EPL228 Annual Environmental Monitoring Report 2023-2024

Report

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Revision	Date	Issue Reason	Prepared	Checked	Endorsed	Approved
0	16.09.2024	For issue	B Dry J Puntoriero J Carle K Pannell	B Davis	ERM	B Schmidt
1	31.10.2024	Incorporate NT EPA comments	B Dry J Carle	B Davis	C Serginson	B Schmidt
2	07.04.2025	Onshore emissions amended	J Carle	A Parody	C Serginson	B Schmidt

RECORD OF AMENDMENT

Revision	Section	Amendment
1	3.2.3	Incorporated NT EPA comment to refer to Table 5 (instead of Table 6) of Appendix 3, EPL228-05.
2	3.1	Updated Table 3-1 following an NT EPA audit of INPEX's 2023-24 AEMR vs NPI emissions in Q1 2025.

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LIST OF TABLES

Abbreviation and definitions

Abbreviation	Description
µg/L	microgram per litre
µm	micrometre
µs/cm	microsiemens per centimetre
AEMR	annual environmental monitoring report
AGI	acid gas incinerator
AGRU	acid gas removal unit
aMDEA	activated methyl diethanolamine
AOC	accidentally oil contaminated
AQMS	air quality monitoring stations
AS	Australian Standard
ASU	artificial settlement unit
BTEX	benzene, toluene, ethylbenzene, xylenes
BTX	benzene, toluene, xylenes
CCPP	combined cycle power plant
CCR	central control room
CFI	calibrated field instrument
CFU	colony-forming unit
cm	centimetre
COA	certificate of analysis
COC	continuously oily contaminated
COD	chemical oxygen demand
DO	dissolved oxygen
EC	electrical conductivity
E. coli	*Escherichia coli*
EPL228	Environment Protection Licence 228 (as amended)
FRP	filterable reactive phosphorus
GEP	gas export pipeline
GTG	gas turbine generator

Abbreviation	Description
H_2S	hydrogen sulphide
Hg	mercury
HM	hinterland margin
HRSG	heat recovery steam generator
Ichthys LNG	collectively, the onshore gas export pipeline and the gas processing plant
INPEX	Ichthys LNG Pty Ltd
km	kilometre
LIMS	laboratory information management system
LNG	liquified natural gas
LOR	limit of reporting
LPG	liquified propane gas
m	metre
mm	millimetres
MEG	mono ethylene glycol
MDEA	methyl diethanolamine
mg/kg	milligram per kilogram
ml	millilitres
m^3/h	cubic metres per hour
MPN	most probable number
NATA	National Association of Testing Authorities, Australia
NCW	non-contaminated water
NGERS	National Greenhouse and Energy Reporting Scheme
NO	nitrogen monoxide
NO_2	nitrogen dioxide
NOx	nitrogen oxide (NO and/or NO_2)
NPI	National Pollutant Inventory
NSW	New South Wales
NT	Northern Territory

Abbreviation	Description
NT DITT	Northern Territory Department of Industry, Tourism and Trade
NT EPA	Northern Territory Environment Protection Authority
O_2	oxygen
OEMP	Onshore Operations Environmental Management Plan (L060-AH-PLN-60005)
PAH	polycyclic aromatic hydrocarbons
PCS	process control system
pH	measure of acidity or alkalinity
$PM_{2.5}$	particulate matter with aerodynamic diameter less than 2.5 µm
PM_{10}	particulate matter with aerodynamic diameter less than 10 µm
ppm	parts per million
ppmv	parts per million by volume
PSD	particle size distribution
QA/QC	quality assurance/quality control
RBL	rating background level
REMP	Receiving Environment Monitoring Program
SFLA	sample for laboratory analysis
SQGV	sediment quality guideline value
SWL	standing water level
TC	tidal creek
TF	tidal flat
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TPH	total petroleum hydrocarbons
TRH	total recoverable hydrocarbons
TSS	total suspended solid
USEPA	United States Environmental Protection Authority
UV	ultraviolet

EXECUTIVE SUMMARY

Ichthys LNG Pty Ltd (INPEX) was issued Environment Protection Licence 228 (as amended from time to time) on 13 December 2017 (EPL228). Activation of EPL228 occurred on 14 September 2018 triggering several EPL228 monitoring conditions and Onshore Operations Environmental Management Plan (OEMP) monitoring commitments.

Condition 76 of EPL228-05[1] requires an Annual Environmental Monitoring Report (AEMR) to be submitted to the Northern Territory Environment Protection Authority (NT EPA) for each year of the licence, unless otherwise agreed, for scheduled activities conducted during the preceding 12 months (i.e., the reporting period) from 1 July to 30 June. For this AEMR, the reporting period is defined as 1 July 2023 to 30 June 2024. This AEMR has been developed to meet the requirements of Condition 77 of EPL228-05.

Monitoring undertaken during the reporting period found that liquid effluent discharges were typically within EPL228 discharge limits, and these discharges had no discernible impact on Darwin Harbour.

All other terrestrial and marine monitoring programs (e.g. groundwater, mangroves, weeds, etc.) found that monitoring results were consistent with those reported during the previous years' AEMR and construction phase.

Based on monitoring results for the reporting period, there were no adverse effects to the declared beneficial uses and objectives of Darwin Harbour.

The point source emission monitoring reported that all permanent plant and equipment were typically within EPL228 air emission limits, and the emissions had no discernible impact on the ambient air quality of the Darwin Region.

[1] EPL228-05 came into effect on 13 December 2022.

1 INTRODUCTION

Ichthys LNG Pty Ltd (hereafter referred to as INPEX) was issued Environment Protection Licence 228 (as amended and hereafter referred to as the EPL228) for the purposes of:

Operating premises for processing hydrocarbons so as to produce, store and/or despatch liquefied natural gas or methanol, where:

a. the premises are designed to produce more than 500,000 tonnes annually of liquefied natural gas and/or methanol; and

b. no lease, licence or permit under the Petroleum Act or the Petroleum (Submerged lands) Act relates to the land on which the premises are situated.

All the activities in relation to onshore production design capacity of 12.89 million tonnes per annum of hydrocarbons[2], being up to:

- *9.64 million tonnes of liquefied natural gas per annum from two LNG processing trains;*
- *1.65 million tonnes of liquefied petroleum gas per annum; and*
- *20,000 barrels of condensate per day (1.6 million tonnes of condensate per annum).*

Since the 2019/2020 Annual Environmental Monitoring Report, the Ichthys LNG facility has been in steady state operations. The key milestones are shown in Section 1.4.1.

1.1 Purpose

The purpose of the AEMR is to satisfy Condition 76 of EPL228-05 for the Licensed Premises (hereafter Ichthys LNG)[3]. The reporting period for this AEMR is 1 July 2023 to 30 June 2024.

1.2 AEMR Condition requirements

Table 1-1 provides details of Condition 77 of EPL228-05 as they relate to the AEMR requirements and the relevant section for where the conditions have been addressed within this report.

Table 1-1: Annual environmental monitoring report condition requirements

EPL288 Condition #	Condition detail	Section
77	The Annual Environmental Monitoring Report must:	-
77.1	report on monitoring required under this licence;	This AEMR
77.2	include a tabulation in Microsoft ® Excel ® format, of all monitoring data required to be collected in accordance with this licence;	Provided to NT EPA separately
77.3	summarise performance of the authorised discharge to water, compared to the discharge limits specified in Table 3 in Appendix 2;	2.1

[2] As defined in EPL228-05

[3] Condition 76 reads: *The licensee must submit an Annual Environmental Monitoring Report to the NT EPA by 30 September for each year of this licence unless otherwise authorised, for the Scheduled Activity conducted during the preceding 12 month period from 1 July to 30 June.*

EPL288 Condition #	Condition detail	Section
77.4	summarise performance of the authorised emissions to air, compared to the emission limits and targets specified in Table 5 in Appendix 3, when the fuel burning or combustion facilities for the Scheduled Activity have operated under normal and maximum operating conditions for the annual period;	3
77.5	summarise operating conditions of each emission source and the resulting air emission quality;	3.2
77.6	provide total emissions to air in tonnes per year for the air quality parameters listed in Table 6 in Appendix 3;	3.1
77.7	assess the contribution of the authorised emissions on the Darwin region ambient air quality during periods not affected by bushfire smoke for Wet and Dry seasons;	3.3
77.8	report on outcomes of the REMP monitoring and assessment;	This AEMR
77.9	summarise measures taken to reduce waste;	6
77.10	consider the NT EPA Guideline for Reporting on Environmental Monitoring;	APPENDIX A:
77.11	be reviewed by Qualified Professional(s); and	APPENDIX B:
77.12	be provided to the NT EPA with the Qualified Professional(s) written, certified review(s) of the Annual Environmental Monitoring Report.	APPENDIX B:

1.3 Program objective

An overview of the environmental monitoring programs, their objectives, and cross-references to sections within the AEMR which provide more detail, are listed in Table 1-2. Monitoring was undertaken in accordance with the Onshore Operations Environmental Management Plan (OEMP) and EPL228 requirements.

Table 1-2: Monitoring program objectives

Program	Objective	Section
Commingled treated effluent (750-SC-003)	To ensure commingled treated effluent does not exceed discharge criteria specified in EPL228.	2.1
Harbour sediment	To detect changes in surficial sediment quality in the vicinity of the jetty outfall and determine if changes are attributable to Ichthys LNG operations.	2.2
Point source emissions to air	To determine if air emissions from stationary point sources are within acceptable limits	3.2
Dark-smoke events	To determine if air emissions from the flare systems are within acceptable limits.	3.4
Groundwater quality	To detect changes in groundwater quality and determine if these changes are attributable to Ichthys LNG operations.	4.1
Nearshore marine pests	To assess the presence/absence of invasive marine pest at the Ichthys LNG product loading jetties, through a coordinated approach with the Northern Territory (NT) Biosecurity Unit.	5.2

Program	Objective	Section
Introduced terrestrial fauna	To determine the presence, location and methods used to control nuisance species.	5.3
Weed survey	To identify the abundance and spatial distribution of known and new emergent weed populations, especially in areas susceptible to weed invasion, to inform weed management control activities.	5.4
Weed management	To manage invasive weeds onsite.	5.5
Vegetation rehabilitation monitoring	To determine if vegetation recovery through natural processes has occurred.	5.6
Cultural heritage	To determine if there has been any interference to cultural heritage sites.	5.7

1.4 Site information

1.4.1 Ichthys LNG operational milestones

Table 1-3 provides an overview of the Ichthys LNG key milestones for the reporting period. A general Ichthys LNG site layout is shown in Figure 1-1.

