUBT - ASK
 TOLERANCES ISO2768-m UNO.
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 waterservices@scidev.com.au
 www.scidev.com.au



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