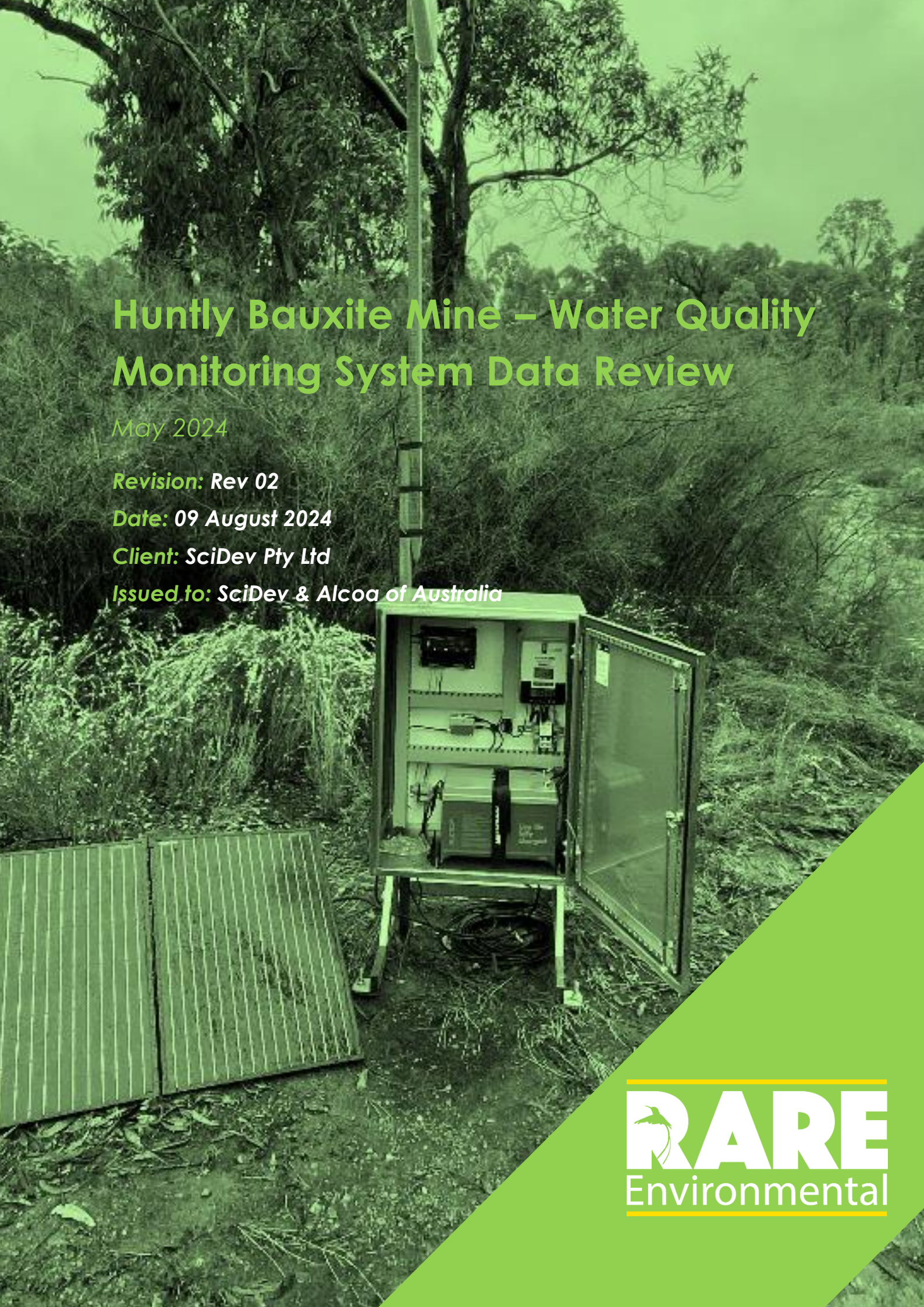


Huntly Bauxite Mine – Water Quality Monitoring System Data Review

May 2024

Revision: ***Rev 02***

Date: ***09 August 2024***

Client: ***SciDev Pty Ltd***

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

RARE Environmental

Document Control

Project Details	
Document Title	Huntly Bauxite Mine – Water Quality Monitoring System Data Review
Document No	RP24050 HUN WQMS Data Review - May 2024 Rev02
Project Name	SciDev WQ Data Processing
Project Number	RP24050
Client	SciDev
Client Reference	PO002447

Document History and Status						
Revision	Date	Description	Prepared	Reviewed	Approved	Issued to
01	06/08/24	Issued for internal review	SM	RD	RD	SciDev
02	09/08/24	Issued with event classification	SM	RD	RD	Scidev & Alcoa

Report Sign Off					
Report Version	02				
Prepared by		Technical Review		Approved for Issue	
Name	Sarah Mathew	Name	Rob Dwyer	Name	Rob Dwyer
Position	Env. Scientist	Position	Regional Manager	Position	Regional Manager
Date	09/08/2024	Date	09/08/2024	Date	09/08/2024

RARE Environmental Pty Ltd
ABN 41617855017
110/117 Old Pittwater Rd
Brookvale NSW 2100 Australia
P: 0413 223 401
www.rare-enviro.com.au

Infrastructure Sustainability Council MEMBER

Contents

Document Control i
1. Introduction 1
1.1. Purpose 1
1.2. Context 1
1.3. Monitoring Requirements 1
1.4. Water Quality Monitoring System (WQMS) 1
1.5. Data Review & Event Classification Process 2
2. WQMS Data Review 4
2.1. Deployment & Collection 4
2.2. Classification 1
2.2.1. ND06T Potential Turbidity Events 1
2.2.2. ND14T Potential Turbidity Events 2
2.2.3. PD01T Potential Turbidity Event 2
2.2.4. SE03T Potential Turbidity Events 3
2.2.5. SE05T Potential Turbidity Events 4
2.2.6. SE10T Potential Turbidity Events 5
2.2.7. SE51T Potential Turbidity Events 6
2.2.8. SE59T Potential Turbidity Events 8
2.2.9. SE61T Potential Turbidity Events 9
2.3. True Turbidity Events 10
2.4. Investigation Outcomes 11
3. Recommendations 13
3.1. WQMS Network 13
4. Raw WQMS Data 14
Appendix A. Huntly WQMS Locations 1
Appendix B. WQMS General Arrangement 2

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 May 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, 16 (sixteen) 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.

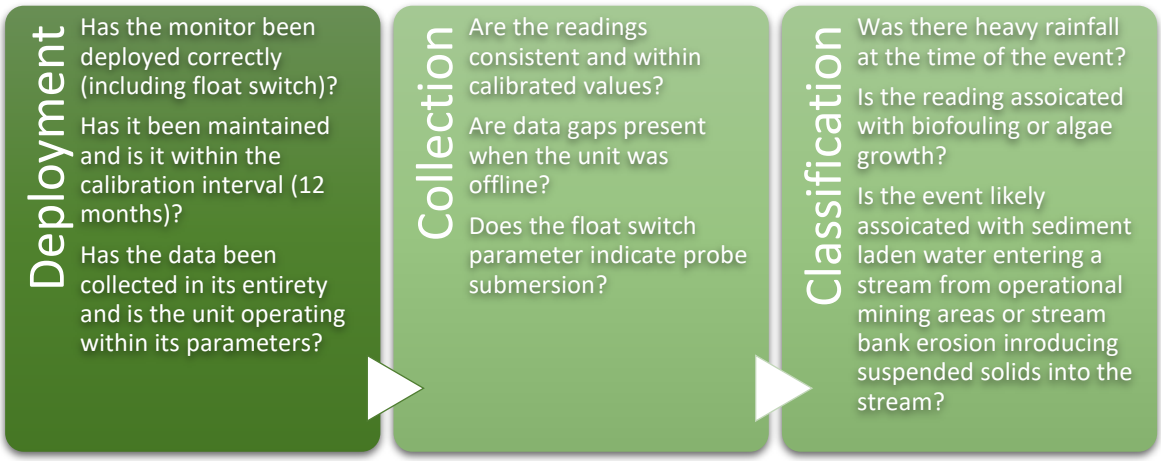


Figure 1: Data Review & Event Classification Process

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.

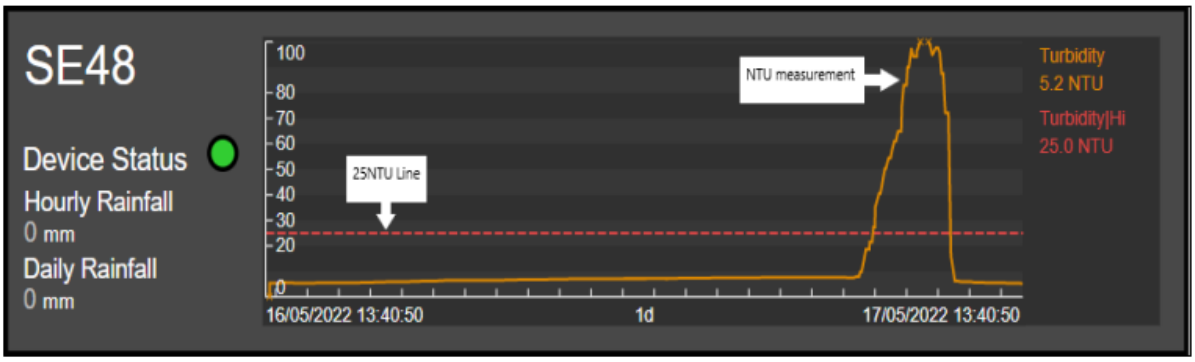


Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

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

2. WQMS Data Review

For the reporting period of May 2024, 90,871 data points were collected by 16 (sixteen) WQMSs across the Huntly site. From this data a total of 45 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. Furthermore, from information provided by SciDev, RARE understands the flow switch on several units was nonfunctional for the reporting period due to blockages or incorrect deployment.

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 34 (thirty-four) potential turbidity events during the reporting period across 9 (nine) units as discussed in the following section.

Table 1: WQMS Requiring Review

Unit	Dates	SciDev Comment
PD01T	April 29th to May 1st	*Included in April report. Site inspected on 1/05/2024 to manually download data as site is not telemetered. NTU on arrival 70.83, dropped to 1.09 after cleaning. Event caused by algae build up on lens due to low stream level.*
SE06T	May 1st to 3rd	*Site inspected on 1/05/2024 and observed that the stream was very low and dark with tannins. A heavy layer of vegetation/algae was present in the stream bed and around the sensor. Turbidity dropped to 1.9 after cleaning the sensor.*
SE03T	May 2nd	*Site inspection on 8/05/2024 confirmed stream has begun to flow. Stream flow had caused vegetation/debris to flush through, with some debris build up still evident around the sensor. Sensor was also sitting low in the stream and covered with sediment.*
SE02T	May 2nd to 6th	*SciDev inspection on 6/05/2024 noted vegetation caught around the sensor within the flow cell. Turbidity dropped to 10.3 once flow cell and sensor was cleaned and repositioned*
SE06T	May 23rd	*Scidev inspection on 23/05/2024 noted that the sensor was impacted by algae and stream bed debris. Turbidity dropped from 26.76 to 0.32 after cleaning the lens.*
SE53T	May 25th	*Site was inspected on 30/05/2024 after NTU on arrival was 13.5, dropped to 0.04 after lens cleaning. 47.4mm of rainfall was recorded between the time the event ceased and time of inspection, no further events were recorded during this time.*
SE06T	May 28th	*Scidev confirmed that the stream bed is heavily impacted by algae/debris and water level is low.*

2.2. Classification

Analysing the data collected outside of the above periods leaves 34 (thirty-four) potential turbidity events during the reporting period across 9 (nine) units as summarised in **Table 2**. For this reporting period there were 13 (thirteen) 'true' turbidity events identified. Refer to the following section for analysis.