Table 1-3: Ichthys LNG key milestones during the reporting period

Date	Report
July 2023	Unplanned outage on train 1 & 2 for 9 days due to high level alarm in ILNG inlet liquid level
July 2023	Non-Statutory audit of *Liquid Discharge Management Plan* L060-AH-PLN-60050 Rev 4
October 2023	NTEPA Site Inspection at ILNG facility
October -November 2023	Changeover of major ILNG maintenance contractor
November 2023	External RINA audit and site inspection at ILNG

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Figure 1-1: Ichthys LNG layout

1.4.2 Environmental context

Ichthys LNG is located on Bladin Point, on the northern side of Middle Arm Peninsula in Darwin Harbour (Figure 1-2). Bladin Point is a low-lying peninsula in Darwin Harbour, which is separated from the mainland by a mudflat. Ichthys LNG is approximately 4 km from Palmerston (the nearest residential zone) and approximately 10 km south-east of the Darwin central business district, across Darwin Harbour.

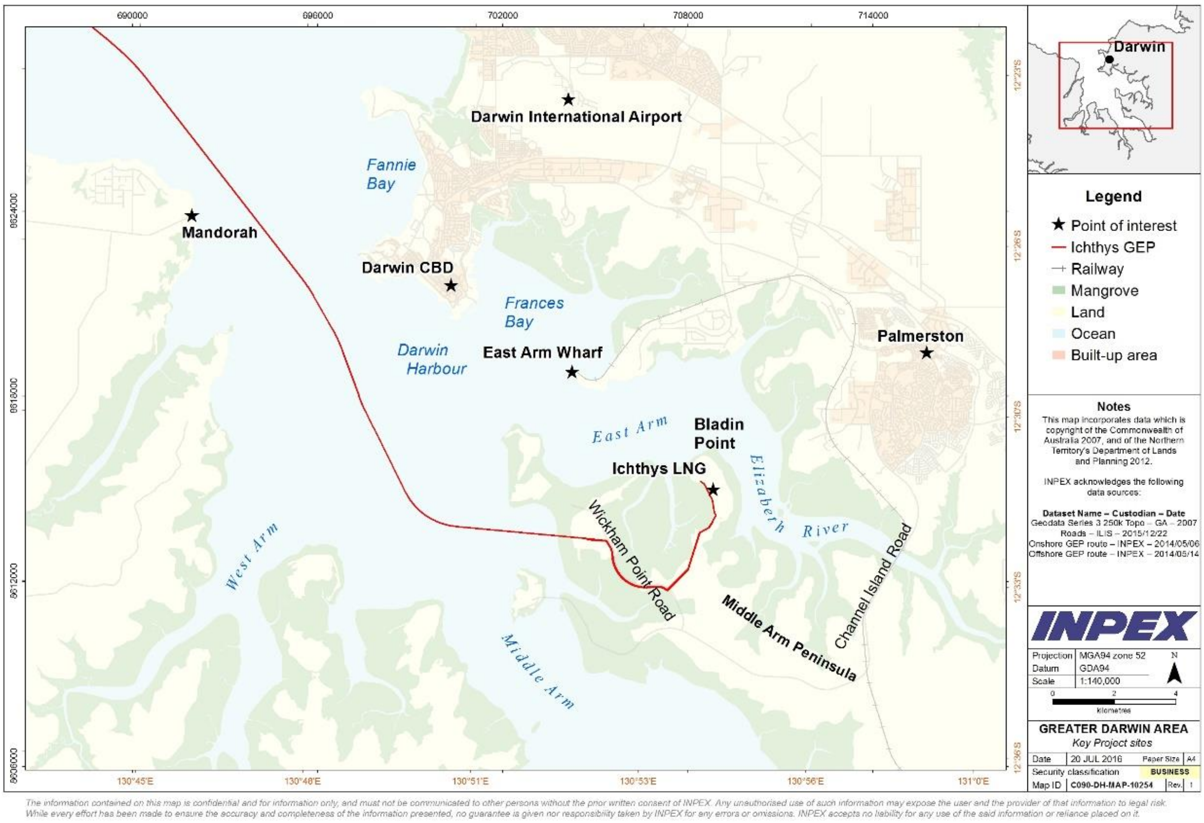


Figure 1-2: Location of Ichthys LNG

Ichthys LNG lies in the monsoonal tropics of northern Australia, which has two distinct seasons; a hot wet season from November to April and a warm dry season from May to October. April and October are transitional months between the wet and dry seasons. Darwin experiences an overall mean annual rainfall of ~1,643 mm, the majority of which occurs during the wet season. The 2023/2024 wet season recorded 1153.4 mm of rainfall (Table 1-4 and Figure 1-3).

Table 1-4: Bladin Point wet season and transitional months rainfall (mm)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Darwin average	**70.6**	**141.7**	**250.8**	**426.3**	**374.6**	**319.0**	**102.2**	**1,610.1**
2012/2013	36.8	199.8	232.4	282.8	291.2	415.2	141.6	1,599.8
2013/2014	134.8	352	268	780	335	14.4	111	1,995.2
2014/2015	13	226.4	175.4	630	492.2	233.8	54.2	1,825.0
2015/2016	12.6	140.6	709.4	243.2	213.4	231.8	63.8	1,614.8
2016/2017	83.8	265.4	469.8	614.2	736	515.8	220.6	2,905.6
2017/2018	93	249.2	125.4	1,031.6	380.4	423.4	39	2,342.0
2018/2019	2.6	183.8	91.6	311.4	159.6	147.8	125.8	1,022.6
2019/2020	24.0	71.2	51.5	327.2	217.7	179.9	72.9	944.3
2020/2021	69.1	87.8	343.5	333.5	194.7	163.4	55.6	1,247.5
2021/2022	67.9	131.9	282.0	357.0	222.2	121.2	89.6	1,271.7
2022/2023	155.9	177.9	341.3	196.2	228.2	207.8	92.1	1,399.4
2023/2024	9.0	52.0	111.3	476.1	289.5	203.7	11.8	1153.4

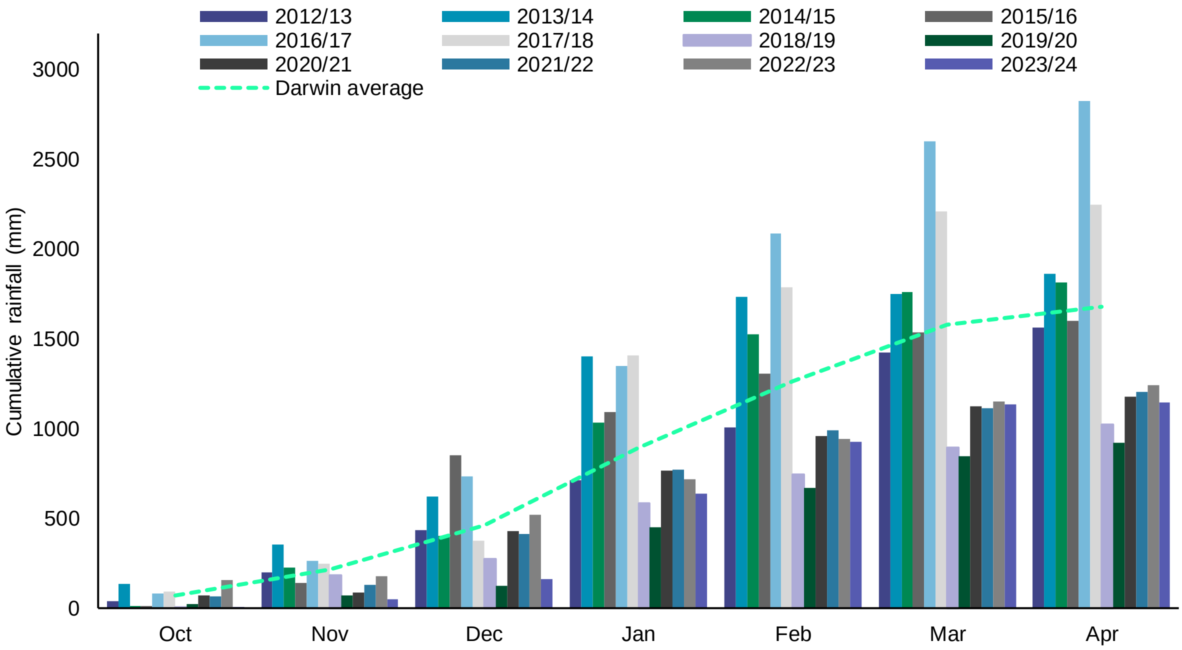


Figure 1-3: Bladin Point cumulative wet seasons

2 DISCHARGES TO WATER

This section describes the outcomes of the comingled treated effluent wastewater monitoring program.

2.1 Commingled treated effluent

The key objective of commingled treated effluent sampling (sampling point 750-SC-003) is to ensure discharge criteria specified in Table 3, Appendix 2 of EPL228 is not exceeded for wastewater discharged from Ichthys LNG.

The monitoring frequency, as specified in Table 3, Appendix 2 of EPL228 was implemented, with sampling occurring monthly (refer to Table 2-1).

Table 2-1: Commingled treated effluent sampling dates

Sample month	Sample collection date(s)
Jul-2023	18
Aug-2023	8
Sep-2023	5
Oct-2023	17
Nov-2023	14
Dec-2023	12
Jan-2024	8, 19*
Feb-2024	13, 16**
Mar-2024	12, 14**
Apr-2024	15
May-2024	15
Jun-2024	11

* Additional sampling following an exceedance at location 750-SC-003.

