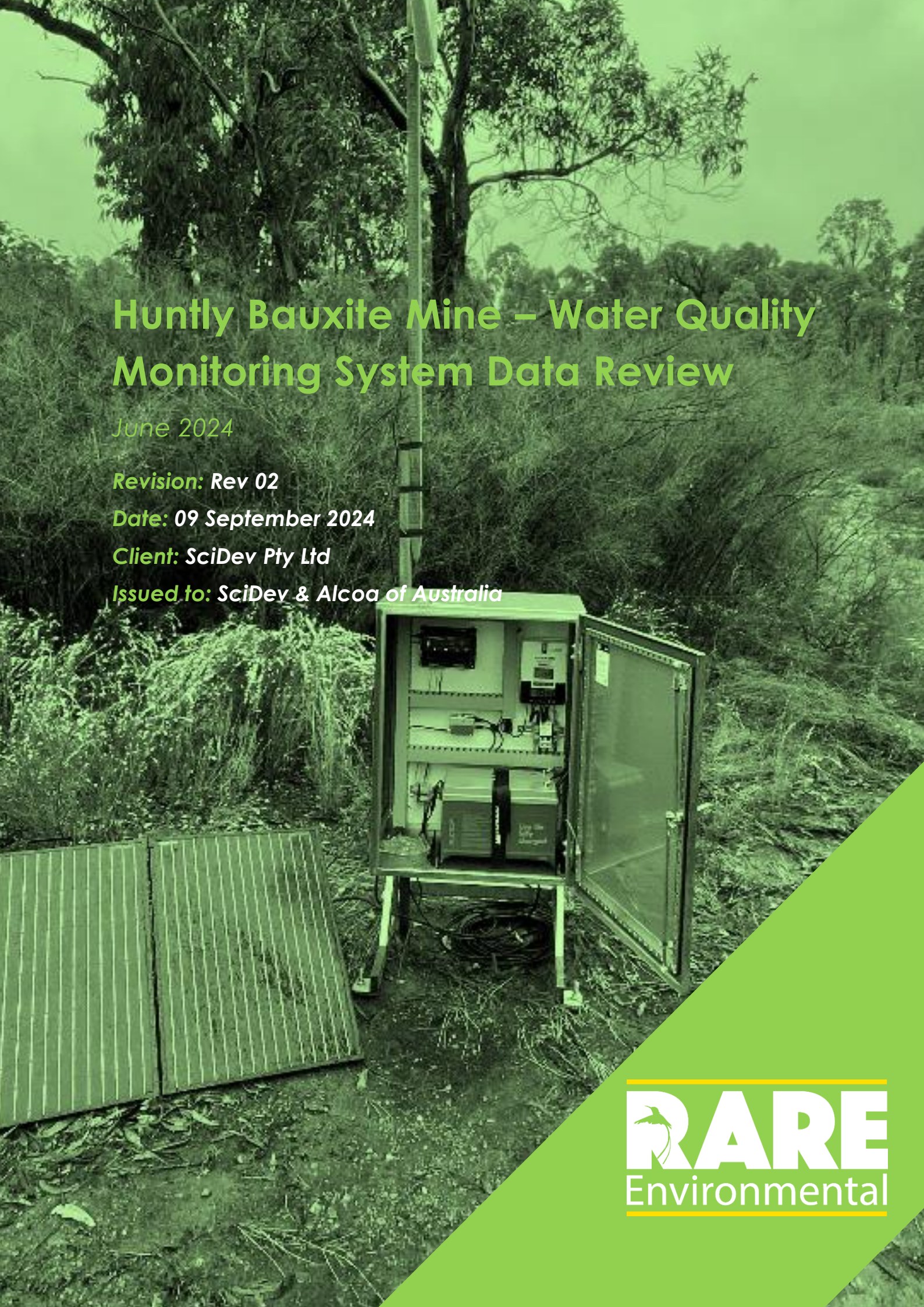

Huntly Bauxite Mine – Water Quality Monitoring System Data Review

June 2024

Revision: ***Rev 02***

Date: ***09 September 2024***

Client: ***SciDev Pty Ltd***

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

RARE Environmental

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Infrastructure Sustainability Council MEMBER

Contents

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 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 June 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, 24 (twenty-four) 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.

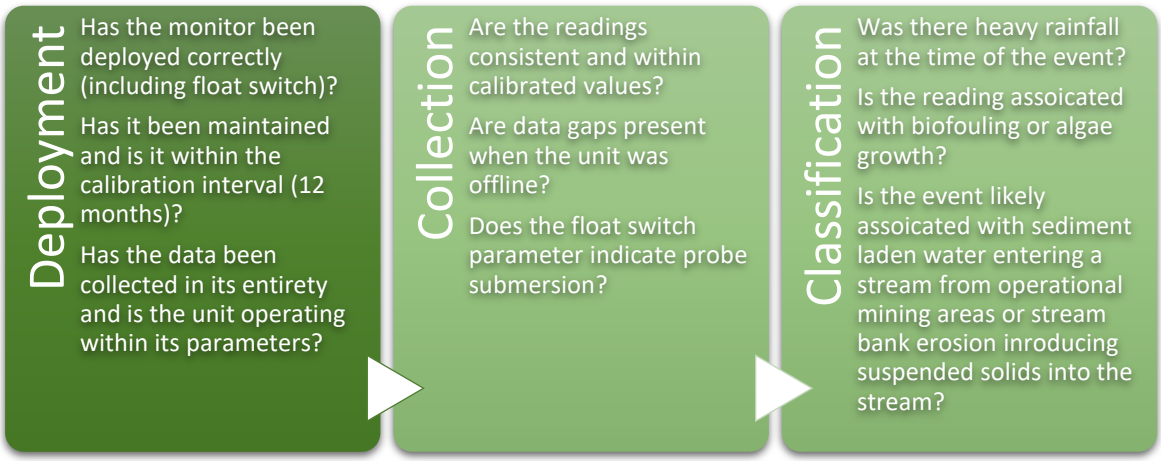

Figure 1: Data Review & Event Classification Process

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.

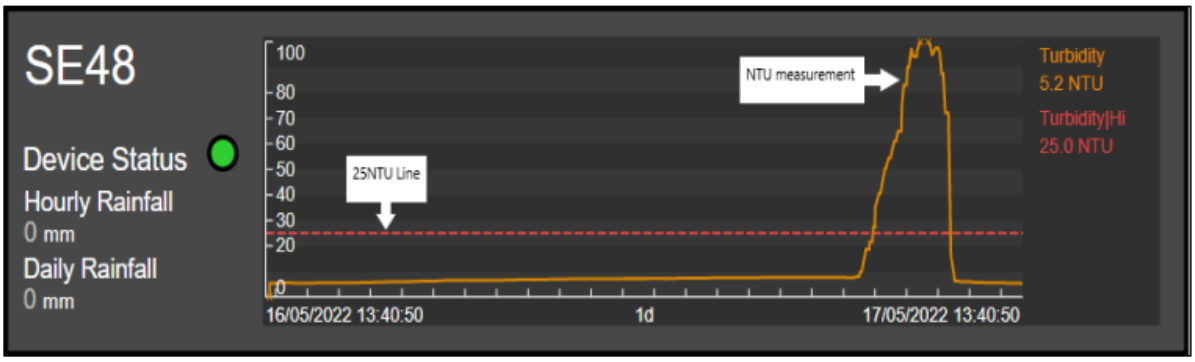

Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

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

2. WQMS Data Review

For the reporting period of June 2024, 164,403 data points were collected by 24 (twenty-four) WQMSs across the Huntly site. From this data a total of 94 (ninety-four) events were flagged where turbidity levels above 25 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 have confirmed that the data generated by these units is invalid and has been excluded from further analysis.

Excluding the data from these units leaves 75 (seventy-five) potential turbidity events during the reporting period across 16 (sixteen) units as discussed in the following section.

Table 1: WQMS Requiring Review

Unit	Dates	SciDev Comment
SE06T	June 2nd – 3rd (4 events)	Site inspected on 3/06/2024, noting that the sensor was impacted by algae/debris. NTU on arrival 61.36, dropped to 0.34 after cleaning.
SE09T	June 2nd	Site was inspected on 30/05/2024. The stream bed was very dry and float switch was confirmed to be reading accurately. Data indicates stream flow at approximately 21:32 on 30/05/2024. The initial stream flow likely flushed the stream bed, causing debris to become lodged around the sensor. Minimal rainfall was recorded during the remainder of the event, circa 5mm, and at the time of inspection on 6/06/2024, heavy debris was found caught around the sensor. NTU on arrival 30.99, dropped to 6.49 after lens cleaning.
SE52T	June 12th (2 events)	Due to a radio communications issue, the monitor was showing as "online" and displaying false turbidity values, so this event was not found until a general site inspection on 15/06/2024. At the time of inspection, leaf litter/debris was caught around the sensor, and algae on lens. NTU on arrival was 47.96 which dropped to 1.3 after cleaning.
SE03T	June 14th (4 events)	Site was inspected on the 14/06/2024, noting that the stream was flowing and a notable amount of organic debris was wedged under and on top of the sensor. NTU trend declined rapidly which aligns with debris wash through. NTU on arrival was 32.1393 and NTU on departure was 1.94.
SE36T	June 24th - 25th (7 events)	Site inspected 25/06/2024 and the probe sensor was cleaned, however it immediately started demonstrating another event when put back into water. There was no change of water quality observed that would trigger a significant change in NTU. Evidence suggests an issue with the sensor on the monitor. This monitor has been flagged for inspection by maintenance contractor.
SE48T	June 14th	Stream began to flow on 9/06/2024. Site inspected on 14/06/2024, water level has since dropped and sensors were out of water.

2.2. Classification

Analysing the data collected outside of the above periods leaves 75 (seventy-five) potential turbidity events during the reporting period across 16 (sixteen) units as summarised in **Table 2**. For this reporting period there were 38 (thirty-eight) 'true' turbidity events identified. Refer to the following section for analysis.

Table 2: Turbidity events summary

Date	Huntly WQMS Data - June 2024 - Events with turbidity > 25 NTU for an hour or more																						
	DB01T	DB02T	ND06T	ND07T	ND13T	ND12T	ND14T	PD01T	SE01T	SE02T	SE03T	SE05T	SE06T	SE07T	SE08T	SE09T	SE10T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE61T
1/06/2024					1																			
2/06/2024				1				1	1		1	2			1					3	1		1	1
3/06/2024																								
4/06/2024																								
5/06/2024																				1				
6/06/2024								1		1	1	1						1		1	1		2	1
7/06/2024														1	1			1						
8/06/2024															1									
9/06/2024															1						3			
10/06/2024															1						2			
11/06/2024														1							1			
12/06/2024							1							1										
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14/06/2024														1				1						
15/06/2024																		1 | 1						
16/06/2024																		1						
17/06/2024																	1							
18/06/2024																								1
19/06/2024																		3						2
20/06/2024																		4						4
21/06/2024																		3						4
22/06/2024																		1						
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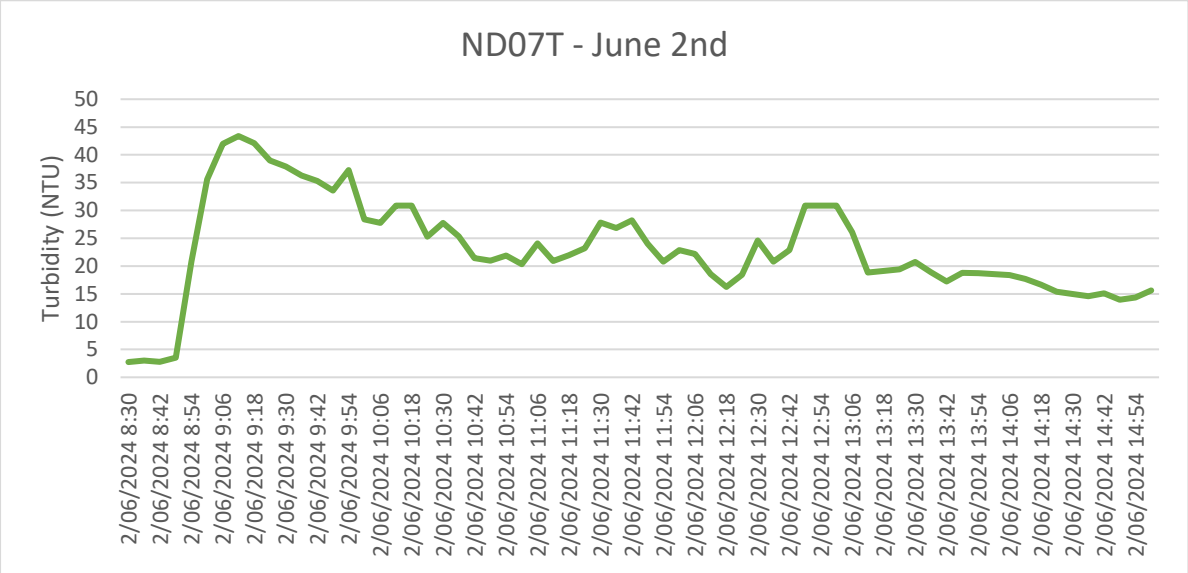
25/06/2024																								
26/06/2024																								
27/06/2024												1												1
28/06/2024														2										
29/06/2024																								
30/06/2024																		1						

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. ND07T Potential Turbidity Events

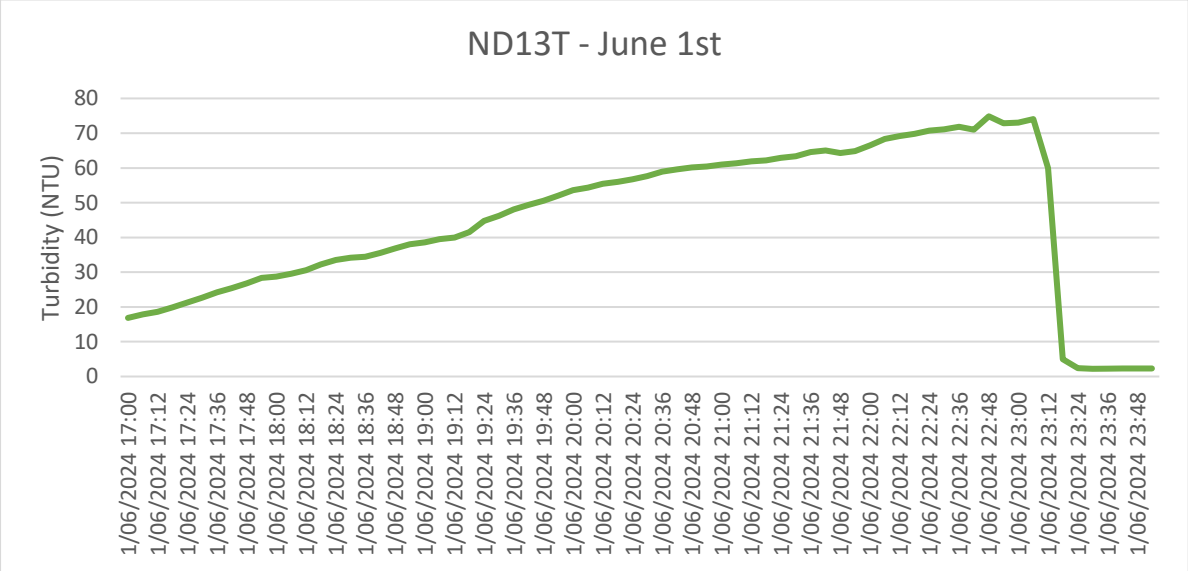
Chart(s) for data flagged at monitor ND07T are shown below for the potential events identified in the reporting period.



The event is marked by sharp incline and slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.2. ND13T Potential Turbidity Events

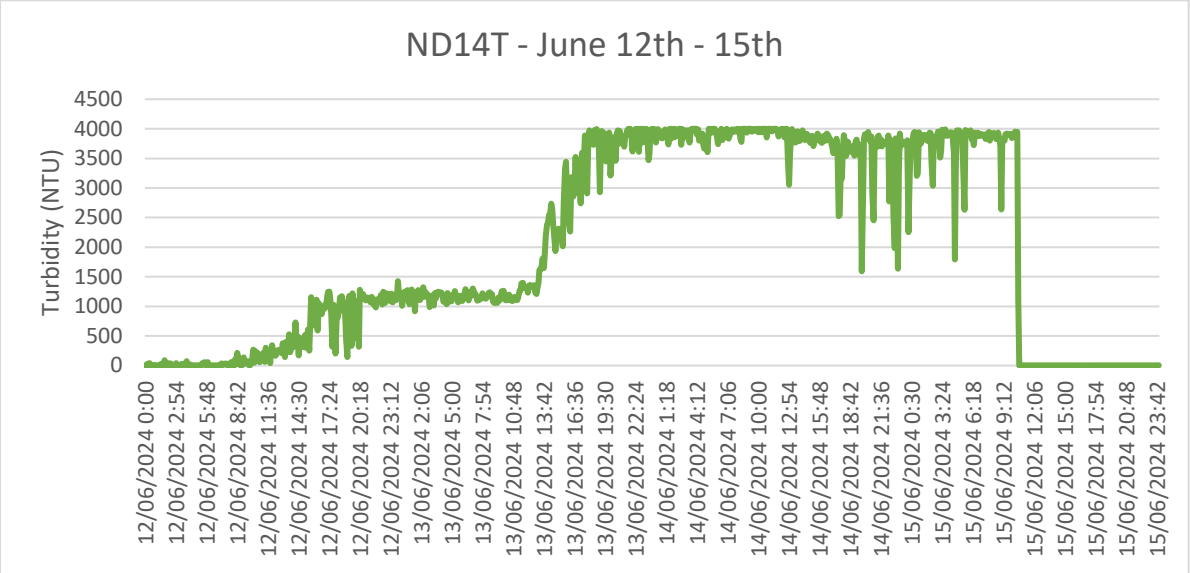
Chart(s) for data flagged at monitor ND13T are shown below for the potential events identified in the reporting period.



This event is marked by a gradual incline and a sharp return to normal values indicative of a 'false' event.

2.2.3. ND14T Potential Turbidity Events

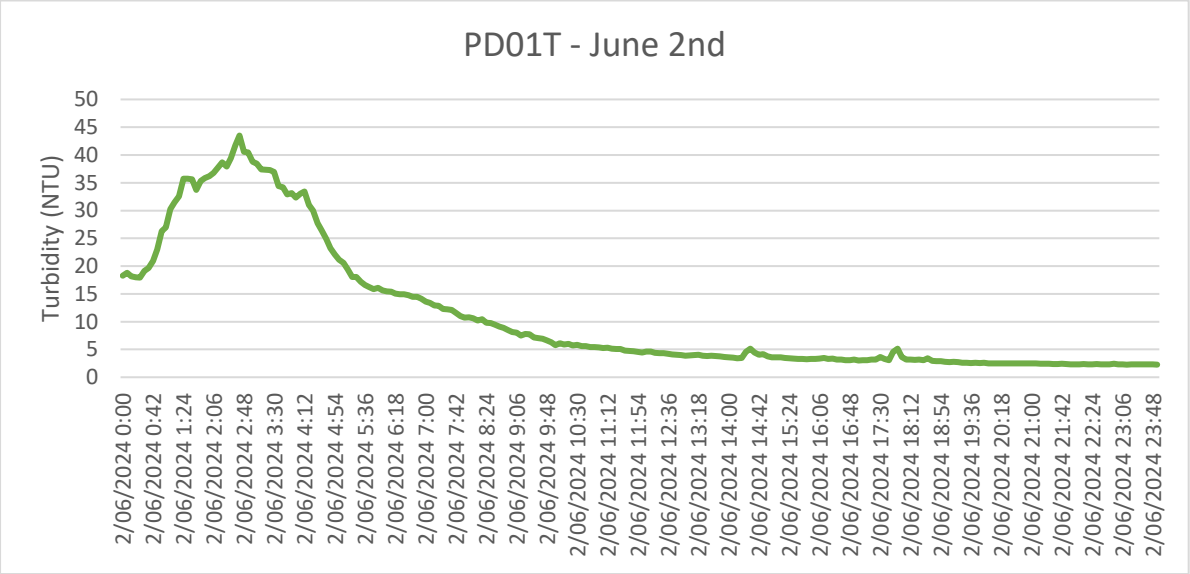
Chart(s) for data flagged at monitor ND14T are shown below for the potential events identified in the reporting period.



