

Gove Operations

WDL Annual Monitoring Report

13 July 2022

For the reporting period of 1 April 2021 to 31 March 2022.

Prepared in accordance with the requirements of the Northern Territory Government Waste Discharge Licence (WDL171-11, 15 February 2022) and Northern Territory Environment Protection Authority "Guideline for Reporting on Environmental Monitoring (Version 1.0, May 2016)."

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Abbreviations

ABBREVIATIONS	DESCRIPTION
ANZG	Australia and New Zealand Guidelines for fresh and marine water quality
AS	Australian Standards
BTEX	benzene, toluene, ethylbenzene and xylene
CFU	Colony Forming Units
COC	Chain of Custody
EC	Electrical Conductivity
DEPWS	Department of Environment, Parks and Water Security (NT)
DITT	Department of Industry, Tourism and Trade (NT)
EPA	Environment Protection Authority (NT)
FSANZ	Food Standards Australia New Zealand
Gove Operations	Rio Tinto Gove Operations Pty Ltd, RTA Gove Pty Limited (ABN 76 000 453 663)
LFTF	Light Fuel Tank Farm
LOR	Limit of reporting
MHMP	Marine Health Monitoring Program
ML	Mega litre
ml	Millilitre
MPN	Most-Probable Number
µg/L	microgram/litre
NATA	National Association of Testing Authorities
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NTU	Nephelometric Turbidity
NT	Northern Territory
NZS	New Zealand Standards
PAH	Polycyclic Aromatic Hydrocarbons
QA/QC	Quality Assurance and Quality Control
RDA	Residue Disposal Area
SNL	SuperNatant Liquor
STP	Sewerage Treatment Plant
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
TV	Trigger Value
WDL	Waste Discharge Licence
WWNP	Wastewater Neutralisation Plant
WMP	Water Monitoring Plan

Executive Summary

This Waste Discharge Licence (WDL) Annual Monitoring Report presents the results of the WDL monitoring program carried out across the Refinery and marine domains of the RTA Gove Pty Limited (Gove Operations) for the reporting period 1 April 2021 to 31 March 2022. This report has been prepared in accordance with Conditions 46 and 47 of WDL171-11 (“the Licence”).

The current version of the Licence was issued to Gove Operations by the Northern Territory Government on 15 February 2022, and covers the “*controlled discharge of treated wastewater from authorised discharge points at the Refinery*” to Gove Harbour. The Licence specifies the monitoring frequency, sampling and analytical requirements, and nominates site specific Trigger Values (TVs) and Limits, for a series of “Authorised Discharge Points,” “Authorised Monitoring Points” and “Compliance Points.”

Prior to the commencement of WDL171-11 on 15 February 2022, surface water and marine monitoring was undertaken in accordance with WDL171-10 (17 September 2020 to 15 February 2022). This includes the majority of the current reporting period. From 15 February 2022 to 31 March 2022, surface water and marine monitoring was undertaken in accordance with WDL171-11.

The primary objectives of this report are to assess compliance against the monitoring and reporting requirements outlined in the Licence, summarise data trends for the reporting period, and assess the potential impact (if any) of authorised discharge on marine ecosystem health.

Review of the monitoring data for the reporting period indicated that monitoring and reporting was completed in general compliance with the Licence.

The following conclusions are noted:

- Sampling of both surface water and marine environments was completed with reference to the Water Monitoring Plan (WMP, 2019). No deviations from the WMP methodology were noted during the reporting period;
- The seawater outfall channel at the Refinery discharges to the marine receiving environment, unless offline operational maintenance, shutdowns of the seawater discharge channel or trigger actions in response to the Wastewater Neutralisation Plant (WWNP) Trigger Action Response Plan (TARP) occur. In instances where the seawater outfall discharge is offline and surface water flow in the channel is absent, sampling at locations S001 and S074 cannot be undertaken. However, monitoring at these locations is not applicable when channel flow is absent. During the reporting period, the seawater outfall channel was not discharging for periods between July 2021 and October 2021.
- Monitoring was completed in compliance with the Licence, with the exception of the non-compliance notifications that have previously been reported to the Department of Environment, Parks and Water Security (DEPWS) and are discussed in this report:
 - The frequency of monitoring at Authorised Discharge Point S001 for pH and EC (continuous/daily) was not met on three occasions due to periodic equipment faults and loss of communication. (Incident **1000578371**, **1000608476** and **1000608477**);
 - Daily analysis of alkalinity at S001 was not conducted on one occasion when the seawater outfall discharge channel was online on 4 June 2021 (Incident **1000609084**);
 - Daily sampling at Authorised Discharge Point S074 was not conducted on two occasions when the seawater outfall discharge channel was online on 23 August 2021 and 3 January 2022 (Incident **1000585261** and **1000595869**);
 - Daily sampling was conducted at S001 and S074 and analysed for daily parameters, however alkalinity was not analysed on Saturday 22 January 2022 (Incident **1000600062**);
 - Hydrocarbon samples were not conducted at SW9, SW10 and RR2 during sampling on 17 May 2021 (Incident **1000578910**) when discharging from S086, S087, S088 and S044 for the 21 May release event; and

- o Monthly TSS was not analysed for SW3 and SW4 for February 2022 round (Incident **1000603157**);
- o One exceedance of the WDL171-11 Limit for Total Dissolved Nitrogen was recorded. Total Dissolved Nitrogen was reported at Authorised Discharge Point S001 on 8 March 2022 at a concentration of 4,600 µg/L, which exceeded the WDL Limit (1,700 µg/L) (Incident **1000609048**).
- Three unauthorised discharge events occurred on 25 December 2021 (Incident **1000595416**), 6 February 2022 (Incident **1000598739**) and 25 March 2022 (Incident **1000603062**)

This report also presents the 17th annual monitoring report under Gove Operations Marine Health Monitoring Program (MHMP) for Southern Melville Bay (*Routine Surveillance Monitoring Program – Receiving Environment Quality Survey*). It presents new data for seawater, sediment and oysters for the reporting period and is presented in *Appendix E*.

No current evidence of deterioration of marine ecosystem health (as a result of the authorised discharge) was identified based on the monitoring data collected and incident reports reviewed for this monitoring period. The following table presents a summary of the licence conditions that are relevant to this report, and compliance relative to those conditions during the April 2021 – March 2022 monitoring period.

Table ES-1 Summary of Compliance with WDL171-11 (and previous WDL 171-10)

Licence Condition	Compliance Statement	Report Section
1-13	Not addressed in this report.	Not included in this report.
14-15	The licensee understands this condition, however no complaints were made during the reporting period.	Section 5.7
16-21	Not addressed in this report.	Not included in this report.
22	The licensee recorded three events that were from unauthorised discharge points. These are reported as incidents within the monitoring report.	Section 5.3.1.3
23	The licensee measured and recorded, for each discharge event at each discharge point: 23.1. the time the discharge commenced and the duration of the discharge 23.2. the discharge rate of flow and 23.3. for S001, the discharge volume.	Section 5.3.1.1 Section 5.3.1.2
24	Not addressed in this report.	Not included in this report.
25	Monitoring points S098 and S0125 are to be installed by 30 August 2022 and as such this condition is not relevant for the current monitoring period.	Not applicable.
26	Where trigger values were exceeded they were acted upon.	Section 5.3.4.2.2 Section 5.3.4.3 Section 5.3.4.4
27	Monitoring of the authorised discharge points for all discharge events occurred and did not indicate the presence of floating debris etc. (27.1), or affect the health of marine organisms (27.3-27.5).	The marine monitoring report (summarised in Section 6 and reproduced in Appendix E) indicates that there was not adverse impact on marine health. Oil, grease and petroleum hydrocarbon sheen monitoring results are discussed in Section 5.4.
28	Except as indicated in Incidents 1000578371 , 1000609084 , 1000585261 , 1000595869 , 1000600062 and 1000603157 monitoring was conducted in accordance with Appendix 2.	Section 5.3.2

Licence Condition	Compliance Statement	Report Section
29	Sediment and biological monitoring was conducted as specified in Table 1.	The marine monitoring report (summarised in Section 6 and reproduced in Appendix E) summarises the sediment and biological monitoring that was conducted.
30	Sampling locations S001 and compliance points SW9, SW10, and RR2 were sampled on the same day and in order from the authorised discharge point to the mixing zone boundary.	The results presented in the marine monitoring report (summarised in Section 6 and reproduced in Appendix E) indicate that these locations were sampled on the same day and in the order specified.
31	Conditions of the WDL have taken precedence over the Water Monitoring Plan 2019 where there is any conflict.	Section 5.2.2 summarises the monitoring conducted relative to either WDL171- 10 or WDL171-11, depending on the date.
32	Samples and field environmental data were representative of conditions at the time of sampling.	Section 5.3.3 and Appendix A discuss the field and laboratory QA/QC results. Section 5.2.2 indicates that samples were collected by suitably qualified personnel.
33	Samples and field environmental data were collected in accordance with recognised Australian Standards and guidelines.	Sections 5.2.2
34	All monitoring samples were analysed at a laboratory with NATA accreditation or equivalent at the time of monitoring, for the parameters measured.	Section 5.2.2
35	Not addressed in this report	Not included in this report.
36	Samples collected in connection with the activity of this licence were obtained by a qualified sampler.	Section 5.2.2 states that samples were collected by suitably qualified personnel.
37	For the activity, the date, time, locations, name, chain of custody, field measurements, analytical results, and lab QA/QC documentation were recorded and retained for each sample collected as described throughout this report.	Section 5.2.2 references records and data are held by Gove Operations, and results summarised in this report.
38	Non-compliances with this licence are presented as Incidents in this report.	See Appendix F, Executive Summary, Section 5.3.2 and Conclusions.
39	Details of specific timing regarding notifications of non-compliances are not included in this report	Not included in this report.
40	Notification of non-compliance.	Details regarding specific notifications of non-compliances are included in the incident reports provided in Appendix F.
41	Non-compliances were identified as an exceedance of a limit or trigger value as specified in Appendix 2 of the licence.	Incident 1000603062 – Section 5.3.4.2.2 Incident 1000609048). – Section 5.3.4.1
42	Details regarding exceedance of trigger values including:	Details are provided in the Incident Reports included in Appendix F.

Licence Condition	Compliance Statement	Report Section
	42.1. the actual and potential causes and contributing factors to the exceedance 42.2. the risk of environmental harm resulting from the exceedance 42.3. actions undertaken to mitigate any environmental harm arising from the exceedance; and 42.4. if no action was taken why no action was taken; are not included in this report.	
43	This report identifies and records all exceedances of trigger values. Records are kept in this report, the associated data files and by Gove in their data management system.	Section 5.3.4.2.2 Section 5.3.4.3 Section 5.3.4.4 Appendix C and D
44	Details regarding the trigger value exceedances are included in this report, and recorded in the associated data files.	Section 5.3.4.2.2 Section 5.3.4.3 Section 5.3.4.4
45	The Annual Return is reported under separate cover.	Not included in this report.
46	This report represents the Monitoring Report.	Entire report and accompanying Excel files.
47	This Monitoring Report includes details as follows:	
47.1	Requirements of the Administering Agency were taken into consideration when preparing the report.	Table 3-2
47.2	All monitoring data was tabulated and presented in Appendix C of the report and separate Excel tables.	Appendix C (Tables) and accompanying Excel files.
47.3	Monitoring points S098 and S015 are not required to be installed until 30 August 2022 and as such this condition is not relevant for the current monitoring period.	Not applicable.
47.4	Authorised discharges were recorded by Gove Operations and summarised in this report.	Section 5.3.1.1 and Section 5.3.1.2
47.5	Environmental monitoring data is assessed as per the requirements in Appendix 2.	Section 5.3.2, Section 5.3.3 and Section 5.3.4
47.6	Marine Health Monitoring Report was reviewed and from the data collected it was demonstrated that no deterioration of marine health occurred as a result of authorised discharge.	Section 6 and Appendix E (Marine Health Monitoring Report).
47.7	Long term trend analysis was performed over a minimum period of three years.	Section 5.6 Appendix D and accompanying Excel files.
47.8	Assessment of environmental impact was included.	Section 7
48	The Continuous Improvement Plan is included as Appendix G of this report.	Appendix G.
49	The options analysis to avoid discharge from S086-S088 is included in Section 5.7.2	Section 5.7.2
50	The Marine Health Monitoring Plan is included as Appendix E of this report.	Appendix E.
51-54	The Adaptive Management Plan is not part of this report. It is provided under separate cover.	Not included in this report.

1. Operator Details

Table 1-1 Operator Details

Details	
Operator	RTA Gove Pty Limited (ABN 76 000 453 663)
Owner	Swiss Aluminium Australia Limited (ACN 008 589 099)
Operator Registered Address	155 Charlotte Street, Brisbane QLD 4000
Operator Postal Address	PO Box 21, Nhulunbuy NT 0881
Operator Street Address	1 Melville Bay Road, Nhulunbuy NT 0880
Waste Discharge Licence	171-11 (previous version 171-10 also applicable during reporting period)
Reporting timeframe	1 April 2021 – 31 March 2022 to cover the 2021-22 wet season
Date of report	17 July 2022
Key site contact	Ben McTavish

2. Introduction

RTA Gove Pty Limited ("Gove Operations") is committed to undertake annual surface water and marine monitoring and produce an Annual Monitoring Report (this report), in accordance with the Waste Discharge Licence (WDL 171-11; "the Licence").

The current version of the Licence was issued to Gove Operations by the Northern Territory Government on 15 February 2022, and covers the "*controlled discharge of treated wastewater from Authorised Discharge Points at the Refinery*" to Gove Harbour. The WDL is issued by the Department of Environment, Parks and Water Security (DEPWS) and is pursuant to Section 73 and Section 93 of the *Water Act 1992* (2016). In accordance with Condition 46 of the Licence (was previously Condition 43 of WDL171-10), this report presents the monitoring data collected for the reporting period: 1 April 2021 to 31 March 2022. Prior to the commencement of WDL171-11 on 15 February 2022, surface water and marine monitoring was undertaken in accordance with WDL171-10 (17 September 2020 to 15 February 2022). This includes the majority of the current reporting period. From 15 February 2022 to 31 March 2022, surface water and marine monitoring was undertaken in accordance with WDL171-11.

The domains discussed in this report include:

- the Refinery (refer Figure 1, Appendix B); and
- the Marine receiving environment.

The WDL also requires the maintenance and implementation of the following Gove Operations documents:

- Water Monitoring Plan (WMP) (2019);
- WDL Continuous Improvement Plan (2022); and
- RTA Gove Water Management Plan Rev 0 (2021).

3. Objectives

The objectives of the WDL Annual Monitoring Report are to:

- Demonstrate compliance with the monitoring and reporting requirements outlined within WDL171-11 (and where applicable, WDL171-10);
- Detail sampling methodology over the reporting period, including deviations from the WMP (Gove Operations, 2019);
- Summarise data trends and provide data interpretation for the reporting period: 1 April 2021 to 31 March 2022;
- Demonstrate no deterioration of marine ecosystem health, as a result of authorised discharge;

- Make an assessment of environmental impact associated with authorised discharges; and
- Suggest changes to improve efficiencies in sampling and/or in the WMP.

3.1 Reporting Requirements

This report has been prepared in accordance with the requirements of the Northern Territory Environment Protection Authority (NT EPA) document "Guideline for Reporting on Environmental Monitoring" (NT EPA, 2016). It has also been prepared in consideration of WDL171-11 Condition 47 (was previously Condition 44 of WDL171-10), which outlines the licence requirements for the WDL Annual Monitoring Report (this report).

Table 3-1 and Table 3-2 below summarise the sections of the report that address the reporting requirements of the WDL and NT EPA, respectively.

Table 3-1 Summary of Compliance with WDL171-11 (Condition 47)

Licence Condition	Relevant Licence Requirement	Report Section
47.1	Is prepared in accordance with the requirements of the Administering Agency 'Guideline for Reporting on Environmental Monitoring' (NT EPA, 2016)	Table 3-2
47.2	Includes a tabulation of all monitoring data required as a condition of this licence.	Appendix C (Tables) and accompanying Excel files.
47.3	Includes tabulation of monthly and annual contaminant loads discharged from the STP (S015) and WWNP (S098). Contaminant loads must be calculated for total metals, total metalloids and total nutrients listed in Appendix 2 Table 4 (of WDL171-11). The calculations must be based on the daily discharge volume and the concentration of contaminant present in the discharge on that day. On the days when a sample was not taken then the concentration of the contaminant must be estimated during linear interpolation methodology.	Not yet applicable as monitoring points of daily discharge at S098 and S0125 are to be commissioned by 30 August 2022
47.4	Collectively summarises each authorised discharge from an authorised discharge point, as per requirements of Condition 23. Condition 23 requires "for each authorised discharge point measure and record, for each discharge event: • The time the discharge commenced and the duration of discharge; • The discharge rate of flow; and • For S001, the discharge volume."	Section 5.3.1.1 and Section 5.3.1.2
47.5	Includes an assessment of environmental monitoring data representativeness as it relates to samples collected from S001, SW9, SW10 and RR2 during release periods from the WWNP (S098) and STP (S015).	Section 5.3.2, Section 5.3.3 and Section 5.3.4
47.6	Uses information collected in accordance with Condition 28 and Condition 29 to demonstrate that there is no deterioration of marine ecosystem health as a result of authorised discharge.	Section 6 and Appendix E (Marine Health Monitoring Report)
47.7	Includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of three years (where the data is available).	Section 5.6 Appendix D and accompanying Excel files.
47.8	Includes an assessment of environmental impact from the activity.	Section 7

Table 3-2 NT EPA (2016) Reporting Requirements

Monitoring Report Requirements	Report Section
Title page	Title page
Executive summary	Executive Summary
Monitoring objective	Section 3
Monitoring method	Section 5.2.2
Monitoring results – presentation	Appendix B (Table 1 to Table 4)
Monitoring results – quality assurance/ quality control (QA/QC) evaluation	Appendix A
Discussion and interpretation of results	Section 5.3
Conclusion and proposed actions	Section 7
Certification	Title page
Abbreviations	Abbreviations
References	Section 8
Appendices	Appendix A to Appendix F

4. Background

4.1 Surface Water Management Overview

Gove Operations manages four primary operational domains within the overall Gove mining lease area, including: the Mine, the Refinery, the Residue Disposal Area (RDA) and the marine receiving environment (refer Figure 1, Appendix B). The monitoring activities conducted within the four domains differ considerably, as each domain resides in a different surface water catchment and has different surface water management strategies and priorities.

As mentioned in Section 2, the discharge of treated wastewater from the Refinery to the marine receiving environment (Gove Harbour) is licenced under WDL171-11. There are five (5) nominated Authorised Discharge Points from which discharge can occur, being: S001, S044, S086, S087 and S088 (see Section 4.2.1 and Figure 2, Appendix B; note that S001 is co-located with Authorised Monitoring Point S074). The Licence requires that surface water quality at each of the five (5) Authorised Discharge Points be monitored (see Section 5.2 for discussion on the surface water monitoring program). There are also a series of marine monitoring points specified in the Licence where marine water quality, sediment and biological monitoring is required to be undertaken (see Section 6 and Appendix E).

Surface water management plans and priorities are continually reviewed for relevance and accuracy, in conjunction with the Department of Industry, Tourism and Trade (DITT) and DEPWS, via the NT EPA.

4.2 Waste Discharge Licence (WDL)

The WDL specifies the monitoring frequency, sampling and analytical requirements, and nominates site specific Trigger Values (TVs) and Limits for the Authorised Discharge Points and Authorised Monitoring Points and Compliance Points of the Refinery, RDA and marine domains.

During the reporting period (1 April 2021 - 31 March 2022), the following WDL versions were valid:

- WDL171-10: Valid from 17 September 2020 – 15 February 2022; and
- WDL 171-11: Valid from 15 February 2022 – Current (expires 16 September 2030).

The Gove WMP (2019) was developed in accordance with the WDL171-08 monitoring program, rather than the current version of the WDL.

Consistent with Condition 46 of WDL171-11 (Condition 43 of WDL171-10), the monitoring and analytical results for this reporting period will be assessed against the most recent licence (WDL171-11) only. However, some of the monitoring requirements (frequency, locations and parameters) outlined in WDL171-10 are different to those in WDL171-11, and this is discussed where relevant.

The locations of the Authorised Discharge Points and Authorised Monitoring Points / Compliance Points are shown on Figure 2, Appendix B.

4.2.1 Authorised Discharge Points

Table 4-1 below provides a summary of the Authorised Discharge Points, as outlined in the Licence. All five (5) Authorised Discharge Points have trigger values and limits specified in the Licence. Further information on this is provided in Section 5.2.3 below.

Monitoring results from the Authorised Discharge Points (as well as the associated Authorised Monitoring Points S074 and S094) are discussed in Section 5.3.4.

Table 4-1 WDL Authorised Discharge Points

Discharge Point	Description	Active Discharge
S001	Seawater Outfall Channel	Treated wastewater from the Wastewater Neutralisation Plant (WWNP) and the Sewerage Treatment Plant (STP)
S044	Refinery Light Fuel Tank Farm (LFTF) Bund (housing an oily water separator)	Stormwater contained in the bunded area
S086	Refinery Tank Farm Bund	
S087		
S088		

4.2.2 Authorised Monitoring Points

Table 4-2 below provides a summary of the Authorised Monitoring Points, as outlined in the Licence. Monitoring results for the marine monitoring points are summarised in Section 6, with the exception of S074 and S094 (which are discussed in Section 5.3.4) and hydrocarbon monitoring at Compliance Points SW9, SW10 and RR2 (which is discussed in Section 5.4).

Table 4-2 WDL Authorised Monitoring Points

Monitoring Point	Area	Source and Description
S074	Seawater Outfall Channel (Refinery)	Composite sampler at the seawater outfall channel (as per S001)
S094	Public boat ramp (Refinery)	Detects potential bacteriological impacts from S001 discharge
SW2	Arafura Sea – Off West Woody Island	Information
SW3	Gove Harbour – Off Granite Island	
SW4	Melville Bay – Off Dolphin Rocks	
SW7	Offshore Drimmie Arm	
SW8	Inverell Bay / Gove Harbour	
SW9*	Mixing Zone Boundary	Impact for authorised discharge from Refinery
SW10*	Mixing Zone Boundary	Impact for authorised discharge from Refinery
SW11	Gove Harbour – Off Outfall	Information – in seawater discharge plume
RR2*	Mixing Zone Boundary	Impact for authorised discharge from Refinery
MB1	Mixing zone boundary test site (Refinery)	
MB2	Mixing zone boundary test site (Refinery)	
MB3	Mixing zone boundary test site (Refinery)	
MB4	Mixing zone boundary test site (Refinery)	
S098^	WWNP neutralised SuperNatant Liquor (SNL) prior to entering seawater channel	Measure of analytical concentrations output from the waste water neutralisation plant prior to discharge into seawater channel
S015^	Sewerage Treatment Plant (STP)	Measure of analytical concentrations output from the sewerage treatment plant prior to discharge into seawater channel

* SW9, SW10 and RR2 are also considered to be Compliance Points under WDL171-11 (and also WDL171-10). As such, the Licence specifies trigger values for these locations. The remaining Monitoring Points do not have specific trigger values/limits in the WDL.

^S098 and S015 are included in WDL171-11, but are not in WDL171-10.

4.2.3 Sediment and Biological Monitoring

Biological and sediment monitoring is also required at the Refinery, in accordance with the WMP (2019) and Condition 29 of the Licence (Condition 28 of WDL171-10). This is discussed in Section 6.

4.3 Site Rainfall

Gove Operations currently operates five rainfall gauges around the RDA; the location of these are presented on Figure 2, Appendix B. These gauges collect rainfall at five minute intervals and are accessible via an online system for real time interrogation. Rainfall data from all gauges collected over the reporting period were downloaded and assessed for this report as average daily rainfall.

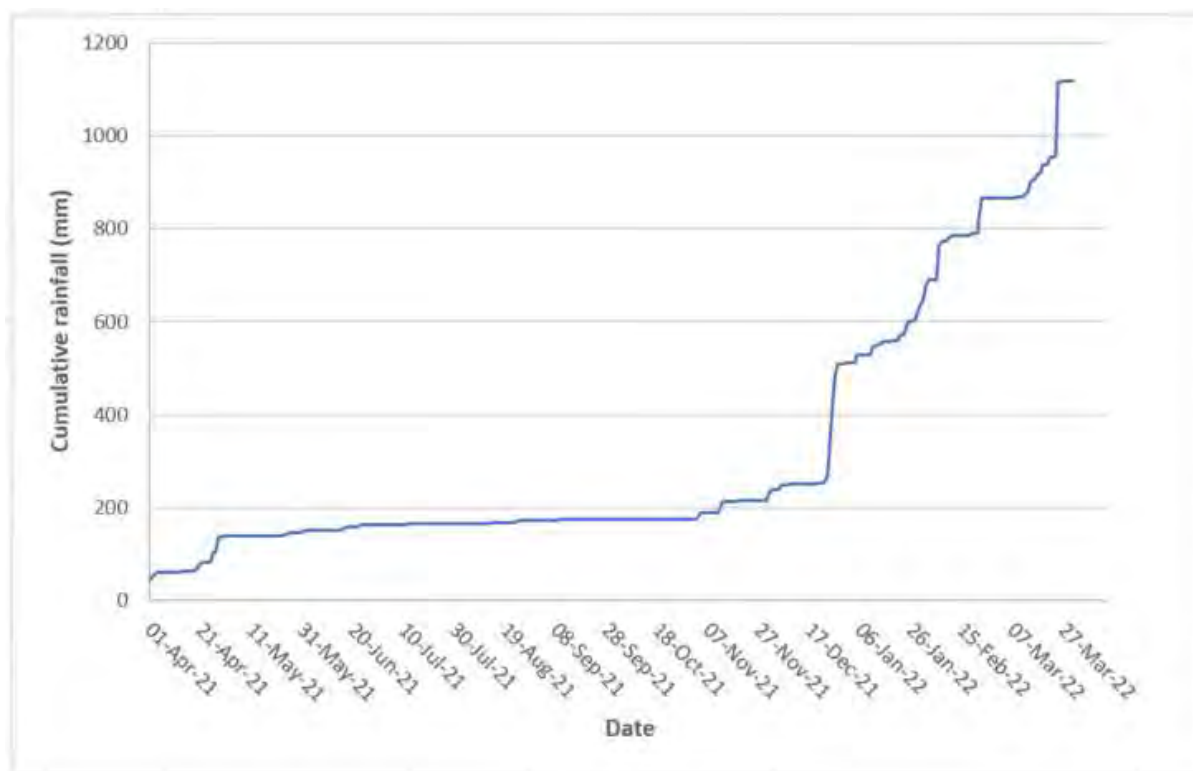
Despite their close proximity, the rainfall gauges display variable volumes of total rainfall in any given day. The average rainfall values on any given day for the 5 gauges have been calculated and are presented on Graph 4.3-1 below.

The first rainfall for the 2021-2022 reporting period occurred on 1 April 2021 with gauges across the RDA recording an average daily rainfall of 44.1 mm. Rainfall was recorded for the following five days with a cumulative average rainfall of 61.18 mm. Additional rainfall events were recorded between 25 April and 1 December 2021. Rainfall occurring during April 2021 and May 2021 is considered to be reflective of the end of the 2020/21 wet season, and there was little rainfall between May 2021 and December 2021 (Graph 4.3-1).

With the onset of the 2021/22 wet season, rainfall was recorded on 30 November 2021, increasing the average cumulative total rainfall for the reporting period to 1,210 mm. Most of this rainfall occurred over the following events:

- Event 1 – 61.18 mm (average) between 1 April 2021 and 6 April 2021 (representing 2020/21 wet season);
- Event 2 – 57.75 mm (average) between 25 April – 3 May 2021 (representing 2020/21 wet season);
- Event 3 – 33.2 mm (average) between 30 November – 6 December 2021;
- Event 4 – 273.8 mm (average) between 24 December 2021 – 6 January 2022;
- Event 5 – 30.85 mm (average) between 11 January – 19 January 2022;
- Event 6 – 226.35 mm (average) between 22 January – 11 February 2022;
- Event 7 – 75.76 mm (average) between 22 February – 24 February 2022; and
- Event 8 – 251.2 mm (average) between 12 March – 27 March 2022.

Graph 4.3-1 Cumulative Average Site Daily Rainfall



5. The Refinery: Surface Water Condition Review

5.1 Refinery Surface Water Catchments

The Refinery has a total of 14 surface water sub-catchments that drain to the Eastern, Western and Southern Containment Ponds located within the Refinery (refer Figure 3, Appendix B). These ponds are designed to collect and retain surface water runoff, including any operational release of liquids, for subsequent re-processing and/or treatment. During storm events, the Containment Ponds also provide a runoff surge capacity and, if required, allow contaminated surface water to be recycled to the RDA, and then treated via the WWNP, prior to discharge (under the Licence) via the Seawater Outfall Channel (S001).

The Seawater Outfall Channel is located down-gradient of the convergence of the “seawater circuit” channels (Eastern Channel and Western Channel). The seawater circuit of the Refinery comprises the main process water intake and wastewater discharge system within the Refinery Catchment, with a seawater channel discharge rate of approximately 10,500 m³/hr.

At the LFTF and Harbour Tank Farm, stormwater is collected in bunds and is released into Gove Harbour under licence (WDL171-11) via Authorised Discharge Points S044, S086, S087, and S088.

5.2 Surface Water Monitoring Program

5.2.1 Sampling Locations

The following Authorised Discharge Points and associated surface water sampling locations (Authorised Monitoring Points) are defined by WDL171-11 for the Refinery:

- Seawater Outfall Channel (S001 – discharge and S074 - monitoring);
- Public boat ramp (S094 - monitoring);
- Sewerage Treatment plant (S015 - monitoring, new to WDL171-11);
- Waste Water Neutralisation Plant (S098 - monitoring, new to WDL171-11);

- Light Fuel Tank Farm Bund (S044 - discharge); and
- Harbour Tank Farm Bunds (S086, S087, S088 – all discharge).

Aside from S001 (the Seawater Outfall Channel) which generally continuously discharges to Gove Harbour, the remaining four (S044, S086, S087, and S088) Authorised Discharge Points are seasonal and typically only discharge during the wet season, or monsoonal/cyclone events. Authorised Monitoring Point S074 is not a Discharge Point, rather it is an automated, composite surface water sampler located adjacent to Authorised Discharge Point S001.

Sampling locations S074 and S094 are incorporated as part of the Marine Health Monitoring Program (MHMP) in WDL171-11, however they are included within the Surface Water Monitoring Program in the WMP (Gove Operations, 2019). As such, they are included within the Surface Water discussion in this report (Section 5.3).

Locations of the Authorised Discharge Points and Authorised Monitoring Points are shown on Figure 2, Appendix B.

5.2.2 Sampling Methodology and Frequency

Surface water sampling was conducted during the reporting period by experienced and qualified Gove Operations personnel in accordance with the following documents and the WMP (2019):

- Australian Standards / New Zealand Standards (AS/NZS) 5667.1:1998 *Water Quality – Sampling, Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*; and
- National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM)*, 1999 (amended 2013).

The approved WMP (2019) for Gove Operations covers surface water, groundwater and marine monitoring across all four domains of the site. The current version of the WMP is dated October 2019.

The WMP (2019) was written with reference to WDL171-08, which has since been superseded by the WDL171-09 (July 2020), WDL171-10 (September 2020) and, most recently, the current version WDL171-11 (February 2022). The required monitoring frequency, locations and analytical suite and, trigger values and limits for the Authorised Discharge Points have been revised in the superseding licences.

Table 5-1 below compares the monitoring frequency detailed in the WDL171-10 and WDL171-11.

Table 5-1 Surface Water Monitoring Frequency (as per WDL 171-11)

Authorised Discharge Point:	S001		S044, S086, S087 & S088	
WDL Number:	WDL171-10	WDL171-11	WDL171-10	WDL171-11
Environmental Parameters				
pH	Continuous / Daily	Continuous ³ / Daily	Daily ⁴	Daily ⁴
Electrical Conductivity (EC)	Continuous	Continuous ³	-	-
Turbidity	Daily	Daily	-	-
Alkalinity	Daily	Daily	-	-
Total Suspended Solids (TSS)	Weekly	Weekly	-	-
Metals and Metalloids				
Aluminium (total & filtered)	Weekly ¹	Weekly	-	-
Arsenic (total & filtered)	Weekly ¹	Weekly	-	-
Gallium (total & filtered)	-	Weekly	-	-
Molybdenum (total & filtered)	-	Weekly	-	-
Vanadium (total & filtered)	Weekly ¹	Weekly	-	-
Nutrient Indicators & Bacteriological				
Total Phosphorous (filtered)	-	Monthly		
Total Nitrogen (filtered)	-	Monthly		
Enterococci	-	Monthly [^]		

Authorised Discharge Point:	S001		S044, S086, S087 & S088	
WDL Number:	WDL171-10	WDL171-11	WDL171-10	WDL171-11
Hydrocarbons				
Total Petroleum Hydrocarbons (TPH)	Daily ²	Daily ²	Weekly ⁵	Weekly ⁵
1. Filtered only 2. Daily when there is a hydrocarbon related incident at the Refinery 3. Continuous data where maximum period between measurements is no greater than one hour. 4. Daily when discharging from S086, S087, S088 & S044 only (authorised or otherwise) and at least once per discharge event 5. Weekly when discharging from S086, S087, S088 & S044 only (authorised or otherwise) and at least once per discharge event ^Monthly and Responsive: Responsive sampling to be undertaken at an identical frequency to S094, until concentrations at S094 are <35 cfu/100mL.				

As noted in Section 5.2.1, S074 and S094 are incorporated as part of the MHMP in WDL171-10 and WDL171-11. However, they are included within the Surface Water Monitoring Program in the WMP (Gove Operations, 2019). For this reason, they are discussed alongside the Surface Water results in this report (Section 5). Table 5-2 below summarises the monitoring program for S074 and S094, as per WDL171-11. The frequency of monitoring at S074 and S094 were the same under WDL171-10 and WDL171-11, with the exception of monthly frequency of Enterococcus sampling at S094 under WDL171-10; under WDL171-11, the frequency is monthly and responsive.

Table 5-2 Monitoring Frequency for S074 and S094

Authorised Monitoring Point:	S074	S094
WDL Number:	WDL171-11	WDL171-11
Environmental Parameters		
pH	Daily	-
EC	Daily	-
Turbidity	Daily	-
Alkalinity	Daily	-
TSS	Daily	-
Metals and Metalloids		
Aluminium (filtered)	Monthly	-
Arsenic (filtered)	Monthly	-
Chromium (filtered)	Monthly	-
Copper (filtered)	Monthly	-
Gallium (filtered)	Monthly	-
Manganese (filtered)	Monthly	-
Molybdenum (filtered)	Monthly	-
Vanadium (filtered)	Monthly	-
Zinc (filtered)	Monthly	-
Bacteriological Parameters		
Enterococci	-	Monthly [^]
^Monthly and Responsive: Monthly sampling with Enterococci results compared to a trigger value of 35 cfu/100mL. Responsive sampling to be undertaken within 1 week of a result >35 cfu/100mL at S094 and weekly thereafter until concentrations at S094 are <35 cfu/100mL.		

Table 5-3 below summarises the monitoring program for SW9, SW10, RR2, S015, S098, as per WDL171-10 and WDL171-11.

Table 5-3 Monitoring Frequency for SW9, SW10, RR2, S015 and S098

Authorised Monitoring Point	SW9, SW10, RR2		S015	S098
WDL Number:	WDL171-10	WDL171-11	WDL171-11	WDL171-11
Environmental Parameters				
Flow rate	-	-	Weekly ²	Daily ³
Volume	-	-	Weekly ²	Daily ³
Discharge period	-	-	Weekly ²	Daily ³
pH	Monthly	Monthly	-	-
EC	Monthly	Monthly	-	-
Turbidity	Monthly	Monthly	-	-
Dissolved Oxygen	Monthly	Monthly	-	-
Alkalinity	Monthly	Monthly	-	-
TSS	Monthly	Monthly	-	-
Metals and Metalloids				
Aluminium (total & filtered)	Monthly	Monthly	-	Weekly ⁴
Arsenic (total & filtered)	Monthly	Monthly	-	Weekly ⁴
Copper (total & filtered)	Monthly	-	-	-
Gallium (total & filtered)	Monthly	Monthly	-	Weekly ⁴
Iron (total & filtered)	Monthly	Monthly	-	-
Magnesium (total & filtered)	Monthly	Monthly	-	-
Molybdenum (total & filtered)	Monthly	Monthly	-	Weekly ⁴
Vanadium (total & filtered)	Monthly	Monthly	-	Weekly ⁴
Zinc (total & filtered)	Monthly	-	-	-
Nutrient Indicators				
Total Dissolved Phosphorus	Monthly	Monthly	Weekly ^{4, 5}	-
Total Dissolved Nitrogen	Monthly	Monthly	Weekly ^{4, 5}	-
Enterococci	Incidental ¹	-	-	-
Chlorophyll A	Monthly	-	-	-
Hydrocarbons				
Total Petroleum Hydrocarbons	Monthly [^]	Monthly [^]	-	-
Polycyclic Aromatic Hydrocarbons	Monthly [^]	Monthly [^]	-	-
Benzene	Monthly [^]	Monthly [^]	-	-
Toluene	Monthly [^]	Monthly [^]	-	-
Ethylbenzene	Monthly [^]	Monthly [^]	-	-
Xylene	Monthly [^]	Monthly [^]	-	-

1. Within 1 week of a result >35 cfu/100mL at S094 and monthly thereafter until concentrations at the compliance points return to normal levels.
 2. Weekly when discharging via the seawater channel to S001 following installation of instrumentation in accordance with Condition 25 of WDL171-11.
 3. Daily when discharging via the seawater channel to S001 following installation of instrumentation in accordance with Condition 25 of WDL171-11.
 4. Total only.
 5. Weekly when discharging via the seawater channel to S001.
- [^] Monthly when discharging from S086, S087, S088 and S044 only when safe to do so, acknowledging some discharge events will occur during monsoonal conditions.

With the exception of continuous recordings for pH and EC at S001, and S074 (which has an automated, 24-hour composite sampler, discussed in Section 5.3.4.2), all surface water locations are typically sampled via grab samples by Gove Operations personnel. Field observations were made regarding surface condition (no debris, oil, grease, sheen or odour was observed) along with a record of location, date and time samples were collected, personnel doing the sampling, and field measurements reported at time of sample collection.

The grab samples were then either analysed by an external National Association of Testing Authorities (NATA) accredited laboratory (as per data reported in Appendix C) or by the Gove Operations in the field or the internal laboratory (as per data presented in Section 5.3.4.2). All samples analysed by an external laboratory included

chain of custody (COC) documentation, laboratory certificates containing analytical results and quality assurance and quality control documentation. This documentation is retained by Gove Operations, however is not included in this report.

When discharging from S086, S087, S088 and S044, monthly monitoring for Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAH), benzene, toluene, ethylbenzene and xylene (BTEX) is also required at SW9, SW10 and RR2 (when safe to do so and acknowledging some discharges will occur during monsoon conditions). The analytical results for TPH, PAH and BTEX are presented in Table 3, Appendix C and discussed in Section 5.4.

5.2.3 Trigger Values and Limits

Trigger Values (TVs) and Limits defined by the WDL171-11, and WDL171-10, are outlined in Table 5-4 below. Trigger Values and Limits were generally the same under WDL171-10 and WDL171-11, with a few exceptions. Differences are indicated in the table below.

Table 5-4 Trigger Values and Limits for Refinery Monitoring Sites (WDL171-11)

Parameter	Unit	S001 – WDL171-10		S001 – WDL171-11		SW9, SW10, RR2 - WDL171-10	SW9, SW10, RR2 - WDL171-11
		TV	Limit	TV	Limit	TV	TV
Environmental Parameters							
pH	pH	9.0	9.5	9.0	9.5	7.7-8.4	7.7-8.4
EC	µS/cm	-	-	-	-	-	-
Turbidity	NTU	20 ¹ / 75 ²	100	20 ¹ / 75 ²	100	20	20
Dissolved oxygen	mg/L	-	-	-	-	5.81	5.8
Alkalinity	mg/L	-	-	-	-	-	-
TSS	mg/L	-	-	-	-	-	-
Metals and Metalloids ³							
Aluminium	µg/L	-	200	-	560	56	56
Arsenic	µg/L	-	20	-	200	20	20
Copper	µg/L	-	-	-	-	1.3	-
Gallium	µg/L	-	-	-	8000	800	800
Molybdenum	µg/L	-	-	-	38800	3880	3880
Vanadium	µg/L	-	2000	-	1000	100	100
Zinc	µg/L	-	-	-	-	15	-
Hydrocarbons							
TPH	µg/L	-	600	100	600	-	-
Nutrient Indicators & Bacteriological							
Total Phosphorous (filtered)	µg/L	-	-	-	140	14	14
Total Nitrogen (filtered)	µg/L	-	-	-	1700	170	170
Enterococci	cfu/100mL	-	-	-	-	35	-
Chlorophyll A	µg/L	-	-	-	-	1.4	-

1. Dry conditions – when unaffected by rainfall runoff associated with a storm event
2. Storm event – includes the actual rainfall event and the time it takes for the rain that fell at the furthest areas of the catchment to travel through the catchment to the discharge point
3. Metal(loid) trigger values and limits are considered applicable to <0.45 µm field filtered results

Table 5-5 Trigger Values and Limits, Tank Farm Bund Monitoring Sites (WDL171-10 and WDL171-11)

Parameter	Unit	S044, S086, S087, S088 WDL171-10		S044, S086, S087, S088 WDL171-11	
		TV	Limit	TV	Limit
Environmental Parameters					
pH	pH	9.0	9.5	9.0	9.5
Hydrocarbons					
TPH	µg/L	-	600	100	600

Under Condition 41 of the License (Condition 39 of WDL171-10), a non-compliance with the licence includes;

- An exceedance of the limit specified in WDL171-11 (as per Table 5-4 and Table 5-5);
- An exceedance of a trigger value of three times or more than the trigger value; and
- An exceedance of the trigger value on three consecutive sampling occasions.

All analytical results for the reporting period have been screened against these Trigger Values and Limits, and are presented in Table 1 (Seawater Outfall Channel) or Table 2 (Tank Farm Bunds), Appendix C. Results exceeding these criteria are discussed in Section 5.3.

5.3 Data Review and Interpretation

5.3.1 Discharge Events

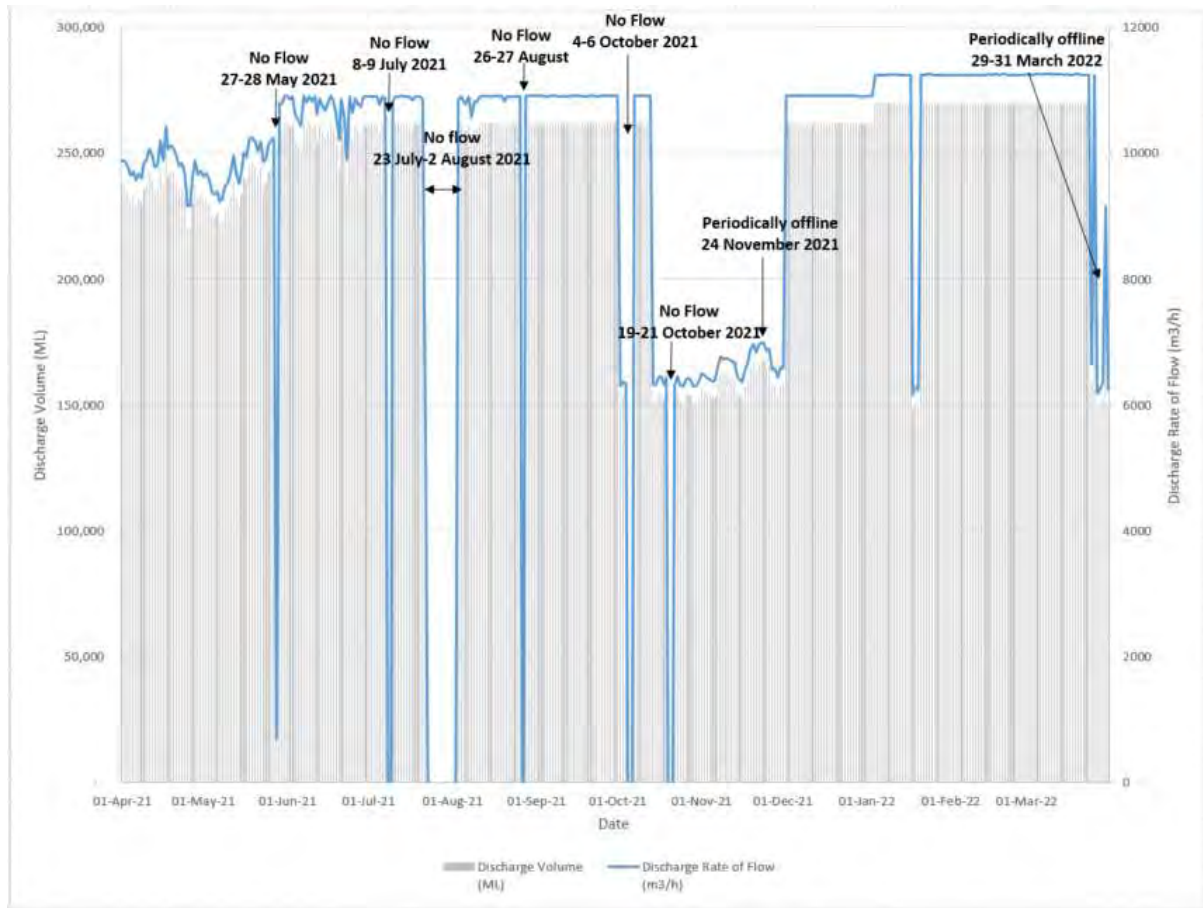
5.3.1.1 Seawater Outfall Channel Operational Flow

Graph 5-1 below shows the discharge flow from the Seawater Outfall Channel and instances when the channel flow was absent and not operational during the reporting period.

The seawater outfall channel discharges continuously, unless offline operational maintenance or shutdowns of the seawater discharge channel occur. In instances when the seawater outfall discharge is offline and surface water flow in the channel is absent, sampling at S001 and S074 cannot be undertaken, and is not required under the WDL (i.e. monitoring at these locations is not applicable when channel flow is absent.)

Discharge volumes from the Seawater Outfall Channel (S001) were recorded for 24-hour periods, with the exception of a number of days between May 2021 and March 2022 (refer Graph 5-1 below) when there was no discharge for at least part of the day. When the outfall channel was discharging, the average daily discharge rate for this period was 9,991 m³/hr, and the average daily discharge volume was 239,791 ML.

Graph 5-1 Seawater Outfall Channel Discharge Flow



The seawater outfall channel was offline with absent flow events recorded (not discharging for at least part of the 24 hour period) on 29 days over the reporting period, specifically during the following dates;

- 27-28 May 2021
- 7-9 July 2021;
- 22 July - 2 August 2021;
- 26-27 August 2021;
- 4-6 October 2021;
- 19-21 October 2021 (offline until 8 am 21 October);
- 24 November 2021;
- 29 March 2022
- 30 March 2022 (offline for 3.5 hours only); and
- 31 March 2022 (offline for 5 hours).

5.3.1.2 Tank Farm Bunds

Discharge volumes and durations (start and stop times) were recorded for the Tank Farm Discharge Points. Discharge durations were all between 0.5 – 2.5 hours, and discharge volumes ranged from 15 m³ - 8936 m³ at each point. A discharge flow meter is planned to be commissioned at S044, S086, S087, and S088 in 2022. However, flow rates may currently be assessed based on the duration and volumes of discharge.

Based on field sheets provided by Gove Operations, the following releases (discharges) occurred during the reporting period (Table 5-6). The timing of the surface water releases (April 2021 and December 2021 to March 2022), is consistent with the periods during which rainfall was recorded (Section 4.3).

Table 5-6 Summary of Releases from the Tank Farm Bunds

Date of Release	S044	S086	S087	S088
2 April 2021*	-	X	X	X
29 April 2021	X	X	X	X
21 May 2021	-	-	-	X
22 December 2021	X	X	X	X
26 December 2021	X	X	X	X
27 December 2021*	X	X	X	X
28 December 2021*	X	X	X	X
16 January 2022	X	X	X	X
30 January 2022	X	X	X	X
3 February 2022	X	X	X	-
5 February 2022*	-	-	-	X
7 February 2022	X	X	X	X
10 February 2022*	-	-	-	X
23 February 2022	X	X	X	X
24 February 2022	X	X	X	X
27 March 2022	X	X	X	X

X – Release recorded at surface water Discharge Point

*TPH not collected however was collected as part of weekly sampling prior to release event

5.3.1.3 Unauthorised Discharge

Under Condition 22 of WDL171-11 (and WDL171-10), discharge events at authorised discharge points must consist only of waste from sources specified in the license. These sources include the waste water neutralisation plant (WWNP), the sewerage treatment plant (STP), Refinery Light Fuel Tank Farm Bund and the Refinery Tank Farm Bund.

Three unauthorised discharge events occurred on 25 December 2021 (Incident **1000595416**), 6 February 2022 (Incident **1000598739**) and 25 March 2022 (Incident **1000603062**) where a period of heavy rainfall caused overflow from the Southern and Western Containment Ponds (SCP & WCP) into the seawater channel resulting in discharge via S001.

5.3.2 Sample Numbers and Analysis

The number of samples collected from each WDL Discharge Point within the Refinery is provided in Table 5-7.

Table 5-7 Summary of WDL Samples Collected During the Reporting Period

Parameter	Number of Days Samples Analysed								
	S001	S044	S086	S087	S088	S074	S094	S015	S098
pH (field)	14	12	12	12	14	13	-	-	-
EC (field)	14	-	-	-	-	13	-	-	-
pH (Gove Operations lab)	348*	-	-	-	-	347*	-	-	-
EC (Gove Operations lab)	347*	-	-	-	-	436*	-	-	-
Turbidity (Gove Operations lab)	348*	-	-	-	-	347*	-	-	-
Alkalinity (Gove Operations lab)	344*	-	-	-	-	344*	-	-	-
TSS (Gove Operations lab)	55*	-	-	-	-	344*	-	-	-
Aluminium (total & filtered)^	56	-	-	-	-	13	-	-	3
Arsenic (total & filtered)^	56	-	-	-	-	13	-	-	3
Chromium (total & filtered)^	-	-	-	-	-	13	-	-	-
Copper (total & filtered)^	-	-	-	-	-	13	-	-	-

Parameter	Number of Days Samples Analysed							S015	S098
	S001	S044	S086	S087	S088	S074	S094		
Gallium (total & filtered)^	56	-	-	-	-	13	-	-	3
Magnesium (total & filtered)^	-	-	-	-	-	13	-	-	-
Manganese (total & filtered)^	-	-	-	-	-	13	-	-	-
Molybdenum (total & filtered)^	56	-	-	-	-	13	-	-	3
Vanadium (total & filtered)^	56	-	-	-	-	13	-	-	
Zinc (total & filtered)^	-	-	-	-	-	13	-	-	-
Total Dissolved Phosphorous	14	-	-	-	-	-	-	2	-
Total Dissolved Nitrogen	14	-	-	-	-	-	-	2	-
TPH	16	12	11	11	13	-	-	-	-
Enterococci	14	-	-	-	-	-	14	-	-

- Analysis not required under WDL171-10 or WDL171-11

Reporting period: 1 April 2021 – 31 March 2022

^ Filtered metals only for S074

*Continuous and/or daily data for pH, EC, turbidity, alkalinity and weekly TSS at S001 and daily pH, EC, turbidity, alkalinity and TSS at S074 are discussed in Section 5.3.4.2.

Table 5-8 Summary of Mixing Zone Compliance Samples Collected During the Monitoring Period

Parameter	Number of samples collected		
	RR2	SW9	SW10
TPH	15	15	15
PAH	15	15	15
Benzene	15	15	15
Toluene	15	15	15
Ethylbenzene	15	15	15
Xylene	15	15	15

Frequency for all other parameters for RR2, SW9, and SW10 has not been considered, as this is discussed in the MHMP report.

According to the monitoring data available for the reporting period (Table 1, Appendix C for S001, S074 and S094, and Table 2, Appendix C for S044, S086, S087 and S088), the following non-compliances with WDL171-10 and WDL171-11 monitoring frequency are noted with respect to the sampling frequency and have been reported to the Northern Territory Government by Gove Operations. Incident reports for each are presented in Appendix F:

- 17 May 2021 – Incident **1000578910** – Hydrocarbon samples are required at SW9, SW10 and RR2 monthly when discharging from S086, S087, and S088 & S044 under WDL171-10. During a monthly compliance check it was observed that hydrocarbon samples were not taken at SW9, SW10 and RR2 during sampling on 17 May 2021. There had been one discharge event in May 2021.
- 27 May 2021 – Incident **1000578371** – Continuous measurements of electrical conductivity are required at S001 under WDL171-10. It was observed at approximately 06:00 on 27 May 2021 the electrical conductivity sensor returned data of unreliable quality.
- 4 June – 2021 – Incident **1000609084** - Under Appendix 2, Table 1, Alkalinity is to be monitored daily at S001. On 4 June 2021 alkalinity testing was not completed. The S001 sample was received by the site laboratory, however alkalinity was not analysed for this sample. All other parameters were within historical ranges for the S001 sample.
- 23 August 2021 – Incident **1000585261** – Daily composite sample is required to be collected at S074 under WDL171-10. It was identified during the weekly compliance check that the auto-sampler had failed to collect samples on 23/08/2021. This resulted in daily pH, electrical conductivity, turbidity, alkalinity and total suspended solids not being available for 23/08/2021.

- 3 January 2022 – Incident **1000595869** – Daily composite sample is required to be collected at S074 under WDL171-11, noting the requirement is also the same in WDL171-10. For Monday 3 January 2022, there was no daily sample available for analysis from S074. It was noted during routine collection of S074 that the composite pump-sampler had failed and there was insufficient water present for analysis.
- 22 January 2022 – Incident **1000600062** – Daily analysis of alkalinity at S001 and S074 is required under WDL171-11, noting the requirement is also the same in WDL171-10. Alkalinity was not analysed at S001 and S074 on Saturday 22 January 2022. It was identified during an end of month compliance check that the results were not present in the data management system.
- February 2022 – Incident **1000603157** – Monthly TSS was not analysed for SW3 and SW4 for February 2022 round. Samples were collected on 12 February 2022 and dispatched to Charles Darwin University (CDU) Laboratory in Darwin for analysis. The laboratory report received indicated TSS was not analysed.

As indicated in Section 5.2.2, some differences in the WDL frequency of monitoring requirements were noted when comparing WDL171-10 and WDL171-11. The frequency of monitoring at S001 for gallium and molybdenum (weekly) is required from February onwards, consistent with their inclusion in WDL171-11. However, whilst not required under WDL171-10, these metals were monitored during the entire reporting period.

5.3.3 Variability and Quality Control of Dataset

With the exception of the flows from the Refinery Seawater Outfall Channel (S001) which are generally continuous, the remaining surface water sampling locations are representative of ephemeral or seasonally responsive flow conditions. As a result, there is considerable variability in the analytical results over time, with this variability being strongly influenced by the flow conditions or residual pooled water quality present at the time of sampling.

A quality assurance and quality control (QAQC) program was implemented during the reporting period. The QAQC results are presented in Appendix A. It should be noted that QAQC did not assess the following (consistent with the previous WDL reporting):

- sample receipt (security seals and appropriateness of bottles);
- frequency of QAQC completed by laboratory;
- surrogate recoveries;
- laboratory control spikes; or
- method blanks.

The main outcome of the QAQC assessment was that the majority of samples collected during the reporting period exceeded the temperature on receipt, and some holding times were exceeded. This was likely due to air freight delays between Gove and Sydney laboratories. It is noted that all samples were transported with ice, and were received below the NT ambient temperatures (which exceeded 30°C).

Matrix spike outliers were reported by the laboratory. In these cases matrix spike recovery was not determined as the background level was greater than or equal to 4x spike level. Therefore these do not represent a laboratory data quality control issue.

Overall, the results of the QA/QC assessment, when considered with the previous analytical results, indicate that the data is suitable for use and interpretation within this report.

5.3.4 Surface Water Analytical Results

The sections below provide a summary of the monitoring analytical results for the Seawater Outfall Channel (S001 and S074) and the Tank Farm bund monitoring (S044, S086, S087, and S088), as reported by the external laboratory.

Field measured water quality and laboratory analytical results for the reporting period are summarised in the following tables in Appendix C.

- Table 1: Surface Water Analytical Results – Seawater Outfall Channel (S001, S074, S094);
- Table 2: Surface Water Analytical Results – Tank Farm Bund Release Sampling (S044, S086, S087, S088);
- Table 3: Marine Mixing Zone Compliance Points (RR2, SW9, SW10); and
- Table 4: Surface Water Analytical Results – Discharge Load Monitoring (S015, S098).

The results of continuous and daily monitoring undertaken by Gove Operations are either measured in the field or analysed by the internal laboratory, and are discussed in Section 5.3.4.2.

5.3.4.1 Seawater Outfall Channel – WDL Samples

The Seawater Outfall Channel is located between the Light Fuel Tank Farm (east) and the Harbour Tank Farm (west), down-gradient of the convergence of the seawater circuit channels (Eastern Channel and Western Channel) (Figure 3, Appendix B). The Western Containment Pond, Oily Water Pond, the sewage treatment plant and the WWNP all have the potential to discharge into the seawater circuit, and subsequently, discharge via the Seawater Outfall Channel.

The seawater circuit comprises the main process water intake and wastewater discharge system within the Refinery. It incorporates a number of monitoring points, however only S001 has TVs associated with it under WDL171-10 and WDL171-11.

The Seawater Outfall Channel discharges under licence (WDL 171-11) to the south into Gove Harbour. Surface water quality is monitored via the collection of grab samples (S001), continuous monitoring (pH and EC), and a 24-hour composite sample via an automated sampler that collects 50 mL of water per 20 minutes (S074).

Bacterial parameters are monitored at Monitoring Point S094 and are discussed further in Section 5.3.4.4 below.

Table 1, Appendix C presents the analytical results for S001 against the relevant WDL TVs and Limits. Results for S074 are also included in this table, however no screening criteria are applicable under WDL171-11 or WDL171-10.

All analytical results for the surface water samples collected at S001 were reported below the relevant WDL TVs and Limits over the reporting period (refer Table 5-4), with the exception of Total Dissolved Nitrogen concentration on 8 March 2022 (4600 mg/L), exceeding the WDL171-11 Limit of Total Dissolved Nitrogen (1700 mg/L) (Incident **1000609048**).

5.3.4.2 Seawater Outfall Channel - Daily and Continuous Monitoring

5.3.4.2.1 S001 - pH and EC

pH and EC at S001 are required to be monitored on a continuous basis (at least hourly), with pH also to be monitored on a daily basis under the WDL171-11. These parameters are measured continuously using a data logger, with pH and EC data being collected every 30 seconds. Due to the large volume of data available, the daily average pH and EC from the continuous measurements are presented in Graph 5-2 and Graph 5-3 below. The seawater outfall discharge flow is also plotted to identify when flow is absent and continuous monitoring is not recorded.

Over the reporting period, the daily average pH was generally recorded within the range 7.3 – 9.2, with an overall average of 8.5. There were four exceedances of the WDL pH TV (9.0) on 23 and 24 April 2021, 26 July 2021 and 8 March 2022; however, since the TV was not exceeded on three consecutive sampling occasions, these are not non-compliance breaches under Condition 41 of the Licence (Condition 39 of WDL171-10). No exceedances of the WDL pH limit (9.5) were recorded.

When the seawater outfall channel was discharging, the daily average EC typically oscillated between 32,000 µS/cm and 62,000 µS/cm. There are no TVs or Limits for EC at S001.

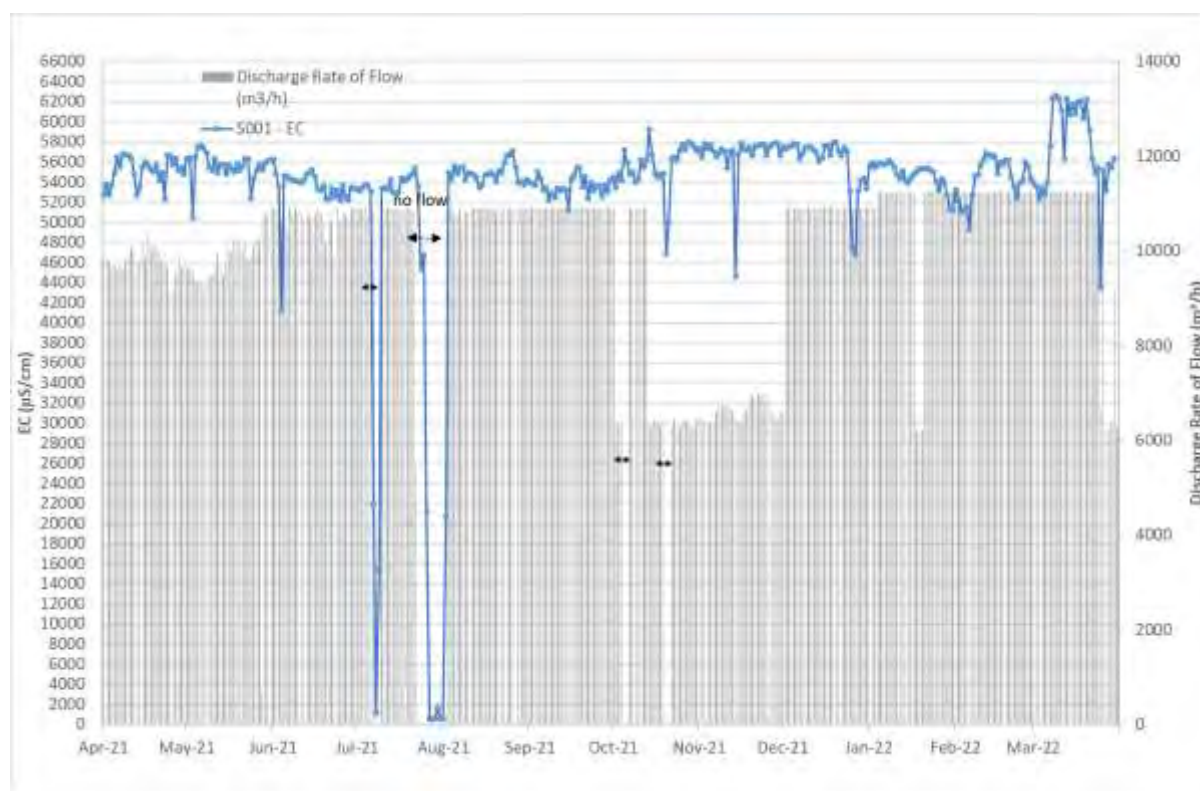
The seawater outfall discharge was offline for 18 days over certain periods, as discussed in Section 5.3.1.1. On 3 occasions on 27 May 2021, 26 August 2021 and 7 January 2022, loss of communication and/or equipment error was reported by Gove Operations, and continuous readings could not be recorded where the maximum time

between readings was one hour. The events (recorded under **1000578371**, **1000608476** and **1000608477**) were reported to the Northern Territory Government (refer Appendix F).

Graph 5-2 Daily Average pH at S001



Graph 5-3 Daily Average EC at S001

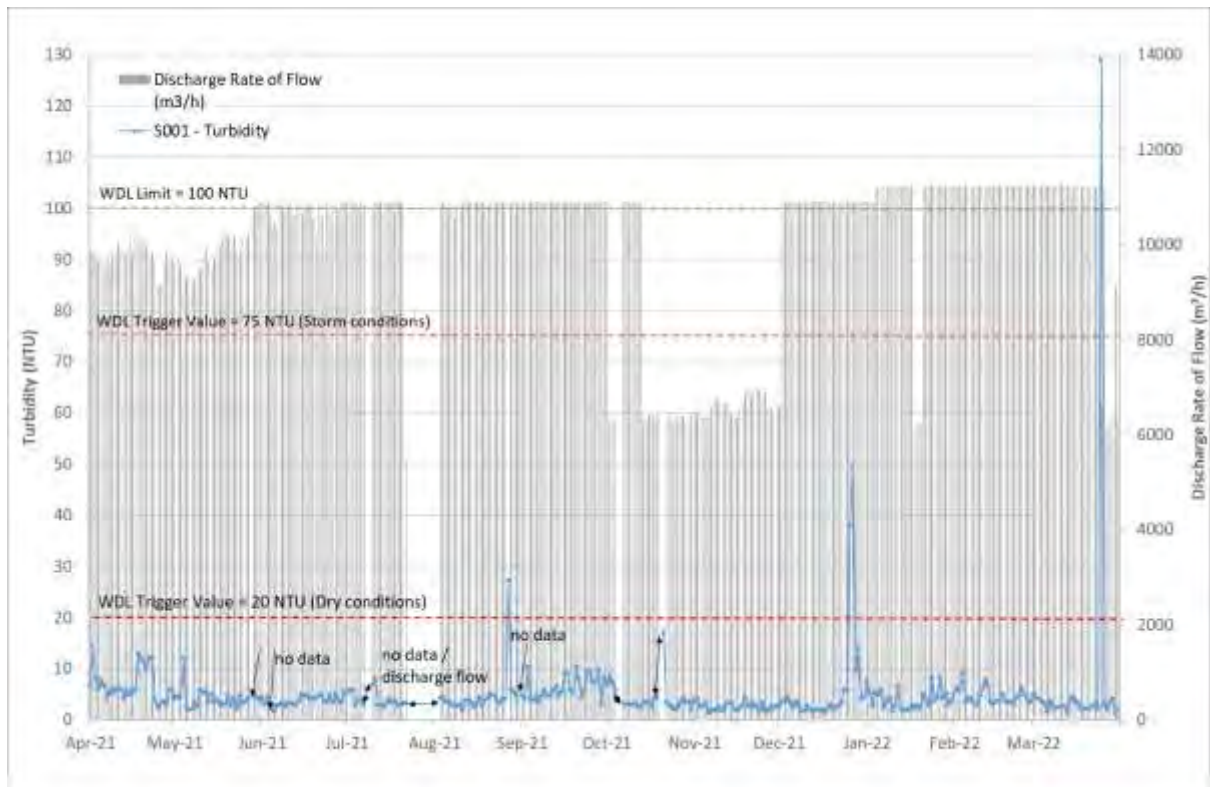


Turbidity and alkalinity are required to be monitored on a daily basis, while TSS is required to be monitored weekly under WDL171-10 and WDL171-11. Of these parameters, only turbidity has a WDL TV (20 NTU / 75 NTU) and Limit (100 NTU) associated with it. The daily and/or weekly analytical data for these parameters is presented below in Graphs 5.4 – 5.6.

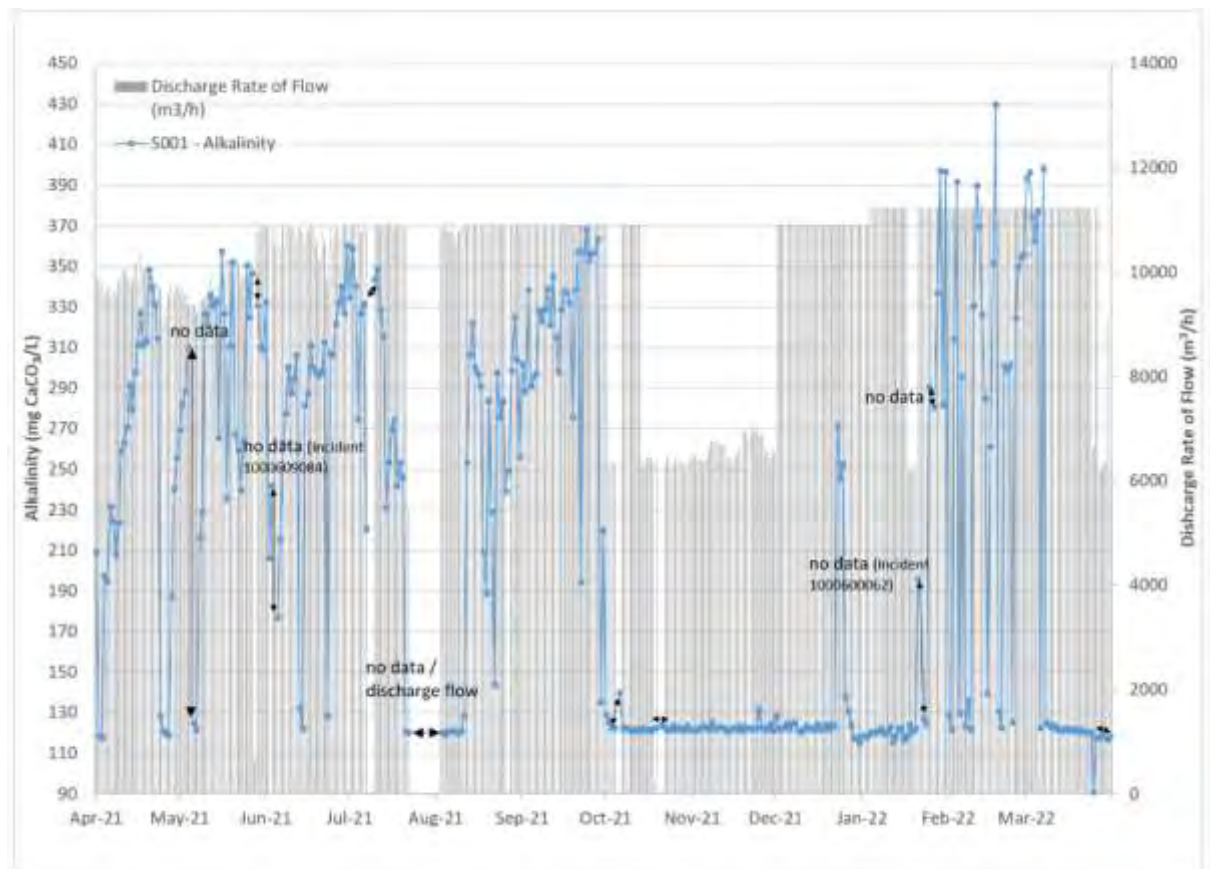
The following is noted with regards to these parameters during the reporting period:

- Daily turbidity data was recorded for the entirety of the reporting period, with the exception of 4 June 2021 and periods when the seawater outfall discharge channel was offline. Results for turbidity generally ranged from 1.35 – 17 NTU (Graph 5-4) and were reported less than the WDL TV and Limit for the duration of the reporting period, with the following exceptions:
 - On 27 August 2021 a turbidity concentration of 27.3 NTU was recorded, which is greater than the 20 NTU TV for dry conditions. There was no rainfall event around this date, therefore the TV for dry conditions (20 NTU) would be applicable. The turbidity recorded on 27 August was greater than the WDL TV for dry conditions, however as this was below the WDL limit (100 NTU) and only a single exceedance of the trigger value, this is not considered to be non-compliance with the licence under Condition 39 of WDL171-10 (licence applicable at the time). Turbidity result was recorded at 8am on 27 August 2021 by automated sampler. As it was a one off occurrence, no environmental harm expected and no follow up action required. It is unclear what caused the exceedance.
 - On 26 and 27 December 2021 turbidity concentrations of 38 and 49.4 NTU were recorded, respectively, which are greater than the 20 NTU trigger value for dry conditions. Rainfall events were recorded on 26 December (71.4 mm) and 27 December (84.9 mm) and therefore the TV of 75 NTU for storm events is applicable. The turbidity concentrations were below the storm event TV and therefore this is not considered to be a non-compliance with the licence under Condition 39 of WDL171-10 (licence applicable at the time).
 - On 25 March, 2022, a turbidity concentration of 129 NTU was recorded, which is greater than the 100 NTU limit. This is considered to be a non-compliance under Condition 41 of WDL171-11 and was reported to the Department of Environment, Parks and Water Security (DEPWS) (Incident **1000603062**).
- Daily alkalinity data was recorded for the entirety of the reporting period, with the exception of 4 June 2021 (Incident **1000609084**), and periods when the seawater outfall discharge channel was offline. Alkalinity results were reported within the range 90.9 – 429.8 mg/L over the reporting period as presented in Graph 5-5 below.
- Weekly TSS data analysed by Gove Operations internal laboratory is available for the reporting period. There are also periods of no recordings for TSS when the seawater outfall discharge channel was offline. Results were reported within the range 1.7 – 19.2 mg/L over the reporting period as presented in Graph 5-6 below.