** Subsequent sampling from initial monthly sampling event

2.1.1 Method overview

All samples for the monitoring of the comingled effluent were taken from the nominated sampling point 750-SC-003 in accordance with INPEX's sample schedule (document number L290-A1-LIS-60006). All testing equipment passed QC requirements during the 2023-2024 audit period with all calibration records maintained by INPEX's NATA certified onsite laboratory. Records of calibration are referenced on the Certificate of Authenticity issued by the onsite laboratory for each sample. Applicable calibration records are verified during the statutory audit conducted every two years. The commingled treated effluent sampling point (750-SC-003) is located downstream of treated effluent observation basin and upstream of the jetty outfall. Samples collected from 750-SC-003 represent liquid effluent that is discharged to Darwin Harbour via the jetty outfall. The jetty outfall discharge is visually inspected daily by Inpex operations staff for any visible sheen caused by hydrocarbons. Sightings are recorded only by exception in the J5 logbook for reference. No visible hydrocarbon sheen observed during this reporting period. The sampling point consists of two valves, an isolation valve, and a sample needle valve, with the latter used to regulate flow for sample collection. Sampling from the commingled treated effluent sample point was conducted by trained laboratory analysts using National Association of Testing Authorities, Australia (NATA) accredited analysis methods by both the INPEX onshore laboratory and external third-party laboratories.

The parameters, sampling methods, limit of reporting (LOR) and discharge limits for the commingled treated effluent monitoring program are provided in Table 2-2: Commingled treated effluent discharge monitoring, methods, and discharge limits

All results are reported through the INPEX onshore laboratory database systems (laboratory information management system; (LIMS) that produce sample Certificates of Analysis (COA) inclusive of the laboratory NATA accreditation number. To enable the identification of an exceedance, the discharge limits specified in Table 3, Appendix 2 of EPL228 (refer to Table 2-2: Commingled treated effluent discharge monitoring, methods, and discharge limits) have been entered into the LIMS. Sample results are compared to their respective discharge limits in the COA. If a result exceeds the discharge limit, it is highlighted in the COA and the onshore laboratory generate an out of specification report. The external laboratory responsible for the micro analysis updated the reporting name for Faecal Coliforms in May 2024. These are now presented as Thermotolerant Coliforms as part of NATA accreditation requirements with testing, LOR and discharge limits remaining the same.

Table 2-2: Commingled treated effluent discharge monitoring, methods, and discharge limits

Parameter	Sampling method*	Unit	LOR	Discharge limit
Volumetric flow rate	CFI	m^3/hr	n/a	180
pH	INPEX Lab	pH Unit	n/a	6.0 - 9.0
Electrical conductivity (EC)	INPEX Lab	µS/cm	10	n/a
Temperature	CFI	°C	-	35°C
Turbidity	INPEX Lab	NTU	0.5	n/a
Dissolved oxygen	CFI	%	-	n/a
TPH as oil and grease	INPEX Lab	mg/L	1.0	6
Total recoverable hydrocarbons (TRH; C10-C40)	External lab	µg/L	100	n/a

Parameter	Sampling method*	Unit	LOR	Discharge limit
Total suspended solids (TSS)	INPEX Lab	mg/L	5	10
Biochemical oxygen demand (BOD)	External lab	mg/L	2	20
Chemical oxygen demand (COD)	INPEX Lab	mg O_2/L	10	125
Free Chlorine	INPEX Lab	mg/L	0.02	2
Ammonia	INPEX Lab	mg N/L	2	n/a
Total nitrogen (TN)†	Calculation	mg N/L	2	10
Total phosphorus (TP)	INPEX Lab	mg P/L	0.5	2
Filterable reactive phosphorus (FRP)	INPEX Lab	mg P/L	0.2 and 0.5	n/a
Cadmium (total)	External lab	µg/L	0.1	n/a
Chromium (total)	External lab	µg/L	1	n/a
Copper (total)	External lab	µg/L	1	n/a
Lead (total)	External lab	µg/L	1	n/a
Mercury (total)	External lab	µg/L	0.1	n/a
Nickel (total)	External lab	µg/L	1	n/a
Silver (total)	External lab	µg/L	1	n/a
Zinc (total)	External lab	µg/L	5	n/a
Enterococci	External lab	cfu/100mL	1	n/a
Escherichia coli	External lab	cfu/100mL	1	100
Faecal coliforms (Thermotolerant Coliforms)	External lab	cfu/100mL	1	400
Anionic surfactants	External lab	mg/L	0.1	n/a
Activated methyl diethanolamine (aMDEA)	External lab/INPEX lab	mg/L	0.001 and 5	n/a
Glycol	External lab/INPEX lab	mg/L	2 and 5	n/a

* CFI = calibrated field instrument

† Total nitrogen is a sum of Nitrite, Nitrate and total Kjeldahl nitrogen (TKN). TKN analysis was completed by both INPEX onshore laboratory and external laboratory interchangeable, depending on INPEX onshore laboratory equipment availability. Nitrate and nitrite were measured by INPEX onshore laboratory.

2.1.2 Results and discussion

Routine monitoring results

The results for 750-SC-003 sampling for the reporting period are presented in APPENDIX C:.

During the reporting period, there were two occurrences where wastewater quality was above discharge limits, these are further discussed in Section 2.1.3. Note, following an initial exceedance, further sampling at 750-SC-003 was undertaken to confirm the results as part of an investigation. Any elevated results during the investigation sampling process are considered part of an ongoing original event and the results are included in APPENDIX C:.

Overall, there was little variability of the wastewater quality during the 2023/2024 reporting period in comparison to previous reporting timeframes. There was a significant reduction in overall EPL228 exceedances associated with wastewater discharges with the total exceedance events reducing from ten in the 2022-2023 period, to two in the 2023/2024 period. The main sampling considerations for this reporting period were Total Nitrogen exceedances (one event) and Total Suspended Solids exceedances (one event). These will be discussed further in Table 2-4.

The total number of discharge exceedances experienced in the 2023/2024 reporting period (two) varies significantly from the ten discharge exceedance events during the 2022/2023 reporting period (Table 2-3). Although this may be considered significant between these reporting periods, the 2022/2023 reporting period total events (ten) is an anomaly in comparison to reporting periods to date which are summarised in Table 2-3: Yearly discharge exceedance comparison at 750-SC-003 below. The 2023/2024 reporting period saw a return to a total number of events to be "as expected" for a 12-month reporting period.

Table 2-3: Yearly discharge exceedance comparison at 750-SC-003

Reporting Period	Total Number of Exceedances at 750-SC-003
2018-2019	4
2019-2020	4
2020-2021	2
2021-2022	3
2022-2023	10
2023-2024	2

In general, INPEX's main wastewater discharge exceedances during the 2023/2024 reporting period were related to Total Nitrogen and Total Suspended Solids at the Jetty Outfall discharge location 750-SC-003. Due to the year-on-year trend of TN exceedances at ILNG, a more in-depth investigation was undertaken in Q1 and Q2, 2024 to obtain a better understanding of this issue. The TN exceedance in January 2024 was investigated in detail with a report presented to the NT EPA in Q2 2024. The report investigated all incoming waste streams originating with nitrogen and/or ammonia and the cumulative impacts each source impacts along the process to the eventual final level of nitrogen obtained at the 750-SC-003 sample point. The investigation report identified the increasing nitrogen trend during the wet season since 2018; however, the cause of the trend is still unknown. A New Environmental Impact Risk Assessment (NEIRA) was proposed to be completed by 31 December 2024 to further evaluate the wet season trend.

Volumetric flow rate data for the reporting period is shown in Figure 2-1. The data confirms that the volumetric flowrate throughout the period remained well below the 180 m^3/h discharge limit.

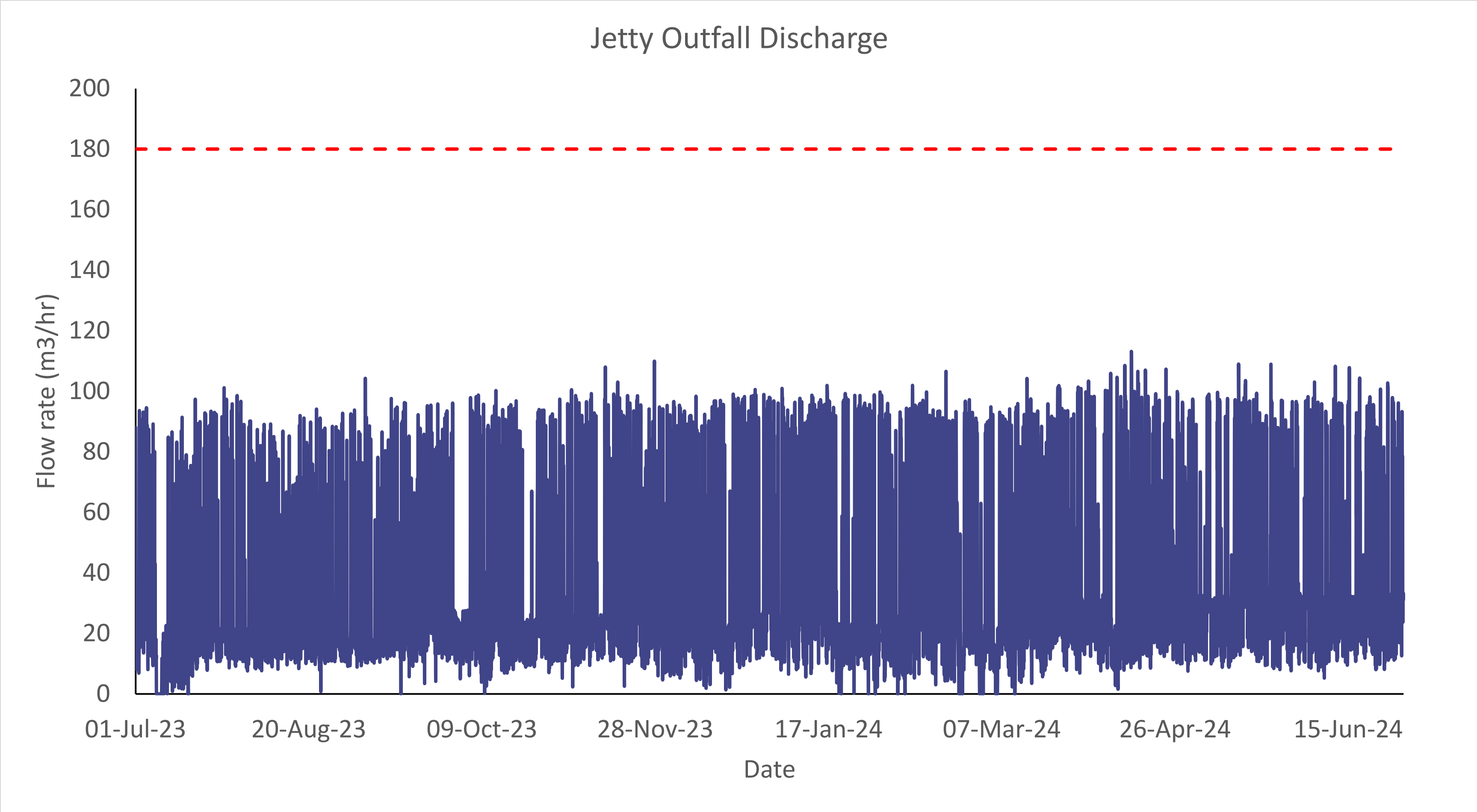


Figure 2-1: Flow rate measured at L-750-FI-0002 flow meter

Quality assurance/quality control

The quality assurance/quality control (QA/QC) procedures specific to the collection and analysis of samples from sample location 750-SC-003 included:

- NATA accredited analytical laboratories were used for all analysis, or a test method managed under a NATA accredited quality management system
- laboratory designated sample holding times met
- chain of custody forms was completed and accompanied the samples
- INPEX laboratory QA/QC procedures were completed as follows:
  - laboratory blanks
  - replicates/duplicate
  - spikes
  - calibration against standard reference materials
  - INPEX laboratory review of external laboratory QA/QC analysis reports
  - annual sampling verification, which involves the collection of two samples and trip blanks
- calibration of all field-testing equipment using the INPEX standard method(s) was undertaken.