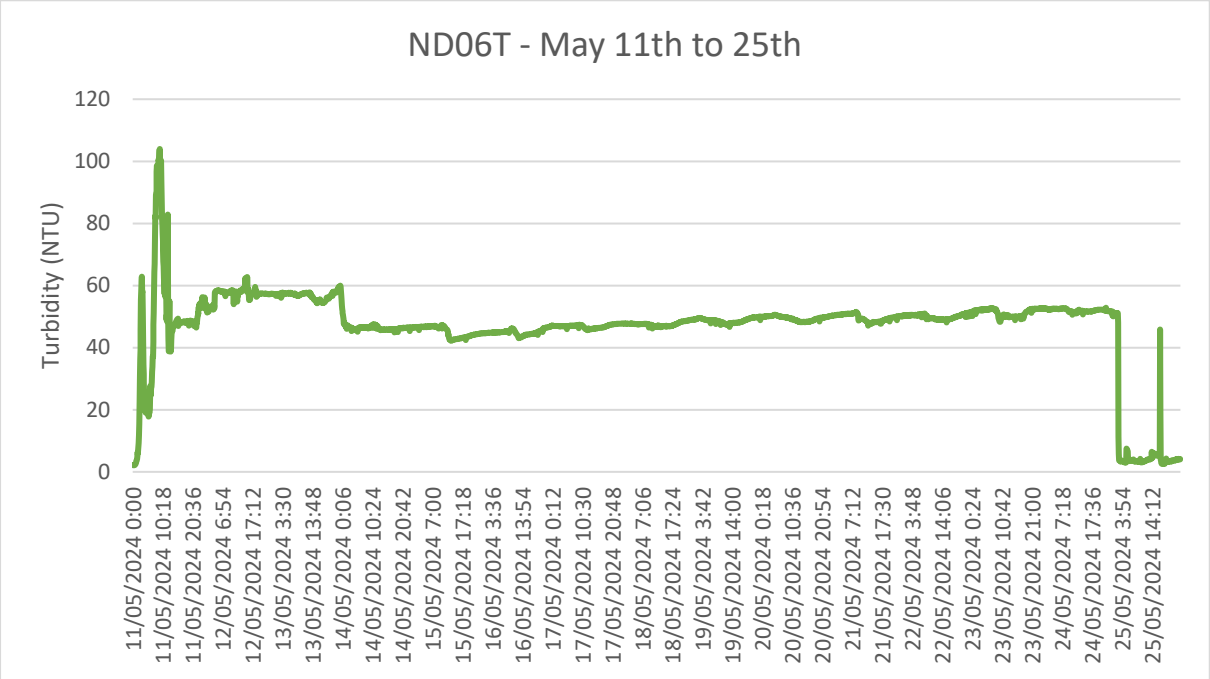
Table 2: Turbidity events summary

Date	Huntly WQMS Data - May 2024 - Events with turbidity > 25 NTU for an hour or more															
	DB02T	ND06T	ND07T	ND14T	PD01T	SE02T	SE03T	SE05T	SE06T	SE09T	SE10T	SE51T	SE52T	SE53T	SE59T	SE61T
1/05/2024																
2/05/2024				1	1			3				2			1	1
3/05/2024																
4/05/2024																
5/05/2024												1				
6/05/2024																
7/05/2024												2				
8/05/2024												2				
9/05/2024												4				
10/05/2024												3				
11/05/2024		2					1									
12/05/2024																
13/05/2024																
14/05/2024																
15/05/2024																
16/05/2024																
17/05/2024																
18/05/2024																
19/05/2024																
20/05/2024																
21/05/2024																
22/05/2024																
23/05/2024																
24/05/2024																
25/05/2024																
26/05/2024																
27/05/2024		1														
28/05/2024																
29/05/2024							1	1				2			1	
30/05/2024											3					
31/05/2024											1					

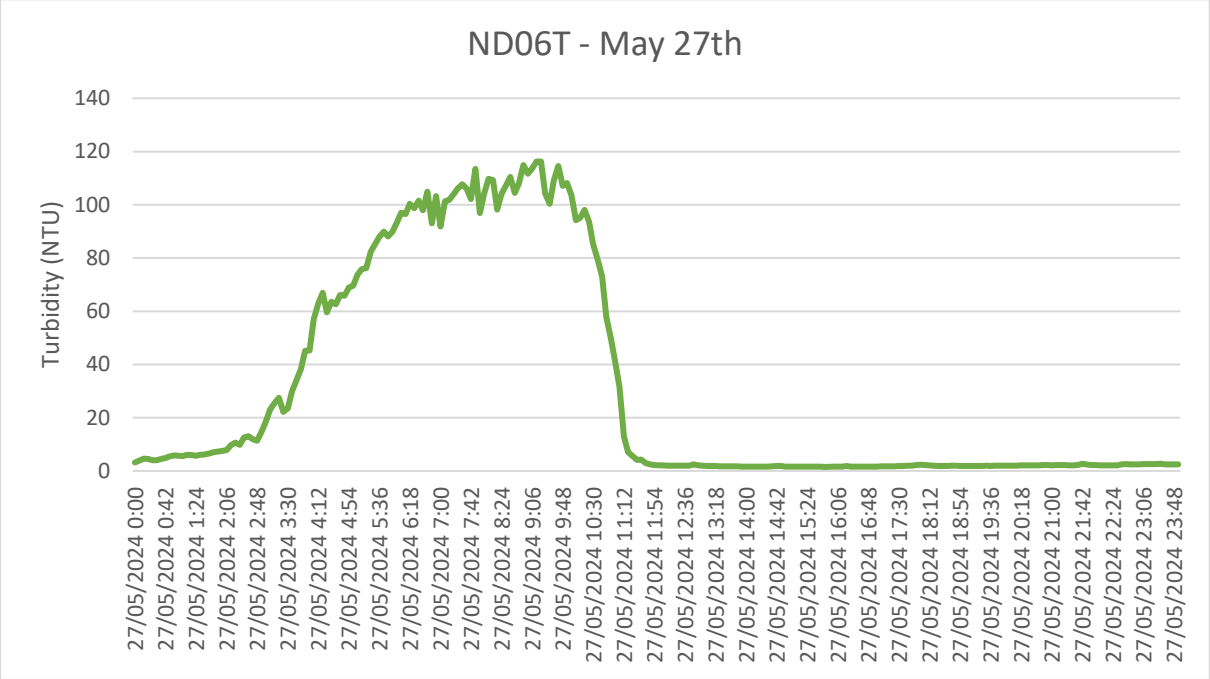
Note: Grey cells indicate data has been excluded. False events have been annotated by **black** bold text. True events for further investigation are annotated by **red** bold text. See following section for analysis.

2.2.1. ND06T Potential Turbidity Events

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



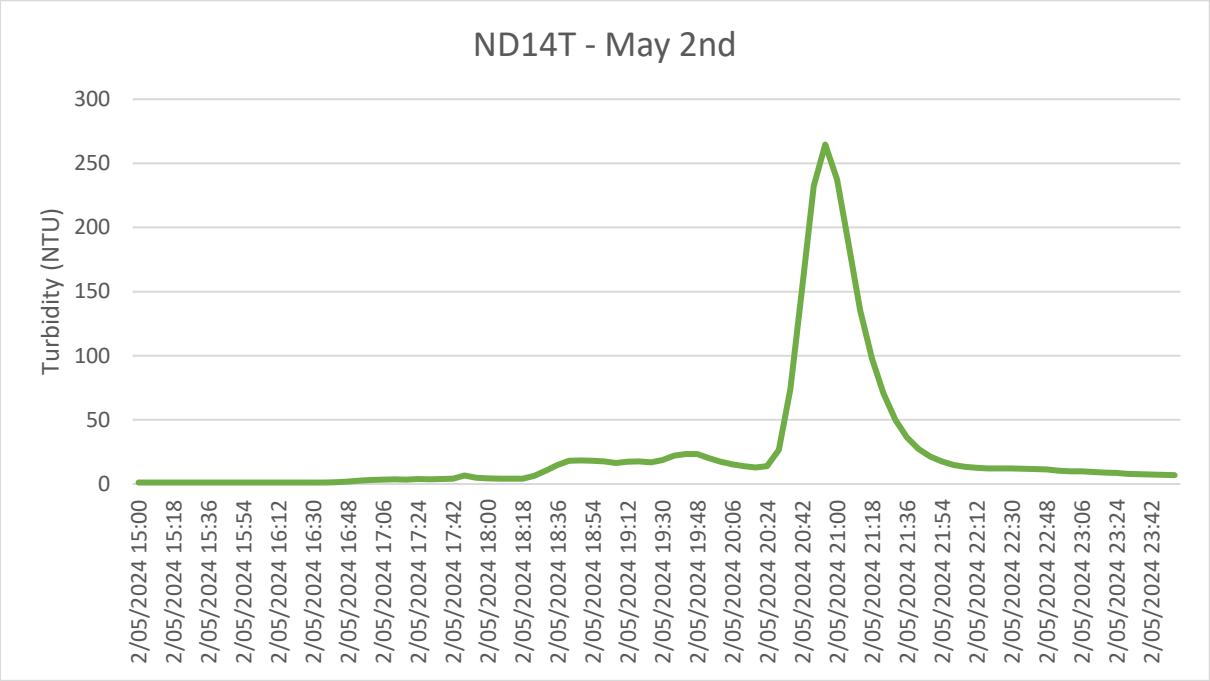
This event is marked by a sharp return to normal values indicative of a 'false' event.