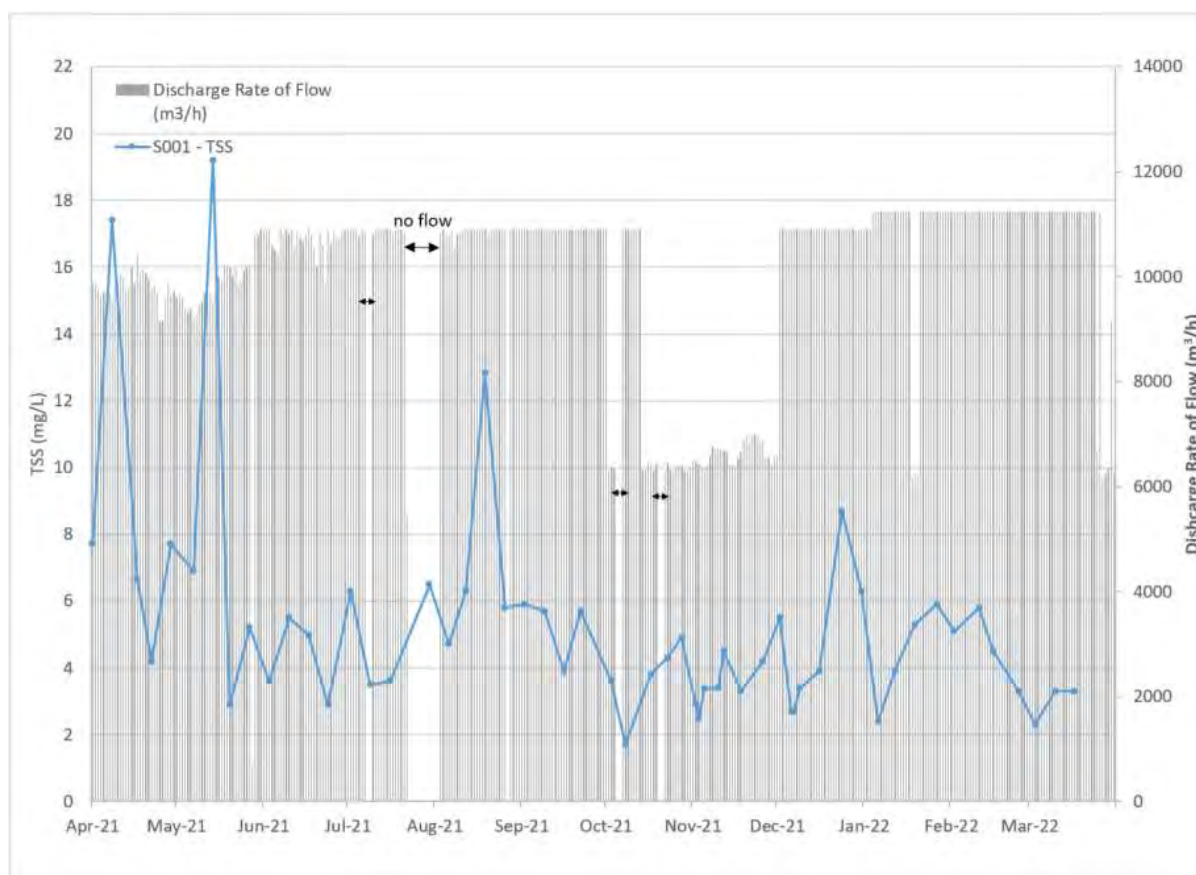
Graph 5-4 Daily Turbidity at S001



Graph 5-5 Daily Alkalinity at S001



Graph 5-6 Weekly TSS at S001



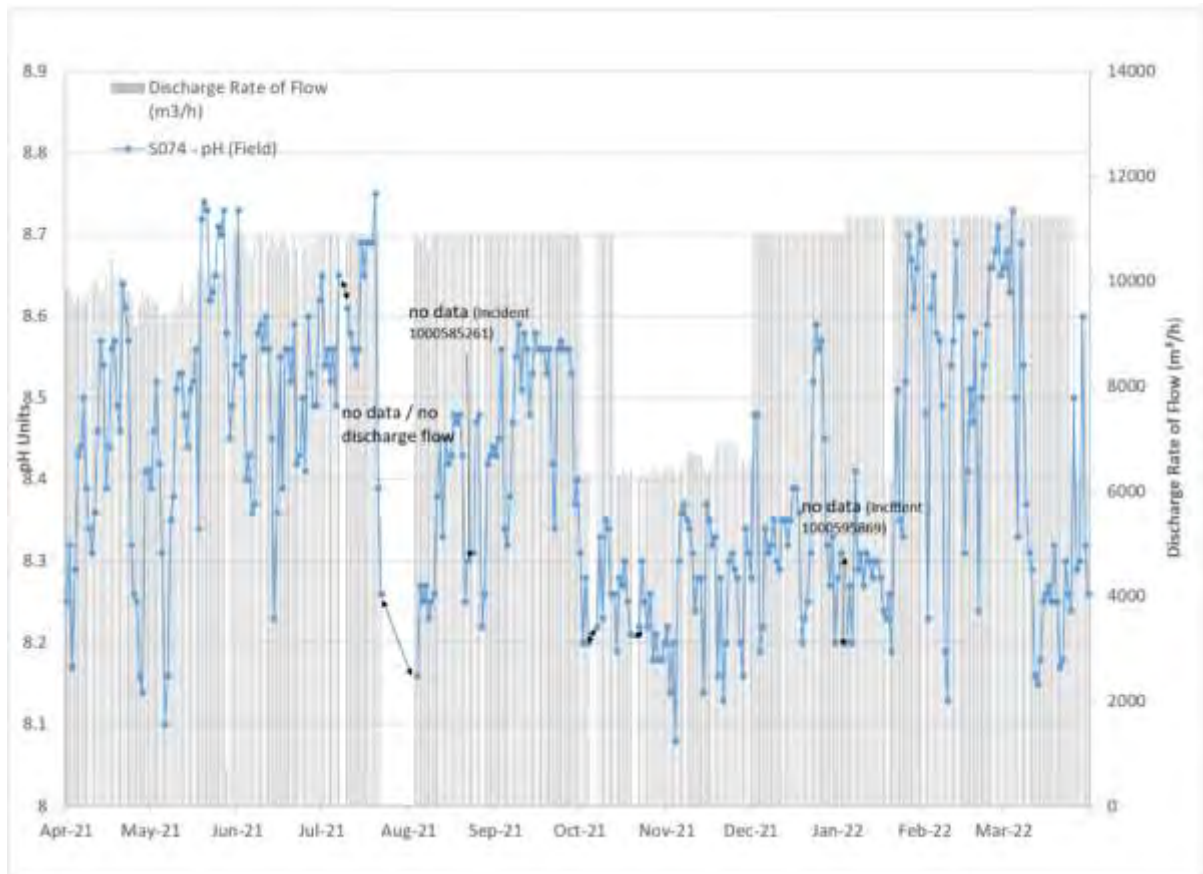
5.3.4.2.3 S074 – Daily Monitoring of pH, EC, TSS, Alkalinity and Turbidity

pH, EC, turbidity, alkalinity and TSS are required to be monitored on a daily basis at S074 under the WDL171-11. Alkalinity was not monitored on 22 January 2022 (**1000600062**). No WDL trigger values or limits are associated with monitoring location S074. All available data for these parameters is presented in Graphs 5-7 to 5-11 below.

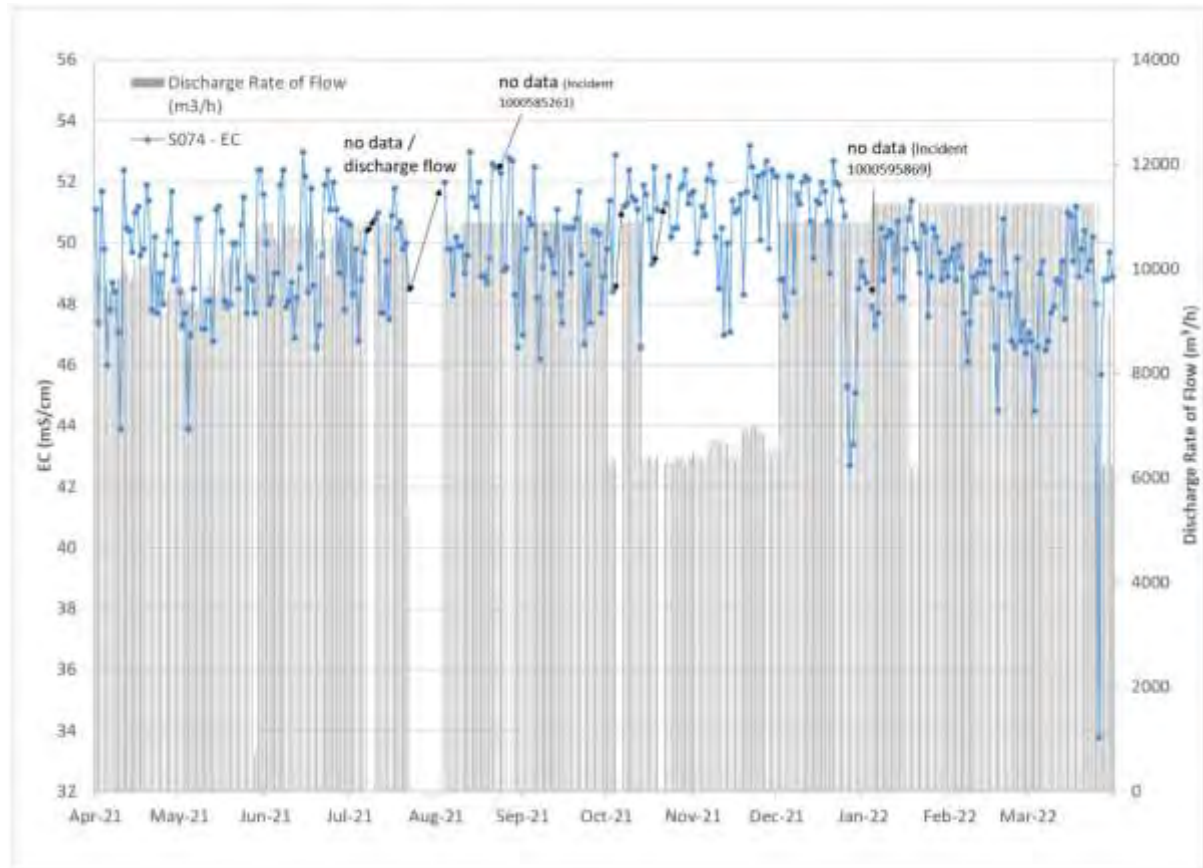
The following is noted with regards to these parameters during the reporting period:

- pH was measured between 8.08 – 8.75;
- EC was reported consistently within the range of 42,700 – 53,200 $\mu\text{S}/\text{cm}$, with the exception of one result on 26 March 2022 (33,800 $\mu\text{S}/\text{cm}$) (Incident **1000603062**);
- Alkalinity oscillated within the range 99 – 372 mg/L, but generally stabilised at around 120 mg/L between October 2021 – January 2022 and during March 2022;
- TSS was reported within the range 1.7 - 29.3 mg/L, with the exception of two results from March 2022 (50 mg/L and 44.75 mg/L); and
- Turbidity oscillated between 1.4– 25.3 NTU, with the exception of one result from 26 December 2021 (56.1 NTU), a result from 12 January 2022 (36.5 NTU) due to rainfall events at the time, and a result from 26 March 2022 (76.3 NTU) (Incident **1000603062**).

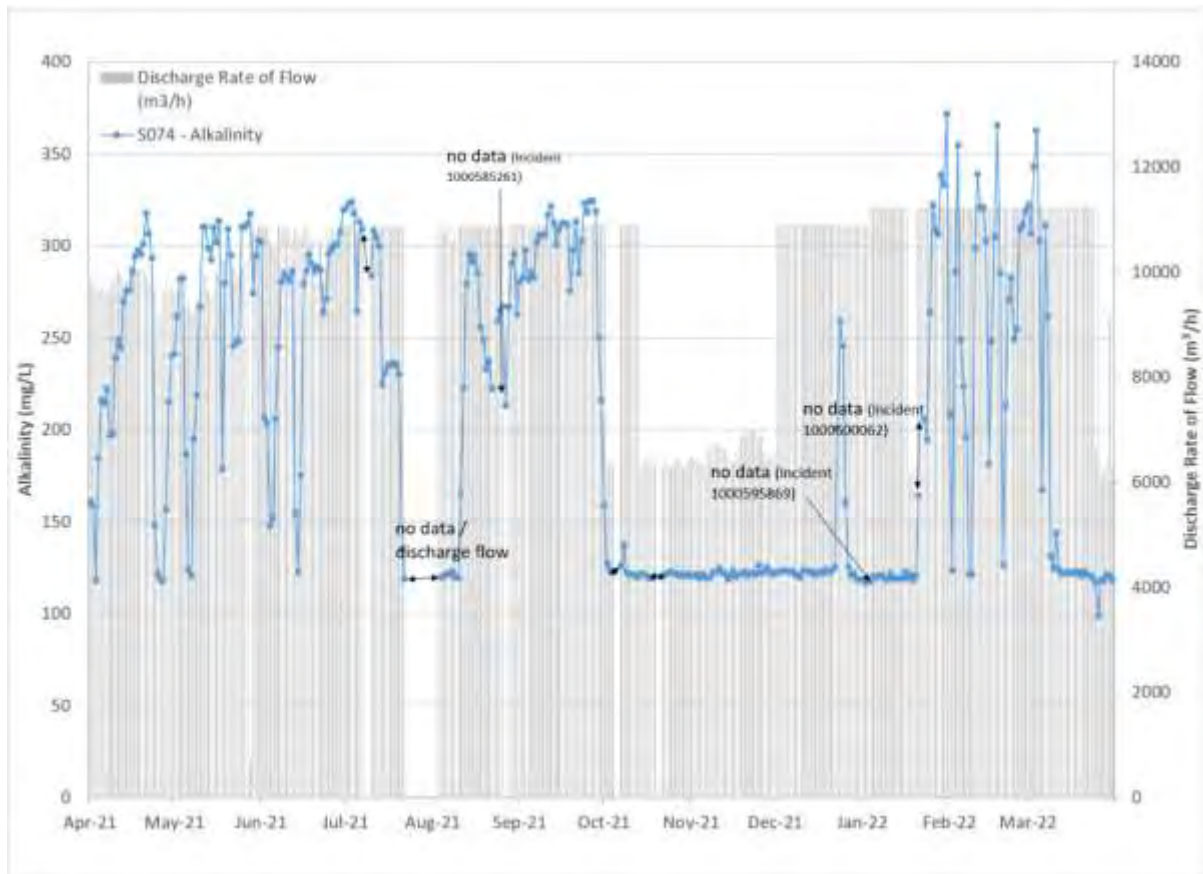
Graph 5-7 Daily pH at S074



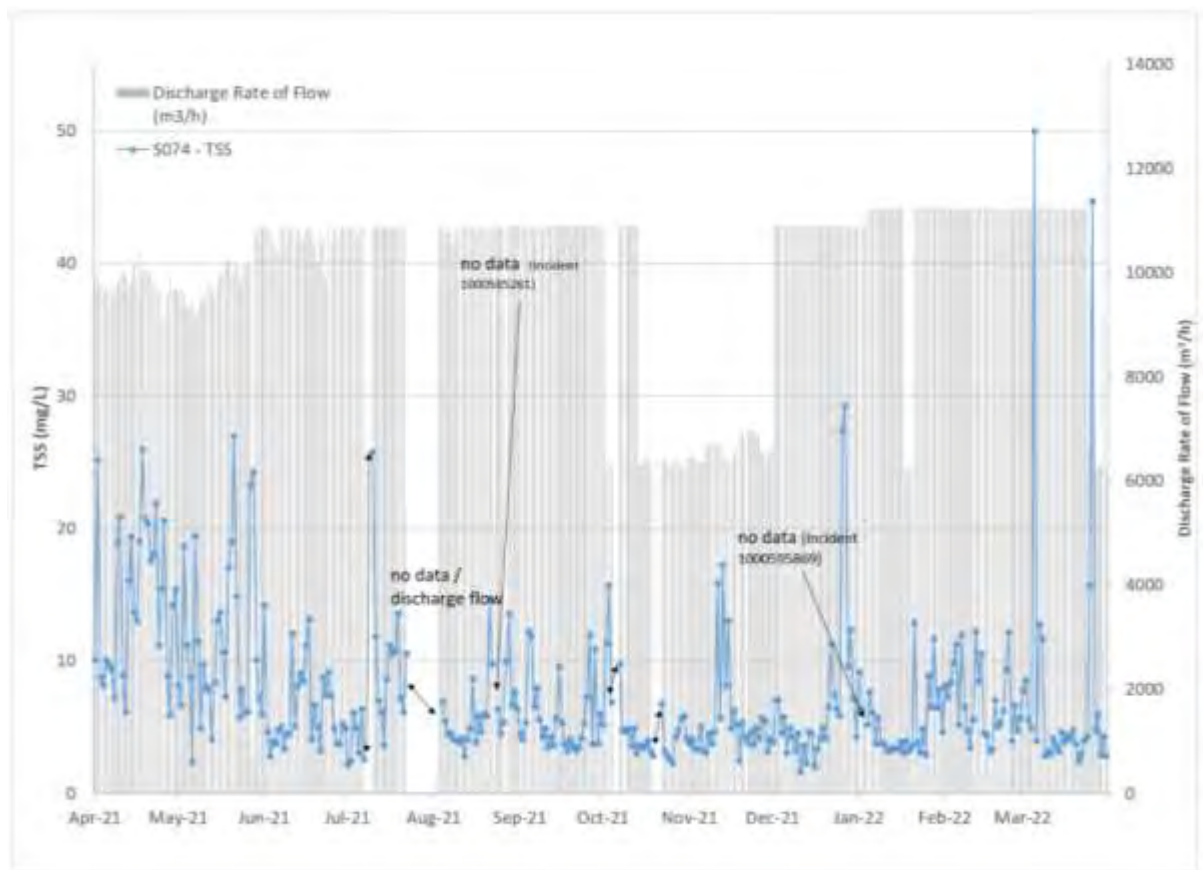
Graph 5-8 Daily EC at S074



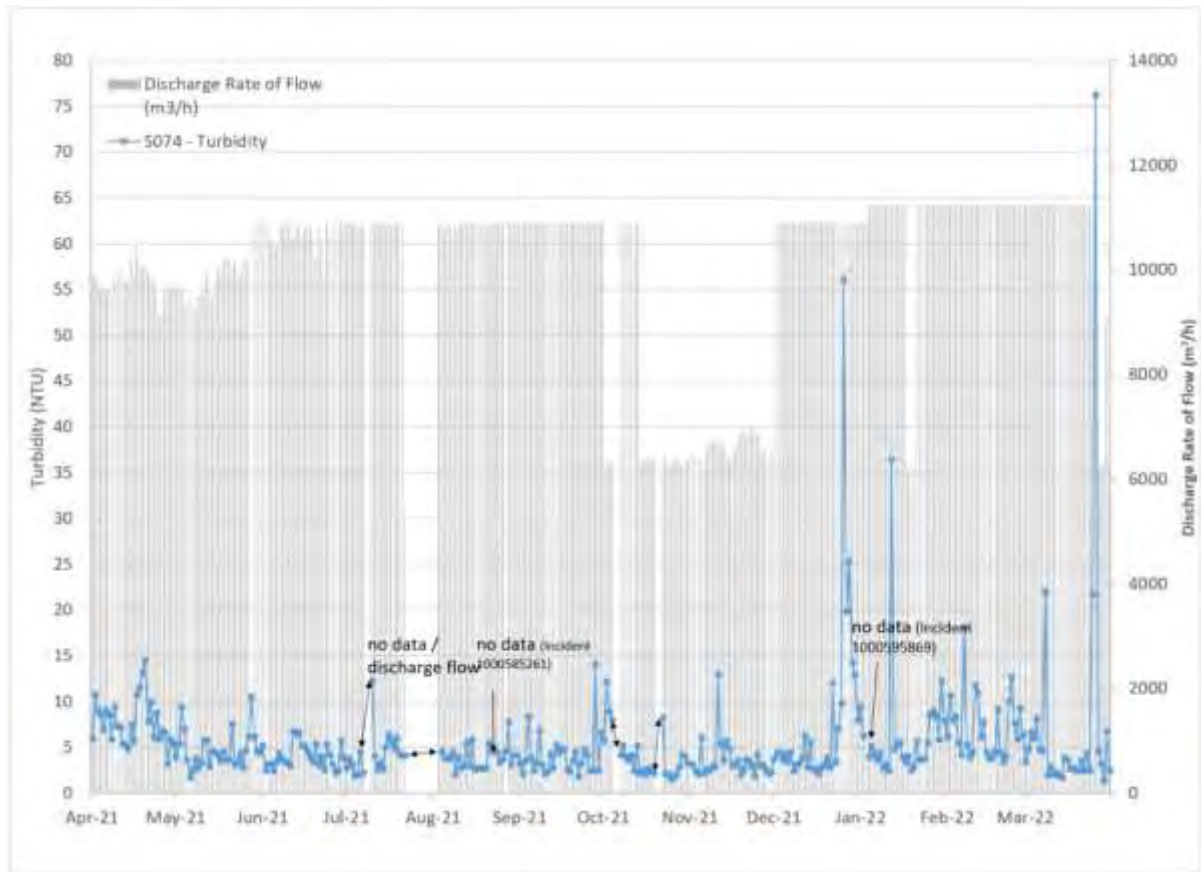
Graph 5-9 Daily Alkalinity at S074



Graph 5-10 Daily TSS at S074



Graph 5-11 Daily Turbidity at S074



5.3.4.3 Tank Farm Bund monitoring (S044, S086, S087, S088)

WDL171-11 discharge points located within the Light Fuel Tank Farm (S044) and Harbour Tank Farm bunds (S086, S087 and S088) were monitored for TPH C₁₀-C₃₆ (Total) between 10 – 12 times, predominantly between December 2021 and February 2022 (as per Section 5.3.1.2 and Section 5.3.2).

Weekly TPH sampling and analysis is required at S044, S086, S087 and S088 when discharging is occurring, as per WDL171-10 and WDL171-11. As identified in Section 5.3.1.2 and Table 5-66, TPH analysis was completed within the required frequency for all release events.

All results reported for TPH C₁₀-C₃₆ (Total) during the reporting period were reported less than the laboratory limit of reporting (LOR) (50 µg/L). As such, no results exceeded the WDL Limit for TPH (600 µg/L). Table 2, Appendix C presents the analytical results for S044, S086, S087 and S088.

Field pH samples were collected for surface water from S044, S086, S087, and S088 at least once during discharge events, as per WDL requirements. All surface water samples were recorded less than the WDL trigger value (9.0) and limit (9.5), with the exception of the following:

- pH was reported at 9.16 on 21 December 2021 at S044, which is greater than the trigger value but did not exceed the WDL limit and was therefore not considered to be a non-compliance.

5.3.4.4 Bacteriological (Enterococci) Monitoring (S094)

The boat ramp (monitoring location S094) and areas near where the seawater channel discharges into Gove Harbour are visited by members of the public for fishing and boating activities. The area is therefore monitored for potential bacteriological impacts from wastewater discharged by Gove Operations from the Refinery STP. The current Refinery STP was re-commissioned in June 2016.

In accordance with WDL171-10 and WDL171-11, seawater samples are collected from S094 (Public Boat Ramp) for laboratory analysis (Enterococci). The analysis of seawater samples for Enterococci at the Public Boat Ramp provides direct monitoring of the receiving environment for sewerage contamination.

Analytical results of the monthly sampling (in most-probable number (MPN) per 100 mL) are presented in Table 1, Appendix C. As per the footnotes of Table 2 in the WDL171-11, the guideline relevant to S094 is 35 CFU/100 mL and exceedance of this guideline requires follow up incident sampling at Seawater Outfall Channel, S001. This guideline (35 CFU/100 mL) is the recommended recreational guideline value from Australian and New Zealand Guidelines (ANZG, 2018). The analytical results are presented in MPN/100 mL, and the discussion below assumes this is equivalent to Colony Forming Units (CFU)/100 mL.

All samples collected during the reporting period were generally less than the LOR (10 MPN/100 mL), or were less than the WDL guideline (35 CFU/100 mL) with the exception of the following:

- A sample collected on 27 April 2021 which reported a concentration of 52 MPN/100 mL. This concentration exceeds the WDL guideline (35 CFU/100 mL), however a sample was collected within a week of receiving the elevated results and the concentration was below LOR (<10 MPN/100 mL). Sample was collected at 8:50 am on 27 April 2021 and follow up sample was collected at 7:55 am on 5 May 2021;
- A sample collected on 15 September 2021 which reported a concentration of 54 MPN/100 mL. This concentration exceeds the WDL guideline (35 CFU/100 mL), however a sample was collected within a week of receiving the elevated results and the concentration was below LOR (<10 MPN/100 mL). Sample was collected at 7:35 am on 15 September 2021 and follow up sample was collected at 8:50 am on 22 September 2021; and
- A sample collected on 21 February 2022 which reported a concentration of 156 MPN/100 mL. This concentration exceeds the WDL guideline (35 CFU/100 mL), however a sample was collected within a week of receiving the elevated results and the concentration was below LOR (<10 MPN/100 mL). Sample was collected at 8:25 am on 21 February 2022 and follow up sample was collected at 7:45 am on 2 March 2022

As these exceedances were a one off occurrence, no environmental harm was expected and no further action required. It was unclear what caused the exceedances.

5.3.4.5 Discharge Load Monitoring (S098, S015)

As per new Condition 25 and Table 4, Appendix 2 under the amended Licence (WDL171-11), Gove Operations must install at authorised monitoring points S098 and S015 by 30 August 2022 a device to measure:

- The time discharge commenced and the duration of discharge;
- The discharge rate of flow; and
- The discharge volume.

Monitoring of these locations when discharging via the seawater channel to S001 must commence following installation of instrumentation.

Following the commencement of WDL171-11, total dissolved phosphorous and total dissolved nitrogen at S015 and metal(oids) at S098 are required to be monitored on a weekly basis when discharging via the seawater outfall channel.

Analytical results of the weekly sampling are presented in Table 4, Appendix C.

5.4 Field Observations

Field observations were made during sampling events and no debris, oil, grease, sheen or hydrocarbon odour was observed.

5.5 Mixing Zone Compliance Point Monitoring (SW9, SW10, RR2)

The laboratory analytical results for the reporting period for TPH are summarised in Table 3, Appendix C.

As part of the WDL171-10 and WDL171-11 compliance locations SW9, SW10 and RR2, located in the mixing zone boundary of the authorised Discharge Points, are monitored for hydrocarbons. As per Section 5.2.2, Table 5-3, SW9, SW10 and RR2 are required to be monitored monthly when discharging from S044, S086, S087 and S088.

All results for TPH, BTEX and PAH at SW9, SW10 and RR2 were recorded less than the laboratory LORs, and are presented in Table 3, Appendix C.

Additional required monitoring of compliance locations SW9, SW10 and RR2, is discussed in the Marine Health Monitoring Report, summarised in Section 6.

5.6 Long Term Trend Analysis

Graphs showing long-term surface water concentrations at S001 (pH, EC, turbidity, alkalinity, TSS, aluminium, arsenic, vanadium), and S044, S086, S087, and S088 (pH and TPH) are presented in Appendix D. The data presented is based on the external laboratory data and field analysed pH and EC data only, with data presented from 2013 to 2022. A summary of the long-term trends is discussed below.

Seawater Outfall Channel (S001)

The following key observations are noted for S001:

- pH has historically oscillated between 7.5 and 9, with typically lower pH values recorded since approximately 2019;
- Turbidity has historically oscillated between 1 – 10 NTU;
- EC has generally remained stable since March 2016, generally oscillating between 40,000 – 60,000 $\mu\text{S}/\text{cm}$;
- Alkalinity has generally remained stable between 100 – 200 mg/L since January 2019, with the exception of seven occasions during the current reporting period when concentrations were recorded greater than 200 mg/L (13 April 2021, 261 mg/L; 19 May 2021, 241 mg/L; 15 June 2021, 279 mg/L; 6 July 2021, 272 mg/L; 17 August 2021, 254 mg/L; 14 September 2021, 246 mg/L; and 25 January 2022, 239 mg/L). These concentrations are comparable to historic ranges of 100 – 500 mg/L. It is noted that Bicarbonate Alkalinity was graphed instead of Total Alkalinity, as this is what was available from historic data and bicarbonate is the dominant alkalinity species in the pH range reported.
- TSS has generally been stable between 5 – 50 mg/L since March 2016, despite data gaps for 2017 and 2018;
- Dissolved aluminium and vanadium concentrations have generally been reported at concentrations below the WDL Limit. Concentrations reported have decreased since approximately January 2019, this is attributable to the WWNP being offline for prolonged periods since January 2019; and
- Dissolved arsenic concentrations have been reported at less than the WDL Limit since January 2019, and have generally remained stable since this date.

Seawater Outfall Channel (S074)

- Historically, pH has been reported within the range 7.4 – 8.8. Since December 2018 the pH range is reported between 7.0 and 8.7;
- EC has generally fluctuated between 40,000 $\mu\text{S}/\text{cm}$ and 55,000 $\mu\text{S}/\text{cm}$;
- Alkalinity and turbidity have remained relatively stable at the lower range of the historical data set since September 2018, with increasing trends since March 2020;
- TSS has remained stable since the beginning of 2014, fluctuating between <5 mg/L and 25 mg/L;
- Concentrations of aluminium have overall decreased since January 2020 and have remained relatively stable since September 2020, with some periodic spikes;
- Concentrations of molybdenum have overall decreased since January 2018, with frequent spikes since April 2020;
- Concentrations of arsenic and vanadium have overall decreased since January 2018, however there have been some periodic spikes and a slight upwards trend is apparent since October 2021;

- Concentrations of manganese have increased since monitoring began in September 2020;
- Historically, concentrations of copper have generally been reported below the LOR, however there have been some periodic spikes, showing a decreasing trend since February 2021; and
- Historically, concentrations of chromium, gallium, and zinc have generally been reported below the laboratory LORs.

Tank Farm Bund Release (S044, S086, S087 and S088)

The following key observations are noted for surface water samples from the Tank Farm Bunds:

- pH values at S044, S086, S087 and S088 have historically fluctuated between 7-9; and
- TPH concentrations have been reported below the laboratory LOR since December 2016 at S044, S086, S087 and S088.

The Boat Ramp (S094)

- Enterococci concentrations have generally been reported at concentrations less than the laboratory LOR or less than the WDL guideline (35 CFU/100 mL), with the exception of three occasions in the reporting period (27 April 2021, 52 CFU/100 mL; 15 September 2021, 52 CFU/100 mL; and 21 February 2022, 156 CFU/100 mL) as discussed in Section 5.3.4.3. Periodic exceedances of the guideline have been reported historically.

5.7 Performance Improvement

5.7.1 Continuous Improvement Plan

A progress report on the Continuous Improvement Plan specified in Table 1 of WDL171-11 is attached in Appendix G.

5.7.2 Options Analysis

The Harbour Tank Farm area is part of the Refinery closure plan. Decontamination work for the area is scheduled to commence in July 2022 with an anticipated end date of January 2023. Demolition will commence February 2023 and extend through to August 2023. Following structure removal and demolition, the soil will be remediated and ready for revegetation commencement by August 2024.

The existing bunding will be maintained during demolition through to remediation phase for containment and management of potentially contaminated water. Bunds at S086, S087 and S088 will be removed post remediation once it is confirmed that surface water management in the area is no longer required.

5.7.3 Adaptive Management Plan

An Adaptive Management Plan has been prepared in accordance with the NTEPSA's Guideline on Adaptive Management as required under conditions 51-54 of WDL-11 and has been submitted to the regulator separately.

5.8 Complaints Log

No complaints have been logged with Gove Operations in relation to activities conducted under the licence.

6. Marine

The Marine Health Monitoring Program (MHMP) for the Southern Melville Bay has been reported by Charles Darwin University – *Routine Surveillance Monitoring Program – Receiving Environment Quality Survey*, dated June 2022. The report presents new data for seawater, sediment and oysters for the period 1 April 2021 – 31 March 2022, and is attached as Appendix E. The key findings from this report are presented below.

6.1.1 Seawater Monitoring

Monthly data for compliance sites along the mixing zone boundary in Inner Gove Harbour showed that all parameters monitored were recorded less than the trigger values specified by WDL171-10 and WDL-11.

Filtered (dissolved) concentrations of V and associated elements (Al, Ga, As and Mo) have remained near background levels at the mixing zone boundary compliance sites in Inner Gove Harbour as well as most other information sites in Southern Melville Bay.

Total element concentrations at the compliance sites (unfiltered sample) were added to the MHMP in October 2020. As would be expected, total concentrations of Al and Fe substantially exceeded dissolved concentrations. Total concentrations of Cr, Mn and Ga also exceeded dissolved concentrations of the same metals. In contrast, dissolved phases of V, Cu, Zn, As, Mo and U accounted for almost all the total concentrations of these elements.

6.1.2 Sediment Monitoring

The most recent sediment survey was conducted in April 2021, with long term trends (2004 – 2021) showing several elements that have been recorded as elevated in surface sediment in Inner Gove Harbour compared to background sites. However, all parameters monitored since 2004 have been recorded less than the ANZG (2018) sediment quality guideline values.

6.1.3 Oyster Monitoring

Biannual oyster sampling under the MHMP was carried out in May and November 2020. A qualitative comparison of the temporal variation in average compositions for four monitoring groups (Granite Island, Harbour Islets, West Woody Island and Bonner Rocks) is carried out biannually. Where available, comparisons are made to Australia New Zealand Food Authority maximum permitted concentrations of metals in food. The results from oyster monitoring include the following;

- Long term trends (2004 – 2020) indicate that oysters from Harbour Islets, Granite Islands and West Woody Islands relatively close to the RTG Refinery continue to have greater concentrations of aluminium and gallium compared to oysters from the more distant background site at Bonner Rocks;
- Oysters from Harbour Islets continue to show elevated zinc and reduced cadmium concentrations relative to oysters from other sampling sites;
- Cadmium concentrations in oysters from Bonner Rocks, West Woody Island and occasionally Granite Islands have been above the Food Standards Australian and New Zealand (FSANZ) food standard (2 mg/kg) during most of the 2004-2021 monitoring period. However, this phenomenon appears to have natural causes and have been reported previously from locations in Northern Australia;
- Arsenic concentrations in oysters from all sampling sites exceeded the FSANZ maximum permitted concentrations for inorganic Arsenic. However, Arsenic speciation analyses carried out on samples from 2009 and 2017 showed that inorganic arsenic concentrations were below the FSANZ food standard; and
- Where applicable, all other concentrations were recorded less than the FSANZ food standard.

7. Conclusions

Gove Operations has undertaken annual surface water and marine monitoring and presents this report with respect to the Waste Discharge Licence (WDL171-11) and, where relevant, the previous WDL171-10. The following key conclusions are made for the monitoring period (1 April 2021 to 31 March 2022):

- Sampling was completed with reference to the WMP (2019). No deviations from the WMP methodology were noted during the reporting period;
- Monitoring Frequency Notifications

Monitoring was generally completed at frequencies in compliance with the WDL, with the exception of relevant incidents previously reported by Gove Operations to the Northern Territory Government and discussed in this report.

- o Daily analysis of alkalinity at S001 was not conducted on one occasion when the seawater outfall discharge channel was online on 4 June 2021;
- o The frequency of monitoring at S001 for pH and EC (continuous) was not met on 3 occasions on 27 May 2021, 26 August 2021 and 7 January 2022, due to periodic equipment faults and loss of communication;
- o There was no daily sample available for analysis from S074 on 23 August 2021 and 3 January 2022;
- o Daily sampling was conducted at S001 and S074 and analysed for daily parameters, however alkalinity was not analysed on Saturday 22 January 2022; and
- o Monthly TSS was not analysed for SW3 and SW4 for February 2022 round.
- WDL Exceedances:
Analytical results completed throughout the reporting period were generally recorded in compliance with the WDL, with the exception of relevant incidents.
 - o Exceedance of the WDL171-11 Total Dissolved Nitrogen limit was recorded at S001 on 8 March 2022 (Incident **1000609048**).
- Long term data trends and interpretation indicate:
 - o Recent trends for pH, EC and TSS at S001 were stable and similar to the historical ranges;
 - o Alkalinity and turbidity at S001 have remained relatively stable, with increasing trends since March 2020;
 - o A general improvement in aluminium, arsenic, and vanadium concentrations at S001 since January 2019;
 - o Alkalinity and turbidity at S074 have remained relatively stable at the lower range of the historical data set since September 2018, with an increasing trend since March 2020; and
 - o Metal concentrations at S074 have shown a general improvement since January 2018, with some periodic spikes and slight increasing trends in arsenic and vanadium since October 2021.
- No complaints have been logged in relation to activities conducted under the licence;

Marine monitoring continues to recommend that monthly sampling and analysis of seawater and annual sampling and analysis of sediment continues as part of the MHMP. The oyster monitoring component of the MHMP should also continue unchanged with half yearly (biannual) sampling to maintain the biological component of the MHMP. Overall, there is no current evidence of deterioration of marine ecosystem health as a result of the authorised discharge, and no significant environmental impact associated with authorised discharges, based on the monitoring data and incident reports reviewed for this monitoring period.

Table 7-1 below presents a summary of the licence conditions that are relevant to this report and compliance relative to those conditions during the April 2021 – March 2022 monitoring period.

Table 7-1 Summary of Compliance with WDL171-11 (and previous WDL 171-10)

Licence Condition	Compliance Statement	Report Section
1-13	Not addressed in this report.	Not included in this report.
14-15	The licensee understands this condition, however no complaints were made during the reporting period.	Section 5.7
16-21	Not addressed in this report.	Not included in this report.
22	The licensee recorded three events that were from unauthorised discharge points. These are reported as incidents within the monitoring report.	Section 5.3.1.3

Licence Condition	Compliance Statement	Report Section
23	The licensee measured and recorded, for each discharge event at each discharge point: 23.1. the time the discharge commenced and the duration of the discharge 23.2. the discharge rate of flow and 23.3. for S001, the discharge volume.	Section 5.3.1.1 Section 5.3.1.2
24	Not addressed in this report.	Not included in this report.
25	Monitoring points S098 and S0125 are to be installed by 30 August 2022 and as such this condition is not relevant for the current monitoring period.	Not applicable.
26	Where trigger values were exceeded they were acted upon.	Section 5.3.4.2.2 Section 5.3.4.3 Section 5.3.4.4
27	Monitoring of the authorised discharge points for all discharge events occurred and did not indicate the presence of floating debris etc. (27.1), or affect the health of marine organisms (27.3-27.5).	The marine monitoring report (summarised in Section 6 and reproduced in Appendix E) indicates that there was not adverse impact on marine health. Oil, grease and petroleum hydrocarbon sheen monitoring results are discussed in Section 5.4.
28	Except as indicated in Incidents 1000578371 , 1000609084 , 1000585261 , 1000595869 , 1000600062 and 1000603157 monitoring was conducted in accordance with Appendix 2.	Section 5.3.2
29	Sediment and biological monitoring was conducted as specified in Table 1.	The marine monitoring report (summarised in Section 6 and reproduced in Appendix E) summarises the sediment and biological monitoring that was conducted.
30	Sampling locations S001 and compliance points SW9, SW10, and RR2 were sampled on the same day and in order from the authorised discharge point to the mixing zone boundary.	The results presented in the marine monitoring report (summarised in Section 6 and reproduced in Appendix E) indicate that these locations were sampled on the same day and in the order specified.
31	Conditions of the WDL have taken precedence over the Water Monitoring Plan 2019 where there is any conflict.	Section 5.2.2 summarises the monitoring conducted relative to either WDL171- 10 or WDL171-11, depending on the date.
32	Samples and field environmental data were representative of conditions at the time of sampling.	Section 5.3.3 and Appendix A discuss the field and laboratory QA/QC results. Section 5.2.2 indicates that samples were collected by suitably qualified personnel.
33	Samples and field environmental data were collected in accordance with recognised Australian Standards and guidelines.	Sections 5.2.2

Licence Condition	Compliance Statement	Report Section
34	All monitoring samples were analysed at a laboratory with NATA accreditation or equivalent at the time of monitoring, for the parameters measured.	Section 5.2.2
35	Not addressed in this report	Not included in this report.
36	Samples collected in connection with the activity of this licence were obtained by a qualified sampler.	Section 5.2.2 states that samples were collected by suitably qualified personnel.
37	For the activity, the date, time, locations, name, chain of custody, field measurements, analytical results, and lab QA/QC documentation were recorded and retained for each sample collected as described throughout this report.	Section 5.2.2 references records and data are held by Gove Operations, and results summarised in this report.
38	Non-compliances with this licence are presented as Incidents in this report.	See Appendix F, Executive Summary, Section 5.3.2 and Conclusions.
39	Details of specific timing regarding notifications of non-compliances are not included in this report	Not included in this report.
40	Notification of non-compliance – details to be included.	Details regarding specific notifications of non-compliances are included in the incident reports provided in Appendix F.
41	Non-compliances were identified as an exceedance of a limit or trigger value as specified in Appendix 2 of the licence.	Incident 1000603062 – Section 5.3.4.2.2 Incident 1000609048). – Section 5.3.4.1
42	Details regarding exceedance of trigger values including: 42.1. the actual and potential causes and contributing factors to the exceedance 42.2. the risk of environmental harm resulting from the exceedance 42.3. actions undertaken to mitigate any environmental harm arising from the exceedance; and 42.4. if no action was taken why no action was taken; are not included in this report.	Details are provided in the Incident Reports included in Appendix F.
43	This report identifies and records all exceedances of trigger values. Records are kept in this report, the associated data files and by Gove in their data management system.	Section 5.3.4.2.2 Section 5.3.4.3 Section 5.3.4.4 Appendix C and D
44	Details regarding the trigger value exceedances are included in this report, and recorded in the associated data files.	Section 5.3.4.2.2 Section 5.3.4.3 Section 5.3.4.4
45	The Annual Return is reported under separate cover.	Not included in this report.
46	This report represents the Monitoring Report.	Entire report and accompanying Excel files.
47	This Monitoring Report includes details as follows:	
47.1	Requirements of the Administering Agency were taken into consideration when preparing the report.	Table 3-2
47.2	All monitoring data was tabulated and presented in Appendix C of the report and separate Excel tables.	Appendix C (Tables) and accompanying Excel files.

Licence Condition	Compliance Statement	Report Section
47.3	Monitoring points S098 and S015 are not required to be installed until 30 August 2022 and as such this condition is not relevant for the current monitoring period.	Not applicable.
47.4	Authorised discharges were recorded by Gove Operations and summarised in this report.	Section 5.3.1.1 and Section 5.3.1.2
47.5	Environmental monitoring data is assessed as per the requirements in Appendix 2.	Section 5.3.2, Section 5.3.3 and Section 5.3.4
47.6	Marine Health Monitoring Report was reviewed and from the data collected it was demonstrated that no deterioration of marine health occurred as a result of authorised discharge.	Section 6 and Appendix E (Marine Health Monitoring Report).
47.7	Long term trend analysis was performed over a minimum period of three years.	Section 5.6 Appendix D and accompanying Excel files.
47.8	Assessment of environmental impact was included.	Section 7
48	The Continuous Improvement Plan is included as Appendix G of this report.	Appendix G.
49	The options analysis to avoid discharge from S086-S088 is not part of this report. It is provided under separate cover.	Not included in this report.
50	The Marine Health Monitoring Plan is included as Appendix E of this report.	Appendix E.
51-54	The Adaptive Management Plan is not part of this report. It is provided under separate cover.	Not included in this report.

8. References

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National Environment Protection Council (NEPC) (2013) *National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM)*, 1999 (amended 2013).

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Rio Tinto Gove Operations (RTA Gove) (2022) *Continuous Improvement Plan*, 2022.

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Rio Tinto Gove Operations (RTA Gove) (2019) *Water Monitoring Plan (GPM-EHS-081)*, October 2019.

Appendix A – Quality Assurance Quality Control

QAQC – WDL Surface Water

Monitoring Round Date	Laboratory Report Number	Holding Times Met	Comment on Holding Times	Temperature Received (°C)*	Comment on Temperature	Laboratory Duplicate RPD Acceptable**	Comment on Laboratory RPDs	Matrix Spike Acceptable	Comment on Matrix Spikes
Apr-21	ES2113811	No	• S074 & S001 analysis for turbidity 1 day overdue.	12.9	Ice bricks present	Yes	No comment	No	"MS recovery not determined, background level greater than or equal to 4x spike level." - Total Phosphorus as P
Apr-21	ES2115753	Yes	No comment	15.6	Ice bricks present	Yes	No comment	Yes	No comment
Apr-21	ES2116093	No	• SW9, SW10 & RR2 analysis for TPH & PAH 4 days overdue.	14.4	Ice bricks present	Yes	No comment	Yes	No comment
Apr-21	ES2116266	Yes	No comment	15.9	Ice bricks present	Yes	No comment	Yes	No comment
May-21	ES2117065	Yes	No comment	13.7	Ice bricks present	Yes	No comment	Yes	No comment
May-21	ES2119130	Yes	No comment	13.8	Ice bricks present	Yes	No comment	No	"MS recovery not determined, background level greater than or equal to 4x spike level." - Zinc
May-21	ES2119459	Yes	No comment	13.7	Ice bricks present	Yes	No comment	Yes	No comment
Jun-21	ES2122155	Yes	No comment	15.7	Ice bricks present	Yes	No comment	Yes	No comment
Jun-21	ES2122510	No	• S074 & S001 analysis for turbidity 1 day overdue.	15.5	Ice bricks present	Yes	No comment	Yes	No comment
Jul-21	ES2125136	Yes	No comment	6.7	Ice bricks present	Yes	No comment	No	"MS recovery not determined, background level greater than or equal to 4x spike level." - Total Phosphorus as P
Jul-21	ES2126195	Yes	No comment	14.2	Ice bricks present	Yes	No comment	Yes	No comment
Aug-21	ES2130897	Yes	No comment	10	Ice bricks present	Yes	No comment	Yes	No comment
Aug-21	ES2130902	No	• S001 & S074 analysis for suspended solids 3 days overdue. • S001 & S074 analysis for turbidity 9 days overdue. • S001 & S074 extraction for TPH & PAH 2 days overdue. • S074 & S001 analysis for turbidity 2 days overdue.	10	Ice bricks present	Yes	No comment	Yes	No comment
Sep-21	ES2133723	No	• S074 & S001 analysis for turbidity 2 days overdue.	11.9	Ice bricks present	Yes	No comment	Yes	No comment
Sep-21	ES2133725	No	• SW9, SW10 & RR2 extraction for TPH & PAH 2 days overdue.	11.9	Ice bricks present	Yes	No comment	Yes	No comment
Oct-21	ES2136796	Yes	No comment	17.7	Ice bricks present	Yes	No comment	Yes	No comment
Oct-21	ES2137398	No	• S001 & S074 analysis for pH and Turbidity 5 days overdue.	13.7	Ice bricks present	Yes	No comment	Yes	No comment
Nov-21	ES2140195	No	• S001 & S074 analysis for pH 6 days overdue. • S001 & S074 analysis for Turbidity 4 days overdue.	12.5	Ice bricks present	Yes	No comment	Yes	No comment
Nov-21	ES2140537	Yes	No comment	16.1	Ice bricks present	Yes	No comment	Yes	No comment
Nov-21	ES2142567	No	• SW9, SW10 & RR2 extraction for TPH & PAH 1 day overdue.	13.4	Ice bricks present	Yes	No comment	Yes	No comment
Dec-21	ES2144281	No	• S001 & S074 analysis for pH 5 days overdue. • S001 & S074 analysis for Turbidity 8 days overdue.	14.1	Ice bricks present	Yes	No comment	No	"MS recovery not determined, background level greater than or equal to 4x spike level." - Total Phosphorus as P and Total Kjeldahl Nitrogen
Dec-21	ES2145768	Yes	No comment	10.4	Ice bricks present	Yes	No comment	Yes	No comment
Dec-21	ES2147316	No	• S044, S086, S087 & S088 extraction for TPH & PAH 3 days overdue.	12	Ice bricks present	Yes	No comment	Yes	No comment
Dec-21	ES2147450	Yes	No comment	16.9	Ice bricks present	Yes	No comment	Yes	No comment
Jan-22	ES2200337	No	• S001 & S074 analysis for pH 5 days overdue.	19.1	Ice bricks present	Yes	No comment	Yes	No comment
Jan-22	ES2201475	No	• S001 extraction & analysis for TPH and 2 days overdue.	18	Ice bricks present	Yes	No comment	Yes	No comment
Jan-22	ES2201476	Yes	No comment	18	Ice bricks present	Yes	No comment	Yes	No comment
Jan-22	ES2202612	No	• S001 analysis for pH 10 days overdue. • S001 analysis for pH 10 days overdue. • S001 analysis for TSS 2 days overdue. • S001 analysis for Turbidity 8 days overdue • S001 extraction for TPH, PAH 3 days overdue. • S044 extraction for TPH & PAH 3 days overdue.	16.2	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2203631	No	• S001 analysis for pH 10 days overdue. • S001 analysis for pH 10 days overdue. • S001 analysis for TSS 2 days overdue. • S001 analysis for Turbidity 8 days overdue • S001 extraction for TPH, PAH 3 days overdue. • S044 extraction for TPH & PAH 3 days overdue.	9.8	Ice bricks present	Yes	No comment	No	Recovery greater than upper control limit for Total Phosphorus as P
Feb-22	ES2203632	No	• S044 extraction for TPH & PAH 3 days overdue.	9.8	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2203743	Yes	No comment	9.8	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2203799	No	• S001 & S074 analysis for pH 3 days overdue. • S001 & S074 analysis for Turbidity 4 days overdue.	15.4	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2204372	Yes	No comment	15.1	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2204880	No	• S001 analysis for pH 7 days overdue. • S001 for Turbidity 5 days overdue.	NP	NP	Yes	No comment	Yes	No comment
Feb-22	ES2204881	Yes	No comment	9.8	NP	Yes	No comment	Yes	No comment
Feb-22	ES2204882	No	• SW9, SW10 & RR2 analysis for pH 7 days overdue. • SW9, SW10 & RR2 analysis for Turbidity 6 days overdue.	9.8	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2205204	Yes	No comment	15.8	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2205207	Yes	No comment	15.8	Ice bricks present	Yes	No comment	Yes	No comment
Feb-22	ES2206599	Yes	No comment	17.7	Ice bricks present	Yes	No comment	Yes	No comment
Mar-22	ES2207563	No	• S044, S086, S087 & S088 extraction for TPH & PAH 1 day overdue.	18.2	Ice bricks present	Yes	No comment	Yes	No comment
Mar-22	ES2208631	No	• S001 & S074 analysis for pH and Turbidity 5 days overdue.	18.2	Ice bricks present	Yes	No comment	Yes	No comment
Mar-22	ES2209524	Yes	No comment	9.6	Ice bricks present	Yes	No comment	Yes	No comment
Mar-22	ES2211512	No	• SW9, SW10 & RR2 extraction for TPH & PAH 2 days overdue. • SW9, SW10 & RR2 analysis for pH 9 days overdue.	6.5	Ice bricks present	Yes	No comment	Yes	No comment

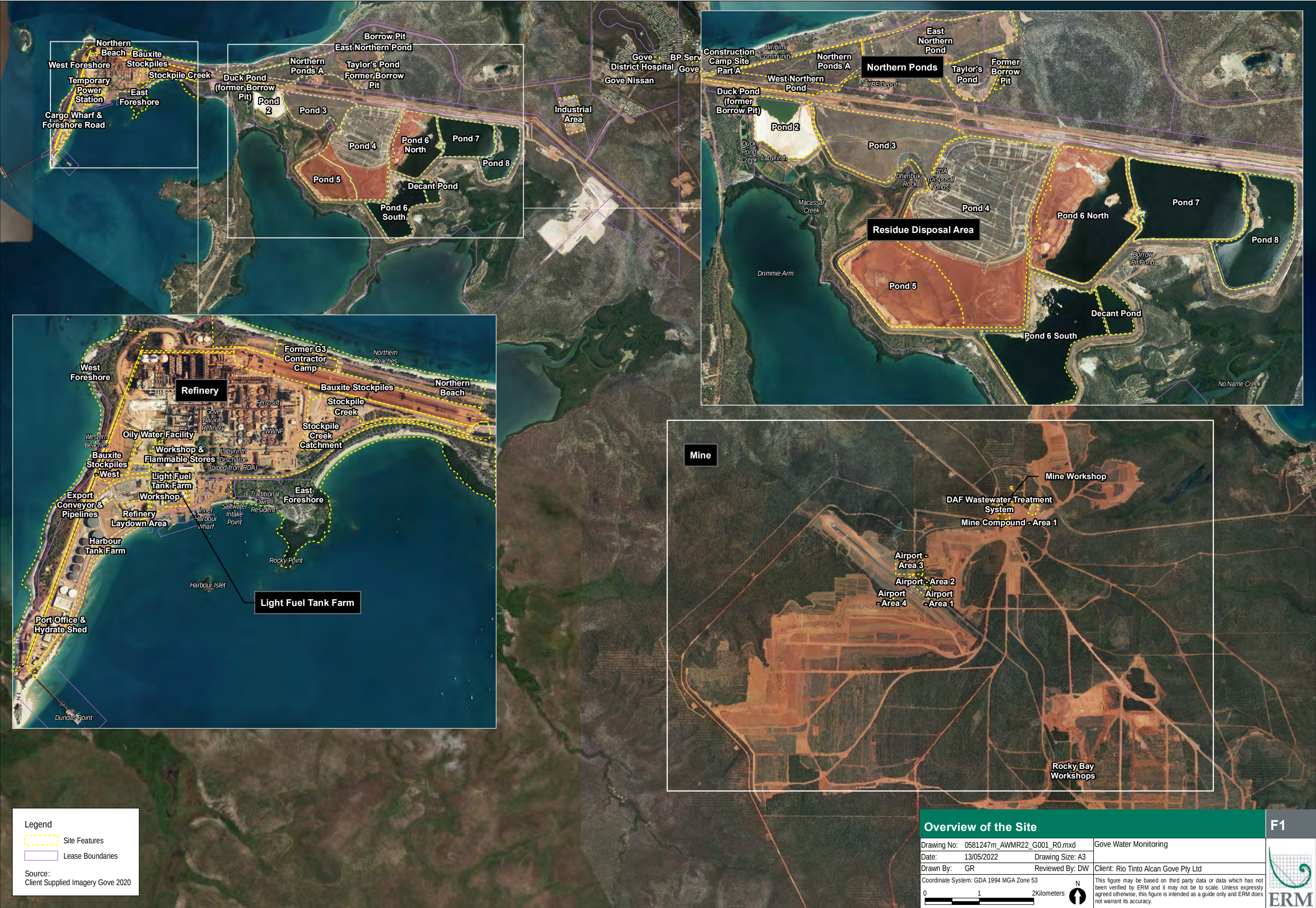
Notes: The laboratory reports included in the review above was limited to reports that were categorised as part of the WDL monitoring
*Likely due to air freight between Gove and Sydney laboratory, acceptable considering below Northern Territory ambient temperatures (>30°C).
**Relative Percentage Differences (RPD)'s due to non-detects have not been included.
NP - Not Provided

Appendix B – Figures

Figure 1 – Overview of the Site

Figure 2 – Rainfall Gauges, Authorised Discharge and Monitoring Points

Figure 3 – Refinery Surface Water Catchments and Key Features



Authorised Discharge Points	Description
S001	Seaw ater Outfall Channel
S044	Refinery Light Fuel Tank Farm Bund
S086	Refinery Tank Farm Bund
S087	Refinery Tank Farm Bund
S088	Refinery Tank Farm Bund
Authorised Monitoring Points	Description
S015	Sew erage Treatment Plan (STP)
S074	Seaw ater Outfall Channel (Refinery)
S094	Public boat ramp (Refinery)
S098	WWNP
SW2	Arafura Sea – Off West Woody Island
SW3	Gove Harbour – Off Granite Island
SW4	Melville Bay – Off Dolphin Rocks
SW7	Offshore Drimmie Arm
SW8	Inverell Bay / Gove Harbour
SW9	Mixing Zone Boundary
SW10	Mixing Zone Boundary
SW11	Gove Harbour – Off Outfall
RR2	Mixing Zone Boundary
MB1, MB2, MB3, MB4	Mixing Zone boundary test sites (Refinery)



- Legend
- Rainfall Gauges
 - Authorised Discharge Point
 - Authorised Monitoring Point
 - Lease Boundaries

Source:
Client Supplied Imagery Gove 2020

Rainfall Gauges,
Authorised Discharge and Monitoring Points

Drawing No: 0581247m_AWMR22_G006_R0.mxd

Date: 13/05/2022

Drawn By: GR

Coordinate System: GDA 1994 MGA Zone 53

Gove Water Monitoring

Reviewed By: DW

Client: Rio Tinto Alcan Gove Pty Ltd

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

00.51Kilometers

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Appendix C – Data Tables

Table 1 – Surface Water Analytical Results – Seawater Outfall Channel

Table 2 – Surface Water Analytical Results – Tank Farm Bund Release Sampling

Table 3 – Surface Water Analytical Results – Marine Mixing Zone Compliance Points

Table 4 – Surface Water Analytical Results – Discharge Load Monitoring

[illegible]

Appendix C
Table 1
Surface Water Analytical Results – Seawater Outfall Channel Sampling

					Analyte Unit		pH, Lab	pH, Field	Conductivity, Lab	Conductivity, Field	Turbidity	Alkalinity, Total as CaCO3	Total suspended solids	Aluminum, Dissolved	Aluminum, Total	Arsenic, Dissolved	Arsenic, Total	Chromium, Dissolved	Copper, Dissolved	Gallium, Dissolved	Gallium, Total	Magnesium, Dissolved	Manganese, Dissolved	Molybdenum, Dissolved	Molybdenum, Total	Vanadium, Dissolved	Vanadium, Total	Zinc, Dissolved	Total Dissolved Phosphorus	Total Dissolved Nitrogen	C10-C36-Total	Enterococcus		
					pH units	pH units	µS/cm	µS/cm	NTU	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mpn/100ml		
RIO TINTO GOVE - WDL171-10 TV					9	9					20			200		20											2000					600		
RIO_TINTO-GOVE-WS-WDL171-10 LIMIT					9.5	9.5					100																					600		
RIO TINTO GOVE - WDL171-11 TV					9	9					20																			140	1700	100		
RIO_TINTO-GOVE-WS-WDL171-11 LIMIT					9.5	9.5					100			560		200					8000				38800	1000						600		
RIO_TINTO-GOVE-WS-S094																																	35	
Location ID	Sample Date	Sample Name	Sample Type	Lab SDG																														
S001	6/04/2021	S001_20210604	N	ES2112757	-	-	-	-	-	-	-	-	5	230	5.8	7.3	< 0.5	< 1	< 10.0	< 10.0	1230000	-	21.6	23.4	2.2	3.1	< 5	-	-	-	-	-	-	
S001	13/04/2021	S001_20210413	N	ES2113811	-	8.47	-	54000	3.2	304	13	8	87	5.3	6.2	< 0.5	< 1	< 1	< 1	1170000	-	25.5	30.1	7.4	8.9	< 5	< 10	< 100	-	-	-	-	-	
S001	27/04/2021	S001_20210427	N	ES2115754	-	-	-	-	-	-	-	-	8	86	8.8	9.0	< 0.5	< 1	< 10.0	< 10.0	1310000	-	30.9	32.6	16.4	17.8	< 5	-	-	-	-	-	20	
S001	4/05/2021	S001_20210504	N	ES2117041	-	-	-	-	-	-	-	-	8	67	5.6	7.0	< 0.5	< 1	< 10	< 10	1200000	-	25.7	31.9	9.2	10.5	< 5	-	-	-	-	-	-	
S001	24/01/2022	S001_20220124	N	ES2202614	8.11	-	48200	-	1.7	154	< 5	5	127	2.1	2.2	< 0.5	< 1	< 10	< 10	1200000	2.0	11.3	11.3	2.3	2.8	6	-	-	-	-	-	-	-	
S001	25/01/2022	S001_20220125	N	ES2203631	8.51	8.28	50400	49050	6.0	296	21	12	276	7.0	7.7	< 0.5	< 1	< 1	< 1	1290000	11.9	27.2	27.7	12.8	15.0	< 5	< 10	< 100	< 50	-	-	-	-	
S001	1/02/2022	S001_20220201	N	ES2203799	7.99	7.8	52400	49690	3.8	117	< 5	< 5	174	2.1	2.2	< 0.5	< 1	< 1	< 1	1360000	1.1	10.2	11.2	2.2	2.8	< 5	< 10	< 100	< 50	-	-	-	-	
S001	7/02/2022	S001_20220207	N	ES2204880	7.96	7.57	52000	48700	2.5	121	5	< 5	77	1.7	2.0	< 0.5	< 1	< 10	< 10	1260000	1.9	10.4	11.9	2.5	3.1	21	< 100	2400	< 50	-	-	-	-	
S001	12/02/2022	S001_20220212	N	ES2205210	8.45	-	53200	-	4.3	335	12	6	122	7.9	8.8	< 0.5	< 1	< 10	< 10	1230000	18.3	33.6	33.2	17.2	19.6	< 5	-	-	-	-	-	-	-	
S001	16/02/2022	S001_20220216	N	ES2206166	8.10	-	41300	-	5.2	255	11	14	156	6.5	8.0	< 0.5	< 1	< 10	< 10	1200000	9.6	27.0	29.7	17.9	18.2	< 5	-	-	-	-	-	-	-	
S001	21/02/2022	S001_20220221	N	ES2206168	8.34	-	39100	-	3.6	250	13	14	104	7.5	8.1	< 0.5	< 1	< 10	< 10	1260000	16.3	26.6	28.3	7.1	8.2	< 5	-	-	-	-	-	-	< 10	
S001	2/03/2022	S001_20220302	N	ES2207582	8.42	-	46800	-	3.5	343	16	9	81	9.0	9.5	< 0.5	< 1	< 10	< 10	1200000	13.0	34.6	38.9	19.8	22.1	< 5	-	-	-	-	-	-	< 10	
S001	8/03/2022	S001_20220308	N	ES2208631	8.03	8.18	59400	51200	1.7	117	6	< 5	< 100	1.9	< 10	< 0.5	< 1	-	-	1350000	2.0	11.0	13	2.6	< 100	< 5	< 100	4600	< 50	-	-	-	-	
S001	9/03/2022	S001_20220309	N	ES2208631	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 10	
S001	13/03/2022	S001_20220313	N	ES2209523	8.03	-	50700	-	1.6	121	7	9	95	1.9	2.0	< 0.5	< 1	< 10	< 10	1290000	1.6	11.0	12.9	2.1	2.6	19	-	-	-	-	-	-	-	-
S001	15/03/2022	S001_20220315	N	ES2209789	7.73	-	52900	-	1.8	117	< 5	8	104	1.8	2.0	< 0.5	< 1	< 10	< 10	1540000	1.4	10.7	10.6	2.6	2.9	< 5	-	-	-	-	-	-	-	-
S001	22/03/2022	S001_20220322	N	ES2210736	8.02	-	54800	-	2.0	114	22	8	77	1.5	1.4	< 0.5	< 1	< 10	< 10	1310000	1.2	10.3	10.4	2.2	2.4	6	-	-	-	-	-	-	-	-
S074	13/04/2021	S074_20210413	N	ES2113811	-	8.57	-	50400	7.8	288	11	8	64	5.5	5.7	< 0.5	2	< 1	< 1	1160000	-	28.5	31.0	6.6	7.0	< 5	< 10	< 100	-	-	-	-	-	-
S074	19/05/2021	S074_20210519	N	ES2119130	-	8.72	-	48000	1.2	287	7	9	28	6.6	6.8	< 0.5	4	< 1	< 1	1220000	-	27.0	28.1	11.2	12.9	< 5	340	< 100	< 50	-	-	-	-	-
S074	15/06/2021	S074_20210615	N	ES2122510	-	8.36	-	52200	1.1	179	10	12	86	9.8	9.7	< 0.5	1	< 1	< 1	1190000	< 0.5	20.6	22.0	34.8	36.0	< 5	< 10	< 100	< 50	-	-	-	-	-
S074	6/07/2021	S074_20210706	N	ES2125136	-	8.24	-	49660	1.1	307	5	27	57	5.5	6.1	0.6	2	< 1	< 1	1190000	0.9	35.7	38.6	134	143	< 5	< 10	< 100	< 50	-	-	-	-	-
S074	17/08/2021	S074_20210817	N	ES2130902	8.11	8.48	50400	48900	1.8	296	16	25	112	5.1	5.2	< 0.5	< 1	< 1	< 1	1210000	0.7	38.8	39.3	106	109	< 5	< 10	1300	< 50	-	-	-	-	-
S074	14/09/2021	S074_20210914	N	ES2133723	8.10	8.46	51400	50800	1.0	325	< 5	26	69	5.4	11.5	< 0.5	< 1	< 1	< 1	1070000	< 0.5	39.5	42.4	114	118	< 5	< 10	< 100	< 50	-	-	-	-	-
S074	13/10/2021	S074_20211013	N	ES2137398	7.80	7.57	52000	50770	1.6	127	< 5	7	85	1.6	2.1	< 0.5	< 1	< 1	< 1	1280000	0.7	10.2	11.3	3.3	3.7	< 5	< 10	< 100	< 50	-	-	-	-	-
S074	2/11/2021	S074_20211102	N	ES2140195	7.60	7.17	52500	51600	2.4	131	6	9	85	1.6	1.6	< 0.5	< 1	< 1	< 1	1310000	1.5	10.5	9.8	2.6	3.0	< 5	< 10	2200	< 50	-	-	-	-	-
S074	5/11/2021	S074_20211105	N	ES2140537	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 50	
S074	1/12/2021	S074_20211201	N	ES2144281	7.85	7.07	53000	51700	2.2	137	9	6	131	1.7	1.9	< 0.5	< 1	< 1	< 1	1300000	0.8	10.9	11.3	2.8	3.2	< 5	< 10	< 100	< 50	-	-	-	-	-
S074	5/01/2022	S074_20220105	N	ES2200337	7.90	7.5	51000	48520	2.2	140	15	< 5	182	2.0	2.0	< 0.5	1	< 1	< 1	1200000	1.8	9.4	10.0	2.1	2.3	< 5	< 10	< 100	< 50	-	-	-	-	-
S074	1/02/2022	S074_20220201	N	ES2203799	8.20	8.05	52100	49470	6.0	205	< 5	7	150	4.7	5.2	0.9	< 1	< 1	< 1	1300000	5.4	18.5												

Appendix C
Table 2
Surface Water Analytical Results – Tank Farm Bund Release Sampling

Surface Water Analytical Results
Rio Tinto-Gove
WDL Annual Monitoring Report
2021 - 2022

Analyte Unit				pH, Field	C10-C36-Total
RIO_TINTO-GOVE-WS-WDL171-11 TV				pH units	ug/L
RIO_TINTO-GOVE-WS-WDL171-11 Limit				9	100
				9.5	600
Location ID	Sample Date	Sample Name	Lab SDG		
S044	2/04/2021	S044_20210402		9.53**	-
S044	26/04/2021	S044_20210426	ES2115753	9.27*	< 50
S044	28/04/2021	S044_20210428	ES2116266	8.8	< 50
S044	21/12/2021	S044_20211221	ES2147316	9.16	< 50
S044	26/12/2021	S044_20211226	ES2147450	7.42	< 50
S044	15/01/2022	S044_20220115	ES2201476	7.83	< 50
S044	25/01/2022	S044_20220125	ES2203632	-	< 50
S044	30/01/2022	S044_20220130	ES2203743	7.66	< 50
S044	3/02/2022	S044_20220203	ES2204372	8.75	< 50
S044	7/02/2022	S044_20220207	ES2204881	7.5	< 50
S044	23/02/2022	S044_20220223	ES2206599	7.67	< 50
S044	24/02/2022	S044_20220224	ES2207563	7.7	< 50
S044	26/03/2022	S044_20220326	ES2211513	8.76	< 50
S086	2/04/2021	S086_20210402		8.5	-
S086	26/04/2021	S086_20210426	ES2115753	8.56	< 50
S086	28/04/2021	S086_20210428	ES2116266	7.9	< 50
S086	21/12/2021	S086_20211221	ES2147316	8.44	< 50
S086	26/12/2021	S086_20211226	ES2147450	7.65	< 50
S086	15/01/2022	S086_20220115	ES2201476	7.88	< 50
S086	30/01/2022	S086_20220130	ES2203743	8.17	< 50
S086	3/02/2022	S086_20220203	ES2204372	8.44	< 50
S086	7/02/2022	S086_20220207	ES2204881	7.9	< 50
S086	23/02/2022	S086_20220223	ES2206599	7.7	< 50
S086	24/02/2022	S086_20220224	ES2207563	7.76	< 50
S086	26/03/2022	S086_20220326	ES2211513	8.31	< 50
S087	2/04/2021	S087_20210402		8.98	-
S087	26/04/2021	S087_20210426	ES2115753	9.07*	< 50
S087	28/04/2021	S087_20210428	ES2116266	7.91	< 50
S087	21/12/2021	S087_20211221	ES2147316	8.33	< 50
S087	26/12/2021	S087_20211226	ES2147450	7.38	< 50
S087	15/01/2022	S087_20220115	ES2201476	7.67	< 50
S087	30/01/2022	S087_20220130	ES2203743	7.99	< 50
S087	3/02/2022	S087_20220203	ES2204372	8.8	< 50
S087	7/02/2022	S087_20220207	ES2204881	7.5	< 50
S087	23/02/2022	S087_20220223	ES2206599	7.75	< 50
S087	24/02/2022	S087_20220224	ES2207563	7.67	< 50
S087	26/03/2022	S087_20220326	ES2211513	8.06	< 50
S088	2/04/2021	S088_20210402		8.85	-
S088	26/04/2021	S088_20210426	ES2115753	9.05*	< 50
S088	28/04/2021	S088_20210428	ES2116266	8.47	< 50
S088	21/05/2021	S088_20210521	ES2119459	8.64	< 50
S088	21/12/2021	S088_20211221	ES2147316	8.44	< 50
S088	26/12/2021	S088_20211226	ES2147450	7.53	< 50
S088	15/01/2022	S088_20220115	ES2201476	7.56	< 50
S088	30/01/2022	S088_20220130	ES2203743	8.01	< 50
S088	3/02/2022	S088_20220203	ES2204372	9.19*	< 50
S088	7/02/2022	S088_20220207	ES2204881	7.6	< 50
S088	9/02/2022	S088_20220209	ES2205204	8.03	< 50
S088	23/02/2022	S088_20220223	ES2206599	7.72	< 50
S088	24/02/2022	S088_20220224	ES2207563	7.94	< 50
S088	26/03/2022	S088_20220326	ES2211513	8.31	< 50

* Trigger value exceeded however no discharge event occurred on this date at specified location.
** Limit exceeded however no discharge event occurred on this date at the specified location.