2.1.3 Assessment off limit exceedances and investigation outcomes

Throughout the reporting period, and displayed on the Certificates of Authority (COA), there were two discharge limit exceedances (refer to APPENDIX C:). A summary table of all discharge limit exceedances, including contributing factors and corrective actions is provided in Table 2-4.

Table 2-4: Summary of commingled treated effluent sample point exceedance events

Date sampled	Exceedance reported	Parameter	Result	Limit	Contributing factors	Corrective actions
8th January 2024	9th January 2024	TN	TN 12 mg/L	TN 10 mg/L	As part of the incident investigation, a detailed report was provided to the NT EPA (L060-AH-REP-70059) detailing the following: During the routine monthly sampling event on 08 January 2024, the following three wastewater streams were flowing into the combined jetty discharge outfall line: • Combined Cycle Power Plant (CCPP) Neutralisation Package • Observation Basin Pump • Irrigation Tank (treated sewage) Following the exceedance, an investigation into the cause of the exceedance was conducted. Non-routine sampling was undertaken across all eight sources contributing to Total Nitrogen at sample point L750-SC-003. Samples were taken from the following points: • Filter Package L750-SC-002 • Demin Package L720-SC-016 • CCPP L630-MV-6880 • Sewage Treatment Package L750-SC-009 • Liquid Rim Vacuum Pump (LRVP) Seal Water L630-MV-99381 • Observation Basin L750-SU-404 • Irrigation Tank L750-SC-004 • Sea Loading Jetty Outfall L750-SC-003 1 0F The investigation concluded that wastewater contributions (volume) from each source can vary. This is dependent on packages being online (i.e. filter package), operational requirements (i.e. maintaining levels in tanks and sumps) and other factors (i.e. wet season, Persons on site etc). The main source of Nitrogen was confirmed to be from within the CCPP Neutralisation Package. This source is the most stable and continuous source of Nitrogen. Within the CCPP Neutralisation Package, Nitrogen was initially identified from within the Liquid Ring Vacuum Pump (LRVP) seal water system. This sample was collected and tested which showed Ammonia as N concentrations at 0.8% (8,000 mg/L). Further investigation was undertaken into the operation and performance of the CCPP system to understand the root cause. The investigation revealed that an MOC 200006566 was raised in 2019 relating to Thermal Power Cycle (TPC)-line from LRVP tank to Steam Tank (ST) flash tank, which was superseded by MOC 200007253 in 2020. • There were various attempts to deal with the condensed steam following original issues with the AOC system's inability to handle high pH liquids. • Initially the condensed steam containing high pH was directed into Intermediate Bulk Carrier (IBC), collected by a licensed waste contractor to be taken offsite. • However, this process was amended to send the condensed steam to the condensate tanks; which subsequently resulted in issues with Concentrated Acid Condensate Extract (CACE) at Condensate/Saturated Steam/Superheated Steam. Currently, the condensed steam is sent to STG flash tanks with intent to warm and vaporise dissolved ammonia to atmosphere. The flash tanks drain into the CCPP sumps and flow into the neutralisation package.	In conclusion, the main source of the elevated TN in the combine Jetty Outfall was identified in the LRVP seal water within the CCPP Neutralisation Package. Contributing factors to the increased TN levels appear to be related to lower operating temperatures of the Steam Turbine Generator (STG) Flash Separator. Routine monthly sampling of the Jetty Outfall L-750-SC-003 on 12 February 2024 confirmed that the TN concentration was back below the EPL228-05 limit (4 mg/L). Average TN concentrations during the wet season appear to have been increasing since Q4 2018. The cause for this gradual increase in TN is unknown and will be evaluated through a NEIRA. The NEIRA process will internally evaluate these increasing TN trends and consider if there are any operational implications; consider whether additional engineering controls or laboratory testing are necessary. ACTIONS TO PREVENT REOCCURANCE Confirmation of the effectiveness of operational procedures to manage TN confirmed by routine monthly sampling of the Jetty Outfall L-750-SC-003 on 12 February 2024 which returned a result of 4 mg/L. Through the incident investigation process, the following actions were identified to understand the issue and prevent reoccurrence: • Review operational procedure for dealing with condensed steam water from the LRVP seal by increasing temperature of STG flash tank to vaporise ammonia. Temperatures in the ST Flash Tanks were increased to 130°C with the objective to improve ammonia volatilisation, thereby reducing the Nitrogen contributions originating from the CCPP Neutralisation Package. (Completed) • Fortnightly monitoring of TN at the following locations, for a period of three months, to determine contributions of all streams and variations: o L750-SC-004 o L750-SU-404 o L750-SC-003 (ensuring that one of the tests falls on the monthly routine testing for Jetty Outfall) • Complete a NIERA (due Q4 2024) to internally evaluate increasing TN trends and consider if there are any operational implications; consider whether additional engineering controls or laboratory testing are necessary.

Date sampled	Exceedance reported	Parameter	Result	Limit	Contributing factors	Corrective actions
					The root cause of the TN, following the Non-Routine Request (NRR). Sampling was still not clear, so further investigations of all the sumps in the CCPP and one of the Heat Recovery Steam Generator (HRSG) Drums (Blowdown Water) was undertaken to understand the influence of temperature on TN levels, and to verify whether the LRVP seal water was the root cause. This is summarised in the corrective actions listed in this table.	
12th March 2024	14th March 2024	Total Suspended Solids	60mg/L	10mg/L	A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 at 8:50am (CST) Tuesday 12 March 2024. The NATA accredited interim testing results issued on Thursday 14 March 2024 reported a Total Suspended Solid (TSS) concentration of 60 mg/L, which exceeds the discharge limit of 10 mg/L. As standard practise, the INPEX laboratory collect a duplicate sample when undertaking the required monthly sampling from location 750-SC-003. The duplicate was collected approximately at 9:15am on Tuesday 12 March after the primary TSS sample (following the sample collection protocol) and reported a TSS value of <5 mg/L, which is below the discharge limit of 10 mg/L.	The follow up sample came back within specification, therefore there was no actual or potential cause for harm. No further investigation was undertaken.

2.1.4 Program rationalisation

Sampling is to remain as per EPL228 requirements, no changes are proposed to the sampling process.

2.2 Harbour sediment

In accordance with the OEMP (L60-AH-PLN-60005), harbour sediment monitoring occurs biennially (every two years). Harbour sediment monitoring were monitored last in July 2022, and therefore were not monitored in the 2023/2024 reporting period.

The key objective of the harbour sediment quality program is to:

- detect changes in surficial sediment quality in the vicinity of the jetty outfall and determine if changes are attributable to Ichthys LNG operations.

2.2.1 Program rationalisation

No program rationalisation was proposed for harbour sediment monitoring from the previously conducted 2022 harbour sediment monitoring. The next proposed survey was undertaken in July 2024 and will be included in the next reporting period.

3 EMISSIONS TO AIR

This section includes the outcomes of the following monitoring programs:

- point source emissions (Section 3.2)
- dark smoke events (Section 3.4).

This section also summarises the operating condition of each emission source and the resulting air emission quality (Section 3.3) and provides a summary of total emissions to air in tonnes per year for the main parameters outlined in EPL228 (Section 3.1).

3.1 Total emissions to air

INPEX is required to provide total stationary emissions[4] to air (tonnes/year) for air quality parameters (Condition 77.6 of EPL228-05 listed in Table 6, Appendix 3 of EPL228). Estimated total stationary emissions to air for the reporting period are provided in Table 3-1, which are based on INPEX's similar data sources used for Commonwealth emission reporting requirements for National Pollutant Inventory (NPI) and National Greenhouse and Energy Reporting Scheme (NGERS).

Table 3-1: Estimated total stationary emissions to air for the reporting period

Parameter	Emissions (t/yr)
NOx as nitrogen dioxide (NO_2)	1,941.326
Mercury (Hg)	0.00000247
Benzene	3.412
Toluene	4.557
Ethylbenzene	0.848
Xylenes	1.815
Hydrogen sulphide (H_2S)	270.166
Carbon monoxide	2,823.742
Total hydrocarbons flared	Refer Table 3-5

INPEX is currently transitioning to a new emissions reporting management system, which includes a review of current NPI calculation methods for flaring and venting. This review will consider replacing the industry averaged NPI emission factors for flaring and venting with plant specific factors derived from stack testing data, which will more accurately reflect the performance of the ILNG Plant and its associated emissions.

3.2 Point source emissions to air

The key objective of point source emission monitoring (commonly referred to as stack sampling) is to ensure air emissions do not exceed the concentration limit criteria specified in Table 5, Appendix 3 of EPL228. The frequency of monitoring is outlined in EPL228, which requires annual monitoring of most emission points, monthly monitoring of hot venting, and hydrocarbons monitoring for all flare events.

[4] Fugitive emissions from mobile plant are not calculated for the AEMR because Table 6 of Appendix 3 in EPL228-05 only requires stationary emissions. NPI reporting, however, includes both stationary and fugitive emissions.

Annual monitoring is undertaken in accordance with the requirements of EPL228.

Table 3-2 provides a summary of the point source emission monitoring conducted for the reporting period.