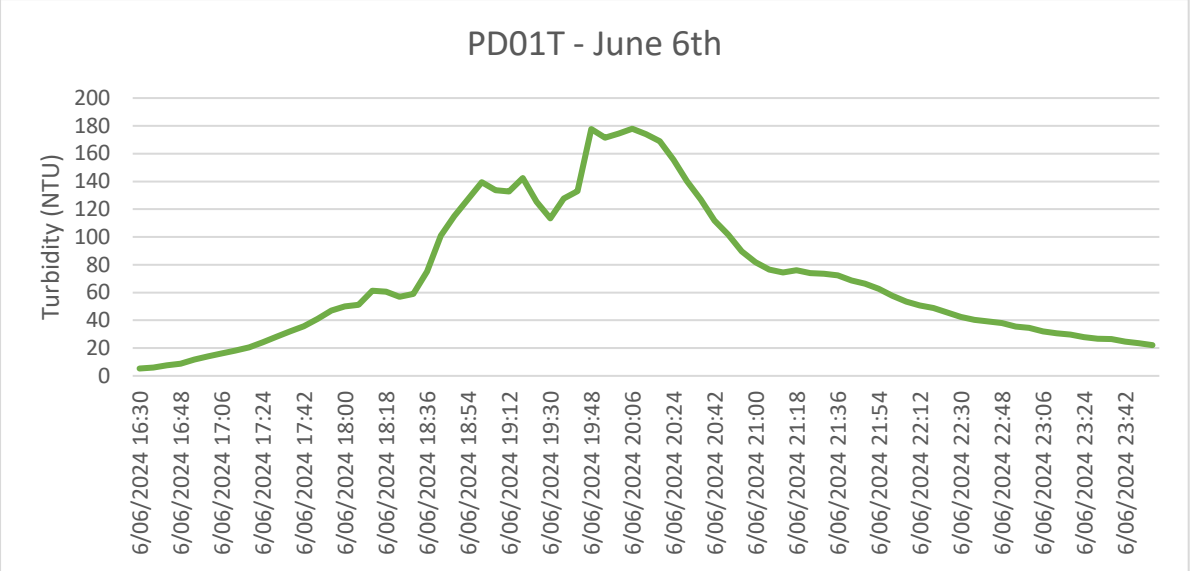
This event is marked by a sharp return to normal values indicative of a 'false' event.

2.2.4. PD01T Potential Turbidity Event

Chart(s) for data flagged at monitor PD01T are shown below for the potential events identified in the reporting period.



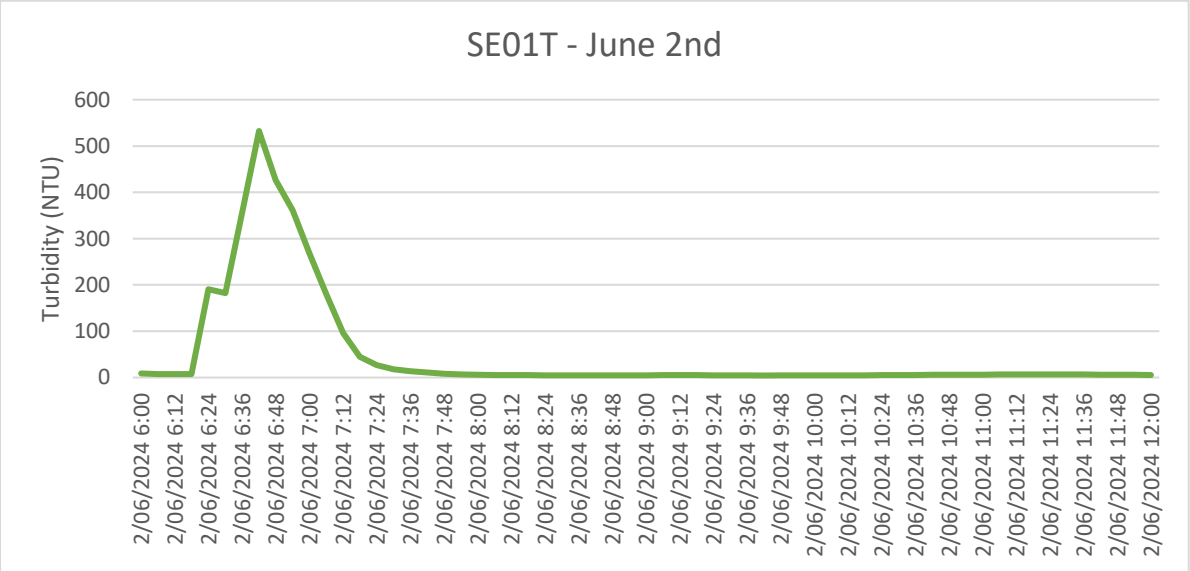
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.5. SE01T Potential Turbidity Events

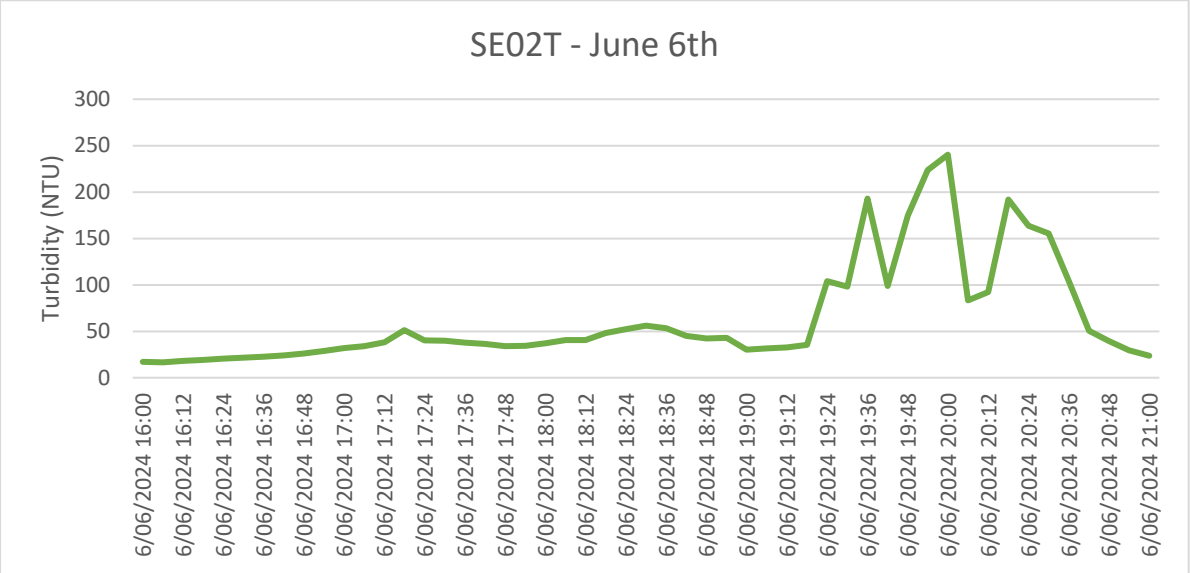
Chart(s) for data flagged at monitor SE01T are shown below for the potential events identified in the reporting period.



The event is marked by gradual return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.6. SE02T Potential Turbidity Events

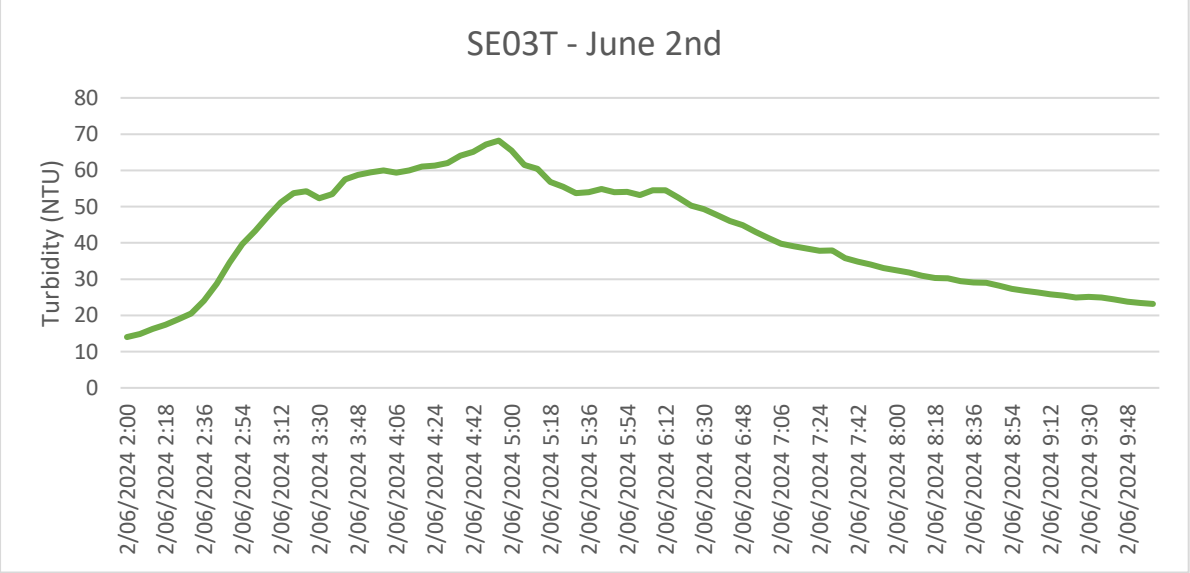
Chart(s) for data flagged at monitor SE02T are shown below for the potential events identified in the reporting period.



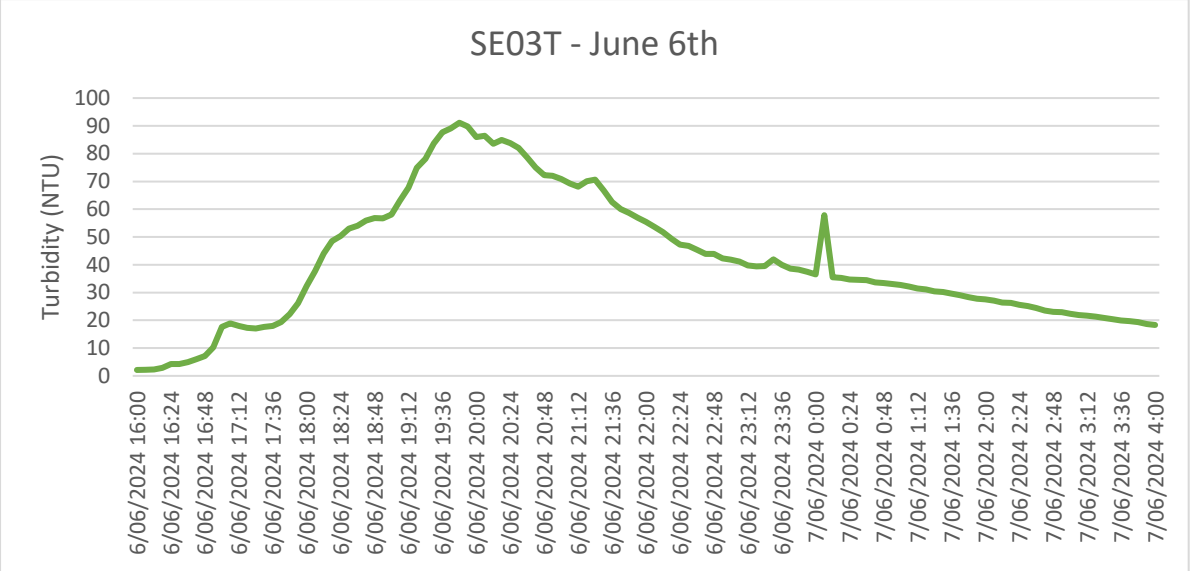
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.7. SE03T Potential Turbidity Events

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



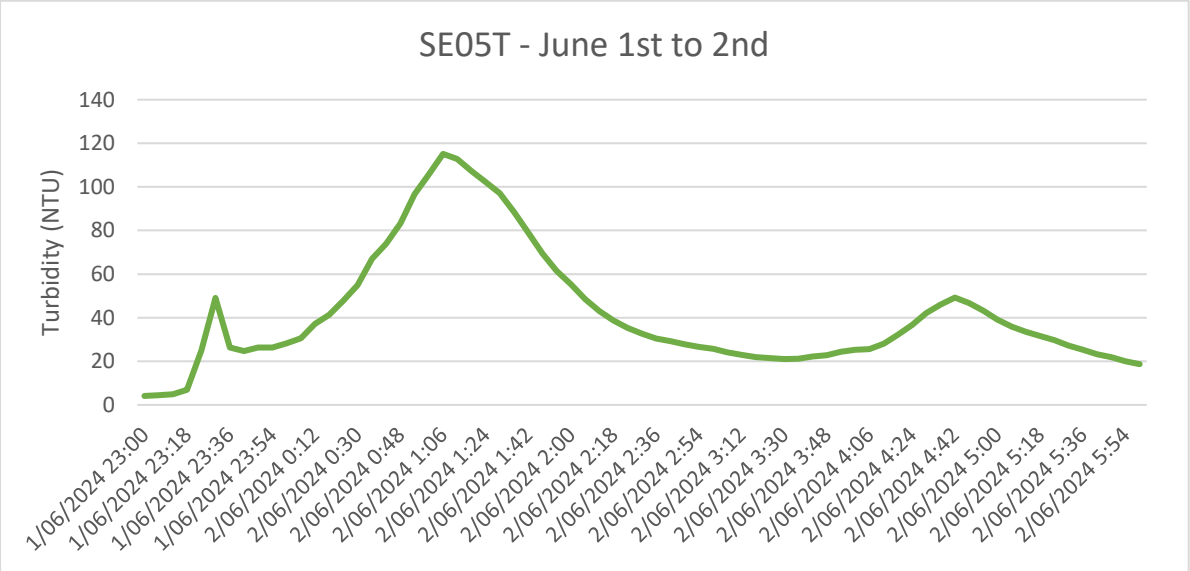
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



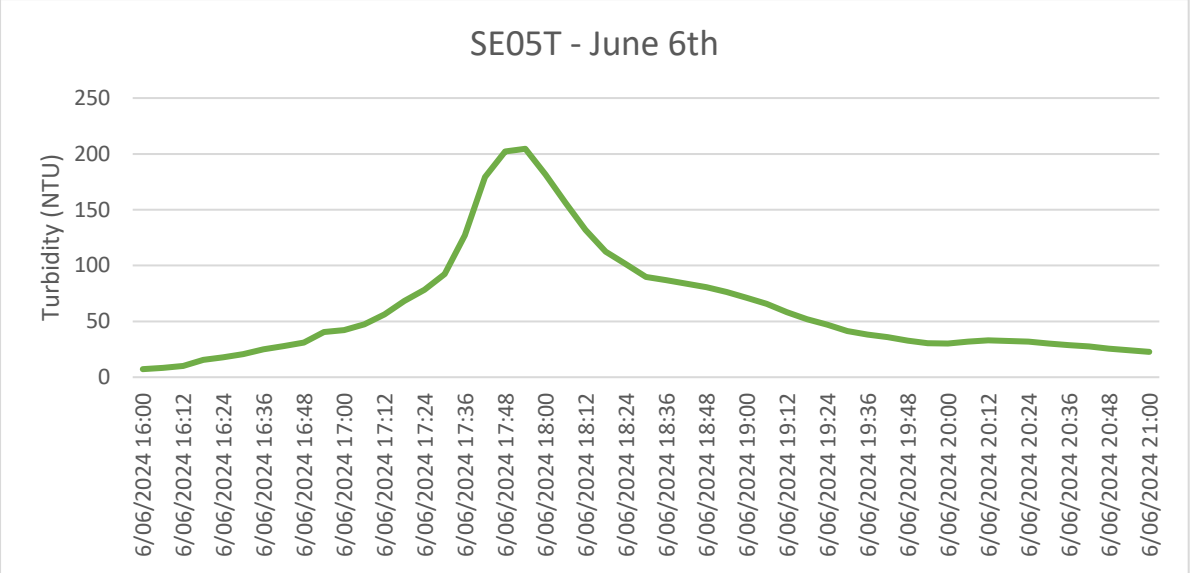
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.8. SE05T Potential Turbidity Events

Chart(s) for data flagged at monitor SE05T are shown below for the potential events identified in the reporting period.



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

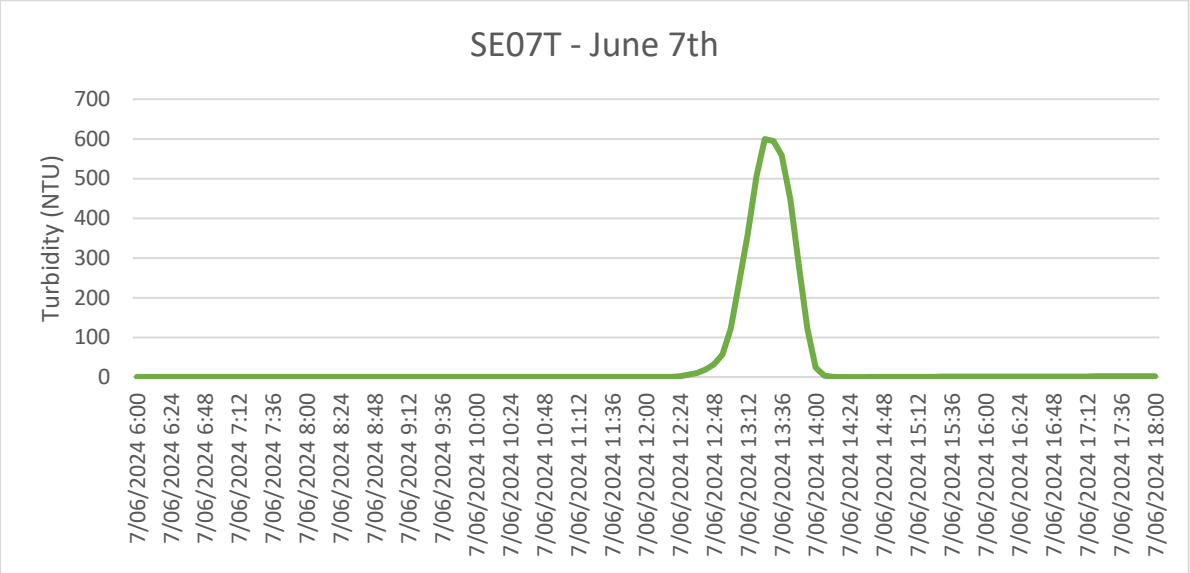


The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

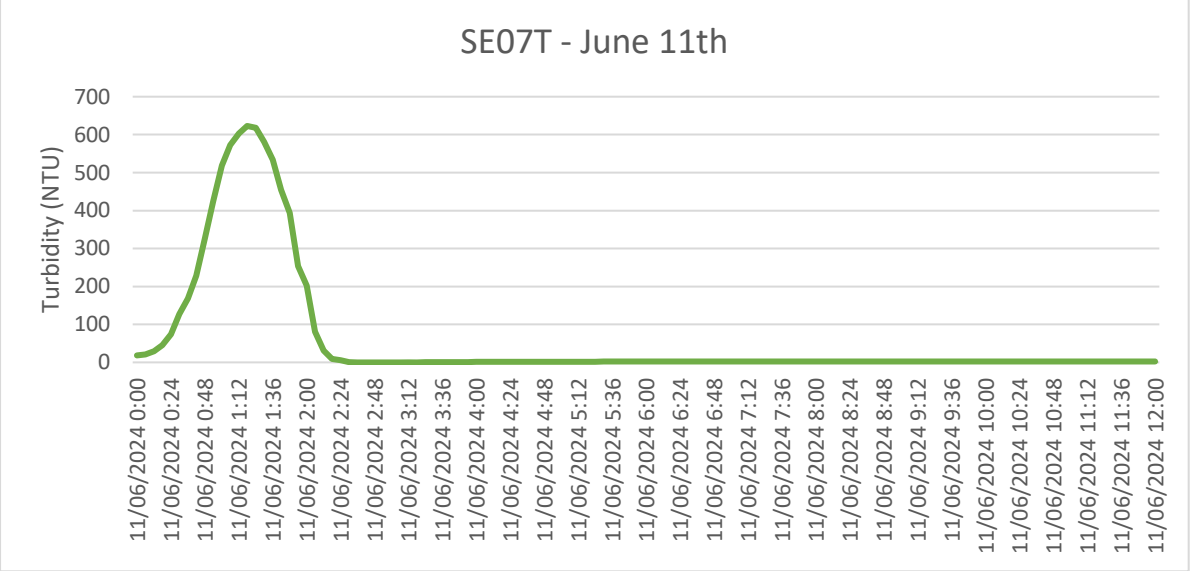
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.9. SE07T Potential Turbidity Events

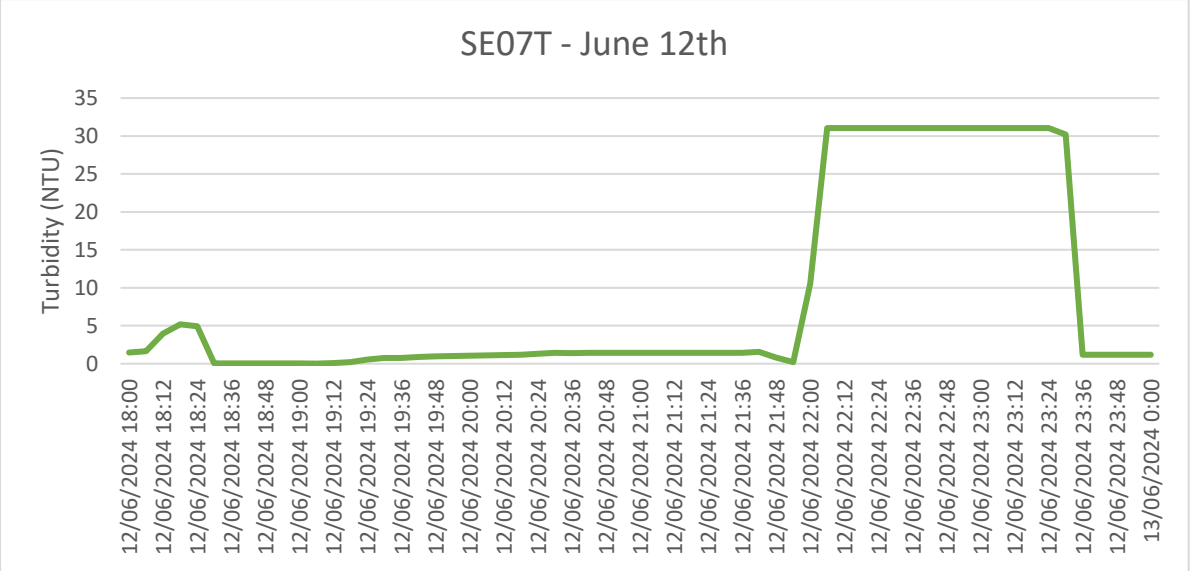
Chart(s) for data flagged at monitor SE7T are shown below for the potential events identified in the reporting period.