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

2.2.2. ND14T Potential Turbidity Events

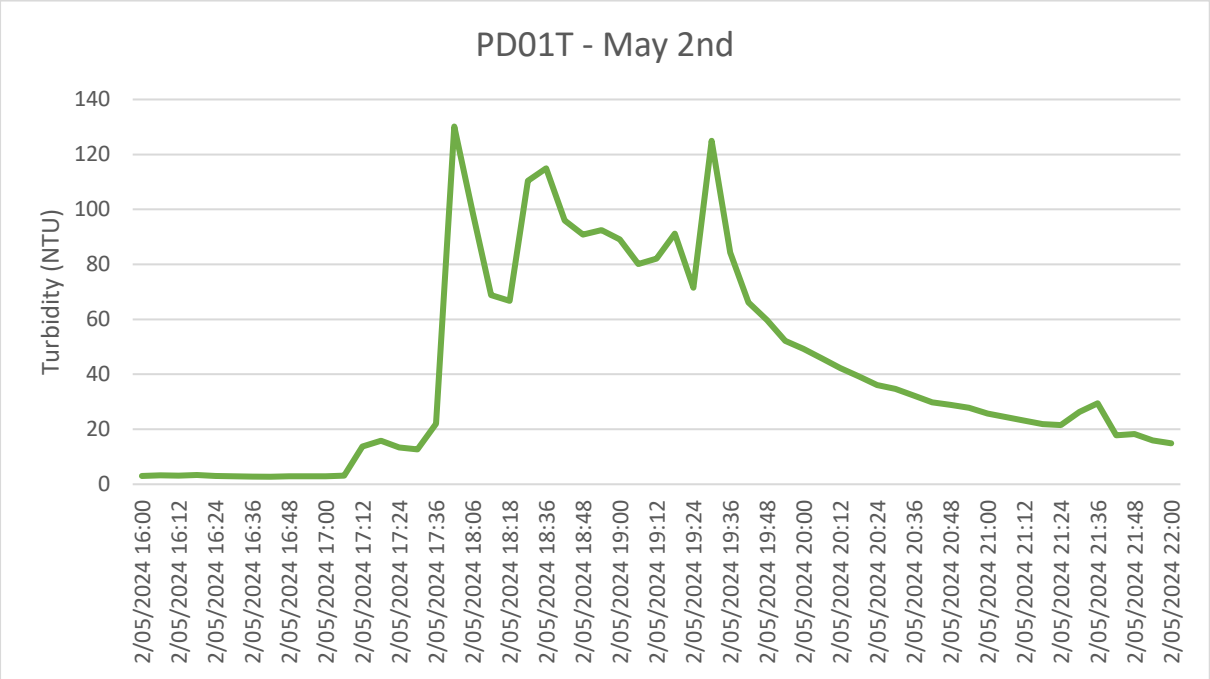
Chart(s) for data flagged at monitor ND14T are shown below for the potential events identified in the reporting period.



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

2.2.3. PD01T Potential Turbidity Event

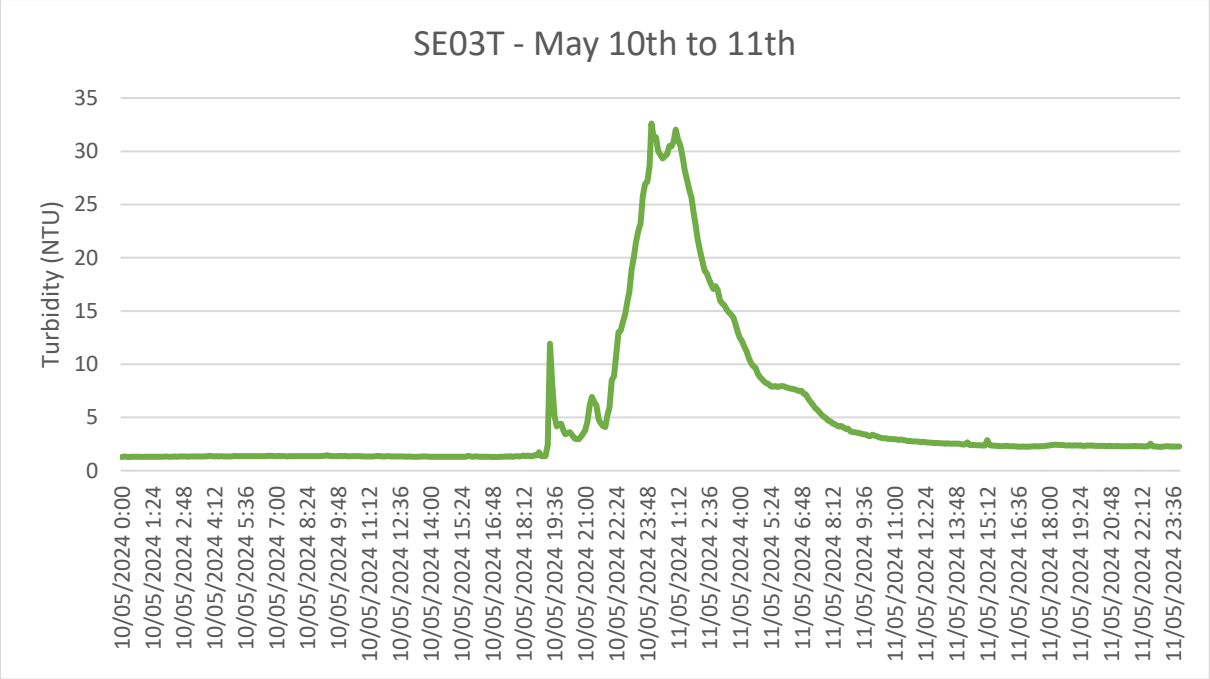
Chart(s) for data flagged at monitor PD01T are shown below for the potential events identified in the reporting period.



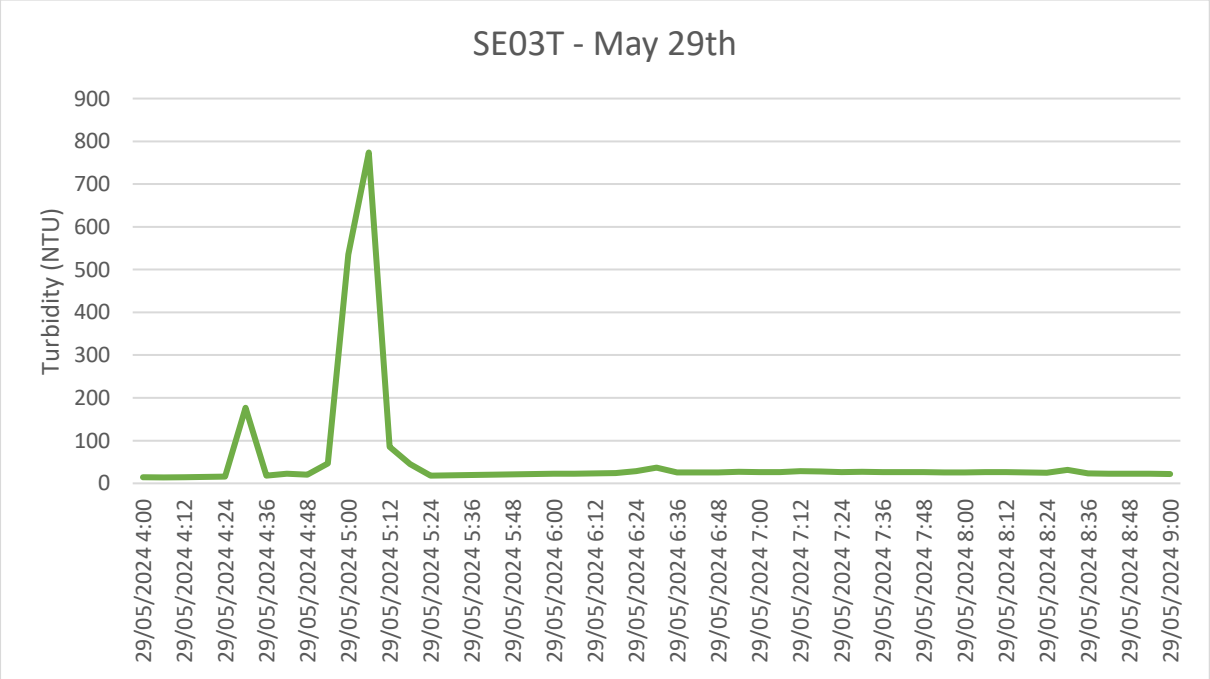
The event is marked by sharp incline and slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.4. SE03T Potential Turbidity Events

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



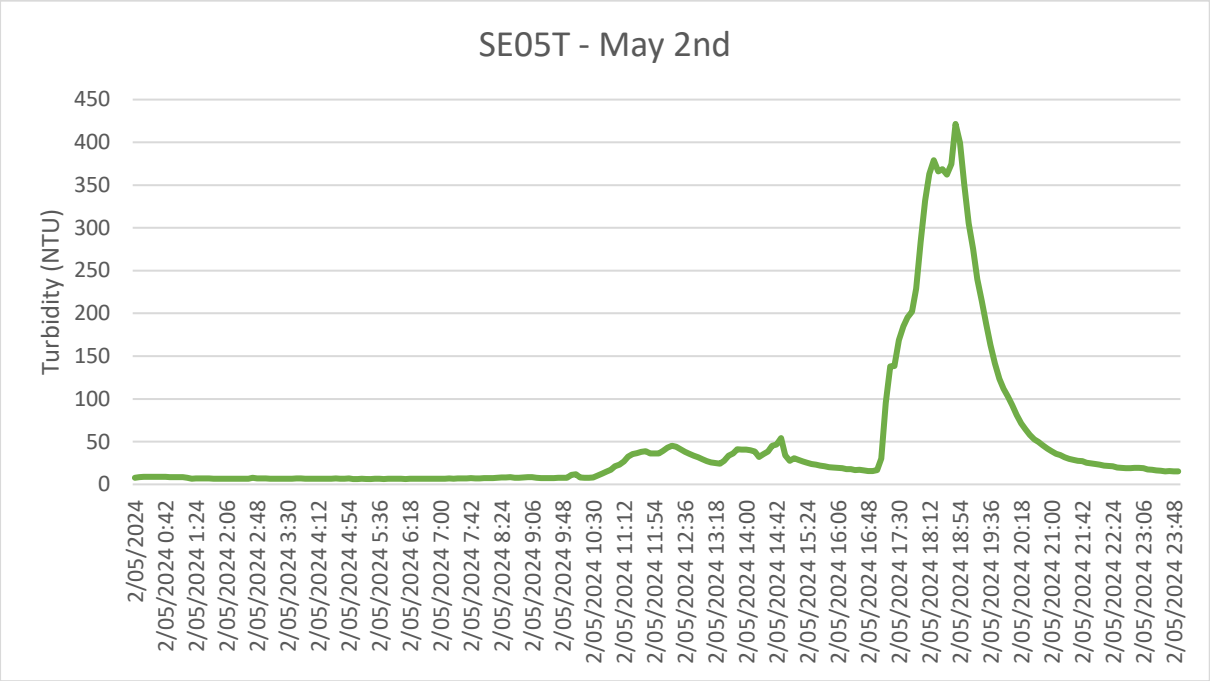
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



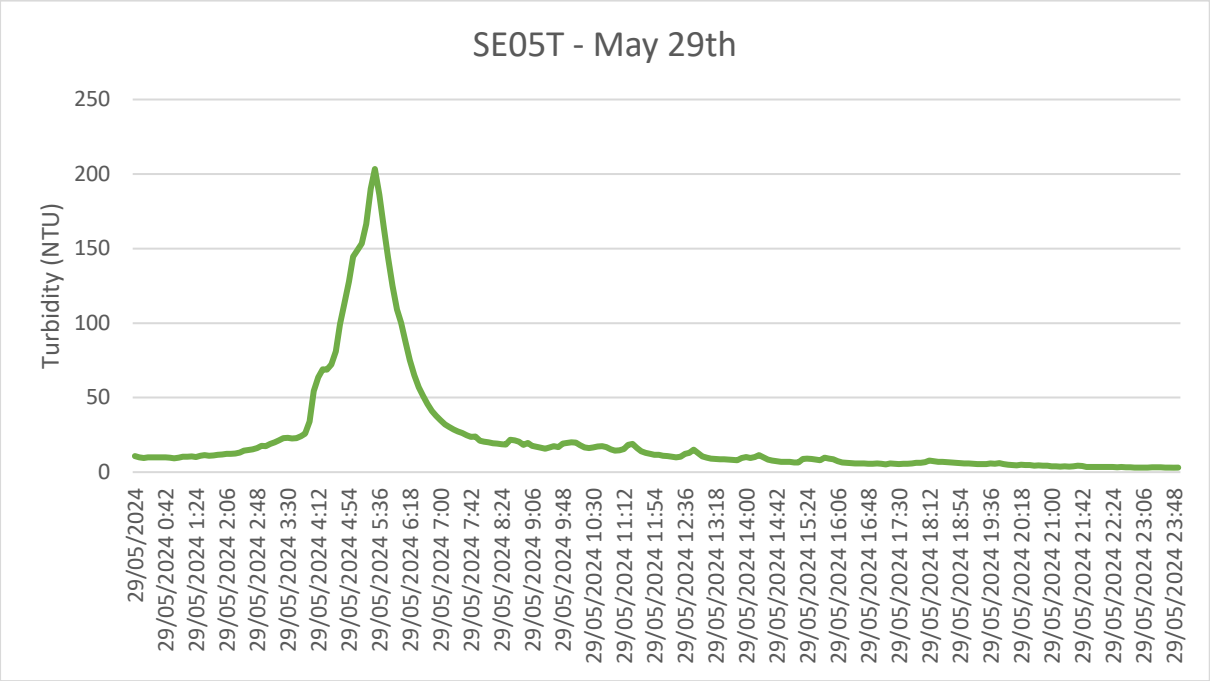
The event is marked by sharp incline and slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.5. SE05T Potential Turbidity Events