Table 3-2: Point source emissions survey dates

Survey	Start date	End Date
Survey 9 Q4 2023	October 2023	November 2023

3.2.1 Method overview

Stationary source emissions monitoring was completed at 10 point sources (out of a total of 18 stacks) on the Frame 7 compression turbines (4), CCPP Frame 6 heat recovery system generator (HRSG) stacks (4) and heating medium furnaces (2).

For the CCPP Frame 6 turbines, each turbine has two stacks, one which allows for normal operation of the turbine (with exhaust emissions directed to a conventional stack) and a separate stack with an associated HRSG, allowing for steam to be generated through the duct burning of fuel. The two stacks cannot be operated together so stack monitoring is dependent on which stack is in use at the time of sampling.

Table 3-3 and Table 3-4 show the EPL228 air emission target and limits plus the constituents that are required to be monitored at the point source locations as per Appendix 3, Table 5 and Table 6 respectively, of EPL228-05. Figure 3-1 shows the locations of the stationary source emissions monitoring locations at Ichthys LNG.

The following locations are inline gas sampling points (not ports) and as such are exempt from the standard methods for point source emissions sampling:

- 551-SC-003 (release point number A13-2)
- 552-SC-003 (release point number A14-2)
- 541-SC-001 (release point number A13-3) and
- 542-SC-001 (release point number A14-3).

INPEX conducts inhouse gas sampling and analysis from these locations for benzene, toluene, ethylbenzene and xylene (BTEX), hydrogen sulphide (H_2S) and mercury (Hg) using conventional industry methods which are not NATA accredited. The analysis of these gases is conducted on a monthly basis using test methods that are managed under a NATA accredited Quality Management System.

Stationary source and gas samples are either collected by INPEX laboratory technicians and tested in the on-site NATA accredited laboratory or are collected by an external NATA-accredited contractor and analysed in the field or by external laboratories.

All stack sampling ports have been installed in accordance with AS4323.1-1995 Stationary Source Emissions - Selection of Sampling Positions.

All stack sampling, where applicable, is undertaken in accordance with:

- New South Wales (NSW) Environment Protection Authority (formerly the Department of Environment and Conservation) Approved Methods for the Sampling and Analysis of Air Pollutants in NSW; or
- United States Environmental Protection Agency (USEPA) Method 30B (Mercury Sorbent Trap Procedure) for mercury emissions.

However, currently there are no approved NSW test methods for the sampling and analysis of nitrous oxide, nor any approved Australian Standard or USEPA methods.

For the sampling and analysis of nitrous oxide, INPEX and the stack emission monitoring Contractor, have followed the procedures as listed in NSW Test Method 11, which cross references to USEPA Method 7E *Determination of Nitrogen Oxide Emission from Stationary Sources (Instrumental Analyser Procedure)*. This lists comprehensive quality control and calibration procedures that must be followed to ensure accurate and reliable results. The analysis of nitrous oxide is also managed under a NATA accredited Quality Management System.

Table 3-3: Contaminant release limits to air at authorised stationary emission release points

Release point number	**Source**	**Pollutant**	**Concentration target**		**Concentration limit**	
			mg/Nm^3	ppmv	mg/Nm^3	ppmv
A1, A2, A3, A4	LNG Refrigerant Compressor Driver Gas Turbines (GE Frame 7s)	NO_x as NO_2	50 @ 15% O_2 dry	25 @ 15% O_2 dry	70@ 15% O_2 dry	35 @ 15% O_2 dry
A5-1, A6-1, A7-1, A8-1, A9-1	CCPP Gas Turbine Generators (GE Frame 6s, 38 MW)	NOx as NO_2	50 @ 15% O_2 dry	25 @ 15% O_2 dry	70@ 15% O_2 dry	35 @ 15% O_2 dry
A5-2, A6-2, A7-2, A8-2, A9-2	CCPP Gas Turbine Generators (GE Frame 6s, 38 MW) also burning vaporised iso-pentane in duct burners	NO_x as NO_2	150 @ 15% O_2 dry	75 @ 15% O_2 dry	350@ 15% O_2 dry	175 @ 15% O_2 dry
A13-1, A14-1	AGRU Incinerators	NO_x	320 @ 3% O_2 dry	160 @ 3% O_2 dry	350@ 3% O_2 dry	175 @ 3% O_2 dry
A15, A16	Heating Medium Furnaces	NO_x	160 @ 3% O_2 dry	80 @ 3% O_2 dry	350@ 3% O_2 dry	175 @ 3% O_2 dry

Table 3-4: Air emission monitoring program

Release Point Number	Sampling Location Number	Source	Monitoring Frequency	Parameter
A1	L-641-A-001	LNG Train 1 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A2	L-642-A-001	LNG Train 2 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)		
A3	L-641-A-002	LNG Train 1 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)		
A4	L-642-A-002	LNG Train 2 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)		
A5-1	L-780-GT-001	CCPP Gas Turbine Generator #1 (GE Frame 6) – conventional stack	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A6-1	L-780-GT-002	CCPP Gas Turbine Generator #2 (GE Frame 6) – conventional stack		
A7-1	L-780-GT-003	CCPP Gas Turbine Generator #3 (GE Frame 6) – conventional stack		
A8-1	L-780-GT-004	CCPP Gas Turbine Generator #4 (GE Frame 6) – conventional stack		
A9-1	L-780-GT-005	CCPP Gas Turbine Generator #5 (GE Frame 6) – conventional stack		
A5-2	L-630-F-001	CCPP Gas Turbine Generator #1 (GE Frame 6) – HRSG stack		
A6-2	L-630-F-002	CCPP Gas Turbine Generator #2 (GE Frame 6) – HRSG stack		
A7-2	L-630-F-003	CCPP Gas Turbine Generator #3 (GE Frame 6) – HRSG stack		
A8-2	L-630-F-004	CCPP Gas Turbine Generator #4 (GE Frame 6) – HRSG stack		
A9-2	L-630-F-005	CCPP Gas Turbine Generator #5 (GE Frame 6) – HRSG stack	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A13-1	L-551-FT-031	AGRU Incinerator – LNG Train 1	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A13-2	551-SC-003	AGRU Hot Vent – LNG Train 1, prior to release at A3	monthly	BTEX, H_2S, volumetric flow rate
A13-3	541-SC-001	Feed gas to AGRU – LNG Train 1 – prior to release at A3	monthly	Hg
A14-1	L-552-FT-031	AGRU Incinerator – LNG Train 2	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A14-2	552-SC-003	AGRU Hot Vent – LNG Train 2, prior to release at A4	monthly	BTEX, H_2S, volumetric flow rate
A14-3	542-SC-001	Feed gas to AGRU – LNG Train 2 – prior to release at A4	monthly	Hg
A15	L-640-A-001-A	Heating Medium Furnaces	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A16	L-640-A-001-B	Heating Medium Furnaces	annual	NO_x as NO_2, CO, temperature, efflux velocity, volumetric flow rate
A17	L-700-F-002	Ground flare #5 warm	all Flare events	Mass of hydrocarbons flared
A18	L-700-F-001-A/B	Ground flare #2 cold		
A19	L-700-F-003	Ground flare #1 spare		
A20	L-700-F-005-A/B	Tank flare #1 LNG		
A21	L-700-F-006-A/B	Tank flare #2 LPG		
A22	L-700-F-007	Tank flare #3 LNG/LPG		
A23	L-700-F-004	Liquid flare		

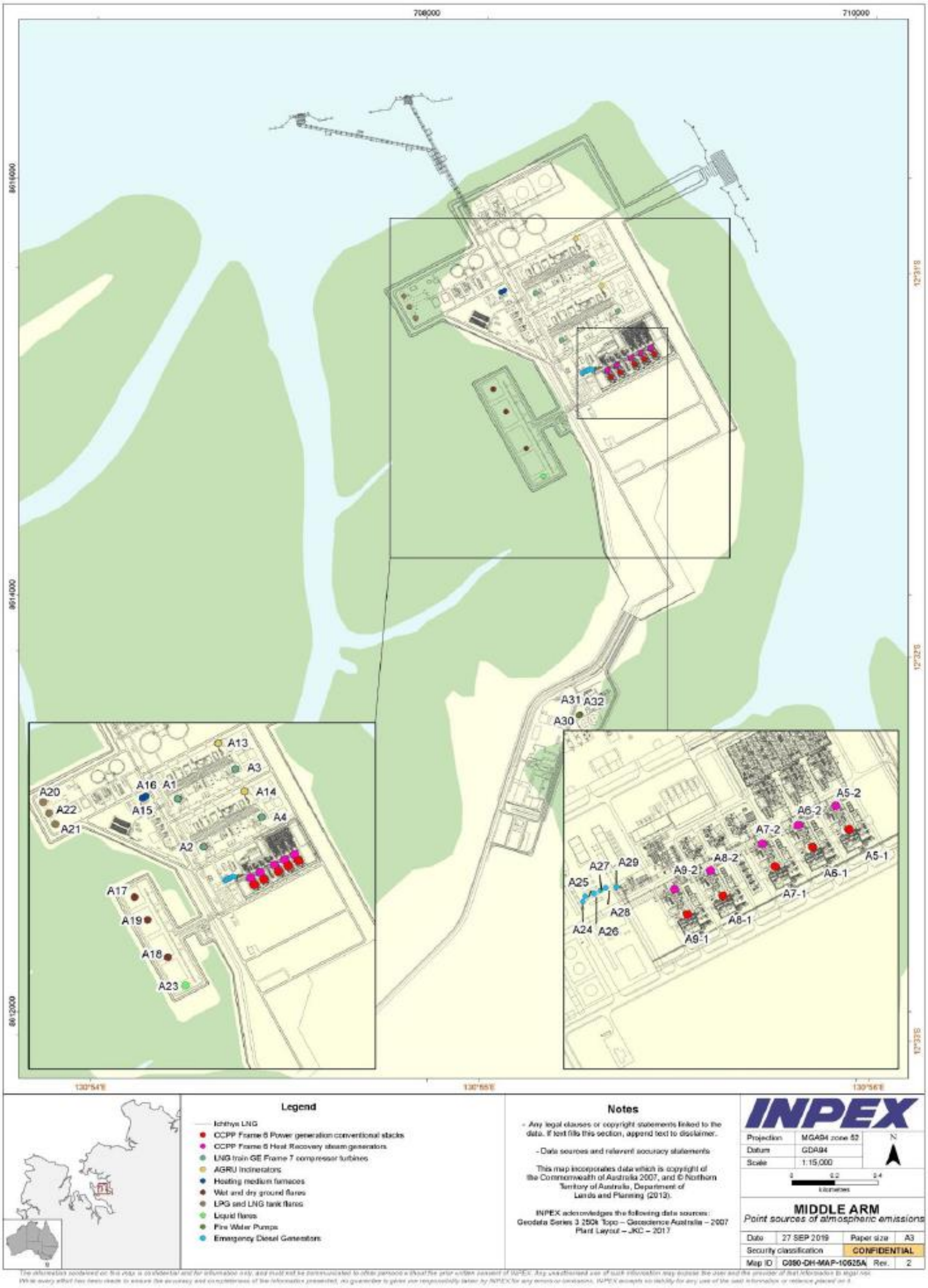


Figure 3-1: Location of authorised stationary emission release points

3.2.2 Quality control assessment

Stationary source emissions testing undertaken in October-November 2023, were carried out as per the nominated test method within EPL228-05 license condition 58.2 following the NSW Department of Environment and Conservation Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales or USEPA Method 30B for mercury emissions. This was completed in conjunction with Appendix 3, Table 6 of EPL228. All samples were collected and sampled as per above conditions. NATA accredited environmental consultants Ektimo were engaged to carry out onsite stationary source testing as INPEX's NATA accreditation is still pending.