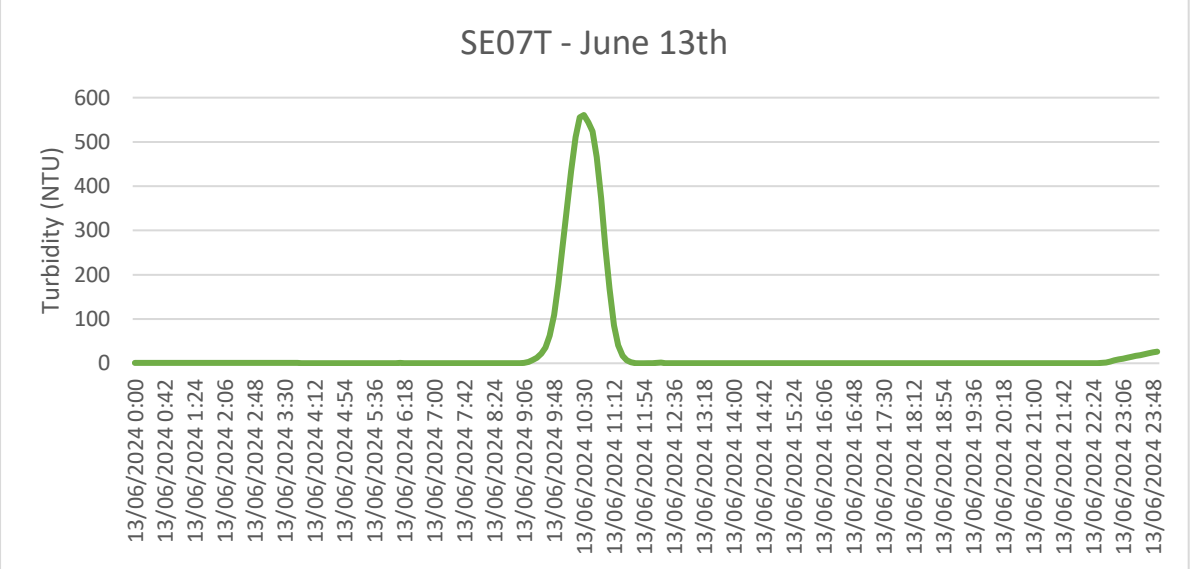
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



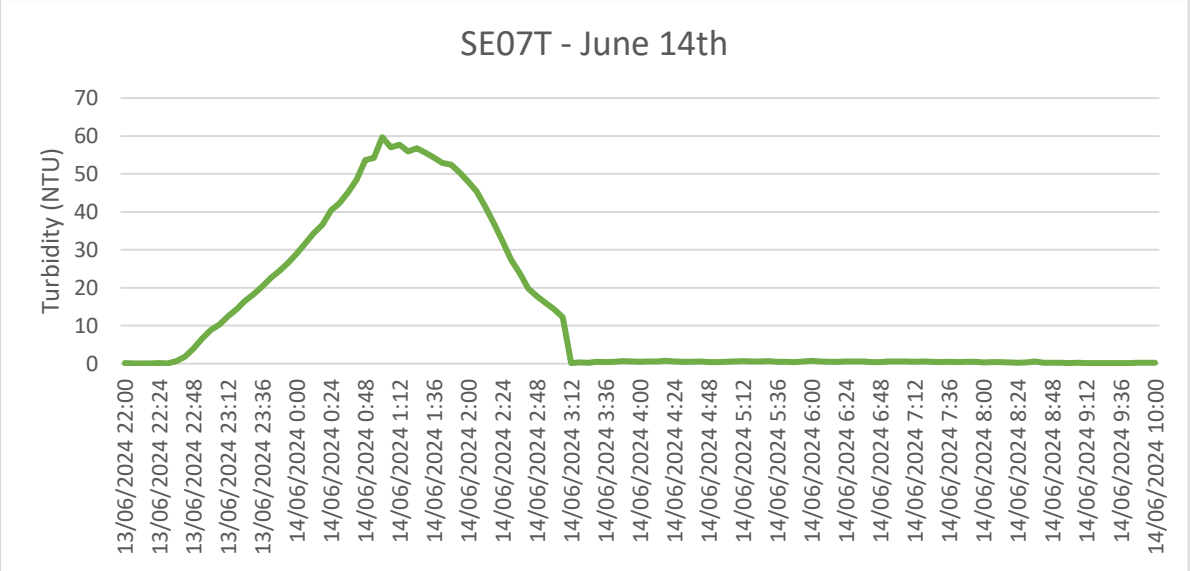
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



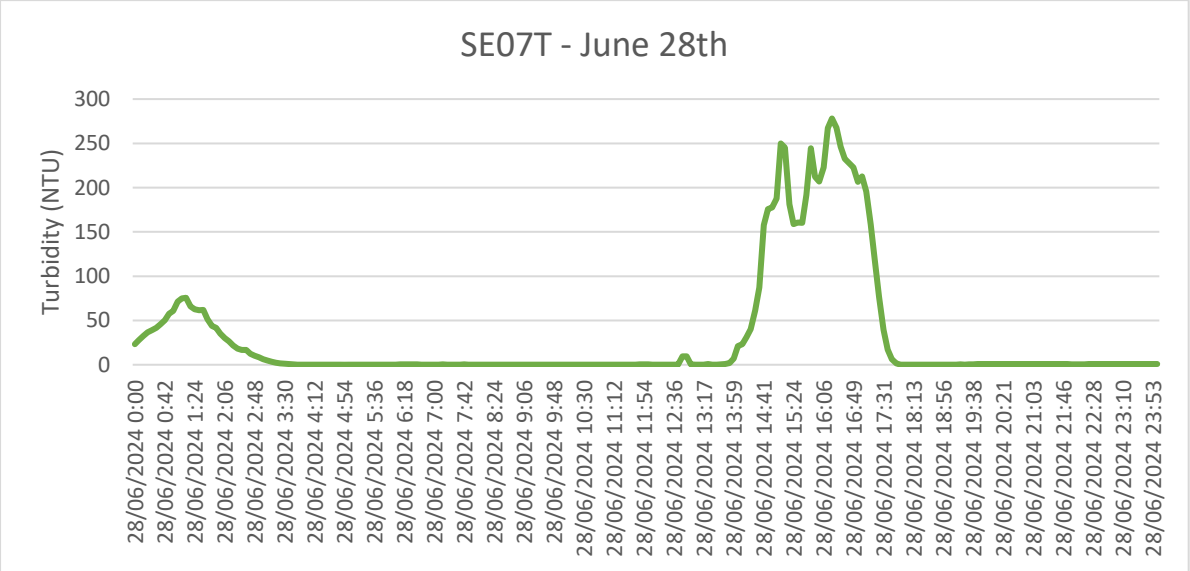
This event is marked by a sharp incline and decline indicative of a 'false' event.



The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



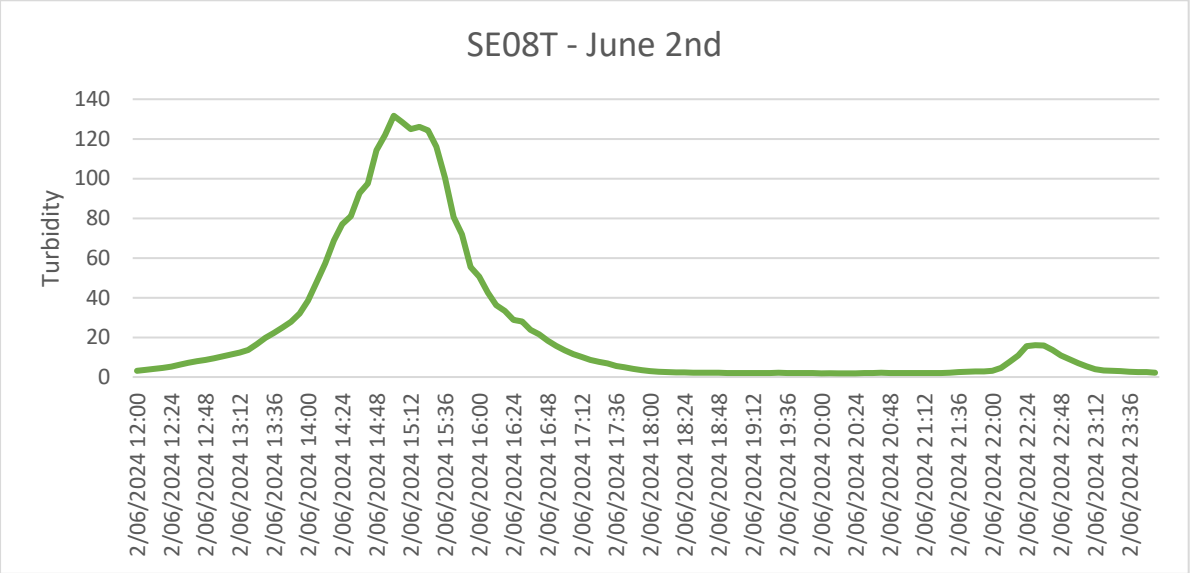
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



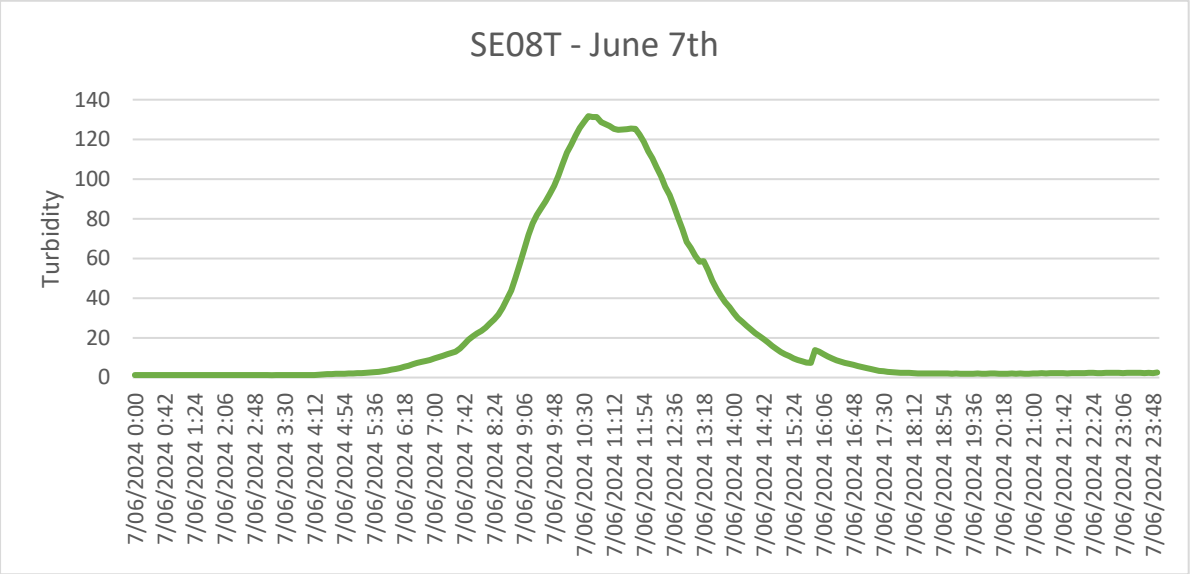
These events are marked by a slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.10. SE8T Potential Turbidity Events

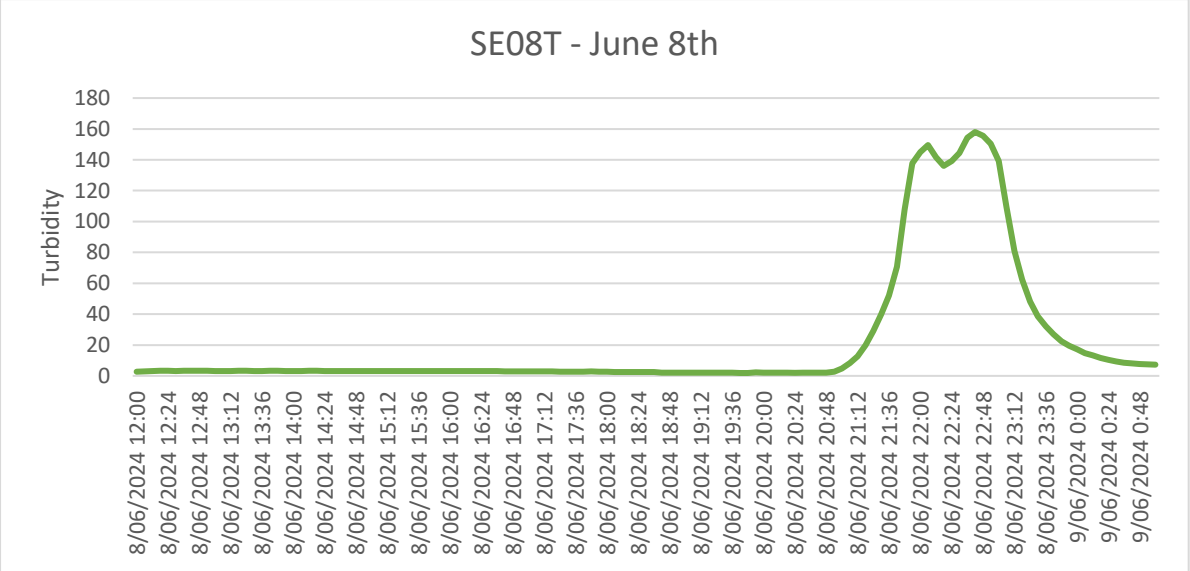
Chart(s) for data flagged at monitor SE10T are shown below for the potential events identified in the reporting period.



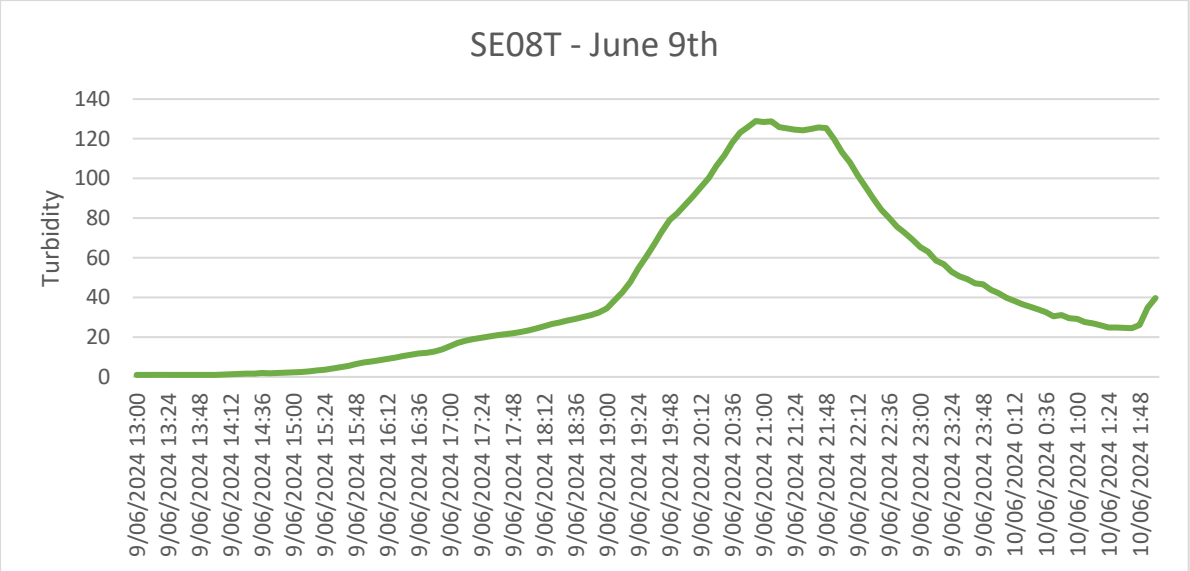
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



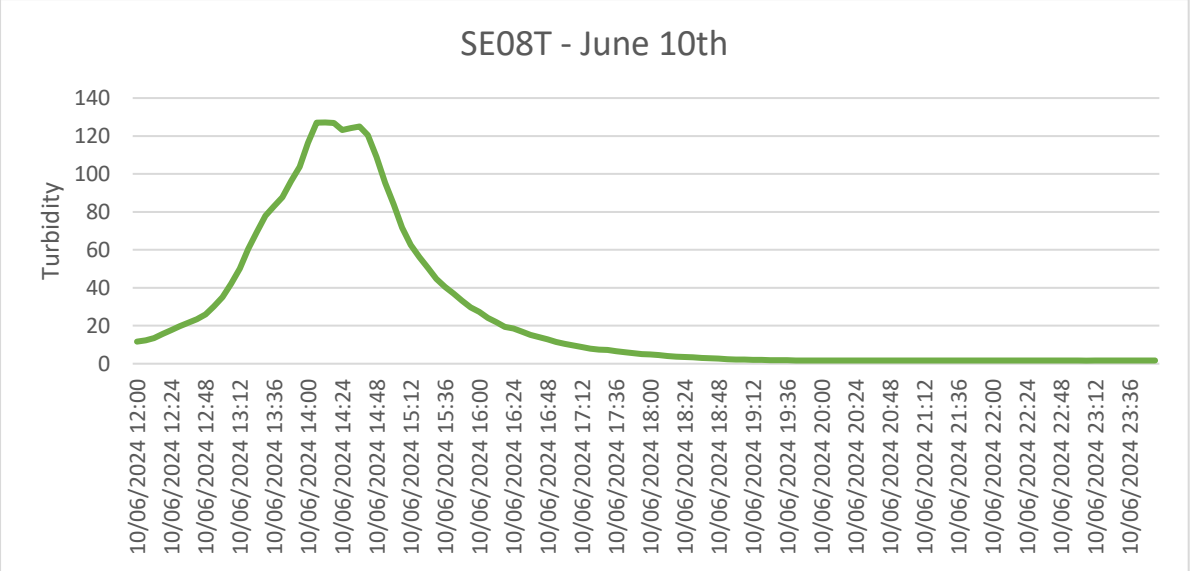
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



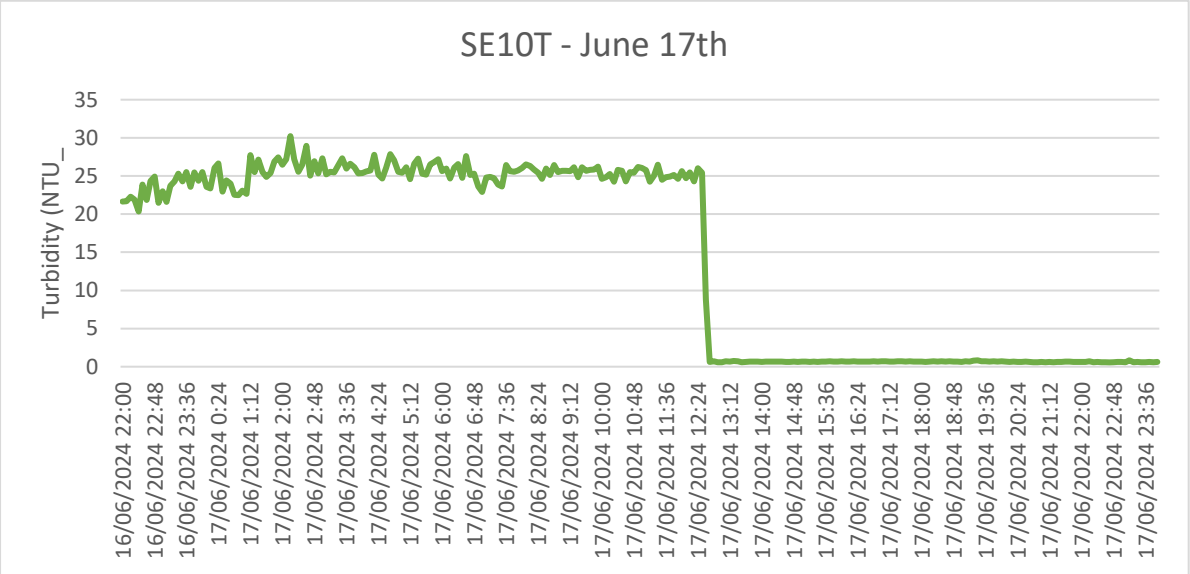
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.11. SE10T Potential Turbidity Events