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



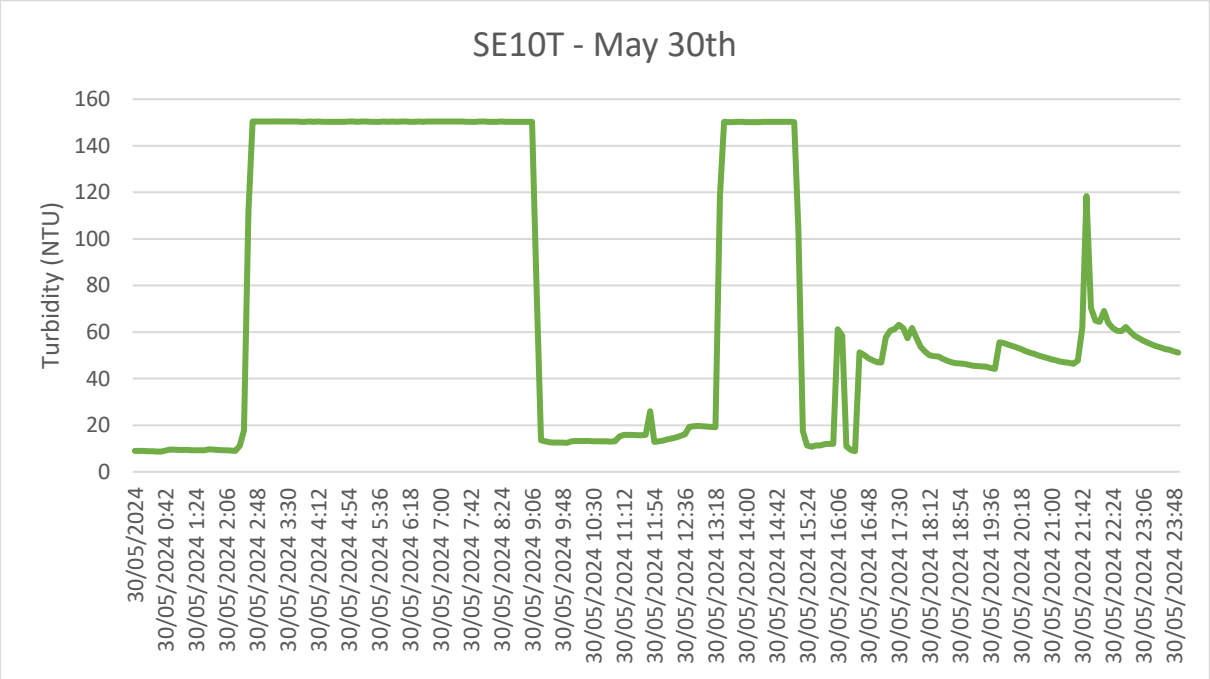
These events are marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.



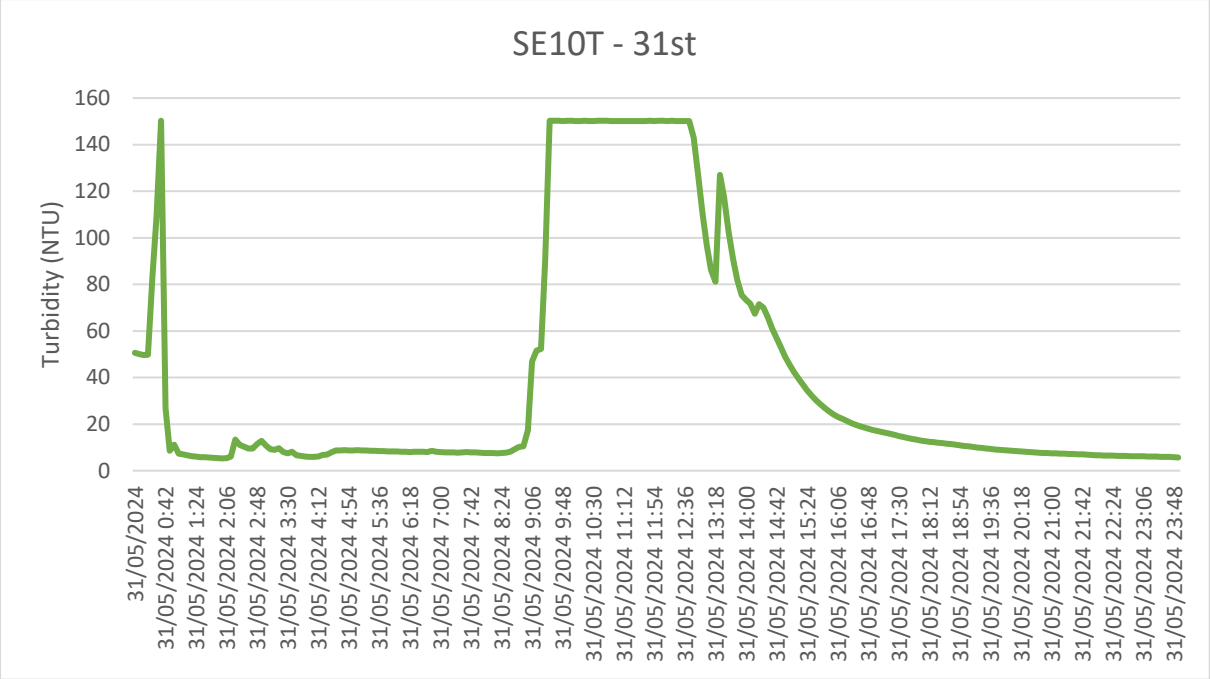
The event is marked by slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.6. SE10T Potential Turbidity Events

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



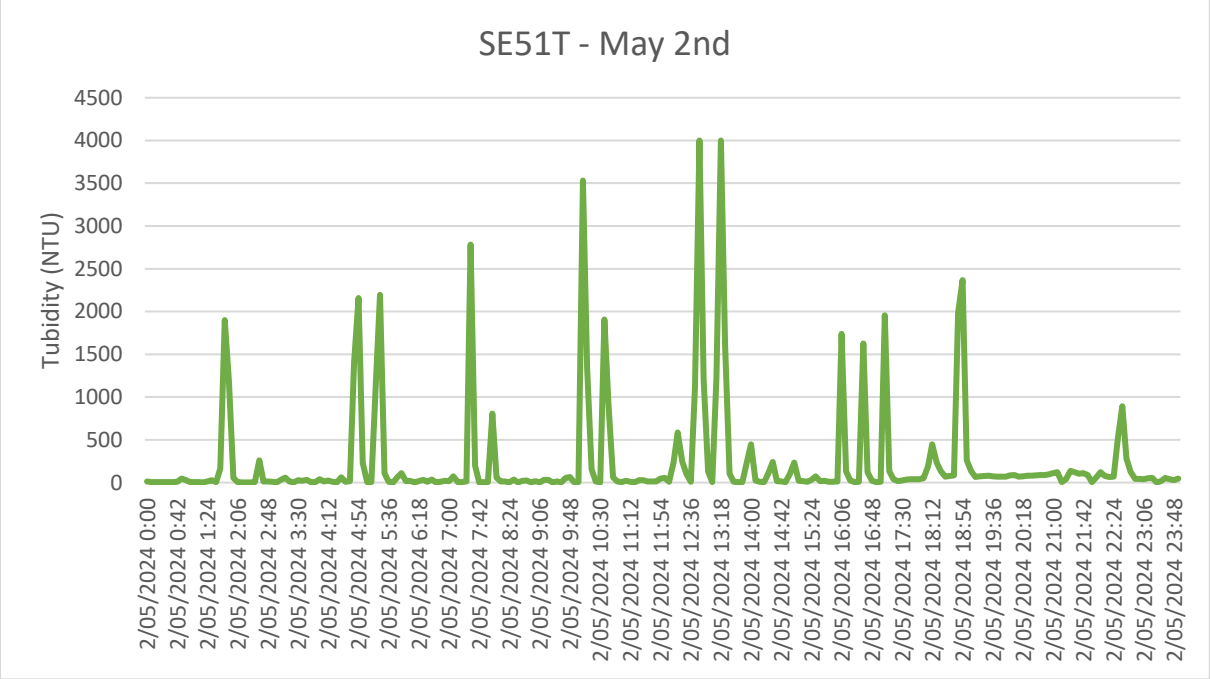
This event is marked by sharp inclines and declines indicative of a 'false' event.



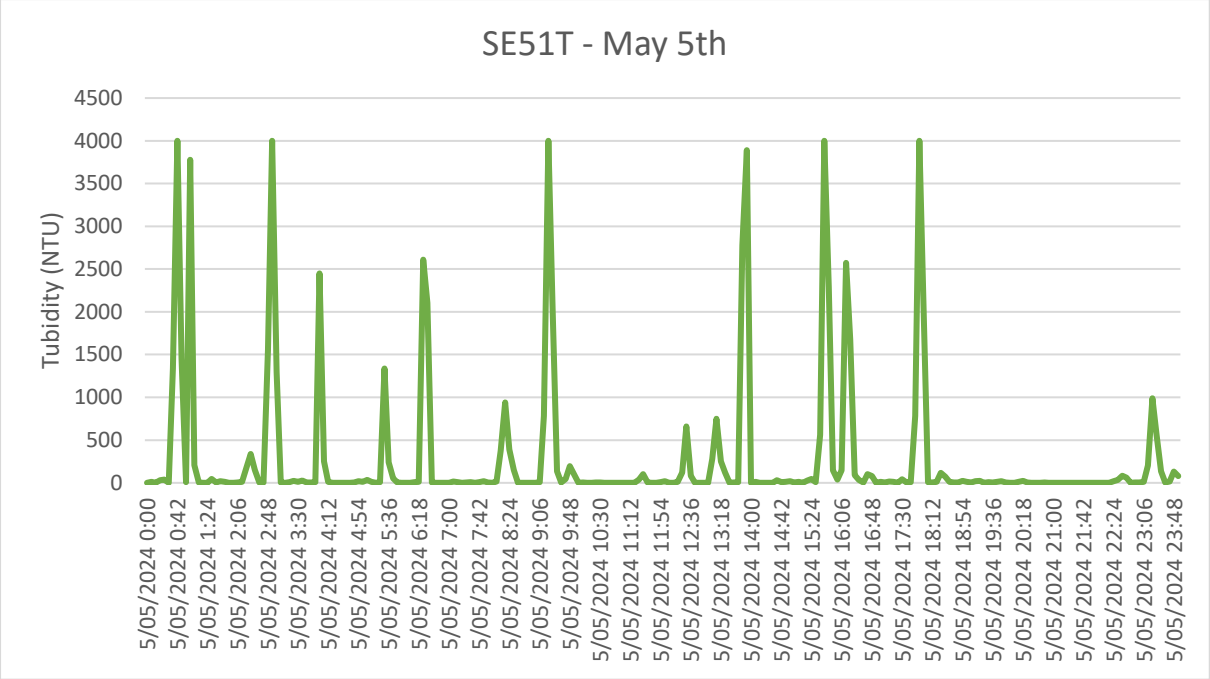
The event is marked by a sharp incline and slow return to background levels indicative of a 'true' event, flagged for further investigation.