3.2.3 Results and discussion

All results for the permanent plant were below limit criteria provided in Appendix 3, Table 5 of EPL228 (Table 3-3). The stationary source emission monitoring results are provided in APPENDIX D:

Due to equipment being offline for planned maintenance and extended unplanned equipment fault outages; release point number A5-1 (L-780-GT-001), A6-1 (L-780-GT-002), A7-1 (L-780-GT-003), A8-1 (L-780-GT-004) and A9-1 (L-780-GT-00 5) were unable to be tested during the Q4 2023 survey. Similarly, A7-2 (L-630-F-003) CCPP Gas Turbine Generator 3 was offline during the survey. As previously mentioned in section 3.2.1, CCPP frame 6 turbines have two stacks with only one of the two stacks running at a time. As such, release port numbers A5-1 to A9-1 (conventional stack series) were not tested in this reporting period as they were not online while the "HRSG stack series" frame 6 sampling locations (A5-2 (L-630-F-001), A6-2 (L-630-F-002), A8-2 (L-630-F-004) and A9-2 (L-630-F-005), were online and utilised in this survey.

The mass of hydrocarbons flared for the reporting period for each flare source is presented in Table 3-5.

Table 3-5: Mass of hydrocarbons flared

Release Point number	Location Number	Source	Mass of hydrocarbons flared (tonnes)
A17 / A19	L-700-F-002 / L-700-F-003	Ground flare #5 warm/ Ground flare #1 spare	10,010
A18 / A19	L-700-F-001-A/B / L-700-F-003	Ground flare #2 cold / Ground flare #1 spare	21,443
A20	L-700-F-005-A/B	Tank flare #1 LNG	6,902
A21	L-700-F-006-A/B	Tank flare #2 LPG	13,339
A22	L-700-F-007	Tank flare #3 LNG/LPG	0
A23	L-700-F-004	Liquid flare	0

Figure 3-2 and Figure 3-3 show the vented acid gas flow rates in standard cubic metre per hour Sm^3/h for Train 1 and Train 2 respectively. During the time the acid gas incinerators (AGIs) were offline, the acid gas was hot vented when the LNG trains were online. Figure 3-4 and Figure 3-5 provide the flow rate of acid gas to the Train 1 and Train 2 AGIs, while the incinerator was in service.

While the AGIs were offline and venting was occurring, gas sampling was undertaken in accordance with EPL228-05 condition 58.1. Throughout the reporting period, INPEX experienced a number of performance issues with Train 1 and Train 2 AGIs resulting in subsequent trips of both AGIs. They were taken offline for a full review and Management of Change process before being re-implemented. The NT EPA were notified of the AGI performance issues in accordance with EPL228-05 condition 70.