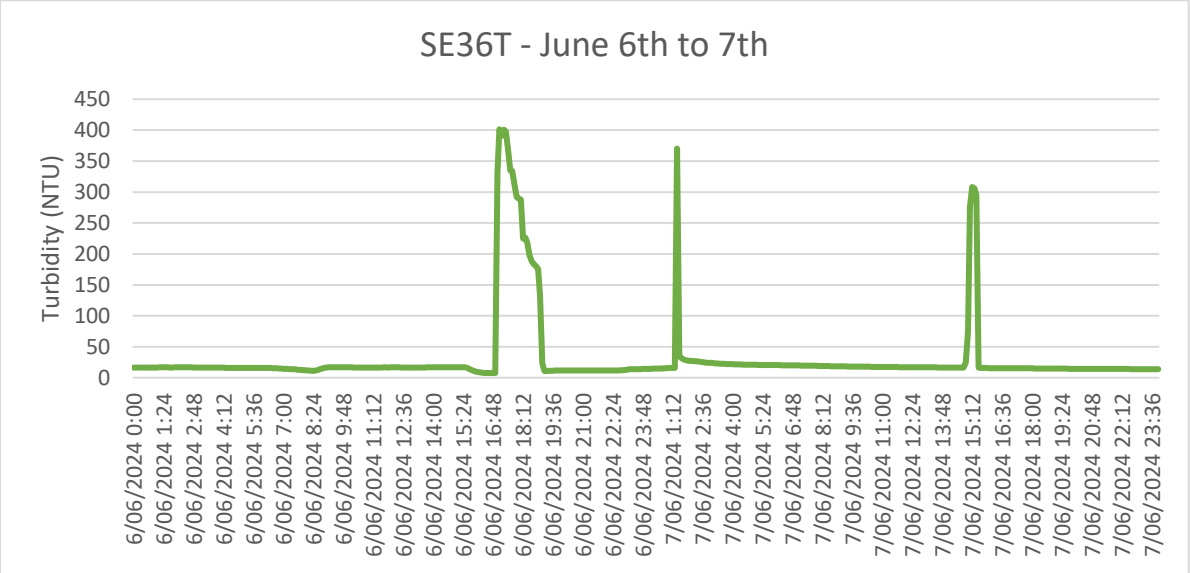
Chart(s) for data flagged at monitor SE10T are shown below for the potential events identified in the reporting period.



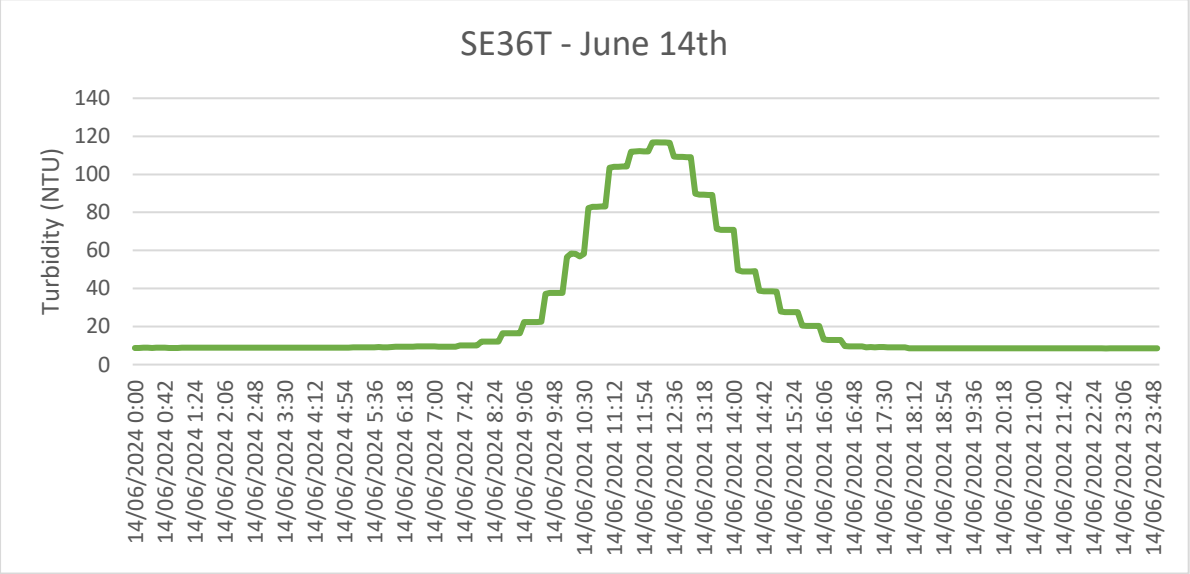
This event is marked by a sharp decline indicative of a 'false' event.

2.2.12. SE36T Potential Turbidity Events

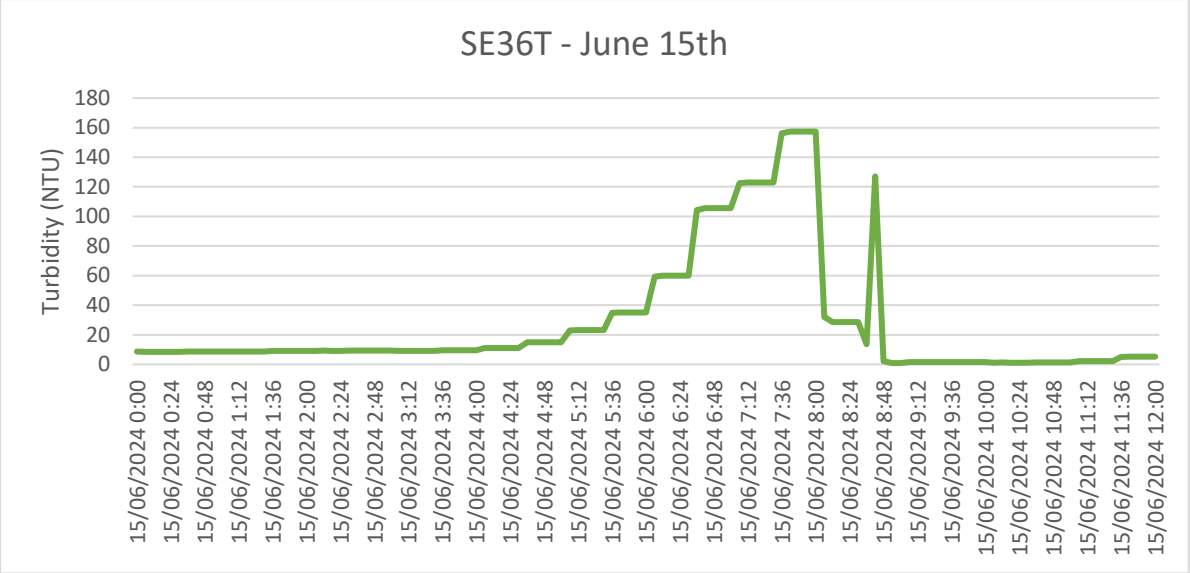
Chart(s) for data flagged at monitor SE36T are shown below for the potential events identified in the reporting period.



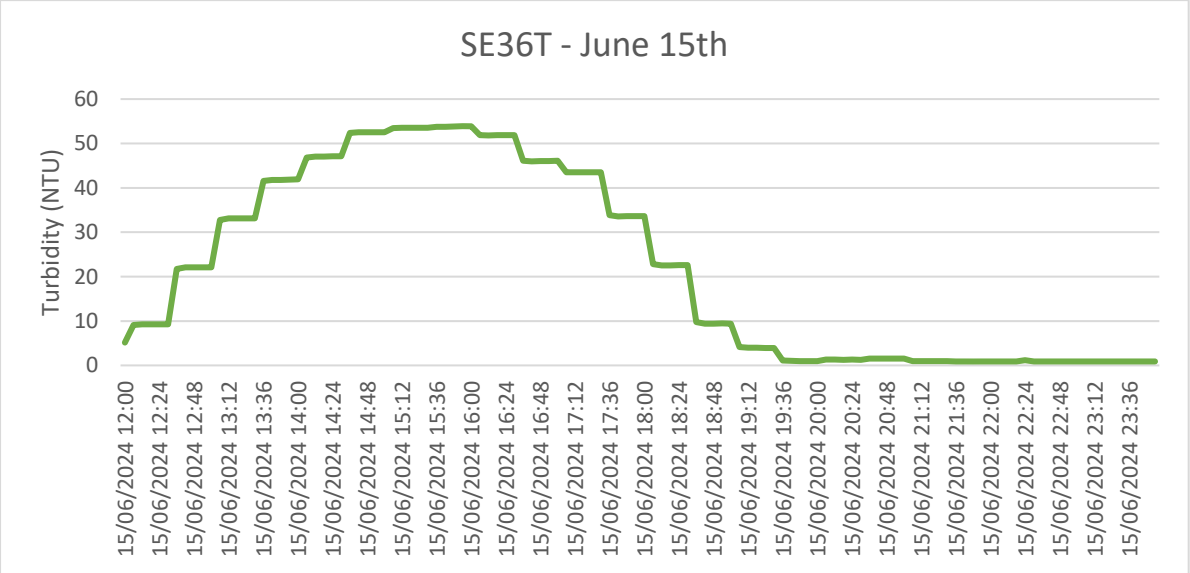
These events are marked by a sharp incline and declines indicative of 'false' events.



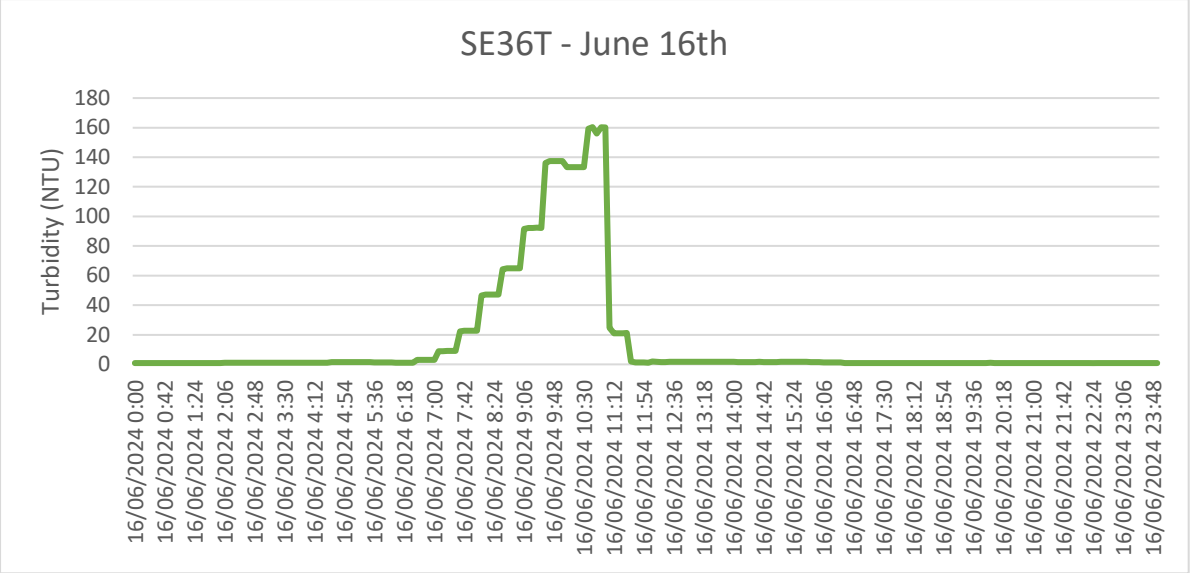
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation



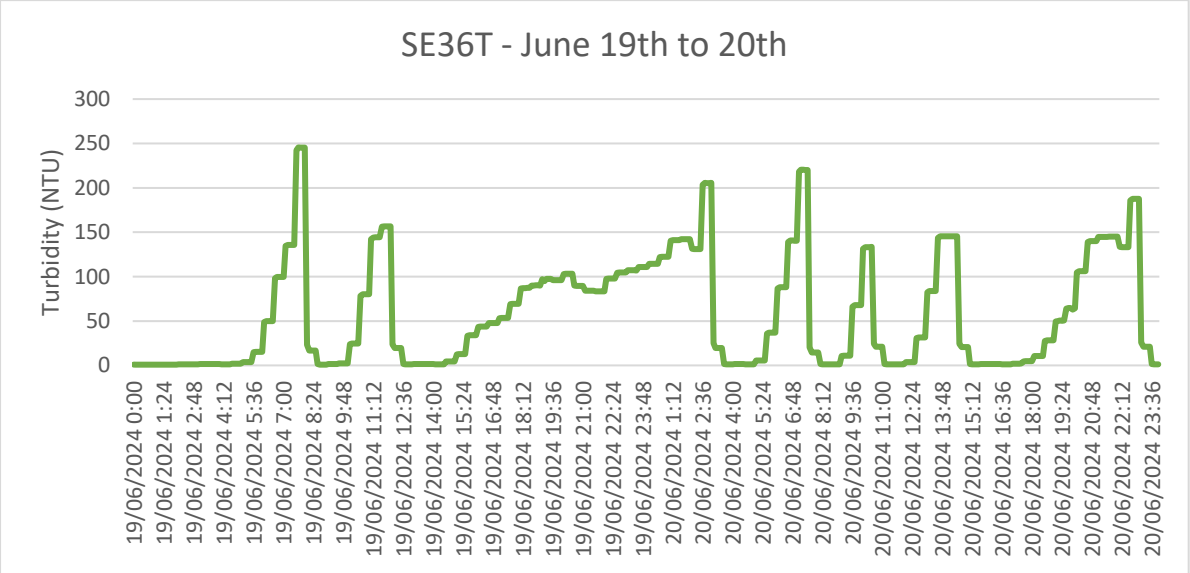
This event is marked by a sharp decline indicative of 'false' events.



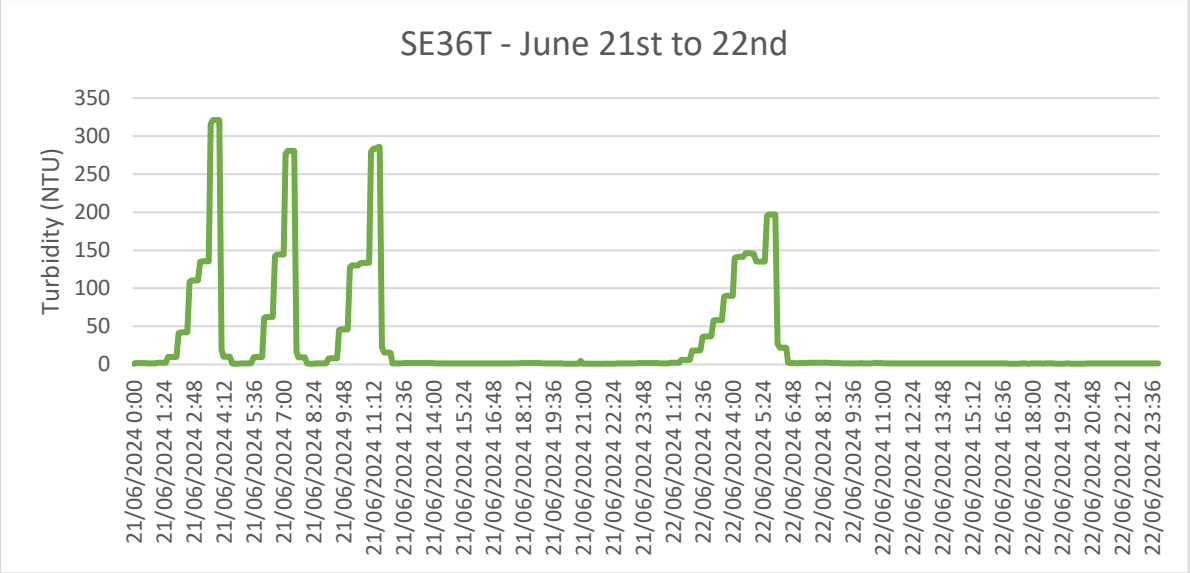
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



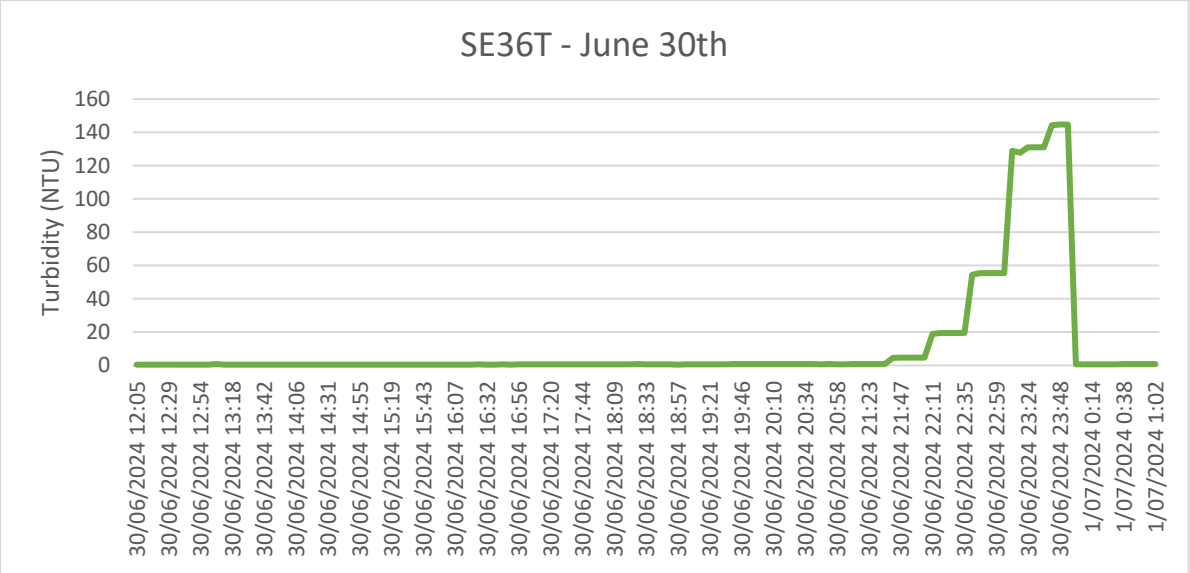
This event is marked by a sharp decline indicative of 'false' events.



These events are marked by sharp declines indicative of 'false' events.



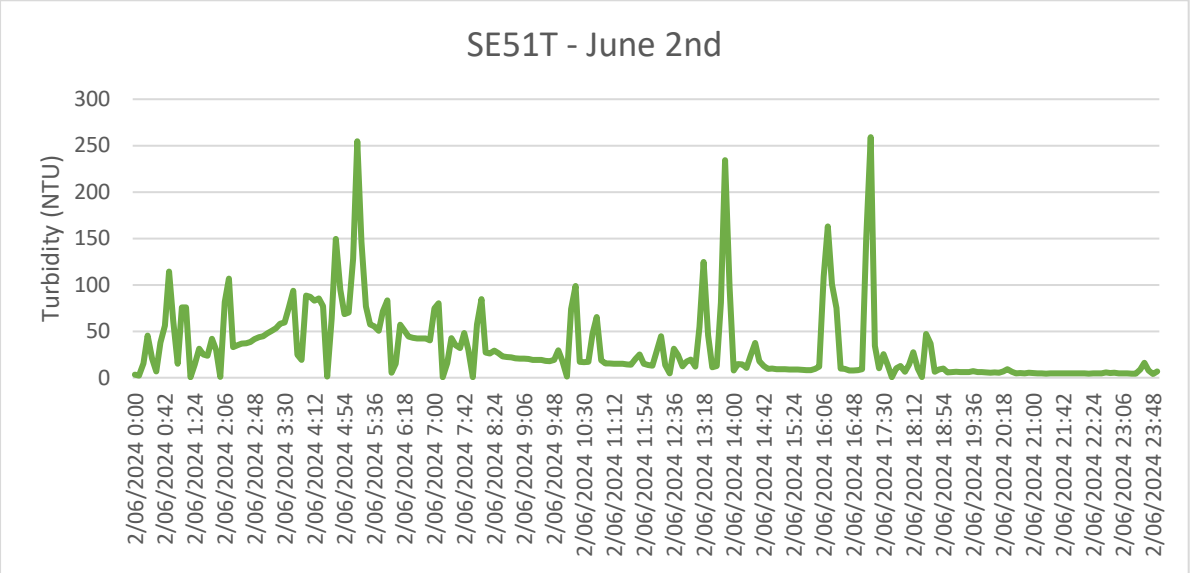
These events are marked by sharp declines indicative of 'false' events.