2.2.7. SE51T Potential Turbidity Events

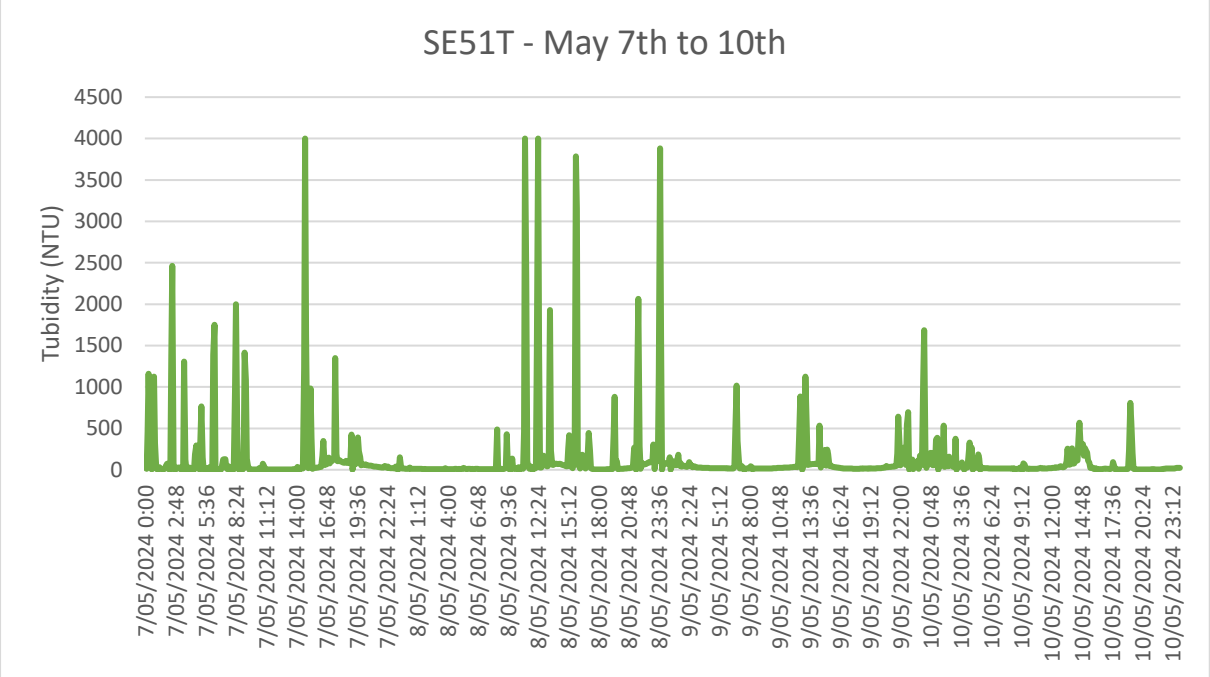
Chart(s) for data flagged at monitor SE51T are shown below for the potential events identified in the reporting period.



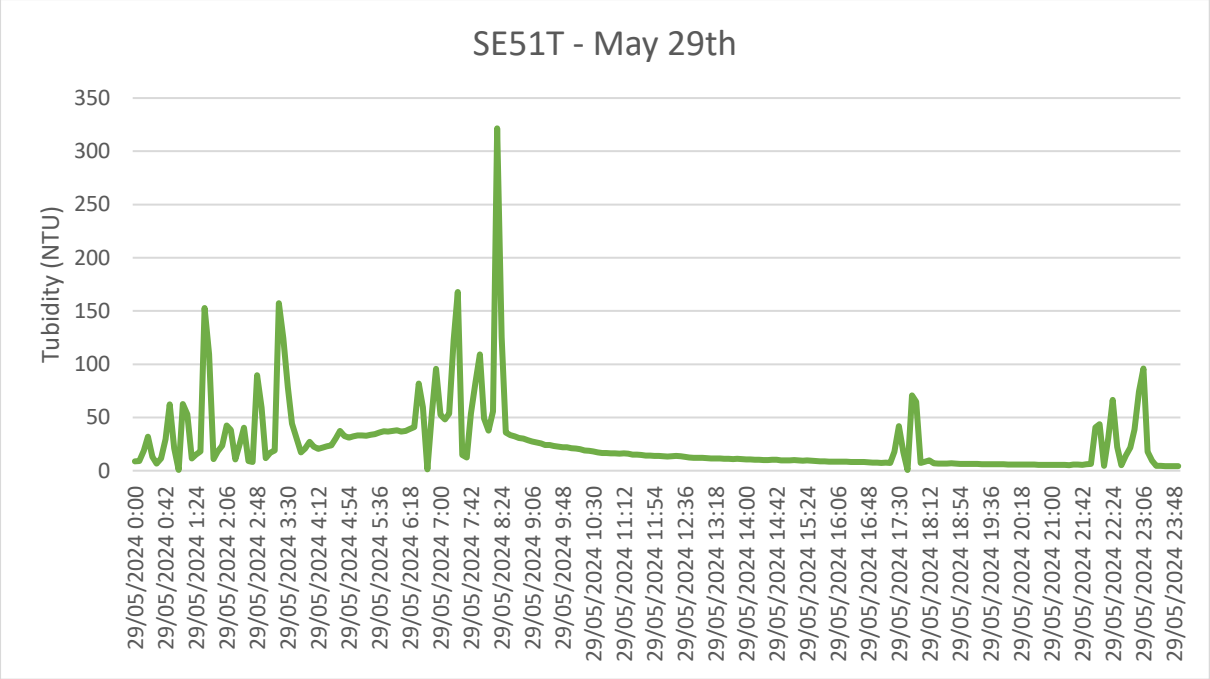
This event is marked by sporadic peaks indicative of a 'false' event.



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



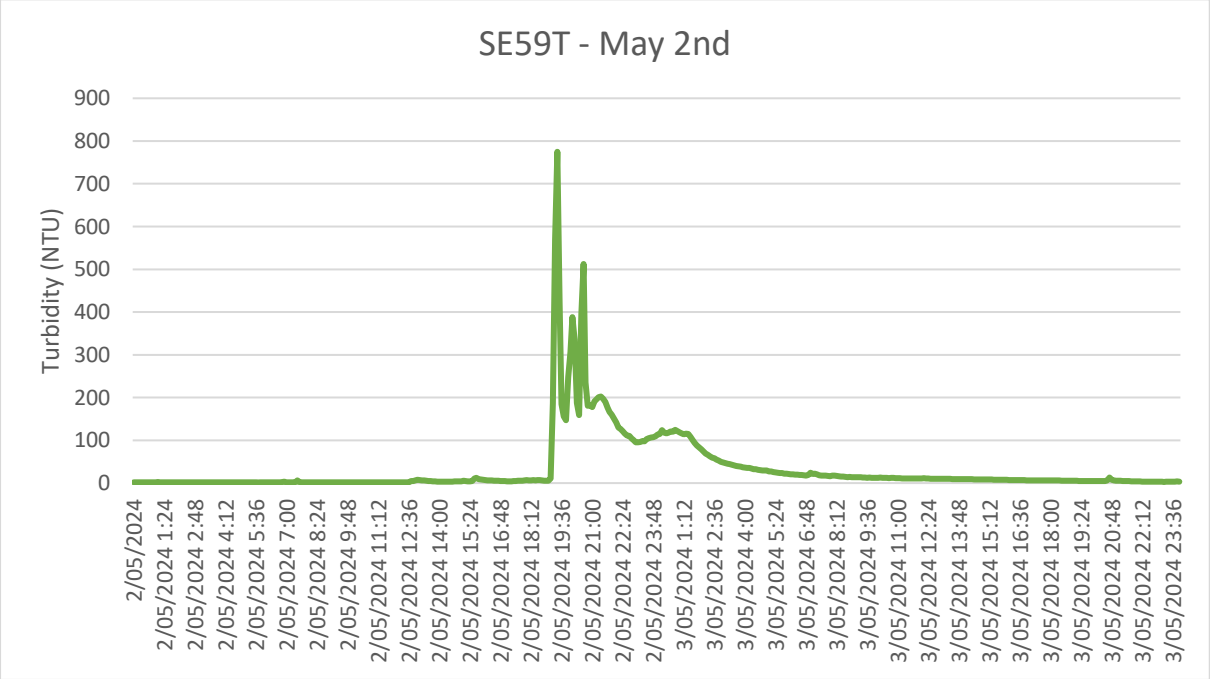
This event is marked by sporadic peaks indicative of a 'false' event.



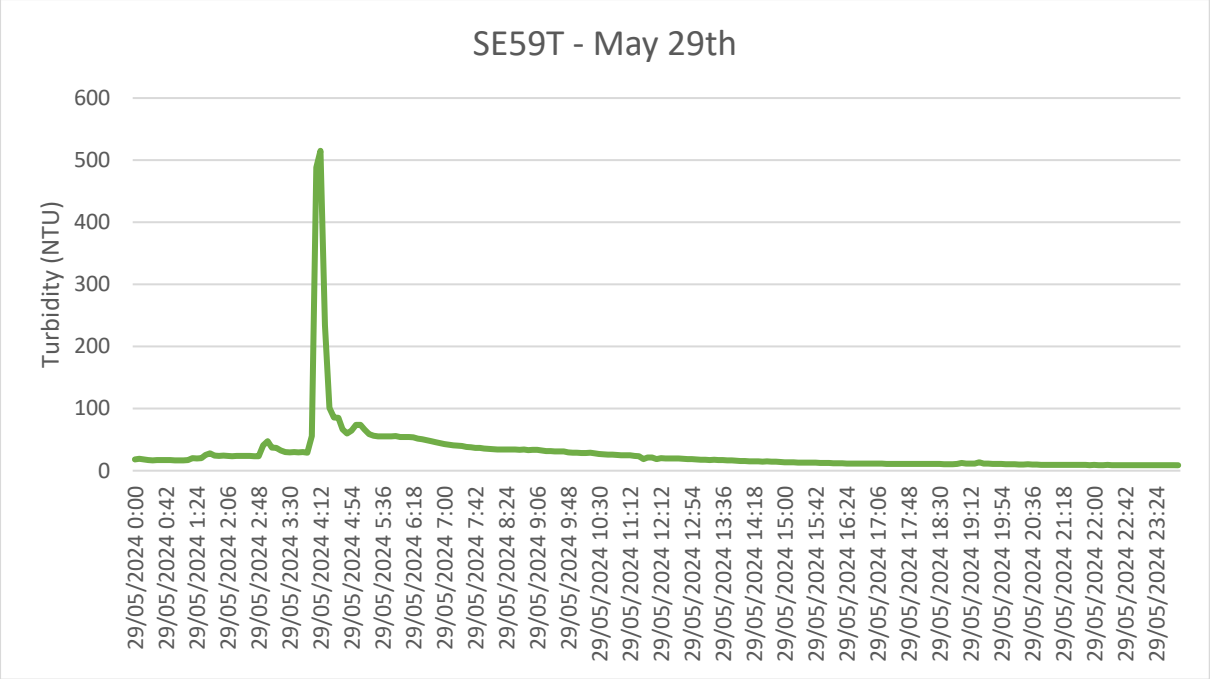
This event is marked by sporadic peaks indicative of a 'false' event.