1 of 1

Appendix C
Table 4
Surface Water Analytical Results – Discharge Load Monitoring

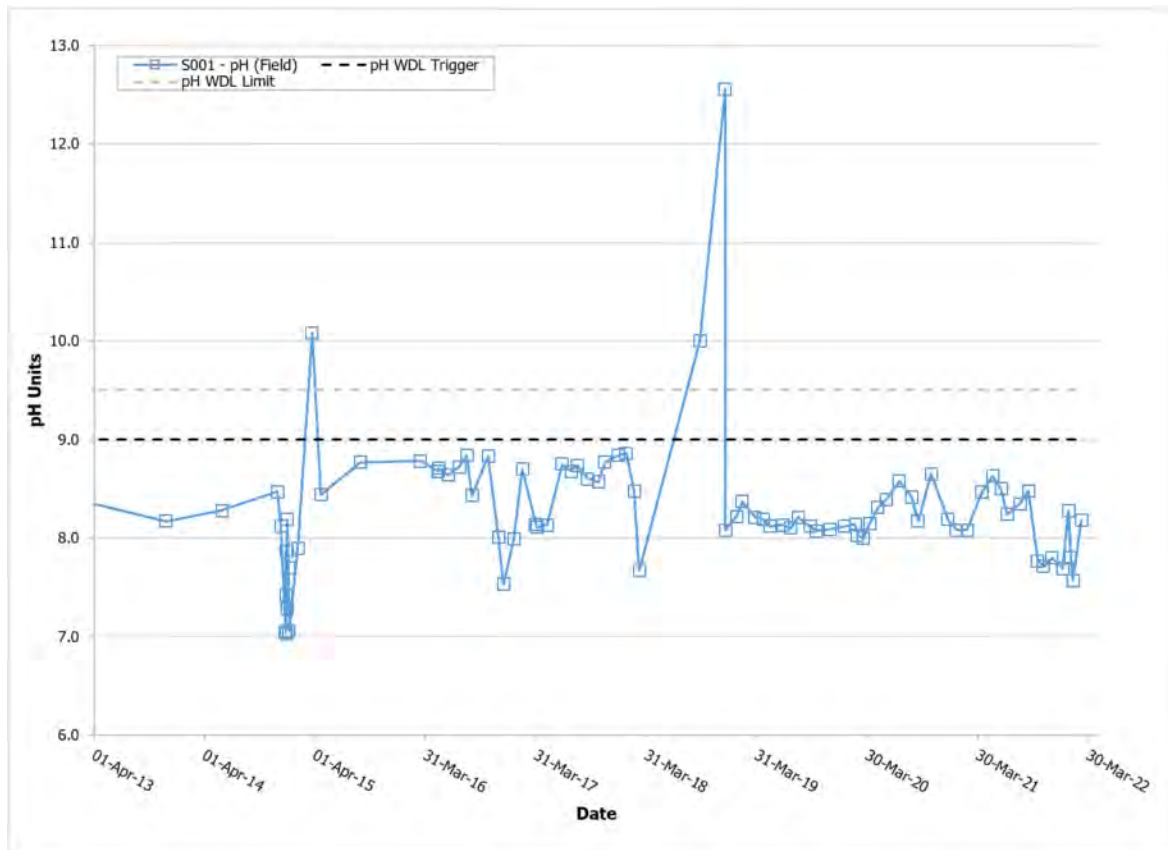
Surface Water Analytical Results
Rio Tinto-Gove
WDL Annual Monitoring Report
2021 - 2022

Location ID	Sample Date	Sample Name	Sample Type	Lab SDG	Analyte Unit		Aluminum, Total ug/L	Arsenic, Total ug/L	Gallium, Total ug/L	Molybdenum, Total ug/L	Vanadium, Total ug/L	Total Phosphorus ug/L	Nitrogen, Total Kjeldahl ug/L
S015	23/02/2022	S015_20220323	N	ES2206598	-	-	-	-	-	-	-	3100	12800
S015	29/03/2022	S015_20220329	N	ES2211510	-	-	-	-	-	-	-	5660	26200
S098	23/02/2022	S098_20220323	N	ES2206598	220	75	27	163	120	-	-	-	-
S098	2/03/2022	S098_20220302	N	ES2207580	< 100	42	22	126	< 100	-	-	-	-
S098	8/03/2022	S098_20220308	N	ES2208631	< 100	53	< 10	166	230	-	-	-	-

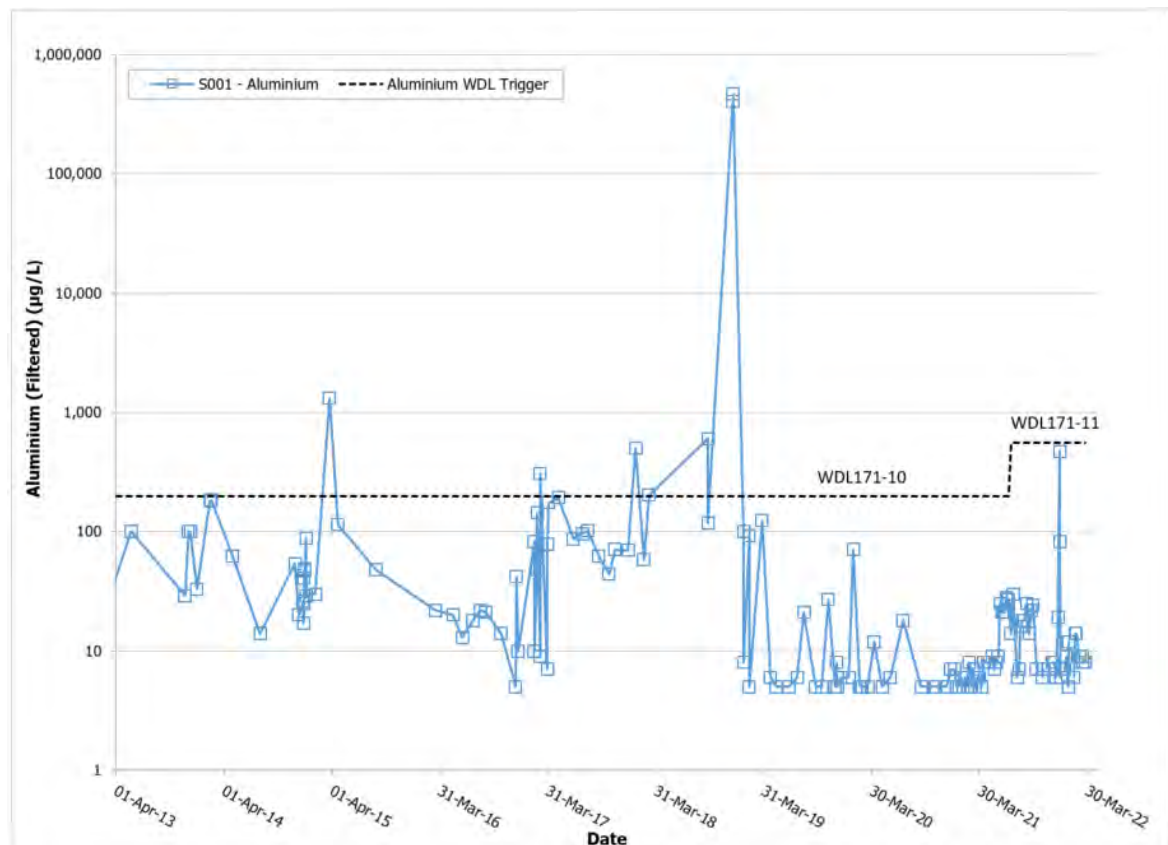
Note: Monitoring requirement only applicable under WDL171-11, commencing 15/02/2022

Appendix D – WDL Surface Water Data Trends

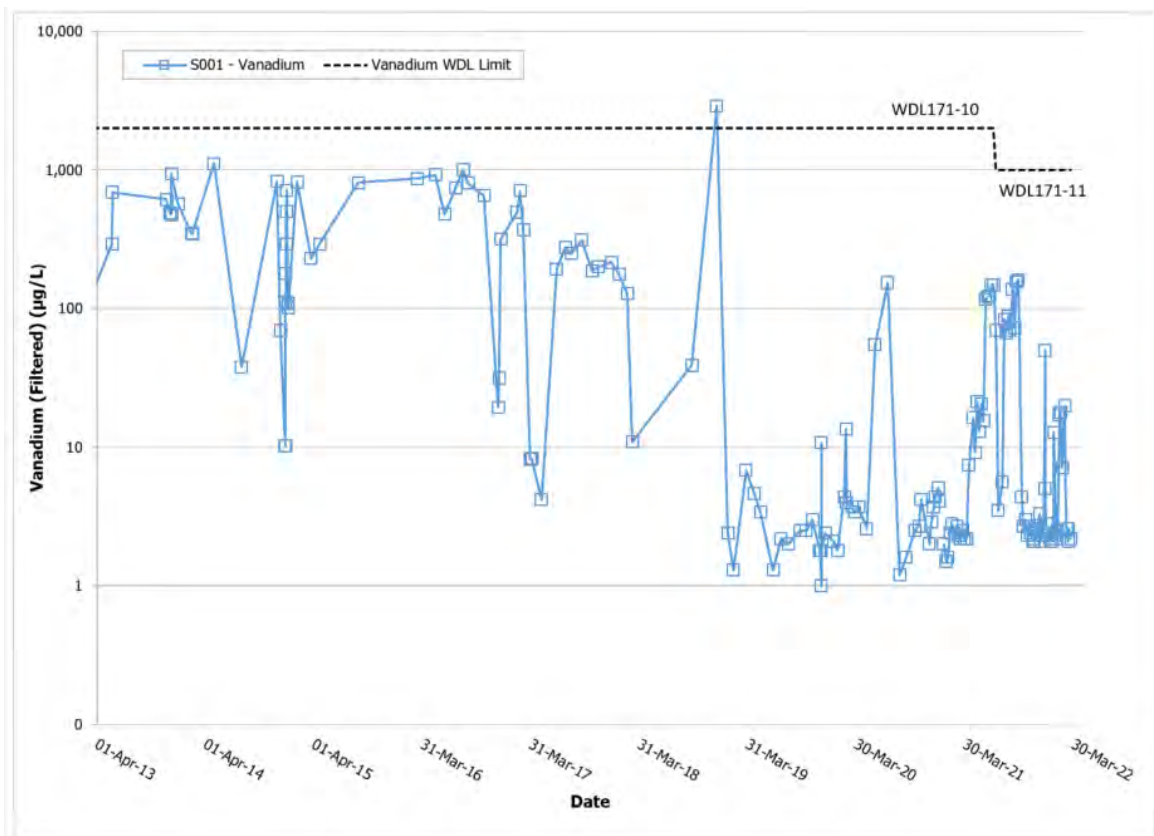
Soo1 (grab sample) – pH (Field)



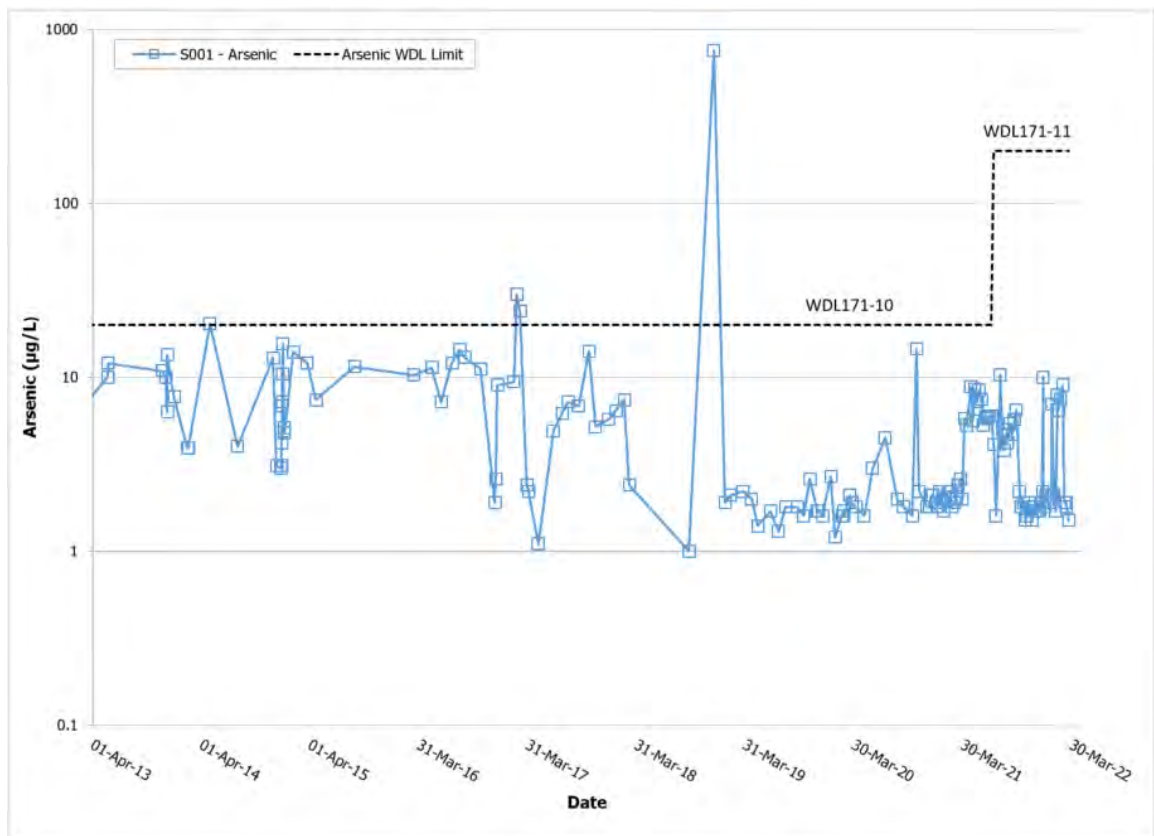
Soo1 (grab sample) – Aluminium Concentrations (filtered)



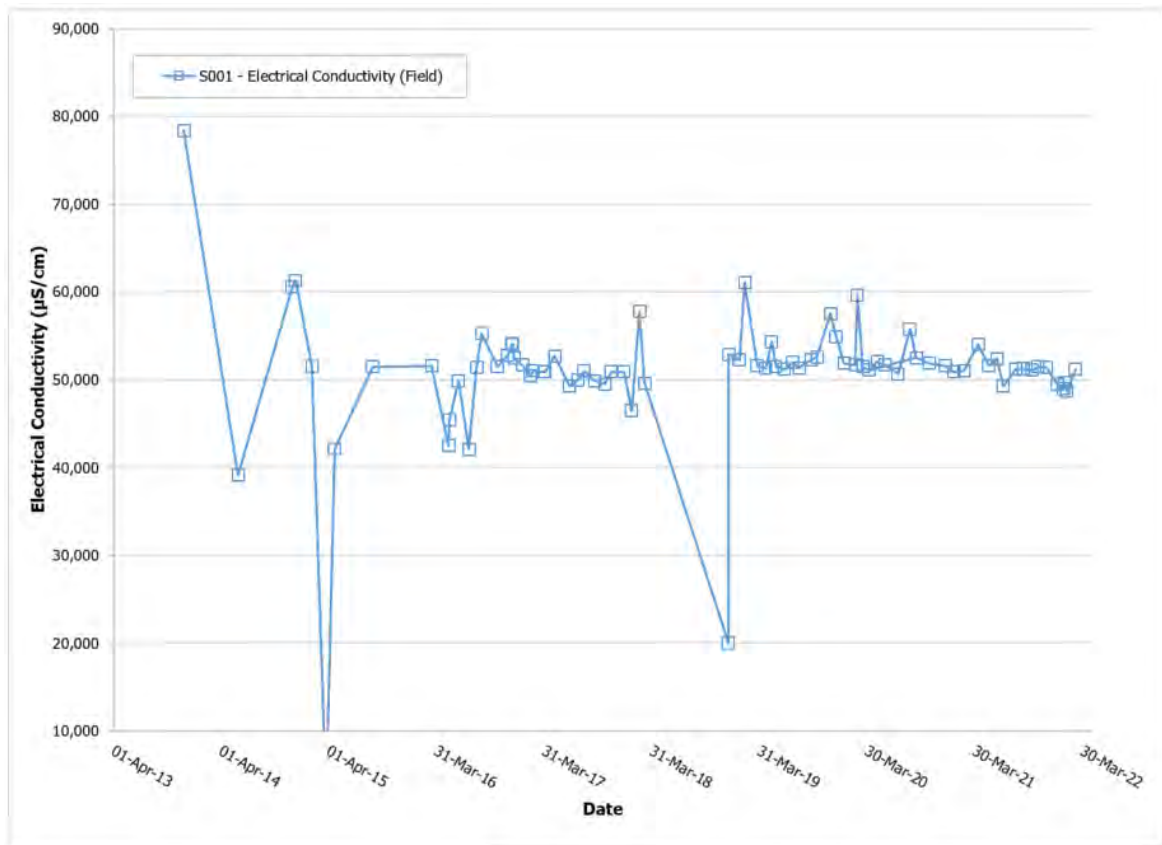
S001 (grab sample) – Vanadium Concentrations (filtered)



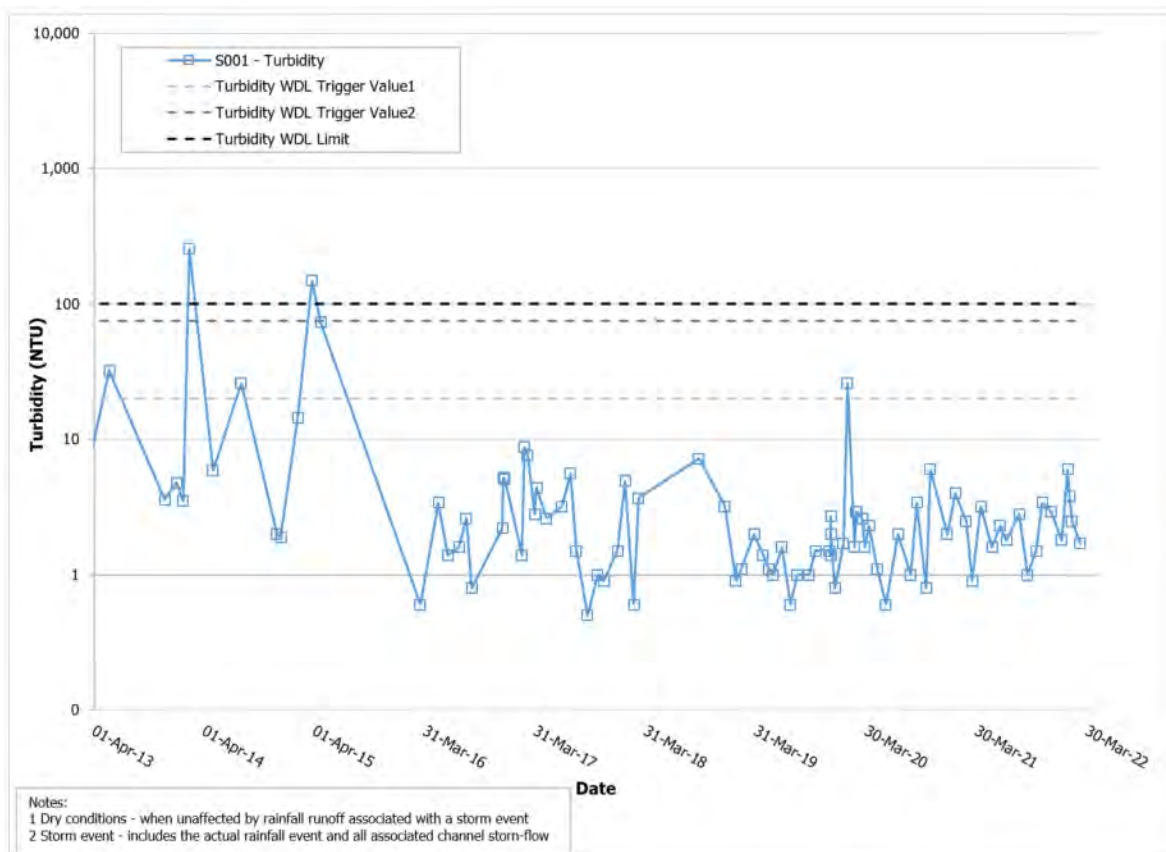
S001 (grab sample) – Arsenic (filtered)



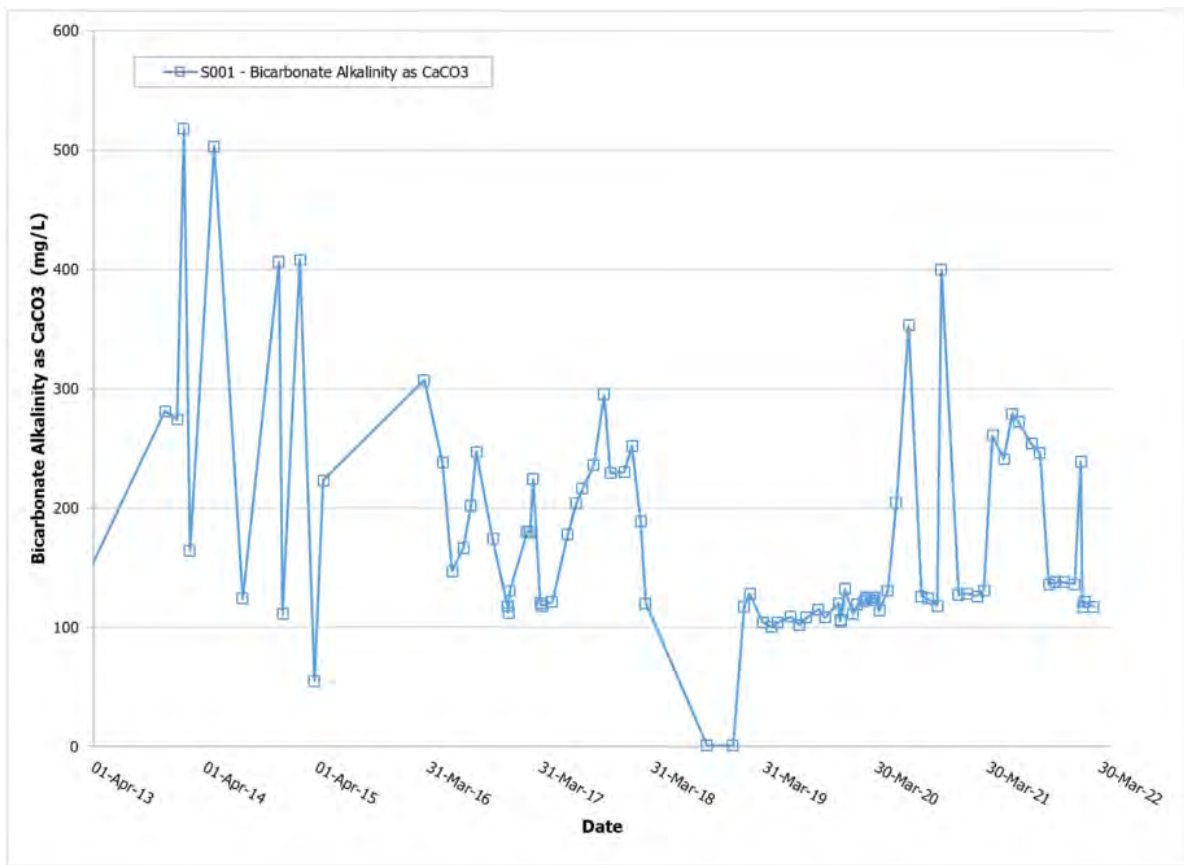
S001 (grab sample) – Electrical Conductivity



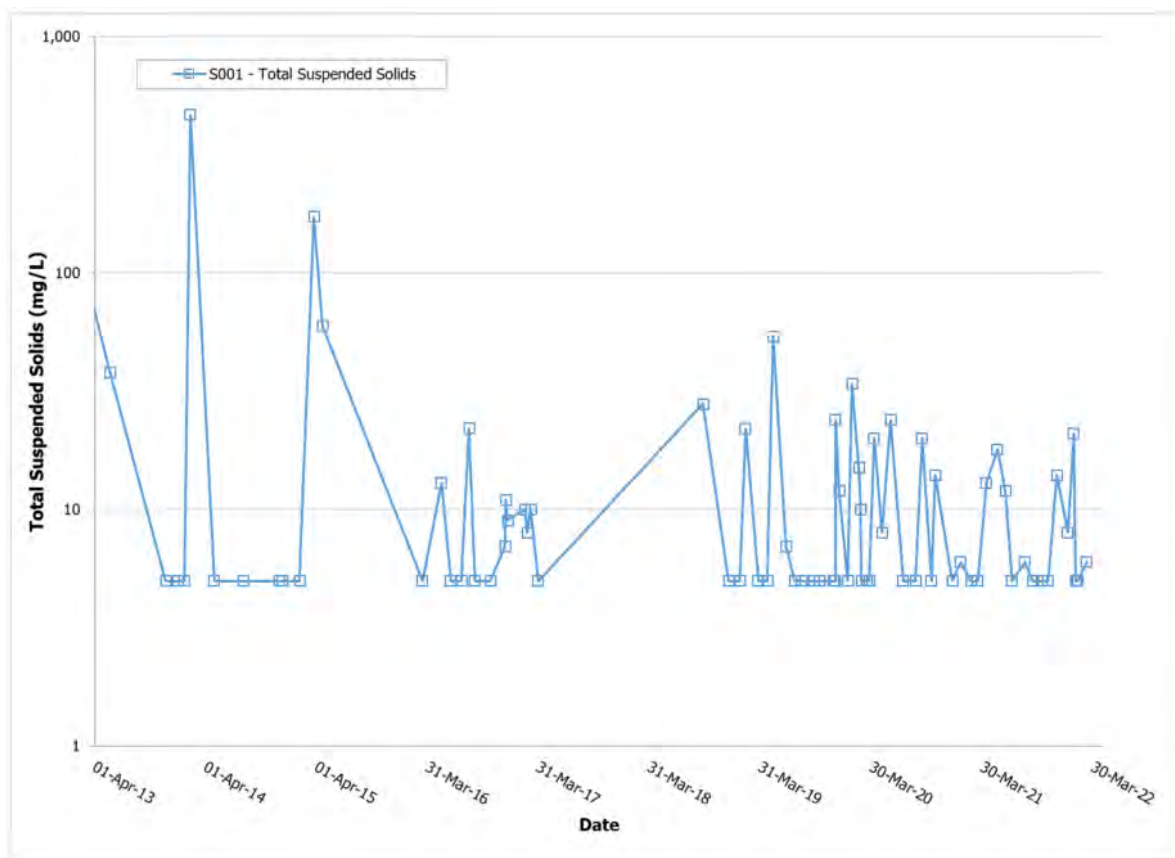
S001 (grab sample) – Turbidity



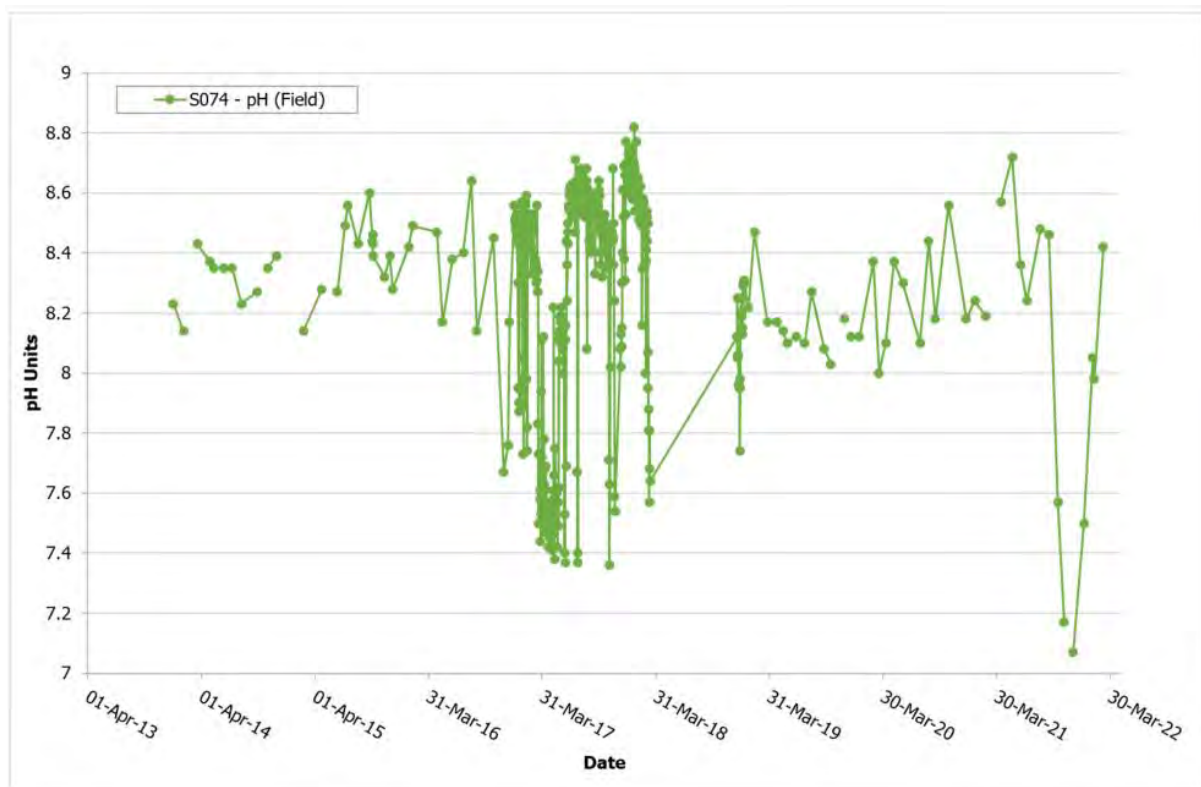
S001 (grab sample) – Alkalinity



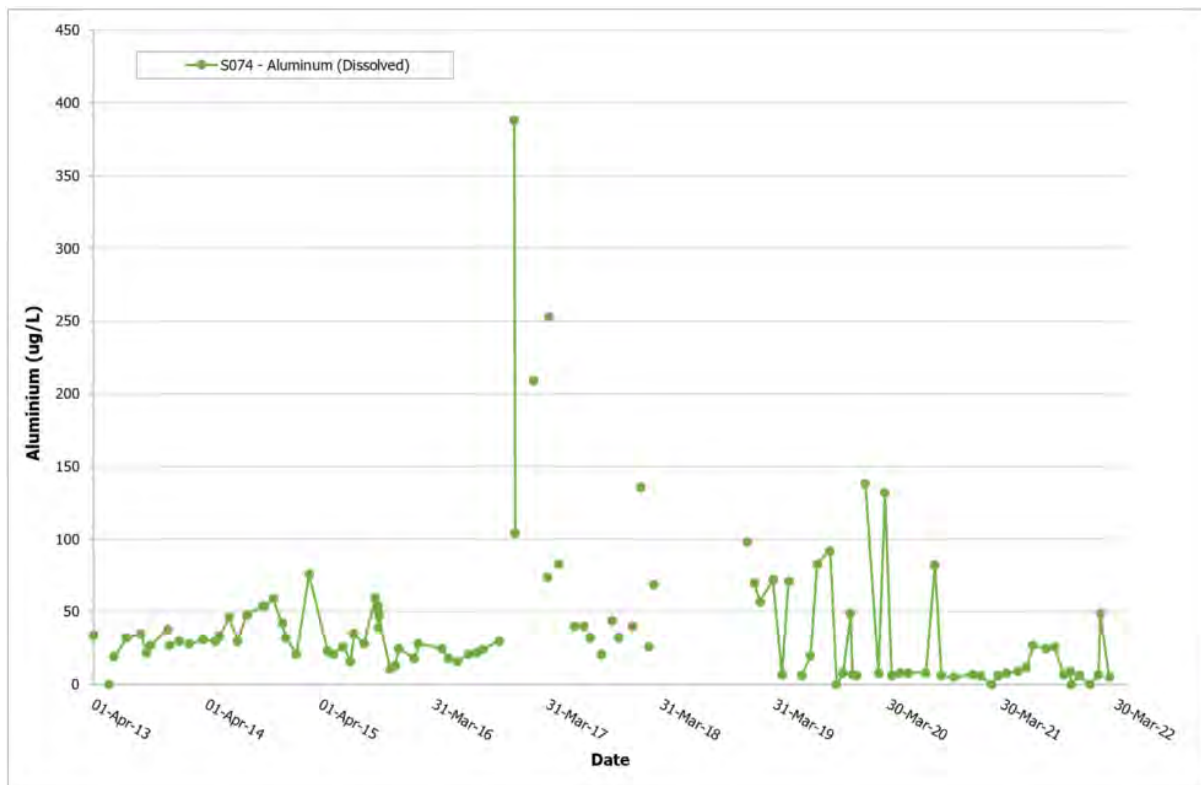
S001 (grab sample) – Total Suspended Solids (TSS)



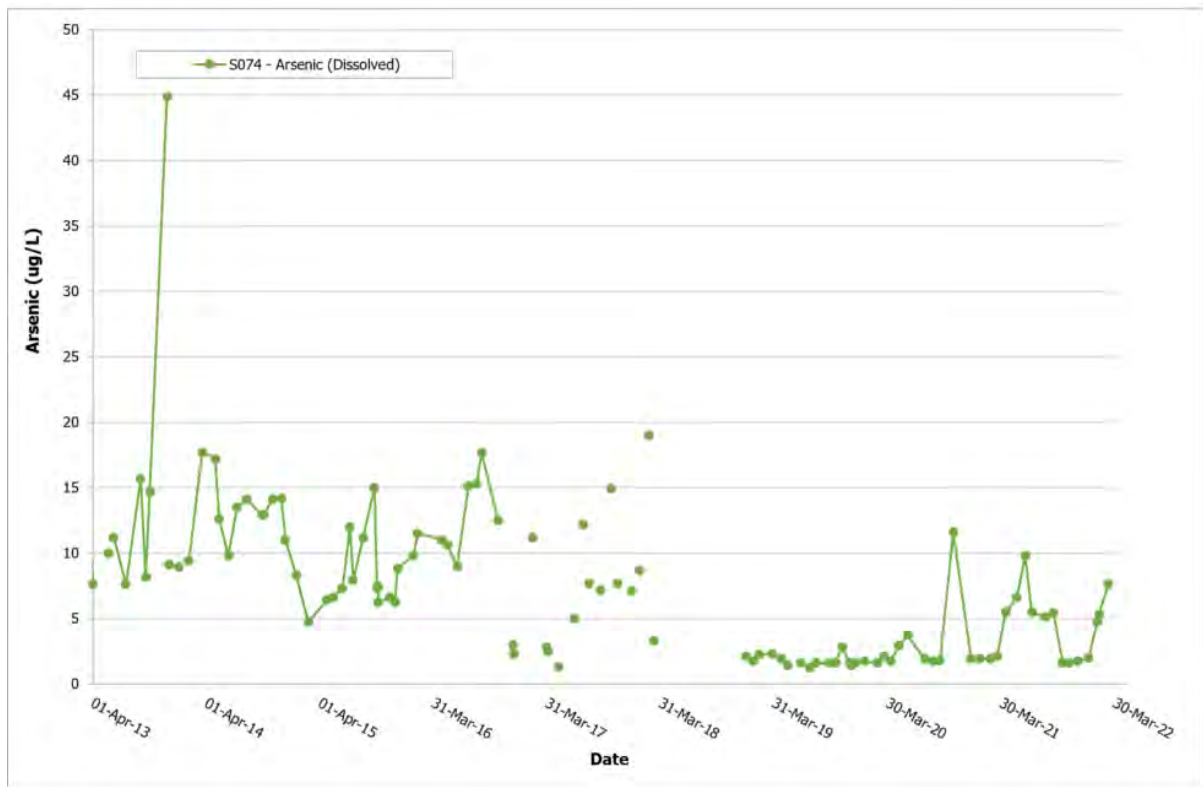
So74 (composite sample) – pH (Field)



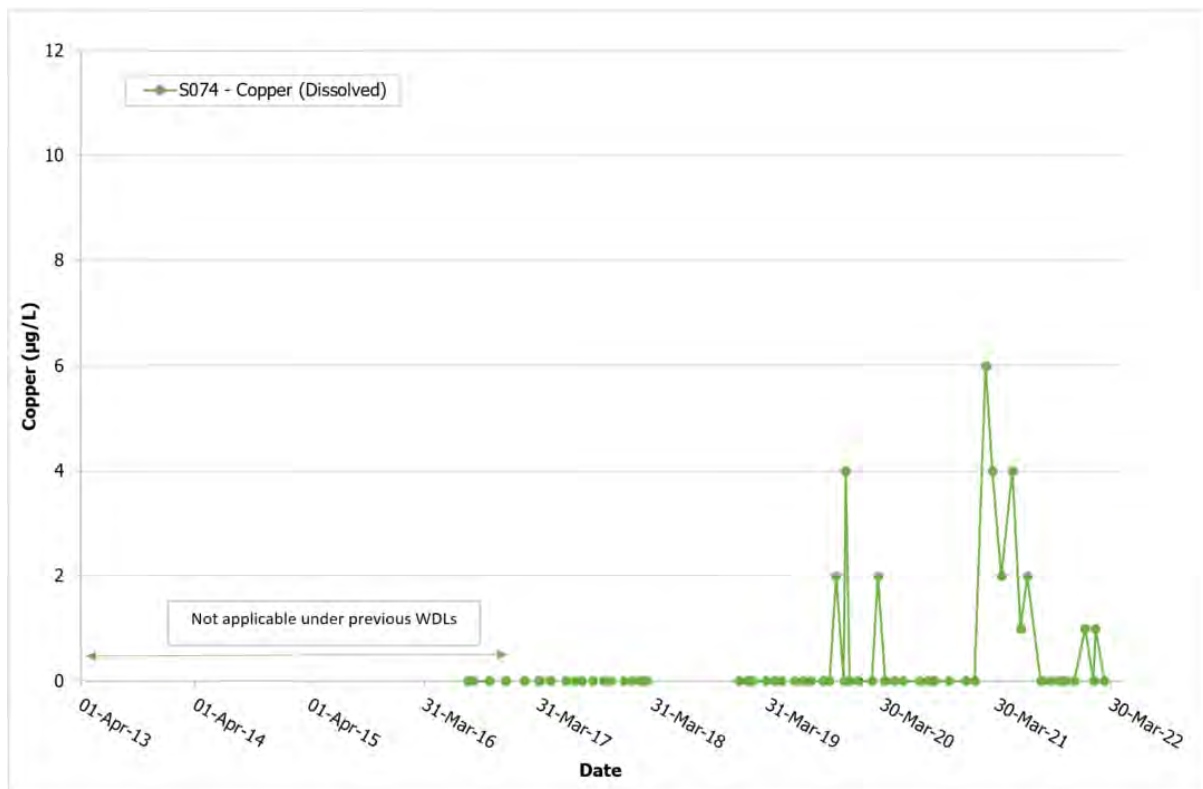
So74 (composite sample) – Aluminium (filtered)



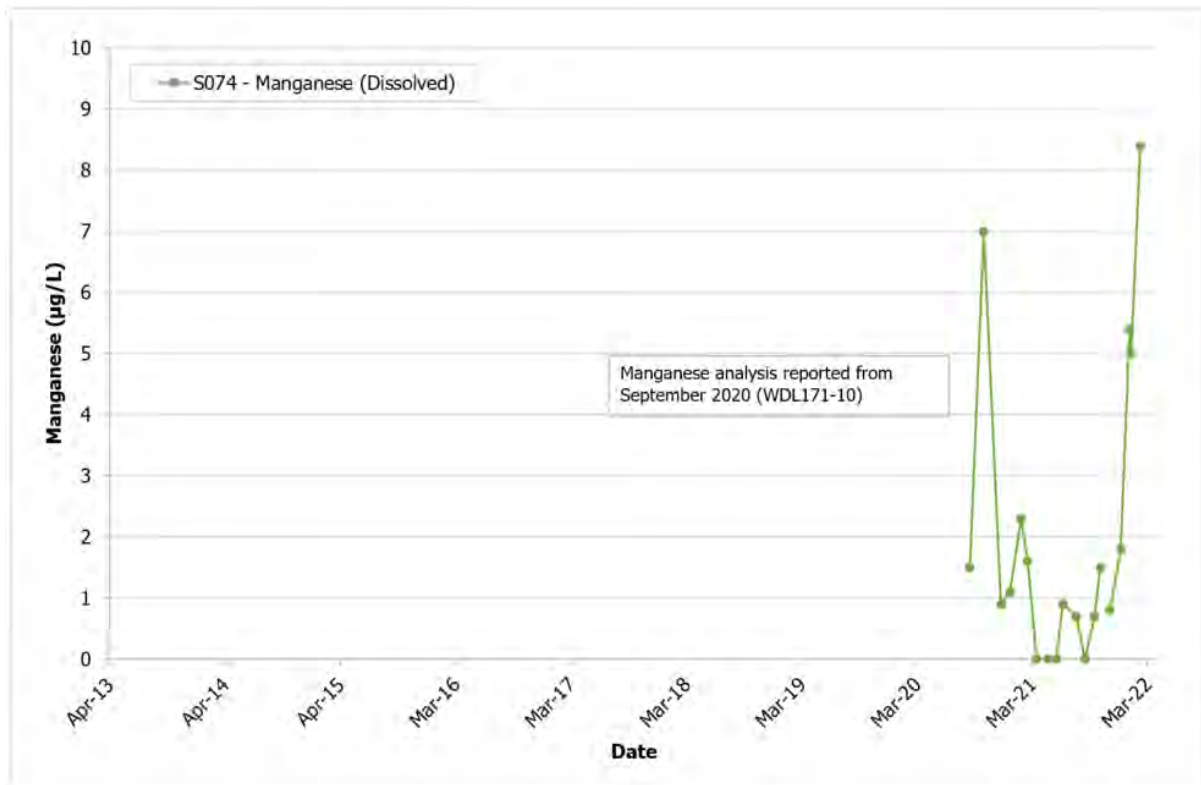
So74 (composite sample) – Arsenic (filtered)



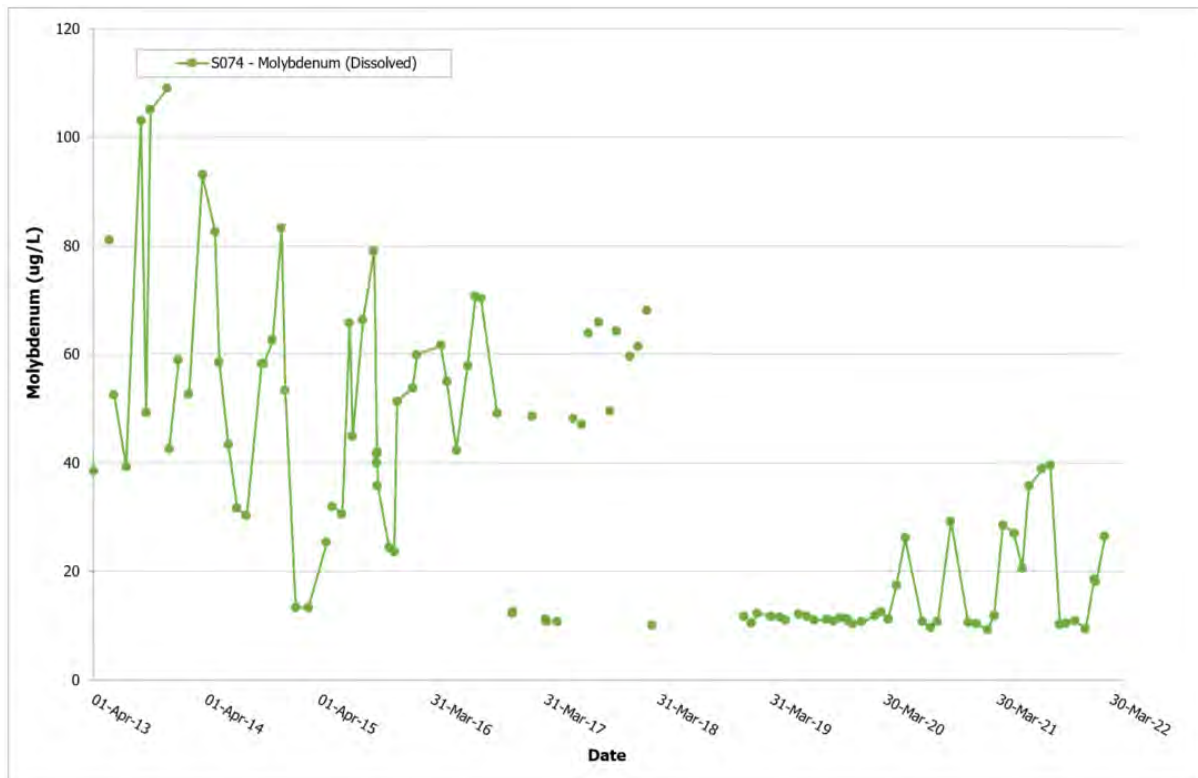
So74 (composite sample) – Copper (filtered)



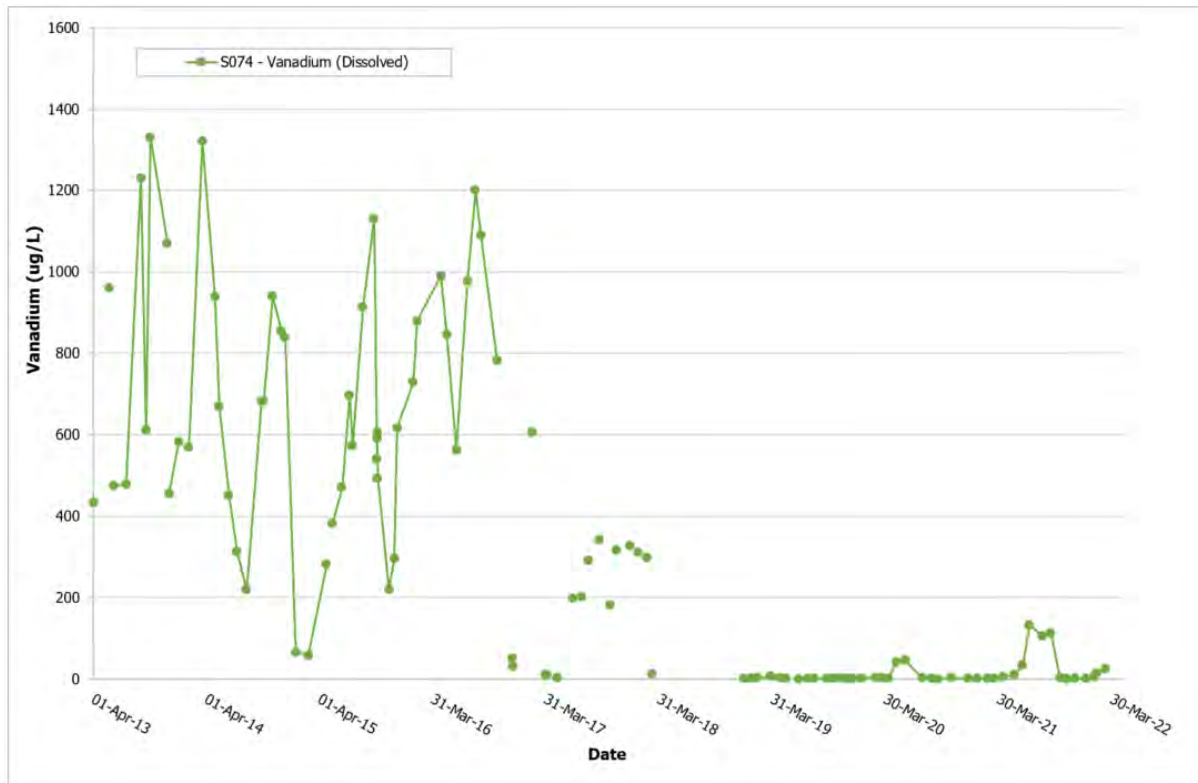
So74 (composite sample) – Manganese (filtered)



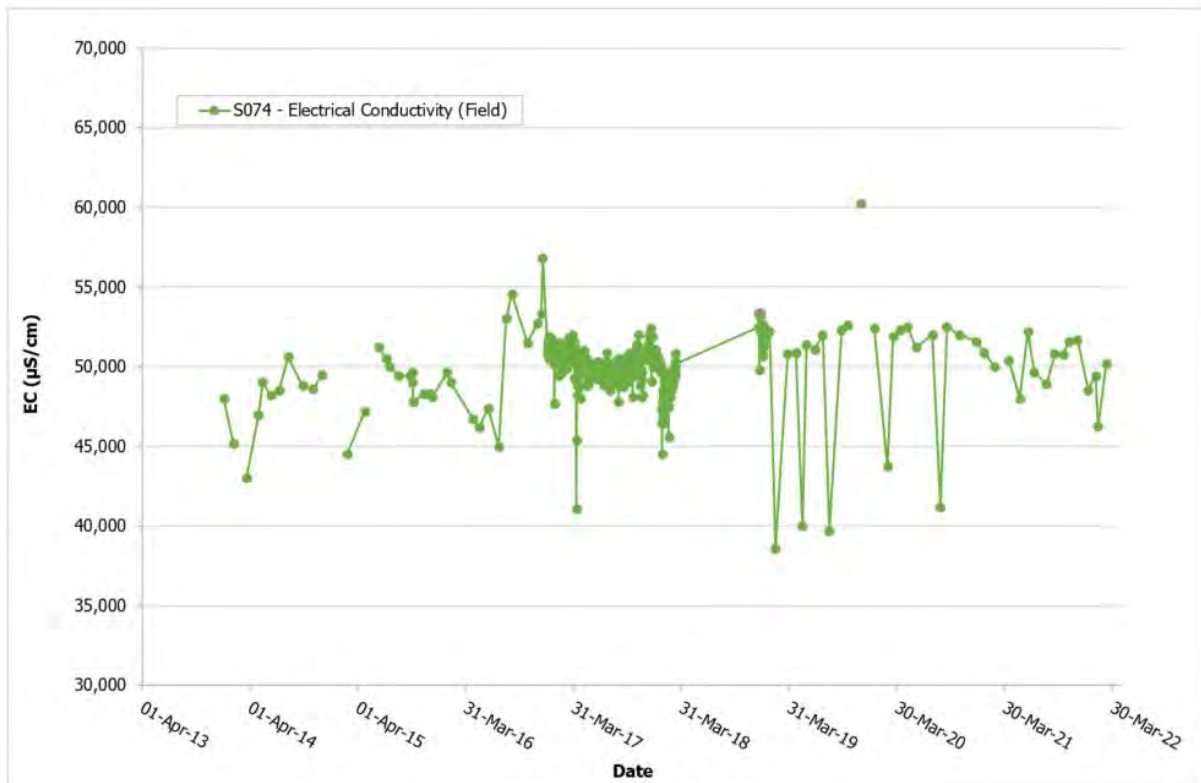
So74 (composite sample) – Molybdenum (filtered)



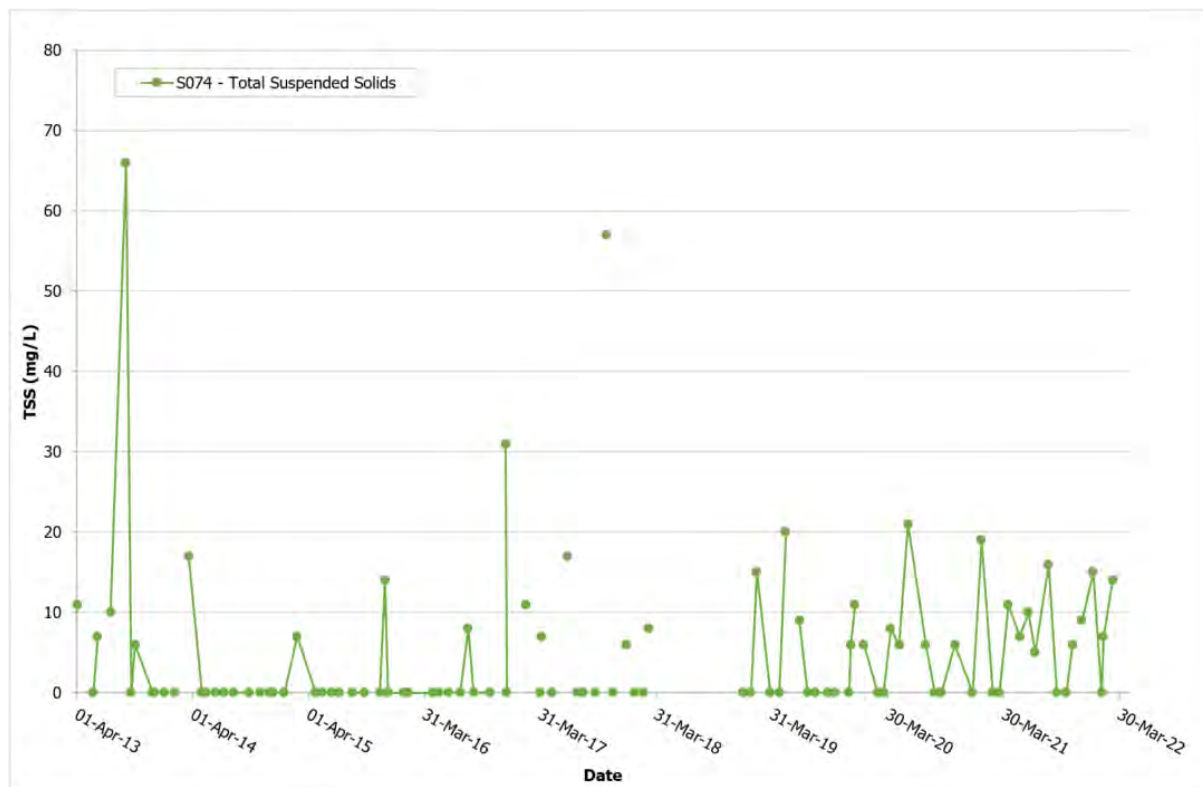
S074 (composite sample) – Vanadium (filtered)



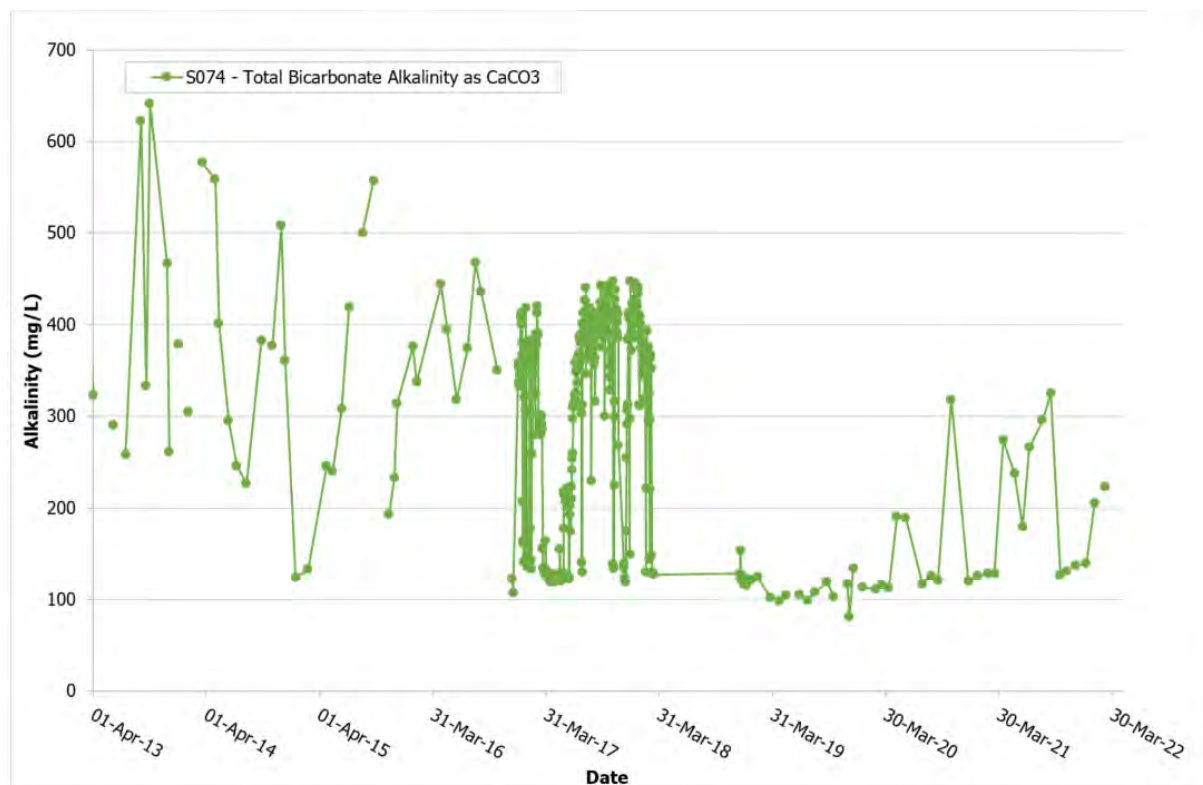
S074 (composite sample) – Electrical Conductivity



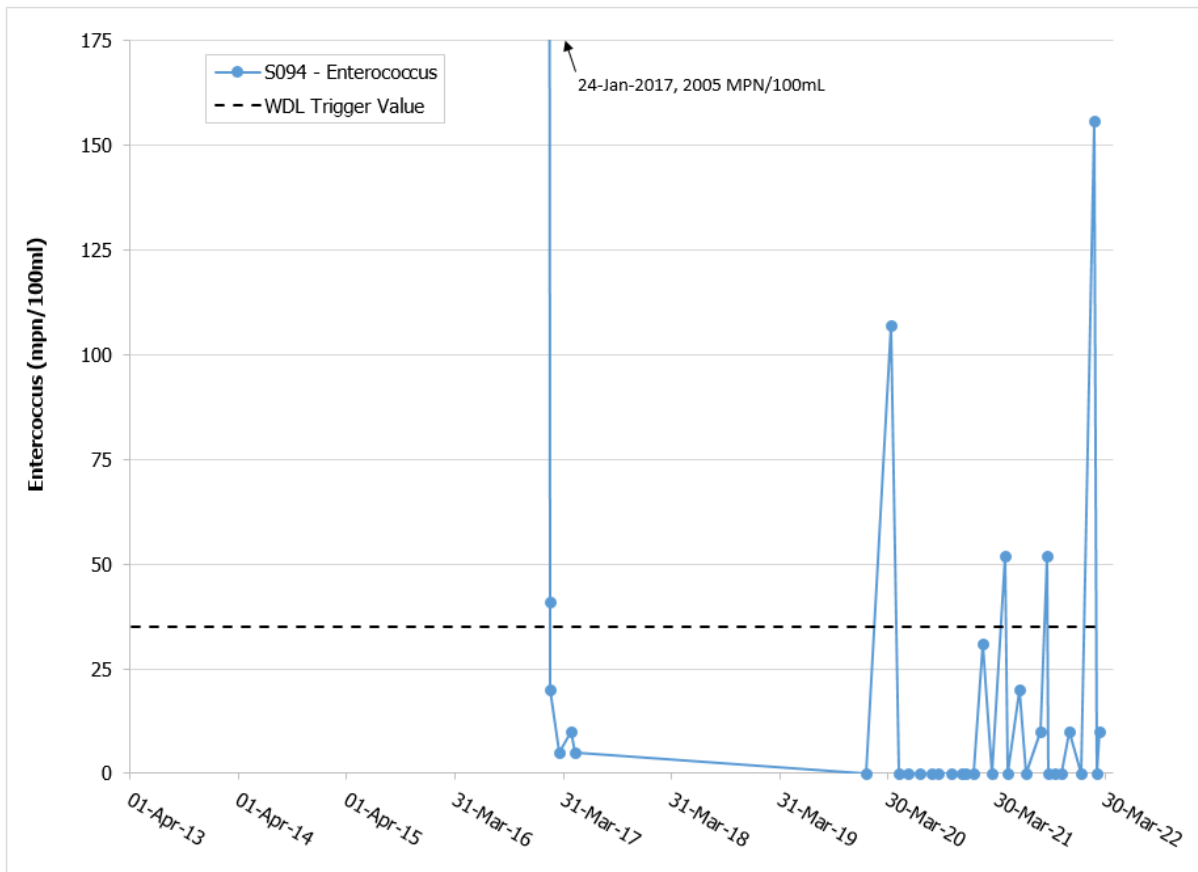
So74 (composite sample) – Total Suspended Solids



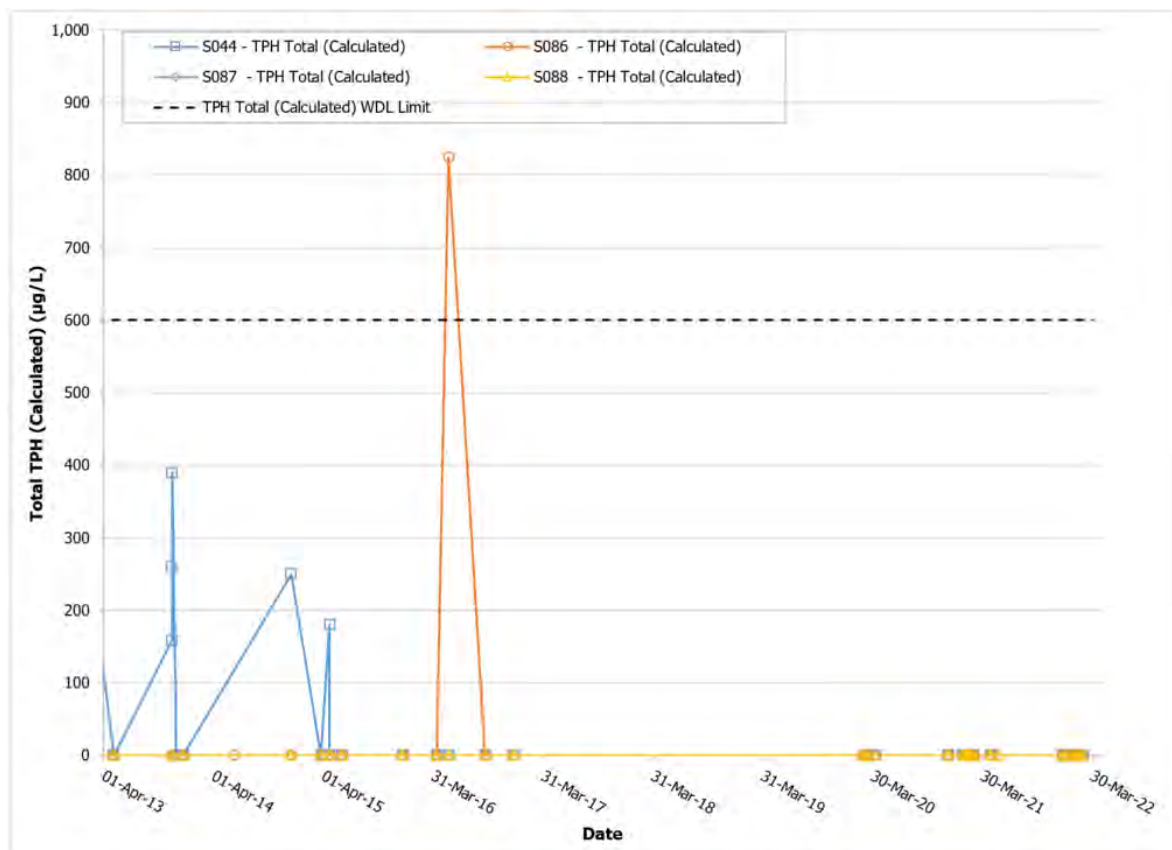
So74 (composite sample) – Alkalinity



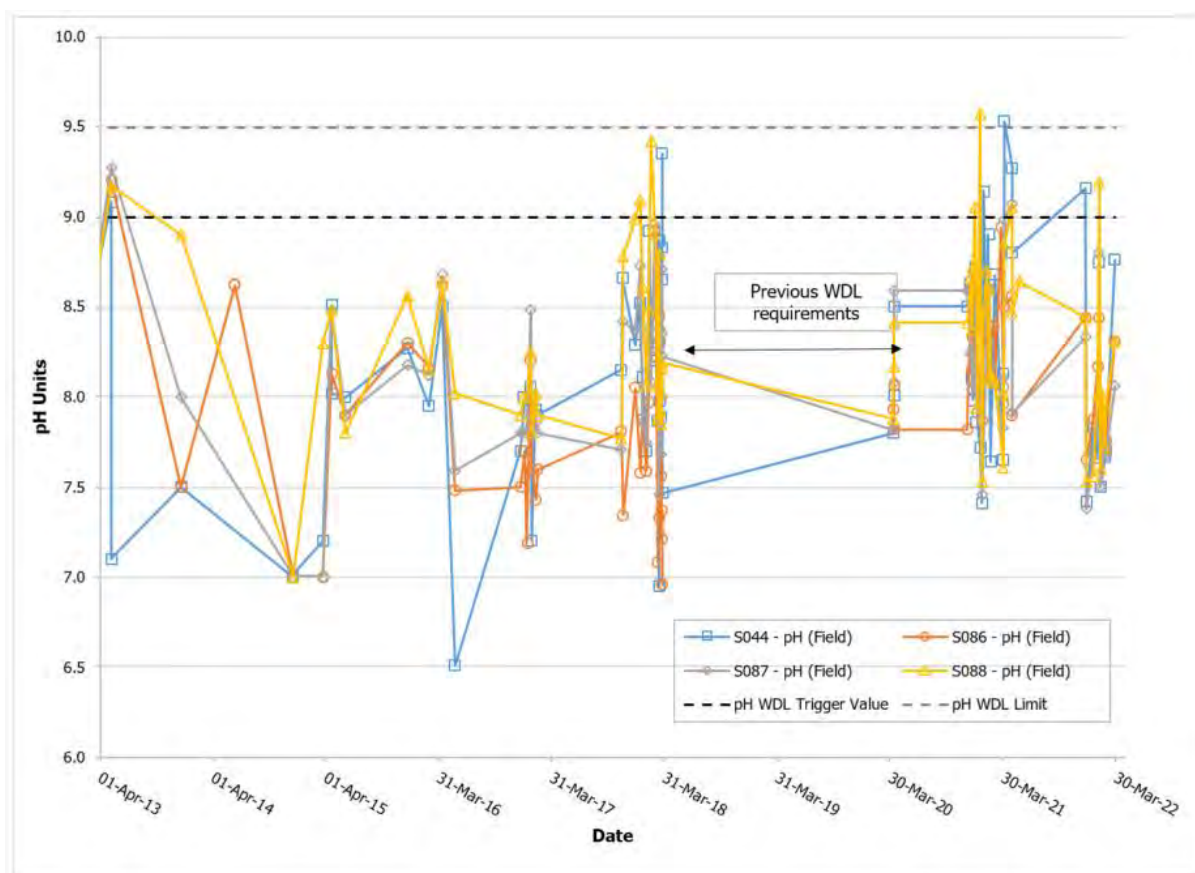
S094 Boat Ramp – Enterococcus



So44, So86, So87, So88 – Total petroleum hydrocarbons (calculated)



So44, So86, So87, So88 – pH (Field)



Appendix E – Marine Monitoring Report

**RIEL**

Research Institute for
the Environment and
Livelihoods

Rio Tinto Gove Operations Marine Health Monitoring Program

Routine Surveillance Monitoring Program: Receiving Environment Quality Survey Report no. 17: 1st April 2021 - 31st March 2022

Environmental Chemistry & Microbiology Unit

Charles Darwin University

Darwin, NT 0909 Australia

Dr Niels Crosley Munksgaard and Dylan Campbell

June 2022

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Executive Summary

This report is the seventeenth annual monitoring report under Rio Tinto Gove's (RTG's) Marine Health Monitoring Program (MHMP) for Southern Melville Bay. It presents new data for seawater, sediment and oysters for the period 1st April 2021 – 31st March 2022.