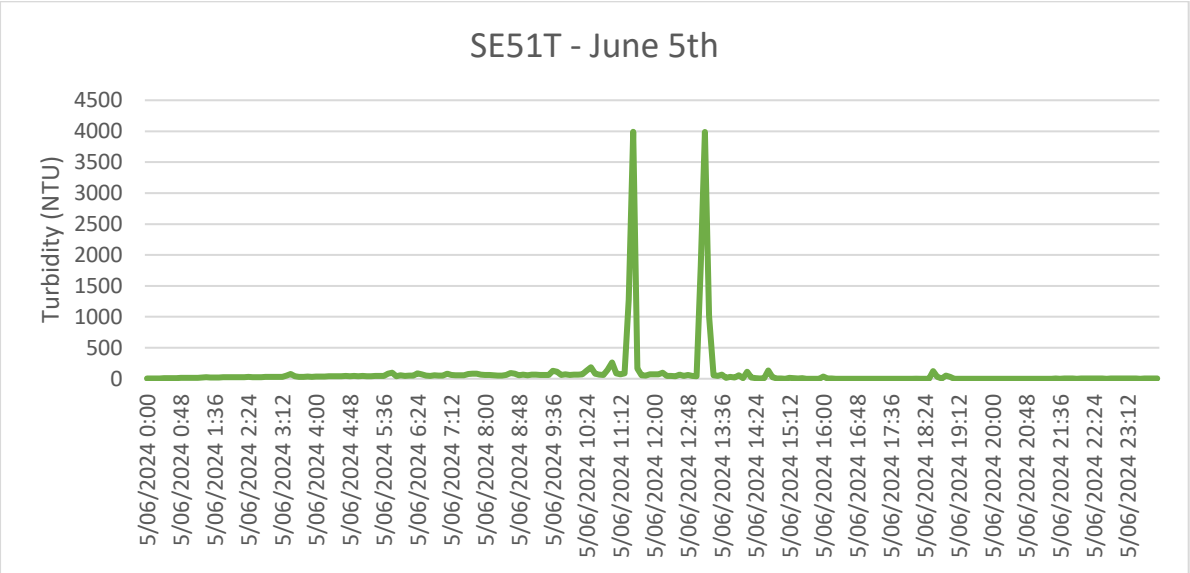
These events are marked by a sharp decline by July 1st (see July data) indicative of 'false' events.

2.2.13. SE51T Potential Turbidity Events

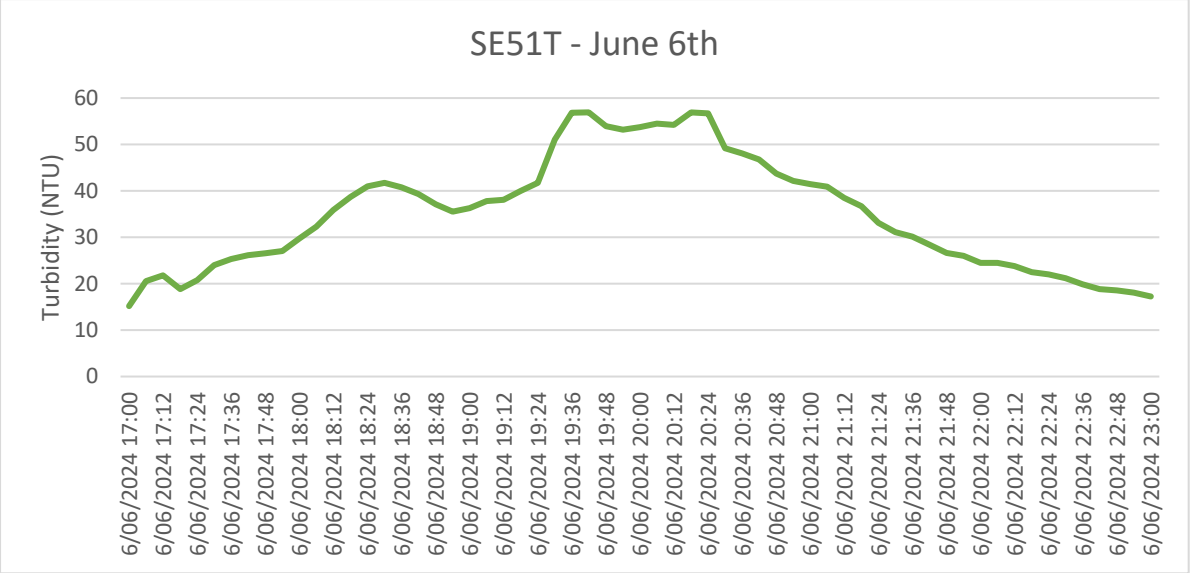
Chart(s) for data flagged at monitor SE51T are shown below for the potential events identified in the reporting period.



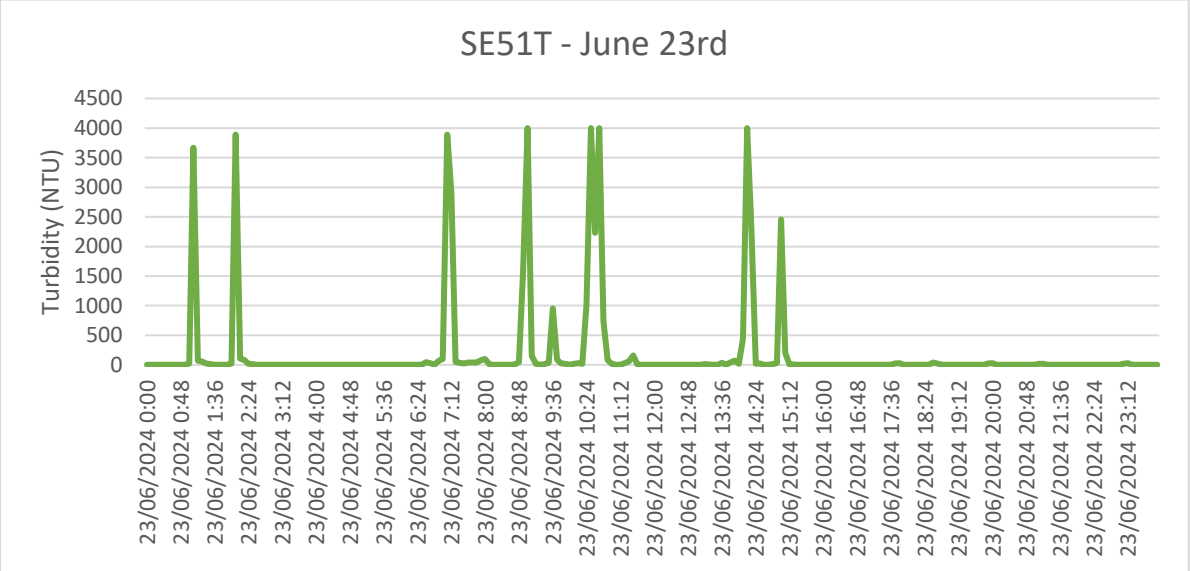
These events are marked by sporadic peaks indicative of 'false' events.



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



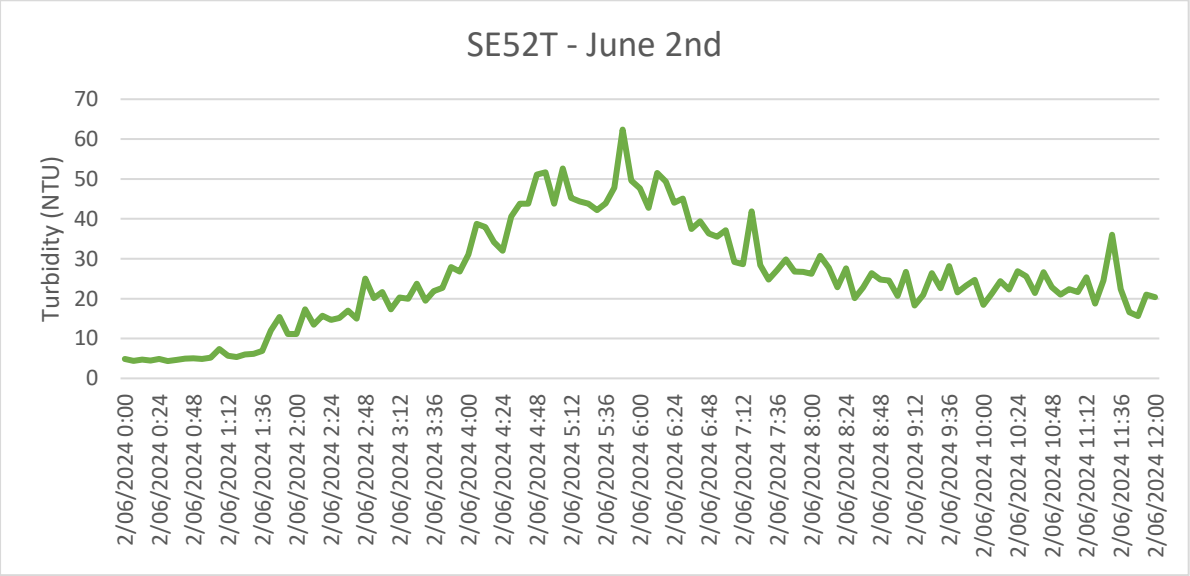
This event is marked by a slow return to background levels indicative of a 'true' event, flagged for further investigation.



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

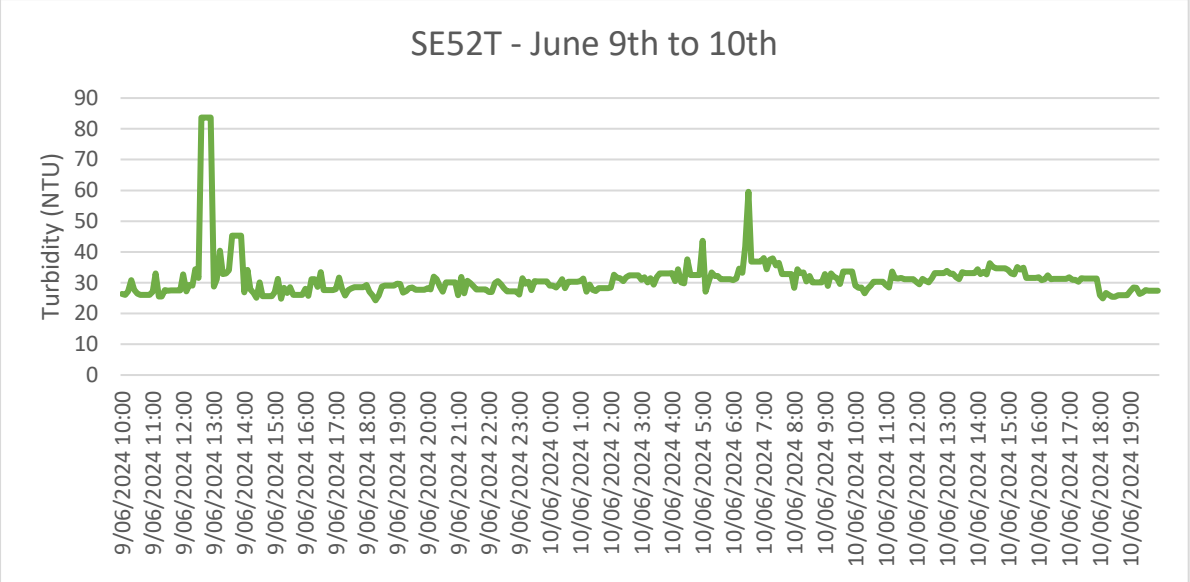
2.2.14. SE52T Potential Turbidity Events

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

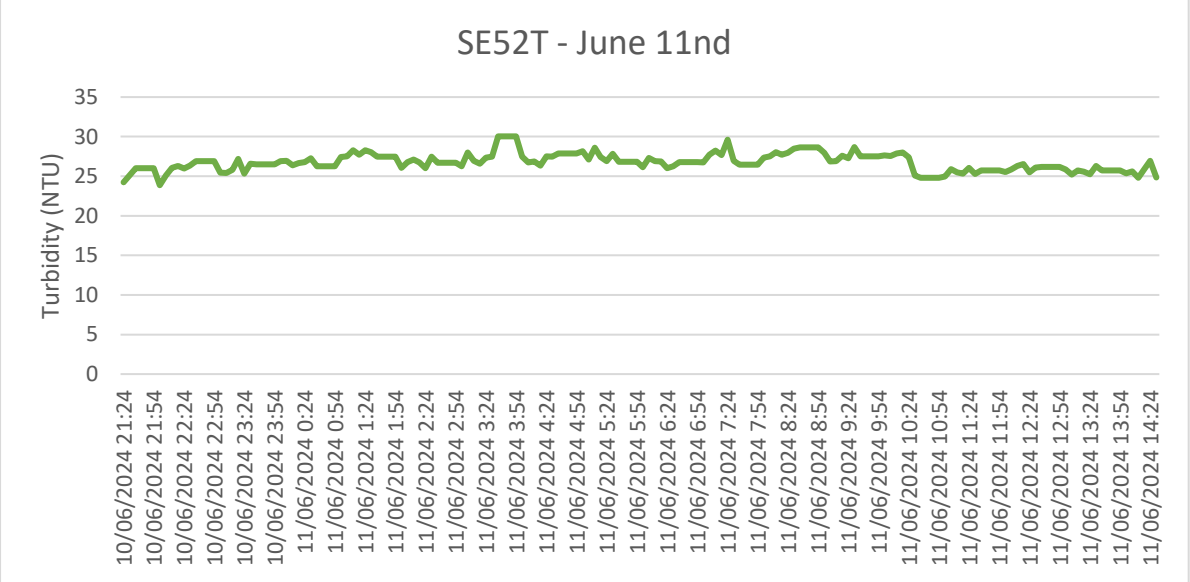


The event is marked by minor peaks but gradual return to background levels indicative of a 'true' event, flagged for further investigation

The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



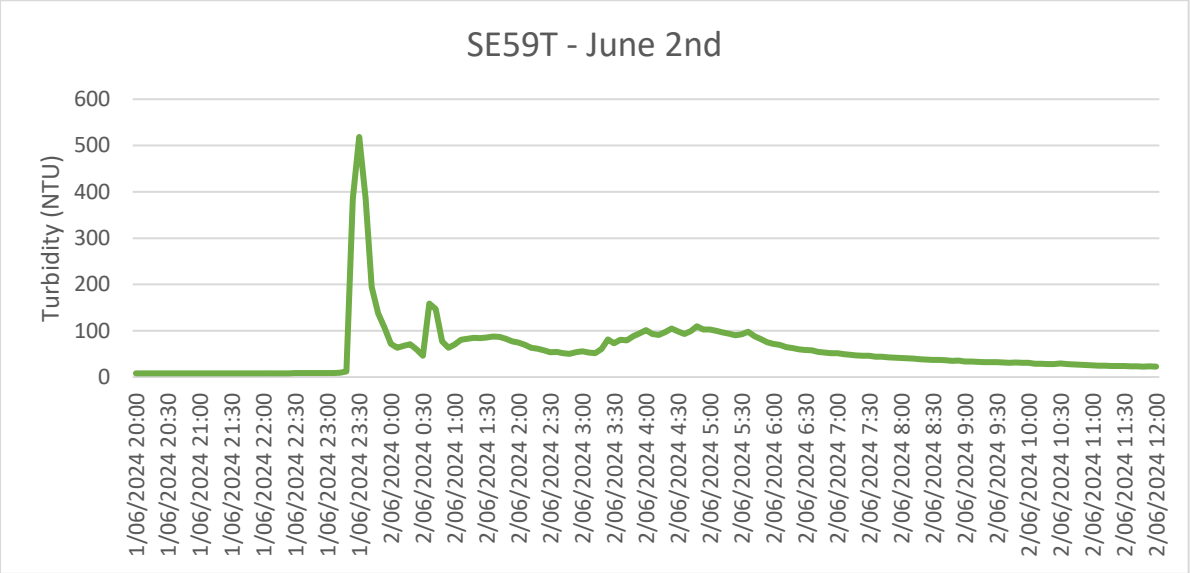
These events are assumed to be 'true' as a conservative measure, flagged for further investigation.



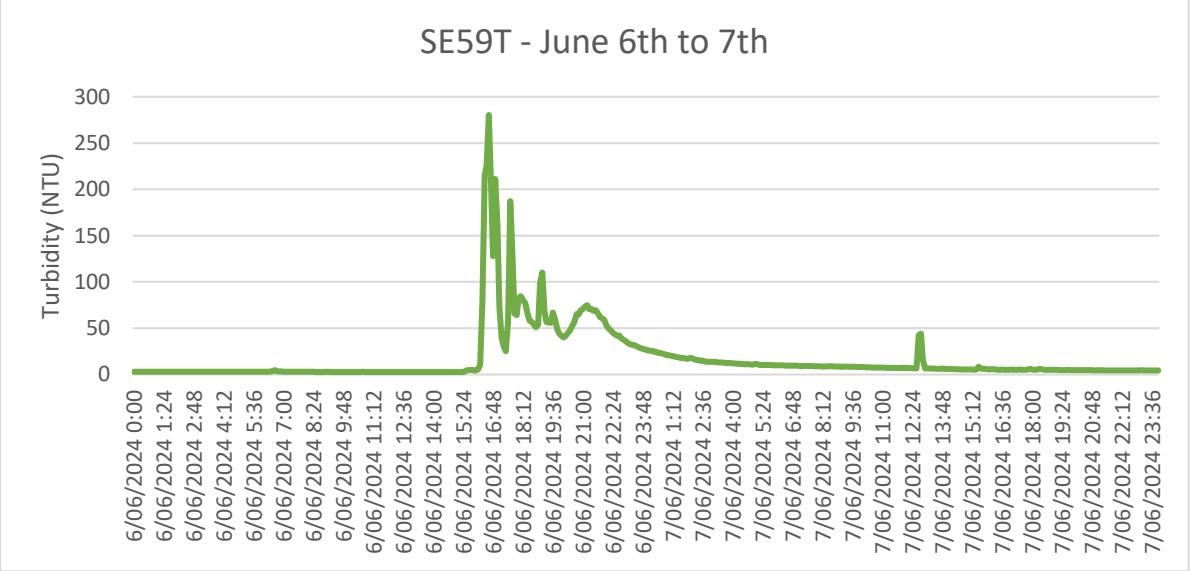
These events are assumed to be 'true' as a conservative measure, flagged for further investigation.

2.2.15. SE59T Potential Turbidity Events

Chart(s) for data flagged at monitor SE59T are shown below for the potential events identified in the reporting period.



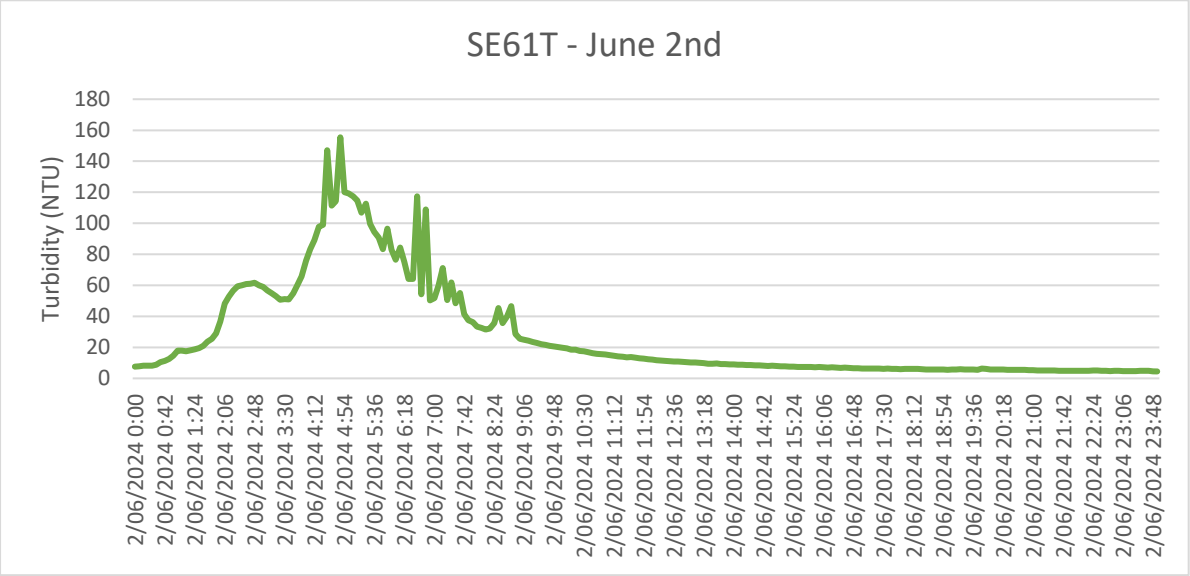
This event is marked by a slow return to background levels indicative of a 'true' event, flagged for further investigation.