2.2.8. SE59T Potential Turbidity Events

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



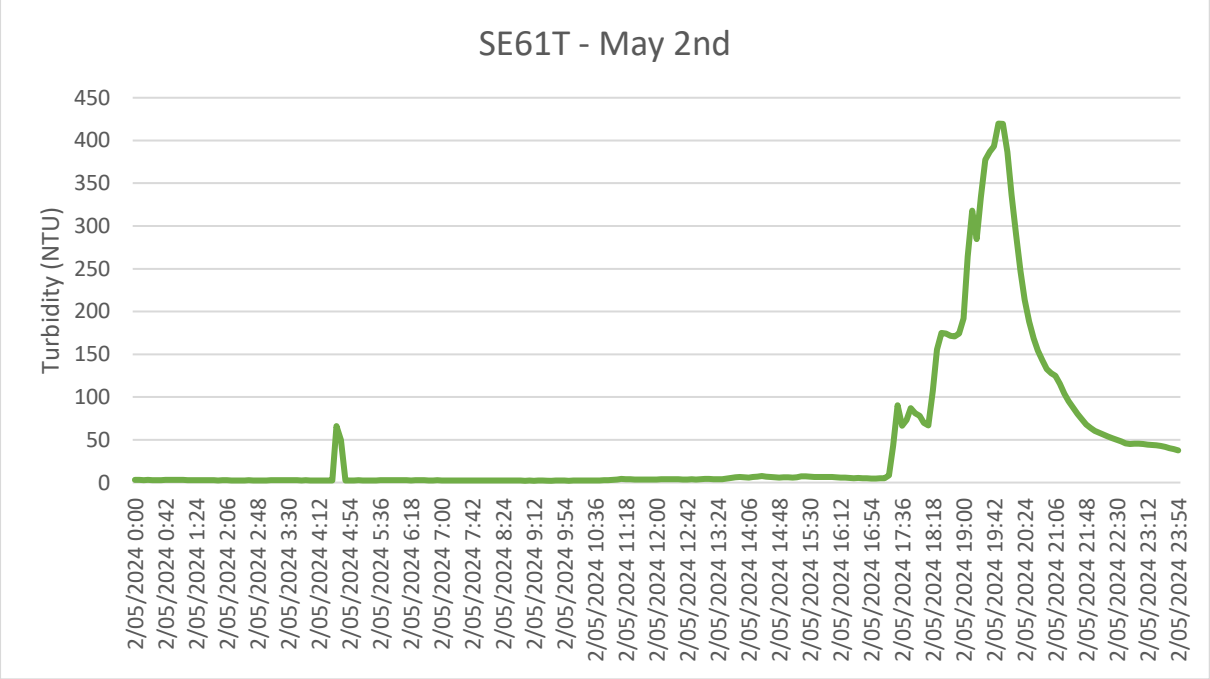
The event is marked by a sharp incline and slow return to background levels indicative of a 'true' event, flagged for further investigation.



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

2.2.9. SE61T Potential Turbidity Events

Chart(s) for data flagged at monitor SE61T 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.

2.3. True Turbidity Events

For this reporting period, 10 (ten) 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-2405-001	ND14T	02/05/24	8:30:00 PM	9:42:00 PM	1hr 12min	264.71
HUN-2405-002	SE05T	02/05/24	11:12:00 AM	9:48:00 PM	8hrs 54min	421.54
HUN-2405-003	SE59T	02/05/24	7:12:00 PM	5:18:00 AM	10hrs 6min	774.85
HUN-2405-004	SE61T	02/05/24	5:24:00 PM	1:00:00 AM	7hrs 36min	800.78
HUN-2405-005	PD01T	02/05/24	6:00:00 PM	9:00:00 PM	3hrs	130.15
HUN-2405-006	SE03T	10/05/24 to 11/05/24	11:36:00 PM	1:48:00 AM	2hrs 12min	32.61
HUN-2405-007	ND06T	27/05/2024	3:12:00 AM	11:06:00 AM	7hrs 54min	116.25
HUN-2405-008	SE03T	29/05/24	6:24:00 AM	8:30:00 AM	2hrs 6min	37.08
HUN-2405-009	SE05T	29/05/24	3:54:00 AM	7:30:00 AM	3hrs 36min	203.37
HUN-2405-010	SE59T	29/05/24	2:54:00 AM	11:00:00 AM	8hrs 6min	515.06
HUN-2405-011	SE10T	31/05/24	9:06:00 AM	3:54:00 PM	6hrs 46min	150.23

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-2405-001	Non-Mining Related	*Data trend shows typical bell curve incline and decline indicating true event. Inspections of surrounding areas have shown no evidence of mining related contribution. Some forest track run-off noted from North Road, appearing to have made contact with the stream, upstream of turbidity monitoring site. A flushing effect caused by increased streamflow/significant rainfall early in the season could also be a contributing factor*
HUN-2405-002	Non-Mining Related	*Site inspection on 3/05/2024 triggered by >25mm rain event. Stream turbidity appearance noted dark in colour. Data trend shows irregular turbidity values, generally evident with flush through of vegetation with increased stream flow. Inspections of mining areas within SE05T catchment completed, no evidence of mining contribution has been identified.*
HUN-2405-003	Non-Mining Related	*Data trend shows extreme turbidity value spikes followed by a gradual decline. Surrounding forest was impacted by fire in November 2023 which has left the forest bare with exposed soil, this is likely to contribute to stream turbidity during rainfall. During investigation of surrounding areas, erosion scours across the bare forest floor where sighted, making contact with the stream, upstream of the turbidity monitoring site. Catchment inspection has been completed, no evidence of mining contribution has been identified.*
HUN-2405-004	Non-Mining Related	*Data trend shows extreme turbidity spikes followed by a gradual decline. Catchment inspection has been completed, no evidence of mining contribution has been identified. Algal growth has been a consistent issue at this site, and water testing has shown high levels of Biochemical Oxygen Demand. Planning is underway to relocate this monitor to a more suitable location. Areas of potential forest track run off have also been identified although have unlikely contacted the stream during this rain event, could pose an issue with future rainfall. Mitigation methods are also being explored to rectify this.*
HUN-2405-005	Non-Mining Related	*Site inspection on 3/05/2024 triggered by >25mm rain event. Stream clear and flowing. Sensor still clean from previous inspection, however rainfall and additional stream flow has caused a build up of leaf litter around the sensor and float. Data trend shows irregular turbidity spikes followed by a gradual decline. Catchment inspection has been completed, no evidence of mining contribution has been identified. Some forest track runoff has been indentified and will be monitored.*
HUN-2405-006	Non-Mining Related	*Data trend shows typical bell curve incline and decline, coinciding with rainfall event. Catchment inspection has been completed, no evidence of mining contribution has been found. Erosion scours have been identified on a forest track intersecting the stream, approximately 1.9km upstream of SE03T, runoff appears to have contacted the stream. The concern will be communicated to DBCA.*
HUN-2405-007	Non-Mining Related	*Data trend indicates true event, showing relatively gradual turbidity values coinciding with rainfall commencing. However Rainfall was increasing at the time the event ceased, with a further 10.6mm recorded in the 24 hrs after the event during which time turbidity values were steady at circa 1.9NTU. Site was inspected on 28/05/2024, stream was clear and water level sufficiently covering*

		sensor, turbidity reading 1.9NTU. Site inspected again on 29/05/2024 after a further 28mm and stream clarity was slightly turbid, reading at time of download 16.5 NTU. No further events were recorded at this site during the 7 days following this event, over which time approximately 111mm of rainfall was recorded. Catchment inspection has been completed and no evidence of mining contribution was found.
HUN-2405-008	Non-Mining Related	*Data trend shows gradual incline and decline as well as extreme spikes in turbidity vales, coinciding with rainfall. Site inspected on 29/05/2024, stream clear. NTU on arrival 15.25, dropped to 9.85 after lens cleaning. 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-2405-009	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, no evidence of mining contribution found.*
HUN-2405-010	Non-Mining Related	*Data trend shows an increase in stream turbidity after 15.5mm of rainfall was recorded, with an extreme spike 2 hours into the event, followed by a gradual decline. Erosion scours are evident across the bare forest floor following the November fires. Erosions scours are making contact with the stream and ash sediment is visibly built up in the stream bed and on the sensor. Catchment area has been inspected, no evidence of mining contribution has been found*
HUN-2405-011	Non-Mining Related	*Site was inspected on 30/05/2024 at 15:00, stream bed was very dry. Float switch for this unit is reading incorrectly, therefore time of flow can not be confirmed. This unit is scheduled for an upgrade in June. SE09T upstream was also inspected on the 30/05/2024 and float switch confirmed to be reading correctly, SE09T was also dry at time of inspection however data indicates stream flow at approximately 21:32. Both sites were inspected and confirmed to be flowing on 6/06/2024. Data trend shows irregular turbidity spikes. At the time of inspection on 6/06/2024 after a further approximately 56.8mm of rainfall was recorded, major stream bed debris was built up around the sensor.*

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.
- Replace float switch at SE10T
- Perform routine maintenance on all units to ensure their correct operation.