RTG's Waste Discharge Licence specifies trigger values for a range of water quality parameters in seawater at several monitoring sites near RTG's operations. The monitoring and analytical results for this reporting period are assessed against the Waste Discharge Licences (WDL 171-10 & WDL 171-11). The WDL specifies trigger values for pH, dissolved oxygen, turbidity, chlorophyll-a, total dissolved nitrogen and phosphorus, and several metals/metalloid concentrations in seawater at compliance sites SW9, SW10 and RR2 in Inner Gove Harbour. Additional seawater monitoring occurs at 22 information sites in Southern Melville Bay.

The MHMP also includes monitoring of metals/metalloids in marine sediment and oyster tissue across Southern Melville Bay. This data is assessed by evaluating temporal trends since the commencement of the MHMP in 2004 and is also compared to the ANZG (2018) sediment quality guidelines and the FSANZ food quality standards, where available.

Before its curtailment in late 2014, the Gove Refinery's principal impact on marine water and sediment quality in Gove Harbour resulted from occasional entrainment of process liquor into the refinery's cooling seawater circuit which was discharged to the harbour. The refinery discharge contained elevated aluminium (Al), vanadium (V), gallium (Ga), arsenic (As) and molybdenum (Mo) which were incorporated in hydrotalcite-rich precipitates resulting in the formation of an anoxic, microbially active, sulfide-rich sediment with elevated nutrient, metal and metalloid concentrations.

In late 2012, a Waste Water Neutralisation Plant (WWNP) was commissioned to treat liquor previously retained in the Residue Disposal Area (RDA). The WWNP effluent resulted in an increase in the discharge of mainly V (and lesser amounts of Al, Ga, As and Mo) to Inner Gove Harbour. As a result, dissolved V concentrations in seawater at monitoring sites located along the mixing zone boundary increased compared to previous years. Elevated concentrations of dissolved V, compared to background, were also detected at several sampling sites outside the mixing zone. Discharges from the WWNP ceased in March 2018 for major maintenance works. Intermittent WWNP operation resumed in April 2020.

Summary of main findings:

Seawater monitoring April 2021 – March 2022:

- Monthly data for compliance sites along the mixing zone boundary in Inner Gove Harbour showed that all parameters monitored were below the trigger values specified by Waste Discharge Licence.

- Filtered (dissolved) concentrations of V and associated elements (Al, Ga, As and Mo) have remained near background levels at the mixing zone boundary compliance sites in Inner Gove Harbour as well as most other information sites in Southern Melville Bay.
- Total element concentrations at the compliance sites (unfiltered sample) were added to the MHMP in October 2020. As would be expected, total concentrations of Al and Fe substantially exceeded dissolved concentrations. Total concentrations of Cr, Mn and Ga also exceeded dissolved concentrations of the same metals. In contrast, dissolved phases of V, Cu, Zn, As, Mo and U accounted for almost all the total concentrations of these elements.

Sediment monitoring 2004-2021:

- The most recent sediment survey was conducted in April 2021.
- Several elements are elevated in surface sediment in Inner Gove Harbour compared to background sites. However, since 2006-07 Mg, Zn and Ga concentrations have decreased in surface sediment in Inner Gove Harbour. Vanadium concentrations in sediment increased in 2014 and have been slightly higher in Inner Gove Harbour compared to other monitored areas throughout 2014-21.
- Drimmie Arm sediment had slightly elevated concentrations of As compared to background sediments during 2004-2021. No temporal trends were observed.
- Sediment from Crawford's Creek had slightly elevated TKN and As concentrations compared to background sites. These concentrations can be ascribed to the organic-rich and mud-dominated mangrove environment and have been observed every year of the MHMP.
- The concentrations of all parameters monitored in sediment during 2004-2021 were below the ANZG (2018) SQGVs where available.

Oyster monitoring 2004-2021:

- During 2004-21 oysters from Harbour Islets, Granite Islands and West Woody Islands relatively close to the RTG Refinery continued to show higher concentrations of Al and Ga compared to oysters from the more distant background site at Bonner Rocks.
- Oysters from Harbour Islets continued to show elevated Zn and reduced Cd concentrations relative to oysters from other sampling sites. The reduced Cd concentrations are likely to be related to the increased Zn concentration in Gove Harbour due to a mechanism of competitive exclusion of Cd by Zn.
- Cadmium concentrations in oysters from Bonner Rocks, West Woody Island and occasionally Granite Islands have been above the FSANZ food standard (2 mg/kg) during most of the 2004-21 monitoring period.

However, this phenomenon appears to have natural causes and have been reported previously from locations in Northern Australia (Noller, 1991; McConchie & Saenger, 1993). Cadmium is not a chemical of concern in Gove Refinery discharges.

- Total As concentrations in oysters from all four sampling sites increased substantially in April and October 2017 compared to the previous concentrations. However, since 2017 As concentrations at all four sampling sites have been lower, but variable. It is likely that As concentrations in oysters is subject to a naturally occurring environmental cycle.
- Total As in oysters from all sampling sites exceeded the FSANZ maximum permitted concentrations for inorganic As. However, As speciation analyses carried out on samples from 2009 and 2017 showed that inorganic As concentrations were below the FSANZ food standard.
- Lead concentrations in oysters from all sampling sites were below the FSANZ maximum permitted concentrations.

Recommendations:

- It is recommended that monthly sampling and analysis of seawater and annual sampling and analysis of sediment continues as part of the MHMP.
- The oyster monitoring component of the MHMP should also continue unchanged with half yearly sampling. It is an important biological component of the MHMP and remains an important tool for monitoring of both environmental health and marine food safety.
- Careful monitoring of data quality for water samples should continue to ensure that 'clean' sampling techniques appropriate for trace level metal/metalloid analysis is followed and that recent improvements in MHMP data quality is maintained. Adherence to RTG's field sampling procedures is essential.

1. Introduction

Monitoring of Melville Bay marine receiving environment commenced in 2004. The program was designed following the Marine Health Monitoring Program (MHMP) baseline studies conducted in 2004 (dry season) and 2005 (wet season) and formed the basis for establishing the sampling types (seawater, marine sediment and oyster). The program includes consideration of all releases to the marine environment as a result of RTA Gove activities, including surface water discharges, groundwater seepage, atmospheric deposition, and effect of shipping.

MHMP is a planning strategy for developing appropriate discharge water quality guidelines and receiving environment indicators for assessing ecosystem health. It is also a strategy for reviewing routine surveillance monitoring programs to ensure the guidelines and indicators remain appropriate.

MHMP monitoring are conducted in area potentially impacted by RTA Gove in Inner Gove Harbour, Crawford's Creek and Drimmie Arm. Additional monitoring are conducted in selected location of Arafura Sea. Monitoring sites are grouped as follow:

- Compliance sites: monitoring data for these sites are assessed according to applicable WDL 171 trigger values and limits requirements.
- Information sites: this includes monitoring sites required under WDL 171 and other sites required for the overall Marine Health Monitoring Program; and
- Background sites: these sites were identified in the baseline studies (Parry and Munksgaard, 2005; Munksgaard and Parry, 2005) as being near-pristine.

The MHMP consists of:

- annual sampling for chemical analysis of sediment
- half-yearly sampling for chemical analysis of oysters
- monthly recording of physico-chemical parameters and sampling for chemical analysis of seawater samples.

The program assists in meeting the following MHMP objectives:

1. Assess and monitor the level of impact RTG operations are having on the marine environment.
2. Establish internal RTG water quality discharge guidelines for Gove operations.

The MHMP component as detailed in the Water Monitoring Plan (October 2019) was implemented as required in Condition 28 of the Gove Waste Discharge Licence (WDL 171-11). This report references trigger values and concentration limits contained in WDL171-11 for the entire reporting period (as per WDL171-11, condition 46). However, it is noted that the preceding license WDL171-10 was in operation until 15 February 2022. A standalone

monitoring plan for RTG Marine Health Monitoring Program (APM-EHS-039) has been developed, this will supersede marine monitoring aspects of the Water Monitoring Plan of October 2019 for future monitoring and reporting.

This report presents new data for the period 1st April 2021 – 31st March 2022 and is the seventeenth annual monitoring report. The monitoring surveys build on the 2004-2005 baseline studies of southern Melville Bay (Parry and Munksgaard, April 2005; Munksgaard and Parry, Sept 2005). These studies formed the basis for establishing the sample types, sites and analytes to be included in the half-yearly monitoring surveys. RTG commenced monthly monitoring surveys of the receiving waters of southern Melville Bay in May 2005 using the same sites as used in the half-yearly and yearly surveys.

A mixing zone for the refinery main discharge was established in accordance with WDL requirements and monitoring at test sites along the edge of the mixing zone boundary commenced in August 2007. The mixing zone was subsequently reduced with new mixing zone boundary monitoring sites, albeit sites that already were included in the MHMP.

2. Sampling sites and Methodology

The ***Inner Gove Harbour***, ***Crawford's Creek*** and ***Drimmie Arm*** are the main areas of potential impact from the RTG operation, mainly via the ***Refinery Seawater Channel Outfall*** and ***Residue Disposal Area (RDA)*** discharge and seepage. Table 1 shows the monthly, half-yearly and yearly sampling and analytical programs as of March 2021. Sampling sites are shown in Figures 1 and 2, with the location coordinates in Appendix 1.

Table 1. Rio Tinto Gove's Marine Health Monitoring Program (MHMP)

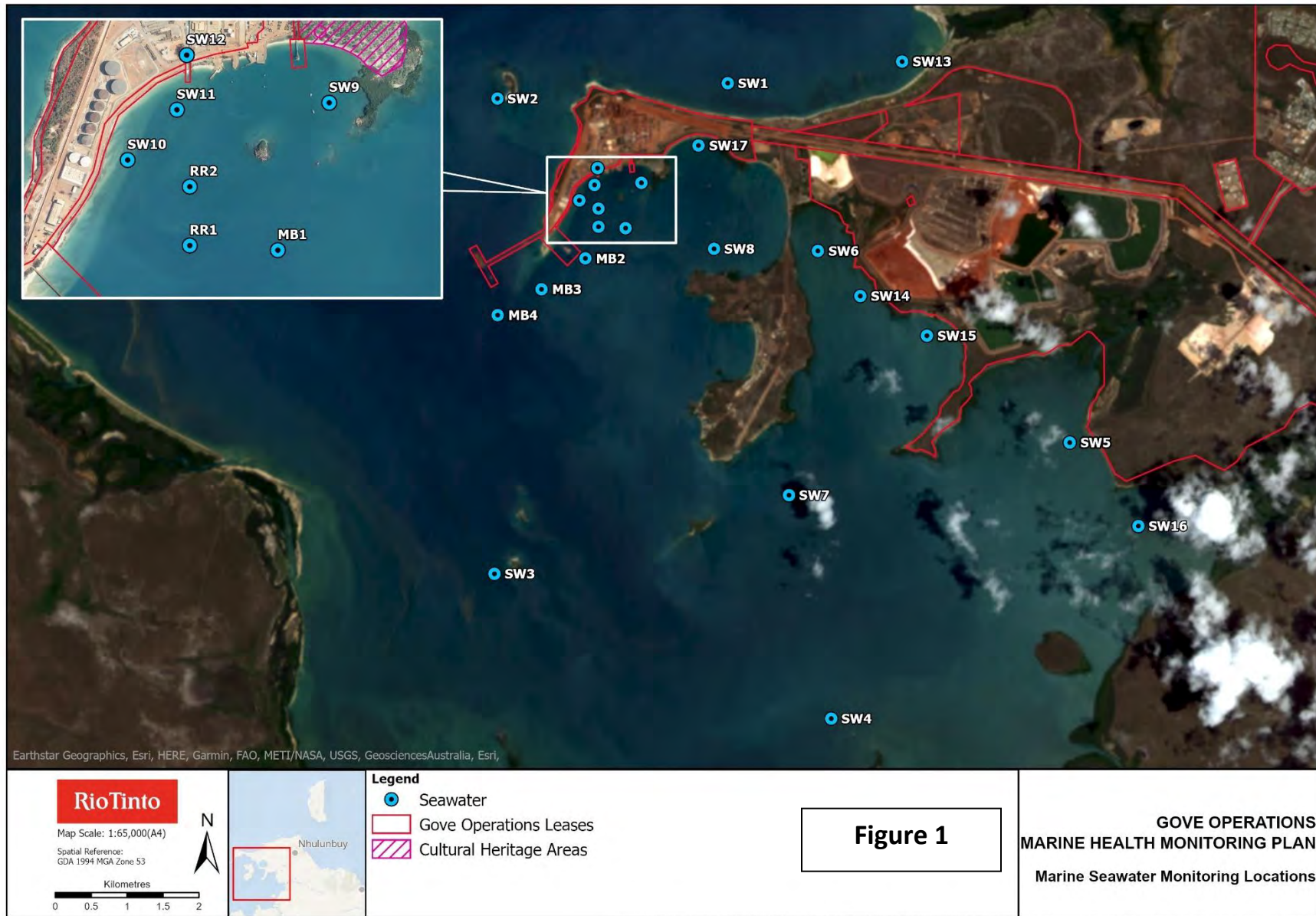
Parameter	Method Reference Numbers*	Seawater monthly	Sediment yearly, oysters half-yearly
Seawater <i>in situ</i>			
pH, Dissolved Oxygen, Turbidity, Conductivity, Temperature	GO - Water Monitoring Plan, October 2019	22 sites, 0.5m depth	
Seawater – unfiltered sample			
Acid Neutralising Capacity*	GO - ENV-M-05	22 sites, 0.5m depth	
Total Suspended Solids	CDU - ALC02	22 sites, 0.5m depth	
Chlorophyll a	CDU - ALC09	22 sites, 0.5m depth	
Seawater – filtered (<0.45µm) sample			
Al, V, Cr, Mn, Fe, Cu, Zn, As, Ga, Mo, U	CDU - ALC03A	22 sites, 0.5m depth	
Total Dissolved P and N	FSSQH - 13802, 13800	22 sites, 0.5m depth	
Seawater – unfiltered (total) samples			
Al, V, Cr, Mn, Fe, Cu, Zn, As, Ga, Mo, U	CDU - ALC03A	13 sites, 0.5m depth	
Sediments – sieved to <0.063mm - yearly sampling			
Mg, Al, V, Fe, Cu, Zn, Ga, As, Mo, Cd, Pb, U	CDU - ALC05		32 sites
Sediments – sieved to <2mm – yearly sampling			
Total Kjeldahl N	FSSQH - 13804		32 sites
Oysters – soft tissue – half-yearly sampling			
Al, V, Fe, Cu, Zn, Ga, As, Mo, Cd, Pb	CDU - ALC07		4 sites

***Note:** Analysing laboratory and method reference: GO = Gove Operations Environment Section; CDU = Charles Darwin University; FSSQH = Forensic and Scientific Services Queensland Health.

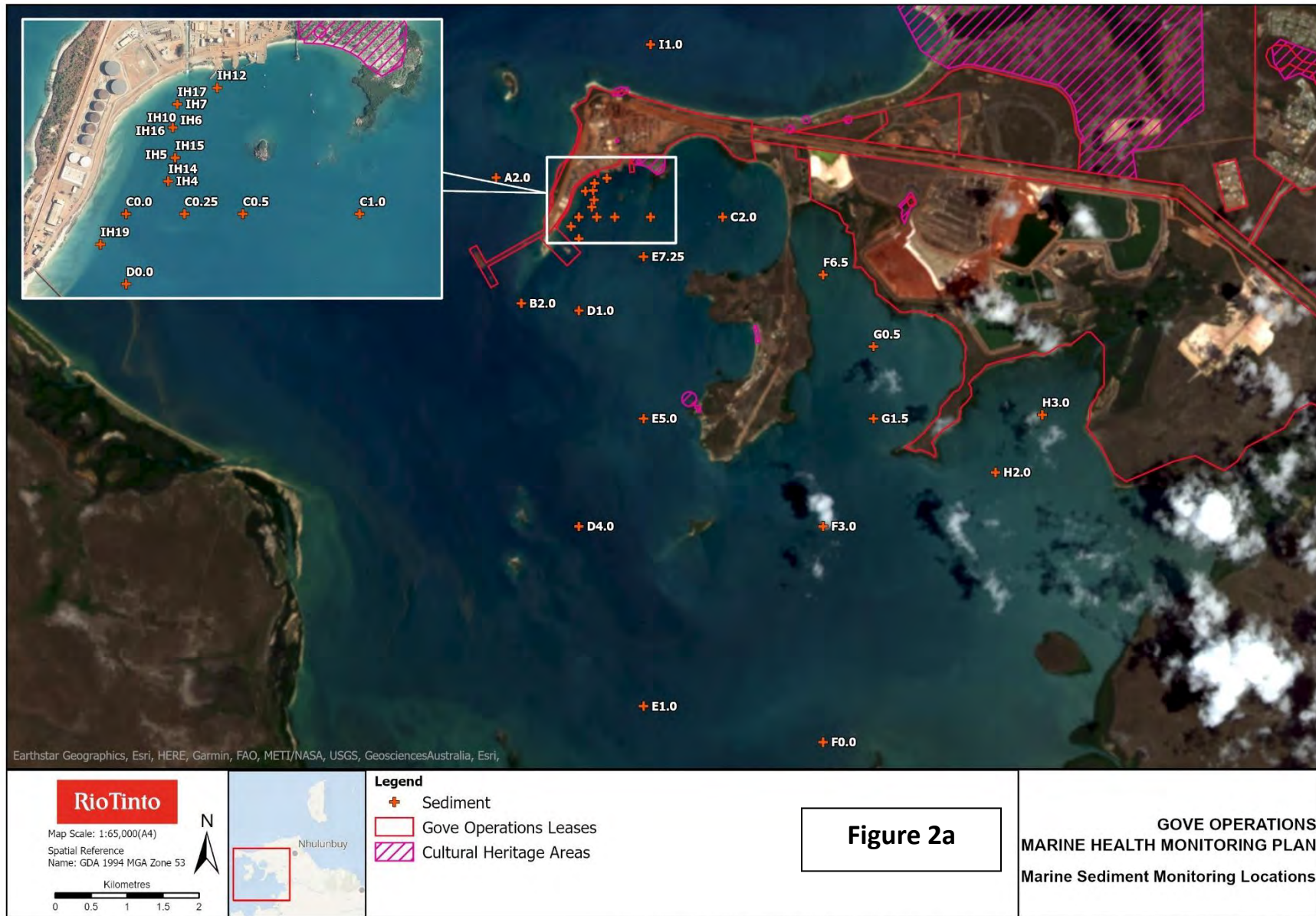
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Figure 1. Southern Melville Bay MHMP seawater sampling sites.

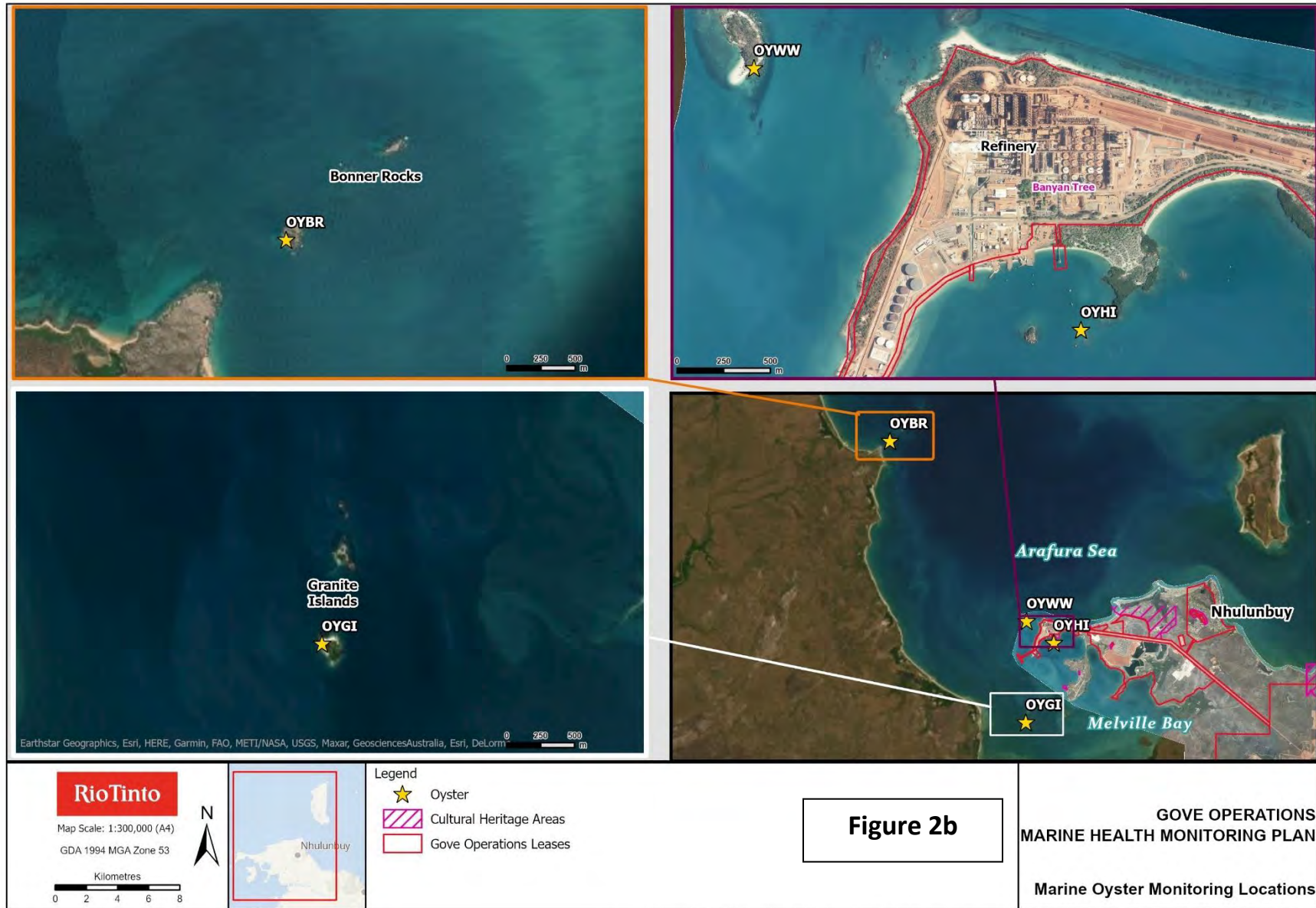
Figure 2 a, b. Southern Melville Bay MHMP sediment and oyster sampling sites.



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Seawater sampling sites:

- Background sites: SW1, SW3, SW4, SW7. These sites were identified in the baseline studies (Parry and Munksgaard, 2005; Munksgaard and Parry, 2005) as being near-pristine.
- Compliance sites: SW9, SW10, RR2 at the mixing zone boundary. Data for these sites are assessed according to WDL 171-11 requirements (or WDL 171-10 where relevant).
- Information sites: These are monitoring sites required under WDL 171 (MB1, MB2, MB3, MB4, SW2, SW8, SW11) and/or part of the overall Marine Health Monitoring Program SW5, SW6, SW12 (seawater channel discharge), SW13, SW14, SW15, SW16 and SW17.

Sediment sampling sites:

- Background sites: A2.0, B2.0, C2.0, D1.0, D4.0, E1.0, E5.0, E7.25, F0.0, F3.0, G1.5, H2.0, I1.0. These sites were identified in the baseline studies (Parry and Munksgaard, 2005; Munksgaard and Parry, 2005) as having no anthropogenic impact.
- Information sites Potential impact zones in Inner Harbour, Drimmie Arm and Crawford's Creek: C0.0, C0.25, C0.50, C1.0, D0.0, F6.5, G0.5, H3.0, IH4, IH5, IH6, IH7, IH10, IH12, IH14, IH15, IH16, IH17, IH19.

Oyster sampling sites:

- Background site: Bonner Rocks.
- Information sites: Harbour Islets, West Woody Island, Granite Islands.

The routine marine field sampling methodology is described in Gove Operations Water Monitoring Plan, October 2019. Description of sampling and analytical methodology can be found in the Baseline Study reports (Parry and Munksgaard, April 2005; Munksgaard and Parry, Sept 2005) and updates can be requested from CDU. A brief outline of the current MHMP sampling and analytical methodology is given below:

In situ measurements: pH, dissolved oxygen (DO), turbidity, conductivity and temperature profiles are collected with a YSI water quality sonde.

Seawater sampling and analysis: A peristaltic pump is used to collect unfiltered and filtered samples (0.45µm in-line filter capsule). Samples are analysed for metal and arsenic concentrations by Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Total dissolved nitrogen and phosphorus concentrations are determined by Flow Injection Analysis and

Chlorophyll concentrations by fluorometric analysis. Total suspended solids are filtered (0.45µm) and determined gravimetrically.

Sediment sampling and analysis: Seafloor sediments are sampled from the top 5-10cm of sediment using a Van-Veen stainless steel grab sampler. Samples for elemental analysis are wet-sieved to <63µm and digested in nitric + perchloric acid in an open tube block digester at 180°C for 6-8 hours. Elemental concentrations are determined by ICP-MS. Samples for Total Kjeldahl Nitrogen (TKN) analysis are wet-sieved to <2mm and TKN is determined by Flow Injection Analysis after digestion in sulfuric acid in the presence of copper sulfate.

Oyster sampling: Oysters are collected whole using a hammer and chisel. The soft tissue is extracted in the laboratory under clean room conditions and digested in nitric acid and hydrogen peroxide at approximately 130°C for 60 min. Elemental concentrations are determined by ICP-MS.

Note 1: Three main species of oysters commonly found in Southern Melville Bay are *Saccostrea cucullata*, *Saccostrea mordax* and *Saccostrea mytiloides*. The subtle differences between these species were not initially identified and the comparison of data from different surveys may be affected by different species distributions.

3. Quality Control

Field sampling is conducted according to Gove Operations Water Monitoring Plan, October 2019. Quality control includes replicate sampling. Chain of custody documentation accompanies all samples dispatched to the analysing laboratory.

The YSI EXO water quality probe is calibrated immediately prior to taking it into the field and the calibration is checked on return from the field. Calibration records are maintained in the RTG environmental laboratory.

Laboratory quality control procedures included procedural blanks, replicate analyses, spike recovery analysis and analysis of certified reference materials.

4. Results and Discussion

4.1 Seawater

4.1.1 Data presentation

In-situ instrumental and laboratory seawater data for April 2021 – March 2022 are presented in Appendix 2. There are separate tables for each water quality parameter. Each table includes statistics for the total dataset (2004 to 2022) and include minimum, maximum, median values plus 20th, 80th and 90th percentile values. The median value of each parameter for the last 12-month period (April 2021 to March 2022) is also provided. The tables also include the 80th percentile value of background sites (SW1, SW3, SW4 and SW7) and the Trigger Investigation Limits (TILs) previously used in the assessment of MHMP data (prior to April 2016) and continues to be included for continuity of data.

Water quality data is presented and discussed in two sections below: Section 4.2 contains data for the mixing zone boundary sites (SW9, SW10 and RR2) in Inner Gove Harbour and Section 4.3 contains monitoring data for sites at Crawford's Creek (SW5) and Drimmie Arm (SW6).

Note: Some Chlorophyll-a, TDN, TDP, Al, Cu, Zn and Ga data were below the limit of reporting (LOR). To enable continuity of statistical data, concentration values below the LOR have been replaced by half the LOR. A small number of erroneous data for EC, TSS, TDN, TDP and dissolved Al in seawater samples in past years have been removed in order that they do not influence the statistical summaries. The erroneous data were identified in previous annual reports based on probable sampling or laboratory errors. The removed data are identified in Appendix 2.

4.1.2 Waste Discharge Licence Trigger Values

The monitored parameters under the MHMP are temperature (T), conductivity (EC), pH, dissolved oxygen (DO), turbidity, total suspended solids (TSS), acid neutralising capacity (ANC), chlorophyll-a, total dissolved nitrogen (TDN), total dissolved phosphorus (TDP), filtered (dissolved) aluminium (Al), filtered (dissolved) vanadium (V), iron (Fe), copper (Cu), zinc (Zn), gallium (Ga), arsenic (As), molybdenum (Mo) and uranium (U). The dissolved fraction is the filtrate from 0.45 µm membrane filtration. In addition, the same metals and As are monitored in unfiltered (total) samples at background, compliance and selected information sites. Some of the parameters monitored provide contextual information although no trigger values are specified in WDL 171-11.

Waste Discharge Licence WDL171-11 specifies 'Trigger Values' for pH, dissolved oxygen, turbidity, TDN, TDP and dissolved Al, V, Ga, As, and Mo at compliance sites SW9, SW10 and RR2 along the mixing zone boundary in Gove Inner Harbour (Table 2). The trigger values are based on a reassessment of the local ecotoxicity studies or species protection trigger value concentrations published by ANZG (2018), van Dam et al. (2016, 2018) and hydrodynamic modelling of discharge dilution and dispersion (Australian Institute of Marine Sciences, 2020).

Table 2. WDL 171-11 receiving waters Trigger Values

	Trigger Values for sites: SW9, SW10, RR2
pH	< 7.7 or > 8.4
Dissolved Oxygen (mg/L)	<5.8
Turbidity (NTU)	20.0
Total Dissolved Nitrogen (µg/L)	170
Total Dissolved Phosphorus (µg/L)	14
Dissolved Al (µg/L)	56
Dissolved As (µg/L)	20
Dissolved Ga (µg/L)	800
Dissolved Mo (µg/L)	3880
Dissolved V (µg/L)	100

4.2. Monitoring of compliance sites in Inner Gove Harbour

This section reports on monthly monitoring of compliance sites SW9, SW10 and RR2

The Waste Water Neutralisation Plant (WWNP) was taken offline in March 2018 for major maintenance works. The WWNP was restarted in March 2020 with seawater only during commissioning; seawater neutralisation commenced in April 2020. The WWNP was operational during the present reporting period except for 21 July to 12 August 2021, 1 October 2021 to 20 January 2022 and 8 to 31 March 2022. WWNP operation/shutdowns have resulted in measurable changes to several parameters at sampling sites in Inner Gove Harbour and other sites in Southern Melville Bay. The most significant of these changes will be noted in the individual sections below.

4.2.1. Temperature

Variations in temperature at the mixing zone boundary sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 3. There are pronounced seasonal effects on temperature in all monitoring areas with temperature maxima usually occurring during October - March and minima occurring in July - August.

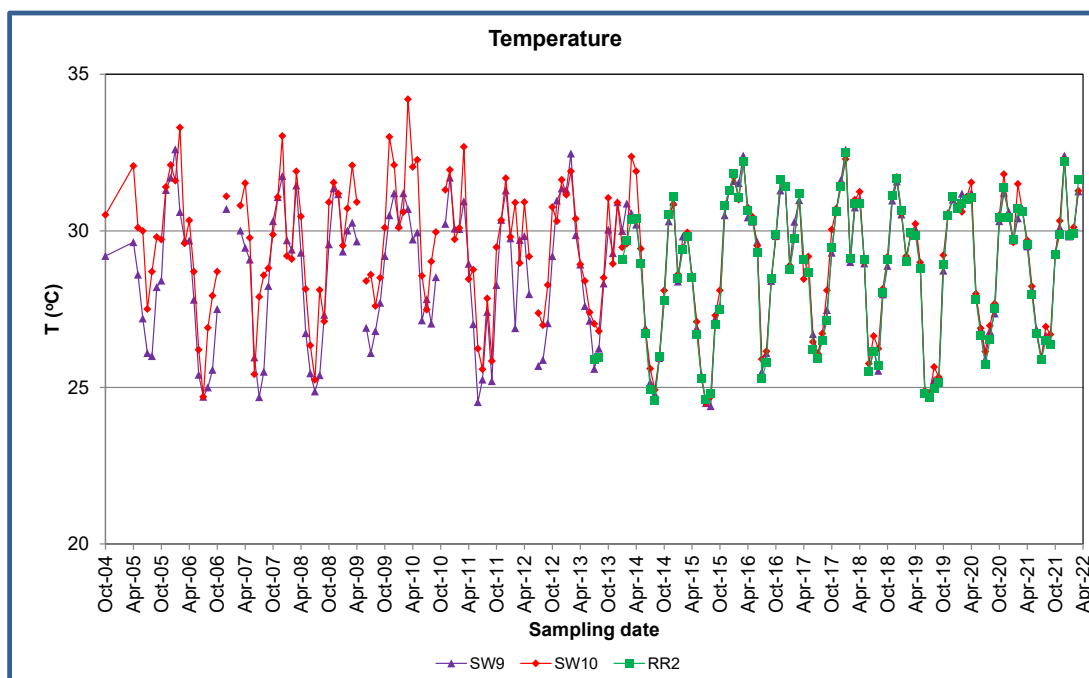


Figure 3. Temperature variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.2. Electrical Conductivity

Variations in EC at the mixing zone boundary sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 4. There are pronounced seasonal effects on electrical conductivity in all monitoring areas with minima usually occurring during December – April (wet season) and maxima in October-November (late dry season).

During 2012-15 several erroneous EC data were collected due to incorrect instrument calibration. These data are no longer included in the assessment.

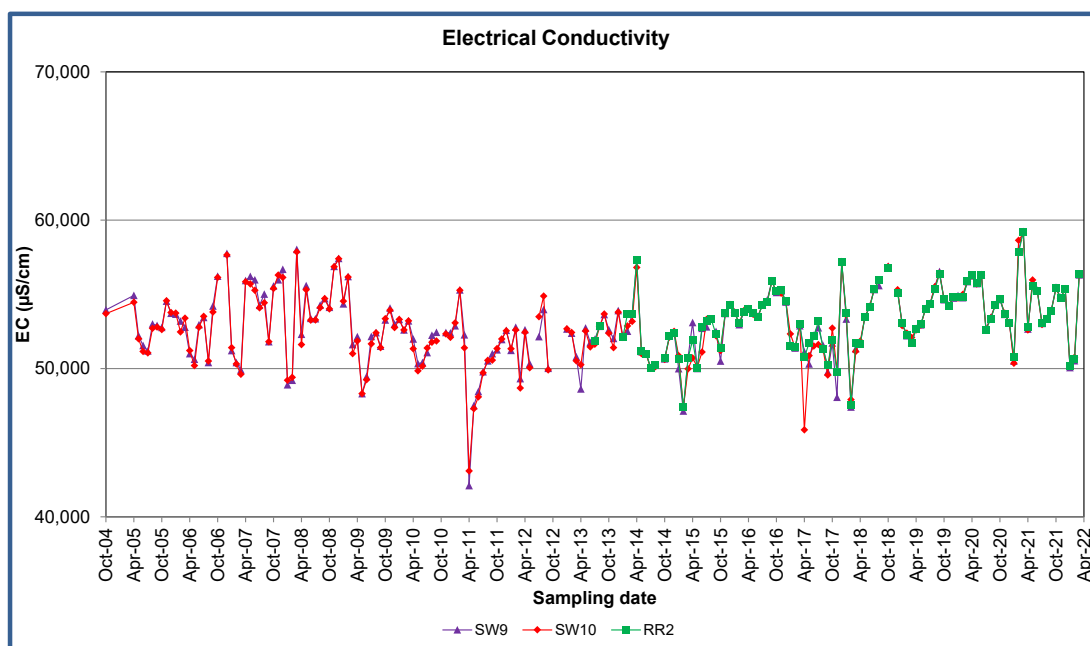


Figure 4. Electrical conductivity variations at the mixing zone boundary compliance sites SW9, SW10 and RR2. Data gaps indicate the removal of erroneous data.

4.2.3. pH (WDL parameter)

Variations in pH at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 5. No exceedances of the pH trigger value <7.7 or >8.4 were recorded during April 2021 – March 2022.

pH variations at the monitoring sites can partly be ascribed to seasonal variations in freshwater runoff mixing into saline waters during the wet season. Limited accuracy of the YSI field pH probes (approximately ± 0.2 units, YSI specifications) is also likely to explain some of the observed variation.

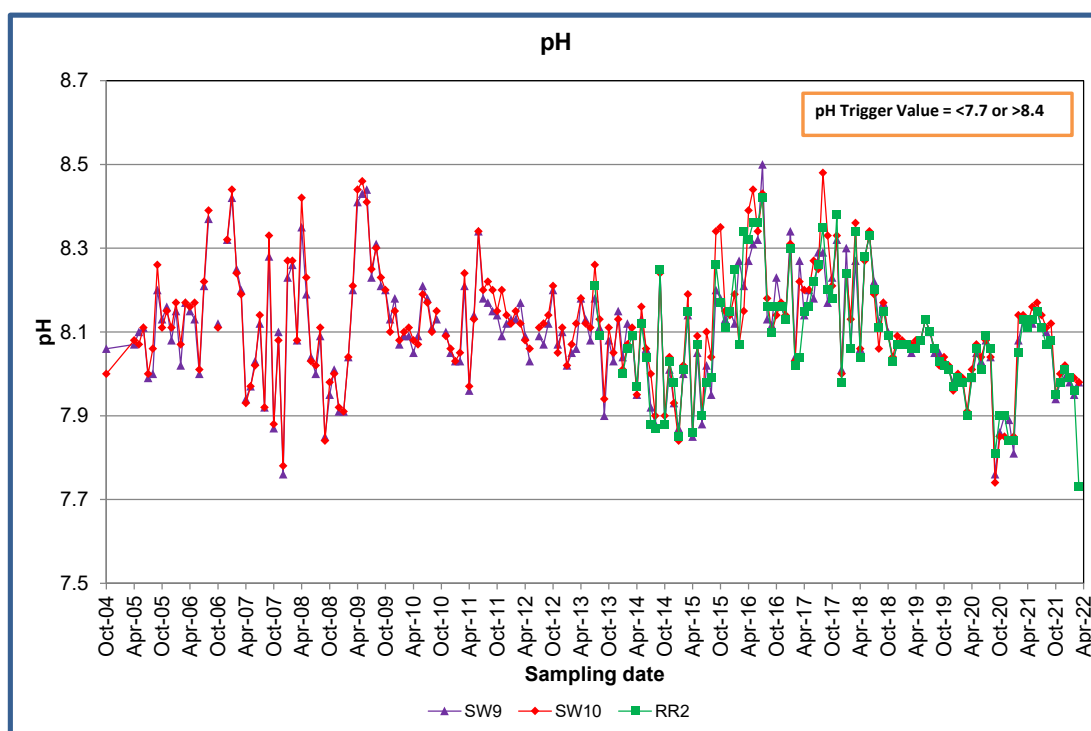


Figure 5. pH variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.4 Dissolved Oxygen (WDL parameter)

Variations in Dissolved Oxygen (DO) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 6. No exceedances of the trigger value for DO (<5.81 mg/L) were recorded during the reporting period

The median DO values for 2021-22 varied little across most monitoring sites including background sites (DO $\approx$ 6.1 – 6.9 mg/L, Appendix 2).

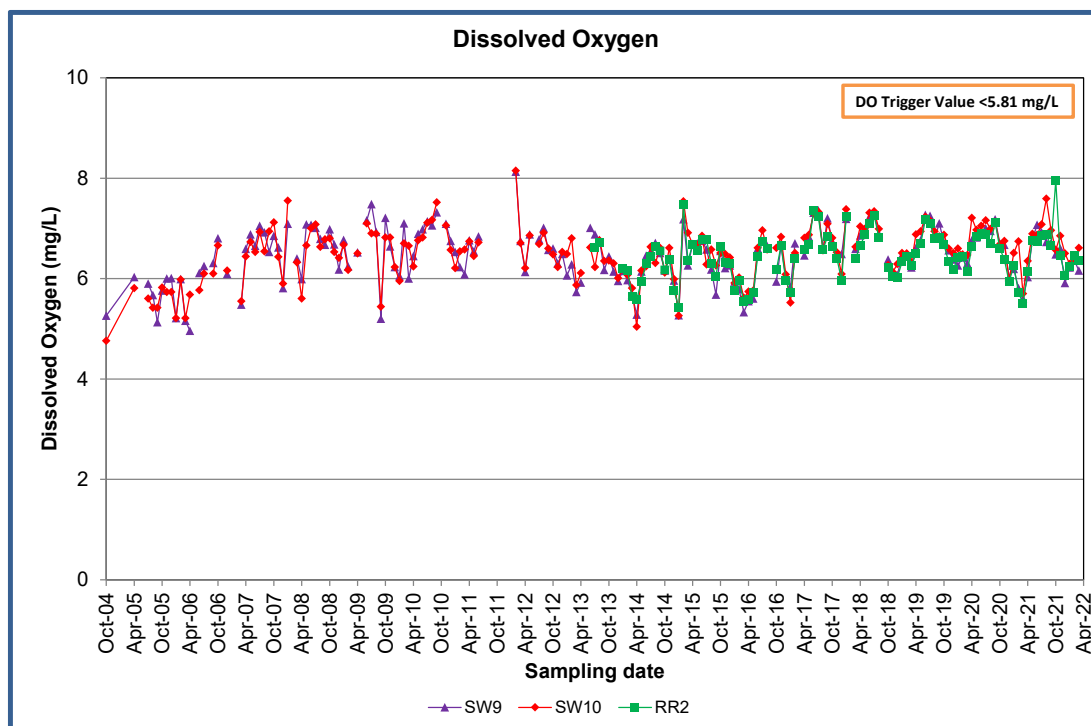


Figure 6. Dissolved oxygen variations at the mixing zone boundary compliance sites SW9, SW10 and RR2. Data gaps indicate the removal of erroneous data.

4.2.5 Turbidity (WDL parameter)

Variations in turbidity at mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 7. There were no exceedances of the trigger value (20.0 NTU) during the reporting period.

Site SW12 at the refinery outfall channel had a median turbidity of 2.9 NTU during 2021-22. This compares to a median turbidity range of 0.5 – 2.2 NTU at the background sites (Appendix 2).

The median turbidity at the compliance sites SW9, SW10 and RR2 (0.9 – 1.4 NTU) were within the background range.

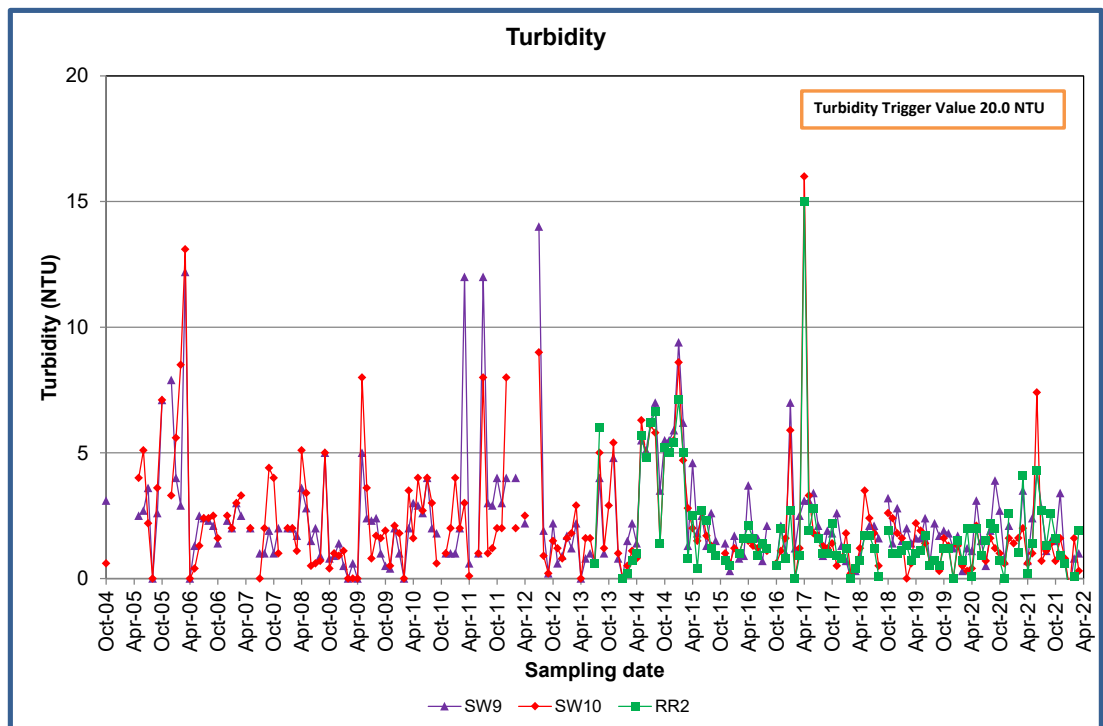


Figure 7. Turbidity variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.6 Total Suspended Solids

Variations in Total Suspended Solids (TSS) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 8.

Site SW12 at the refinery outfall channel had a median TSS of 4.9 mg/L during 2021-22. This is higher than the median TSS concentrations (1.9 – 2.4 mg/L) at the compliance sites SW9, SW10 and RR2 and the range of median concentrations (0.2 – 1.2 mg/L) at the background sites (Appendix 2). A very high TSS concentration of 1,830 mg/L were recorded at site SW12 in February 2022. No other sites had elevated TSS concentrations at that time.

Erroneous TSS concentrations were recorded at several sampling sites in March-August 2012 due to laboratory error. These data points are no longer included in the MHMP assessment.

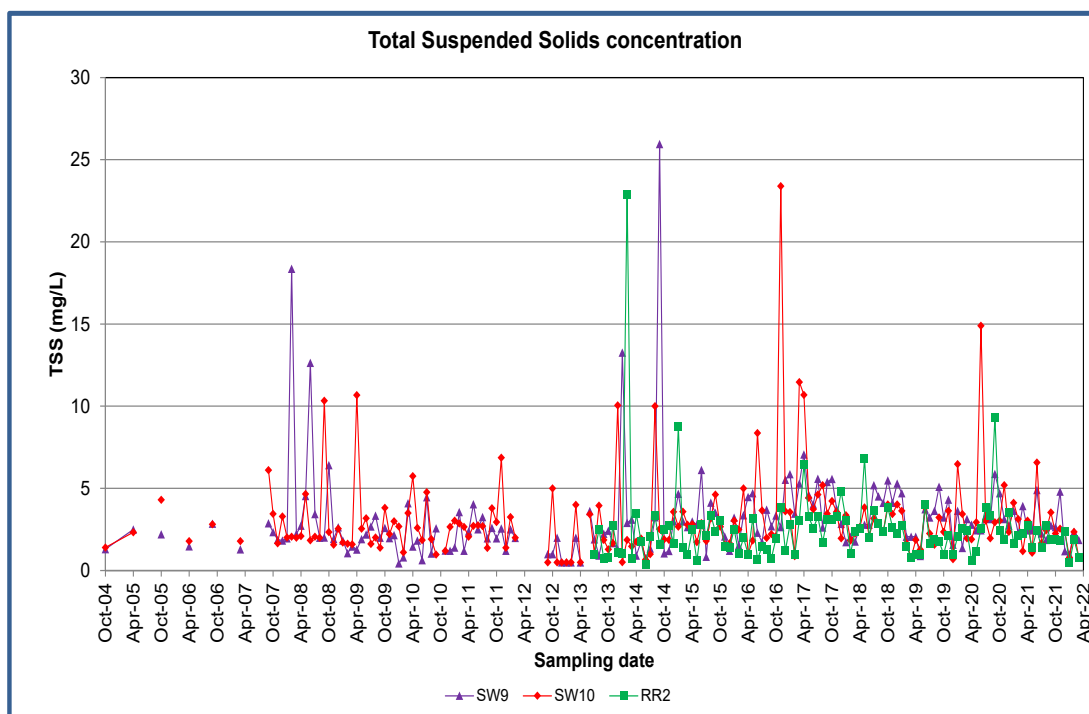


Figure 8. Total Suspended Solids variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.7 Acid neutralising capacity

Variations in Acid Neutralising Capacity (ANC) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 9.

Site SW12 at the refinery outfall channel had a median ANC of 162 mg/L CaCO_3 during 2021-22. This was higher than the median ANC values (122-124 mg/L CaCO_3) at compliance sites SW9, SW10 and RR2 which were similar to the median values (121-122 mg/L CaCO_3) at the background sites (Appendix 2). ANC values decreased following cessation of WWNP discharges in 2018.

Acid Neutralising Capacity values at site SW12 as well as one or more of sites in Inner Gove Harbour were elevated from April to September 2021 and in February 2022 but were still considerably lower than during WWNP operations in previous reporting periods.

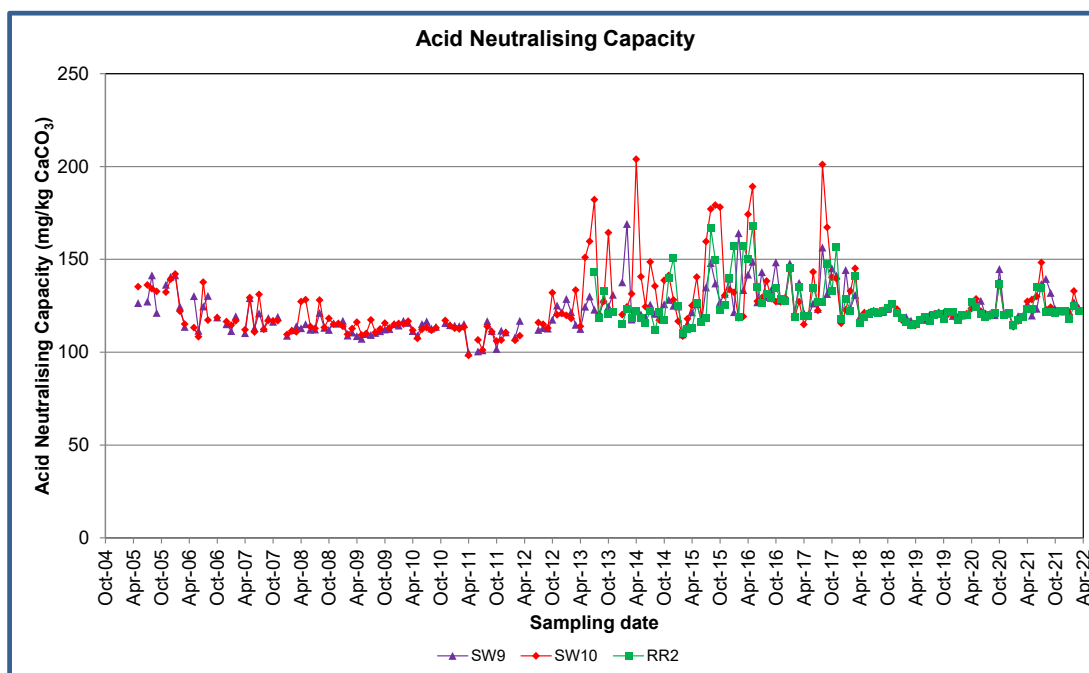


Figure 9. Acid Neutralising Capacity variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.8 Chlorophyll-a

Variations in Chlorophyll-a at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-21 are shown in Figure 10.

During 2021-22 the median chlorophyll-a value was 0.7 µg/L at compliance sites SW9, SW10 and RR2, similar to the range of median concentrations at background sites (0.5 – 0.8 µg/L). Site SW12 at the refinery outfall channel had a median Chlorophyll-a concentration of 1.8 µg/L.

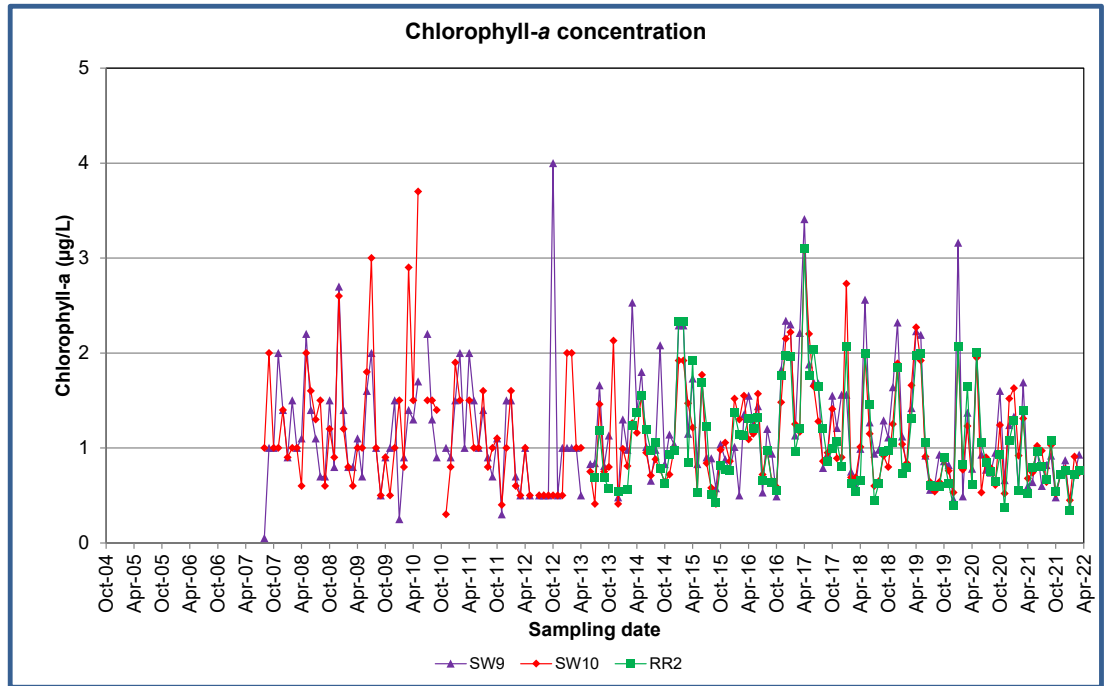


Figure 10. Chlorophyll-a variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.9 Total Dissolved Nitrogen (WDL parameter)

Variations in Total Dissolved Nitrogen (TDN) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 11.

During 2021-22 the median TDN concentrations (120 - 125 µg/L) at compliance sites SW9, SW10 and RR2 were within the range of median values (120 - 150 µg/L) at background sites. There were no exceedances of the TDN trigger value (170 µg/L). Site SW12 at the refinery outfall channel had a median TDN concentration of 200 µg/L.

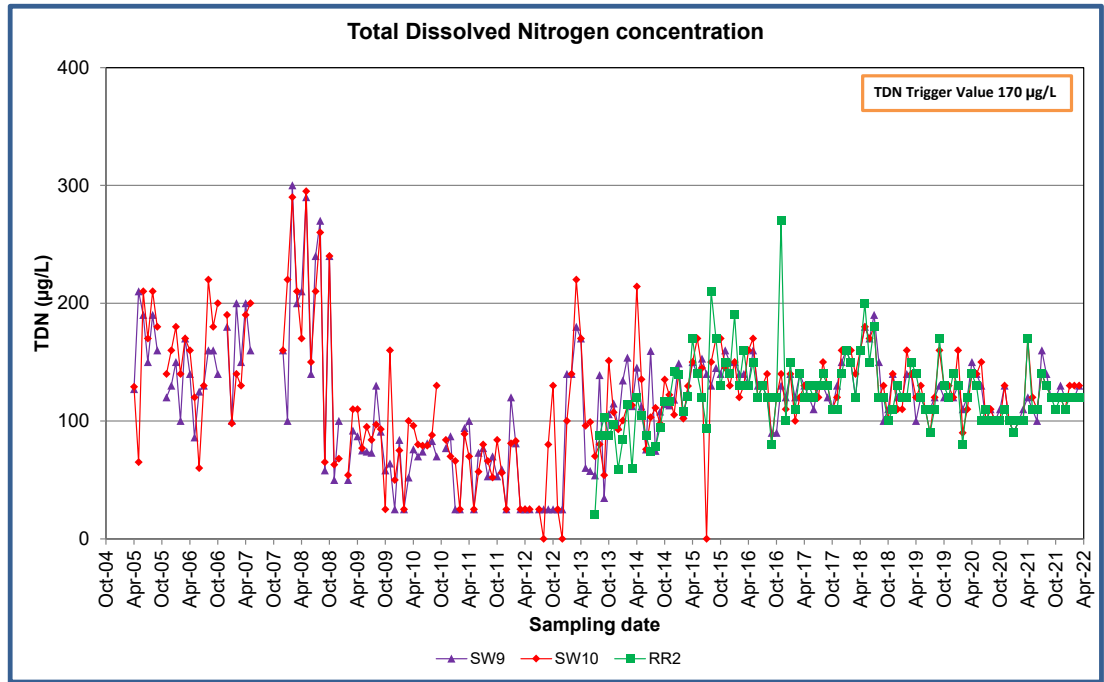


Figure 11. Total Dissolved Nitrogen variations at the mixing zone boundary compliance sites SW9, SW10 and RR2. Data gaps indicate the removal of erroneous data.

4.2.10 Total Dissolved Phosphorus (WDL parameter)

Variations in Total Dissolved Phosphorus (TDP) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 12.

During 2021-22 the median TDP concentrations at compliance sites SW9, SW10 and RR2 were 2 - 3 µg/L while they were 3 - 4 µg/L at background sites. There were no exceedances of the TDP trigger value (14 µg/L). Site SW12 at the refinery outfall channel had a median TDP concentration of 5 µg/L.

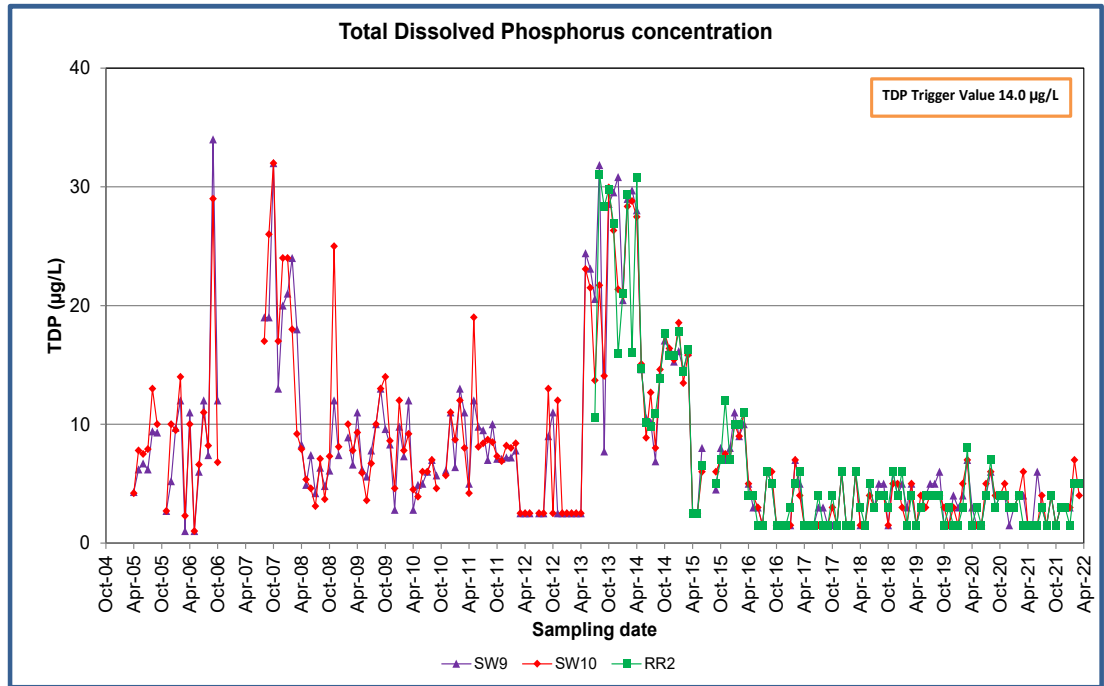


Figure 12. Total Dissolved Phosphorus variations at the mixing zone boundary compliance sites SW9, SW10 and RR2. Data gaps indicate the removal of erroneous data.

4.2.11 Dissolved and Total Aluminium (WDL parameter)

Variations in dissolved aluminium (Al) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 13. There were no recorded exceedances of the WDL dissolved Al Trigger Value (56 µg/L).

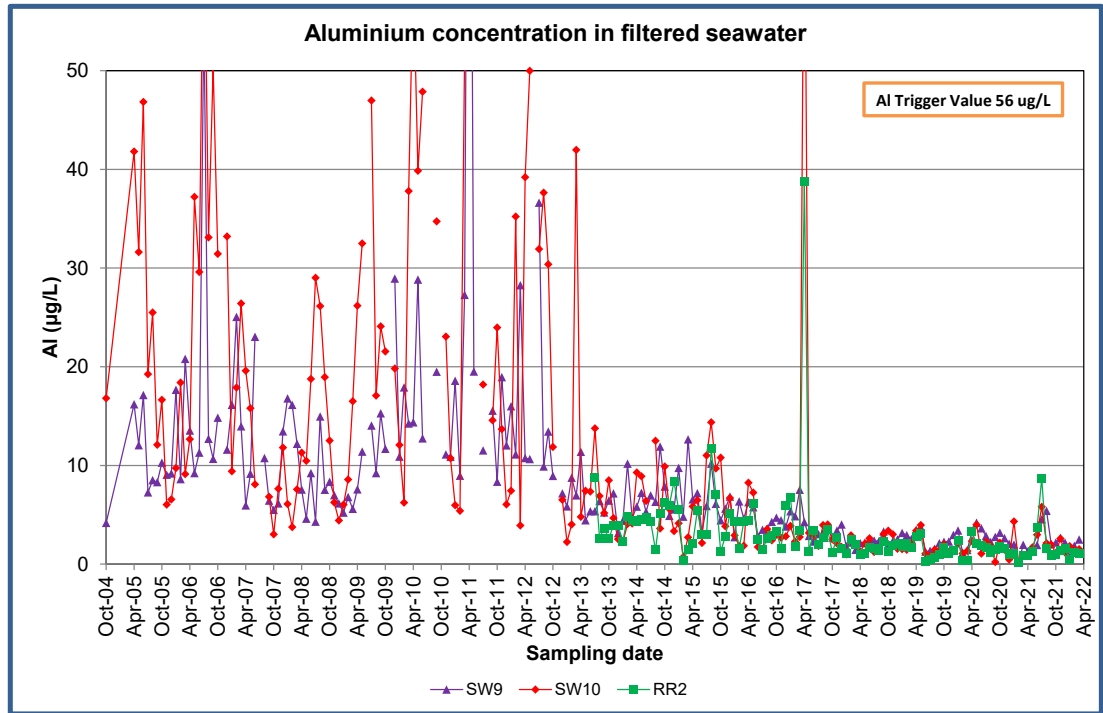


Figure 13. Dissolved aluminium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2. Data gaps indicate the removal of erroneous data.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Al concentration of 3.8 µg/L. This was substantially below the discharge limit of 560 µg/L at the seawater channel licensed discharge site S001.

The median concentration at compliance sites SW9, SW10 and RR2 ranged from 1.2 to 2.1 µg/L and at the background sites the range was 0.2 to 1.2 µg/L. There has been a reduction in the median dissolved Al concentrations at sites SW9, SW10 and RR2 in recent years, mainly because of the reduction in WWNP discharges since March 2018. WWNP discharges occurred intermittently during April - September 2021 and from late January to early March 2022. Increases in dissolved Al concentrations at compliance sites SW9, SW10 and RR2 (up to 8.7 µg/L) were recorded during this time but were well below the trigger value of 56 µg/L. Occasional increases in Al concentrations at information site SW 11 (up to 14.3 µg/L) was noted during periods of elevated concentrations at SW12 (up to 22.2 µg/L).

Dissolved Al data were affected by contamination during the collection process on several occasions during 2007-2011 resulting in falsely elevated data. These data are no longer included in the MHMP assessment.

The concentrations of total aluminium at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 14.

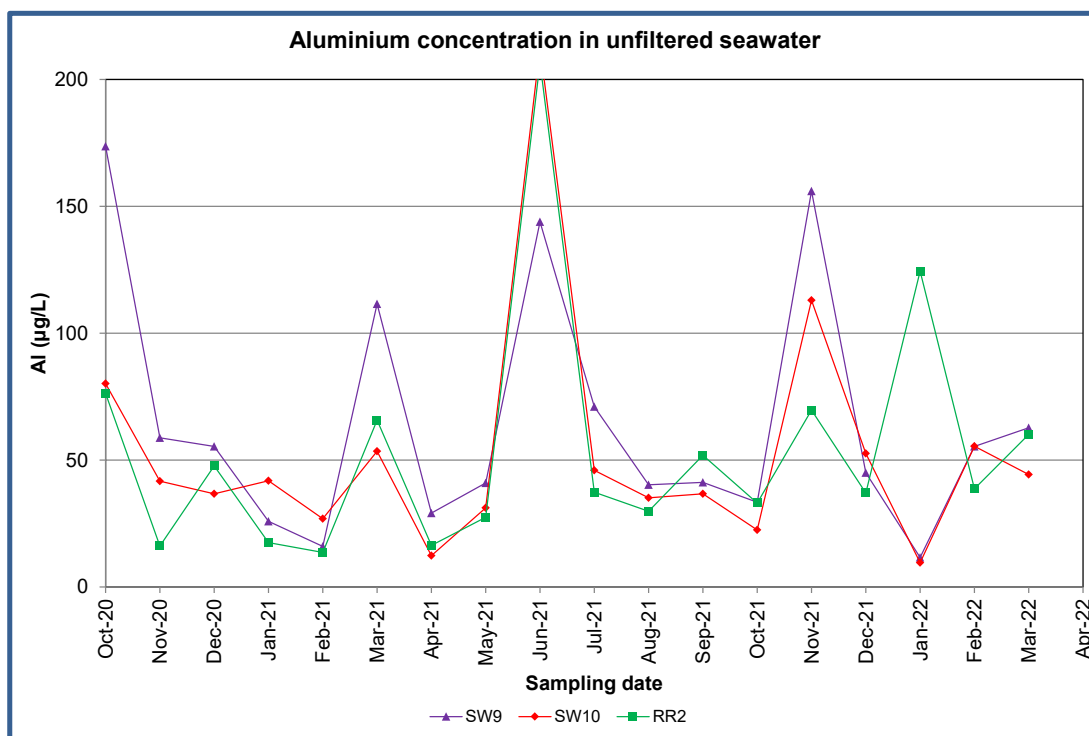


Figure 14. Total (unfiltered) aluminium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.12 Dissolved and Total Vanadium (WDL parameter)

Variations in dissolved vanadium (V) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 15. No exceedance of the dissolved V Trigger Value (100 µg/L) was recorded during 2021-22.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved V concentration of 8.5 µg/L. This was substantially below the discharge limit of 1,000 µg/L at the seawater channel licensed discharge site S001. The median concentration at compliance sites SW9, SW10 and RR2 ranged from 2.6 to 3.0 µg/L and at the background sites the range was 1.9 to 2.2 µg/L.

From late 2012 dissolved V concentrations increased in large parts of Southern Melville Bay. Figure 16 shows dissolved V concentrations at site SW12 (refinery outfall channel), the mixing zone compliance sites SW9, SW10 and RR2 and the background monitoring sites (80th percentile of sites SW1, SW3, SW4 and SW7) during 2004-22. The increase in dissolved V at all sites followed commissioning of the WWNP in September 2012.