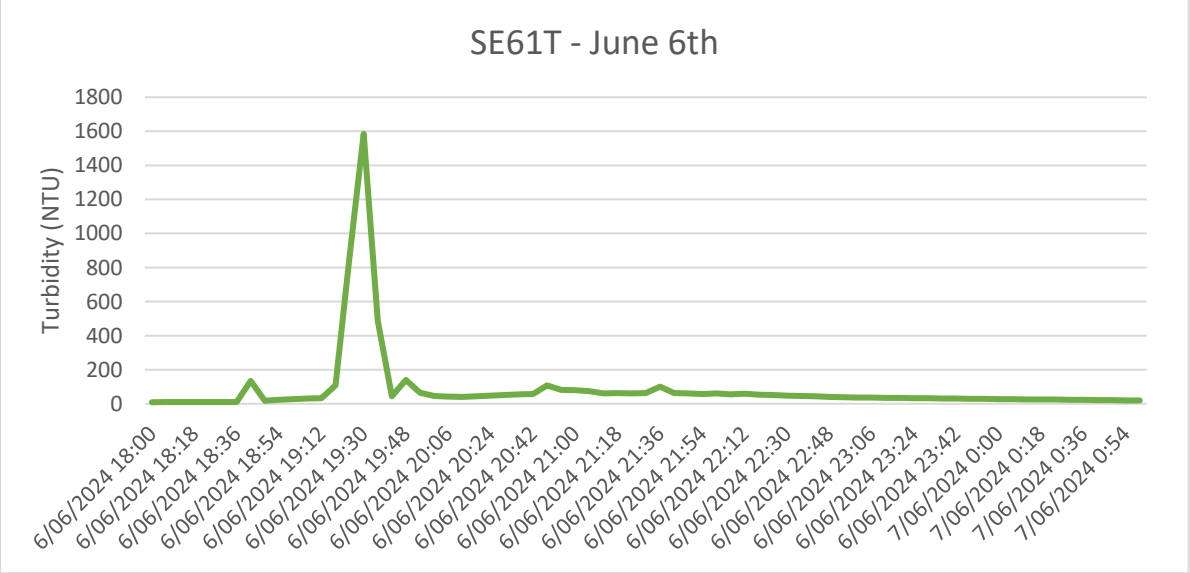
These events are marked by a slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.16. SE61T Potential Turbidity Events

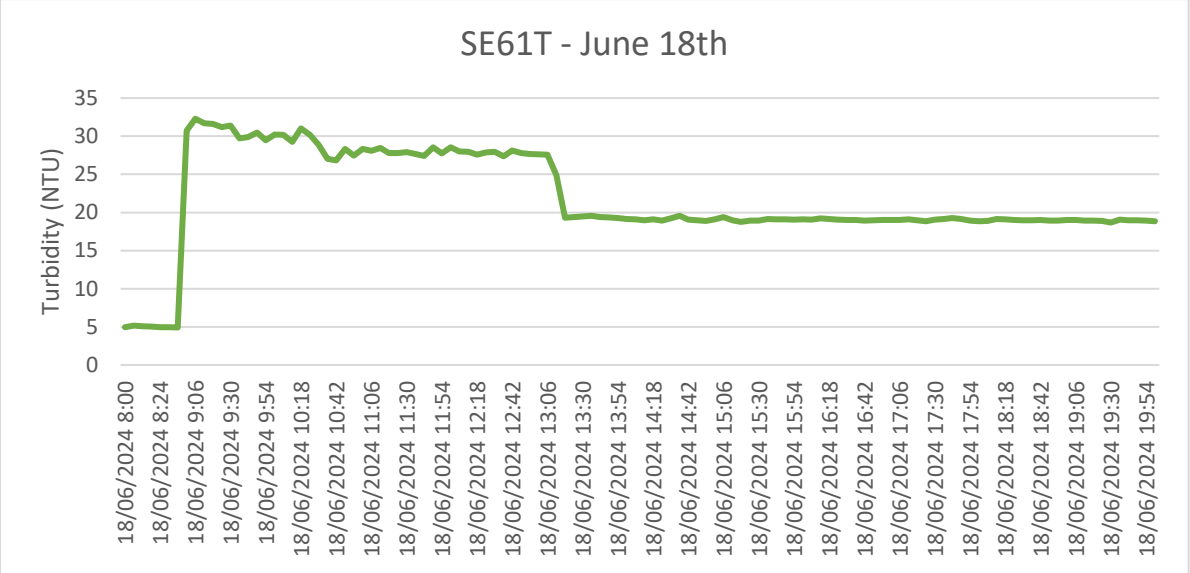
Chart(s) for data flagged at monitor SE61T are shown below for the potential events identified in the reporting period.



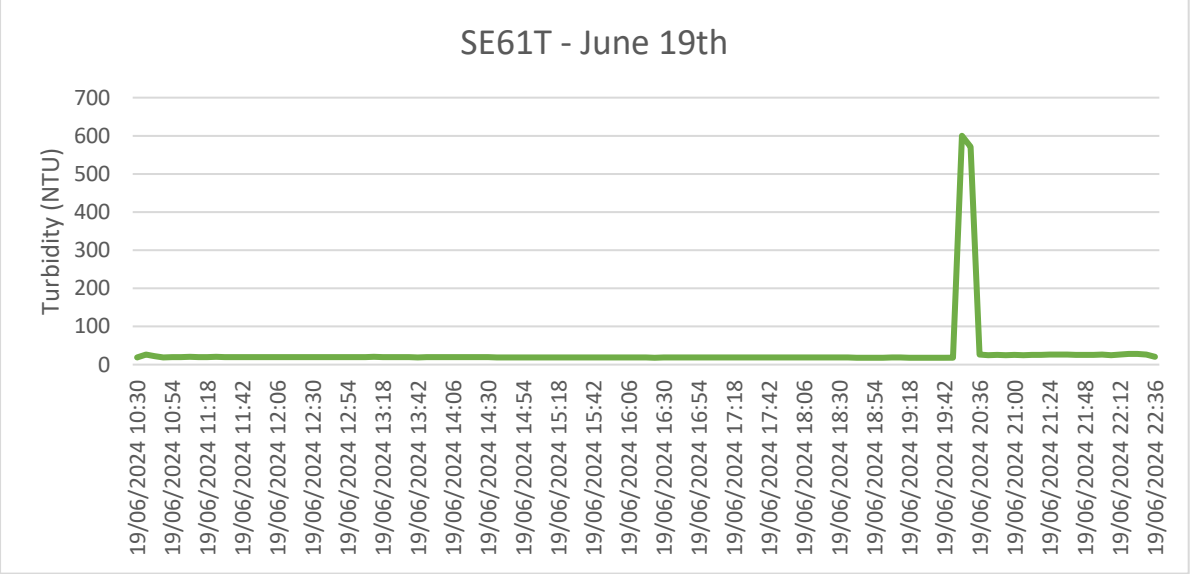
This event is marked by a slow return to background levels indicative of a 'true' event, flagged for further investigation.



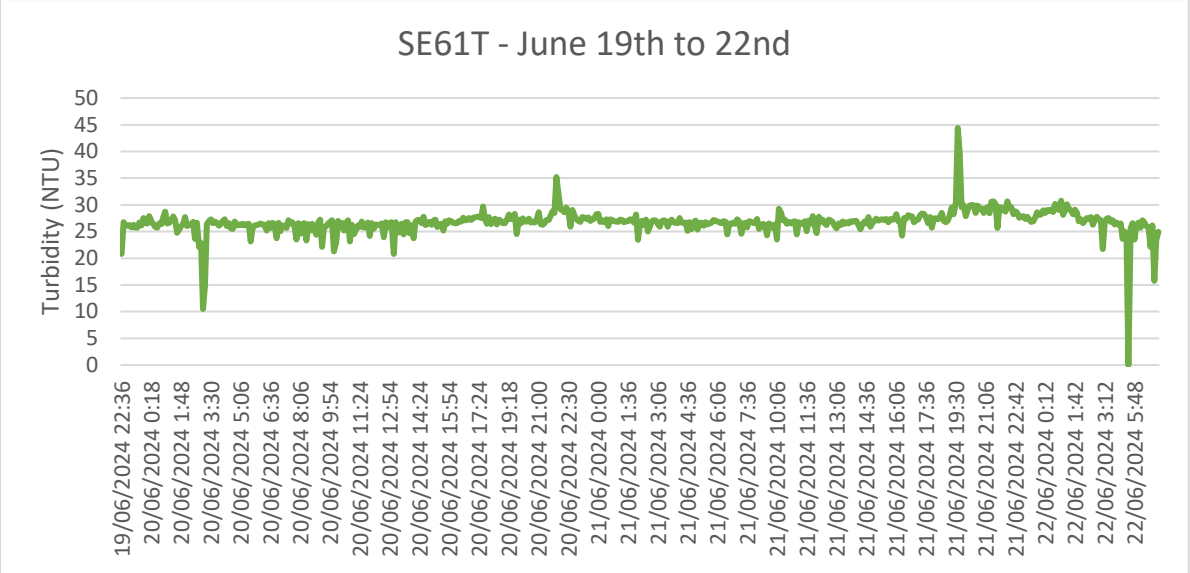
The event is marked by a slow return to background levels indicative of a 'true' event, flagged for further investigation.



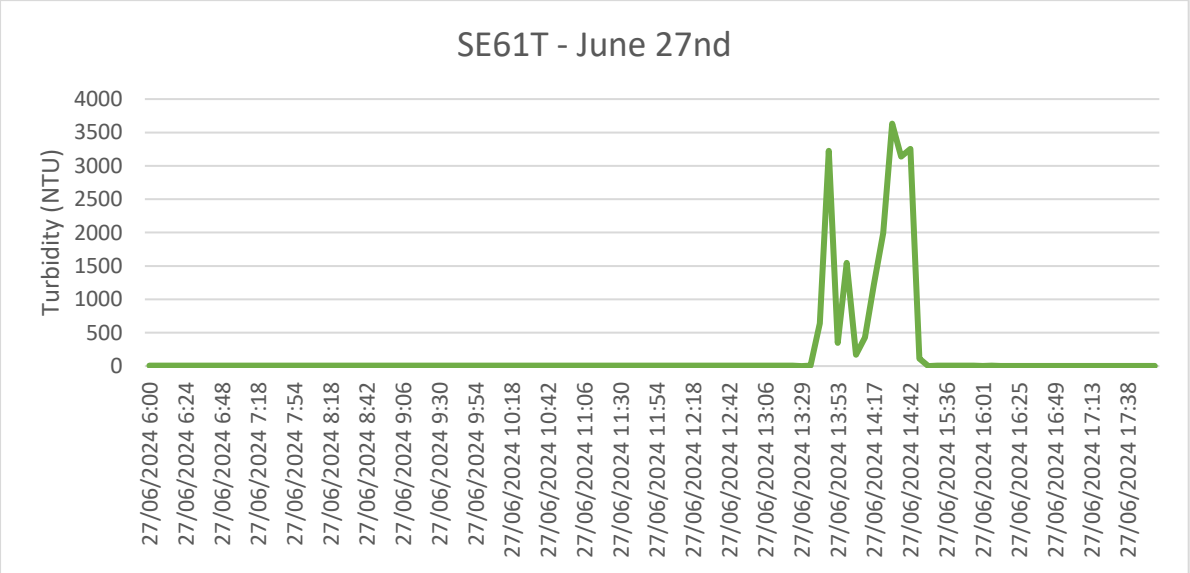
This event is marked by a sharp incline and decline indicative of a 'false' event.



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



These events are marked by sporadic peaks and a sharp decline, indicative of 'false' events.



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

2.3. True Turbidity Events

For this reporting period, 32 (thirty-two) 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-2406-001	ND07T	02/06/24	9:00:00 AM	10:36:00 AM	1hr 36min	43.38
HUN-2406-002	PD01T	02/06/24	12:54:00 AM	4:36:00 AM	3hrs 42min	43.5
HUN-2406-003	PD01T	06/06/24	5:30:00 PM	11:36:00 PM	6hrs 6min	177.91
HUN-2406-004	SE01T	02/06/24	6:24:00 AM	7:24:00 AM	1hr	532.5
HUN-2406-005	SE02T	06/06/24	4:48:00 PM	8:54:00 PM	4hrs 6min	240.25
HUN-2406-006	SE03T	02/06/24	2:42:00 AM	9:30:00 AM	6hrs 48min	68.21
HUN-2406-007	SE03T	06/06/24 -07/06/24	5:54:00 PM	2:30:00 AM	8hrs 36min	91.12
HUN-2406-008	SE05T	01/06/24 - 02/06/24	11:48:00PM	3:00:00AM	3hrs 2min	115.14
	SE05T	02/06/24	4:00:00AM	5:36:00AM	1hr 36min	49.27
HUN-2406-009	SE05T	06/06/24	4:36:00 PM	8:43:00 PM	4hrs 7min	216.23
HUN-2406-010	SE05T	27/06/24	8:18:00 AM	11:24:00 AM	2hrs 54min	85.4
HUN-2406-011	SE07T	07/06/24	12:48:00 PM	1:54:00 AM	1hr 6min	623.26
HUN-2406-012	SE07T	11/06/24	12:12:00 AM	2:12:00 AM	2hrs	622.91
HUN-2406-013	SE07T	13/06/24	9:36:00 AM	11:18:00 AM	1hr 42min	560.68
HUN-2406-014	SE07T	13/06/24 - 14/06/24	11:54:00 PM	2:30:00 AM	2hrs 36min	59.69
HUN-2406-015	SE07T	28/06/24	12:06:00 AM	2:12:00 AM	2hrs 6min	75.74
HUN-2406-016	SE07T	28/06/24	2:17:00 PM	5:31:00 PM	3hrs 12min	278.07
HUN-2406-017	SE08T	02/06/24	1:48:00PM	4:30:00 PM	2hrs 42min	131.67
HUN-2406-018	SE08T	07/06/24	8:12:00 AM	2:18:00 PM	6hrs 6min	131.71
HUN-2406-019	SE08T	08/06/24	9:24:00 PM	11:42:00 PM	2hrs 18min	157.98
HUN-2406-020	SE08T	09/06/24 – 10/06/24	6:12:00 PM	1:18:00 AM	7hrs 6min	128.94
HUN-2406-021	SE08T	10/06/24	12:48:00 PM	4:00:00 PM	3hrs 12min	127.13
HUN-2406-022	SE36T	14/06/24	9:36:00 AM	1:24:00 AM	3hrs 48min	116.83
HUN-2406-023	SE36T	15/06/24	1:06:00 PM	6:00:00 PM	4hrs 54min	53.87
HUN-2406-024	SE51T	06/06/24	5:36:00 PM	9:54:00 PM	4hr 18mins	56.92
HUN-2406-025	SE52T	02/06/24	3:48:00 AM	8:12:00 AM	2hrs 24min	62.39
HUN-2406-026	SE52T	06/06/24 – 07/06/24	6:30:00 PM	12:12:00 AM	5hrs 42min	139.43
HUN-2406-027	SE52T	09/06/24	10:00:00 AM	3:06:00 PM	5hrs 6min	83.67
	SE52T	09/06/24	3:18:00 PM	6:12:00 PM	2hrs 54min	33.44
	SE52T	09/06/24 -10/06/24	6:24:00PM	6:00PM	23hr 36min	59.52
	SE52T	10/06/24	6:12:00 PM	7:54:00 PM	1hr 42min	28.46
HUN-2406-028	SE52T	10/06/24 - 11/06/24	9:30:00 PM	10:30:00 AM	13hrs	30.04
	SE52T	11/06/24	11:06:00 AM	2:24:00 PM	3hrs 18min	26.93
HUN-2406-029	SE59T	01/06/24 - 02/06/24	11:24:00 PM	11:00:00 AM	11hrs 36min	518.5
HUN-2406-030	SE59T	06/06/24	4:18:00 PM	5:18:00 PM	1hr	280.21
	SE59T	06/06/24 -07/06/24	5:30:00 PM	12:12:00 AM	6hrs 42min	187.43
HUN-2406-031	SE61T	02/06/24	1:48:00 AM	9:00:00 AM	7hrs 12min	155.43
HUN-2406-032	SE61T	06/06/24 -07/06/24	7:06:00 PM	12:18:00 PM	5hrs 12min	1585.34

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-2406-001	Non-Mining Related	*Data trend shows extreme spike in turbidity values 1 hour prior to the event. NTU then increases from 3.5 to 35.5 within 12 minutes and remains steady for the remainder of the event before a gradual decline. Potentially a false event. Site was inspected by operations personnel on 2/06/2024, stream clear and flowing fast, with no evidence of mining sediment within the stream. Site inspected again on 3/06/2024, NTU on arrival 9.7, dropped to 0.3 after lens cleaning. Catchment area has been inspected, no evidence of mining contribution found.*
HUN-2406-002	Non-Mining Related	*A fault in the data taker caused time logs to revert to 1989, therefore event start/end time has been estimated based on site visit for installation. Estimated period of the event will be accurate within approximately 2 hours. Data trend shows relatively gradual incline and decline of turbidity values, coinciding with rainfall. Site inspected on 3/06/2024, stream clear, no evidence of mining sediment within the stream bed. Small amount of debris caught around sensor. Catchment area has been inspected, no evidence of mining contribution found.*
HUN-2406-003	Non-Mining Related	*Data trend shows gradual incline and decline coinciding with rainfall. Site was inspected by operational personnel on the 9/06/2024 and stream was clear and flowing. No evidence of mining event or sediments at the time of the inspection. Catchment area inspected, with no evidence of mining contribution found. Access track that runs along stream had lots of water pooled on it with evidence of run off into bush.*
HUN-2406-004	Non-Mining Related	*Stream inspected on 5/7/2024 and sensor cleaned. Stream was flowing but water level very low, sensor impacted by debris at the bottom of the stream bed.*
HUN-2406-005	Non-Mining Related	*Data trend shows erratic turbidity spikes with extreme peak turbidity values, intermittent from 5/06/2024 through to 6/06/2024, with exceedances ending around the time rainfall commenced indicating stream bed debris being flushed through. Over the duration of the rainfall, turbidity values dropped, with the occasional peak indicating debris being flushed through. Stream was inspected on 09/06/2024, flowing clear. Catchment area inspected, with no evidence of mining contribution found.*
HUN-2406-006	Non-Mining Related	*Data trend shows gradual incline and decline coinciding with rainfall. Site inspected on 4/06/2024, stream clear, slight build-up of debris around the sensor and stream level slightly lower than previous inspection on 29/05/2024. Catchment area was inspected, no signs of mining contribution found. Forest track run-off visible at same location 1.9km upstream, observed during previous field inspections.*
HUN-2406-007	Non-Mining Related	*Data trend on pi vision show an increase in spikes during peak of rainfall event with steady increase in NTU value and decrease in NTU as the rainfall intensity reduces. Site was inspected by operations personnel on the 7/06/2024 and stream was clear, flowing. No evidence of mining events or sediments at the time of inspection. Catchment areas inspected, no evidence of mining related event present. There was significant evidence of heavy watershed through the forest floor and erosion from nearby forest tracks*