4. Raw WQMS Data

Date	Huntly WQMS Data - May 2024 - Events with turbidity > 25 NTU for an hour or more															
	DB02T	ND06T	ND07T	ND14T	PD01T	SE02T	SE03T	SE05T	SE06T	SE09T	SE10T	SE51T	SE52T	SE53T	SE59T	SE61T
1/05/2024					**1**				**2**							
2/05/2024				**1**	**1**	**1**	**1**	**3**	**1**			**2**			**1**	**1**
3/05/2024																
4/05/2024																
5/05/2024												**1**				
6/05/2024																
7/05/2024												**2**				
8/05/2024												**2**				
9/05/2024												**4**				
10/05/2024												**3**				
11/05/2024		**2**					**1**									
12/05/2024																
13/05/2024																
14/05/2024																
15/05/2024																
16/05/2024																
17/05/2024																
18/05/2024																
19/05/2024																
20/05/2024																
21/05/2024																
22/05/2024																
23/05/2024									**2**							
24/05/2024																
25/05/2024														**1**		
26/05/2024																
27/05/2024		**1**														
28/05/2024									**2**							
29/05/2024							**1**	**1**				**2**			**1**	
30/05/2024											**3**					
31/05/2024											**1**					

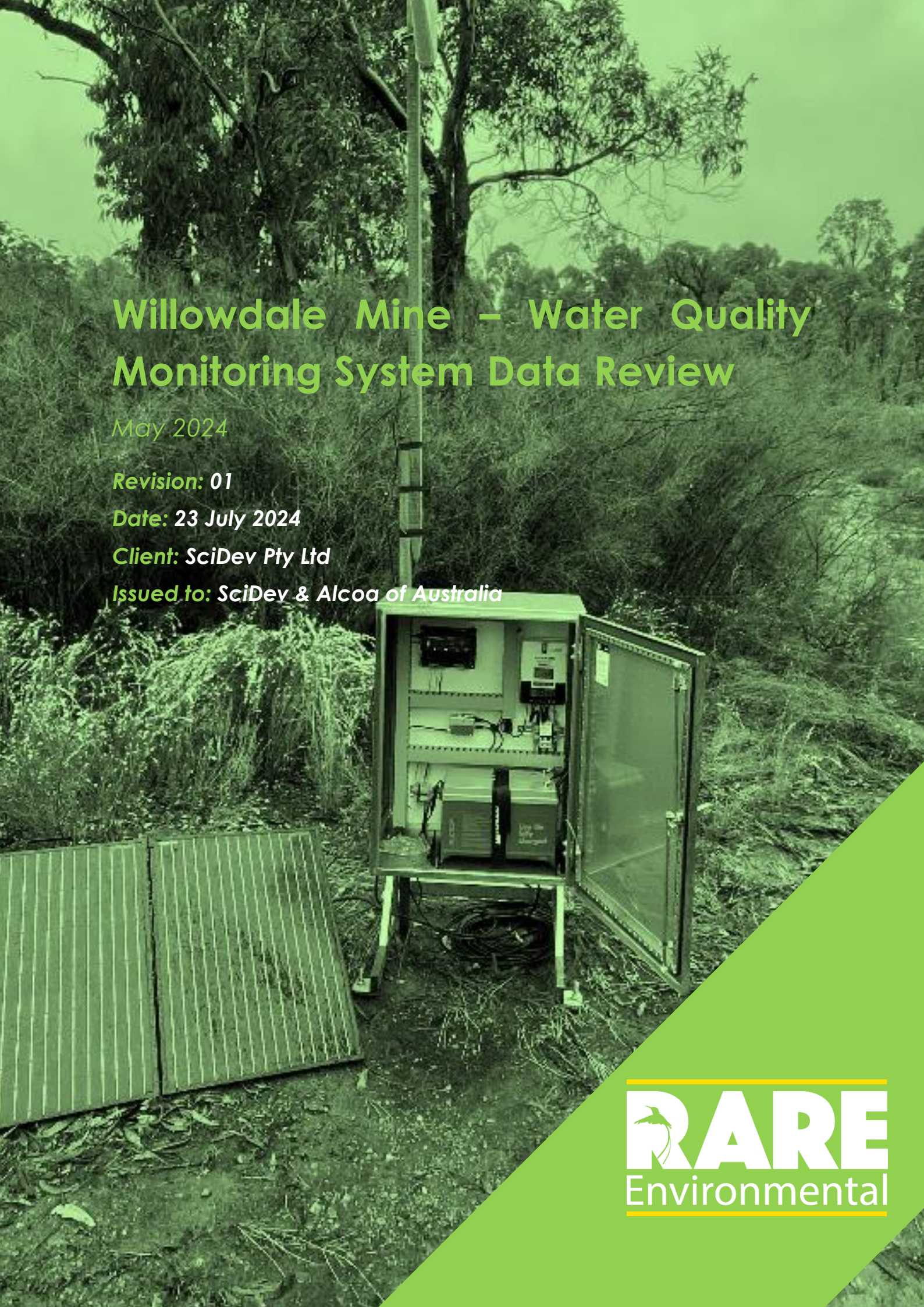
Note: False events have been annotated by **black** bold text. True events for further investigation are annotated by **red** bold text.

Date	Huntly WQMS Data - May 2024 - Turbidity (Daily Average, NTU)															
	DB02T	ND06T	ND07T	ND14T	PD01T	SE02T	SE03T	SE05T	SE06T	SE09T	SE10T	SE51T	SE52T	SE53T	SE59T	SE61T
1/05/2024				1.1	**30.1**	16.1	4.8	10.8	**482.2**			**193.8**		16.9	4.9	6.3
2/05/2024				**10.0**	9.4	**44.6**	18.2	**46.4**	**525.6**			**238.8**		18.1	**40.8**	**41.2**
3/05/2024				2.0	3.1	**81.8**	7.8	5.7	**64.4**			**129.8**		19.4	**25.1**	11.0
4/05/2024				0.9	1.9	**70.3**	5.3	2.4	0.3			**256.8**		20.4	3.5	2.2
5/05/2024				0.9	4.1	**63.6**	5.3	2.5	5.6			**280.1**		20.6	2.4	2.7
6/05/2024				0.8	2.4	**42.7**	5.5	3.3	5.5			**264.7**		20.8	3.0	3.7
7/05/2024				0.8	1.5	11.3	5.8	3.6	0.4			**163.0**		20.8	4.3	2.2
8/05/2024				0.8	1.1	13.3	4.5	3.9	1.4			**161.4**		20.5	3.5	2.3
9/05/2024	2.7	11.9	0.6	0.8	1.2	11.5	1.3	4.5	6.6			**90.2**		12.3	1.3	2.6
10/05/2024	2.4	16.0	0.5	1.2	2.2	16.9	2.6	8.5	18.9			**71.1**		0.3	6.4	3.3
11/05/2024	2.0	**46.1**	0.5	1.9	2.2	12.4	**7.4**	5.0	4.5			5.8		0.3	4.3	3.8
12/05/2024	1.8	**56.9**	1.0	0.8	2.4	12.9	2.2	3.7	9.0			1.4		0.1	2.6	3.5
13/05/2024	1.8	**56.9**	0.5	0.8	4.3	14.0	2.1	3.8	8.3			1.8		0.1	3.7	4.6
14/05/2024	1.7	**46.6**	9.0	0.8	4.2	15.4	1.6	4.0	1.2			1.5		0.0	3.8	6.0
15/05/2024	2.2	**45.1**	15.3	0.8	5.7	16.2	1.6	4.0	1.7			1.5		0.0	4.0	7.8
16/05/2024	1.9	**44.9**	0.7	0.8	7.6	12.4	2.4	4.2	1.1			1.6	6.1	0.1	4.4	7.9
17/05/2024	1.8	**46.9**	0.8	0.9		6.6	1.8		1.0			1.6	5.0	0.2	4.9	8.0
18/05/2024	1.8	**47.5**	0.9	0.9		5.9	1.9		1.8			2.0	5.1	0.6	5.9	10.4
19/05/2024	1.8	**48.7**	1.1	0.8		5.9	1.8		1.3			2.2	5.1	1.1	6.5	12.2
20/05/2024	1.8	**49.4**	1.2	0.9		5.7	1.9		5.4			2.6	4.4	2.0	7.0	11.4
21/05/2024	1.8	**49.6**	1.8	0.9		5.6	2.0		5.3			2.9	4.6	5.5	9.8	12.3
22/05/2024	1.8	**50.0**	0.9	0.9		5.6	2.3		12.6			5.1	5.5	11.3	11.0	12.3
23/05/2024	1.8	**51.2**	0.9	0.9		5.7	2.2		15.3			6.4	7.3	12.8	9.4	13.7
24/05/2024	1.8	**52.1**	0.8	0.9		5.6	2.3		0.5			9.8	8.0	15.4	7.2	12.0
25/05/2024	2.0	10.3	0.8	1.0		5.5	2.6		1.6			10.3	8.7	**26.0**	8.7	12.2
26/05/2024	3.5	4.3	0.8	1.0		5.5	2.9		2.4			18.5	8.1	4.1	8.2	11.1
27/05/2024	7.4	**31.2**	3.8	1.8		5.5	2.6		6.1			**25.9**	10.4	4.7	9.0	7.2
28/05/2024	15.3	2.2	2.4	2.9		5.5	3.8	15.9	**27.8**			**27.5**	8.9	6.5	12.7	6.8
29/05/2024	**95.9**	10.6	2.6	2.1		5.5	**18.5**	**22.6**	3.1			**26.3**	10.3	11.4	**28.8**	12.7
30/05/2024	**97.6**	3.8	3.0	1.0	2.1	5.4	2.1	2.5	1.8	2.6	**76.1**	20.0	2.6	8.6	8.0	4.2
31/05/2024	**141.8**	3.8	4.2	1.0	1.6	5.3	3.4	3.1	1.6	1.1	**40.5**	**32.7**	2.6	1.6	7.8	4.3

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. Huntly WQMS Locations

Appendix B. WQMS General Arrangement



Willowdale Mine – Water Quality Monitoring System Data Review

May 2024

Revision: ***01***

Date: ***23 July 2024***

Client: ***SciDev Pty Ltd***

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

RARE Environmental

Document Control

Project Details	
Document Title	Willowdale Mine – Water Quality Monitoring System Data Review
Document No	RP24050 WDL WQMS Data Review - May 2024
Project Name	SciDev WQ Data Processing
Project Number	RP24050
Client	SciDev
Client Reference	PO002447

Document History and Status						
Revision	Date	Description	Prepared	Reviewed	Approved	Issued to
01	23/07/24	For internal review	SM	RD	RD	SciDev

Report Sign Off					
Report Version	01				
Prepared by		Technical Review		Approved for Issue	
Name	Sarah Mathew	Name	Rob Dwyer	Name	Rob Dwyer
Position	Env. Scientist	Position	Regional Manager	Position	Regional Manager
Date	23/07/2024	Date	26/07/2024	Date	26/07/2024

RARE Environmental Pty Ltd
ABN 41617855017
110/117 Old Pittwater Rd
Brookvale NSW 2100 Australia
P: 0413 223 401
www.rare-enviro.com.au

Infrastructure Sustainability Council MEMBER

Contents

Document Control i
1. Introduction 1
1.1. Purpose 1
1.2. Context 1
1.3. Monitoring Requirements 1
1.4. Water Quality Monitoring System (WQMS) 1
1.5. Data Review & Event Classification Process 2
2. WQMS Data Review 4
2.1. Deployment & Collection 4
2.2. Classification 4
2.2.1. PTM01 Potential Turbidity Events 4
2.2.2. HV07 Potential Turbidity Events 5
2.3. True Turbidity Events 5
3. Recommendations 6
3.1. WQMS Network 6
4. Raw WQMS Data 7
Appendix A. Willowdale WQMS Locations 1
Appendix B. WQMS General Arrangement 2

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 May 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.

1.5. 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.