After the WWNP discharges were reduced from March 2018, a rapid decrease in V concentrations in the Inner Harbour and Southern Melville Bay to near-background levels were recorded within a month. WWNP operations resumed intermittently from April 2020 and increases in dissolved V concentrations at compliance sites SW9, SW10 and RR2 (up to 38.6 µg/L)

were recorded during this time but were well below the trigger value of 100 $\mu\text{g/L}$. Occasional increases in V concentrations at information site SW11 (up to 69.2 $\mu\text{g/L}$) were noted during periods of elevated concentrations at SW12 (up to 137 $\mu\text{g/L}$).¹

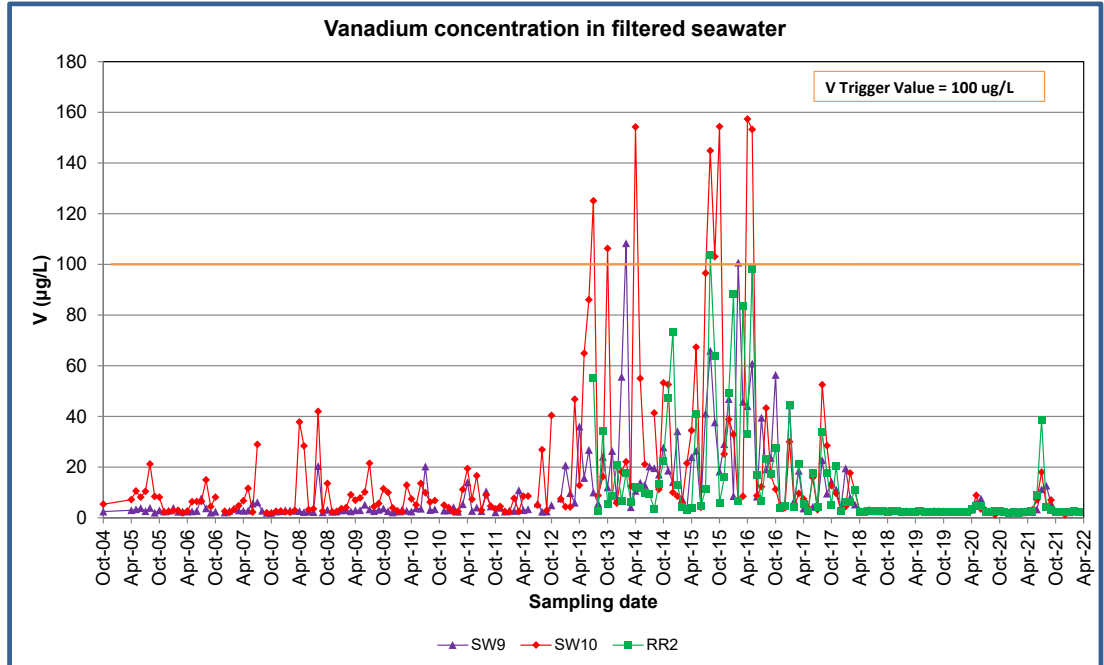


Figure 15. Dissolved vanadium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

¹ In some cases, reported filtered concentrations of V and Ga exceed unfiltered concentrations of the same elements. This may be a result of sequential sampling of unfiltered and filtered waters during incomplete mixing of discharges from the seawater channel.

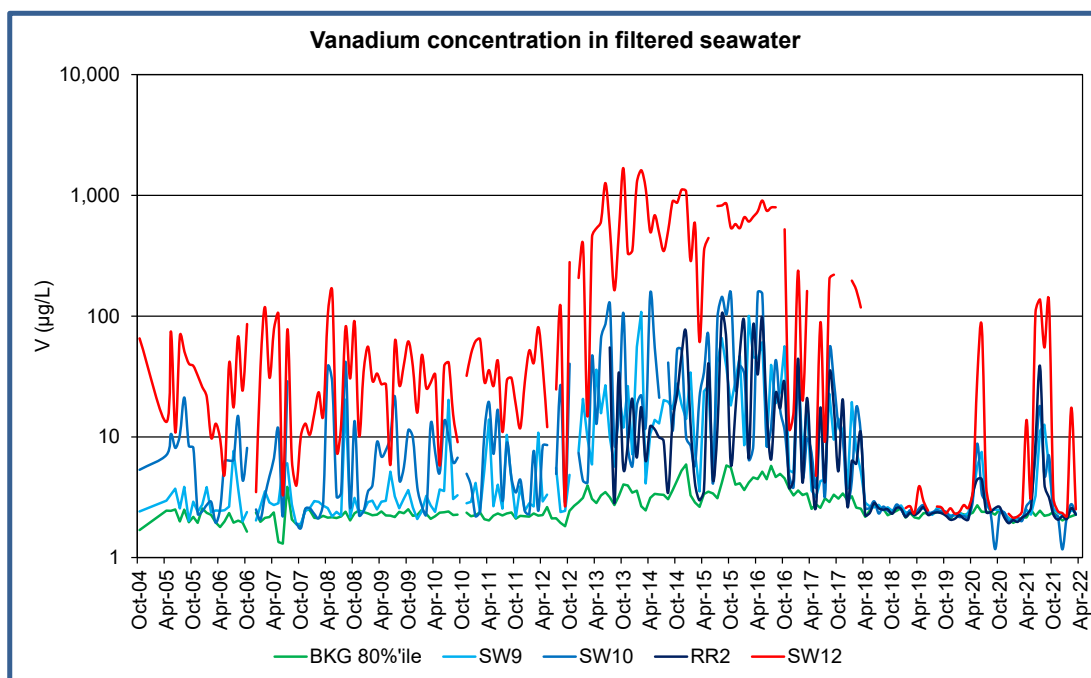


Figure 16. Dissolved vanadium concentrations at background sites (80th percentile of four background sites), compliance sites SW9, SW10 and RR2 and SW12 (refinery outfall channel) during 2004-2022. Note Log scale.

The concentrations of total vanadium at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 17.

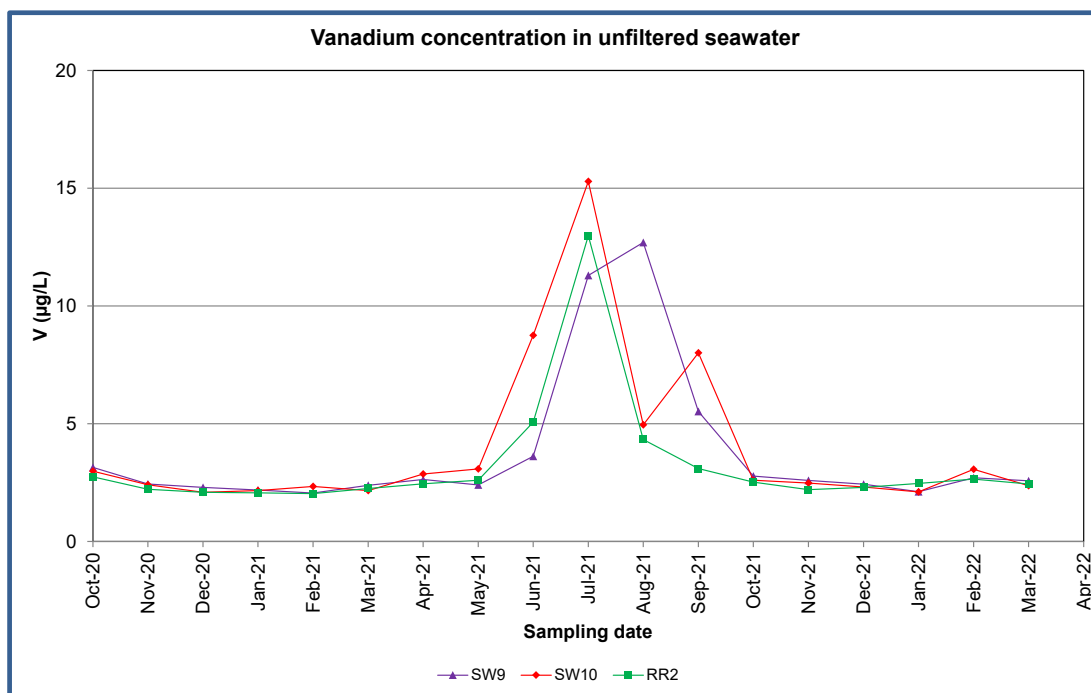


Figure 17. Total (unfiltered) vanadium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.13 Dissolved and Total Chromium

Variations in dissolved chromium (Cr) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 18.

During September 2021-22 site SW12 at the refinery outfall channel had a median dissolved Cr concentration of 0.12 µg/L. Monitoring sites SW9, SW10 and RR2 had median dissolved Cr concentrations of 0.10 – 0.12 µg/L. The median concentrations at the background sites also ranged from 0.10 – 0.12 µg/L.

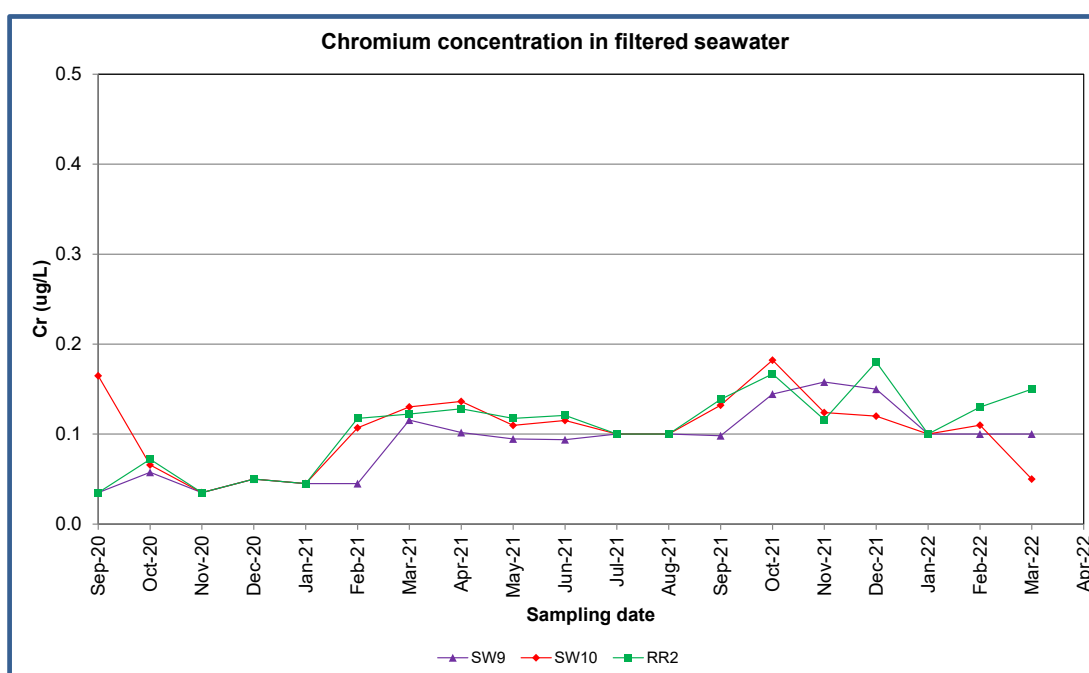


Figure 18. Dissolved chromium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) chromium at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 19.

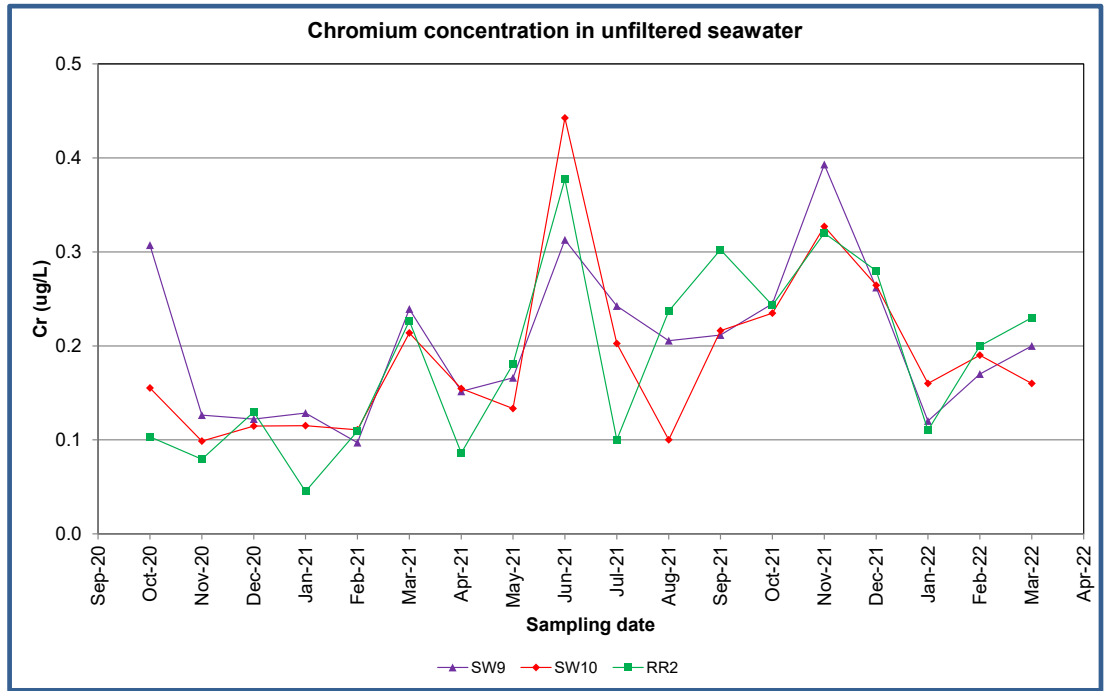


Figure 19. Total chromium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.14 Dissolved and Total Manganese

Variations in dissolved manganese (Mn) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2011-22 are shown in Figure 20 (Mn was not measured 2007-2008).

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Mn of 1.9 µg/L. Compliance sites SW9, SW10 and RR2 had median dissolved Mn concentrations of 1.0 – 1.1 µg/L. The median concentrations at the background sites ranged from 0.8 – 1.0 µg/L.

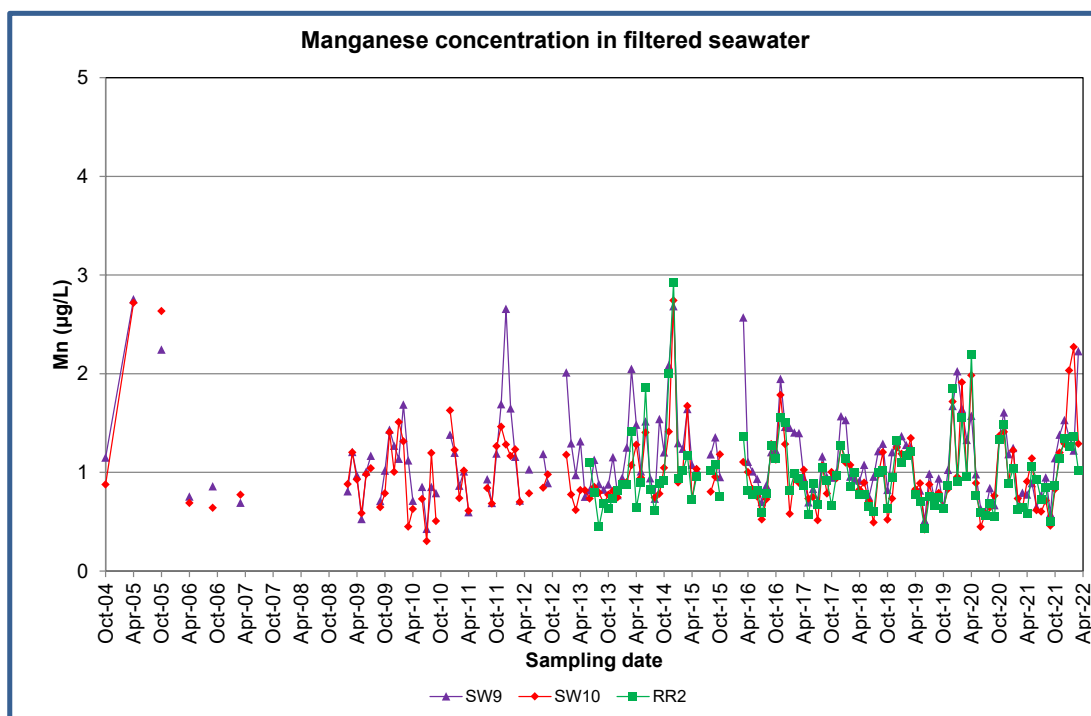


Figure 20. Dissolved manganese variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) manganese at the mixing zone boundary sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 21.

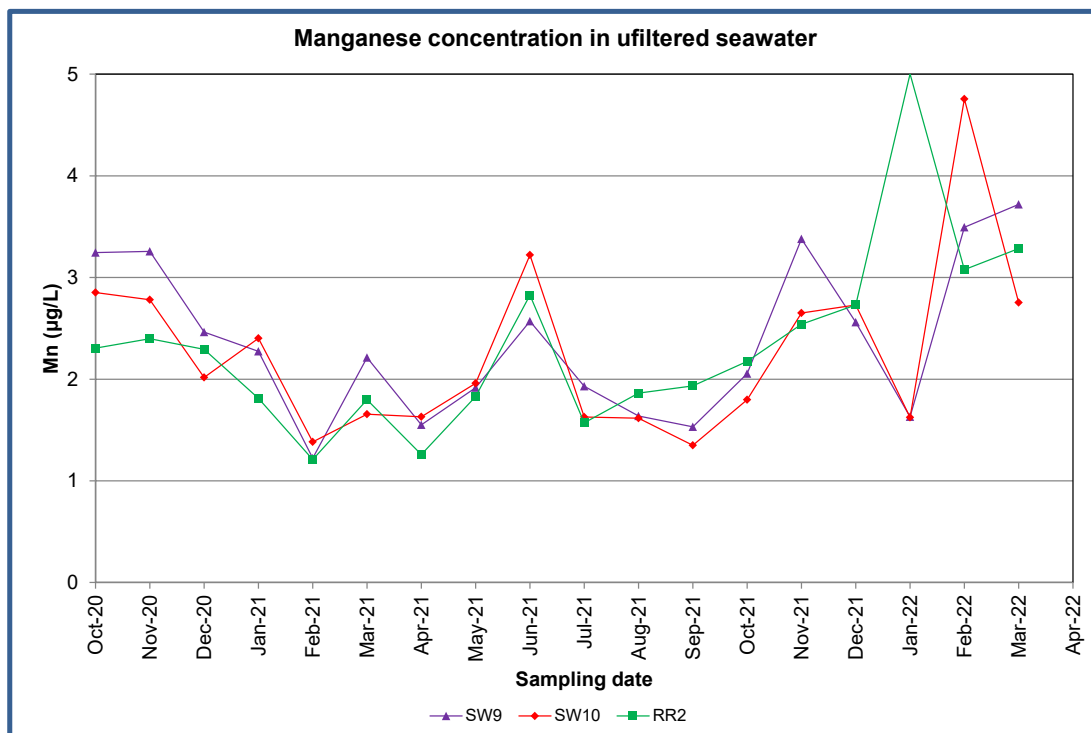


Figure 21. Total (unfiltered) manganese variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.15 Dissolved and Total Iron

Variations in dissolved iron (Fe) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2010-22 are shown in Figure 22 (Fe was not measured prior to 2010).

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Fe concentration of 1.0 µg/L and compliance sites SW9, SW10 and RR2 had median dissolved Fe of 0.4 - 0.5 µg/L. The median concentrations at the background sites also were 0.4 – 0.5 µg/L.

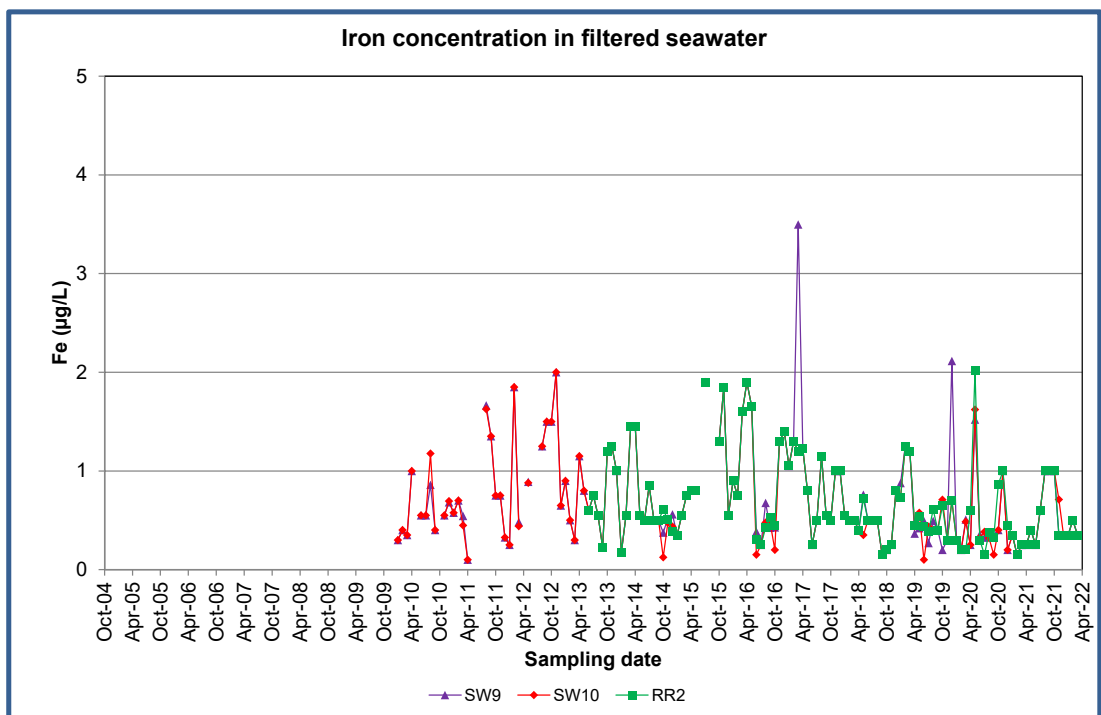


Figure 22. Dissolved iron variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) iron at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 23.

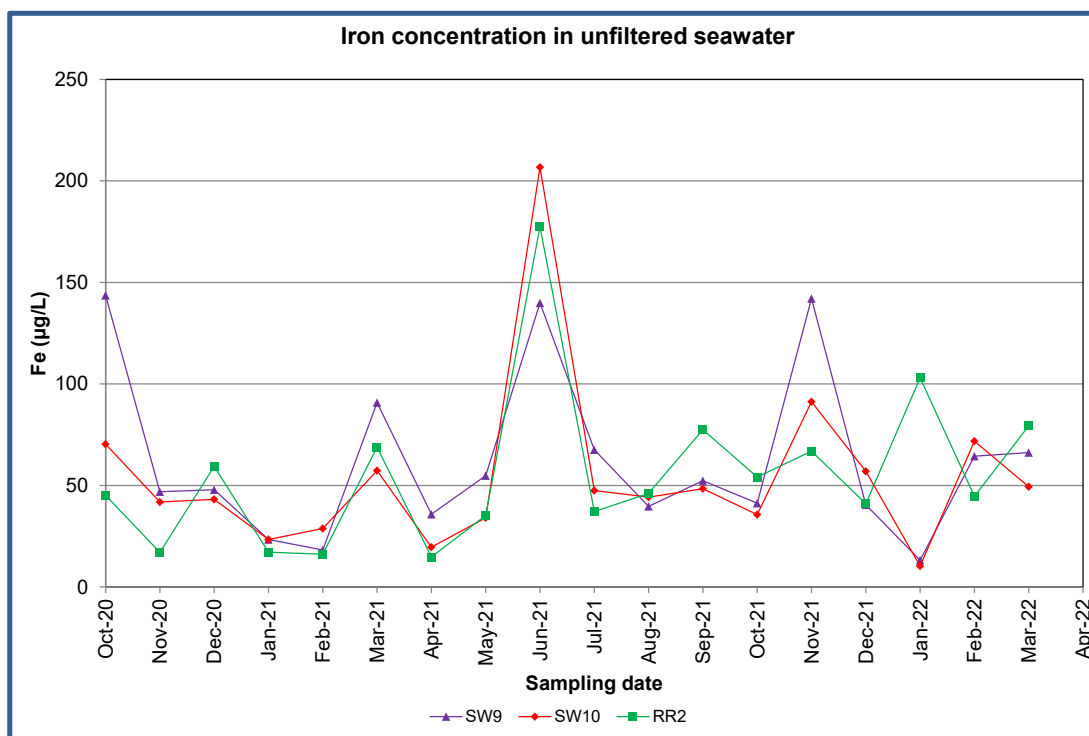


Figure 23. Total (unfiltered) iron variations at the mixing zone boundary sites SW9, SW10 and RR2.

4.2.16 Dissolved and Total Copper

Variations in dissolved copper (Cu) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 24.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Cu concentration of 0.26 µg/L. The median concentrations were 0.21 - 0.25 µg/L at monitoring sites SW9, SW10 and RR2 and 0.10 – 0.26 µg/L at the background sites.

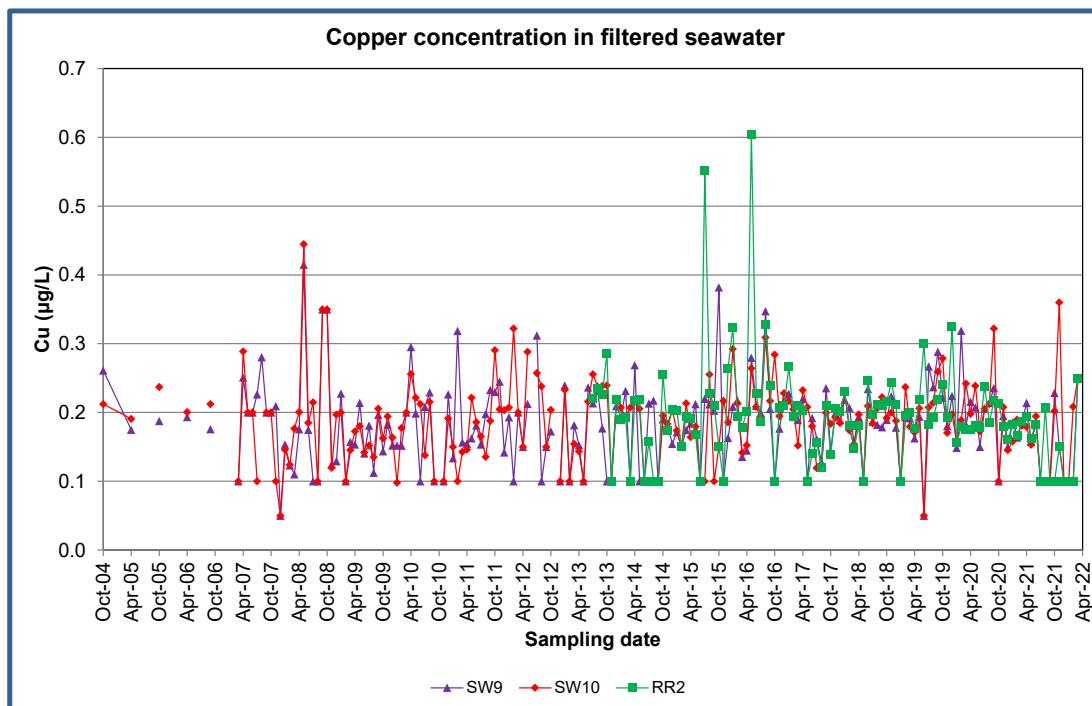


Figure 24. Dissolved copper variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) copper at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 25.

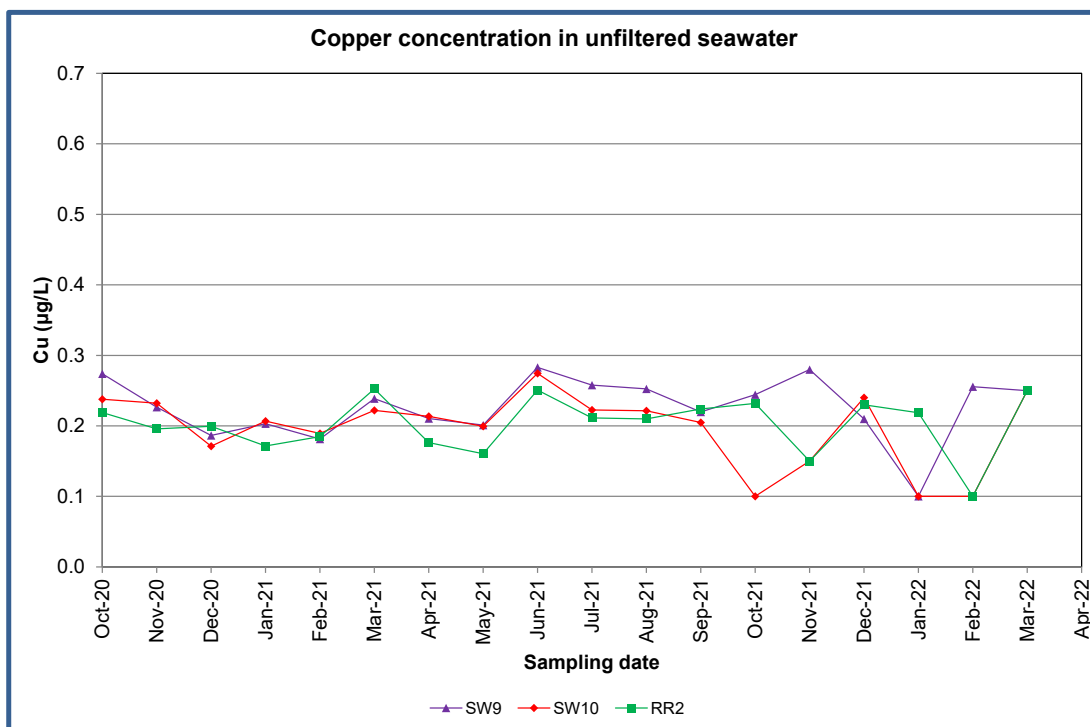


Figure 25. Total (unfiltered) copper variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.17 Dissolved and Total Zinc

Variations in dissolved zinc (Zn) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-21 are shown in Figure 26.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Zn concentration of 0.39 µg/L. The median concentrations at compliance sites SW9, SW10 and RR2 were 0.33 - 0.35 µg/L, the same as at the background sites.

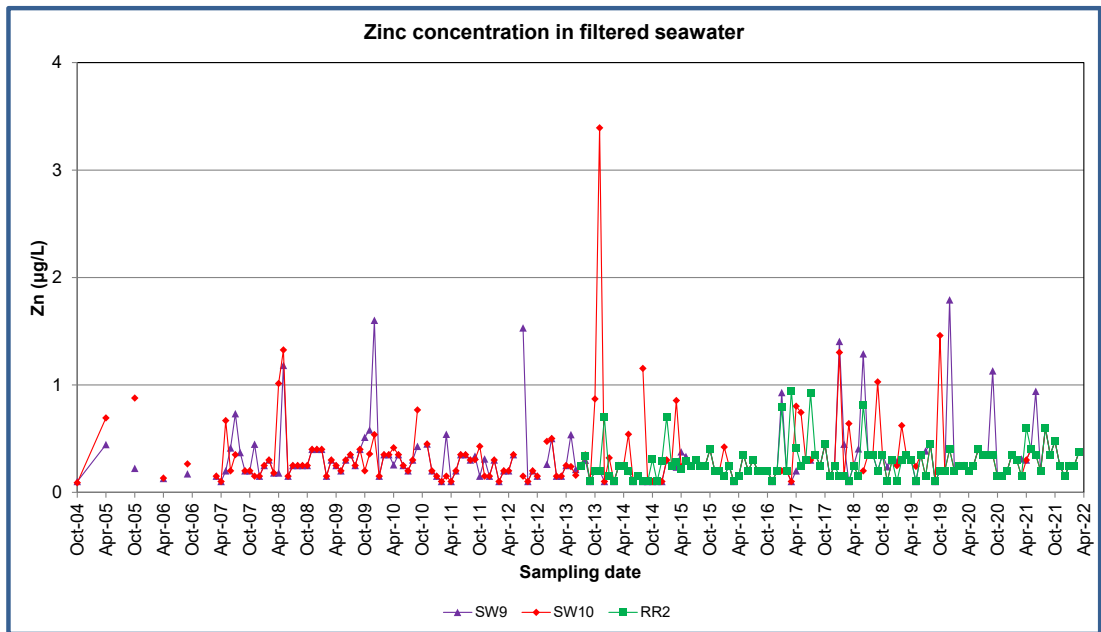


Figure 26. Dissolved zinc variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) zinc at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 27.

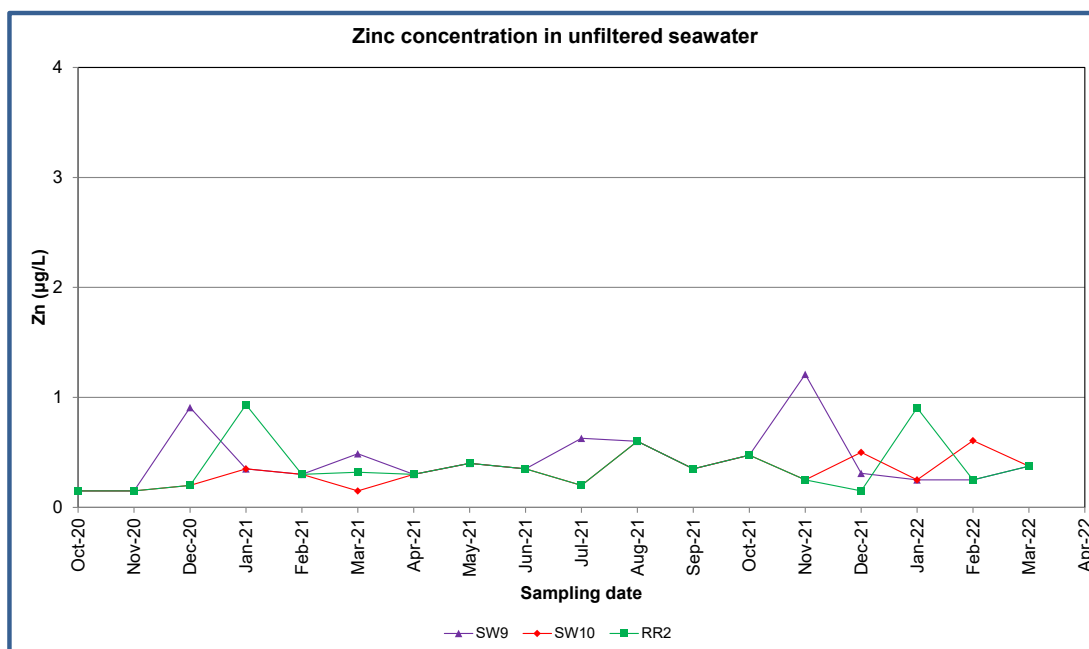


Figure 27. Total (unfiltered) zinc variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.18 Dissolved and Total Gallium (WDL parameter)

Variations in dissolved gallium (Ga) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 28. No exceedances of the dissolved Ga trigger values (800 µg/L) were recorded.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Ga concentration of 0.46 µg/L. The median concentrations at compliance sites SW9, SW10 and RR2 ranged from 0.03 to 0.08 µg/L while the median concentration at background sites ranged from 0.01 to 0.02 µg/L.

WWNP discharges occurred intermittently during April - September 2021 and from late January to early March 2022. Small increases in dissolved Ga concentrations at compliance sites SW9, SW10 and RR2 (up to 0.81 µg/L) were recorded during this time but were well below the trigger value of 800 µg/L. Occasional increases in Ga concentrations at information site SW 11 (up to 1.26 µg/L) was noted during periods of elevated concentrations at SW12 (up to 5.55 µg/L).²

² In some cases, reported filtered concentrations of V and Ga exceed unfiltered concentrations of the same elements. This may be a result of sequential sampling of unfiltered and filtered waters during incomplete mixing of discharges from the seawater channel.

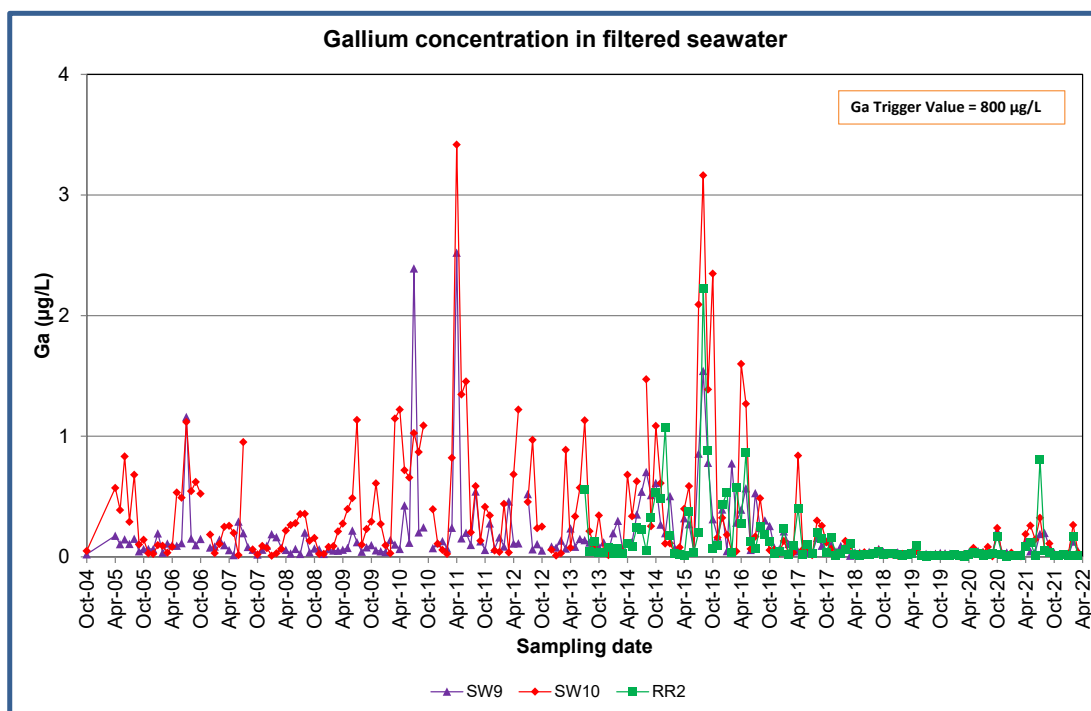


Figure 28. Dissolved gallium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) gallium at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 29.

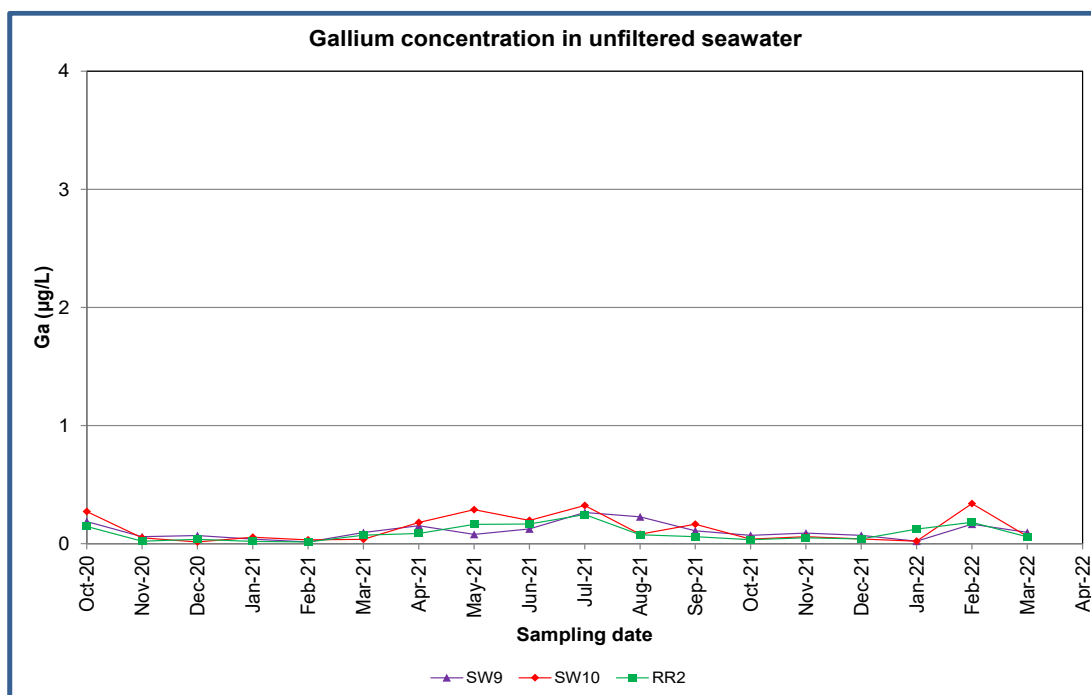


Figure 29. Total (unfiltered) gallium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.19 Dissolved and Total Arsenic (WDL parameter)

Variations in dissolved arsenic (As) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 30. No exceedances of the dissolved As trigger values (20 µg/L) were recorded.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved As concentration of 3.1 µg/L. This was substantially below the discharge limit of 200 µg/L at the seawater channel licensed discharge site S001. The median concentrations at compliance sites SW9, SW10 and RR2 were 1.5 - 1.7 µg/L while the median concentration at background sites ranged from 1.4 to 1.5 µg/L. Occasional increases in As concentrations at information site SW 11 (up to 3.5 µg/L) were noted during periods of elevated concentrations at SW12 (up to 7.9 µg/L).

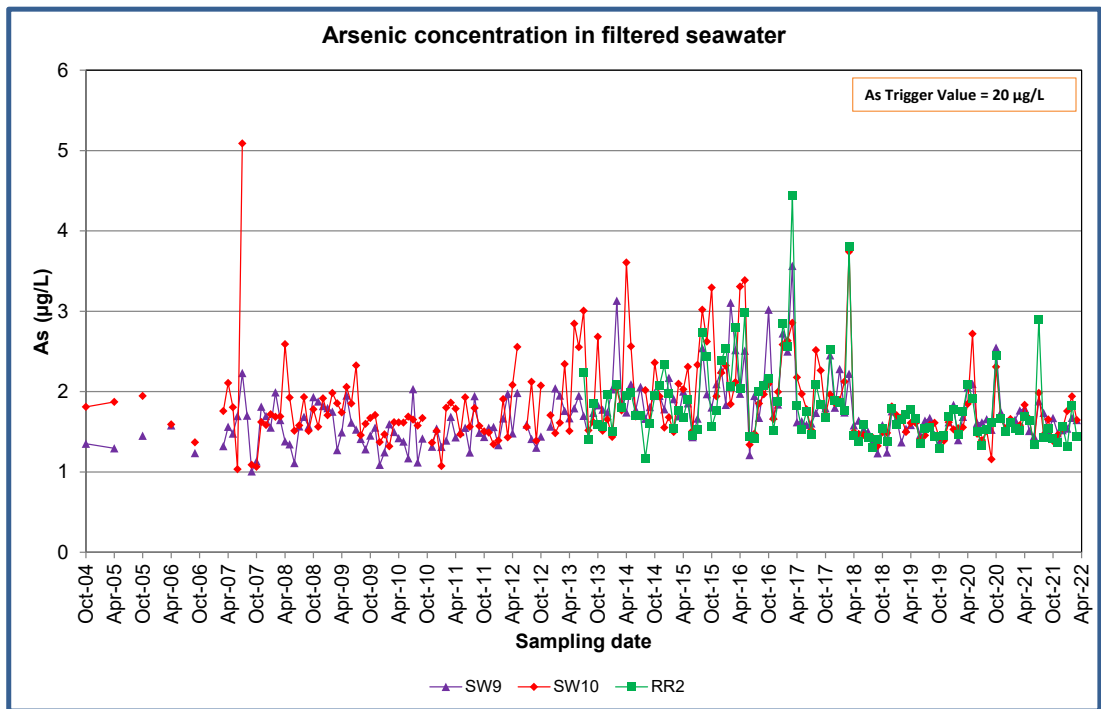


Figure 30. Dissolved arsenic variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) arsenic at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 31.

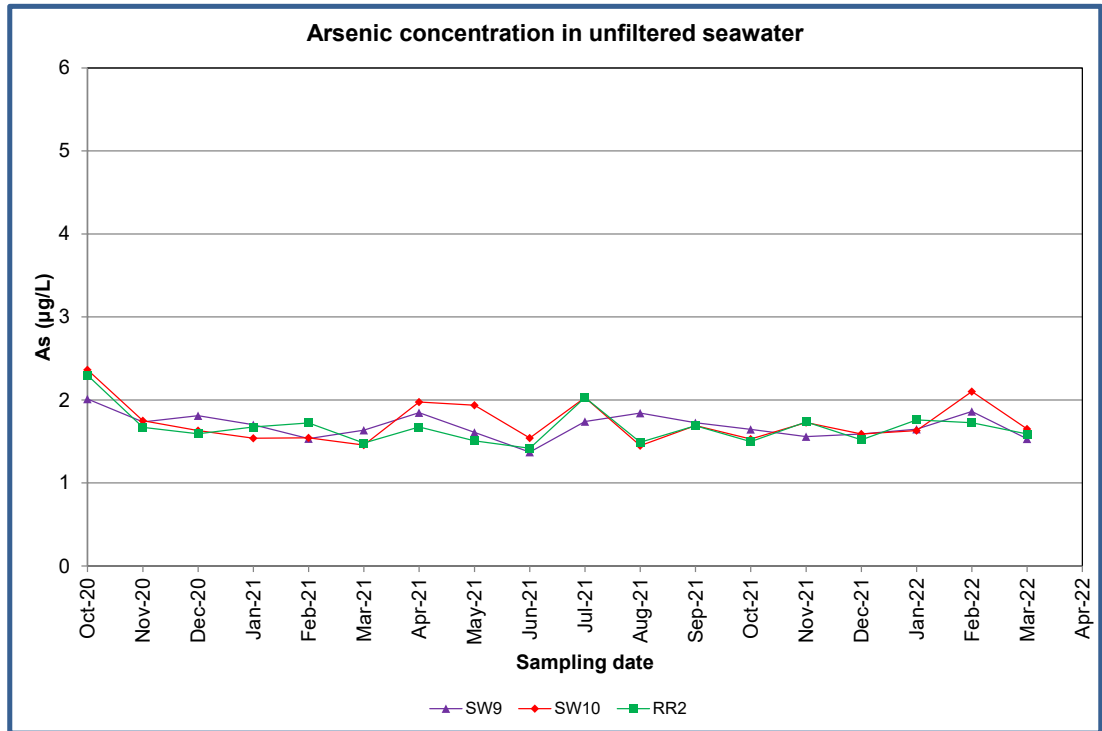


Figure 31. Total (unfiltered) arsenic variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.20 Dissolved and Total Molybdenum (WDL parameter)

Variations in dissolved molybdenum (Mo) at the mixing zone boundary sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 32. No exceedances of the dissolved Mo trigger values (3880 µg/L) were recorded.

During April 2021 to March 2022 site SW12 at the refinery outfall channel had a median dissolved Mo concentration of 17.7 µg/L. The median concentrations at compliance sites SW9, SW10 and RR2 were 10.8 to 11.3 µg/ and at background sites ranged from 10.5 to 10.8 µg/L. Occasional increases in Mo concentrations at information site SW 11 (up to 24.2 µg/L) were noted during periods of elevated concentrations at SW12 (up to 42.8 µg/L).

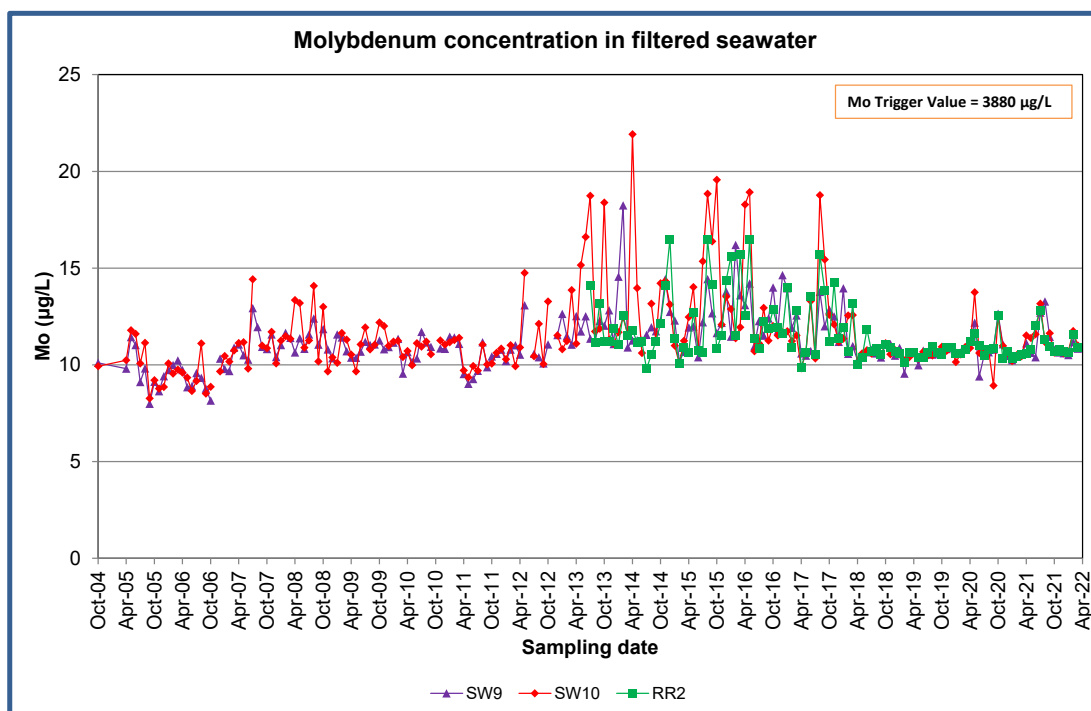


Figure 32. Dissolved molybdenum variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) molybdenum at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 33.

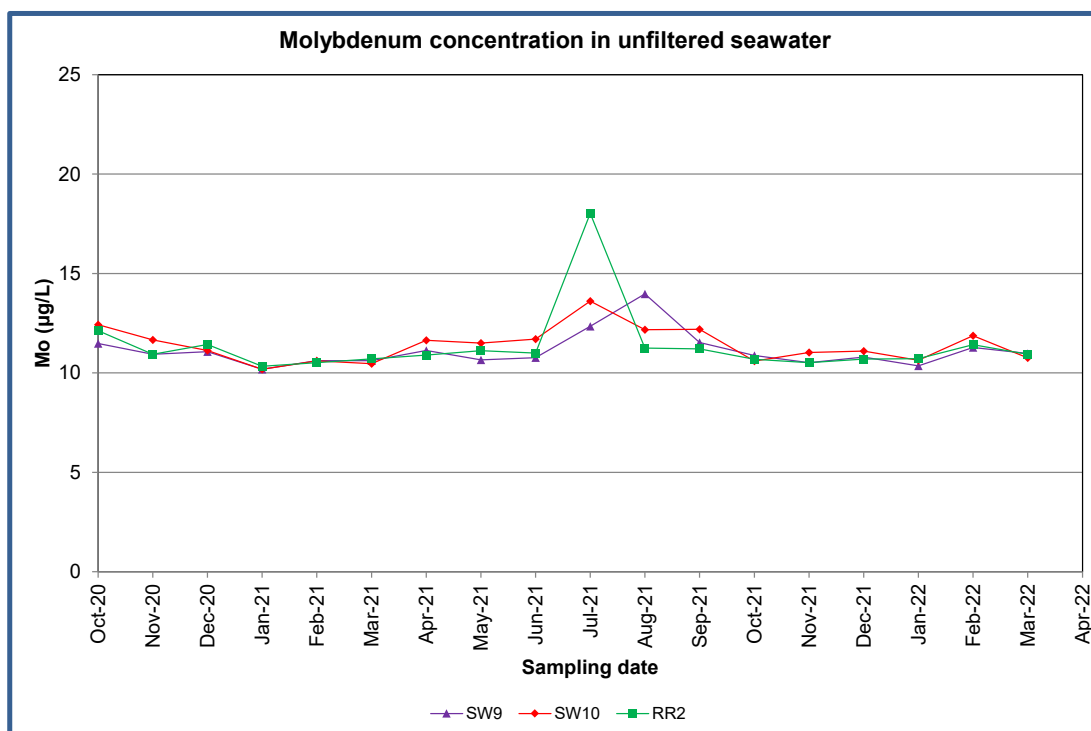


Figure 33. Total (unfiltered) molybdenum variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.21 Dissolved and Total Uranium

Monitoring of U commenced in April 2012. Variations in dissolved uranium (U) at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2004-22 are shown in Figure 34.

There has been no substantial difference in median concentrations of U between any of the monitoring sites with recorded values of 3.2 - 3.3 µg/L during 2021-22.

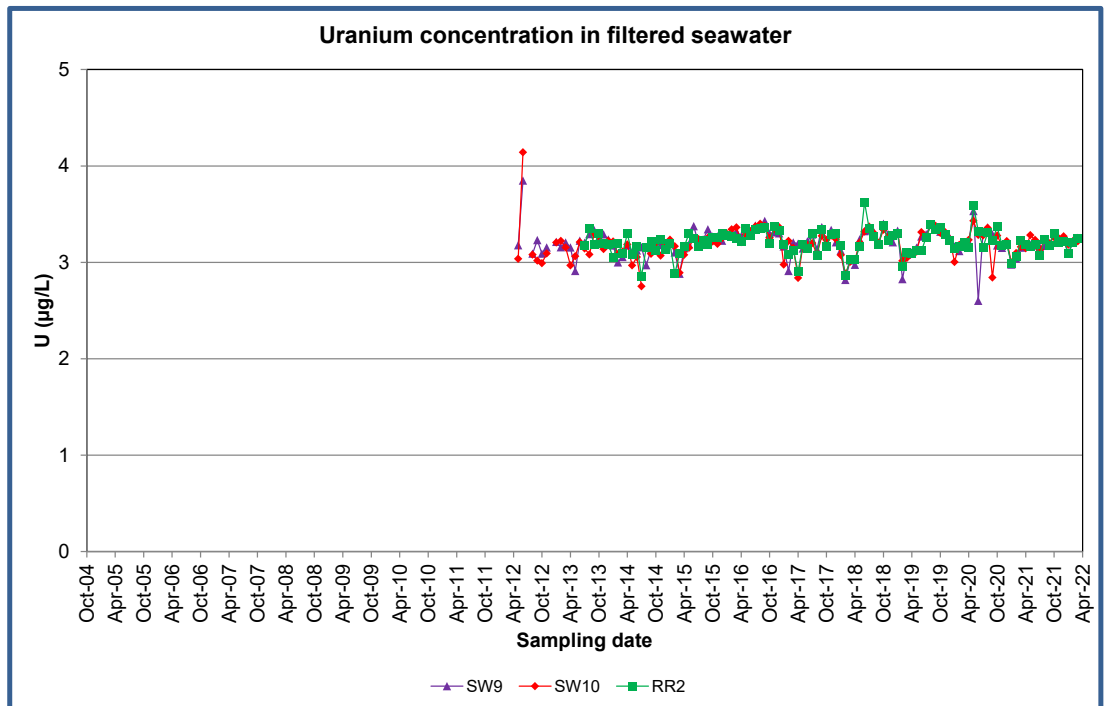


Figure 34. Dissolved uranium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

The concentrations of total (unfiltered) uranium at the mixing zone boundary compliance sites SW9, SW10 and RR2 for 2020-22 are shown in Figure 35.

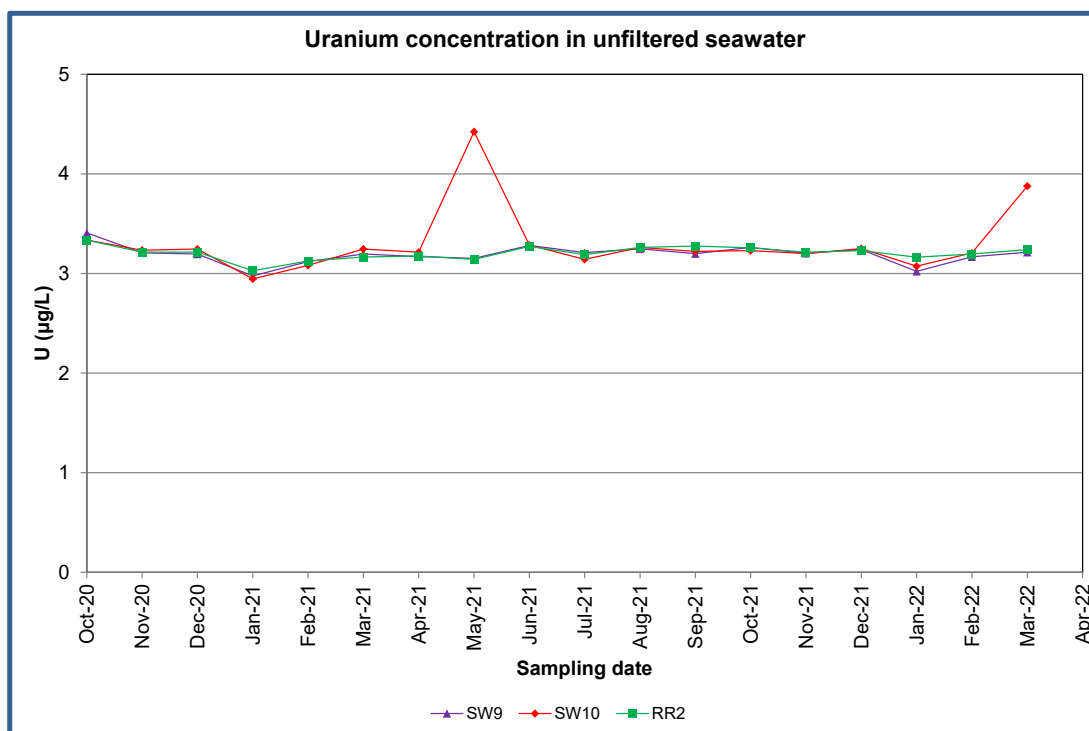


Figure 35. Total uranium variations at the mixing zone boundary compliance sites SW9, SW10 and RR2.

4.2.22 Summary of any Trigger Value exceedances

There were no recorded exceedances of WDL171-11 trigger values at the mixing zone boundary compliance sites in Gove Inner Harbour during April 2021 – March 2022.

4.3 Monitoring of Information Sites SW5 and SW6

This section reports on monitoring sites SW5 (Crawfords Creek also known as No Name Creek) and SW6 (Drimmie Arm). These sites are no longer WDL 171-11 compliance sites but provides information on potential impacts from the Residue Disposal Area.

4.3.1. Temperature

Variations in temperature at information sites SW5 and SW6 for 2004-22 are shown in Figure 36. There are similar seasonal effects on temperature in both areas and at background sites.

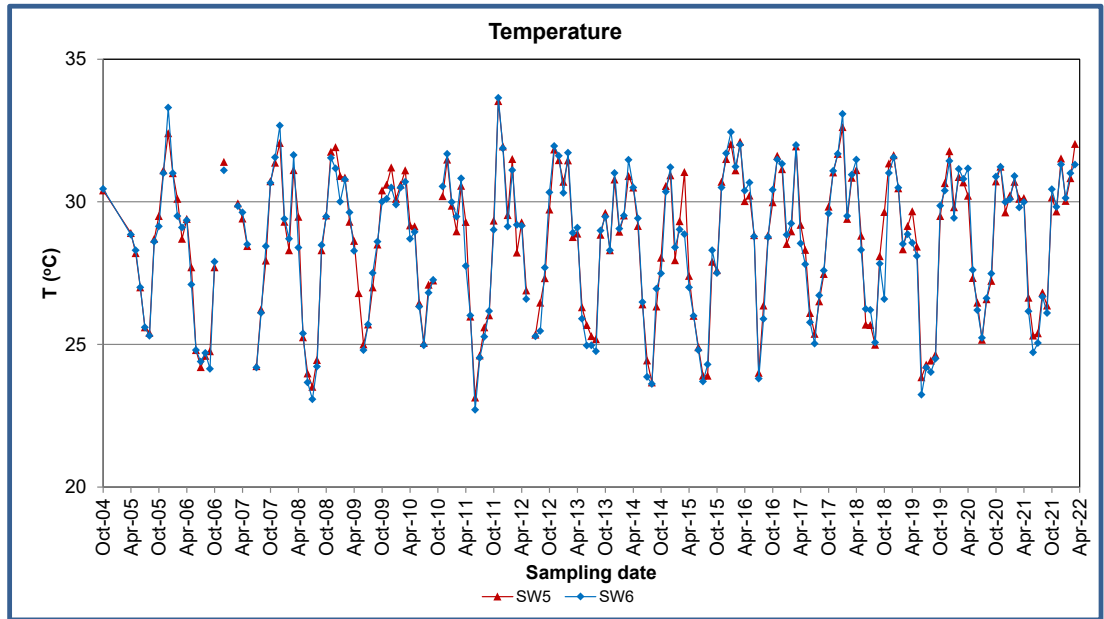


Figure 36. Temperature variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.2. Electrical Conductivity

Variations in EC at information sites SW5 and SW6 for 2004-22 are shown in Figure 37. There are similar seasonal effects on electrical conductivity in both areas and at background sites.

During 2012-15 erroneous EC data were collected on some occasions due to incorrect instrument calibration. These data are no longer included in the assessment.

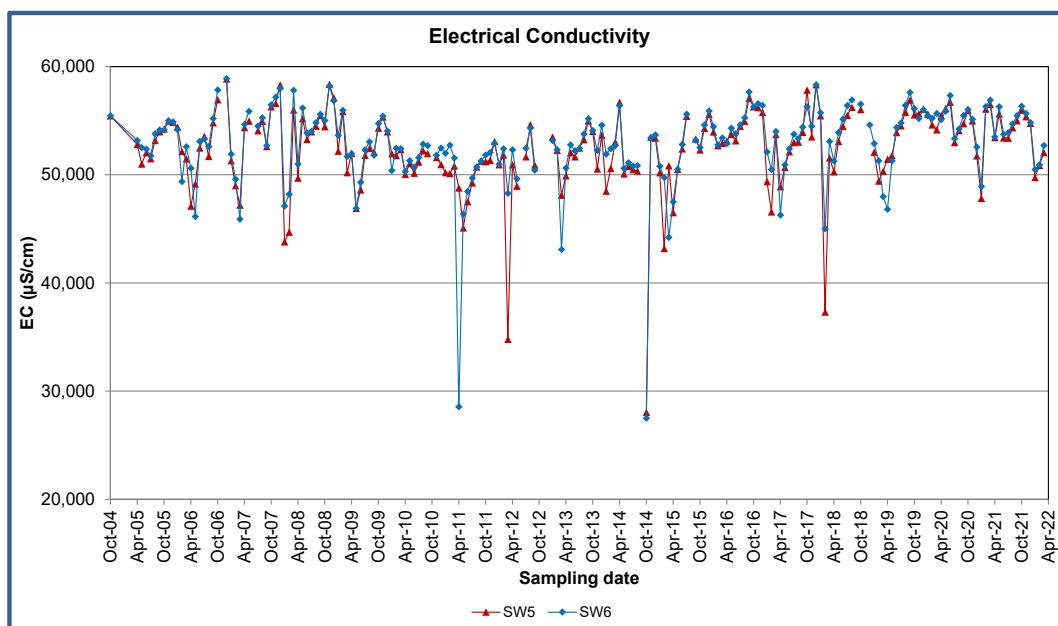


Figure 37. Electrical conductivity variations at Crawford's Creek (SW5) and Drimmie Arm (SW6). Data gaps indicate the removal of erroneous data.

4.3.3. pH

Variations in pH at information sites SW5 and SW6 for 2004-22 shown in Figure 38. The median annual pH values at the two sites were similar to the median range for background sites (pH = 7.9 to 8.0). A trend of declining pH is observed from mid-2018.

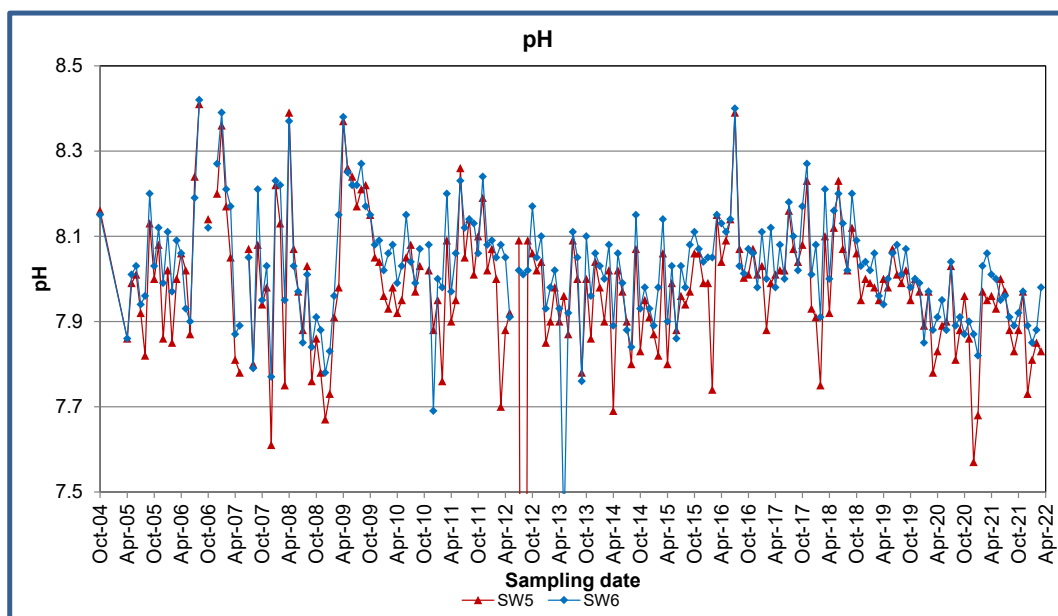


Figure 38. pH variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.4 Dissolved Oxygen

Variations in Dissolved Oxygen (DO) at information sites SW5 and SW6 for 2004-22 are shown in Figure 39. The range of values in both areas were similar to the range obtained for background sites.

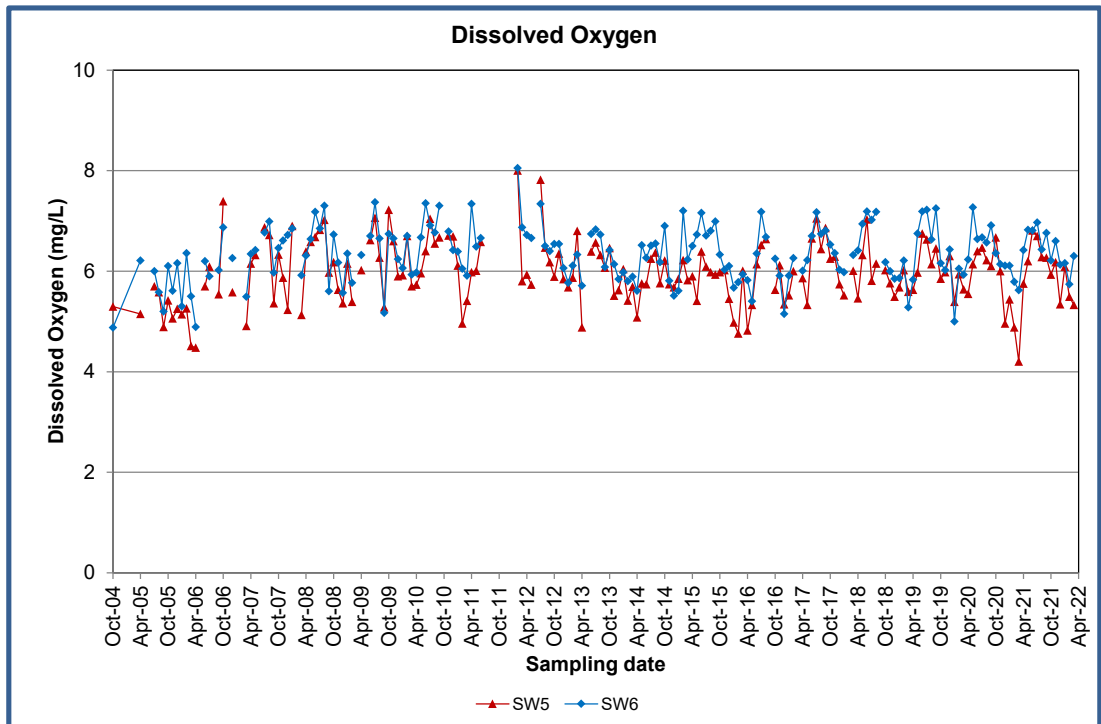


Figure 39. Dissolved oxygen variations at Crawford's Creek (SW5) and Drimmie Arm (SW6). Data gaps indicate the removal of erroneous data.

4.3.5 Turbidity

Variations in Turbidity at information sites SW5 and SW6 for 2004-22 are shown in Figure 40.

Turbidity at sites SW5 and SW6 are occasionally elevated due to resuspension of sediment by tidal flow and/or wave action at these shallow sites (water depth of 1-2 m). High turbidity was recorded in May and June 2021 at SW6. The 2021-22 median turbidity at both SW5 and SW6 was 3.0 NTU. In comparison, the 2021-22 median turbidity at the background sites ranged from 0.5 to 2.2 NTU.

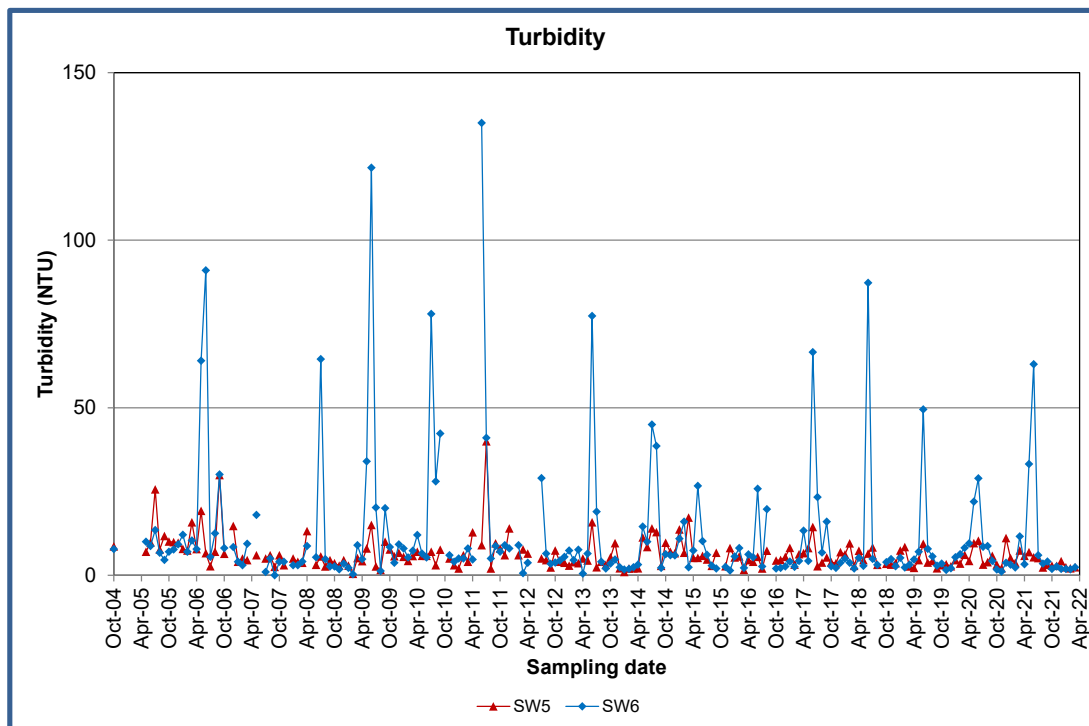


Figure 40. Turbidity variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.6 Total Suspended Solids

Variations in Total Suspended Solids (TSS) at information sites SW5 and SW6 for 2004-22 are shown in Figure 41.