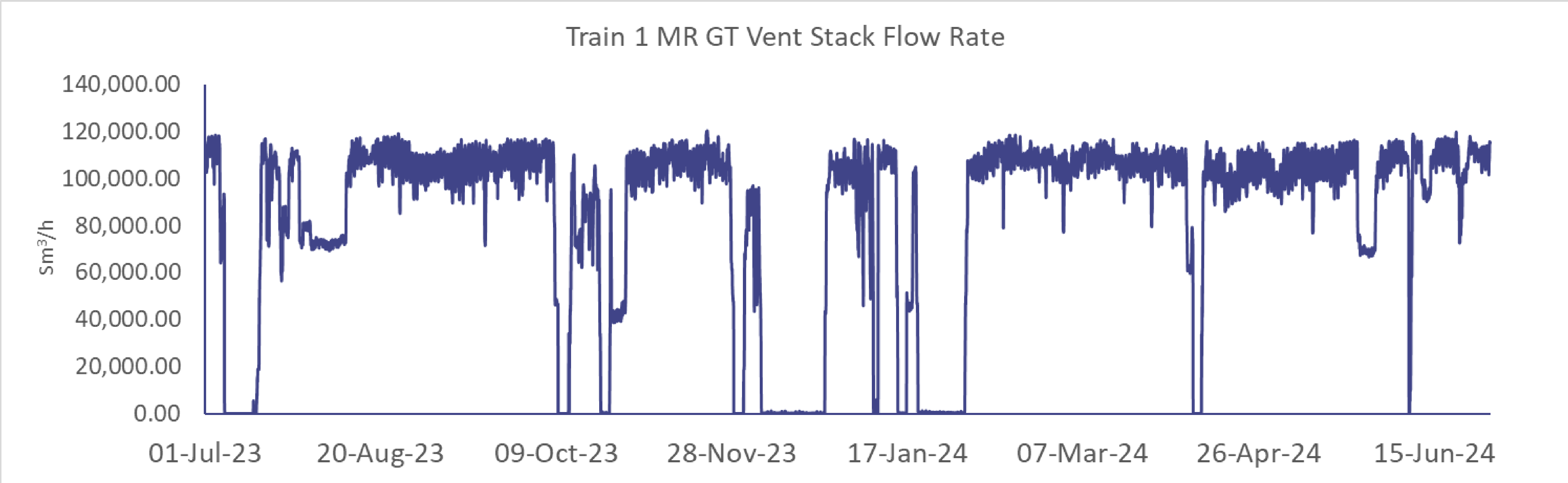


Figure 3-2 Train 1 acid gas venting flow rates

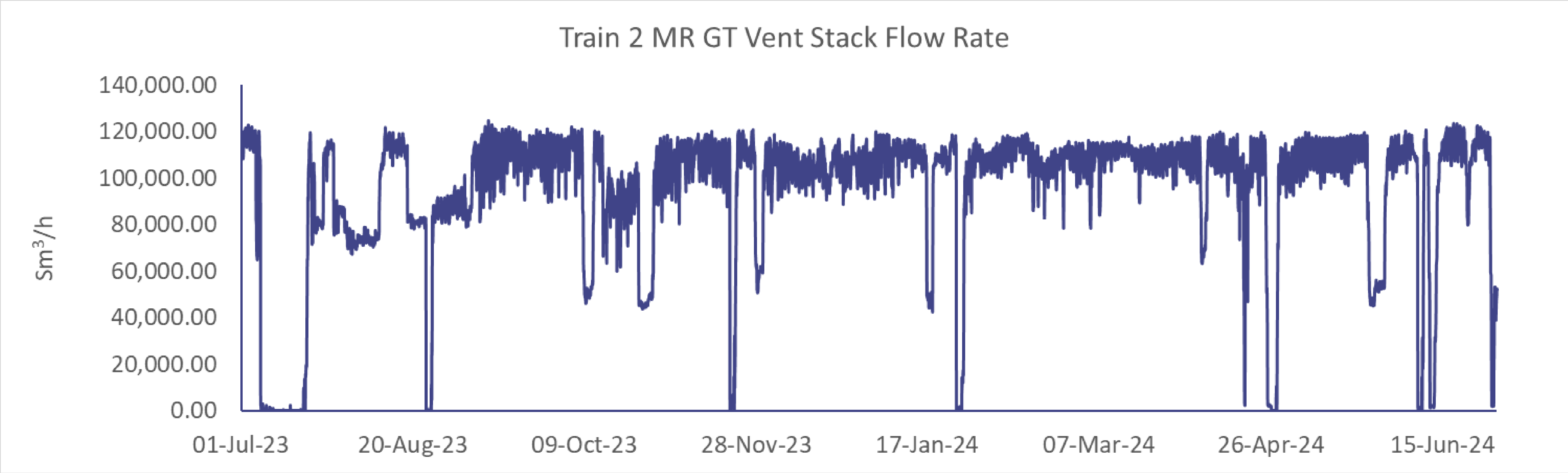


Figure 3-3 Train 2 acid gas venting flow rates

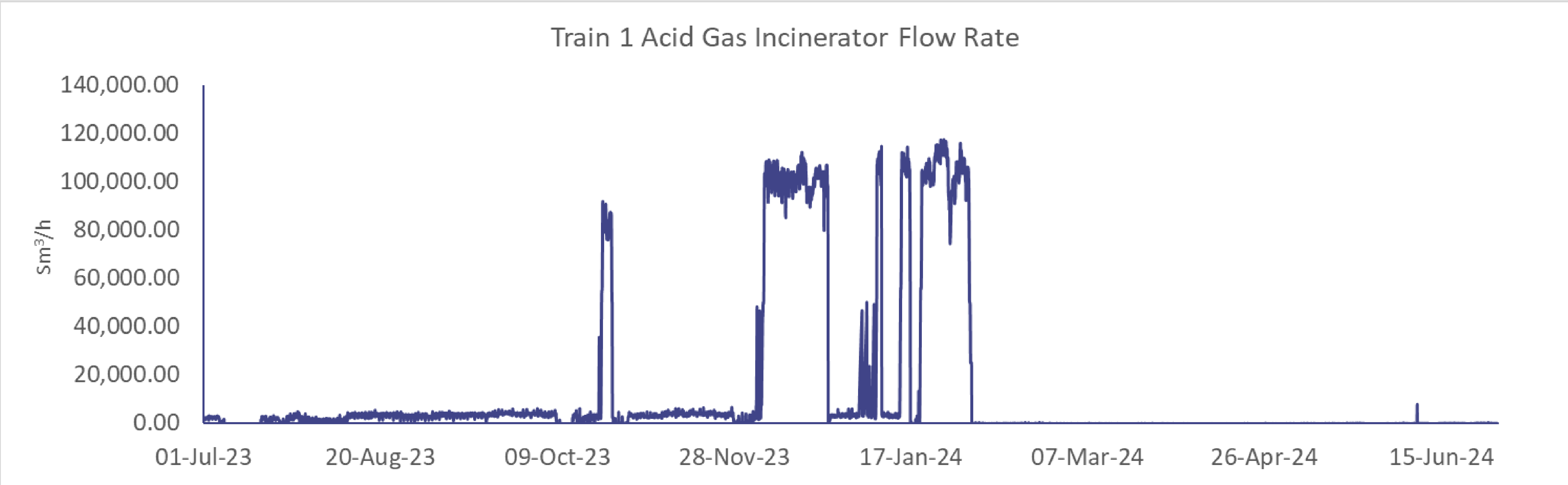


Figure 3-4 Train 1 acid gas incinerator flow rates

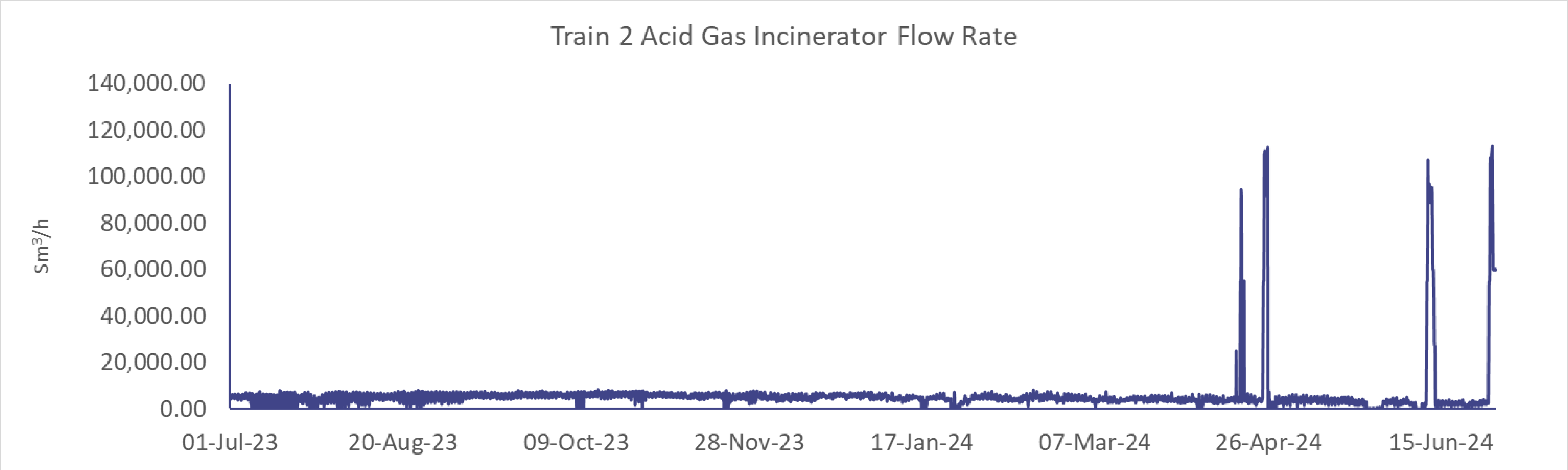


Figure 3-5 Train 2 acid gas incinerator flow rates

3.2.4 Program rationalisation

No rationalisation is currently proposed, and monitoring will be conducted as per the EPL228 requirements.

3.3 Overall summary of performance of stationary emission sources

The status of the stationary point source emissions at Ichthys LNG is provided in Table 3-6 based on information presented in Sections 3.1 and 3.2. As stated above the Train 1 and LNG Train 2 AGIs for both were intermittently offline during the period. While the acid gas incinerators were offline, sampling of the vented gas occurred as per EPL228 condition 58.

Table 3-6: Stack emission status and air quality

Release point number	Emission source	Status	Air emissions
A1	Compressor turbine WHRU West 1 (Frame 7)	Operational	Acceptable
A2	Compressor turbine WHRU West 2 (Frame 7)	Operational	Acceptable
A3	Compressor turbine WHRU East 1 (Frame 7)	Operational	Acceptable
A4	Compressor turbine WHRU East 2 (Frame 7)	Operational	Acceptable
A5-1	Power generation turbine 1 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A6-1	Power generation turbine 2 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A7-1	Power generation turbine 3 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A8-1	Power generation turbine 4 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A9-1	Power generation turbine 5 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A5-2	Power generation turbine 1 HRSG (Frame 6)	Operational	Acceptable
A6-2	Power generation turbine 2 HRSG (Frame 6)	Operational	Acceptable
A7-2	Power generation turbine 3 HRSG (Frame 6)	Off-line during survey	Not tested in this survey
A8-2	Power generation turbine 4 HRSG (Frame 6)	Operational	Acceptable
A9-2	Power generation turbine 5 HRSG (Frame 6)	Operational	Acceptable
A13-1	AGRU Incinerator – LNG Train 1	Off-line during survey	Not tested in this survey

Release point number	Emission source	Status	Air emissions
A13-2	AGRU Hot Vent – LNG Train 1, prior to release at A3	Operational	Acceptable
A14-1	AGRU Incinerator – LNG Train 2	Off-line during survey	Not tested in this survey
A14-2	AGRU Hot Vent – LNG Train 2, prior to release at A4	Operational	Acceptable
A15	Heating medium furnace 1	Operational	Acceptable
A16	Heating medium furnace 2	Operational	Acceptable

3.4 Dark smoke events

Ichthys LNG has been designed to minimise dark-smoke events; however, dark smoke can result during flaring due to incomplete combustion of hydrocarbons. The environmental impacts from smoke are considered negligible but may cause visual amenity impact and community concern.

3.4.1 Method overview

Visual monitoring and closed-circuit television monitoring of flares is undertaken to detect possible dark smoke events in accordance with the Onshore LNG Dark Smoke Management Guideline. If dark smoke is produced during operations, the shade (or darkness) of the smoke is estimated using the Australian Miniature Smoke Chart (AS 3543:2014), which uses Ringelmann shades. The shade and duration of the dark-smoke event is recorded. Dark smoke monitoring targets and limits for all the flare systems are provided in Table 3-7. Any dark smoke events (above Ringelmann 1) are recorded and investigated as an incident and reported to the NT EPA in the annual record of flaring (Condition 71 of EPL228-05).

Table 3-7: Dark smoke monitoring targets and limits

Emission source	Pollutant	Target	Limit
Flares	Smoke	<Ringelmann 1	Visible smoke emissions darker than Ringelmann shade 1

Flaring and other data are stored in the sites Process Control System (PCS). The PCS serves as the primary means to control and monitor Ichthys LNG and automatically maintains operating pressures, temperatures, liquid levels, and flow rates within the normal operating envelope with minimal intervention from operator consoles in the central control room (CCR). The system has built-in redundancy in communication, control, and human interface. Information from the PCS is displayed on visual display units in the CCR. During process upset conditions, the system has detailed alarm handling and interrogation functions to minimise operator overload. The PCS is also equipped with a database function that permits operations personnel to investigate a historical sequence of events. In addition, volatile organic compound emissions are estimated by use of the NPI and NGERS reporting tools.

3.4.2 Results and discussion

No dark smoke events (above Ringelmann 1) occurred during the 2023/2024 reporting period.

3.4.3 Program rationalisation

No program rationalisation is proposed.

4 UNPLANNED DISCHARGES TO LAND

4.1 Groundwater quality

The key objective of the groundwater monitoring program is to detect changes in groundwater quality and determine if these changes are attributable to Ichthys LNG operations. Note there are no planned discharges directly to groundwater, other than rainfall and non-contaminated water (NCW); however, there is potential for groundwater to become contaminated as a result of an accidental spill, leak, or rupture during Ichthys LNG operations.

As per the OEMP, groundwater quality is required to be monitored biannually (e.g. twice yearly at 15 sites). Table 4-1 provides a summary of the groundwater quality surveys completed during the reporting period.

Table 4-1: Groundwater quality monitoring survey details

Survey	Sampling period	Report	INPEX Doc #
12	10-12 October 2023	Groundwater Quality Monitoring – Trigger Assessment: Report No 12	L290-AH-REP-70054
		Groundwater Quality Interpretive Report No 12	L290-AH-REP-70055
13	02-04 April 2024	Groundwater Quality Interpretive Report No 13	L290-AH-REP-70076

4.1.1 Method overview

The groundwater quality monitoring surveys were undertaken in accordance with the Groundwater Quality Monitoring Plan (L290-AH-PLN-70000). The Groundwater Quality Monitoring Plan was developed in consideration of Australian, State and Territory groundwater sampling standards and guidelines. A high-level summary of methods is provided below.

Prior to sampling, groundwater wells were gauged with an interface probe to determine the standing water level (SWL). Following gauging, groundwater wells were purged using a low flow micro purge pump with SWL and in situ parameters being measured every three to five minutes. Once the well had been purged and in-situ parameters had stabilised over three consecutive readings, groundwater samples were then collected for analysis.

Following collection, groundwater samples were sent to NATA accredited laboratories for analysis of parameters listed in Table 4-2. Results were then compared to benchmark levels to ascertain whether a trigger exceedance had occurred.

Exceedance of a benchmark level is defined as a measured analyte exceeding its relevant trigger value (see Table 4-2) and the same analyte also exceeding the background level for each groundwater well. Specific background level trigger values were calculated using the approach described in ANZG (2018). The 80th and/or 20th percentile value for each parameter was determined using the monthly groundwater data collected during the construction phase of Ichthys LNG between 2013 and 2018.