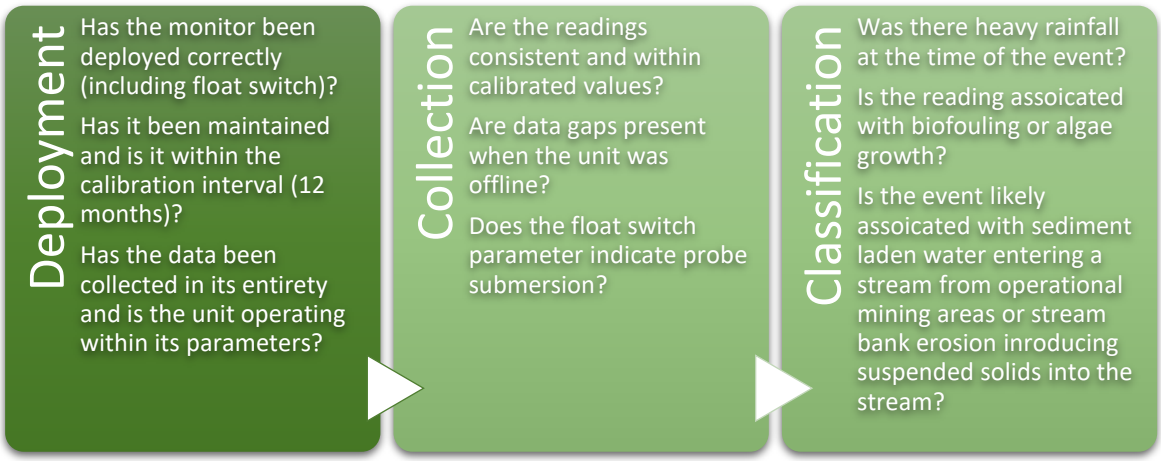


Figure 1: Data Review & Event Classification Process

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.

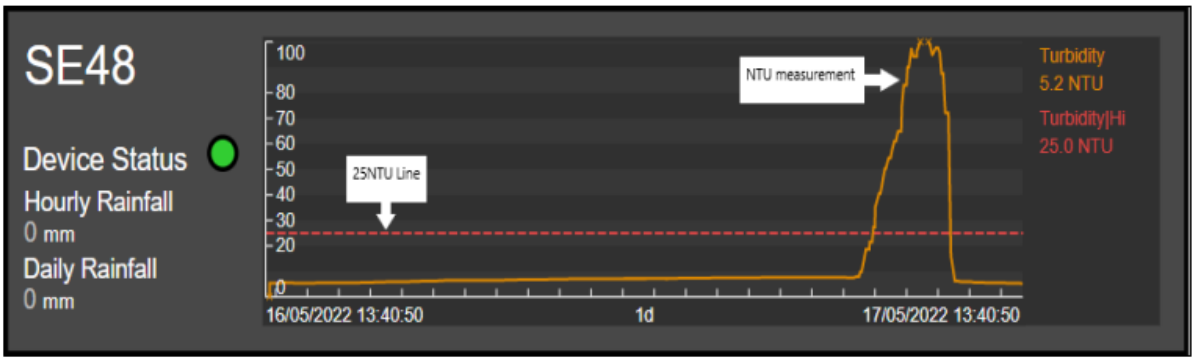


Figure 3: Typical 'false' exceedance event showing both a sharp incline and decline.

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

2. WQMS Data Review

For the reporting period of May 2024, 14,415 data points were collected by 2 (two) WQMSs across the Willowdale site. From this data a total of 3 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 have identified that no WQMSs require review in regards erroneous data. There were 3 (three) days where data was impacted dry stream events as detailed in Table 1. No potential turbidity events during the reporting period across the 2 (two) units were identified as discussed in the following section.

Table 1: WQMS Requiring Review

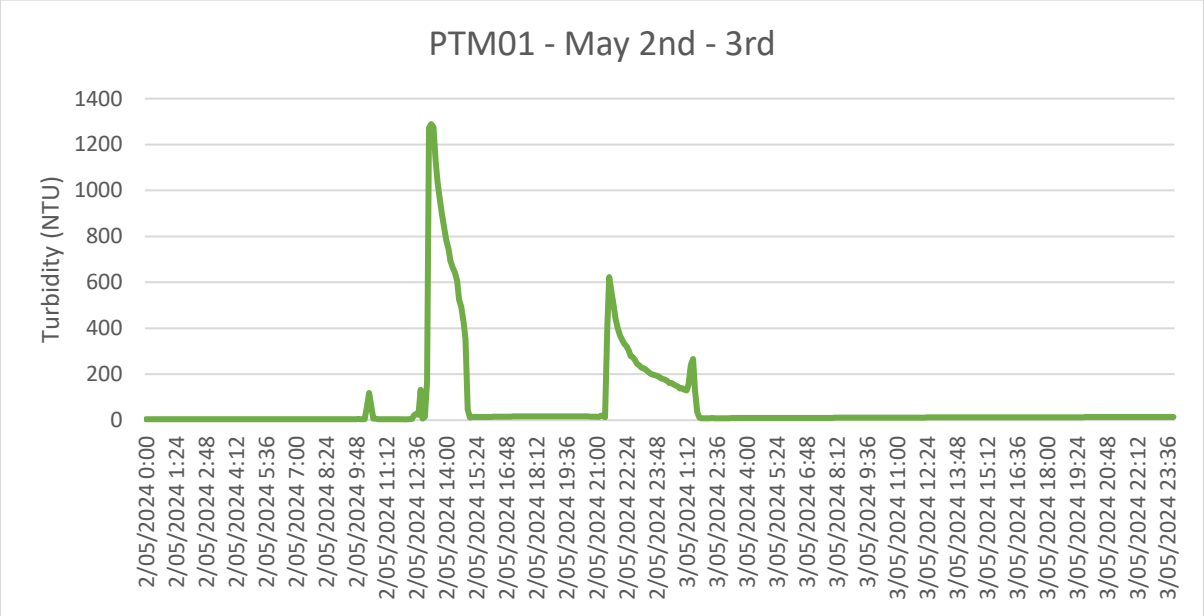
Unit	Dates	Comment
PTM01	2nd May 2024	Stream was dry throughout May 2024, however, there was evidence of water pooling at the monitor location from runoff from the forest track following high rainfall events.
PTM01	3rd May 2024	Stream was dry throughout May 2024, however, there was evidence of water pooling at the monitor location from runoff from the forest track following high rainfall events.
HV07	29th May 2024	Turbidity unit encountered equipment malfunctions in May causing the unit to fail at various points throughout the month. Data invalid for May 2024 due to dry stream.

2.2. Classification

Analysis of the data from the 2 (two) valid WQMSs identified 3 (three) potential turbidity events during the reporting period. For this reporting period there were no 'true' turbidity events identified. Refer to the following section for analysis.

2.2.1. PTM01 Potential Turbidity Events

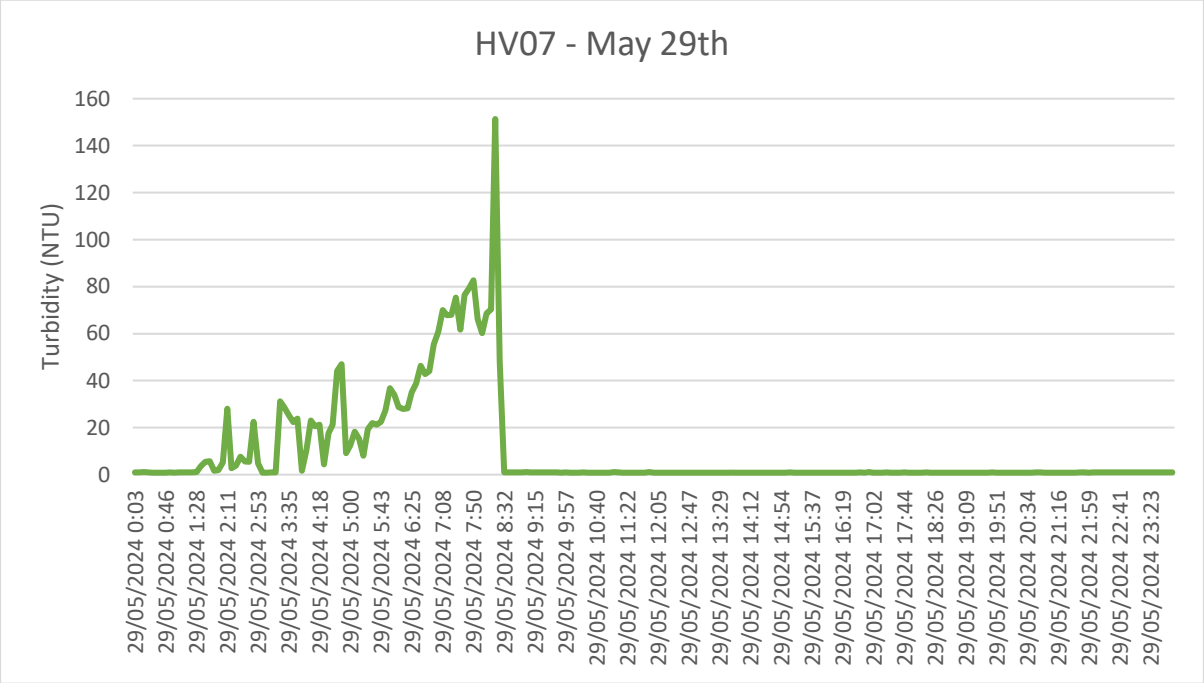
Chart(s) for data flagged at monitor PD01T are shown below for the potential events identified in the reporting period.



The abrupt return to normal levels and dry stream conditions noted is indicative of false events. No further investigation is required.

2.2.2. HV07 Potential Turbidity Events

Chart(s) for data flagged at monitor HV07 are shown below for the potential events identified in the reporting period.



The abrupt return to normal levels and dry stream conditions noted is indicative of a false event. No further investigation is required.

2.3. True Turbidity Events

For this reporting period, no 'true' turbidity events were identified.

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 - May 2024 - Events with turbidity > 25 NTU for an hour or more	
	HV07	PTM01
1/03/2024		
2/03/2024		**1**
3/03/2024		**1**
4/03/2024		
5/03/2024		
6/03/2024		
7/03/2024		
8/03/2024		
9/03/2024		
10/03/2024		
11/03/2024		
12/03/2024		
13/03/2024		
14/03/2024		
15/03/2024		
16/03/2024		
17/03/2024		
18/03/2024		
19/03/2024		
20/03/2024		
21/03/2024		
22/03/2024		
23/03/2024		
24/03/2024		
25/03/2024		
26/03/2024		
27/03/2024		
28/03/2024		
29/03/2024	**1**	
30/03/2024		
31/03/2024		

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 - May 2024 - Turbidity (Daily Average, NTU)	
	HV07	PTM01
1/05/2024	3.2	5.6
2/05/2024	3.7	**98.9**
3/05/2024	3.8	**26.2**
4/05/2024	4.1	14.2
5/05/2024	4.1	14.6
6/05/2024	4.1	12.0
7/05/2024	4.0	9.8
8/05/2024	2.7	10.0
9/05/2024	0.9	10.1
10/05/2024	1.0	9.0
11/05/2024	0.9	7.6
12/05/2024	0.9	10.2
13/05/2024	2.1	10.4
14/05/2024	0.9	10.9
15/05/2024	0.9	11.2
16/05/2024	0.9	11.2
17/05/2024	0.9	11.0
18/05/2024	0.9	10.9
19/05/2024	0.9	11.0
20/05/2024	0.9	11.0
21/05/2024	0.9	10.9
22/05/2024	0.9	10.8
23/05/2024	0.9	11.1
24/05/2024	1.0	10.2
25/05/2024	1.1	4.8
26/05/2024	1.0	6.8
27/05/2024	0.9	6.2
28/05/2024	2.1	6.8
29/05/2024	9.7	7.5
30/05/2024	1.2	6.1
31/05/2024	0.9	6.2

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

Appendix B. WQMS General Arrangement