Similar to turbidity, TSS at site SW6 was elevated in May and June 2021 due to resuspension of sediment at this shallow site (water depth of 1-2 m).

Erroneous TSS concentrations were recorded at several sampling sites in March-August 2012 due to laboratory error. These data are no longer included in the MHMP assessment.

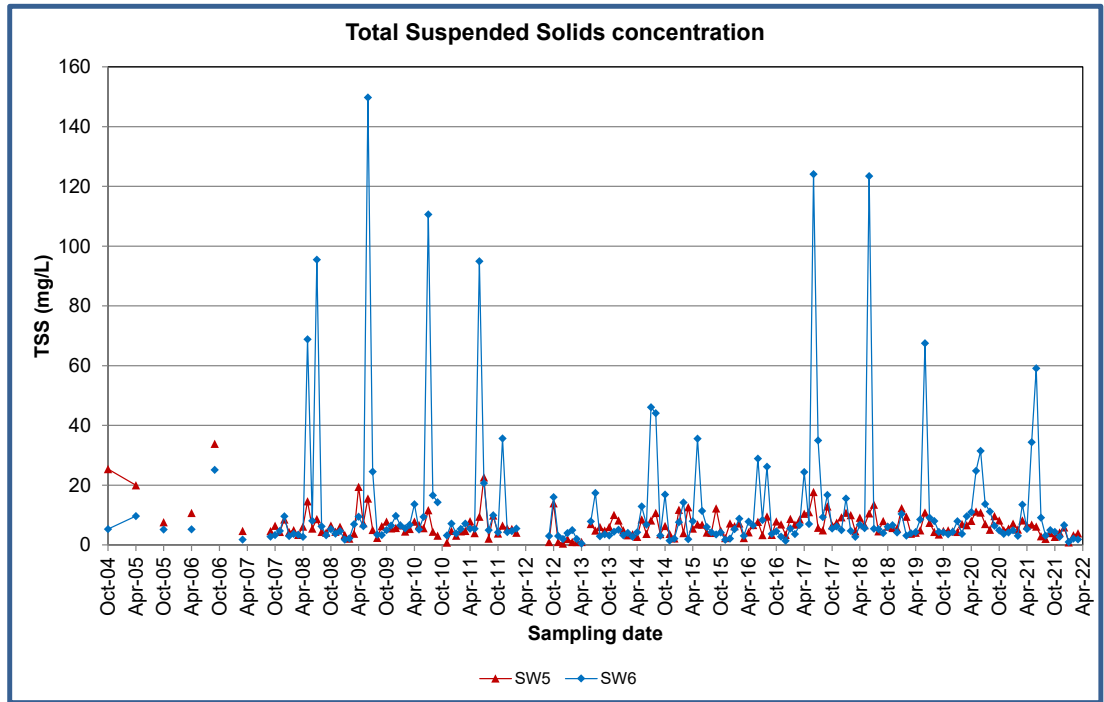


Figure 41. Total Suspended Solids variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.7 Acid neutralising capacity

Variations in Acid Neutralising Capacity (ANC) at information sites SW5 and SW6 for 2004-22 are shown in Figure 42. The 2021-22 median ANC at SW5 and SW6 was 122 and 123 mg/kg CaCO_3 , respectively. In comparison, the 2021-22 median ANC at the background sites ranged from 121 to 122 mg/kg CaCO_3 .

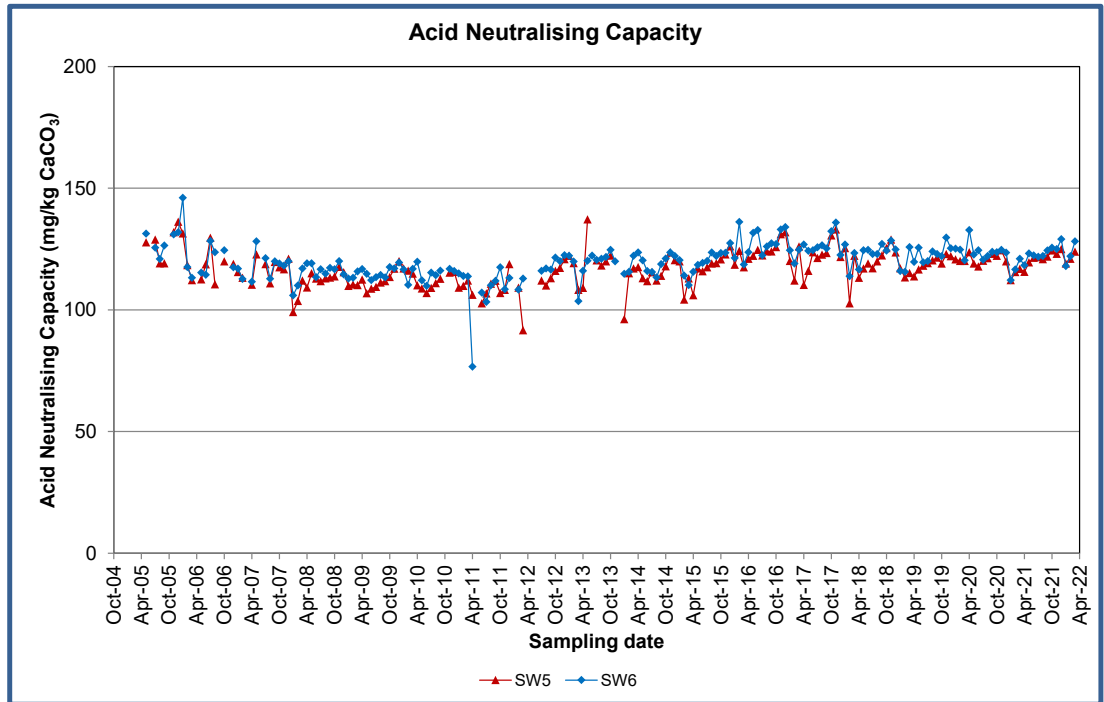


Figure 42. Acid Neutralising Capacity variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.8 Chlorophyll-a

Variations in Chlorophyll-a at information sites SW5 and SW6 for 2004-22 are shown in Figure 43.

During 2021-22 the annual median Chlorophyll-a concentrations at sites SW5 and SW6 (0.9 mg/m³ and 1.1 mg/m³, respectively) were slightly elevated compared to the background sites (0.5 – 0.8 mg/m³).

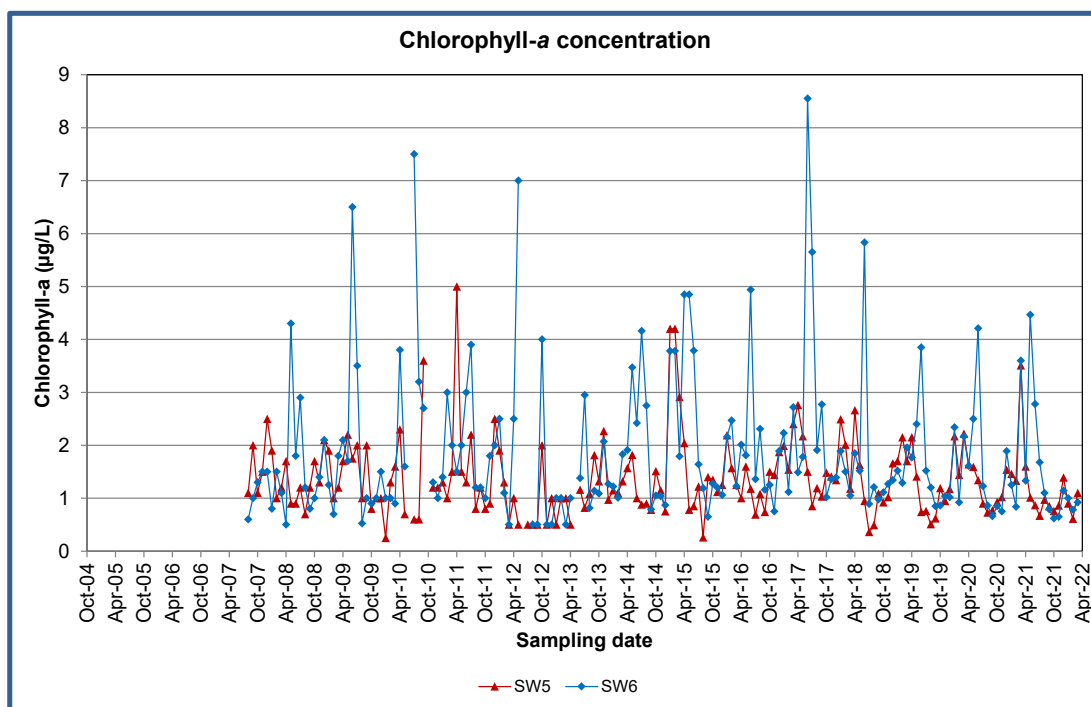


Figure 43. Chlorophyll-a variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.9 Total Dissolved Nitrogen

Variations in Total Dissolved Nitrogen (TDN) at information sites SW5 and SW6 for 2004-22 are shown in Figure 44.

The median TDN concentrations at both sites SW5 and SW6 (140 µg/L) were within the range of median values (120 - 150 µg/L) at background sites.

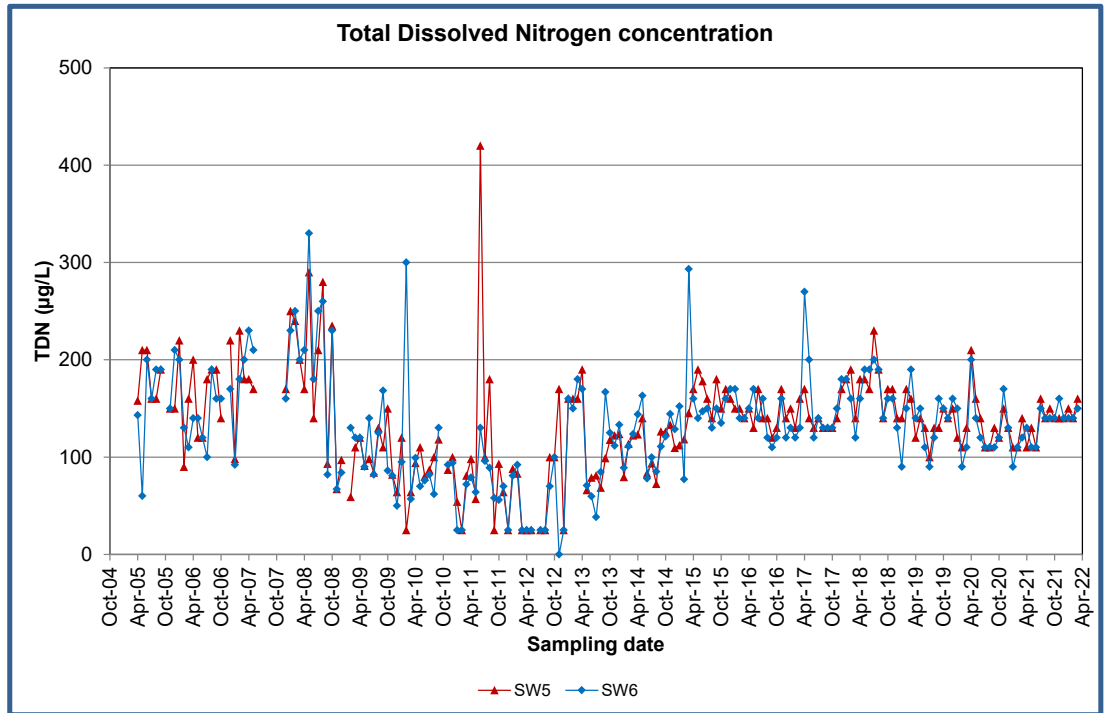


Figure 44. Total Dissolved Nitrogen variations Crawford's Creek (SW5) and Drimmie Arm (SW6). Data gaps indicate the removal of erroneous data.

4.3.10 Total Dissolved Phosphorus

Variations in Total Dissolved Phosphorus (TDP) at information sites SW5 and SW6 for 2004-22 are shown in Figure 45.

The median TDP concentrations at sites SW5 and SW6 (3 µg/L and 4 µg/L, respectively) were identical to the median values at background sites.

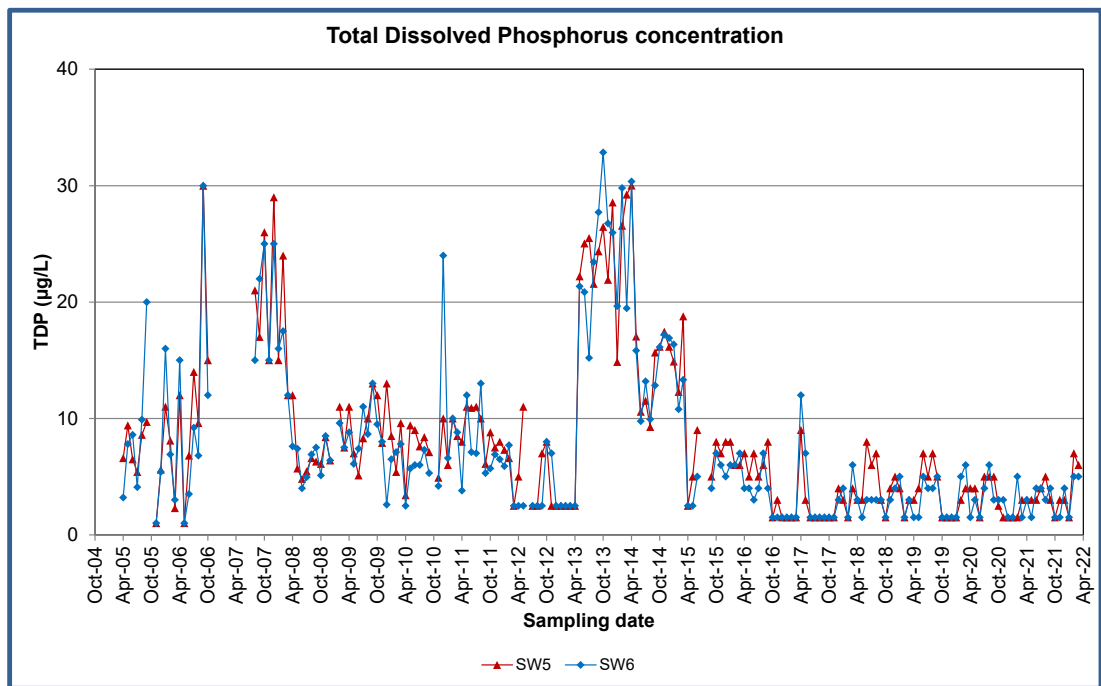


Figure 45. Total Dissolved Phosphorus variations at Crawford's Creek (SW5) and Drimmie Arm (SW6). Data gaps indicate the removal of erroneous data.

4.3.11 Dissolved Aluminium

Variations in dissolved aluminium (Al) at information sites SW5 and SW6 for 2004-22 are shown in Figure 46.

During April 2021 to March 2022 the median concentration of dissolved Al at sites SW5 (2.2 µg/L) and SW6 (2.7 µg/L) were above the range of median concentrations for the background sites (0.2 – 1.2 µg/L). The elevation of dissolved Al levels is likely associated with continual resuspension of the fine sediments at these sites as evidenced by the higher turbidity and TSS levels recorded at these two sites compared to background sites.

Dissolved Al data were affected by contamination during the collection process on several occasions during 2007-2011 resulting in falsely elevated data. These data are no longer included in the MHMP assessment.

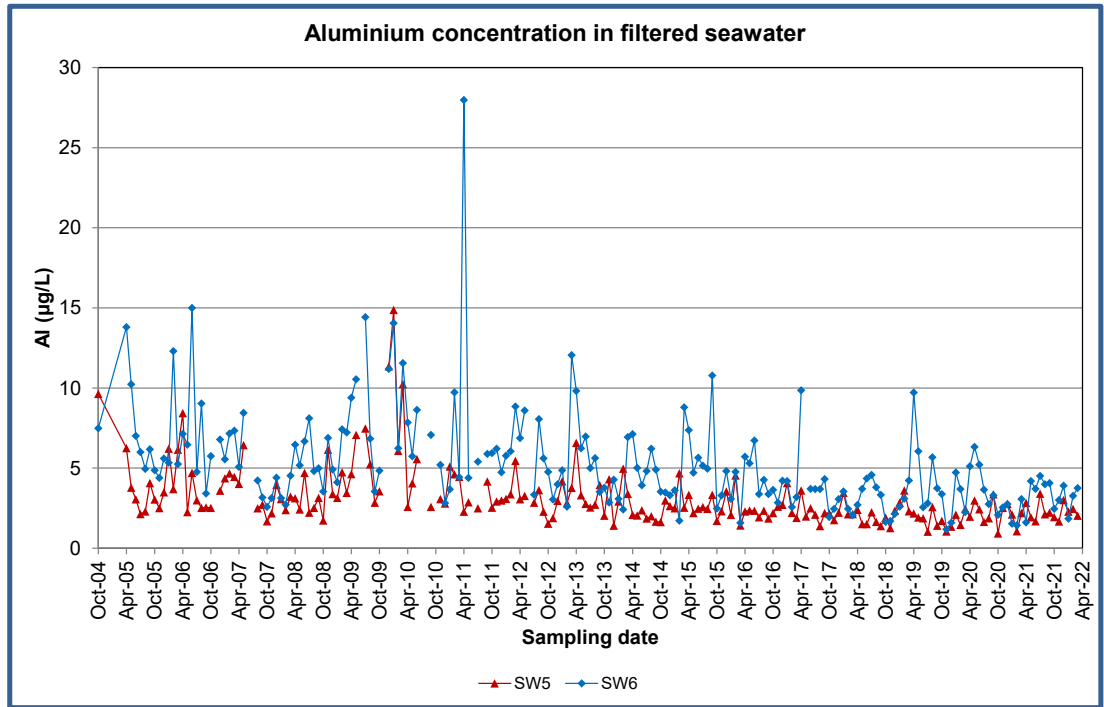


Figure 46. Dissolved aluminium variations at Crawford's Creek (SW5) and Drimmie Arm (SW6). Data gaps indicate the removal of erroneous data.

4.3.12 Dissolved Vanadium

Variations in dissolved vanadium (V) at information sites SW5 and SW6 for 2004-22 are shown in Figure 47.

During April 2021 to March 2022 the median concentration of dissolved V at site SW5 (2.2 µg/L) was within the range of median concentrations at the background sites (1.9 – 2.2 µg/L). The median concentration of dissolved V at site SW6 (2.6 µg/L) was slightly above the range of median concentrations at the background sites. Like dissolved Al, the elevation of dissolved V levels is likely associated with continual resuspension of the fine sediments at SW6. The median dissolved V concentrations at both SW5 and SW6 decreased from early 2018 like the reduced concentrations recorded in Inner Gove Harbour and at sites across Southern Melville Bay.

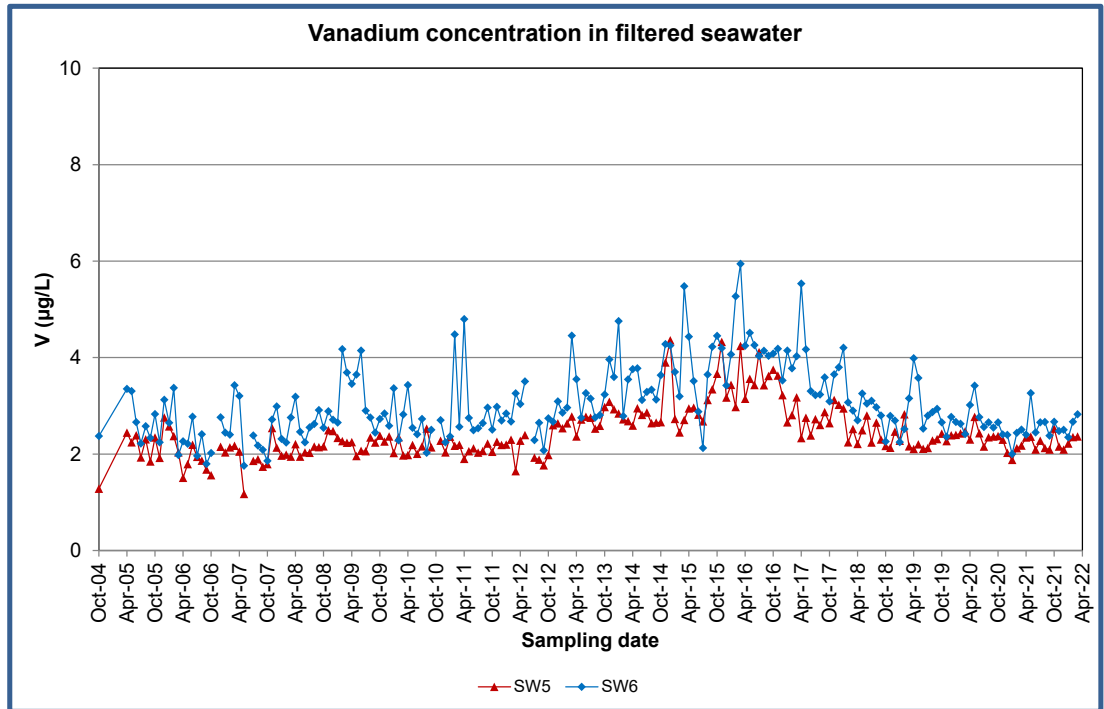


Figure 47. Dissolved vanadium variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.13 Dissolved Chromium

Variations in dissolved chromium (Cr) at information sites SW5 and SW6 for September 2020 to March 2022 are shown in Figure 48.

During April 2021 to March 2022 the median concentrations of dissolved Cr at sites SW5 and SW6 (0.11 µg/L) were within the median concentrations at the background sites (0.10 – 0.12 µg/L).

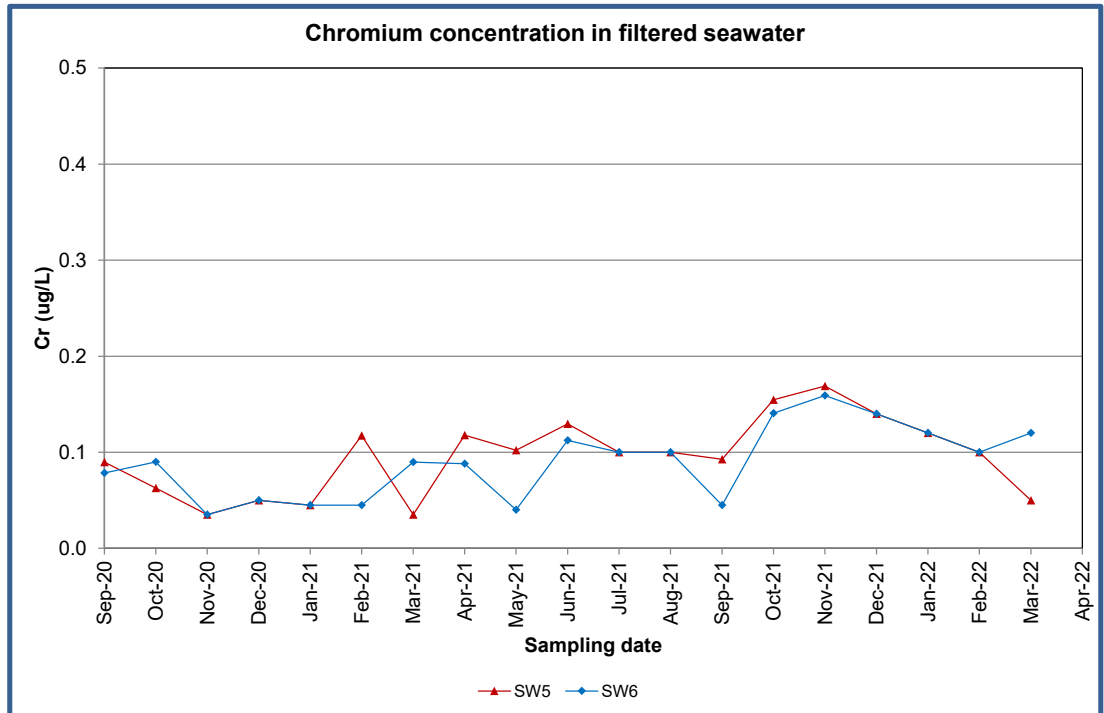


Figure 48. Dissolved chromium variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.14 Dissolved Manganese

Variations in dissolved manganese (Mn) at information sites SW5 and SW6 for 2009-22 are shown in Figure 49.

During April 2021 to March 2022 the median concentrations of dissolved Mn at sites SW5 (2.5 µg/L) and SW6 (1.8 µg/L) were higher than the median concentrations at the background sites (0.8 – 1.0 µg/L). Like dissolved Al, the elevation of dissolved Mn levels is likely associated with continual resuspension of the fine sediments at SW5 and SW6.

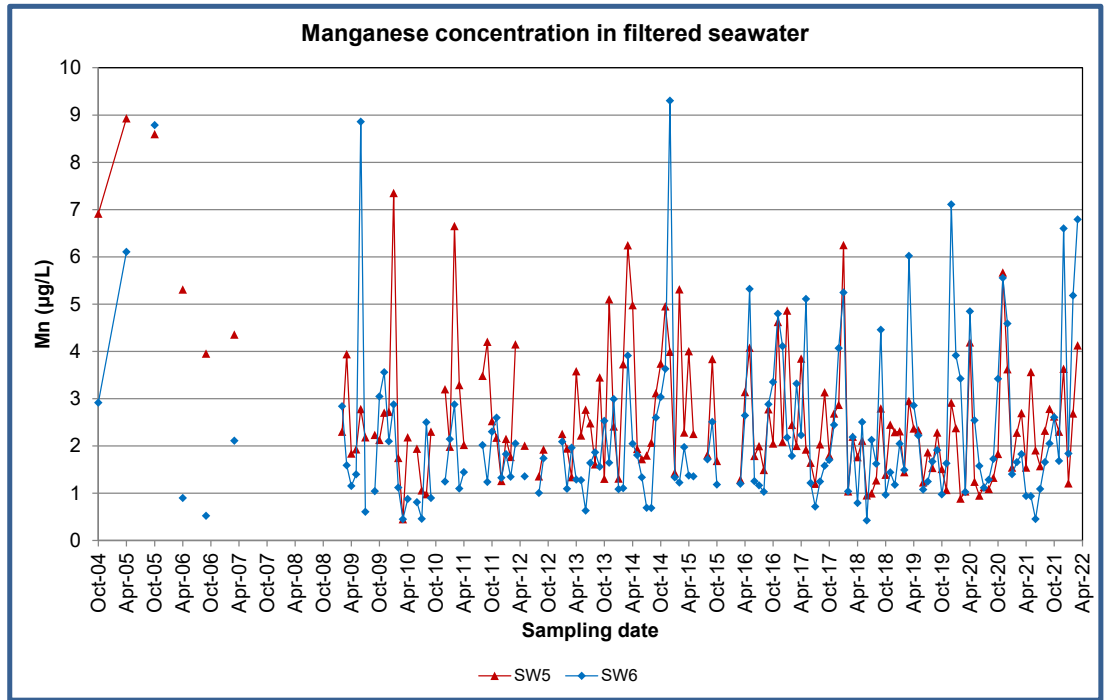


Figure 49. Dissolved manganese variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.15 Dissolved Iron

Variations in dissolved iron (Fe) at information sites SW5 and SW6 for 2009-22 are shown in Figure 50.

During April 2021 to March 2022 the median concentration of dissolved Fe at sites SW5 and SW6 (0.6 µg/L) were slightly higher than the median concentrations at the background sites (0.4 - 0.5 µg/L).

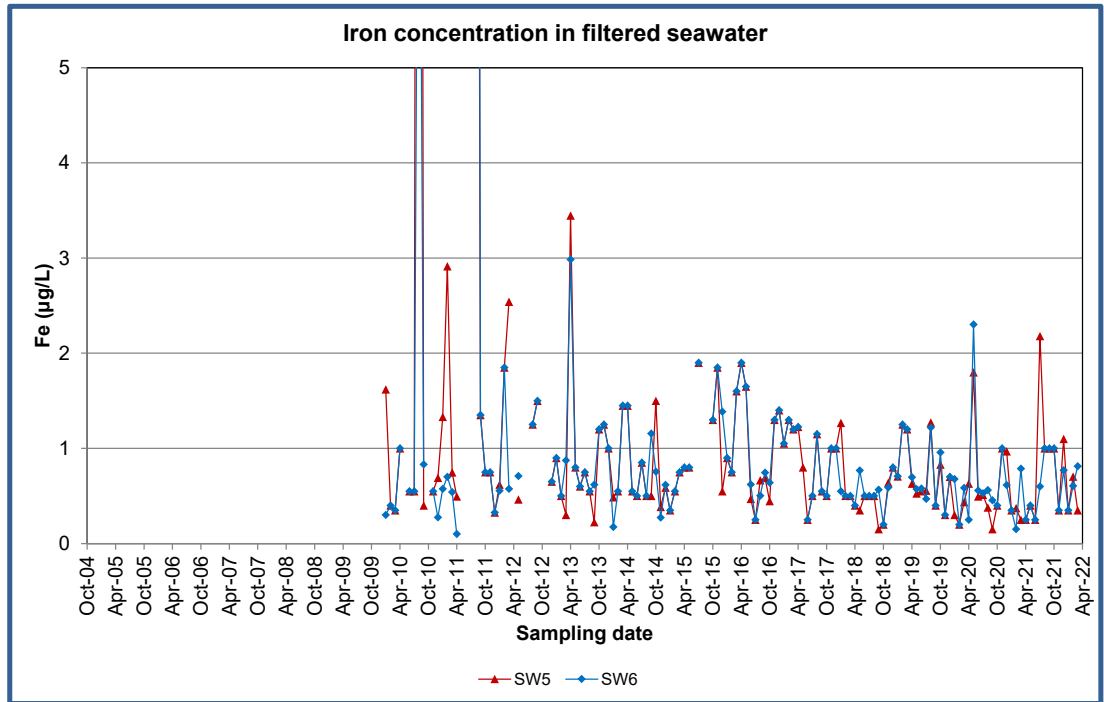


Figure 50. Dissolved iron variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.16 Dissolved Copper

Variations in dissolved Copper (Cu) at information sites SW5 and SW6 for 2004-22 are shown in Figure 51.

During April 2021 to March 2022 the median concentrations of dissolved Cu at sites SW5 and SW6 (0.1 µg/L) were similar to the median concentrations at the background sites (0.1 – 0.3 µg/L).

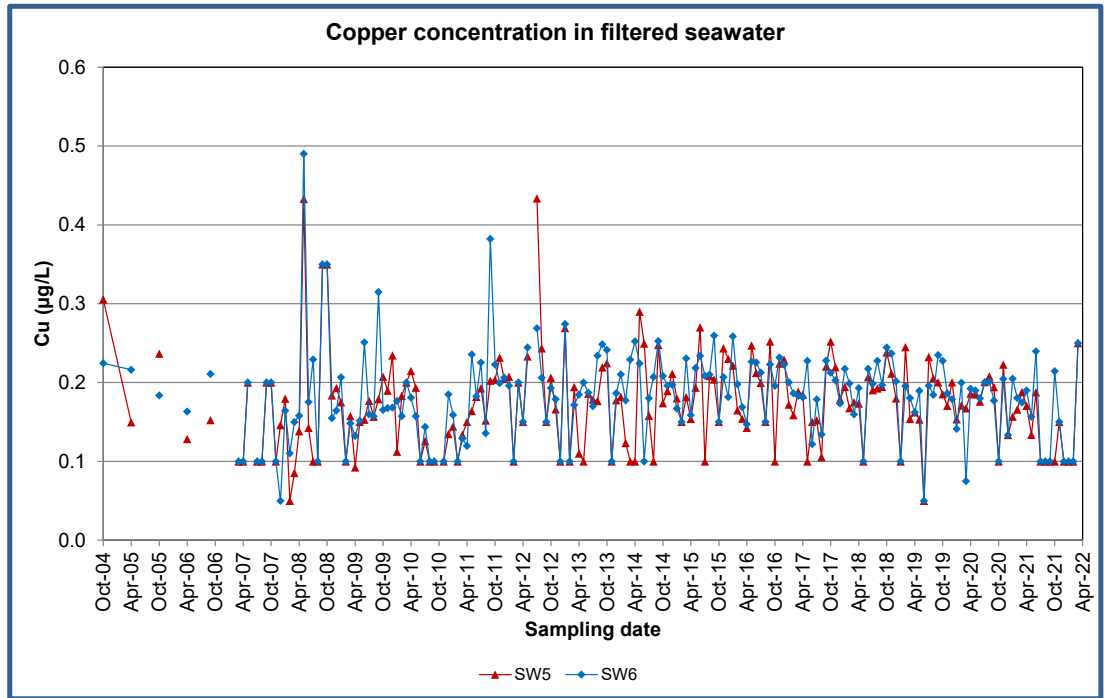


Figure 51. Dissolved copper variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.17 Dissolved Zinc

Variations in dissolved zinc (Zn) at information sites SW5 and SW6 for 2004-22 are shown in Figure 52.

During April 2021 to March 2022 the median concentrations of dissolved Zn at sites SW5 and SW6 (0.3 µg/L) were similar to the median concentrations at the background sites (0.3 – 0.4 µg/L).

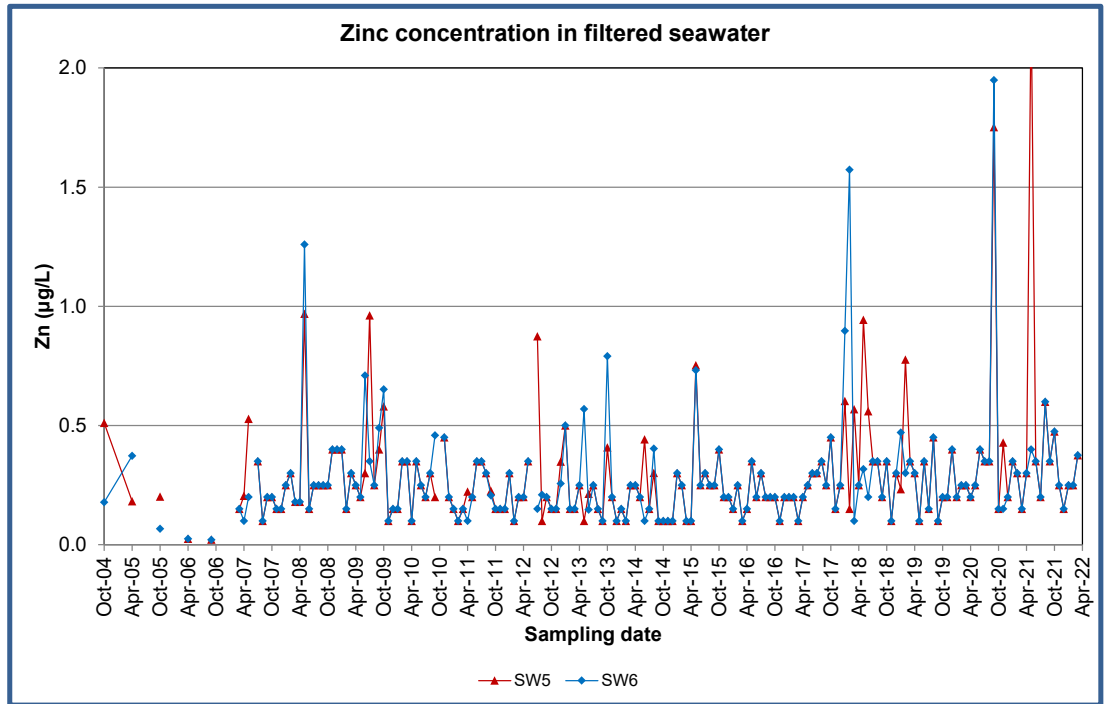


Figure 52. Dissolved zinc variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.18 Dissolved Gallium

Variations in dissolved gallium (Ga) at information sites SW5 and SW6 for 2004-22 are shown in Figure 53.

During April 2021 to March 2022 the median concentration of dissolved Ga at site SW6 (0.05 µg/L) was higher than the median concentrations at the background sites (0.01 – 0.02 µg/L). Like dissolved Al, the elevation of dissolved Ga levels is likely associated with continual resuspension of the fine sediments at SW6. The median concentration of dissolved Ga at site SW5 (0.02 µg/L) was within the range for the background sites.

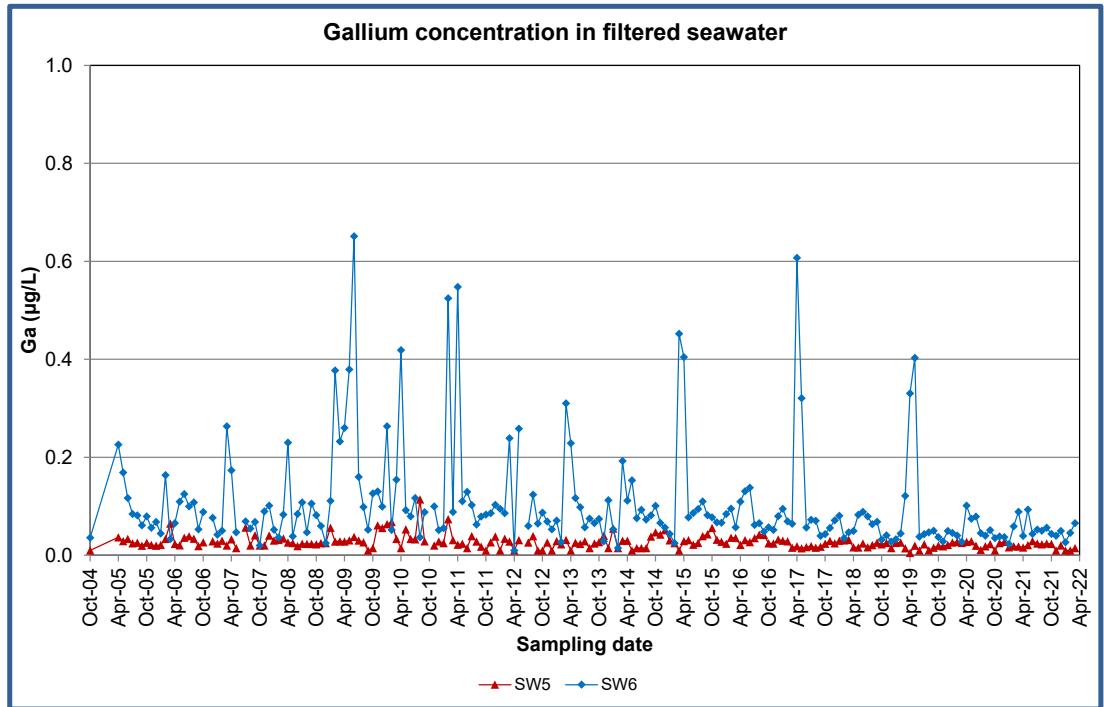


Figure 53. Dissolved gallium variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.19 Dissolved Arsenic

Variations in dissolved arsenic (As) at information sites SW5 and SW6 for 2004-22 are shown in Figure 54.

During April 2021 to March 2022 the median concentration of dissolved As at site SW5 (1.4 µg/L) and SW6 (1.5 µg/L) was within the range of median concentrations at the background sites (1.4 – 1.5 µg/L).

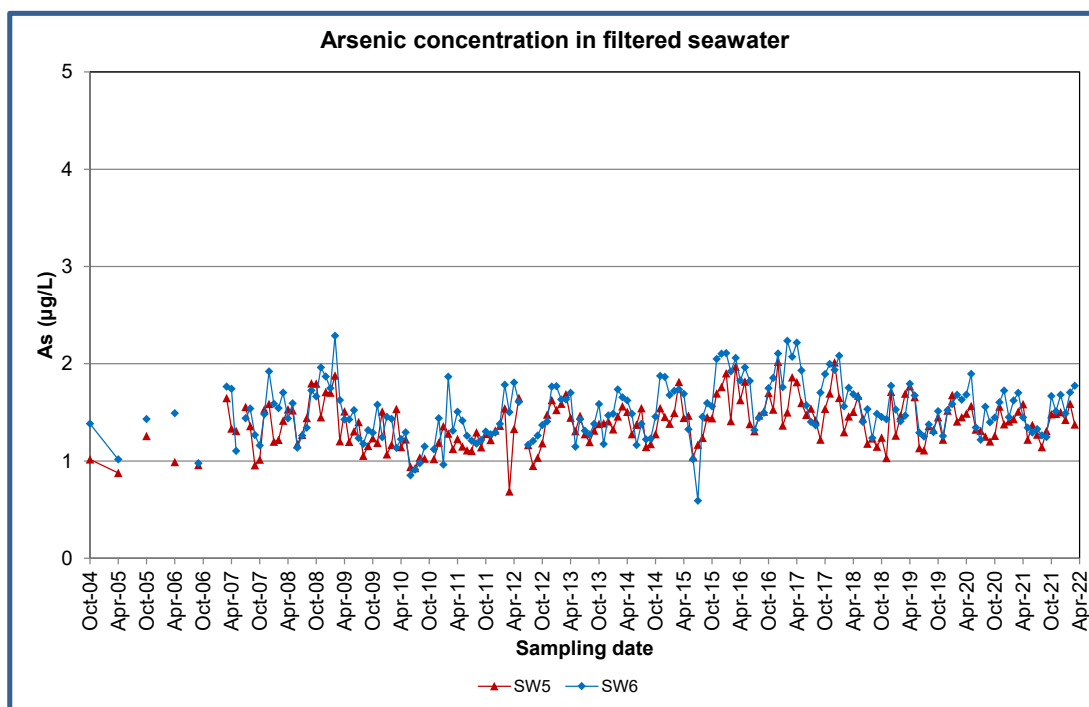


Figure 54. Dissolved arsenic variations Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.20 Dissolved Molybdenum

Variations in dissolved molybdenum (Mo) at information sites SW5 and SW6 for 2004-22 are shown in Figure 55.

During April 2021 to March 2022 the median concentration of dissolved Mo at both sites SW5 and SW6 (10.8 µg/L) were similar to the range of median concentrations at the background sites (10.5 – 10.8 µg/L).

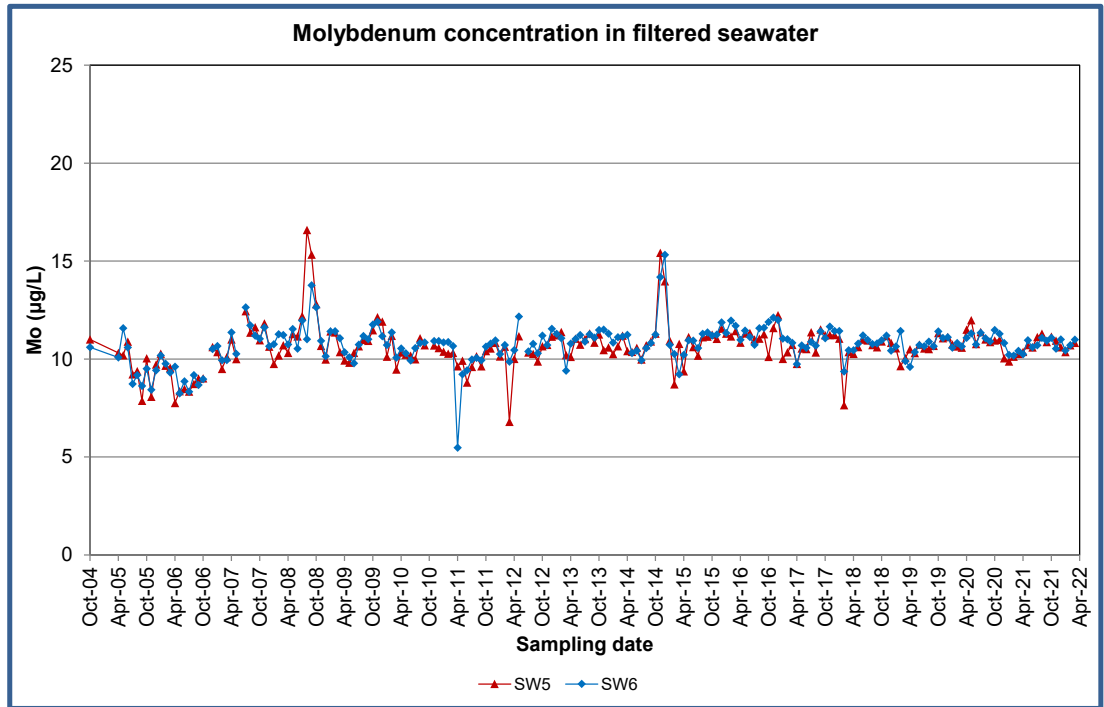


Figure 55. Dissolved molybdenum variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.3.21 Dissolved Uranium

Variations in dissolved uranium (U) at monitoring sites SW5 and SW6 for 2012-22 are shown in Figure 56.

During April 2021 to March 2022 the median concentration of dissolved U at sites SW5 and SW6 (3.2 µg/L and 3.3 µg/L, respectively) were similar to the median concentrations at the background sites (3.2 - 3.3 µg/L).

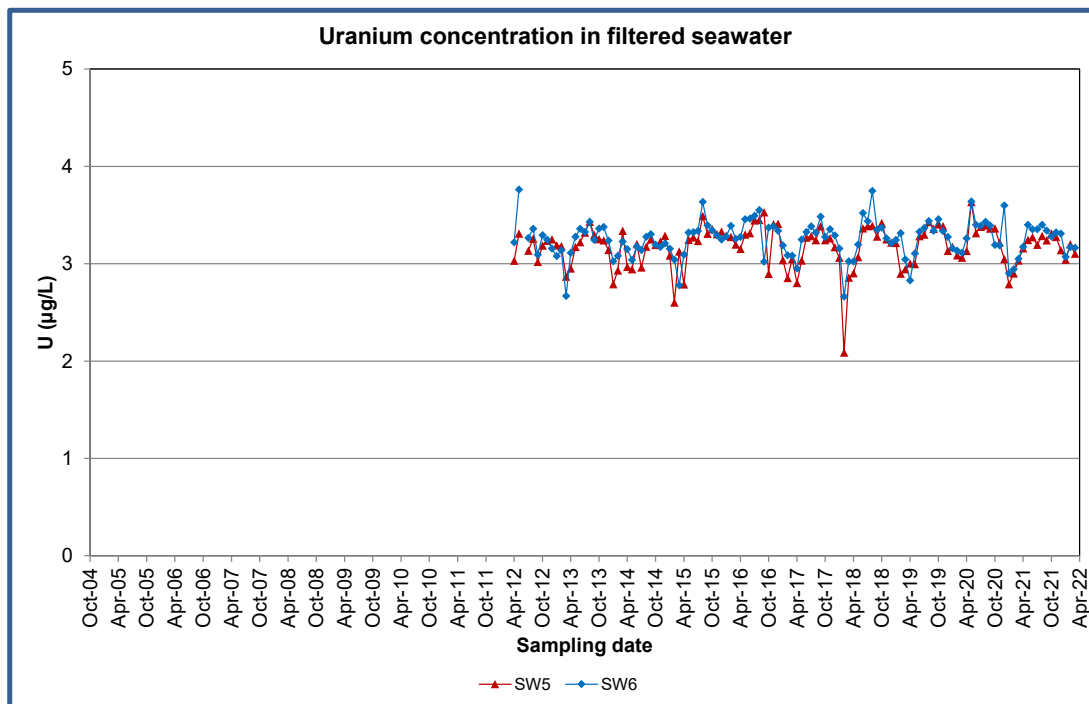


Figure 56. Dissolved uranium variations at Crawford's Creek (SW5) and Drimmie Arm (SW6).

4.4 Sediment

Annual sediment sampling under the MHMP was carried out in April 2021. The analytical data is provided in Appendix 3 which also contains summary statistics for all sampling events (2004-2021) for the following sampling areas:

- Background sites,
- Inner Harbour sites,
- Drimmie Arm sites,
- Crawford's Creek sites.

Monitoring of sediment composition is required under the RTG MHMP. A qualitative comparison of the temporal and spatial variation in average compositions for each of the four groups listed above is carried out on an annual basis.

Where available, comparisons are made to the Australian and New Zealand Environment and Conservation Council guideline concentrations (ANZG 2018).

4.4.1 Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) concentrations in the <2mm fraction of sediment samples from 2004-2021 are shown in Figure 57.

The Inner Harbour sediments had elevated concentrations of TKN concentrations during 2004-2021 compared to background sites. A similar finding was reported by Alongi (2006, 2007) who discussed the link to the RTG Refinery wastewater discharge and nutrient cycling in Inner Gove Harbour.

Drimmie Arm sediments had TKN concentrations similar to the background sites.

Crawford's Creek sediments had elevated TKN concentrations compared to the background sites during most sampling events. This is likely to be related to a higher content of organic material typically present in mangrove lined creeks such as Crawford's Creek. There has been no clear trend in temporal variations.

There is no recommended ANZG sediment quality guideline value for TKN in sediments.

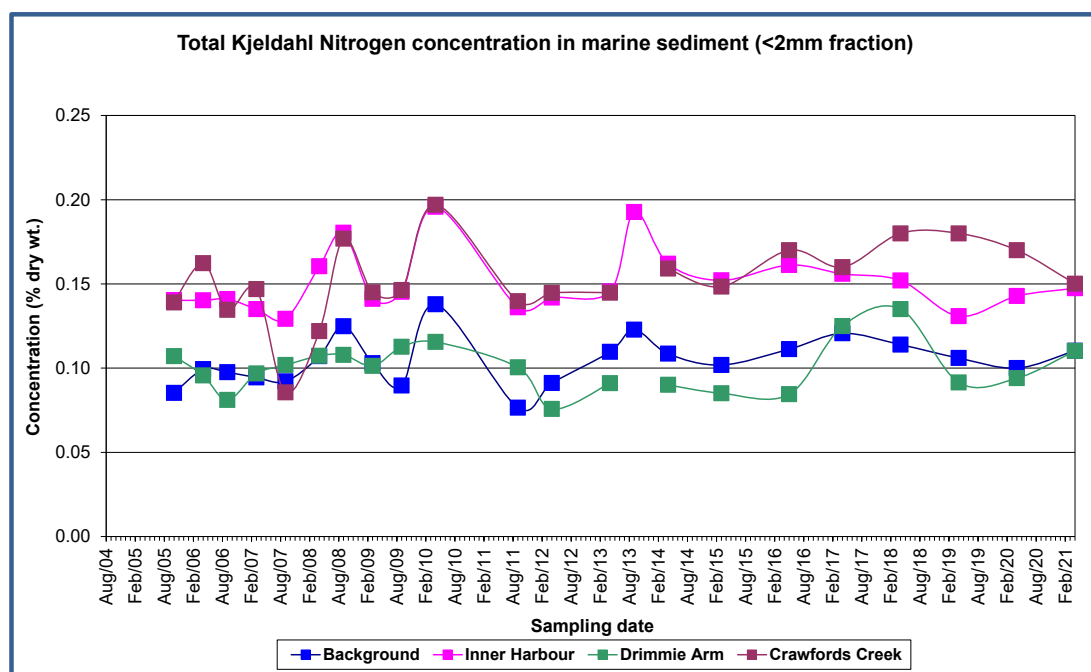


Figure 57. Temporal variations in the average Total Kjeldahl Nitrogen (TKN) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.2 Magnesium

Magnesium (Mg) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 58.

The Inner Gove Harbour sediments had elevated Mg concentrations during 2004-2021 compared to background sites. This can be linked to previous RTG Refinery discharges and associated deposits of hydrotalcite in Inner Gove Harbour (Parry and Munksgaard, April 2005; Munksgaard and Parry Sept 2005, 2006b, 2006c, 2009). The average Mg concentration in the surface sediments of the Inner Harbour samples was approximately 5.1 % dry wt. in September 2006. Since 2008 this has reduced to approximately 2.9 % dry wt. in April 2021. This reduction is likely to correspond to a decline in the amount of hydrotalcite present in the surface layers of Inner Harbour sediment as a result of mixing with natural sediments/sand.

Drimmie Arm and Crawford's Creek sediments had Mg concentrations similar to the background sites (2.3 % Mg dry wt.). Sediment at the Drimmie Arm and Crawford's Creek sites had approximately 2.3 % and 2.1 % Mg dry wt., respectively, in April 2021.

There is no recommended ANZG sediment quality guideline value for Mg.

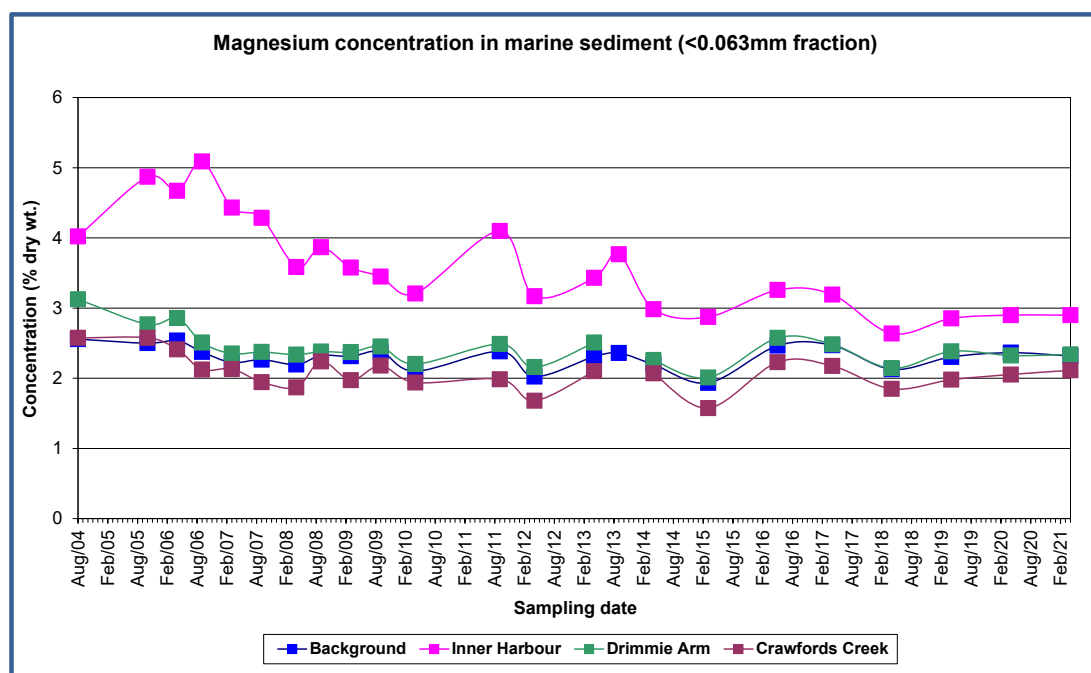


Figure 58. Temporal variations in the average magnesium (Mg) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.3 Aluminium

Aluminium (Al) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 59.

Sediment in Inner Gove Harbour and at background sites had similar Al concentrations during 2004-2021. Despite the high content of Al in hydrotalcite, Al is not elevated in Inner Harbour sediments as the general Al level is high in Southern Melville Bay sediments due to their high content of clay minerals.

Drimmie Arm and Crawford's Creek sediments had slightly higher Al concentrations than background sites throughout 2004-2021 which is likely due to their slightly higher clay content (fine average grainsize).

There is no recommended ANZG sediment quality guideline value for Al.

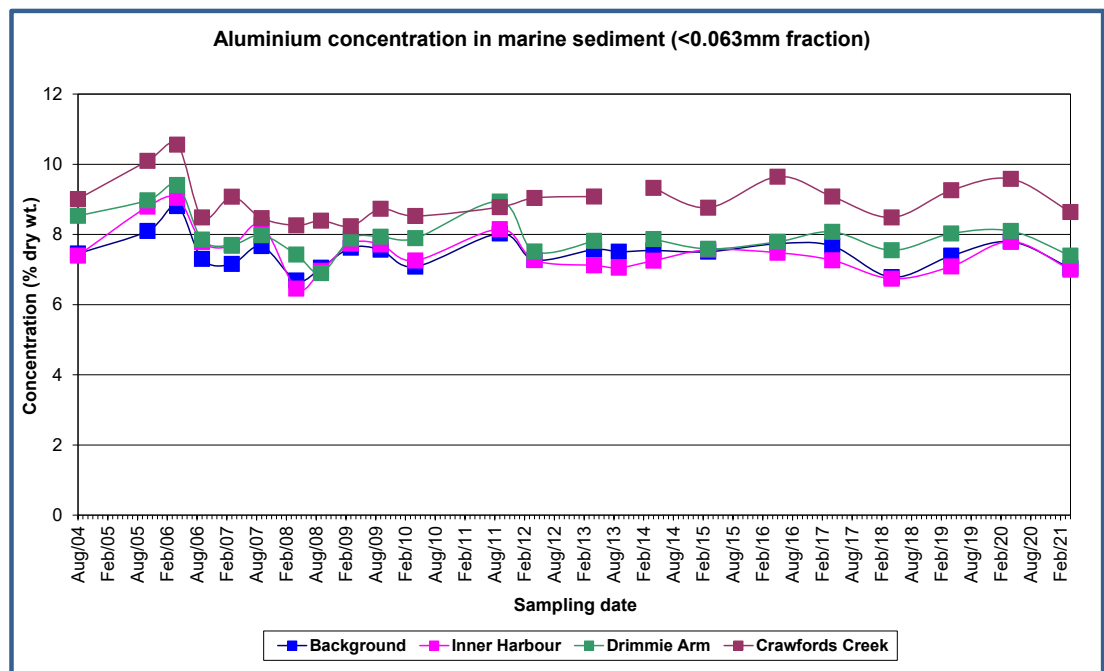


Figure 59. Temporal variations in the average aluminium (Al) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.4 Vanadium

Vanadium (V) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 60.

Sediment in Inner Gove Harbour had similar or slightly higher V concentrations than sediment at background sites during 2004-2013. In 2014-2018, V concentrations in sediment increased in Inner Gove Harbour compared to previous years. This increase is likely related to the increased concentration of V in the discharge from the Waste Water Neutralisation Plant (WWNP) during 2012 - 2018. Since then, V concentrations have decreased slightly as discharges became intermittent and decreased from March 2018.

Drimmie Arm and Crawford's Creek sediments had similar or slightly higher V concentrations than background sites throughout 2004-2021.

During 2004 to early 2006 there was an increase in average V concentrations in sediment from all four areas. This was followed by a rapid decrease in concentrations during late 2006 to early 2007. The reasons for these rapid changes in V concentration are unknown.

There is no recommended ANZG sediment quality guideline values for V.

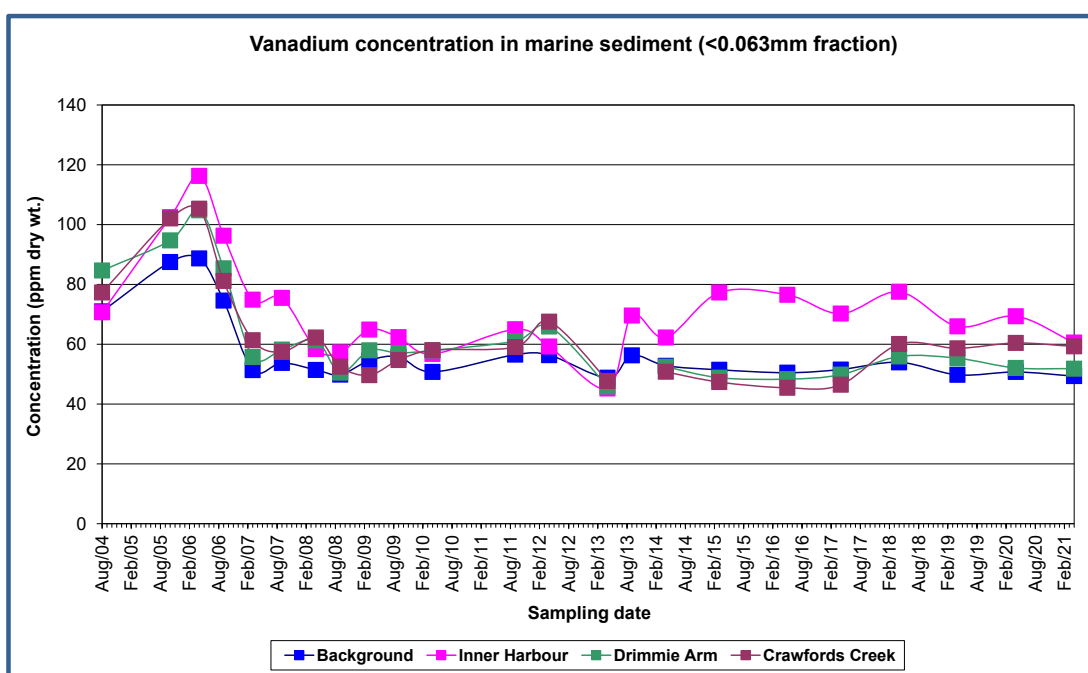


Figure 60. Temporal variations in the average vanadium (V) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.5 Manganese

Manganese (Mn) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 61 (Mn was not analysed

during (2010-11). The average Mn concentrations in sediment from all areas have remained approximately constant since 2006.

There is no recommended ANZG sediment quality guideline value for Mn.

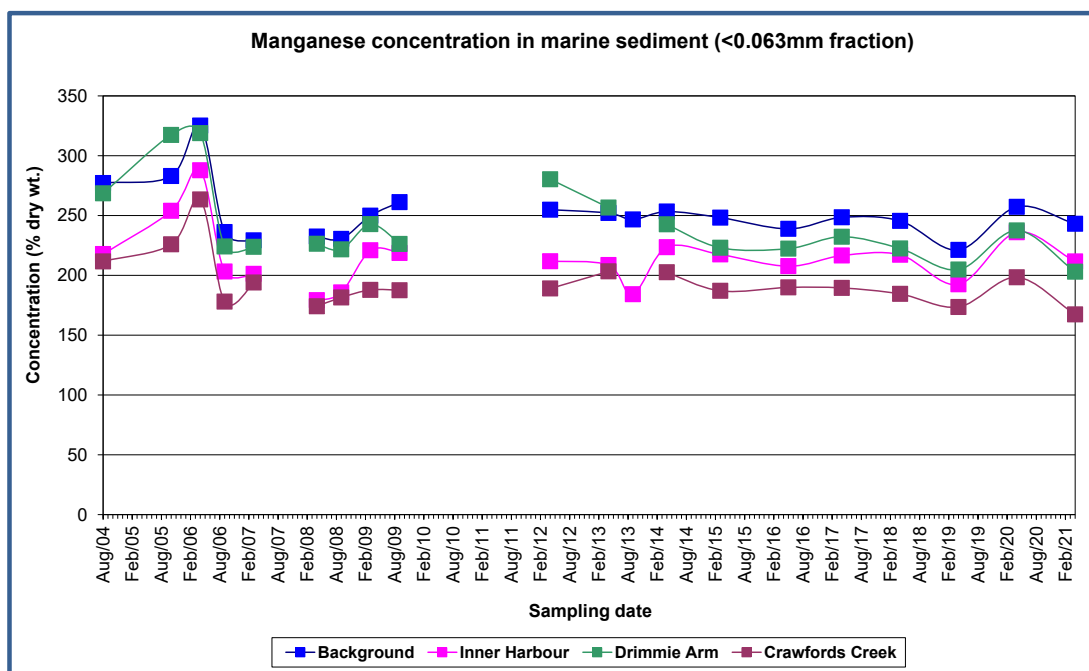


Figure 61. Temporal variations in the average manganese (Mn) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.6 Iron

Iron (Fe) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 62 (Fe was not analysed during 2007-11). There have been no consistent trends in the average Fe concentrations in sediment from all areas since 2011.

There is no recommended ANZG sediment quality guideline value for Fe.

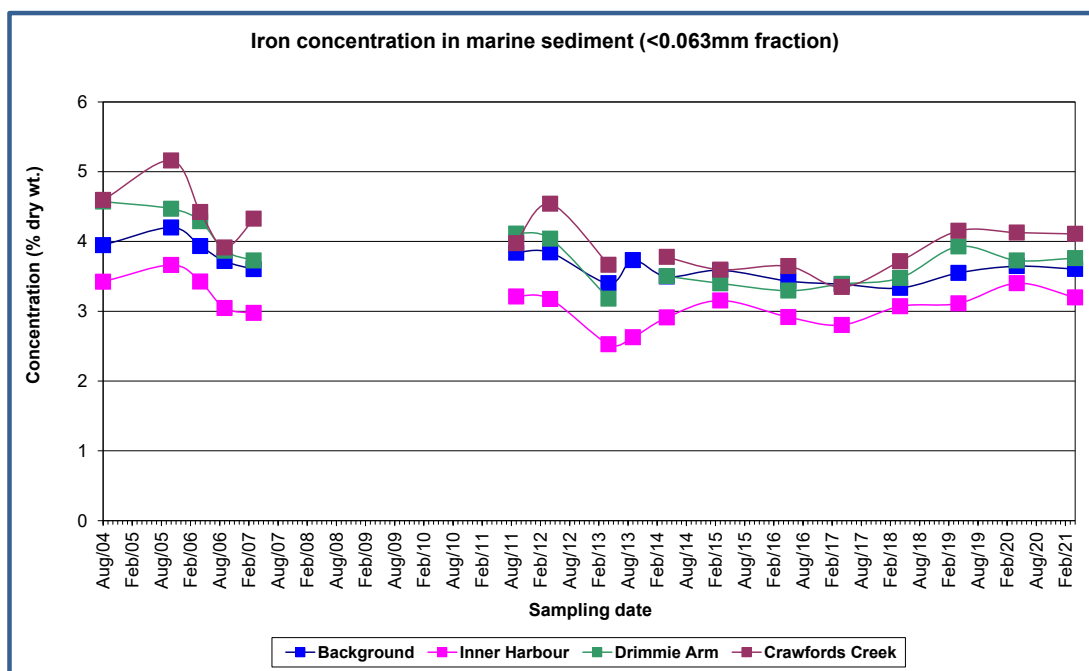


Figure 62. Temporal variations in the average iron (Fe) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.7 Zinc

Zinc (Zn) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 63.

The Inner Harbour sediments had elevated concentrations of Zn during 2004-2021 compared to background sites. Previous refinery wastewater from the Western Channel contained elevated concentrations of Zn, and in the Inner Harbour sediments Zn became bound to sulfides associated with high rates of microbial activity (Alongi, 2006, 2007; Munksgaard and Parry 2006b, 2006c). There are likely additional sources of Zn, such as harbour infrastructure and shipping activity, in Inner Gove Harbour. The average Zn concentrations in surface sediments have decreased substantially between 2004 (97 ppm dry wt.) and 2021 (56 ppm dry wt.).

Drimmie Arm and Crawford's Creek sediments had Zn concentrations similar to the background sites.

The average Zn concentrations for all sampling areas are well below the ANZG sediment quality guideline values (SQGV = 200 mg/kg (ppm); SQG-High = 410 mg/kg (ppm)). Note that the SQGVs are usually applied to the <2mm grainsize fraction; comparing to the <0.063mm grainsize fraction, as done here, is therefore conservative as metals and metalloids are predominantly concentrated in the finer silt and clay fraction.

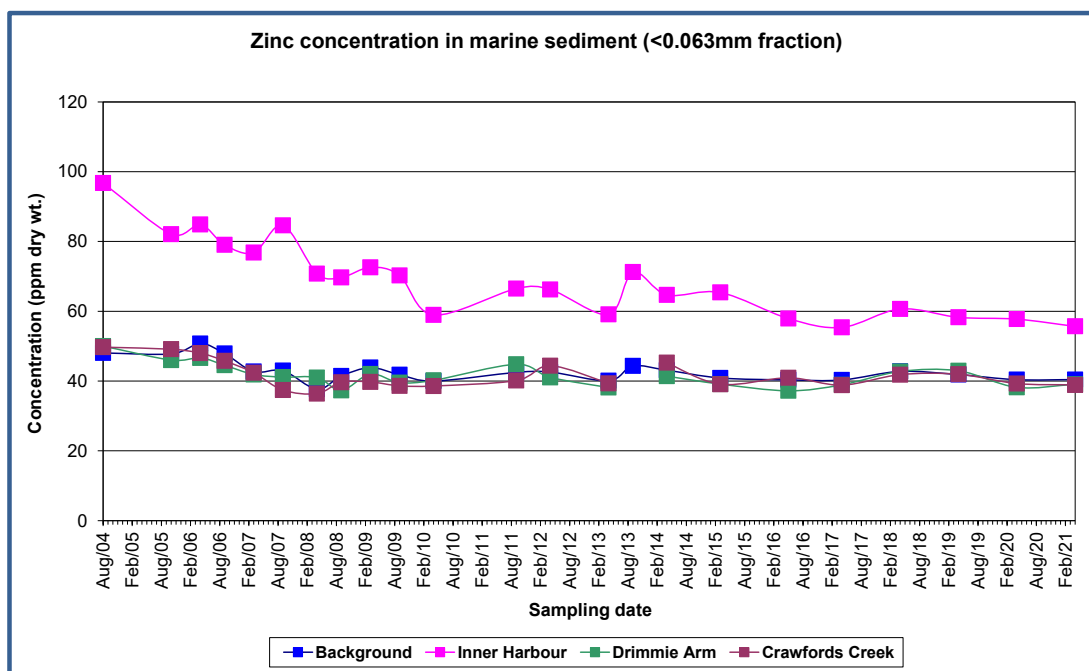


Figure 63. Temporal variations in the average zinc (Zn) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021. SQGV=200 mg/kg (ppm).