HUN-2406-008	Non-Mining Related	*Data trend indicates true event. Stream clear at time of inspection, no evidence of mining sediment within the stream bed. Erosion scours are still visible across the bare forest floor post November fires. Ash sediment is evident within the stream. Catchment area has been inspected and no evidence of mining contribution found.*
HUN-2406-009	Non-Mining Related	*Data trend shows gradual incline and decline coinciding with rainfall, with a steady increase in NTU value. Site was inspected by operations personnel on 07/06/2024, stream was clear but heavily impacted by tannins. No evidence of mining sediment deposition on stream bed. Catchment area was inspected, no evidence of mining contribution found. Area heavily impacted by recent fires with little regrowth of ground vegetation. There was significant evidence of heavy watershed through the forest floor and erosion from nearby forest tracks (see photos).*
HUN-2406-010	Non-Mining Related	*Site was inspected on the 27/06/2024. Stream turbidity appearance at the time of inspection was noted as dark with suspended organic matter/sediment similarly noted after previous turbidity events at this site this year. Surrounding forest was impacted by fires in November 2023 and the forest floor is bare, with visible erosion scours and sediment build up in the stream bed and on the stream bank. Suspended particles are readily dispersed through the water when disturbed. Catchment inspection completed with no evidence of mining related contribution found.*
HUN-2406-011	Non-Mining Related	*Site inspected on the 6/06/2024 and was dry. Data coincides with the first flush of debris. Inspected again on the 9/06/2024 and the creek was flowing with very heavy debris build up in stream bed and on the vegetation on the streambank. Turbidity on arrival was 0.48 NTU.*
HUN-2406-012	Non-Mining Related	*Site inspected on the 13/06/2024, stream was flowing. Probe was partially out of the water. Lots of debris build up in stream bed. No evidence of mining impact. Event did not coincide with rainfall - occurred prior to rainfall.*
HUN-2406-013	Non-Mining Related	*Site inspected on the 13/06/2024, stream was flowing. NTU probe was partially out of the water. Lots of debris build up in stream bed. No evidence of mining impact. Event did not coincide with rainfall - occurred prior to rainfall.*
HUN-2406-014	Non-Mining Related	*Site inspected on the 17/06/2024, stream was dry. A lot of leaf debris present in the stream bed. No evidence of mining impact. Event did not coincide with rainfall - occurred prior to rainfall.*
HUN-2406-015	Non-Mining Related	*First stream flow from 13/06/2024. Stream dry 17/06/2024. Stream flow again on 28/06/2024 after 18mm of rainfall but depth below monitorable levels, sensor out of water. Stream has ponded at location of sensor, build up of leaf litter on the downstream side.*
HUN-2406-016	Non-Mining Related	*First stream flow from 13/06/2024. Stream dry 17/06/2024. Stream flow again on 28/06/2024 after 18mm of rainfall but depth below monitorable levels, sensor out of water. Stream has ponded at location of sensor, build up of leaf litter on the downstream side.*
HUN-2406-017	Non-Mining Related	*Stream flow started at SE08 on 6/06/2024.*

HUN-2406-018	Non-Mining Related	*Site inspected on the 09/06/2024 and was flowing but low. Sensor was out of the water. Increase in rainfall and stream water level increased as well, minor water erosion was observed on track road to SE08T monitor and flowing into the bush. Investigated drainage breach at Blacklock 15, 6, 5, Vern road and upstream of the monitor location. Staff found no evidence of mining related activity impacting stream.*
HUN-2406-019	Non-Mining Related	*Site inspected on the 09/06/2024 and was flowing but low. Sensor was out of the water. Debris noted on sensor and sensor impacted by stream bed soil and sediments.*
HUN-2406-020	Non-Mining Related	*Data trend does not line up with rain fall during event period. Operational staff inspected Monitor and stream is flowing but sensor is above water level.*
HUN-2406-021	Non-Mining Related	*Data trend does not line up with rain fall during event period. Operational staff inspected Monitor and stream is flowing but sensor is above water level.*
HUN-2406-022	Non-Mining Related	*Site inspected on 14/06/2024. Water in stream but stagnant and not flowing.*
HUN-2406-023	Non-Mining Related	*Operational staff inspected SE36T on 22/6/2024. Water in stream but was stagnant and not flowing. No evidence of mining impact.*
HUN-2406-024	Non-Mining Related	*Data trend indicates true event, showing turbidity to coincide with rainfall occurring on day of event. Vegetation growing on the stream bank is flowing with the current around the sensor and is potentially contributing to some of the turbidity spikes. Forest track into SE51T has had round humps installed by DBCA several years ago to slow water flowing down track - water flows directly into stream in multiple places. No mining impact observed - no sumps overflowing or drainage events from surrounding operational areas.*
HUN-2406-025	Non-Mining Related	*Data trend shows irregular spikes however turbidity values do not fluctuate to extremes and appear to coincide with auto-wipe function. Potentially false event. Site inspected on 3/06/2024, stream clear. Turbidity on arrival 26.16 NTU, dropped to 1.5 NTU after cleaning. Catchment area inspected, no evidence of mining contribution found.*
HUN-2406-026	Non-Mining Related	*Due to a radio comms issue, monitor was showing as "online" and displaying false turbidity values, so event was not found until a general site inspection on 15/06/2024. At the time of inspection, leaf litter/debris was caught around the sensor, and algae on lens. Data trend is slightly irregular and does suggest possible debris impacting lens, but increase does coincide with rainfall. Potentially a false event resulting from increased stream flow flushing debris. Catchment inspected to rule out mining contribution, no issues found. SE52T has now been upgraded to the Telstra IOT telemetry platform.*
HUN-2406-027	Non-Mining Related	*Due to a radio comms issue, monitor was showing as "online" and displaying false turbidity values, so event was not found until a general site inspection on 15/06/2024. At the time of inspection, leaf litter/debris was caught around the sensor, and algae on lens. Data trend is slightly irregular and does suggest possible debris impacting lens, but increase does coincide with rainfall. Potentially a false event resulting from increased stream flow flushing debris. Catchment inspected to rule out mining contribution, no issues found. SE52T has now been upgraded to the Telstra IOT telemetry platform.*
HUN-2406-028	Non-Mining Related	*Due to a radio comms issue, monitor was showing as "online" and displaying false turbidity values, so event was not found until a general site inspection on 15/06/2024. At the time of inspection, leaf litter/debris was caught around the sensor, and algae on lens. Data trend is slightly irregular and does suggest possible debris impacting lens, but increase*

		does coincide with rainfall. Potentially a false event resulting from increased stream flow flushing debris. Catchment inspected to rule out mining contribution, no issues found. SE52T has now been upgraded to the Telstra IOT telemetry platform.
HUN-2406-029	Non-Mining Related	*Data trend shows an extreme spike from 11.89 NTU up to 518.50 NTU within 12 minutes, followed by a smaller spike, after 12.7mm of rainfall. Turbidity values then declined and remained steady at an average of 60.60 NTU for the remainder of the event. Site was inspected on 3/06/2024, stream was clear however ash sediment visible in the stream bed and on the sensor. Erosion scours are evident across the bare forest floor following the November fires, stormwater runoff making contact with the stream and ash sediment is visibly built up in areas of the stream bed. Catchment area has been inspected, no evidence of mining contribution has been found.*
HUN-2406-030	Non-Mining Related	*Data trend shows consistent turbidity spikes with rainfall intensity, NTU values went from low to extreme exceedances at the time rain commenced and some debris flushed through sensors occasionally indicating a consistent trend in rainfall event. Catchment area inspection shows no evidence of mining related event. surrounding areas of SE59T still indicates burnt debris due to recent fire events. NTU on arrival is 7.23 NTU and remains consistent without with current trends.*
HUN-2406-031	Non-Mining Related	*Data trend shows gradual incline and decline coinciding with rainfall, with some spikes in turbidity values. Site inspected on 3/06/2024, stream clear, no evidence of mining sediment within the stream bed. Catchment area was inspected, no evidence of mining contribution found. Some areas of forest track run off potentially contacting the stream.*
HUN-2406-032	Non-Mining Related	*Data trends show a spike in NTU and steady decrease coinciding with rainfall intensity. Site was inspected by operations personnel on the 9/06/2024 and stream was clear and flowing. No evidence of mining related activity at the time of inspection. There was visual evidence of water flowing through the forest track and into the stream area. This location seems to be very wet during winter season. Turbidity was recorded at 6.76 NTU*

No further investigation is required at this time of the events flagged within.

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.

4. Raw WQMS Data

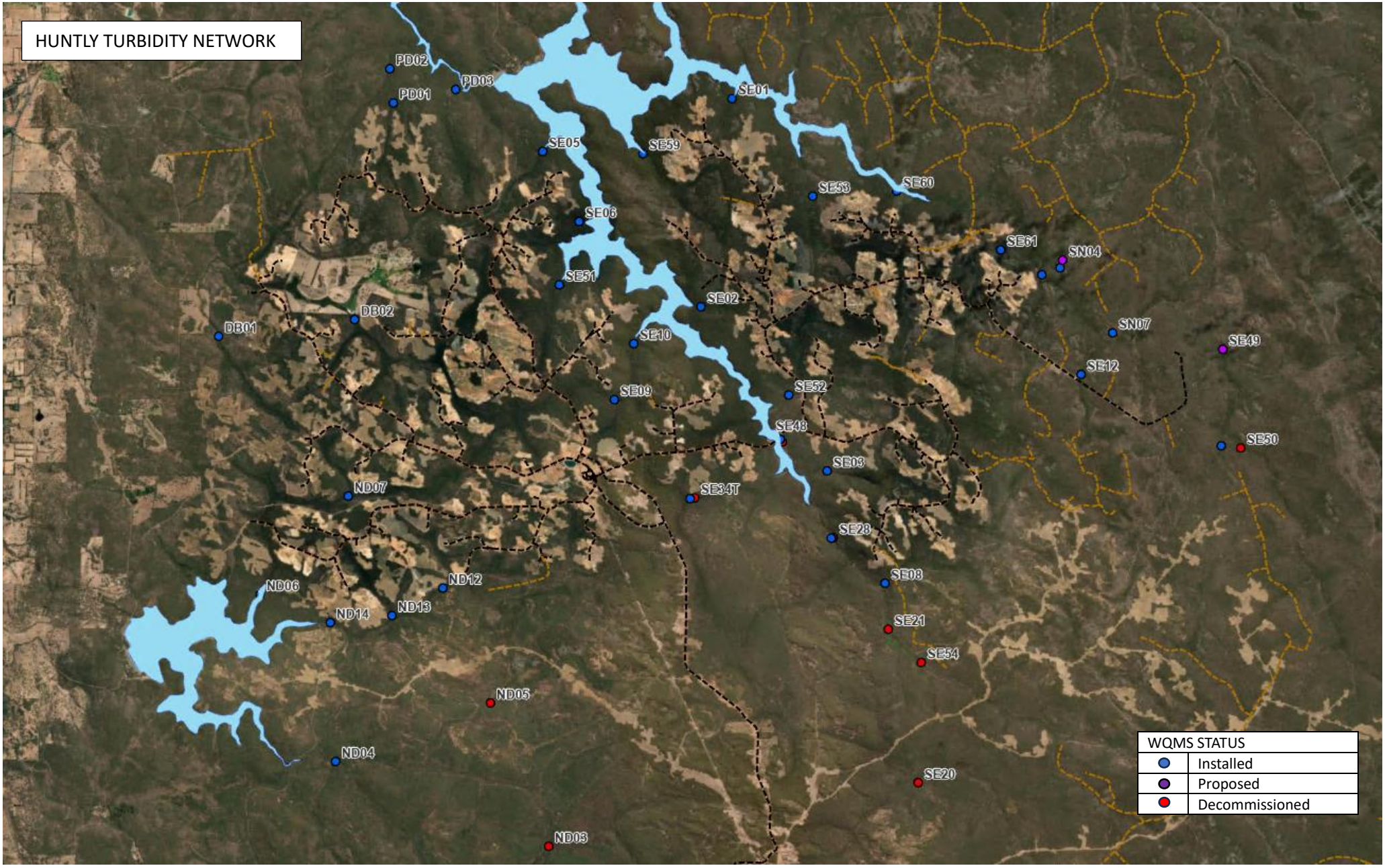
Date	Huntly WQMS Data - June 2024 - Events with turbidity > 25 NTU for an hour or more																						
	DB01T	DB02T	ND06T	ND07T	ND13T	ND12T	ND14T	PD01T	SE01T	SE02T	SE03T	SE05T	SE06T	SE07T	SE08T	SE09T	SE10T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE61T
1/06/2024					**1**																			
2/06/2024				**1**				**1**	**1**		**1**	**2**	**3**		**1**	**1**				**3**	**1**		**1**	**1**
3/06/2024													**1**											
4/06/2024																								
5/06/2024																				**1**				
6/06/2024								**1**		**1**	**1**	**1**						**1**		**1**	**1**		**2**	**1**
7/06/2024														**1**	**1**			**1**						
8/06/2024															**1**									
9/06/2024															**1**						**3**			
10/06/2024															**1**						**2**			
11/06/2024														**1**							**1**			
12/06/2024							**1**							**1**							**2**			
13/06/2024														**1**										
14/06/2024											**4**			**1**				**1**	**1**					
15/06/2024																		**1** | **1**						
16/06/2024																		**1**						
17/06/2024																	**1**							
18/06/2024																								**1**
19/06/2024																		**3**						**2**
20/06/2024																		**4**						**4**
21/06/2024																		**3**						**4**
22/06/2024																		**1**						
23/06/2024																				**1**				
24/06/2024																		**2**						
25/06/2024																		**5**						
26/06/2024																								
27/06/2024												**1**												**1**
28/06/2024														**2**										
29/06/2024																								
30/06/2024																		**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 - June 2024 - Turbidity (Daily Average, NTU)																							
	DB01T	DB02T	ND06T	ND07T	ND13T	ND12T	ND14T	PD01T	SE01T	SE02T	SE03T	SE05T	SE06T	SE07T	SE08T	SE09T	SE10T	SE36T	SE48T	SE51T	SE52T	SE53T	SE59T	SE61T
1/06/2024	0.9	1.6	2.5	5.4	16.5	9.7	0.9	2.1	4.7	5.4	7.9	3.7	3.4	0.5	8.6	1.2	3.9	17.6	13.1	19.9	2.6	0.5	11.2	4.2
2/06/2024	1.1	1.9	8.9	14.7	2.5	5.0	6.9	11.4	**35.6**	5.9	20.6	15.9	**94.9**	7.9	15.0	12.5	5.3	13.3	3.5	**33.0**	22.6	3.6	**40.9**	**27.4**
3/06/2024	1.0	1.7	2.6	7.3	1.9	5.5	1.2	2.4	5.3	5.6	3.9	3.1	**69.2**	0.9	2.5	**62.6**	2.8	14.9	6.1	9.7	11.3	0.2	6.4	4.6
4/06/2024	0.9	1.6	1.6	0.3	1.4	8.6	1.0		5.4	13.8	2.2	2.5	0.4	0.9	4.6	**45.4**	2.7	12.2	8.9	2.0	1.0	0.9	2.8	3.2
5/06/2024	0.9	1.8	1.6	0.4	1.4	10.3	0.9	1.8	3.8	5.6	1.9	3.3	0.5	1.0	6.5	**38.6**	3.8	13.8	12.5	**83.5**	0.9	0.5	2.9	3.2
6/06/2024	1.0	1.7	2.5	0.6	1.4	7.3	3.0	23.5	0.6	20.9	16.5	17.3	2.7	2.2	5.3	14.7	2.8	**37.9**	10.3	**35.1**	15.3	1.7	24.4	**25.8**
7/06/2024	1.0	1.6	2.9	0.5	1.4	2.7	1.8		0.6	15.9	11.8	4.2	0.7	17.6	24.8	1.2	1.2	24.0	7.1	**98.9**	15.9	1.3	9.5	6.7
8/06/2024	0.9	1.6	1.7	0.4	1.6	2.4	1.2	1.6	0.2	20.7	4.1	3.5	1.1	1.6	12.5	1.0	0.3	11.8	13.7	**64.7**	15.6	0.9	4.4	3.3
9/06/2024	1.0	1.7	3.1	0.5	2.2	2.5	3.1	2.4	0.5	22.8	13.0	5.5	2.0	9.6	24.5	1.1	0.8	11.2	3.2	4.4	**25.8**	1.1	10.4	5.4
10/06/2024	4.4	1.7	2.0	0.4	1.4	2.2	1.3		0.4	22.0	8.7	5.7	3.1	2.1	18.6	1.0	0.9	13.1	2.3	2.5	**30.6**	0.2	6.4	4.5
11/06/2024	3.8	1.6	1.7	0.4	1.4	2.7	1.3	2.2	0.0	22.5	3.7	5.1	4.2	**30.7**	1.8	1.0	0.4	13.7	2.0	1.5	**25.5**	0.5	6.0	3.8
12/06/2024	3.0	1.6	1.6	0.4	1.4	2.2	**397.8**	2.1	0.1	**25.1**	3.2	5.5	7.6	3.7	1.8	1.0	0.4	14.1	3.6	1.4	**38.1**	2.1	4.6	4.3
13/06/2024	1.2	1.6	1.6	0.6	1.6	1.9	**2078.3**	1.7	1.6	7.7	6.3	5.4	14.7	24.2	1.1	1.1	1.3	9.5	2.5	1.2	**55.2**	0.5	4.6	5.1
14/06/2024	1.4	1.6	1.7	0.4	1.4	1.9	**3800.2**	1.8	0.2	16.8	17.0	5.6	12.8	6.0	1.2	1.1	1.7	**26.2**	7.3	1.3	**45.2**	0.5	4.6	4.2
15/06/2024	1.7	1.6	1.8	0.6	1.4	1.9	**1739.6**	1.9	0.4	7.3	2.1	6.0	3.0	0.1	1.2	1.0	7.1	**25.3**	1.9	1.6	19.5	0.8	5.5	4.7
16/06/2024	1.6	1.7	1.9	0.4	1.4	2.0	0.9	2.6	0.7	7.7	2.3	7.3	0.7	0.3	1.2	1.2	11.6	15.3	2.0	**31.1**	1.2	3.8	5.5	5.2
17/06/2024	0.9	1.7	1.9		1.4	1.9	0.9		0.3	7.6	2.3	8.0	0.5	0.9	1.1	1.1	14.2	0.9	1.8	8.1	1.1	1.0	5.7	6.3
18/06/2024	0.9	1.5	2.1		1.4	1.9	0.9	2.9	0.4	6.3	2.1	6.9	0.6	0.1	1.2	1.0	0.7	1.0	1.8	1.5	0.8	0.5	5.8	16.0
19/06/2024	0.9	1.4	2.1		1.8	1.9	0.9		0.8	9.4	2.1	10.3	0.8	0.0	1.2	1.1	0.6	**48.1**	1.9	1.6	0.2	0.2	5.7	24.6
20/06/2024	0.9	1.5	2.1		1.4	1.8	0.9	3.4	1.2	6.1	2.1		0.7	0.0	1.2	1.2	0.3	**66.9**	2.1	1.8	0.2	1.1	5.7	**26.4**
21/06/2024	0.9	1.5	2.3		1.4	1.6	0.8	3.7	0.1	6.0	2.1		0.8	0.0	1.2	1.1	0.3	**37.5**	1.9	2.1	0.2	0.5	5.9	**27.3**
22/06/2024	0.9	1.5	2.3		1.4	1.7	1.2		0.1	15.2	2.8	6.2	1.5	0.1	1.2	1.1	0.3	18.8	2.3	**200.8**	0.2	1.3	7.1	12.9
23/06/2024	0.9	1.5	1.8		1.4	1.6	0.8	3.2	0.1	6.2	2.3	6.7	1.6	0.0	1.2	1.1	0.4	1.2	1.9	**188.0**	0.2	0.6	6.1	5.6
24/06/2024	1.0	1.5	1.9		1.4	1.7	0.8	3.4	0.1	10.1	2.2	6.7	1.0	0.0	1.2	1.1	0.4	**39.0**	1.9	**27.6**	0.2	0.7	6.4	5.8
25/06/2024	1.0	1.5	2.0		1.4	1.7	0.9	3.3	0.1	16.0	2.2		1.0	0.3	1.2	1.1	0.4	**106.5**	1.9	8.5	0.2	1.1	6.7	6.1
26/06/2024	0.9	1.5	2.2		1.4	1.7	0.9		0.1	22.8	2.7	8.4	1.4	0.6	1.2	1.1		3.9	2.2	**49.5**	0.2	1.6	7.1	7.0
27/06/2024	0.9	1.5	2.7		1.4	1.7	1.1	5.5	0.1	24.1	6.0	13.5	2.6	1.9	1.2	1.1		0.7	2.2	**40.3**	0.2	0.7	14.3	**92.3**
28/06/2024	0.9	1.5	1.9		1.4	2.0	0.9	3.3	0.1	23.1	3.3	5.7	0.8	**30.6**	1.1	1.1	**61.0**	0.5	1.9	**79.3**	0.2	1.2	4.7	2.4
29/06/2024	0.9	1.5	1.5		1.4	1.7	0.9		0.1	24.3	3.1	6.4	0.6	0.8	1.1	1.1	1.6	0.5	1.8		0.2	1.0	2.4	3.7
30/06/2024	0.9	1.5	1.4		1.6	1.7	0.9		0.1	22.1	3.0	5.3	0.7	1.1	1.1	1.1	1.7	4.1	1.9		0.2	0.6	2.9	1.8

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 NETWORK
PD02
PD03
PD01
SE01
SE05
SE59
SE53
SE60
SE06
SE61
SN04
SE51
SE02
DB02
DB01
SE10
SN07
SE49
SE12
SE09
SE52
SE48
SE50
SE03
ND07
SE34T
SE28
SE08
ND12
ND06
ND13
ND14
SE21
SE54
ND05
ND04
SE20
ND03
WQMS STATUS
Installed
Proposed
Decommissioned