4.4.8 Gallium

Gallium (Ga) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 64.

The Inner Harbour sediments had elevated concentrations of Ga during 2004-2021 compared to background sites. This can be ascribed to the presence of high concentrations of hydrotalcite precipitates in the Inner Harbour sediments (Munksgaard and Parry, 2006b, 2006c, 2009). Gallium concentrations were lower in 2008-2021 than during 2004-2007.

Drimmie Arm and Crawford's Creek sediments had small degrees of elevation in Ga throughout 2004-2021 compared to background sites.

There is no recommended ANZG sediment quality guideline value for Ga.

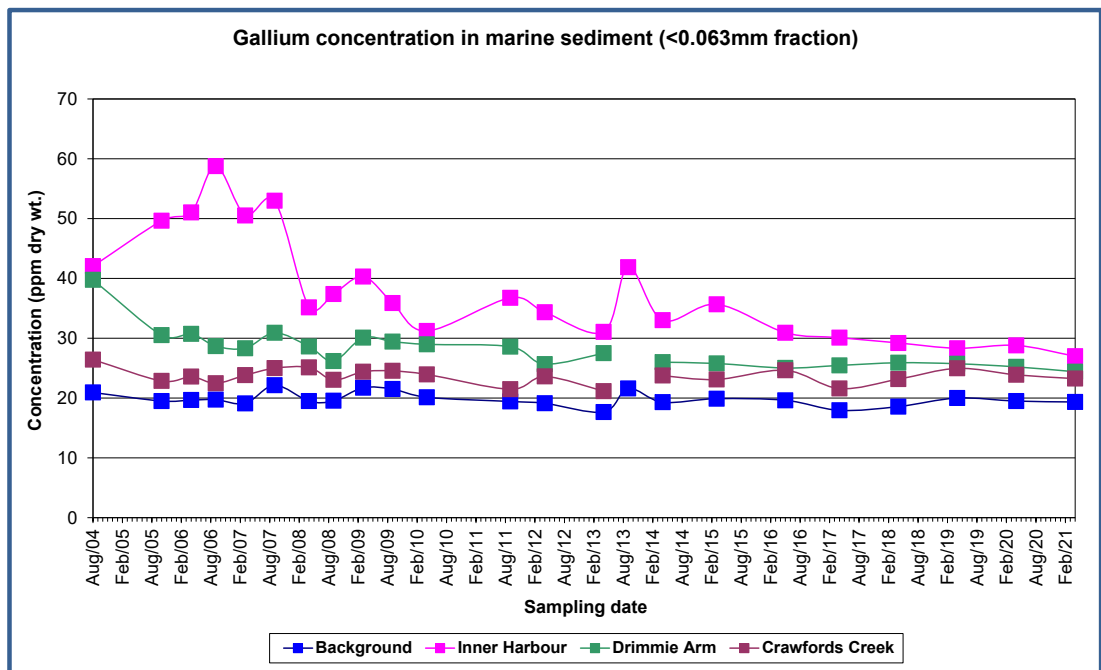


Figure 64. Temporal variations in the average gallium (Ga) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.9 Arsenic

Arsenic (As) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 65.

The Inner Harbour sediments had elevated concentrations of As during 2004-2007 compared to background sites. However, As concentrations have decreased since 2007 and are now at background concentrations.

Drimmie Arm and Crawford's Creek sediments have had elevated As throughout 2004-2021 compared to background sites. The higher As concentrations in Drimmie Arm and Crawford's Creek are likely to be due to anoxic accumulation in sulfide-rich fine grained sediment predominant in this shallow, mangrove lined part of southern Melville Bay.

The average As concentrations for all sampling areas were below the ANZG sediment quality guideline values (SQGV = 20 mg/kg (ppm); SQG-High = 70 mg/kg (ppm)).

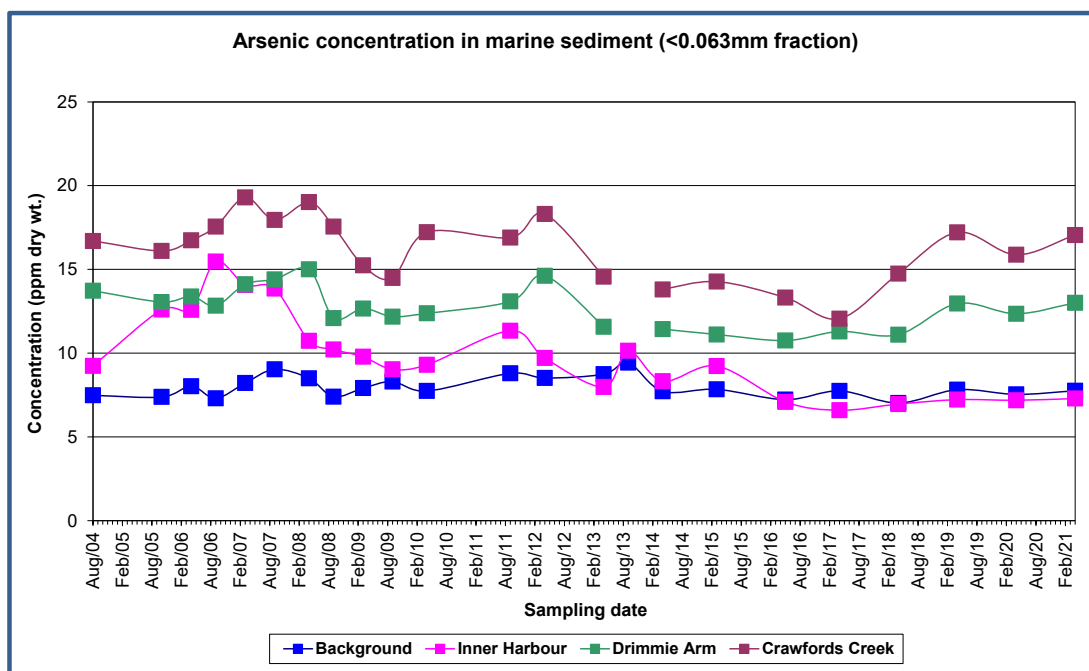


Figure 65. Temporal variations in the average arsenic (As) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021. SQGV=20mg/kg (ppm).

4.4.10 Molybdenum

Molybdenum (Mo) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 66.

The Inner Harbour sediments had elevated, but fluctuating, concentrations of Mo throughout 2004-2021 compared to background sites. This is likely to be linked to the elevated concentrations of refinery-derived hydrotalcite precipitates and/or formation of molybdenum sulfides in Inner Harbour sediments (Munksgaard and Parry, 2006b, 2006c, 2009). Concentrations have stabilised since 2017 to 2-2.5 ppm.

Drimmie Arm and Crawford's Creek sediments had Mo concentrations slightly above the background sites.

There is no recommended ANZG sediment quality guideline value for Mo.

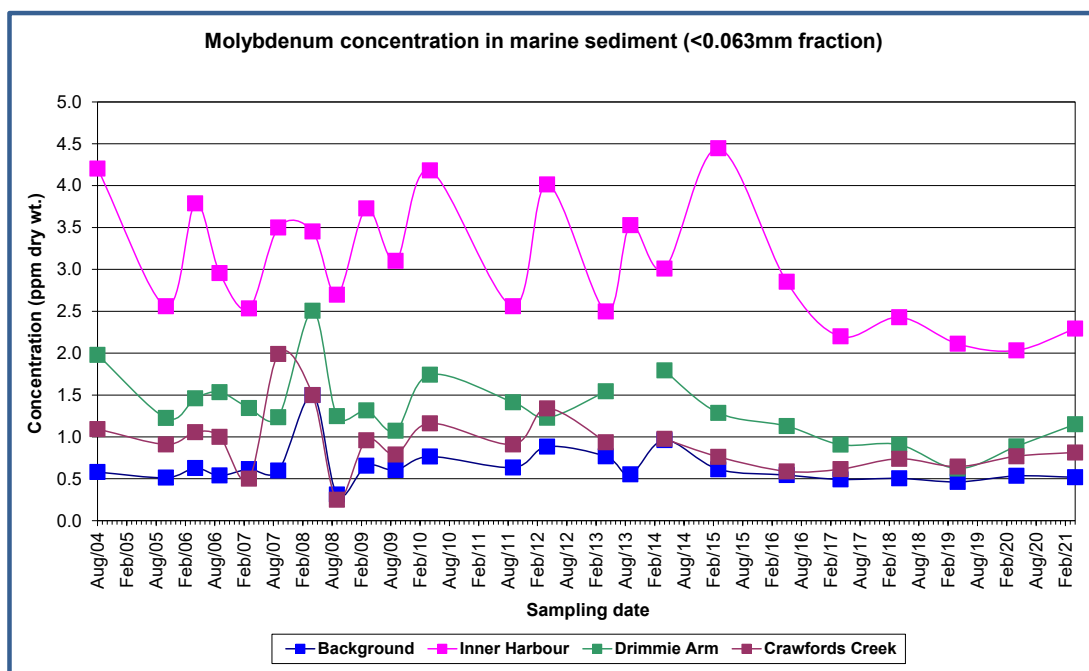


Figure 66. Temporal variations in the average molybdenum (Mo) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021.

4.4.11 Cadmium

Cadmium (Cd) concentrations in the <0.063mm fraction of sediment samples from 2004-2021 are shown in Figure 67.

The Inner Harbour sediments have had elevated concentrations of Cd during 2004-2021 compared to background sites. However, Cd concentrations in sediment have reduced slightly from approximately 0.3 – 0.4 mg/kg during 2004-2009 to approximately 0.25 mg/kg since 2014. Cadmium is not commonly elevated in any refinery wastewater streams (Parry and Munksgaard, 2005, Munksgaard and Parry, 2006a, 2006b, 2006c, 2009) but may be derived from other anthropogenic or natural sources within the harbour. Cadmium is likely to be bound to sulfide phases generated microbially in the hydrotalcite impacted sediments.

Drimmie Arm and Crawford's Creek sediments had Cd concentrations similar to background site sediments.

The average Cd concentrations for all sampling areas are below the ANZG sediment quality guideline values (SQGV = 1.5 mg/kg (ppm); SQG-High = 10 mg/kg (ppm)).

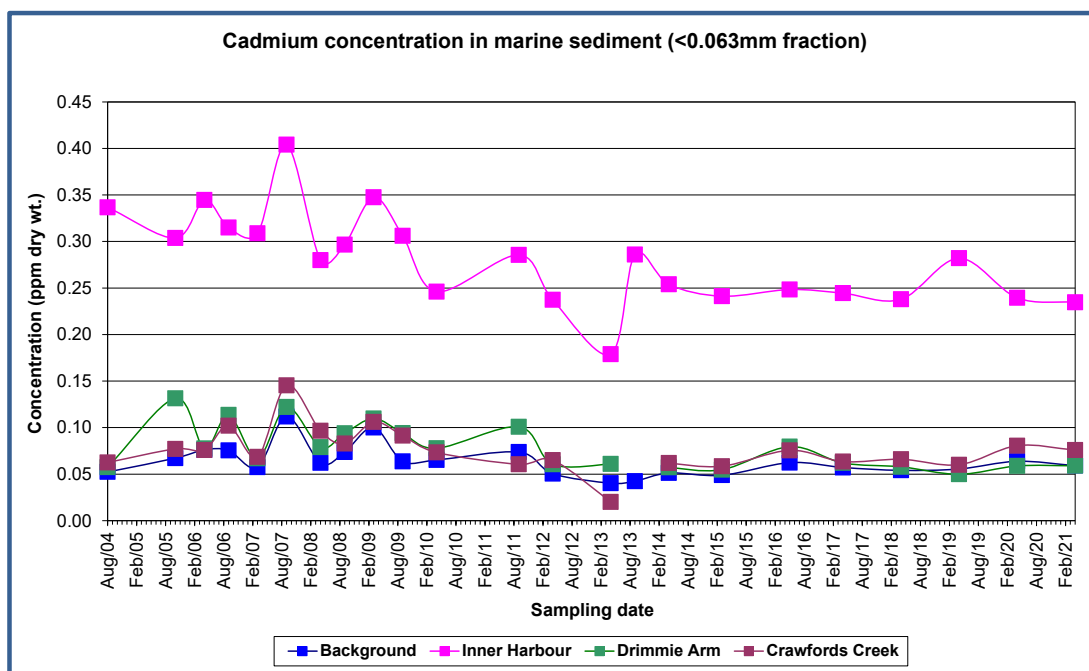


Figure 67. Temporal variations in the average cadmium (Cd) concentration in sediments at Inner Harbour, Background, Drimmie Arm and Crawford's Creek sites 2004-2021. SQGV=1.5mg/kg (ppm).

4.4.12 Other monitored elements

Copper (Cu) concentrations were slightly elevated in Inner Harbour sediments compared to the other sampling areas (Appendix 3). Copper may be derived from previous discharges from the refinery's Western Channel as well as a range of harbour sources and general shipping activity. Sedimentary Cu is likely bound by sulfides. Copper concentrations for all sampling sites are well below the ANZG sediment quality guideline values (SQGV = 65 mg/kg (ppm); SQG-High = 270 mg/kg (ppm)).

Lead (Pb) concentrations are not elevated in the Inner Harbour sediments (Appendix 3) and are not commonly elevated in any refinery wastewater streams (Parry and Munksgaard, 2005, Munksgaard and Parry, 2006a, 2006b, 2006c). Lead concentrations for all sampling areas are below the ANZG sediment quality guideline values (SQGV = 50 mg/kg (ppm); SQG-High = 220 mg/kg (ppm)).

Uranium (U) is slightly elevated in Inner Harbour sediments (Appendix 3) but is not commonly elevated in any refinery wastewater streams (Parry and Munksgaard, 2005, Munksgaard and Parry, 2006a, 2006b, 2006c). The small increase in U may be due to extraction of U from seawater by organic-rich hydrotalcite impacted sediments under reducing conditions. Crawford's Creek sediment is also slightly elevated in U compared to background sediment which may be related to a higher organic content in sediment of the mangrove lined creek. There is no recommended ANZG sediment quality guideline value for U in sediments.

4.5. Oysters

Monitoring of metal and As concentrations in oyster soft tissue is required under the MHMP. A qualitative comparison of the temporal and spatial variation in average compositions at four sites listed below is carried out on an annual basis.

Bi-annual oyster sampling under the MHMP was carried out in April and October 2021. The analytical data is provided in Appendix 4 which also contains summary statistics for all sampling events (2004-2021) for the following sampling areas:

- Granite Island
- Harbour Islets
- West Woody Island
- Bonner Rocks

A qualitative comparison of the temporal variation in average compositions for each of the four groups above is carried out on a half-yearly basis. Where available, comparisons are made to Australia New Zealand Food Authority maximum permitted concentrations of metals in food (FSANZ 2021).

4.5.1. Aluminium

Aluminium (Al) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 68.

For the four sites sampled during 2004-21 oyster Al concentrations were variable with no clear overall temporal trend. During this period, the average Al concentrations for the four oyster collection sites were: Harbour Islets: 9.0 +/- 2.6, West Woody Island: 8.6 +/- 1.7, Granite Islands: 6.1 +/- 2.2 and Bonner Rocks: 3.2 +/- 0.4 mg/kg wet weight. It is notable that the mean Al concentration in oysters for the period 2014-2021 show a statistically significant ($P = 0.02$) decrease with increasing distance from Gove Harbour and the RTAG refinery.

There is no FSANZ (2021) food standard for Al.

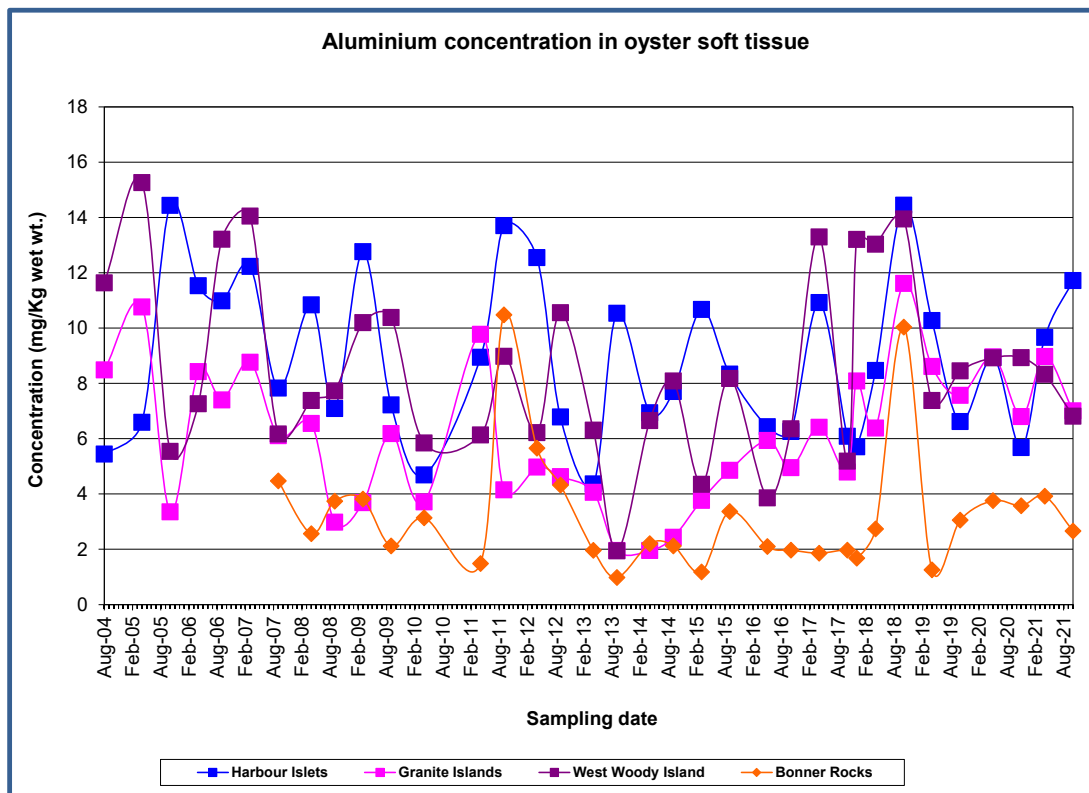


Figure 68. Temporal variations in the average aluminium (Al) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.2. Vanadium

Vanadium (V) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 69.

At Bonner Rocks and West Woody Island, oyster V concentrations were variable during 2004-2021. At Harbour Islets and Granite Islands highly variable concentrations of V have been recorded since 2014. Relatively high values compared to the other sampling sites were recorded in September 2014, May 2016 and April 2018. However, at other sampling times since 2014 the V concentrations at Harbour Islets and Granite Islands were similar to those recorded at Bonner Rocks and West Woody Island. Following the cessation of WWNP discharges in March 2018, V concentrations in oysters have been amongst the lowest recorded since 2004. From April 2020 the WWNP has been operating intermittently.

During 2004-21, the average V concentrations for the four oyster collection sites were: Harbour Islets: 0.31 +/- 0.11, West Woody Island: 0.37 +/- 0.07, Granite Islands: 0.34 +/- 0.05 and Bonner Rocks: 0.19 +/- 0.01 mg/kg wet weight.

There is no FSANZ (2021) food standard for V.

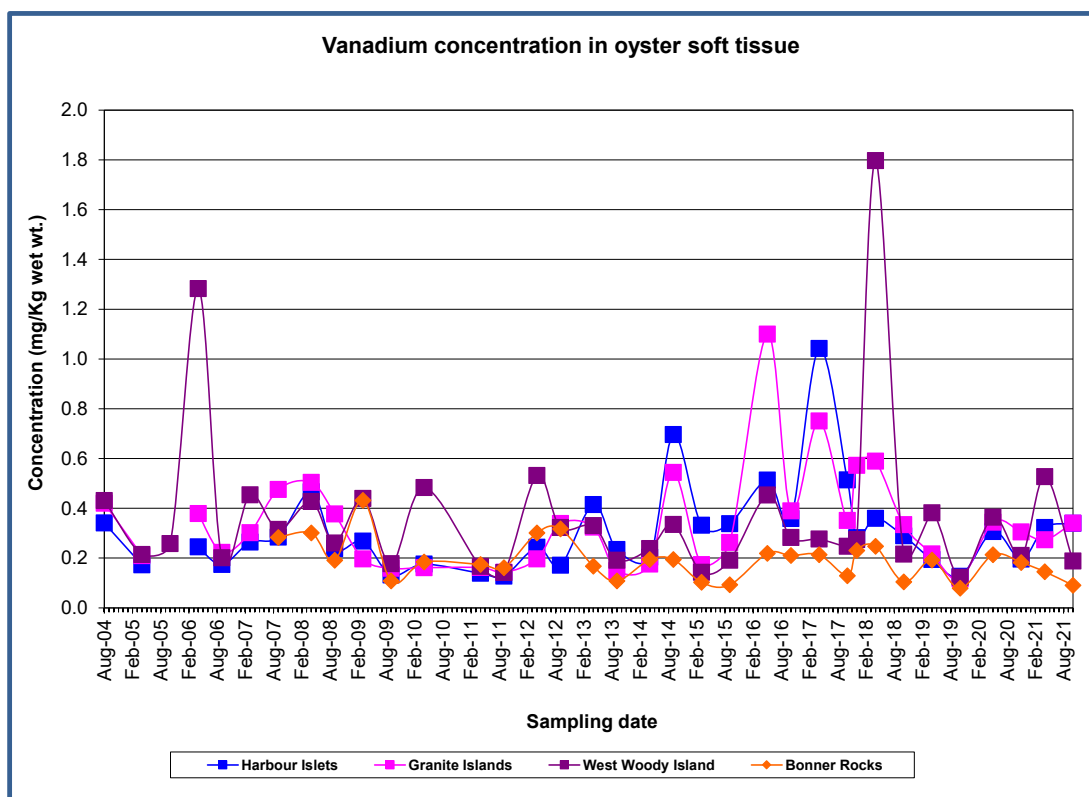


Figure 69. Temporal variations in the average vanadium (V) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.3. Manganese

Manganese (Mn) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 70. Note there are gaps in the data set as Mn was not included as an analyte in the oyster monitoring program on a consistent basis prior to 2016.

For the four sites sampled during 2004-21 oyster Mn concentrations were variable with no clear temporal trend. During this period, the average Mn concentrations for the four oyster collection sites were: Harbour Islets: 1.00 +/- 0.23, West Woody Island: 1.41 +/- 0.50, Granite Islands: 1.04 +/- 0.42 and Bonner Rocks: 0.99 +/- 0.27 mg/kg wet weight.

There is no FSANZ (2021) food standard for Mn.

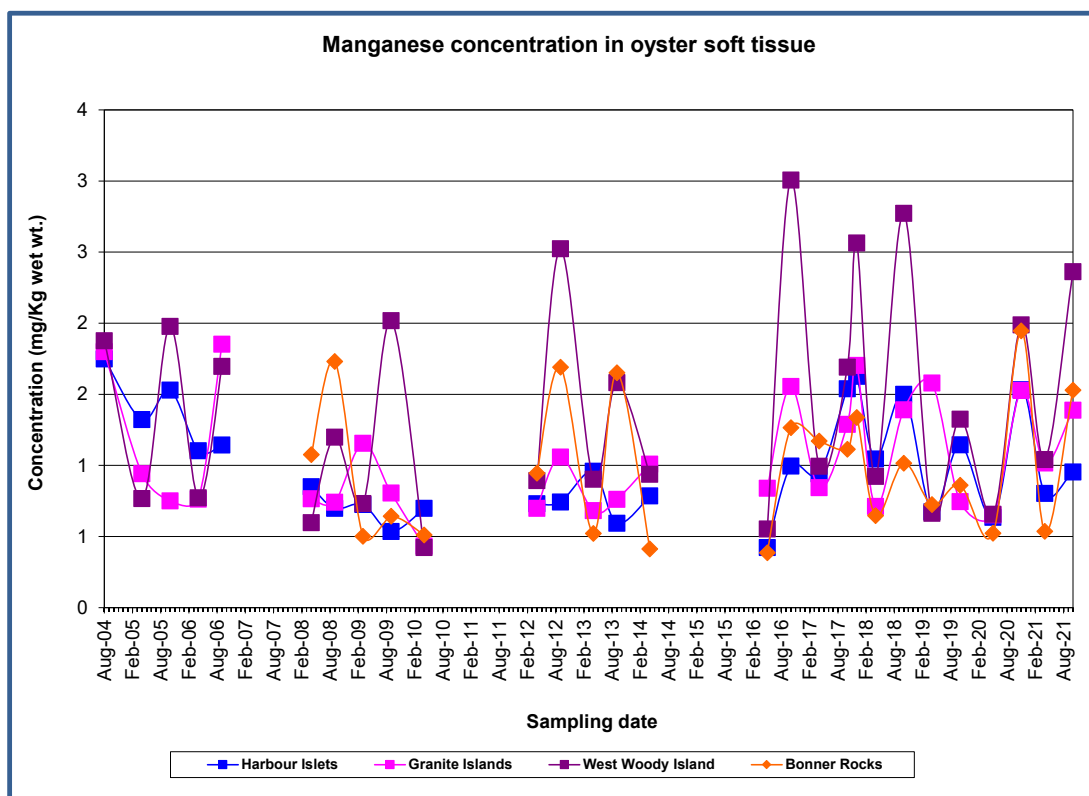


Figure 70. Temporal variations in the average manganese (Mn) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.4. Iron

Iron (Fe) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 71. Note that prior to 2016 Fe was not included as an analyte in the oyster monitoring program on a consistent basis.

For the four sites sampled during 2004-21 oyster Fe concentrations were variable with no clear overall temporal trend. During this period, the average Fe concentrations for the four oyster collection sites were: Harbour Islets: 21.7 +/- 4.0, West Woody Island: 22.3 +/- 1.8, Granite Islands: 22.2 +/- 5.8 and Bonner Rocks with the lowest concentration at 13.9 +/- 0.9 mg/kg wet weight.

There is no FSANZ (2021) food standard for Fe.

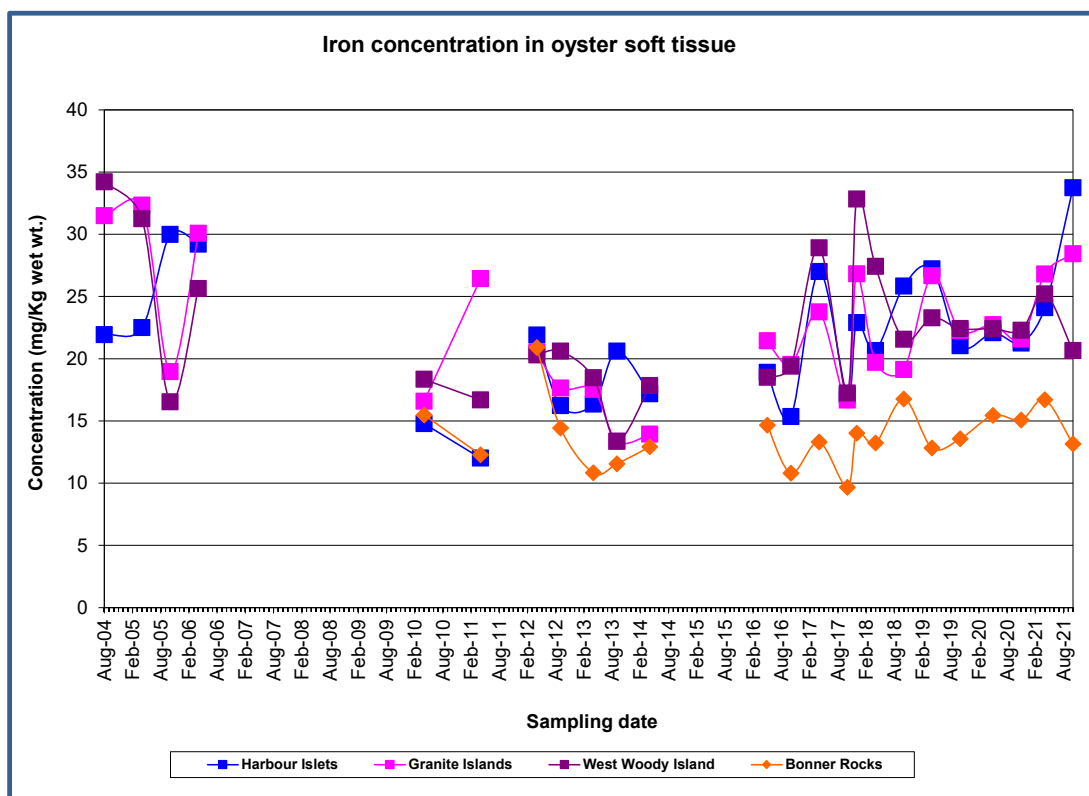


Figure 71. Temporal variations in the average iron (Fe) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.5. Copper

Copper (Cu) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 72.

Oysters from Harbour Islets, West Woody Island and Granite Islands sampled throughout 2004-2021 had variable Cu concentrations with no clear overall temporal trend. During this period, the average Cu concentrations for the four oyster collection sites were: Harbour Islets: 22.0 +/- 4.8, West Woody Island: 20.7 +/- 3.4, Granite Islands: 18.1 +/- 3.5 and Bonner Rocks: 33.8 +/- 2.5 mg/kg wet weight. Copper concentrations in oysters from Bonner Rocks, the most distant sampling site from Gove Harbour, have mostly been above the ranges of all other sites.

Copper concentrations at all sites throughout 2004-2021 exceeded the ANZFA (2004) food standard (Cu = 10 mg/kg). However, the current FSANZ (2021) food standards do not contain a maximum permitted concentration for Cu in food.

Copper concentrations similar to those recorded under the MHMP have been reported previously from southern Melville Bay (Noller, 1991; McConchie & Saenger, 1993) and elsewhere along the North Australian coastline

(McConchie and Lawrance, 1991; Parry and Munksgaard, unpublished data) and appear to be natural concentrations unrelated to anthropogenic sources.

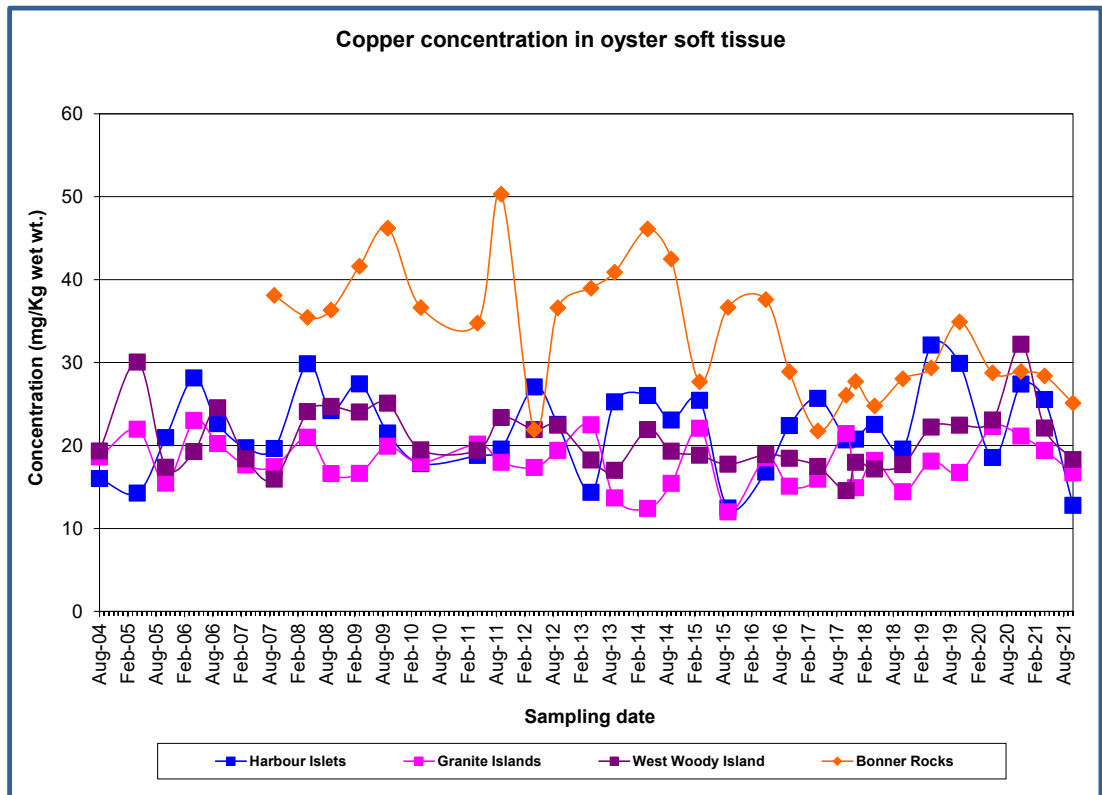


Figure 72. Temporal variations in the average copper (Cu) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.6. Zinc

Zinc (Zn) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 73.

Harbour Islet oysters had consistently elevated concentrations of Zn throughout 2004-2021 compared to all other sites. The increased Zn concentrations are likely to reflect a combination of elevated Zn concentrations in refinery waste waters previously discharged from Western Channel (Munksgaard and Parry, 2006c) and other Zn sources such as general port operations in Gove Harbour. Zinc levels in Inner Harbour oysters have declined since Oct. 2017.

The Bonner Rocks and West Woody Island sites had the lowest Zn concentrations measured during 2004-2021.

Zinc concentrations at all sites throughout 2004-2021 were below the ANZFA (2004) food standard (Zn = 1000 mg/kg). However, the current FSANZ (2021) food standards do not contain a maximum permitted level for Zn in food.

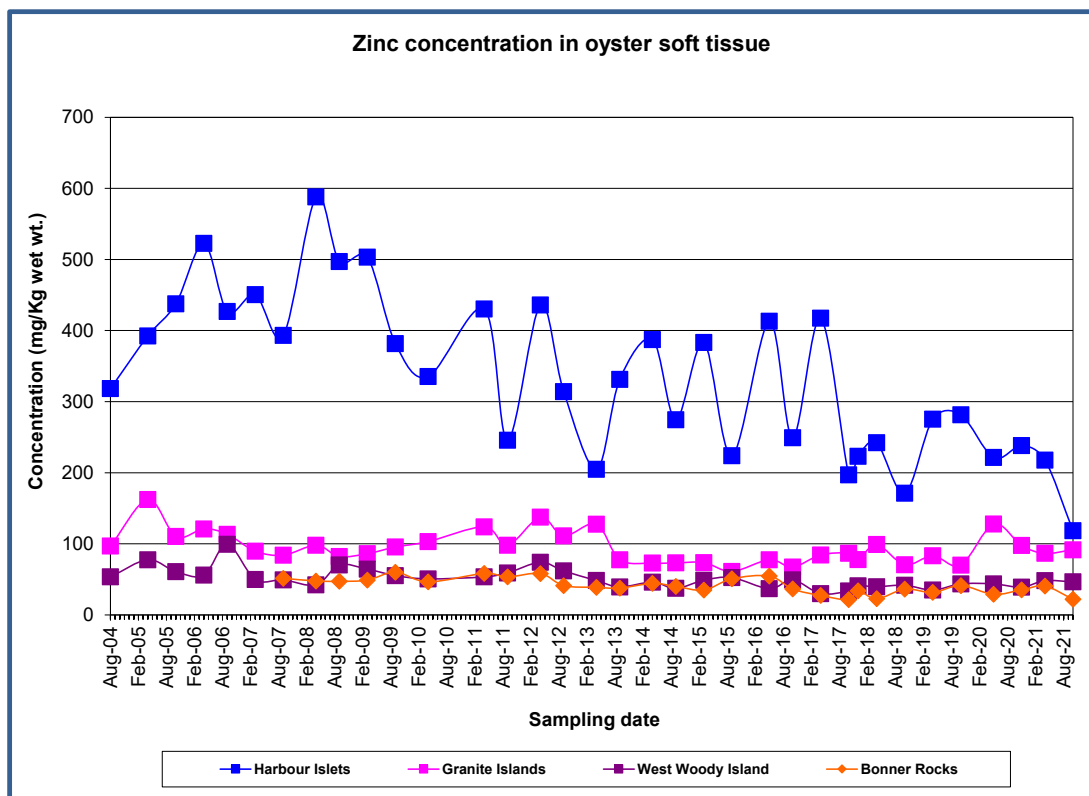


Figure 73. Temporal variations in the average zinc (Zn) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.7. Arsenic

Arsenic (As) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 74. During this period, the average As concentrations for the four oyster collection sites were: Harbour Islets: 6.20 +/- 0.72, West Woody Island: 7.38 +/- 0.79, Granite Islands: 6.48 +/- 1.36 and Bonner Rocks: 8.46 +/- 0.56 mg/kg wet weight.

Oyster As concentrations were variable at the four sites sampled throughout 2004-2016 with no overall temporal trend. However, in April and October 2017, As levels in oysters from all four sampling sites increased substantially compared to the previous range of concentrations. Due to the rapid increase in As concentrations an additional sampling round was undertaken in December 2017. Arsenic concentrations at three of the four sampling sites

(Bonner Rocks excepted) were substantially lower in December 2017 compared to October 2017 and have returned to the previous range since then. It is highly likely that the increase in oyster As concentrations during 2017 was part of a natural cycle of environmental changes as the effect was observed at the control site at Bonner Rocks over 15km distant from the refinery.

Total As concentrations measured at all sites throughout 2004-2021 were above the FSANZ (2021) food standard set for inorganic As (1 mg/kg). However, the food standard is for inorganic As only whereas the total As concentration measured in the MHMP program includes both inorganic and organic As.

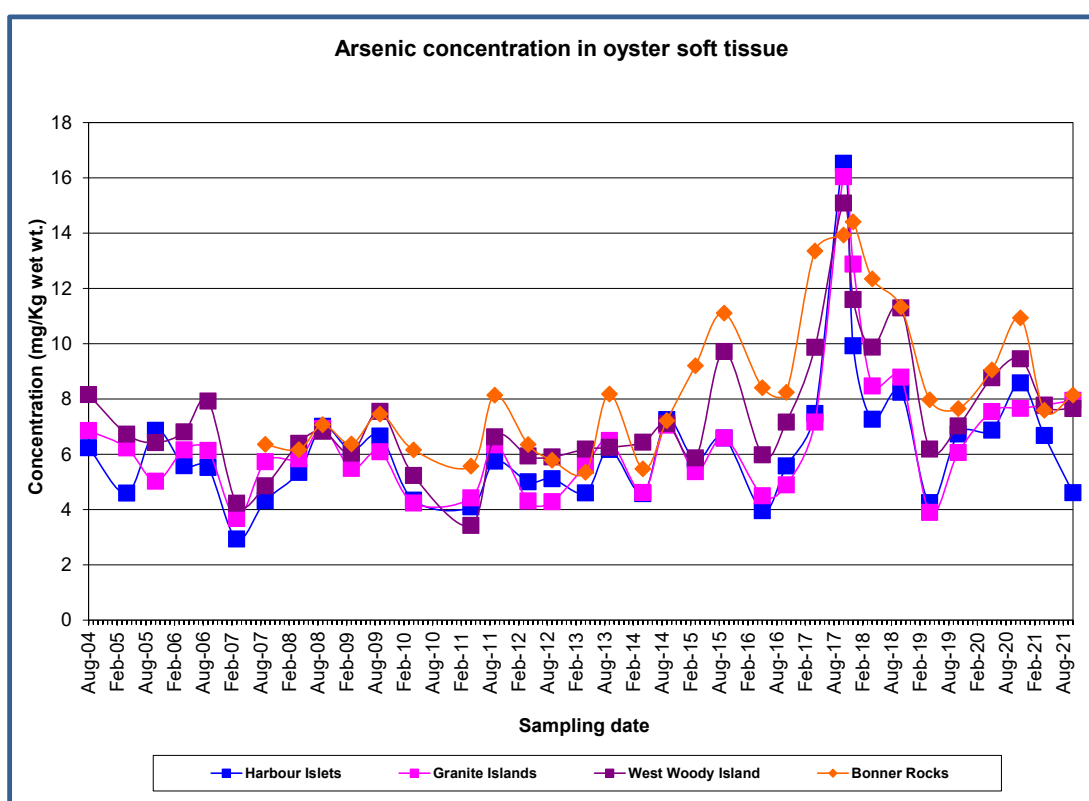


Figure 74. Temporal variations in the average arsenic (As) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

The proportion of inorganic and organic As was determined in ten oyster samples collected in April 2009 (Munksgaard 2010). Less than 1% of the total As content were found to be inorganic. Consequently, inorganic As in most oysters sampled from 2004-2021 are highly likely to have been well below the FSANZ maximum permitted level for inorganic As in food (1 mg/kg). This was confirmed by analysis of inorganic As in oysters from April and October 2017 (data reported separately). The maximum inorganic As concentration recorded was 0.4 mg/kg (2.7% of total As) in a sample from

Harbour Islets. The average inorganic As concentration was 0.2 mg/kg (n=24).

4.5.8. Gallium

Gallium (Ga) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 75.

Gallium concentrations were generally very low (<0.06 mg/kg) in oyster tissues at all sites during 2004-2021. Oysters from Harbour Islets and Granite Islands had variable, but generally higher Ga concentrations than oysters from West Woody Island and Bonner Rocks. However, Ga in oysters from Harbour Islets and Granite islands decreased until April 2021 but Ga concentration increased markedly at these two sites in September 2021. In contrast, oysters from West Woody Island and Bonner Rocks continued to have the lowest Ga concentrations amongst all sampled oysters.

There is no FSANZ (2021) food standard for Ga.

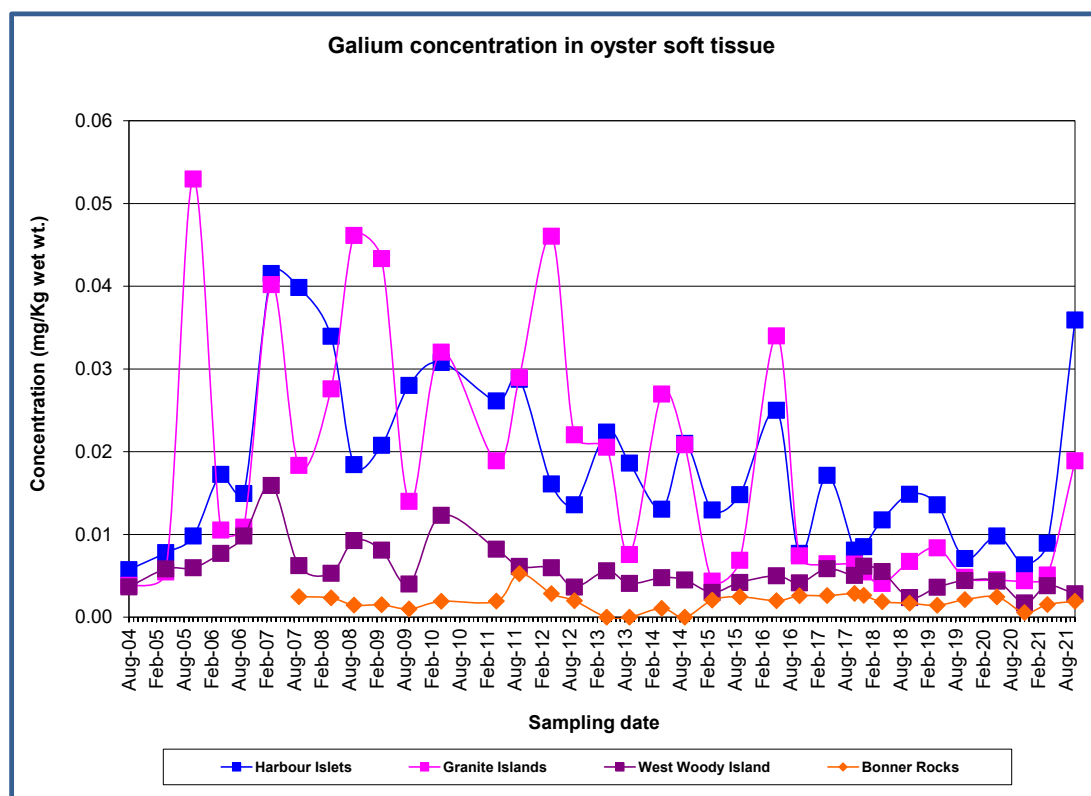


Figure 75. Temporal variations in the average gallium (Ga) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.9. Molybdenum

Molybdenum (Mo) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 76.

For the four sites sampled during 2004-21 oyster Mo concentrations were variable with no clear overall temporal trend. During this period, the average Mo concentrations for the four oyster collection sites were: Harbour Islets: 0.35 +/- 0.23, West Woody Island: 0.42 +/- 0.21, Granite Islands: 0.47 +/- 0.15 and Bonner Rocks: 0.13 +/- 0.02 mg/kg wet weight.

There is no FSANZ (2021) food standard for Mo.

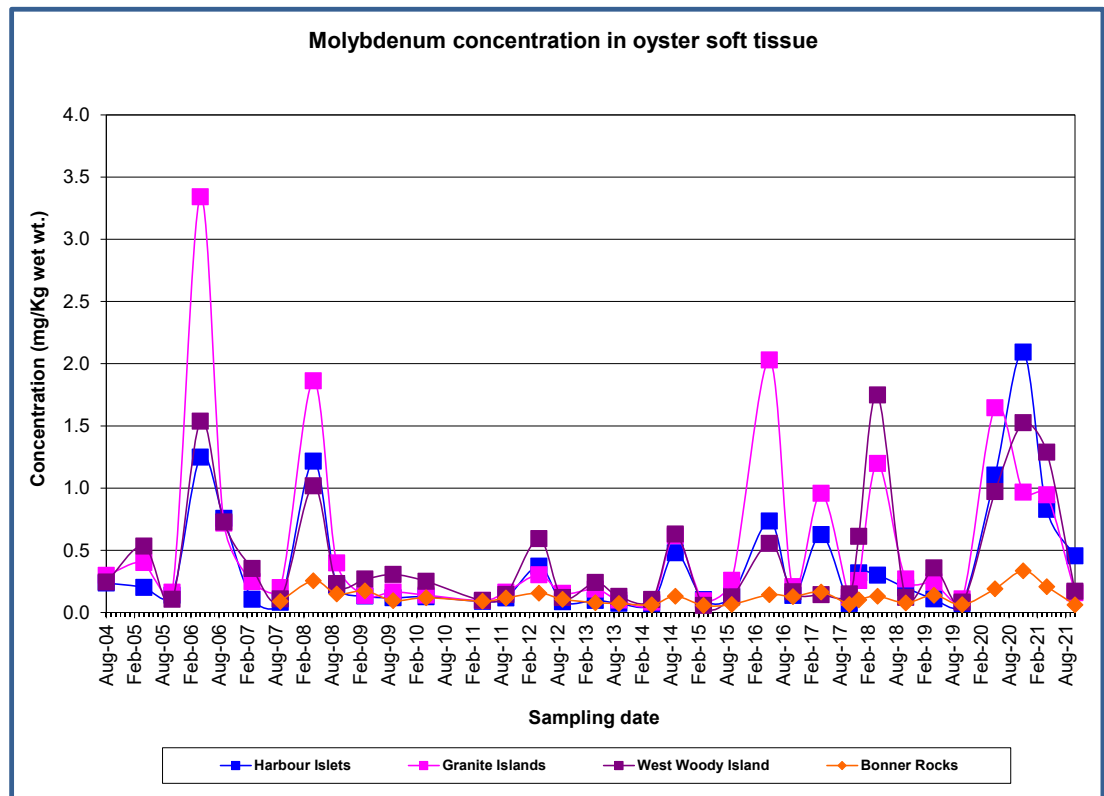


Figure 76. Temporal variations in the average molybdenum (Mo) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.10. Cadmium

Cadmium (Cd) concentrations in oyster soft tissue samples from 2004-2021 are shown in Figure 77.

Harbour Islet oysters had consistently lower concentrations of Cd during 2004-2021 compared to oysters from other sites. The lower Cd concentrations may be explained by competitive Cd exclusion by Zn as the latter metal is in relatively higher concentration in oysters from inner Gove Harbour (Figure 59). Such a mechanism has been shown to occur in trout kidney cells (Gagnon et al, 2007). There is a well correlated inverse relationship between Zn and Cd concentrations in oysters sampled from all sites throughout 2004-2021 ($R^2 = 0.66$).

Oysters from West Woody Island and Bonner Rocks had the highest Cd concentrations measured during 2004-2021. An increase in cadmium has been seen for all sites between 2012 and 2021.

Cadmium concentrations in oysters from West Woody Island, Bonner Rocks and Granite Islands (but not Harbour Islets) have exceeded the FSANZ (2021) food standard (Cd = 2 mg/kg wet weight) during most of 2004-2021. However, high Cd concentrations have been reported previously from southern Melville Bay (Noller, 1991; McConchie & Saenger, 1993) and elsewhere along the North Australian coastline (McConchie and Lawrance, 1991; Parry and Munksgaard, unpublished data) and appear to be a natural phenomenon unrelated to anthropogenic sources.

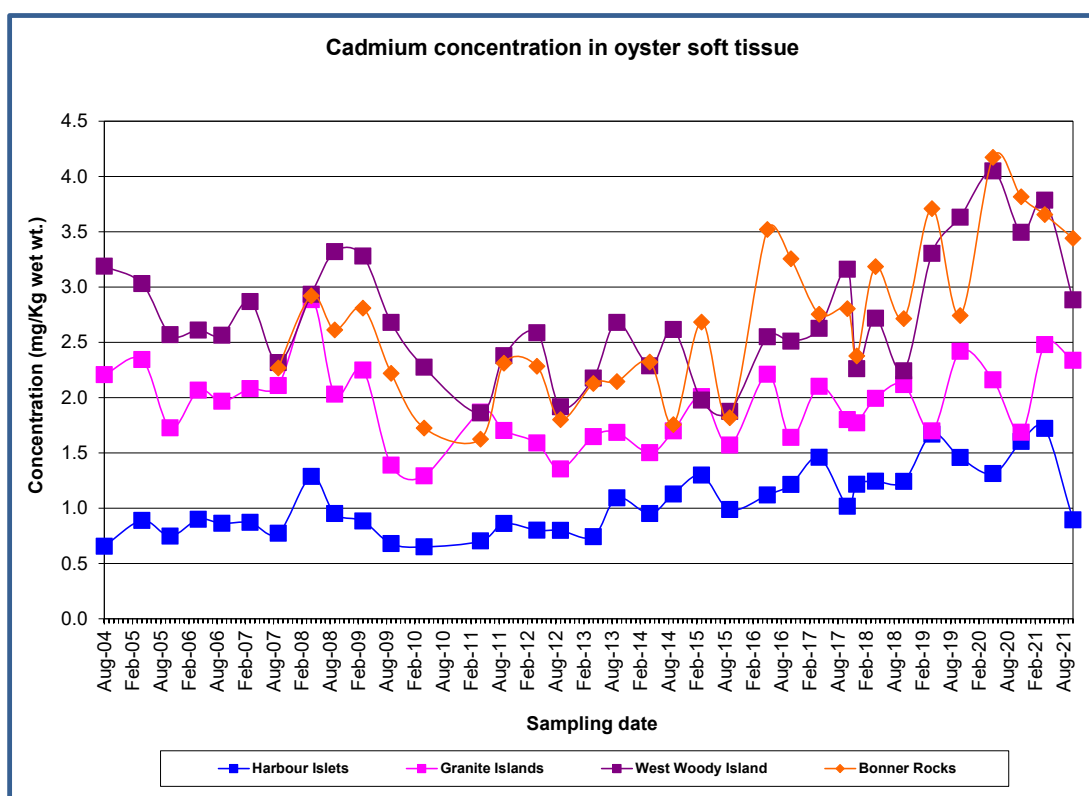


Figure 77. Temporal variations in the average cadmium (Cd) concentration in oyster soft tissue at Harbour Islets, Granite Islands, West Woody Island, and Bonner Rocks 2004-2021.

4.5.11. Other monitored elements

Lead (Pb) concentrations were below 0.1 mg/kg for all samples during 2004-2021 except for one higher concentration of 0.15 mg/kg at West Woody Island in September 2006 (Appendix 4). Oysters from Harbour Islets generally have had slightly higher Pb concentrations during 2004-2021 than oysters from other sites whereas oysters from the control site at Bonner Rocks had the lowest Pb concentrations. All Pb concentrations in oyster soft tissue during 2004-2021 were well below the FSANZ (2021) food standard (Pb = 2.0 mg/kg).

4.6. Summary

The Marine Health Monitoring Program (MHMP) for Rio Tinto Gove's (RTG's) operations in Southern Melville Bay commenced in 2004 and includes sampling and analysis of a range of physico-chemical parameters in seawater, sediment and oysters. RTG's Waste Discharge Licence (WDL 171) specifies Trigger Values in seawater at compliance sites near RTG's operations. Sediment and oyster metal/metalloid data are assessed by evaluating temporal trends since 2004 and by comparison to the ANZG (2018) default sediment quality guidelines and the FSANZ food quality standards.

Before curtailment in late 2014, the Gove Refinery's principal impact on marine water and sediment quality in Gove Harbour resulted from occasional entrainment of process liquor into the refinery's cooling seawater circuit which was discharged to the harbour. The refinery discharge contained elevated metal and metalloid concentrations (mainly Al, V, Ga, As and Mo) which were incorporated in hydrotalcite-rich precipitates resulting in the formation of an anoxic, microbially active, sulfide-rich sediment with elevated nutrient, metal and metalloid concentrations.

In late 2012, a Waste Water Neutralisation Plant (WWNP) was commissioned to treat liquor from the Residue Disposal Area (RDA). The WWNP effluent discharge resulted in an increase in the concentration of mainly V (and lesser amounts of Al, Ga, As and Mo) to Inner Gove Harbour. As a result, dissolved V concentrations in seawater at compliance sites increased compared to previous years. Elevated concentrations of dissolved V, compared to background concentrations, have also been measured at several sampling sites outside the mixing zone. Following the reduction in WWNP discharges since March 2018 substantial decreases in the concentrations of V and associated elements in Inner Gove Harbour and parts of Southern Melville Bay have been recorded. Intermittent operation of the WWNP re-commenced in April 2020.

4.6.1 Seawater monitoring April 2021 – March 2022:

- Monthly data for monitoring sites along the mixing zone boundary in Inner Gove Harbour showed that all parameters monitored were below the Trigger Values specified by the Waste Discharge Licence.
- Dissolved concentrations of V and associated elements (mainly Al, Ga and As) have remained near background levels at the mixing zone boundary compliance sites in Inner Gove Harbour and at information sites in Southern Melville Bay.
- Total element concentrations at the compliance sites (unfiltered sample) were added to the MHMP in October 2020. As would be expected, total concentrations of Al and Fe substantially exceeded dissolved concentrations. Total concentrations of Cr, Mn and Ga also exceeded dissolved concentrations of the same metals. In contrast, dissolved phases of V, Cu, Zn, As, Mo and U accounted for almost all the total concentrations of these elements.

4.6.2 Sediment monitoring 2004-2021:

- The most recent sediment survey was conducted in April 2021.
- Several elements (Mg, V, Zn, Ga, Mo, and Cd) are elevated in surface sediment in Inner Gove Harbour compared to background sites. However, since 2006-07 Mg, Zn and Ga concentrations have decreased in surface sediment in Inner Gove Harbour. Vanadium concentrations in sediment increased in 2014 and have been slightly higher in Inner Gove Harbour compared to other monitored areas throughout 2014-21.
- Drimmie Arm sediment had slightly elevated concentrations of As compared to background sediments during 2004-2021. No temporal trends were observed.
- Sediment from Crawford's Creek had slightly elevated TKN and As concentrations compared to background sites. These concentrations can be ascribed to the organic-rich and mud-dominated mangrove environment.
- The concentrations of all parameters monitored in sediment during 2004-2021 were below the ANZG (2018) SQGVs where available.

4.6.3 Oyster monitoring 2004-2021:

- During 2004-21 oysters from Harbour Islets, Granite Islands and West Woody Islands relatively close to the RTG Refinery had higher concentrations of Al and Ga compared to oysters from the more distant background site at Bonner Rocks.
- Oysters from Harbour Islets had elevated Zn and reduced Cd concentrations relative to oysters from other sampling sites. The reduced Cd concentrations are likely to be related to the increased Zn concentration in Gove Harbour due to a mechanism of competitive exclusion of Cd by Zn.
- Cadmium concentrations in oysters from Bonner Rocks, West Woody Island and occasionally Granite Islands have been above the FSANZ food standard (2 mg/kg) during most of the 2004-21 monitoring period. However, this phenomenon appears to have natural causes and have been reported previously from locations in Northern Australia. Cadmium is not a chemical of primary concern in Gove Refinery discharges.
- Total As concentrations in oysters from all four sampling sites increased substantially in April and October 2017 compared to the previous concentrations. However, since 2017 As concentrations at all four sampling sites have been lower, but variable. It is likely that As concentrations in oysters is subject to a naturally occurring environmental cycle.
- Total As in oysters from all sampling sites exceeded the FSANZ maximum permitted concentrations for inorganic As. However, As speciation analyses carried out on samples from 2009 and 2017 showed that inorganic As concentrations were below the FSANZ food standard.
- Lead concentrations in oysters from all sampling sites were below the FSANZ maximum permitted concentrations.

4.6.4 Recommendations:

- It is recommended that monthly sampling and analysis of seawater and annual sampling and analysis of sediment continues as part of the MHMP.
- The oyster monitoring component of the MHMP should also continue unchanged with half yearly sampling. It is an important biological component of the MHMP and remains an important tool for monitoring of both environmental health and marine food safety.
- Careful monitoring of data quality for water samples should continue to ensure that 'clean' sampling techniques appropriate for trace level

metal/metalloid analysis is followed and that recent improvements in MHMP data quality is maintained. Adherence to RTG's field sampling procedures is essential.

5. Acknowledgements

We thank Arafura Diving and Marine Logistics (John Drysdale) for carrying out the field component of the MHMP. RTA Gove Environment Team are thanked for logistical support and for supplying data and other information for this report.

6. References

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Appendices are provided as electronic files

Appendix 1:

Sampling site coordinates in Southern Melville Bay (Word file 'MHMP sites 2022')

Appendix 2:

Physico-chemical parameters and elemental concentrations in seawater from Southern Melville Bay 2004-2022 (Excel file 'MHMP seawater trends to March 2022')

Appendix 3:

Overview of elemental concentrations in sediment from Southern Melville Bay 2004-2021 (Excel file 'MHMP sediment trends to April 2021')

Appendix 4:

Overview of elemental concentrations in oysters from Southern Melville Bay 2004-2021 (Excel file 'MHMP oyster trends to October 2021')

Appendix F – WDL Incident Reports

Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☐ Preliminary
 ☒ Final

Completed waste@nt.gov.au & mineral.info@nt.gov.au
form:

Incident number:	1000578371		
Name of mining site:	Rio Tinto - Gove operations		
Name of operator:	RTA Gove Pty Limited		
Date & time of detection:	Date: 27.05.2021	Time: ~06:00	
Date & time of incident:	Date: 27.05.2021	Time: ~06:00	
Name of person notifying:	Ben McTavish		
Position/Title:	Environment Superintendent		
Contact person:	Ben McTavish		
Contact details:	Business: 08 8987 5233 Mobile: 0477 353 879		
	E-mail: ben.mctavish@riotinto.com		
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	S001 Outfall -12.19229, 136.68448		
INCIDENT DESCRIPTION (attach photos if available)	Continuous measurements of electrical conductivity are required at S001 as per Table 1 of Appendix 2 of WDL 171-10 (Condition 27). It was observed at approximately 06:00 the electrical conductivity sensor returned data of unreliable quality.		
Causes & contributing factors to the incident:	The electrical conductivity instrument was calibrated incorrectly. The technician performed and accepted a calibration of 58mS whilst using a 58µS calibration solution. The work instruction did not state which calibration solution should be used for the task.		
Potential causes & contributing factors to the incident:	N/A		
Action Taken:	YES ☒	NO ☐	
Document Owner: <i>Environmental Advisor</i>	Authorised By: <i>HSE Superintendent</i>		
Rev No: 12	Date of Issue: 2/03/17	Page 1 Of 3	

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If no, why?	
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	The following corrective actions have/will take place: - Recalibration of the electrical conductivity sensor took place on 27/05/2021 with the correct calibration solution. - The work instruction will be updated to state the correct calibration solution required for the task.

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	All other monitoring parameters remain in place. The electrical conductivity monitoring is not considered an indicator of environmental impact. As all other parameters have been continually monitored RTA Gove are confident the environment remains protected.
Emergency & remedial actions taken:	Cease of treatment and release through S001.
Current situation: (Potential / ongoing / ceased / etc.)	Initially the discharge was ceased through S001. After recalibration the seawater channel discharge came back online on 27/05/2021. The existing electrical conductivity sensor did not require replacement.
Details of any samples taken: (when / where / type / number / time for results /etc)	Spot checks of continuous sensor results compared to calibrated units indicate the electrical conductivity trend remained stable and within historical trends.

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Steve Moratti
	Position:	Utilities Superintendent

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Sally-Anne Orchard	
How: (phone/email/fax)	Phone	
When: (date & time)	27.05.2021 15:30	
By whom:	Ben McTavish	

Document Owner: <i>Environmental Advisor</i>	Authorised By: <i>HSE Superintendent</i>		
Rev No: 12	Date of Issue: 2/03/17		Page 2 Of 3

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FRM-EHS-024

NOTIFICATION OF AN ENVIRONMENTAL INCIDENT

REF: GPM-EHS-020

Name: Ben McTavish

Signed

B McTavish

Date:

6 July 2021

Title: Environment Superintendent

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Received by: _____

Date: _____

Time: _____

Document Owner:	<i>Environmental Advisor</i>	Authorised By:	<i>HSE Superintendent</i>
Rev No:	12	Date of Issue:	2/03/17
			Page 3 Of 3

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Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☐ Preliminary
 ☒ Final

Incident number:	1000578910	
Name of mining site:	Rio Tinto – Gove operations	
Name of operator:	RTA Gove Pty Limited	
Date & time of detection:	Date: 02/06/2021	Time: 3:40 pm
Date & time of incident:	Date: 17/05/2021	Time: 3:30pm
Name of person notifying:	Ben McTavish	
Position/Title:	Environment Superintendent	
Contact person:	Ben McTavish	
Contact details:	Business: 08 8987 5233 Mobile: 0477 353 879	
	E-mail : ben.mctavish@riotinto.com	
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	Compliance Points SW9, SW10, RR2 as per WDL171-10.	
INCIDENT DESCRIPTION (attach photos if available)	Hydrocarbon samples are required at SW9, SW10 and RR2 as per Table 2 of Appendix 2 of WDL171-10 (Condition 27) monthly when discharging from S086, S087, S088 & S044. During a monthly compliance check it was observed that hydrocarbon samples were not taken at SW9, SW10 and RR2 during sampling on 17 May 2021. There had been two discharge events since the previous marine monitoring round.	
Causes & contributing factors to the incident:	- The work instruction did not identify hydrocarbon samples to be taken as per WDL171-10. - The environmental technicians were under time pressure with multiple programs of environmental monitoring. Insufficient time for marine sampling preparation allowed. - A weekly water monitoring compliance check was not in place to identify the missing sample in the month of May.	
Potential causes & contributing factors to the incident:		
Action Taken:	YES ☒	NO ☐
If no, why?		

Document Owner:	Senior Advisor Environment – Gove	Authorised By:	Specialist Environment – Gove
Rev No:	13	Date of Issue:	26/10/20
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NOTIFICATION OF AN ENVIRONMENTAL INCIDENT

REF: GPM-EHS-020

Corrective Actions that have/will be undertaken to ensure this does not reoccur:	- Marine hydrocarbon samples were taken on 10 June 2021. - The work instruction has been updated to prompt hydrocarbon sampling at SW9, SW10 and RR2. - A weekly water monitoring compliance checklist has been created and utilised.
---	---

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	Hydrocarbon samples were taken at S086, S087, S088 and S044 authorised discharge points on 26/04/2021 and 28/04/2021. All results were lower than the laboratory limit of reporting. RTA Gove are confident the environment remained protected.
Emergency & remedial actions taken:	N/A
Current situation: (Potential / ongoing / ceased / etc.)	The marine health monitoring program and compliance point monitoring program has continued to operate as per WDL171-10.
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Hydrocarbon samples were taken at S086, S087, S088, S044 authorised discharge points on 26 April 2021 at 2:30pm and 28 April 2021 at 12:30pm. Hydrocarbon samples were taken at SW9, SW10 and RR2 on 10 June 2021. All results were below the laboratory limit of reporting.

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Ben McTavish
	Position:	Environment Superintendent

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Sally-Anne Orchard	
How: (phone/email/fax)	Phone	
When: (date & time)	03/06/2021 13:10	
By whom:	Ben McTavish	

Name: Ben McTavish

Signed



Date:

07/07/2021

Title: Environment Superintendent

Document Owner: Senior Advisor Environment – Gove	Authorised By: Specialist Environment – Gove
Rev No: 13	Date of Issue: 26/10/20
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Notification of an Environmental Incident

☒ Incident ☐ Critical Incident ☐ Preliminary ☒ Final

Completed form: waste@nt.gov.au & mineral.info@nt.gov.au

PLEASE TYPE / PRINT CLEARLY

Incident number:	1000585261
Name of mining site:	RTA Gove
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 26.08.2021 Time: 09:15
Date & time of incident:	Date: 23.08.2021 Time: 08:00
Name of person notifying:	Seydou Cisse
Position/Title:	Senior Advisor, Environment
Contact person:	Seydou Cisse
Contact details:	Business: 08 8987 5219 Mobile: 0427 806 346
	E-mail: Seydou.Cisse@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	Authorised monitoring point S074

Document Owner:	Senior Advisor Environment – Gove	Authorised By:	Specialist Environment – Gove
Rev No:	13	Date of Issue:	26/10/20
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INCIDENT DESCRIPTION (attach photos if available)	Missed daily sample for S074 Daily composite sample is required to be collected at S074 as per Table 3 in Appendix 2 of WDL171-10 (Condition 27). It was identified during the weekly compliance check that the auto-sampler had failed to collect samples on 23/08/2021. This resulted in daily pH, electrical conductivity, turbidity, alkalinity and total suspended solids not being available for 23/08/2021. System setting: 1. A submersible pump pumps water from the seawater channel into the trough; and 2. The auto-sampler collects water from the trough via a tubing system connected to the sample collection bottle. Investigations were undertaken to identify failure of the auto-sampler. No failure was found in the tubing system of the auto-sampler, no foreign objects were found in the tubing; no split of tubing identified and no power outage was recorded during this period. The trough is cleaned daily to remove scaling and build-ups. EC and pH probes sit in the same trough and recorded data for the entire day of the 23/08/2021 indicating there was water in the trough.	
Causes & contributing factors to the incident:	The tubing in the trough may have been pushed above the water level in the trough during the daily cleaning.	
Potential causes & contributing factors to the incident:	Ongoing cleaning required for the auto-sampler.	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	The auto-sampler was reset and is operating normally since the incident.	
Date when investigation report will be submitted to Administering Agency:	6/09/2021	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	WWNP was operational during the time of the incident and was sampled as per its operational sampling plan. There was no change in the WWNP process between 22-24 August 2021. Daily composite monitoring S074 samples were taken on 22/08/2021 and 24/08/2021 and indicate normal operating conditions. All monitoring parameters for site S001 were analysed on 23/08/2021 and the results indicate normal operating conditions. Based on all of the above, it is likely that no environmental impact would be expected from this incident.																																
Emergency & remedial actions taken:	System was checked and confirmed the tubing is clear of foreign objects.																																
Current situation: (Potential / ongoing / ceased / etc.)	The auto-sampler is working correctly. Routine sampling and analysis program are continuing.																																
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Data from samples collected at S001 on the day of incident (Table 1) and from S074 collected before and after the incident date (Table 2) are presented below. Table 1 Data from S001 sample (23/08/21 @ 08.00hrs) <table border="1"> <tr> <th>pH</th> <th>EC (mS/cm)</th> <th>Turb (NTU)</th> <th>Alk (mg/L)</th> </tr> <tr> <td>8.43</td> <td>53</td> <td>3.8</td> <td>297.6</td> </tr> </table> Table 2 S074 sample on 22/08/2021 and 24/08/2021 <table border="1"> <tr> <th></th> <th>pH</th> <th>EC (mS/cm)</th> <th>Turb (NTU)</th> <th>Alk (mg/L)</th> <th>TSS (mg/L)</th> </tr> <tr> <td>22/08/2021</td> <td>8.3</td> <td>52.5</td> <td>4.5</td> <td>222.4</td> <td>9.8</td> </tr> <tr> <td>23/08/2021</td> <td colspan="5">Not sampled</td> </tr> <tr> <td>24/08/2021</td> <td>8.31</td> <td>52.3</td> <td>4.4</td> <td>259.25</td> <td>6.4</td> </tr> </table>	pH	EC (mS/cm)	Turb (NTU)	Alk (mg/L)	8.43	53	3.8	297.6		pH	EC (mS/cm)	Turb (NTU)	Alk (mg/L)	TSS (mg/L)	22/08/2021	8.3	52.5	4.5	222.4	9.8	23/08/2021	Not sampled					24/08/2021	8.31	52.3	4.4	259.25	6.4
pH	EC (mS/cm)	Turb (NTU)	Alk (mg/L)																														
8.43	53	3.8	297.6																														
	pH	EC (mS/cm)	Turb (NTU)	Alk (mg/L)	TSS (mg/L)																												
22/08/2021	8.3	52.5	4.5	222.4	9.8																												
23/08/2021	Not sampled																																
24/08/2021	8.31	52.3	4.4	259.25	6.4																												

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name: Jon Regan	
	Position: Specialist Laboratory	

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Sally-Anne Orchard	
How: (phone/email/fax)	Email	

Document Owner:	Senior Advisor Environment – Gove	Authorised By:	Specialist Environment – Gove
Rev No:	13	Date of Issue:	26/10/20
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When: (date & time)	26/08/2021
By whom:	Seydou Cisse

Name: Melissa Winks

Signed



Date:

06/09/2021

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Notification of an Environmental Incident

☒ Incident ☐ Critical Incident ☐ Preliminary ☒ Final

Incident number:	1000595416		
Name of mining site:	Rio Tinto - Gove operations		
Name of operator:	RTA Gove Pty Limited		
Date & time of detection:	Date: 25/12/21	Time: 14:00	
Date & time of incident:	Date: 25/12/21	Time: 14:00	
Name of person notifying:	Ben McTavish		
Position/Title:	Environment Superintendent		
Contact person:	Ben McTavish		
Contact details:	Business: 08 8987 5233		Mobile: 0477 353 879
	E-mail: ben.mctavish@riotinto.com		
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	S001 		

Document Owner:	Specialist Environment Gove	Authorised By:	HSE Business Partner
Rev No:	14	Date of Issue:	14/09/21
			Page 1 Of 3

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NOTIFICATION OF AN ENVIRONMENTAL INCIDENT

REF: GPM-EHS-020

INCIDENT DESCRIPTION	Overflow of the Western and Southern Containment Ponds into the sea via the sea water channel (Condition 22).	
Causes & contributing factors to the incident:	Strong monsoonal activity from 25 December led to significant and intense rainfall across the Gove Peninsula, with approximately 300mm recorded over three days.	
Potential causes & contributing factors to the incident:	N/A	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	The Wastewater Neutralisation Plant (WWNP) ceased operation prior to the ponds overflowing to minimise inputs to the sea water channel.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	Refer to attached assessment of environmental impact.
Emergency & remedial actions taken:	WWNP ceased discharge prior to the containment ponds overflowing. Containment pond pumps remained in operation to minimise the flows to the sea water channel.
Current situation: (Potential / ongoing / ceased / etc.)	Containment ponds were pumped down and overflowing of western and southern containment ponds to the sea water channel ceased on 28 and 29 December 2021 respectively.
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Operational samples were taken each day for analysis at the on-site laboratory (additional to the WDL monitoring). Routine WDL discharge point monitoring occurred 29 December. Marine compliance monitoring was conducted on 30 December once weather conditions permitted.