Appendix B. 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

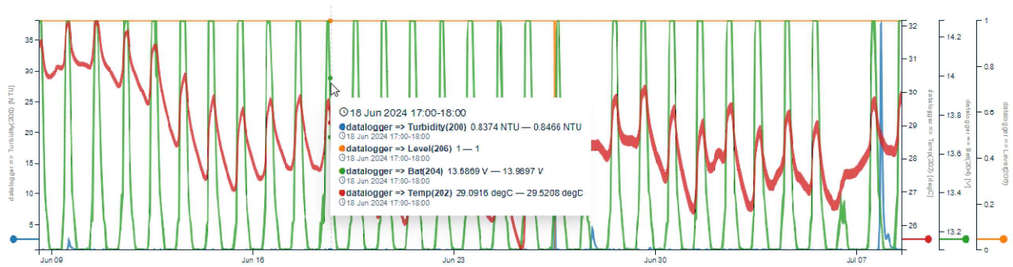
DATA INLET

SENSOR

STREAM DRY

SENSOR

STREAM FLOWING



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 U.N.O.
LEVELS ARE IN METRES ON AHD U.N.O.
DO NOT SCALE DRAWING
IF IN DOUBT - ASK
TOLERANCES ISO2768-m U.N.O.
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SCIDEV

TITLE
IOT TURBIDITY MONITORING STATION
SITE LAYOUT
GENERAL ARRANGEMENT

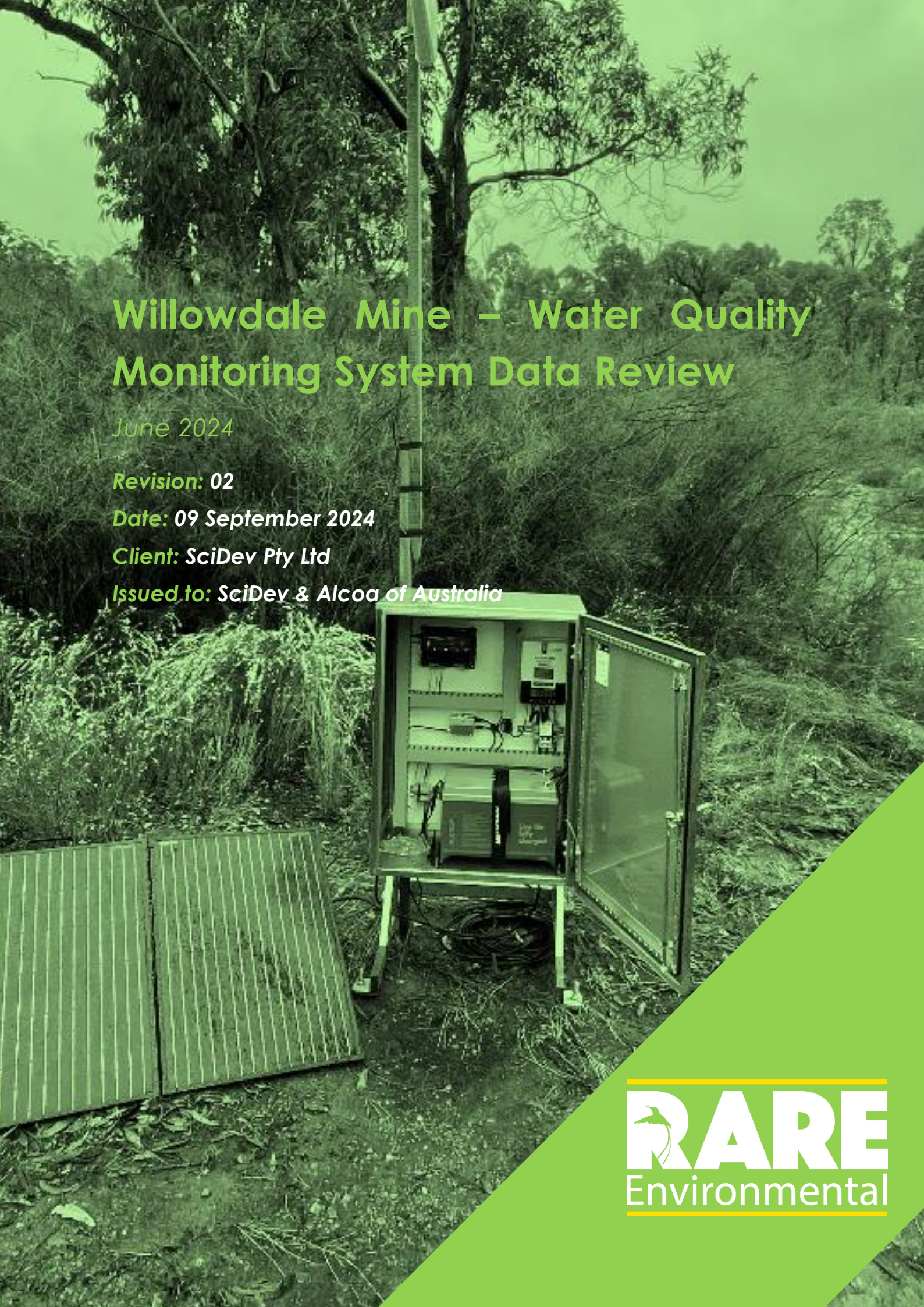
SHEET 1 OF 2

SCALE NTS OR AS SHOWN

DRAWING NO.
HI0090 - ALCOA WQMS

SHEET SIZE
A3

REV.
1



Willowdale Mine – Water Quality Monitoring System Data Review

June 2024

Revision: *02*

Date: *09 September 2024*

Client: *SciDev Pty Ltd*

Issued to: *SciDev & Alcoa of Australia*

RARE Environmental

Document Control

Project Details	
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Project Number	RP24050
Client	SciDev
Client Reference	PO002447

Document History and Status						
Revision	Date	Description	Prepared	Reviewed	Approved	Issued to
01	02/09/24	Issued for internal review	SM	CR	CR	SciDev
02	09/09/24	Alcoa feedback	SM	CR	CR	SciDev

Report Sign Off					
Report Version	02				
Prepared by		Technical Review		Approved for Issue	
Name	Sarah Mathew	Name	Christopher Redford	Name	Christopher Redford
Position	Env. Scientist	Position	Env. Scientist	Position	Env. Scientist
Date	09/09/2024	Date	09/09/2024	Date	09/09/2024

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Infrastructure Sustainability Council MEMBER

Contents

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) of the Willowdale Mine nominated in line with Section 6[1], 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 June 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 Willowdale site, for this reporting period, 2 (two) 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] R. WHITBY, Minister for Environment - Environmental Protection (Darling Range Bauxite Mining Proposals) Exemption Order 2023

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.

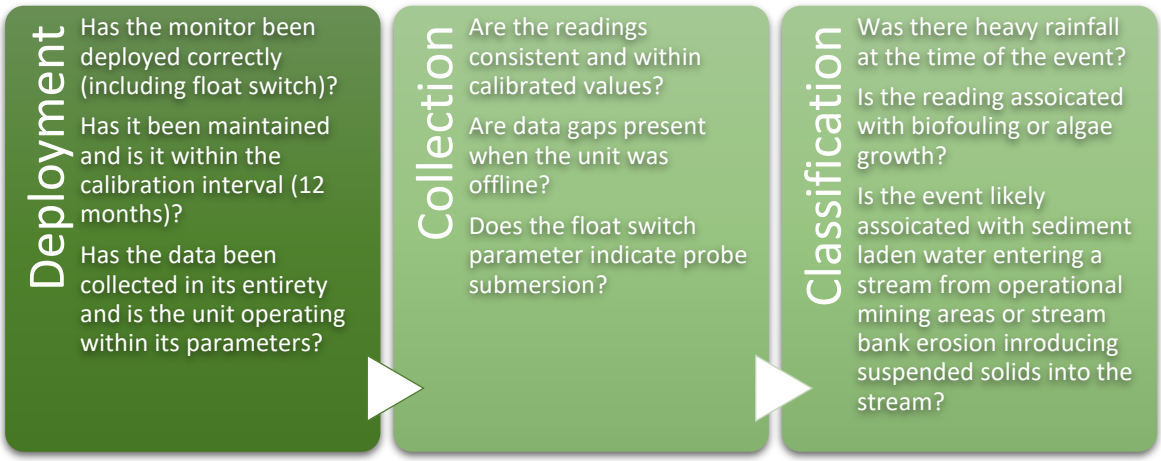


Figure 1: Data Review & Event Classification Process

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.

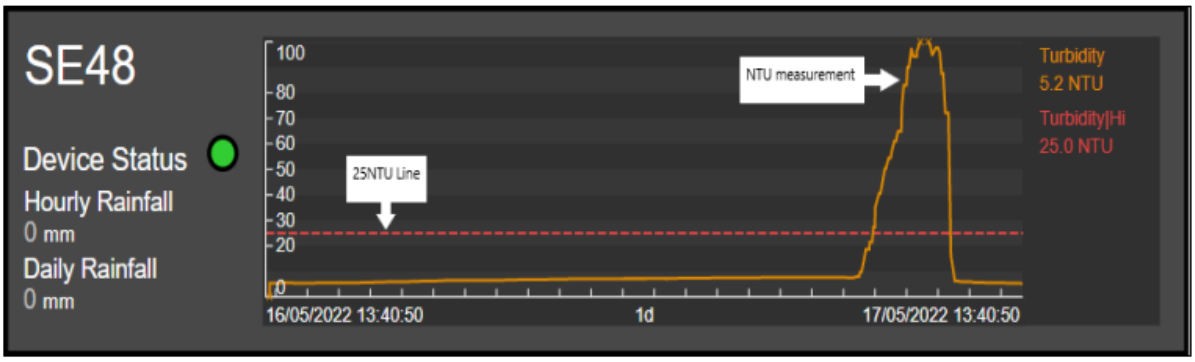


Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

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

2. WQMS Data Review

For the reporting period of June 2024, 12,178 data points were collected by 2 (two) WQMSs across the Willowdale site. From this data a total of 4 (four) events were flagged where turbidity levels above 25 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

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

Excluding the data from these units leaves 1 (one) potential turbidity event during the reporting period across 2 (two) units as discussed in the following section.

Table 1. WQMS Requiring Review

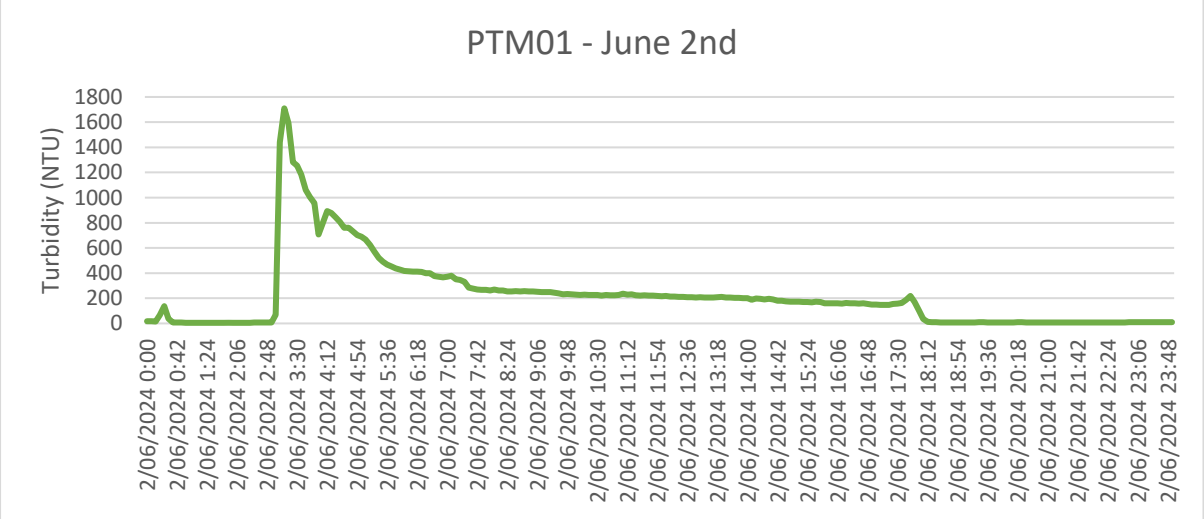
Unit	Dates	SCIDEV Comment
HV07 (two events)	2nd June 2024	Stream was inspected on 04/06/2024 at 11am, noting that it was dry and there were no signs of recent water flow in the stream bed.
PTM01	19th to 30th June 2024	Stream was dry during the period of the turbidity event. Stream was inspected on 28/06/2024 at 12:45pm and 04/07/2024 at 1:00pm, with no signs of recent water flow in the stream bed observed. There was evidence of water flowing off the forest track, pooling at the monitor location. Probe sensor was found to be covered in mud, was cleaned and returned to the dry stream bed however turbidity did not return to a low reading. Maintenance contractor has been contacted to complete a calibration of the probe.

2.2. Classification

Analysis of the data from the 2 (two) valid WQMSs identified 1 (one) potential turbidity event during the reporting period. Refer to the following section for analysis.

2.2.1. PTM01 Potential Turbidity Events

Chart(s) for data flagged at monitor PTM01 are shown below for the potential events identified in the reporting period.



The event is marked by a sharp incline and slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.3. True Turbidity Events

For this reporting period, 1 (one) potential drainage or 'true' incident was identified for further investigation.

Table 2: True Turbidity Events

Event ID	Monitor	Date(s)	Start Time	End Time	Duration	Peak Turbidity (NTU)
WDL-2406-001	PTM01	02/06/24	3:00:00 PM	6:06:00 PM	15hrs 6min	1709.61

2.4. Investigation Outcomes

SciDev provided the following in regard to the identified 'true' events.

Table 3: Investigation Outcomes

Event ID	Event Classification	Alcoa Investigation
WDL-2406-001	Non-Mining Related	*Stream was dry at the time of inspection, though there was evidence that water had been present and pooled at the monitor location. There was evidence of water flow off the forest track into the stream bed at the monitor location. Probe was found to be lying in a section of stream zone in the remaining mud. Probe sensor lens was cleaned of mud and debris and returned to the dry stream bed.*

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 -June 2024 - Events with turbidity > 25 NTU for an hour or more	
	HV07	PTM01
1/06/2024		
2/06/2024	**2**	**1**
3/06/2024		
4/06/2024		
5/06/2024		
6/06/2024		
7/06/2024		
8/06/2024		
9/06/2024		
10/06/2024		
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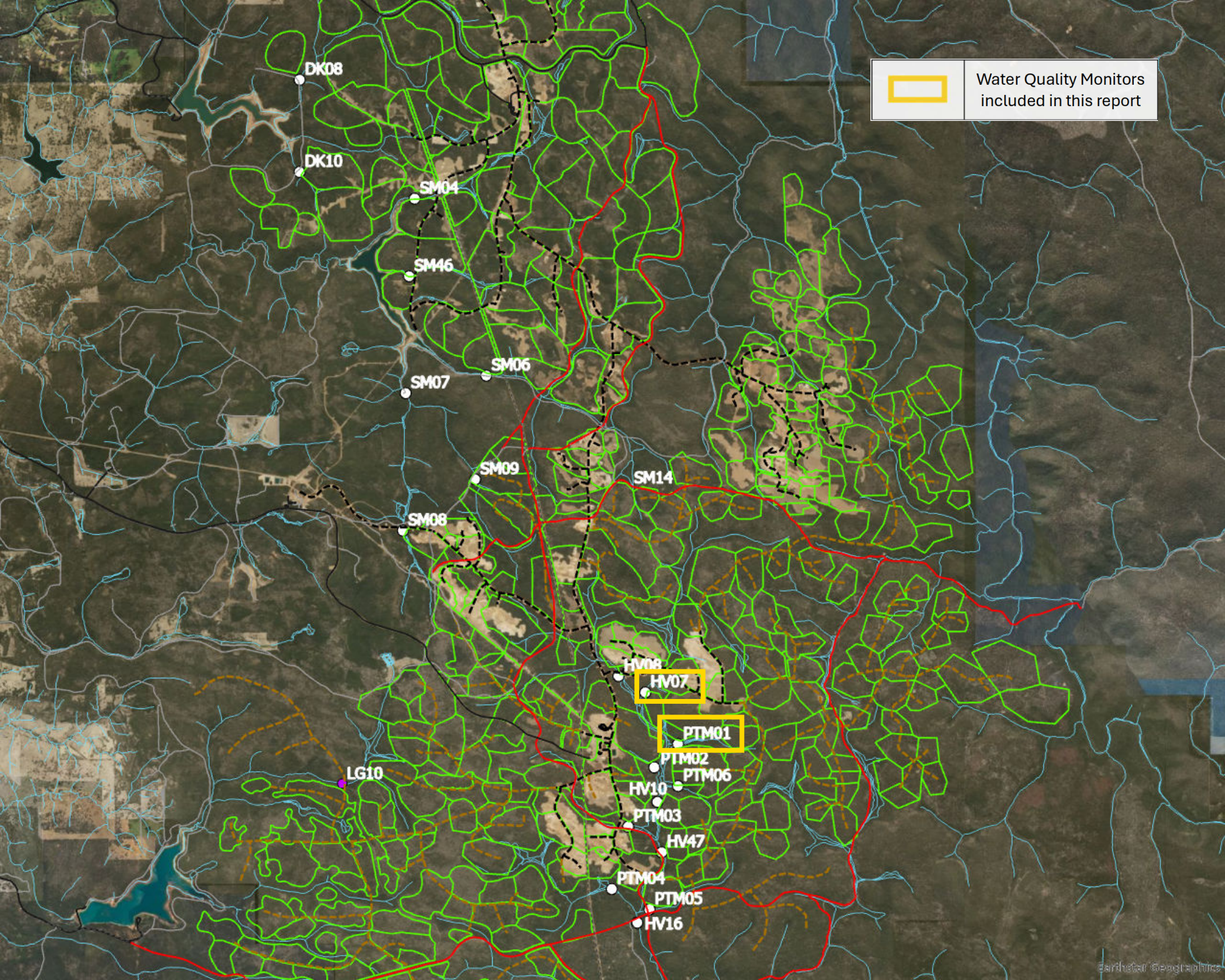
25/06/2024		
26/06/2024		
27/06/2024		
28/06/2024		
29/06/2024		
30/06/2024		

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 -June 2024 - Turbidity (Daily Average, NTU)	
	HV07	PTM01
1/06/2024	2.30	7.85
2/06/2024	18.57	**223.07**
3/06/2024	0.86	9.58
4/06/2024	0.85	10.88
5/06/2024	0.85	9.83
6/06/2024	2.76	21.11
7/06/2024	0.87	11.66
8/06/2024	0.87	14.10
9/06/2024	4.26	8.44
10/06/2024	1.21	5.82
11/06/2024	0.88	
12/06/2024	0.95	
13/06/2024	0.92	
14/06/2024	0.93	
15/06/2024	0.92	
16/06/2024	0.93	
17/06/2024	0.91	
18/06/2024	0.94	
19/06/2024	0.92	**129.85**
20/06/2024	0.92	**138.12**
21/06/2024	0.93	**140.28**
22/06/2024	3.36	**99.22**
23/06/2024	0.92	**97.14**
24/06/2024	0.93	**105.43**
25/06/2024	0.95	**106.89**
26/06/2024	1.27	**107.71**
27/06/2024	2.35	**91.23**
28/06/2024	0.90	**84.49**
29/06/2024	0.90	**80.77**
30/06/2024	0.93	**84.97**

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


Water Quality Monitors included in this report
DK08
DK10
SM04
SM46
SM06
SM07
SM09
SM14
SM08
HV08
HV07
PTM01
PTM02
PTM06
LG10
HV10
PTM03
HV47
PTM04
PTM05
HV16

Appendix B. 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

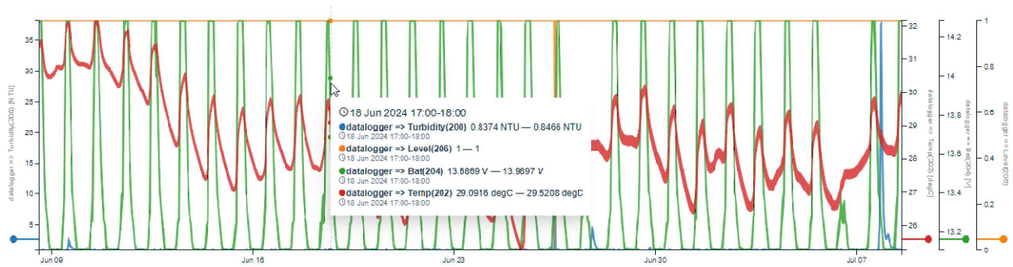
DATA INLET

SENSOR

STREAM DRY

SENSOR

STREAM FLOWING



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 U.N.O.
LEVELS ARE IN METRES ON AHD U.N.O.
DO NOT SCALE DRAWING
IF IN DOUBT - ASK
TOLERANCES ISO2768-m U.N.O.
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SCIDEV

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