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Andres Hoffman
	Position:	Manager Services

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Sally-Anne Orchard & Waste.NTEPA@nt.gov.au	
How: (phone/email/fax)	Email	
When: (date & time)	Tuesday 28 December 16:21	
By whom:	Ben McTavish	

Name: Ben McTavish

Signed: *B McTavish*

Title: Environment Superintendent

Date: 11 February 2022

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Received by:

Date:

Time:

Assessment of Environmental Impact

Introduction

Compliance monitoring and reactive sampling was conducted in response to the incident of Western Containment Pond (WCP) and Southern Containment Pond (SCP) overflow into the Seawater Channel on 25 December 2021, as reported to DEPWS on 28 December 2021 (Incident #1000595416).

The WCP overflowed intermittently from approximately 14:40 25 December 2021 to approximately 17:25 28 December 2021.

The SCP overflowed from 25 December 2021 to 29 December 2021. The SCP pond level sensor was set to observe the pumping sump level rather than the total pond level at the time of the incident. Therefore, only approximate times of the beginning and end of overflow can be provided, which have been based on the water chemistry at S001/S074 and observations of minor flows on 29 December 2021.

The Wastewater Neutralisation Plant (WWNP) ceased operation when the WCP and SCP reached 90% capacity based on RT Gove's operational Trigger Action Response Plan (TARP). This means the WWNP ceased discharge prior to the containment ponds overflowing into the seawater channel.

Clean seawater continued to be pumped through the seawater channel during the period of this incident at approximately 10,500m³/h.

Monitoring sites S001, S074, SW9, SW10 and RR2 were sampled to determine the nature of impact and severity of the incident on the receiving environment.

Results

Analysis of samples are presented based on conditions within Waste Discharge Licence (WDL) 171-10. Operational samples were taken each day and analysed at the onsite laboratory in addition to standard WDL monitoring requirements. Routine WDL discharge point monitoring occurred on 29 December 2021. Marine compliance monitoring occurred on 30 December 2021. Severe monsoonal conditions were prevalent from 26 December 2021 to 29 December 2021, therefore marine compliance sampling could only be conducted safely at the mixing zone boundary sites (SW9, SW10 and RR2) on 30 December 2021.

The routine WDL sample for S001 was collected on 29 December 2021 and repeated on 30 December 2021 prior to the marine compliance monitoring. All results were below the limits specified in the WDL171-10 (Table 1).

Operational reactive samples at S001 were collected on 26, 27, 28 and 30 December 2021 to aid in the investigation. The pH and turbidity remained below WDL limits for these samples (Table 1). Dissolved aluminium exceeded the WDL limit on 26-28 December 2021 and dissolved arsenic limit 27-28 December 2021 (Table 1).

The S074 24-hour composite sample provides a better representation of discharge quality into the receiving environment during this incident (Table 2), as it provides a time-weighted average composition of discharge water quality. This is evaluated further in the *discussion* section.

Table 1: Water quality results of site S001 sampled 26/12/2021 to 30/12/2021.

S001								
		26/12/2021	27/12/2021	28/12/2021	29/12/2021	30/12/2021	S001 Trigger Value	S001 Limit
Environmental Parameters	Unit							
pH		8.45	8.63	8.17	7.87	7.79	9.0	9.5
Electrical Conductivity	µS/cm	47600	N/A	54400	49900	46800	-	-
Turbidity	NTU	38	49.4	9.64	6.1	1.6	75	100
Alkalinity	mg/L	137.8	130.8	123.6	131	111	-	-
Total Suspended Solids	mg/L	N/A	N/A	N/A	<5	<5	-	-
Metals & Metalloids								
Dissolved Aluminium	µg/L	471*	472.2	500.5	82	6	-	200
Dissolved Arsenic	µg/L	10	52.2	43.4	2.2	1.8	-	20
Dissolved Vanadium	µg/L	50	262.8	204.2	5	2.8	-	2000

* S001 sample from 26 December 2021 was sent to the off-site NATA-accredited laboratory for confirmation

**blue text indicates results obtained from the RTA Gove internal laboratory

Table 2: Water quality results of site S074 sampled 26/12/2021 to 30/12/2021

S074						
		26/12/2021	27/12/2021	28/12/2021	29/12/2021	30/12/2021
Environmental Parameters	Unit					
pH		8.57	8.45	8.32	8.27	8.33
Electrical Conductivity	µS/cm	45300	42700	43400	45100	48900
Turbidity	NTU	56.1	19.9	25.3	14.3	12.9
Alkalinity	mg/L	160.45	125.7	121.25	122	118.85
Total Suspended Solids	mg/L	27.4	29.3	9.6	12.4	7.2
Metals & Metalloids						
Dissolved Aluminium	µg/L	169.5	282.4	178.4	112.6	48.3
Dissolved Arsenic	µg/L	9.9	17.7	14.9	6.7	2.8
Dissolved Vanadium	µg/L	37.4	97.5	67.3	28	7.2

**blue text indicates results obtained from the RTA Gove internal laboratory

Results of the marine compliance monitoring show no sign of elevated concentrations for contaminants of potential concern (Table 3). All environmental parameters and metal(loid)s concentrations were below the trigger values specified in WDL171-10 (Table 3).

Table 3: Water quality results of marine compliance sites and SW12 sampled on 30/12/2021.

Marine Compliance Monitoring						
		30/12/2021	30/12/2021	30/12/2021	30/12/2021	SW9, SW10, RR2 Trigger Value
		SW9	SW10	RR2	SW12	
Environmental Parameters	Unit					
pH		7.9	7.93	7.93	7.92	7.7 – 8.4
Electrical Conductivity	µS/cm	46400	46200	45900	46000	-
Turbidity	NTU	3.1	2.1	3.9	2.6	20
Alkalinity	mg/L	112	102	114	101	-
Total Suspended Solids	mg/L	<5	<5	<5	<5	-
Metals and Metalloids						
Dissolved Aluminium	µg/L	<5	<5	<5	6	56
Dissolved Arsenic	µg/L	1.8	1.8	2	1.8	20
Dissolved Copper	µg/L	<1	<1	<1	<1	1.3
Dissolved Gallium	µg/L	<10	<10	<10	<10	800
Dissolved Iron	µg/L	<5	<5	<5	<5	-
Dissolved Magnesium	µg/L	1300	1290	1280	1300	-
Dissolved Molybdenum	µg/L	9.3	9.4	9.3	9.3	3880
Dissolved Vanadium	µg/L	2.6	2.3	2.2	2.7	100
Dissolved Zinc	µg/L	<5	<5	<5	<5	15
Total Aluminium	µg/L	200	64	100	141	-
Total Arsenic	µg/L	1.8	1.8	2	2.1	-
Total Copper	µg/L	<1	<1	<1	<1	-
Total Gallium	µg/L	<10	<10	<10	<10	-
Total Iron	µg/L	186	68	100	120	-
Total Magnesium	µg/L	1210	1190	1280	1160	-
Total Molybdenum	µg/L	9.4	9.6	9.7	9.8	-
Total Vanadium	µg/L	2.9	2.7	3.1	3.2	-
Total Zinc	µg/L	9	<5	<5	6	-
Hydrocarbons						
Total Petroleum Hydrocarbons	µg/L	<50	<50	<50	<50	-
Polycyclic Aromatic Hydrocarbons	µg/L	<0.5	<0.5	<0.5	<0.5	-
Benzene	µg/L	<1	<1	<1	<1	-
Toluene	µg/L	<2	<2	<2	<2	-
Ethylbenzene	µg/L	<2	<2	<2	<2	-
Xylene	µg/L	<2	<2	<2	<2	-

Discussion

The Australian Institute of Marine Science (AIMS) applied the validated hydrodynamic model of Melville Bay to assess the dilution of the seawater channel discharge into inner Gove Harbour. This work has been provided to the Dept. in November 2020 to support the amendment of the S001 trigger values (Limits) as per Condition 45 of WDL171-10. The model predicted a minimum dilution rate of 25:1 for the three mixing zone boundary (MZB) compliance sites SW9, SW10 and RR2 across two lunar cycles. The dilution rates generally ranged from 25:1 to 70:1 across the tidal ranges and different compliance sites.

Concentrations at the mixing zone boundary during the incident can be conservatively predicted by applying the minimum dilution rate from the hydrodynamic model at the MZB of 25:1 to S074 and S001 data.

The S074 24-hour composite samples provide a more representative concentration of discharges during the incident as it provides time-weighted average results over a 24-hour period.

Table 4 shows the predicted concentrations at the mixing zone boundary from S074 and S001 samples. To provide further conservatism the highest reported concentrations have been applied. In all cases the predicted concentrations were substantially lower than the corresponding WDL trigger values at the MZB compliance points.

Table 4: Predicted concentrations at the mixing zone boundary based on highest concentrations from S001 and S074 concentrations

Site	Date	Metal(loid)	Concentration (µg/L)	Estimated concentration after 25:1 dilution (µg/L)	WDL Marine Compliance Point Trigger Values (µg/L)
S074	27/12/21	Dissolved Aluminium	282.4	10.8	56
S074	27/12/21	Dissolved Arsenic	17.7	0.68	20
S074	27/12/21	Dissolved Vanadium	97.5	3.75	100
S001	28/12/21	Dissolved Aluminium	500.5	19.3	56
S001	27/12/21	Dissolved Arsenic	52.2	2.00	20
S001	27/12/21	Dissolved Vanadium	262.8	10.1	100

The predicted results are consistent with the marine compliance monitoring results from 30 December 2021 (Table 3). The reported concentrations for the MZB compliance points were at or approaching background concentrations for Melville Bay.

Conclusion

Based on the discharge concentrations during the incident, the corresponding predicted concentrations at the MZB and the measured concentrations at the MZB immediately following cessation of the pond releases, it is concluded that the environmental impact are be considered to have been negligible from this incident.

Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☐ Preliminary
 ☒ Final

Incident number:	1000595869
Name of mining site:	Rio Tinto - Gove operations
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 03/01/22 Time: 08:15
Date & time of incident:	Date: 03/01/22 Time: 08:15
Name of person notifying:	Ben McTavish
Position/Title:	Environment Superintendent
Contact person:	Ben McTavish
Contact details:	Business: 08 8987 5233 Mobile: 0477 353 879
	E-mail: ben.mctavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	Latitude: -12.192297 Longitude: 136.684483 

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INCIDENT DESCRIPTION	For Monday 3 January 2022 there was no daily sample available for analysis from S074, as required by Condition 28 (formerly Condition 27) of WDL171-11. It was noted during routine collection of S074 that the composite pump-sampler has failed and there was insufficient water present for analysis. Daily analysis of S074 is required within Appendix 2 Table 3 Marine Health Monitoring Program.	
Causes & contributing factors to the incident:	- Components within the autosampler pumping mechanism failed and were deemed to be not repairable - The back up sampler was not able to be successfully started.	
Potential causes & contributing factors to the incident:	Mechanical failure of other components in the autosampler	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	- A spare autosampler unit has been ordered and is pending arrival. - A capital project to increase redundancy at the S001/S074 monitoring station and upgrade monitoring infrastructure has been submitted and is pending approval by site management.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	It was confirmed that the Wastewater Neutralisation Plant (WWNP) was offline and only seawater was discharged through the seawater channel at the time of this incident. RTA Gove are confident that there was no indication of environmental impact.
Emergency & remedial actions taken:	- All discharges into the seawater channel confirmed as ceased - Repair to the autosampler was attempted and was unsuccessful. 4-hourly samples were collected and combined to create a composite sample in the interim for S074. - The new autosampler was installed on 20 January 2022.
Current situation: (Potential / ongoing / ceased / etc.)	Monitoring is occurring in accordance with the WDL. Daily Composite Sampling recommenced on 20 January 2022 with the replacement autosampler.

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Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Routine WDL sampling at S001 continue.																																									
	4-hourly samples were being collected from S074 and combined to create a composite sample. This occurred from 3 to 20 January 2022.																																									
	Samples taken on 2, 3 & 4 January 2022 were analysed for daily parameters for S001 and S074. Data is presented below.																																									
	<table border="1"> <thead> <tr> <th colspan="6">S001</th> </tr> <tr> <th>Date</th> <th>pH</th> <th>EC</th> <th>Turbidity</th> <th colspan="2">Alkalinity</th> </tr> <tr> <th></th> <th></th> <th>mS/cm</th> <th>NTU</th> <th colspan="2">mg/L</th> </tr> </thead> <tbody> <tr> <td>02/01/2022</td> <td>8.17</td> <td>52.3</td> <td>5.3</td> <td colspan="2">118.1</td> </tr> <tr> <td>03/01/2022</td> <td>8.21</td> <td>51.7</td> <td>2.73</td> <td colspan="2">118.5</td> </tr> <tr> <td>04/01/2022</td> <td>8.13</td> <td>53.5</td> <td>5.48</td> <td colspan="2">120.7</td> </tr> </tbody> </table>						S001						Date	pH	EC	Turbidity	Alkalinity				mS/cm	NTU	mg/L		02/01/2022	8.17	52.3	5.3	118.1		03/01/2022	8.21	51.7	2.73	118.5		04/01/2022	8.13	53.5	5.48	120.7	
	S001																																									
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<table border="1"> <thead> <tr> <th colspan="6">S074</th> </tr> <tr> <th>Date</th> <th>pH</th> <th>EC</th> <th>Turbidity</th> <th>Alkalinity</th> <th>TSS</th> </tr> <tr> <th></th> <th></th> <th>mS/cm</th> <th>NTU</th> <th>mg/L</th> <th>mg/L</th> </tr> </thead> <tbody> <tr> <td>02/01/2022</td> <td>8.31</td> <td>48.7</td> <td>6.23</td> <td>116.7</td> <td>6.4</td> </tr> <tr> <td>03/01/2022</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>04/01/2022</td> <td>8.2</td> <td>47.9</td> <td>3.99</td> <td>117.65</td> <td>5.2</td> </tr> </tbody> </table>						S074						Date	pH	EC	Turbidity	Alkalinity	TSS			mS/cm	NTU	mg/L	mg/L	02/01/2022	8.31	48.7	6.23	116.7	6.4	03/01/2022	N/A	N/A	N/A	N/A	N/A	04/01/2022	8.2	47.9	3.99	117.65	5.2	
S074																																										
Date	pH	EC	Turbidity	Alkalinity	TSS																																					
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02/01/2022	8.31	48.7	6.23	116.7	6.4																																					
03/01/2022	N/A	N/A	N/A	N/A	N/A																																					
04/01/2022	8.2	47.9	3.99	117.65	5.2																																					

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Ben McTavish
	Position:	Environmental Superintendent

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Waste NTEPA	
How: (phone/email/fax)	Email	
When: (date & time)	4 January 2022 08:17	
By whom:	Ben McTavish	

Name: Ben McTavish

Signed

B McTavish

Date:

24 February 2022

Title: Environment Superintendent

OFFICE USE ONLY

Received by: _____

Date: _____

Time: _____

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Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☐ Preliminary
 ☒ Final

Incident number:	1000598739		
Name of mining site:	Rio Tinto - Gove operations		
Name of operator:	RTA Gove Pty Limited		
Date & time of detection:	Date: 06/02/22	Time: 17:15	
Date & time of incident:	Date: 06/02/22	Time: 17:15	
Name of person notifying:	Ben McTavish		
Position/Title:	Environment Superintendent		
Contact person:	Ben McTavish		
Contact details:	Business: 08 8987 5233		Mobile: 0477 353 879
	E-mail: Ben.McTavish@riotinto.com		
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	Latitude -12.188147 Longitude 136.685306 		

Document Owner:	Specialist Environment Gove	Authorised By:	HSE Business Partner
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INCIDENT DESCRIPTION	Overflow of Western Containment Pond (WCP) into Seawater Channel resulting in discharge via S001 (Condition 22).	
Causes & contributing factors to the incident:	Following an intense rainfall event across the Gove Peninsula, stormwater inflows from the Western Containment Pond (WCP) catchment exceeded the pumping capacity of the WCP, which resulted in overflow from the WCP into the seawater channel. Over a 6-hour period, a total of 71mm of rain was recorded at the refinery rain gauge. Of that, 48mm fell in a 30-minute period.	
Potential causes & contributing factors to the incident:	N/A	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	The Wastewater Neutralisation Plant (WWNP) ceased operation prior to the pond overflowing to minimise inputs into the seawater channel. The WCP pumping capacity has recently been increased by approximately 10%.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	Refer to attached assessment of environmental impact. No WDL limits exceeded at S001
Emergency & remedial actions taken:	The WWNP ceased discharge prior to the Western Containment Pond overflowing. Containment pond pumps remained in operation to minimise the flows to the sea water channel.
Current situation: (Potential / ongoing / ceased / etc.)	The WCP ceased overflowing at 23:00 on 6/02/2022. The WCP pond was pumped down to its lowest level by 06:40 on 9/02/2022.
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	WDL monitoring was conducted including: - Continuous monitoring at S001 - Daily sample at S001 - Daily composite sample at S074 - Weekly S001 sample (7/02/2022) - Event-based marine compliance monitoring at SW9, SW10 and RR2 (7/02/2022) Additional operational samples have been taken including: - Operational (internal laboratory) 4 hourly samples at S001 - Sample at WCP monitoring site (S030) on 7/02/2022

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OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Andres Hoffman
	Position:	Manager Services

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	NTEPA – Sally-Anne Orchard	
How: (phone/email/fax)	Email	
When: (date & time)	07/02/2022 16:22	
By whom:	Ben McTavish	

Name: Ben McTavish

Signed B McTavish **Date:** 7 April 2022
 Title: Environment Superintendent

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Received by: _____		
Date: _____	Time: _____	

Assessment of Environmental Impact

Introduction

Compliance monitoring and reactive sampling was conducted to address the incident of Western Containment Pond (WCP) overflow into the Seawater Channel on 06 February 2022, as reported to DEPWS on 07 February 2022 (Incident #1000598739).

The WCP overflowed from approximately 17:15 to 23:00 on 6 February 2022.

The Wastewater Neutralisation Plant (WWNP) ceased operation when the WCP reached 90% capacity based on the RT Gove operational trigger action response plan (TARP). This means the WWNP ceased discharge prior to the WCP overflowing into the seawater channel.

Clean seawater continued to be pumped through the seawater channel during the period of this incident at approximately 10,500m³/h.

Monitoring sites S001, S074, SW9, SW10, and RR2 were sampled to determine the nature of impact and severity of the incident on the receiving environment.

Results

Analysis of samples are presented based on conditions within Waste Discharge Licence (WDL) 171-10 (version in place at time of event). Operational samples were taken each day and analysed at the onsite laboratory in addition to standard WDL monitoring requirements. Marine compliance monitoring occurred on 07 February 2022 at the mixing zone boundary (MZB) sites (SW9, SW10 and RR2).

The routine WDL sample for S001 was collected on 07 February 2022. Results for all parameters were below the corresponding limits specified in the WDL171-10 (Table 1).

Operational samples at S001 were collected on 5, 6, 8 and 9 February 2022. All environmental parameters and metals/metalloids results remained below WDL limits for these samples (Table 1).

The S074 24-hour composite sample provides a more comprehensive representation of discharge quality into the receiving environment during this incident as it provides weighted average results over a 24-hour period (Table 2). The S074 sample collected on 07 February 2022 includes the period of the WCP overflow on 06 February 2022.

Table 1: Water quality results of site S001 sampled 5 to 9 February 2022.

		S001					S001 Trigger Value	S001 Limit
		5/02/2022	6/02/2022	7/02/2022	8/02/2022	9/02/2022		
Environmental Parameters	Unit							
pH		8.2	8.5	7.9	8.2	8.1	9.0	9.5
Electrical Conductivity	µS/cm	50700	49900	52000	49800	53800	-	-
Turbidity	NTU	3.5	3.0	2.5	3.4	2.9	75	100
Alkalinity	mg/L	129.6	295.9	121	136.1	122	-	-
Total Suspended Solids	mg/L	N/A	N/A	5	N/A	N/A	-	-
Metals & Metalloids								
Dissolved Aluminium	µg/L	5.4	9.0	<5	8.6	6.6	-	200
Dissolved Arsenic	µg/L	2.0	6.5	1.7	2.1	1.9	-	20
Dissolved Vanadium	µg/L	3.0	12.6	2.5	3.1	2.7	-	2000

**blue text indicates results obtained from the RT Gove internal laboratory

Table 2: Water quality results of site S074 sampled 5 to 9 February 2022

		S074				
		5/02/2022	6/02/2022	7/02/2022	8/02/2022	9/02/2022
Environmental Parameters	Unit					
pH		8.6	8.6	8.5	8.2	8.1
Electrical Conductivity	µS/cm	49200	47700	46100	47400	48900
Turbidity	NTU	5.6	4.2	18.1	5.3	4.0
Alkalinity	mg/L	248.95	223.85	196.3	121.7	121.7
Total Suspended Solids	mg/L	11.3	5.2	12	6.6	4.8
Metals & Metalloids						
Dissolved Aluminium	µg/L	8.9	8.8	58.4	11.9	8.3
Dissolved Arsenic	µg/L	5.0	4.8	6.2	2.0	2.0
Dissolved Vanadium	µg/L	10.1	8.4	15.7	3.0	2.4

**blue text indicates results obtained from RT Gove's internal laboratory

All environmental parameters and metal(loid)s concentrations were below the trigger values specified in WDL171-10 (Table 3), with the exception of dissolved zinc concentrations. This was reported to the DEPWS on 17 March 2022 and is explored further in the *discussion* section.

Table 3: Water quality results of marine compliance sites sampled on 07 February 2022

		7/02/2022	7/02/2022	7/02/2022	SW9, SW10, RR2 Trigger Value
		SW9	SW10	RR2	
Environmental Parameters	Unit				
pH		7.9	7.7	7.8	7.7 – 8.4
Electrical Conductivity	µS/cm	50200	50900	50700	-
Turbidity	NTU	1.0	1.8	0.8	20
Alkalinity	mg/L	120	115	116	-
Total Suspended Solids	mg/L	6	12	<5	-
Metals and Metalloids					
Dissolved Aluminium	µg/L	<5	<5	27	56
Dissolved Arsenic	µg/L	1.7	1.6	1.6	20
Dissolved Copper	µg/L	<1	<1	<1	1.3
Dissolved Gallium	µg/L	<10	<10	<10	800
Dissolved Iron	µg/L	<5	<5	10	-
Dissolved Magnesium	µg/L	1.2	1.1	1.0	-
Dissolved Molybdenum	µg/L	10.0	10.0	9.9	3880
Dissolved Vanadium	µg/L	2.5	2.2	2.2	100
Dissolved Zinc	µg/L	31	94	21	15
Total Aluminium	µg/L	25	36	12	-
Total Arsenic	µg/L	2.0	1.7	1.8	-
Total Copper	µg/L	<1	2	<1	-
Total Gallium	µg/L	<10	<10	<10	-
Total Iron	µg/L	17	17	8	-
Total Magnesium	µg/L	1.5	1.3	1.2	-
Total Molybdenum	µg/L	11.8	11.4	11.9	-
Total Vanadium	µg/L	2.9	2.6	2.4	-
Total Zinc	µg/L	42	105	25	-
Hydrocarbons					
Total Petroleum Hydrocarbons	µg/L	<50	<50	<50	-
Polycyclic Aromatic Hydrocarbons	µg/L	<0.5	<0.5	<0.5	-
Benzene	µg/L	<1	<1	<1	-
Toluene	µg/L	<2	<2	<2	-
Ethylbenzene	µg/L	<2	<2	<2	-
Xylene	µg/L	<2	<2	<2	-

Discussion

The monitoring results for the samples for the MZB sites were at or approaching background concentrations for Melville Bay and below all trigger values, with the exception of zinc.

The zinc (Zn) concentration at SW10 (Table 3) was more than three times the trigger value specified in WDL171-10, which constitutes a non-compliance of Condition 39.2 within WDL171-10. This was reported to DEPWS on 17 March 2022. For the Zn concentrations at the MZB sites to be attributable to the refinery seawater channel discharge, the concentration of dissolved Zn in the seawater channel discharge would have to have been of the order of 2,350µg/L. Whilst the reported Zn concentration at S001 (46.3 µg/L) was slightly elevated compared to historical values, the reported values across all discharge locations samples indicate that the elevated Zn concentrations in the receiving environment were likely a result of broader catchment inflows to the marine environment.

Table 4 shows the predicted concentration of dissolved Zn at the MZB based on concentrations from S074 and S001 sample data. The WCP site, S030, dissolved Zn concentration is included in this calculation as it represents the source of wastewater that overflowed into the seawater channel during the incident. In all cases the predicted results are substantially lower than the corresponding WDL trigger value at the MZB.

Table 4: Predicted concentration at the mixing zone boundary based on Zinc concentrations at WCP site S030 and seawater channel sites S001 and S074.

Site	Date	Metal (dissolved)	Concentration (µg/L)	Concentration after 1:25 dilution (µg/L)	WDL Dissolved Zinc trigger value at MZB (µg/L)
S030	1/02/2022	Zinc	<5	0.19	15
	7/02/2022	Zinc	<5	0.19	15
S001	7/02/2022	Zinc	46.3	1.78	15
	8/02/2022	Zinc	1.5	0.06	15
S074	7/02/2022	Zinc	1.7	0.06	15
	8/02/2022	Zinc	2.2	0.08	15

The samples of the WCP (S030) before and immediately after the incident, 1/02/2022 and 7/02/2022 respectively, were reported as being less than the laboratory limit of reporting (5 µg/L). This data provides strong evidence that the contents that overflowed from the WCP into the seawater channel did not contribute to the elevated Zn at the MZB sites.

In addition, the 24-hour composite at S074 on 7 February 2022 (which includes the whole period of the WCP overflow) had a low concentration of dissolved Zn (1.7 µg/L) (Table 4). Even if the slightly elevated dissolved Zn concentration from S001 on 07/02/2022 would only have contributed <2µg/L dissolved Zn to the MZB sites (Table 4).

Further, dissolved Zn concentrations at MHMP site SW12 (equivalent to S001) from monthly samples for the past 14 years shows 20thile, 50thile and 80thile concentrations of 0.25, 0.48 and 0.97µg/L, respectively. The corresponding dissolved Zn at the MZB sites SW9, SW10, RR2 had 20thile, 50thile and 80thile concentrations of 0.15, 0.25 and 0.35µg/L, respectively, which are equivalent to the background dissolved Zn concentrations for Melville Bay. There is no evidence that Zn is a contaminant of potential concern from refinery discharges.

The new WDL171-11 was issued on 15 February 2022. Dissolved Zn has been removed from Appendix 2 Table 2 as Zn was not identified as a contaminant of potential concern in the refinery discharge. However, RTA Gove continues the analysis of Zn in marine waters through the RTA Gove Marine Health Monitoring Program (MHMP).

Conclusion

Based on the discharge concentrations during the incident and the measured concentrations at the MZB immediately following cessation of the WCP release, it is concluded that the environmental impact was considered negligible from this incident. While the dissolved Zn concentrations at the MZB sites exceeded the Trigger Value, multiple lines of evidence (dissolved Zn concentrations in the WCP, S001, S074 and the 14 years of data from the MHMP) demonstrate that it was not a result of discharges from the seawater channel.

Notification of an Environmental Incident

☒ Incident☐ Critical Incident☐ Preliminary☒ Final

Incident number:	1000600062
Name of mining site:	Rio Tinto - Gove operations
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 17/02/22 Time: 15:00
Date & time of incident:	Date: 22/01/22 Time: 08:15
Name of person notifying:	Ben McTavish
Position/Title:	Environment Superintendent
Contact person:	Ben McTavish
Contact details:	Business: 08 8987 5233 Mobile: 0477 353 879 Ben.mctavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	Outfall monitoring sites S001 and S074.

Document Owner:	Specialist Environment Gove	Authorised By:	HSE Business Partner
Rev No: 14	Date of Issue: 14/09/21		Page 1 Of 3

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INCIDENT DESCRIPTION	Missed daily Alkalinity for S001 and S074. Alkalinity was not analysed at S001 and S074 on Saturday 22 January 2022, as required by Condition 27 of the WDL. Daily analysis of Alkalinity at S001 and S074 is required within Appendix 2 Table 1 Authorised Discharge Point Monitoring Program. It was identified during an end of month compliance check that the results were not present in the data management system.	
Causes & contributing factors to the incident:	- The Alkalinity titrator couldn't be used on Saturday 22 January 2022 due to a site wide power outage. - The samples were handed over to the following shift to conduct Alkalinity analysis. - The next day shift disposed of the samples without confirming the Alkalinity analysis was complete. - The current internal lab procedure does not provide for a confirmation process for analysis of samples required by the WDL.	
Potential causes & contributing factors to the incident:	N/A	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	- Increase sample retention time (minimum 24 hours) - Implement an automated alert system to provide confirmation or absence of required sample analysis in a time frame that will allow for rectification.	
Date when investigation report will be submitted to Administering Agency:	4 April 2022	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	RTA Gove anticipate no environmental impact. WWNP was operational during the time of the incident and ceased operation at 1pm to remain offline for the rest of the day. Parameters analysed indicate normal operating conditions and no exceedances of trigger values and limits specified within the WDL.
Emergency & remedial actions taken:	Continue routine sampling and analysis. Investigation completed to understand root cause of this incident and corrective actions.
Current situation: (Potential / ongoing / ceased / etc.)	Routine sampling and analysis program continued.

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Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Samples taken on 21, 22 & 23 January 2022 were analysed for daily parameters for S001 and S074. Data is presented below.					
	S001					
	Date	pH	EC	Turbidity	Alkalinity	
			mS/cm	NTU	mg/L	
	21/01/2022	8.34	53.3	4.87	196.2	
	22/01/2022	8.19	53.1	3.8	not analysed	
	23/01/2022	8.37	51.9	2.84	127.6	
	S074					
	Date	pH	EC	Turbidity	Alkalinity	TSS
			mS/cm	NTU	mg/L	mg/L
21/01/2022	8.37	49	5.69	164.55	12.9	
22/01/2022	8.51	50.6	3.66	not analysed	3.8	
23/01/2022	8.35	50.4	3.75	205.8	3.1	

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Gavin Humphreys
	Position:	Analytical Chemist (Laboratory)

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Waste NT EPA	
How: (phone/email/fax)	Email	
When: (date & time)	18/02/2022; 10.20am	
By whom:	Seydou Cisse	

Name: Ben McTavish

Signed

Date:

4 April 2022

Title: Environment Superintendent

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Received by:	
Date:	Time:

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Notification of an Environmental Incident

☒ Incident☐ Critical Incident☐ Preliminary☒ Final

Incident number:	1000603062		
Name of mining site:	Rio Tinto - Gove operations		
Name of operator:	RTA Gove Pty Limited		
Date & time of detection:	Date: 25/03/2022	Time: 12:30	
Date & time of incident:	Date: 25/03/2022	Time: 12:30	
Name of person notifying:	Ben McTavish		
Position/Title:	Environment Superintendent		
Contact person:	Ben McTavish		
Contact details:	Business: 08 8987 5233 Mobile: 0477 353 879		
	E-mail: Ben.McTavish@riotinto.com		
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	 S001 Latitude: -12.192297 Longitude: 136.684483		

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INCIDENT DESCRIPTION	Overflow of Western Containment Pond (WCP) and Southern Containment Pond (SCP) into the Seawater Channel resulting in discharge via S001 (Condition 22).	
Causes & contributing factors to the incident:	Stormwater inflows from the WCP and SCP catchment overflowed into the seawater channel following an intense rainfall event across the Gove Peninsula. A power outage across the Gove Peninsula prevented pumping of the ponds from 12:15 to 17:15 Over a 6-hour period, a total of 95mm of rain was recorded at the refinery rain gauge. Of that, 60mm fell in a 2-hour period.	
Potential causes & contributing factors to the incident:	Power Outage from 12:15 to 15:15 on 25/03/2022	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	RTGO is currently investigating options to mitigate reoccurrence of these events and a suite of options will be provided on 26 th May.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	Please see attached Environmental Impact Assessment (EIA).
Emergency & remedial actions taken:	The faulty substation at the power station was taken offline to allow power to be restored to all pumps.
Current situation: (Potential / ongoing / ceased / etc.)	The western containment pond ceased overflowing at 20:25 and the southern containment pond ceased overflowing at 21:45, once pumping capacity exceeded inflows.
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Investigation samples were collected from WDL compliance monitoring sites including: • Grab samples at S001; • Daily composite sample at S074 (4-hourly composite sample as discussed with the Department on 09/03/2022); and • Event-based marine compliance monitoring at SW9, SW10 and RR2. Additional investigation samples were taken including: • Sampling at S001 sample (25/03/2022), including TPH. • Sampling at WCP monitoring site (S030) and at the SCP (S023) on 25/03/2022.

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OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Andres Hoffman
	Position:	Manager Services

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	NTEPA – Sally-Anne Orchard	
How: (phone/email/fax)	Email	
When: (date & time)	07/02/2022 15:35	
By whom:	Ben McTavish	

Name: Ben McTavish

Signed BMcTavish Date: 6 May 2022
Title: Environment Superintendent

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Received by: _____		
Date: _____	Time: _____	

Assessment of Environmental Impact

Introduction

Compliance monitoring and reactive sampling was conducted to address the incident of the Western Containment Pond (WCP) and Southern Containment Pond (SCP) overflow into the Seawater Channel on 25 March 2022, as reported to DEPWS on 25 March 2022 (Incident #1000603062). Stormwater inflows from the WCP and SCP catchment overflowed into the seawater channel following an intense rainfall event across the Gove Peninsula. Over a 6-hour period, a total of 95mm of rain was recorded at the refinery rain gauge. Of that, 60mm fell in a 2-hour period.

The WCP overflowed from approximately 12:15 to 20:25 on 25 March 2022.

The SCP overflowed from approximately 14:00 to 21:45 on 25 March 2022.

The Wastewater Neutralisation Plant (WWNP) was not operational prior to or during the incident on the 25 March 2022, and therefore was not discharging into the seawater channel.

A power outage during the storm event resulted in the seawater channel pumps being offline from 12:15 to 17:15 on 25 March 2022. Clean seawater was pumped through the seawater channel from 17:15 onwards at approximately 10,500 m³/h.

Monitoring sites S001, S074, SW09, SW10, RR2, S030 and S023 were sampled to determine the nature of impact and severity of the incident on the receiving environment.

Results

Analysis of samples are presented based on conditions, trigger values and limits within Waste Discharge Licence (WDL) 171-11. Investigation samples were taken each day and analysed at the onsite laboratory in addition to standard WDL monitoring requirements. The event-based monitoring of the marine compliance locations occurred on 26 March 2022 at the mixing zone boundary (MZB) sites (SW09, SW10 and RR2). Investigation samples were taken at S001, WCP (S030) and SCP (S023) at the time of the event.

The routine WDL samples and operational samples were taken at S001 from 24 to 28 March 2022. Results for all parameters were below the corresponding limits specified in the WDL171-11 except for Turbidity on 25/03/2022 (Table 1).

For the purposes of assessing environmental impact the S074 24-hour composite sample provides a more comprehensive representation of discharge quality into the receiving environment during this incident as it provides weighted average results over a 24-hour period (Table 2). The relevance of the composite sample is based on the WDL trigger values and limits that are based on ecotoxicological data (as opposed to historical datasets) derived from chronic eco-toxicity data (i.e., several days of continuous exposure). The S074 samples results presented are from 24 to 28 March 2022.

Table 1: Water quality results of site S001 sampled 24 to 28 March 2022.

		24/03/2022 0800 hrs	25/03/2022 0800 hrs	26/03/2022 0800 hrs	27/03/2022 0800 hrs	28/03/2022 0800 hrs	S001 Trigger Value	S001 Limit
Environmental Parameters	Unit							
pH		8.3	8.3	8.1	8.2	8.2	9	9.5
Electrical Conductivity	µS/cm	51700	39000	51800	52600	52400	-	-
Turbidity	NTU	2.3	129.0	3.0	2.0	3.2	75	100
Alkalinity	mg/L	120.4	90.9	117.9	117.9	118.4	-	-
Total Suspended Solids	mg/L	N/A	N/A	N/A	N/A	N/A	-	-
Metals & Metalloids								
Dissolved Aluminium	µg/L	7.2	118.4	7.8	4.7	7.9	-	560
Dissolved Arsenic	µg/L	1.6	1.4	1.3	1.3	1.6	-	200
Dissolved Gallium	µg/L	0.1	0.1	0.1	0.1	0.1	-	8000
Dissolved Molybdenum	µg/L	10.0	7.6	9.1	8.4	9.8	-	38800
Dissolved Vanadium	µg/L	2.3	3.0	2.4	2.2	2.6	-	1000

**blue text indicates WDL compliance samples.

** Highlighted values indicate an exceedance of the WDL limit at S001

Table 2: Water quality results of site S074 sampled 24 to 28 March 2022

		24/03/2022 0800 hrs	25/03/2022 0800 hrs	26/03/2022 0800 hrs	27/03/2022 0800 hrs	28/03/2022 0800 hrs
Environmental Parameters	Unit					
pH		8.3	8.2	8.5	8.3	8.3
Electrical Conductivity	µS/cm	50200	48000	33800	45700	48800
Turbidity	NTU	2.5	21.7	76.3	4.6	3.2
Alkalinity	mg/L	119.7	116.6	98.8	118.6	118.6
Total Suspended Solids	mg/L	4.3	15.7	44.8	4.8	6.0
Metals & Metalloids						
Dissolved Aluminium	µg/L	5.3	23.8	131.8	4.6	8.4
Dissolved Arsenic	µg/L	1.5	1.6	5.1	1.6	1.6
Dissolved Gallium	µg/L	0.1	0.2	2.0	0.1	0.1
Dissolved Molybdenum	µg/L	10.1	9.8	7.3	9.1	9.4
Dissolved Vanadium	µg/L	2.2	2.8	24.1	2.4	2.4

Results of the marine compliance monitoring show no sign of elevated concentrations for contaminants of potential concern (Table 3). All environmental parameters and metal(loid)s concentrations were below the trigger values specified in WDL171-11 (Table 3).

Table 3: Water quality results of marine compliance sites sampled on 26 March 2022.

		26/03/2022 0920 hrs	26/03/2022 0900 hrs	26/03/2022 0910 hrs	SW09, SW10, RR2 Trigger Value
Sample Site		RR2	SW09	SW10	
Environmental Parameters	Unit				
pH		8.0	8.0	7.9	7.7 – 8.4
Electrical Conductivity	µS/cm	53000	53300	53700	-
Turbidity	NTU	2	1.8	1.5	20
Alkalinity	mg/L	117	116	123	-
Total Suspended Solids	mg/L	6	8	8	-
Metals and Metalloids					
Dissolved Aluminium	µg/L	<5	<5	10	56
Dissolved Arsenic	µg/L	1.4	1.4	1.6	20
Dissolved Gallium	µg/L	<10	<10	<10	800
Dissolved Iron	µg/L	<5	13	<5	-
Dissolved Magnesium	µg/L	1380	1370	1410	-
Dissolved Molybdenum	µg/L	10.4	10.4	10.4	3880
Dissolved Vanadium	µg/L	2.2	2.1	2.8	100
Total Aluminium	µg/L	46	76	42	-
Total Arsenic	µg/L	1.6	1.8	1.6	-
Total Gallium	µg/L	<10	<10	<10	-
Total Iron	µg/L	44	62	39	-
Total Magnesium	µg/L	1360	1340	1340	-
Total Molybdenum	µg/L	12.2	12.6	12	-
Total Vanadium	µg/L	2.4	2.4	2.3	-
Nutrients					
Total Dissolved Phosphorus	µg/L	<u><100</u>	<u><100</u>	<u><100</u>	14
Total Dissolved Nitrogen	µg/L	<u><1000</u>	<u><1000</u>	<u><1000</u>	170
Hydrocarbons					
Total Petroleum Hydrocarbons	µg/L	<50	<50	<50	-
Polycyclic Aromatic Hydrocarbons	µg/L	<0.5	<0.5	<0.5	-
Benzene	µg/L	<1	<1	<1	-
Toluene	µg/L	<2	<2	<2	-
Ethylbenzene	µg/L	<2	<2	<2	-
Xylene	µg/L	<2	<2	<2	-

Note: The LOR for nutrient concentrations were elevated due to matrix effects. This is being resolved with the laboratory. S001 nutrient results were low, and nutrients are not considered a contaminate of concern for this event.

Investigation samples were taken for S001, S030 and S023 on 25 and 26 March 2022. These results are presented in Table 4. The results show elevated concentrations of dissolved Aluminium at S001 during the overflow event on the 25 March 2022. This is evaluated further in the discussion section.

Hydrocarbon concentrations were reported less than the laboratory Limit of Reporting (LOR) at S001 during the discharge event on 25 March 2022, and at S001 collected the following morning on the 26 March 2022.

Nutrient concentrations reported for all S001 samples indicate nutrients were not elevated and not a contaminant of concern for this event.

Table 4: Water quality results of investigation samples at S030, S023 and S001.

Date		25/03/2022	25/03/2022	25/03/2022	25/03/2022	26/03/2022
Time		13:30	14:00	13:15	14:00	8:00
Sample Site		S030	S023	S001	S001	S001
Environmental Parameters	Unit					
pH		9.5	9.6	8.0	8.4	7.8
Electrical Conductivity	µS/cm	142	149	1050	678	52500
Turbidity	NTU	238	195	316	368	2.1
Alkalinity	mg/L	65	69	40	44	114
Total Suspended Solids	mg/L	184	176	224	230	6
Metals & Metalloids						
Dissolved Aluminium	µg/L	2460	2450	872	1110	7
Dissolved Arsenic	µg/L	6	17	26.9	24.3	1.6
Dissolved Gallium	µg/L	16	17	6	8	<10
Dissolved Iron	µg/L	150	130	204	275	110
Dissolved Magnesium	µg/L	<1	<1	18	10	1350
Dissolved Molybdenum	µg/L	2	2	1.8	1.9	11.1
Dissolved Vanadium	µg/L	40	80	119	113	2.7
Total Aluminium	µg/L	N/A	N/A	16800	20700	130
Total Arsenic	µg/L	N/A	N/A	29.4	26.6	1.8
Total Gallium	µg/L	N/A	N/A	13	15	<10
Total Iron	µg/L	N/A	N/A	7220	8340	110
Total Magnesium	µg/L	N/A	N/A	19	11	1320
Total Molybdenum	µg/L	N/A	N/A	1.8	1.1	12
Total Vanadium	µg/L	N/A	N/A	154	148	3.2
Nutrients						
Total Dissolved Phosphorus	µg/L	N/A	N/A	20	20	<50
Total Dissolved Nitrogen	µg/L	N/A	N/A	<100	<100	<500
Hydrocarbons						
Total Petroleum Hydrocarbons	µg/L	N/A	N/A	<50	<50	<50
Polycyclic Aromatic Hydrocarbons	µg/L	N/A	N/A	<0.5	<0.5	<0.5

Benzene	µg/L	N/A	N/A	<1	<1	<1
Toluene	µg/L	N/A	N/A	<2	<2	<2
Ethylbenzene	µg/L	N/A	N/A	<2	<2	<2
Xylene	µg/L	N/A	N/A	<2	<2	<2

** Highlighted values indicate an exceedance of the WDL Limit at S001

Discussion

On the 25 March 2022, approximately 90mm of rainfall was recorded on site commencing at approximately 06:30 ceasing at approximately 16:00. High rainfall contributed to high volumes of stormwater input into the WCP, SCP and additional inputs into the seawater channel. A power outage on site resulted in the seawater channel pumps being offline from 12:15 to 17:15 on 25 March 2022. The seawater pumps recommenced operation at 17:15 shortly after the rainfall stopped, allowing clean seawater to be pumped through the seawater channel.

Exceedances of the turbidity Limit (100 NTU) were recorded during routine compliance sampling at S001 on the 25 March 2022 (129 NTU), as well as investigation sampling at S001 throughout the afternoon of the rainfall event (316 NTU at 13:15 and 368 NTU at 1400). Operational sampling at the WCP (S030) and the SCP (S023) recorded lower turbidity (238 NTU and 198 NTU respectively). This would indicate that additional stormwater catchment inputs to the seawater channel were occurring throughout the rainfall event, contributing to the increased turbidity recorded on the 25 March 2022 at S001. Additionally, for a period between 12:15 and 17:15, no seawater was being pumped through the channel, which under normal operation would reduce the turbidity at S001. The intense rainfall recorded on site on the 25 March 2022 ceased at approximately 16:00 hrs, shortly before the seawater pumps came back online.

Sampling conducted at S001, and at the marine compliance monitoring locations (RR2, SW09 and SW10) on the morning of the 26 March 2022 reported concentrations within background ranges and show no evidence of residual impact on water quality immediately after the incident event. Additionally, turbidity recorded in the composite sample, S074 (for the 24hrs period spanning the WCP and SCP overflows), did not exceed the WDL Limit of 100 NTU. It is expected that there was no significant environmental impact in the marine environment from high turbidity recorded at compliance monitoring locations during the rainfall event based on the short duration of elevated turbidity.

Elevated concentrations of dissolved aluminium were recorded in investigation samples at S001 on 25 March 2022 during the overflow event (Table 4). However, concentrations recorded at S001 on the morning of the 26 March 2022 returned to normal operating conditions. Marine compliance monitoring at the MZB was also conducted on the 26 March 2022 and results showed background concentrations (Table 3), indicating no residual impact on the marine receiving environment.

The Australian Institute of Marine Science (AIMS) applied a hydrodynamic model of Melville Bay to assess the dilution of the seawater channel discharge into inner Gove Harbour (AIMS, 2020). The model predicted a minimum dilution rate of 1:25 for the three mixing zone boundary (MZB) compliance sites SW09, SW10 and RR2.

Concentrations at the mixing zone boundary during the incident can be conservatively predicted by applying the minimum dilution rate from the hydrodynamic model at the MZB of 1:25 to S001 data from Table 5.

The predicted concentrations at the mixing zone boundary sites are presented in Table 5. In all cases the predicted concentrations for the marine compliance sites were substantially lower than the corresponding WDL Trigger values at the mixing zone boundary.

Table 5: Predicted concentration at the mixing zone boundary based on dissolved Aluminium concentrations at seawater channel site S001.

Date and Time	Sample Site	Metal (dissolved)	Concentration (µg/L)	Concentration after 1:25 dilution (µg/L)	WDL Limit (µg/L)
25/03/2022 13:15	S001	Aluminium	872	34.9	560
25/03/2022 14:00	S001	Aluminium	1110	44.4	560
26/03/2022 08:00	S001	Aluminium	7	0.28	560

Contaminant Load

Contaminant loads have been calculated for the seawater channel output based on average flow rates recorded at S001 over a 24hr period from 0800hrs on 25 March 2022 to 0800 on 26 March 2022 (Table 7 and Table 6 respectively). Concentrations recorded at S074, a 24-hour composite sample, provides a more comprehensive representation of discharge quality into the receiving environment during this incident than the S001 grab samples, and have been used for the contaminant load calculations. As a result, the volume of water released has been reported for the 24-hour duration of the S074 composite sample, which is a greater volume than would have been released from just the WCP and SCP. The calculation has been completed in this manner to provide the most accurate calculation of contaminant load.

The contaminant load calculations are based on the best available data at the time of the incident.

Table 6: Estimated flows during the incident event

	Seawater Channel (S001) Average flow over 24hr period 0800 25 March 2022 to 0800 26 March 2022
Average flow (m ³ /h)	10532
Time period (Hr)	24
Volume (m ³)	252,760
Volume (L)	252,759,676

Table 7: Contaminant Loads at S074 during incident event

		S074 concentrations 24 hr composite sample (0800 25/03/22 to 0800 26/03/22)	Contaminant Load (kg)
Sample Site		S074	Seawater outfall channel
Metals & Metalloids	Unit		
Dissolved Aluminium	µg/L	131.8	33.31
Dissolved Arsenic	µg/L	5.1	1.29
Dissolved Gallium	µg/L	2.0	0.51
Dissolved Iron	µg/L	6.9	1.74
Dissolved Molybdenum	µg/L	7.3	1.85
Dissolved Vanadium	µg/L	24.1	6.06

The WWNP was not operational prior to or during the containment ponds overflowing into the seawater channel, therefore the flows recorded above do not include WWNP discharge loads. However, the flow rates recorded at S001 do include all other catchment runoff, including the overflows from the WCP and SCP, during the intense rainfall event and also the natural load from the operation of the seawater pumps (after 17:15 25 March 2022).

Conclusion

While turbidity exceeded the Limit for routine and investigation sampling at S001, and dissolved Al concentrations recorded at S001 during the incident exceeded the Limit for investigation samples, it is expected that there was no significant environmental impact from the incident based on the short duration of elevated concentrations, being approximately five hours. At which point the seawater pumps were re-started delivering approximately 10,500m³/h, resulting in high dilution rates of the overflow. In addition, the results of samples collected at the MZB sites on the morning immediately following the releases showed background concentrations and no residual impact on marine water quality.

Based on the discharge concentrations during the incident and the measured concentrations at the MZB immediately following cessation of the WCP and SCP discharge, it is expected that there was no significant environmental impact from this incident.

References

Australian Institute of Marine Science, 2020, *Assessment of seawater channel dilution in inner Gove Harbour for development of discharge Trigger Values*. Report to Rio Tinto Aluminium Gove.

Notification of an Environmental Incident

☒ Incident ☐ Critical Incident ☐ Preliminary ☒ Final

Incident number:	1000603157
Name of mining site:	Rio Tinto - Gove operations
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 28/03/22 Time: 07:45
Date & time of incident:	Date: 02/03/22 Time: 08:45
Name of person notifying:	Seydou Cisse
Position/Title:	Senior Advisor Environment
Contact person:	Ben McTavish
Contact details:	Business: 08 8987 5233 Mobile: 04 7735 3879 Email : ben.mctavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	Marine monitoring sites SW3 and SW4.

Document Owner:	Specialist Environment Gove	Authorised By:	HSE Business Partner
Rev No: 14	Date of Issue: 14/09/21		Page 1 Of 3

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INCIDENT DESCRIPTION	Missed monthly TSS for SW3 and SW4. Monthly TSS was not analysed for SW3 and SW4 for February 2022 round, as required by Condition 28 of the WDL171-11. Monthly analysis of TSS at SW3 and SW4 is required within Appendix 2 Table 3 Marine Health Monitoring Program. Samples were collected on 12 February 2022 and dispatched to Charles Darwin University (CDU) Laboratory in Darwin for analysis. Lab report received over this weekend indicated TSS was not analysed.	
Causes & contributing factors to the incident:	TSS sample is filtered then placed in the microwave using half the power of a 1200w microwave for 5 mins to dry the filters. The microwave heated the TSS filters and melted the weigh containers with the TSS samples. This microwave is a newer model and appeared to have too much power than the previous one.	
Potential causes & contributing factors to the incident:	The test method was based on previous microwave which was broken by the time samples were received. Testing is conducted on full volume of samples received (510mL) for each site. CDU did not report this incident to RTA Gove at the time of occurrence.	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	To avoid reoccurrence of such incident, the following actions are envisaged: • The test method has been updated; the power level of the microwave reduced. • Testing to be conducted at earlier convenient period after receiving samples. • CDU to inform RTA as soon as there is any issue with testing, to allow for re-collection of sample where possible. • RTA to provide information pack on WDL requirements for marine monitoring.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	Based on current data, RTA Gove anticipate no environmental impact. Both SW3 and SW4 are background sites where monitoring data are used for comparison to test sites where RTA Gove discharges process water.
Emergency & remedial actions taken:	The microwave was stopped and its power adjusted to a lower range. This permitted TSS testing for the remaining samples.

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Current situation: (Potential / ongoing / ceased / etc.)	Test method has now been adjusted and the power level reduced on the microwave. It has been requested that CDU inform RTA Gove as soon as there is an issue with testing.
Details of any samples taken: (when / where / type / number / time for results / etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Monthly samples for March 2022 round have already been received by CDU. This will be analysed for TSS and other analytes suites.

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Mel Winks
	Position:	HSE Business Partner

Has the department been notified earlier?	☒ YES	☐ NO
Who was notified:	Sally-Anne Orchard	
How: (phone/email/fax)	Email	
When: (date & time)	28/03/2022 3:46PM	
By whom:	Seydou Cisse	

Name: Ben McTavish

Signed

B McTavish

Date:

22/04/2022

Title: Superintendent Environment

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Received by:	
Date:	Time:

Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☒ Preliminary
 ☒ Final

Completed form: waste@nt.gov.au

Incident number:	1000608476
Name of mining site:	Rio Tinto - Gove Operations
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 01/06/2022 Time: 07:30
Date & time of incident:	Date: 07/01/2022 Time: 15:30
Name of person notifying:	Ben McTavish
Position/Title:	Environment Superintendent
Contact person:	Ben McTavish
Contact details:	Business:08 8987 5233 Mobile:0477 353 879
	E-mail: ben.mctavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	WDL Authorised Discharge Point S001 
INCIDENT DESCRIPTION	It has been identified that continuous measurements of pH and electrical conductivity (EC) were displaying erroneous values for the Outfall
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Authorised By:	HSE Business Partner
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(attach photos if available)	Authorised Discharge Point S001 on 07 January 2022. Condition 28 of WDL171-11 requires continuous monitoring of pH and EC as per Table 1 of Appendix 2. However, data recorded on 7 January 2022 shows negative values for pH and EC between 15:30 and 16:45.	
Causes & contributing factors to the incident:	It is likely network issues or communication failure may have caused equipment errors leading to this incident.	
Potential causes & contributing factors to the incident:	Equipment faults have been previously observed at S001 outfall monitoring station.	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	A capital project to increase redundancy at the S001 monitoring station and upgrade infrastructure has been endorsed by site management.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	The pH and EC issues were rectified after 16:45 and continue to work normally. WWNP was offline at the time of the incident and only seawater would have been flowing in the channel. All other monitoring parameters remain in place as specified in the WDL. As all other parameters continued to be monitored and the S001 fault was short-lived, RTA Gove are confident the environment remained protected.
Emergency & remedial actions taken:	In response to this incident, a verification was conducted to confirm correct data quality is reported in the database. Calibration records for the monitoring probes were checked. It shows calibration was completed on the same date and no abnormality was detected.
Current situation: (Potential / ongoing / ceased / etc.)	Normal operating conditions.

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Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Routine sampling as per WDL171-10 continued. S001 continuous data for pH and EC prior and after the incident are presented in the table below:				
	5/01/22 12:00	6/01/22 12:00	7/01/22 12:00	8/01/22 12:00	
pH (pH unit)	8.3	8.3	8.3	8.3	
EC (µS/cm)	56159	55719	55948	56092	

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES		☐ NO
If so, to whom:	Name:	Steve Moratti	
	Position:	Superintendent Utilities	

Has the department been notified earlier?	☐ YES	☒ NO
Who was notified:		
How: (phone/email/fax)		
When: (date & time)		
By whom:		

Name: Ben McTavish**Signed****Date:**

1 June 2022

Title: Superintendent Environment

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Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☒ Preliminary
 ☒ Final

Completed form: waste@nt.gov.au

Incident number:	1000608477
Name of mining site:	Rio Tinto - Gove Operations
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 01/06/2022 Time: 07:30
Date & time of incident:	Date: 26/08/2021 Time: 18:15
Name of person notifying:	Ben McTavish
Position/Title:	Environment Superintendent
Contact person:	Ben McTavish
Contact details:	Business:08 8987 5233 Mobile:0477 353 879
	E-mail: ben.mctavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	WDL Authorised Discharge Point S001 
INCIDENT DESCRIPTION (attach photos if available)	Continuous measurements of pH and electrical conductivity (EC) are required at S001 as per Table 1 of Appendix 2 of WDL171-10

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	(Condition 27) It was observed that a loss of communication at S001 outfall station caused the pH and EC probes to fail to record data for 1.5 hours from approximately 18:15 to 19:45 on 26 August 2021.	
Causes & contributing factors to the incident:	Loss of communication at S001 outfall station.	
Potential causes & contributing factors to the incident:		
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	A capital project to increase redundancy at the S001 monitoring station and upgrade infrastructure has been endorsed by site management.	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	The pH and EC issues were rectified by the electrical team, and data monitoring recommenced at 19:45. All other monitoring parameters remain in place as specified in the WDL. As all other parameters continued to be monitored and the S001 error was short-lived, RTA Gove are confident the environment remained protected.
Emergency & remedial actions taken:	As a response to the loss of communication, there was a cease of release through S001: - The wastewater neutralisation plant (WWNP) was shut offline at 19:20 on 26 August 2021 (approximately 1 hour later). - The seawater pumps were switched offline at 19:35 on 26 August 2021.
Current situation: (Potential / ongoing / ceased / etc.)	Normal operating conditions.

Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	Routine WDL sampling at S001 and S074 continued.					
	S074					
	Date	pH	EC	Turb	Alk	TSS
	25/08/2021	8.5	49100	3.4	264.3	4.5
	26/08/2021	8.5	49200	3.7	267.4	5.4
	27/08/2021	8.2	52800	4.6	213.4	10.0
	S001					
	Date	pH	EC	Turb	Alk	TSS
	25/08/2021	8.4	53100	4.2	283.4	Not req.
	26/08/2021	8.4	52200	4.0	239.3	Not req.
27/08/2021	8.2	52500	27.3	249.1	Not req.	

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES		☐ NO
If so, to whom:	Name:	Steve Moratti	
	Position:	Superintendent Utilities	

Has the department been notified earlier?	☐ YES	☒ NO
Who was notified:		
How: (phone/email/fax)		
When: (date & time)		
By whom:		

Name: Ben McTavish

Signed

Date:

1 June 2022

Title: Environment Superintendent

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Notification of an Environmental Incident

☒ Incident☐ Critical Incident☒ Preliminary☐ Final

Incident number:	1000609048
Name of mining site:	Rio Tinto - Gove Operations
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 01/06/2022 Time: 13:00
Date & time of incident:	Date: 8/03/2022 Time: 18:09
Name of person notifying:	Ben McTavish
Position/Title:	Superintendent Environment
Contact person:	Ben McTavish
Contact details:	Business: 08 8987 5233 Mobile: 0477 353 879
	E-mail: Ben.McTavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	WDL Authorised Discharge Point S001 

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NOTIFICATION OF AN ENVIRONMENTAL INCIDENT

REF: GPM-EHS-020

INCIDENT DESCRIPTION (attach photos if available)	A filtered total nitrogen result of 4,600 µg/L was reported above the S001 Limit (1,700 µg/L) at S001 as per Condition 41.1 Table 1, Appendix 2 of WDL171-11.	
Causes & contributing factors to the incident:	Pending internal investigation.	
Potential causes & contributing factors to the incident:	Inconsistent reporting of unit of measurement for nutrient indicators (i.e., mg/L and µg/L) within laboratory reports were a cause for delayed identification.	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	Pending internal investigation.	
Date when investigation report will be submitted to Administering Agency:	5 August 2022	

ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	Results from the Marine compliance sampling from March 2022 were below the WDL trigger value (170 µg/L). SW9: 130 µg/L SW10: 130 µg/L RR2: 120 µg/L
Emergency & remedial actions taken:	External laboratory was contacted to confirm analysis results.
Current situation: (Potential / ongoing / ceased / etc.)	No exceedance in nutrient indicators in subsequent monthly results.
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-11 section 40.8 for further analysis.	Monitoring results for the incident period are being reviewed and will be provided in the final notification.

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name:	Melissa Winks
	Position:	HSE Business Partner

Has the department been notified earlier?	☐ YES	☒ NO
Who was notified:		
How: (phone/email/fax)		
When: (date & time)		
By whom:		

Name: Ben McTavish

Signed

Date:

1 June 2022

Title: Superintendent Environment

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Notification of an Environmental Incident

☒ Incident
 ☐ Critical Incident
 ☒ Preliminary
 ☐ Final

Incident number:	1000609084
Name of mining site:	RTA Gove
Name of operator:	RTA Gove Pty Limited
Date & time of detection:	Date: 01.06.2022 Time: 12:30
Date & time of incident:	Date: 04.06.2021 Time: 08:00
Name of person notifying:	Ben McTavish
Position/Title:	Superintendent Environment
Contact person:	Ben McTavish
Contact details:	Business: 08 8987 5223 Mobile: 0477 353 879
	E-mail : ben.mctavish@riotinto.com
INCIDENT LOCATION (use GPS co-ordinates, attach map, etc. as appropriate)	WDL Authorised Discharge Point S001

INCIDENT DESCRIPTION (attach photos if available)	Under Appendix 2, Table 1, Alkalinity is to be monitored daily S001. On the 4 June 2021 alkalinity testing was not completed. (Condition 28, formerly Condition of WDL171-10)	
Causes & contributing factors to the incident:	Under investigation	
Potential causes & contributing factors to the incident:	S001 sample may not have delivered at the same time as the rest of the daily samples	
Action Taken:	YES ☒	NO ☐
If no, why?		
Corrective Actions that have/will be undertaken to ensure this does not reoccur:	This incident occurred prior to similar incidents reported under WDL171 and Corrective Actions to address this compliance monitoring have been enacted. However, RTA Gove continues to focus on compliance monitoring and data management as key priorities for the site.	
Date when investigation report will be submitted to Administering Agency:	5 August 2022	

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ENVIRONMENTAL DETAILS

Nature of impact and severity: (Volume of spillage, area impacted, wildlife/vegetation/ erosion, etc.)	The seawater pumps were operating at the time, although the WWNP was offline. The S001 sample was received by the site laboratory, however the alkalinity was not run for this sample. All other parameters were within historical ranges for the S001 sample. The S074 alkalinity over the same time period maintained historically consistent values. Due the WWNP having no output and the results of the samples taken in the days prior and the day of, it is likely that no environmental impact would be expected from this incident.
Emergency & remedial actions taken:	None available due to date of detection.
Current situation: (Potential / ongoing / ceased / etc.)	Sample hold buckets have been implemented to try and prevent the premature disposal of samples in future.
Details of any samples taken: (when / where / type / number / time for results /etc) If incident is related to Total Nitrogen, refer to WDL171-10 section 38.8 for further analysis.	NA

OPERATOR INTERNAL REPORTING

Has the incident been reported internally?	☒ YES	☐ NO
If so, to whom:	Name: Jon Regan	Position: Specialist Laboratory

Has the department been notified earlier?	☐ YES	☒ NO
Who was notified:		
How: (phone/email/fax)		
When: (date & time)		
By whom:		

Name: Ben McTavish

Signed

Date:

1 June 2022

Title: Environment Superintendent

Document Owner: Senior Advisor Environment – Gove	Authorised By: Specialist Environment – Gove
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Appendix G – Continuous Improvement Plan

Gove Operations WDL Continuous Improvement Plan 2021-2022

Background

Gove Operations is granted a Waste Discharge Licence (WDL), under the NT *Water Act*, for the legal discharge of wastewater from RTA Gove Pty Ltd premises at the refinery into receiving environments, that include Gove Harbour, Drimmie Arm and Melville Bay. The licence is granted to regulate discharge quality from the Wastewater Neutralisation Plant (WWNP), sewerage treatment plant, tank farm release bunds (Light Fuel Tank Farm and Harbour Tank Farm) and the seawater circuit at the refinery. It also regulates the quality of surface water runoff from the refinery. This is done by setting trigger values and limits for discharge, surface water runoff, and marine monitoring sites. A requirement of the WDL is to prepare and implement a Continuous Improvement Plan.

Objectives

- Ensure discharge and surface water runoff quality complies with the WDL trigger values and limits.
- Implement improvement plans for processes and physical control measures to protect the receiving environment.

Action Plan

Scope	Actions	Details	Objectives	2021 Progress
Process	Develop and implement a Water Management Plan in 2020 to replace 2019 Water Monitoring Plan	New water management plan to align water monitoring with closure plans and rehabilitation activities. Including adaptive management plan and field Trigger Action Response Plan.	To ensure achievement of compliance with legislative requirements and applicable performance standards, develop and maintain understanding of potential short-term and long-term impacts on the receiving environments.	Water Management Plan was finalised in July 2021. It defines the drivers, targets, and controls at Gove Operations to assist in compliance with legislation, guidance, and internal Rio Tinto standards relating to water management, including adaptive management plan. The Water Monitoring Plan has been split into 3 separate monitoring plans: 1. Surface water monitoring plan (SWMP) - in progress 2. Marine health monitoring program (MHMP) – submitted to DEPWS 3. Groundwater monitoring plan (GWMP) – in progress
	Revise Northern Ponds Discharge Quality Improvement Plan in 2020	Update existing plan to align with closure plan for Northern Ponds and groundwater model.	Development of plan for long term control of contaminated site.	WDL171 is no longer applicable for this area. This improvement plan is now superseded by the Northern Ponds Closure Studies and project (update provided below).
Controls	Stockpile Creek Project - scheduled completion in 2020/21	Construction of sediment containment system and erosion and sediment structures to slow surface flows prior to release at Stockpile Creek. Majority of civil works are complete, revegetation and stabilisation works remain.	Improve the surface water runoff quality released from Stockpile Creek.	WDL171 is no longer applicable for this area. To improve the water quality released from the Stockpile Creek (S006) into Wanaka Bay at the refinery a civil engineering project commenced in late 2019. The project involved the construction of additional forebays and sediment settlement structures to increase the volume and duration of storm water impoundment. At the completion of construction works, impacted areas were revegetated and embankments were stabilised. Approximately 2,000 native tube stock were planted over the 1.65ha Stockpile Creek footprint. Monitoring of the vegetation

				continues to take place to support future revegetation efforts at the refinery.
	Northern Ponds early works Closure Project - 2020 to 2023	The closure plan for the Northern Ponds currently includes the replacement of the original earth cap across the eastern pond area with a HDPE liner. Part of the plan is to be brought forward in the schedule as 'early works' to target the source of the contamination from Taylors Pond. This includes installation of a HDPE liner for Taylors Pond and seepage interception trench.	Prepare and execute long term control for contaminated site.	WDL171 is no longer applicable for this area. Originally scheduled for 2023, this work has been brought forward as part of the Northern Ponds closure plan to control the contamination source and improve discharge water quality. Feasibility study progressed with finalisation of design during 2021. Tender process for execution project commenced, with works scheduled to commence Q2 2022, with completion Q4 2023.
	Northern Ponds - erosion and sediment controls - 2019 to 2020	Erosion and sediment controls installed along the Taylors Pond embankment. Including monitoring program to record effectiveness of control measures, in particular the use of superphosphate to aid in pH reduction, along with erosion and sediment control structures.	Short term controls to improve discharge quality.	WDL171 is no longer applicable for this area Short term erosion and sediment control measures to stabilise the failed embankment of Taylors Pond and the upper reaches of the main drain were completed in 2019 and 2020. This work included installation of jute bales/coir logs, geotextile sediment fences, and hay bales to control erosion and slow surface water flow, whilst providing a source of organic material. In addition, areas of erosion were reprofiled and filled with rock (where accessible) to stabilise the areas.