Table 4-2: Groundwater quality monitoring parameters, methods, and trigger values

Parameter	Unit	Sampling method*	Trigger value	Trigger value reference
pH	pH units	CFI	Outside 6.0 and 8.5	NRETAS 2010
EC	µS/cm	CFI	n/a	n/a
Dissolved oxygen	%	CFI	n/a	
Oxygen reduction potential	mV	CFI	n/a	
Temperature	°C	CFI	n/a	
Total dissolved solids	mg/L	SFLA	n/a	
Oxides of nitrogen	µg N/L	SFLA	20	NRETAS 2010
Ammonia	µg N/L	SFLA	20	
TN	µg N/L	SFLA	300	
TP	µg P/L	SFLA	30	
FRP	µg/L	SFLA	10	
Phenols	µg/L	SFLA	n/a	n/a
TRH[‡]	µg/L	SFLA	600	Ministry of Infrastructure and the Environment (2009)
Benzene	µg/L	SFLA	500	ANZG 2018
Toluene	µg/L	SFLA	180	
Ethylbenzene	µg/L	SFLA	5	
Xylenes	µg/L	SFLA	75	
Aluminium	µg/L	SFLA	24	Golding et al. 2015
Arsenic	µg/L	SFLA	2.3	ANZG 2018
Cadmium	µg/L	SFLA	0.7	
Chromium III	µg/L	SFLA	10	
Chromium VI	µg/L	SFLA	4.4	
Cobalt	µg/L	SFLA	1	
Copper	µg/L	SFLA	1.3	
Lead	µg/L	SFLA	4.4	
Manganese	µg/L	SFLA	390	J. Stauber and R. Van Dam Pers.Com. 23 March 2015 cited in Greencap (2016)
Mercury	µg/L	SFLA	0.1	ANZG 2018
Nickel	µg/L	SFLA	7	
Silver	µg/L	SFLA	1.4	

Parameter	Unit	Sampling method*	Trigger value	Trigger value reference
Vanadium	µg/L	SFLA	100	
Zinc	µg/L	SFLA	15	
Biological oxygen demand (BOD)†	mg/L	SFLA	n/a	n/a
Faecal coliform†	cfu-100mL	SFLA	n/a	
Escherichia coli†	cfu-100mL	SFLA	n/a	

* SFLA = sample for laboratory analysis, CFI = calibrated field instrument

† Only at BPGW19A and BPGW27A

‡ Where TRH is detected over the prescribed limits a silica gel clean-up will be undertaken and reanalysed to remove false positive natural oil results

Figure 4-1: Groundwater quality sampling locations

4.1.2 Quality Control Assessment

Laboratory holding times

All samples arrived at the laboratories within the required holding times for all analytes and chemical compounds with trigger values, for both survey 12 and 13.

Blank samples

Analyte concentrations measured in rinsate and field blank samples reported below the laboratory LORs. It is therefore unlikely that the sampling procedure caused a measurable increase in contaminant concentrations during groundwater sampling.

Duplicate and triplicate samples

Analyses of duplicate samples revealed that the relative percentage differences (RPD) achieved the performance criteria of <30 % for most analytes, with the following exceptions:

- Survey 13
  - Total phosphorus (RPD = 52)

Analyses of triplicate samples revealed that the RPD achieved the performance criteria of <30 % for the majority of analytes, with the following exceptions:

- Survey 12
  - Total kjeldahl nitrogen (TKN) (RPD = 67)
  - Total nitrogen (RPD = 67)
- Survey 13
  - Ammonia (as N) (RPD = 61)
  - Total kjeldahl nitrogen (TKN) (RPD = 34)
  - Total nitrogen (RPD = 34)

For survey 12, the nitrogen concentrations in both the primary sample (500 µg/L) and the triplicate sample (1,000 µg/L) were above the trigger level of 300 µg/L and the background level at BPGW26 of 468 µg/L. This elevated RPD therefore places some uncertainty on the accuracy of nitrogen concentrations recorded in the primary sample from BPGW26, this has been treated as an exceedance and investigated in Sections 4.1.3 and 4.1.4.

For survey 13, the ammonia concentrations in both the primary sample (514 µg/L) and the triplicate sample (970 µg/L) were above the trigger level of 200 µg/L and the background level at BPGW40 of 160 µg/L. This elevated RPD therefore places some uncertainty on the accuracy of ammonia concentrations recorded in the primary sample from BPGW40. The nitrogen concentration of both the primary sample (710 µg/L) and the triplicate sample (1,000 µg/L) were above the trigger level of 300 µg/L and the background level at BPGW40 of 270 µg/L. This elevated RPD therefore places some uncertainty on the accuracy of nitrogen concentrations recorded in the primary sample from BPGW40, this has been treated as an exceedance and investigated in Sections 4.1.3 and 4.1.4.

For both survey 12 and 13 there are no trigger values for TKN.

Limit of reporting

The number of raised LORs during the 12th and 13th groundwater monitoring events is less than what was recorded for previous monitoring rounds. This was achieved following discussion with ALS to develop an improved COC that details the laboratory methods required to attain the LORs outlined in the Ichthys LNG Groundwater Monitoring Plan (INPEX 2020b).

Survey 12

The following observations were made regarding the limit of reporting (LOR) for analytes measured at ALS:

- Trivalent chromium was analysed to an LOR of 10 µg/L in five primary samples. This is higher than the LOR of 0.2 µg/L required for the groundwater monitoring program but equal to the trigger value; therefore, this result does not impact the trigger assessment.
- Vanadium was analysed to an LOR of 0.2 µg/L in three primary samples and an LOR of 0.5 µg/L in four primary samples. This is higher than the LOR of 0.1 µg/L required for the groundwater monitoring program, but less than the trigger value of 100 µg/L; therefore, this result does not impact the trigger assessment.
- Total phosphorus was analysed to an LOR of 25 µg/L in one primary sample. This is higher than the LOR of 20 µg/L required for the groundwater monitoring program, but less than the trigger value of 30 µg/L; therefore, this result does not impact the trigger assessment.

None of the raised LORs were higher than the trigger values, therefore the integrity of this round of groundwater monitoring has not been impacted.

Survey 13

The following observations were made regarding the LOR for analytes measured at the primary laboratory (ALS) for Survey 13:

- Nickel was analysed to an LOR of 0.5 µg/L in in five primary samples. This is higher than the LOR of 0.1 µg/L required for the groundwater monitoring program but less than the trigger value of 7 µg/L; therefore, this result does not impact the trigger assessment.
- Vanadium was analysed to an LOR of 0.2 µg/L in three primary samples and an LOR of 0.5 µg/L in two primary samples. This is higher than the LOR of 0.1 µg/L required for the groundwater monitoring program, but less than the trigger value of 100 µg/L; therefore, this result does not impact the trigger assessment.

None of the raised LORs were higher than the trigger values, therefore the integrity of this round of groundwater monitoring has not been impacted.

A review of accredited laboratory (ALS) procedures and sampling equipment was conducted and implemented following the previous reporting period. This involved ensuring the ultra-trace sample containers designated for analytical testing at low concentration levels.

4.1.3 Results and discussion

A high-level summary of groundwater results and trends is provided in the following sections, with detailed results discussion and data collected during the reporting period provided in APPENDIX E:. Note, presentation of groundwater data trends include data collected during the construction phase. Groundwater surveys undertaken during the reporting period are specified in Table 4-1. To date, groundwater monitoring during the operations phase of Ichthys LNG shows that there has been no change in groundwater quality.

Survey 12: October 2023

Thirty-seven exceedances against both the trigger and background concentrations were recorded in the 12th groundwater monitoring event in October 2023. Exceedances include 21 for nutrients and 16 for dissolved metals. No exceedances were recorded for hydrocarbons, mercury, PH or physicochemical parameters. This is more than the 31 exceedances recorded during the tenth groundwater monitoring event undertaken during October 2022.

All exceedances have been compared to data recorded during the dry season months of May to October between May 2016 and May 2023.

Visual assessment of time plotted data indicates that several of the nutrient analyte exceedances represent short-term spikes, potentially related to seasonal environmental variables, rather than increasing trends. Visual assessment of time plotted data has indicated the following trends for nutrient exceedances:

- Ammonia: Increasing trends at BPGW40 and BPGW41.
- Total Nitrogen: Increasing trends, albeit fluctuating at VWP341 and BPGW40.
- Filterable reactive phosphorus (FRP): Increasing trend at BPGW01.

Visual assessment of time plotted data for metal exceedances has indicated the following trends:

- Arsenic: increasing trend at BPGW09
- Cobalt: Increasing trend at VWP341
- Zinc: Increasing trend at VWP341.

The following historical maximum values were recorded during the October 2023 monitoring event:

- Arsenic at BPGW28 (15.2 µg/L)
- FRP at BPGW01 (17 µg/L)
- Oxides of Nitrogen at BPGW20 (310 µg/L) and at BPGW28 (178 µg/L)

Results of the investigation into each of the exceedances are described in Section 4.1.4.

Survey 13: April 2024

Twenty-eight exceedances against both the trigger and background concentrations were recorded in the thirteenth groundwater monitoring event in April 2024. Exceedances include 13 for nutrients and 15 for dissolved metals. No exceedances were recorded for hydrocarbons, mercury, PH or physicochemical parameters.

Exceedances were plotted on time series graph to compare to pre-construction and construction data and discern trends in the data.

No trigger exceedances for pH or hydrocarbons were recorded from the survey.

A review of the 13 nutrient exceedances from April 2024 monitoring event found that seven of the exceedances were consecutive for at least three surveys. Trend analysis completed by the monitoring contractor indicates:

- Ammonia:
  - Increasing trends for ammonia at BPGW40
  - Increasing trends for ammonia has stabilised at BPGW41 and VWP341
  - Fluctuating trends for ammonia at BPGW18, BPGW20, and BPGW28
- Nitrogen: Fluctuating long-term trend for total nitrogen at BPGW40, BPGW41 and VWP341
- Oxides of nitrogen: Consistent fluctuating trend of oxides of nitrogen, with concentrations increasing in the wet season and decreasing in the dry season at BPGW38A.
- Phosphorus: Slightly increasing trend at BPGW07 has stabilised, fluctuating but stable phosphorus concentrations at BPGW08A.

Trend analysis of the 14 metals exceedances completed by the monitoring contractor indicates that:

- Arsenic: Increasing albeit fluctuating long-term trend at BPGW09 and VWP328.
- Cobalt: Stable but fluctuating at BPGW08A; and increasing trend at BPGW09, VWP328, BPGW40 and VWP341.
- Zinc: Increasing trend at VWP341.
- Copper: Fluctuating trend at BPGW07.
- Manganese: Fluctuating and increasing trend at VWP341 and BPGW09.
- Nickel: Stable overall but fluctuating at VWP341.
- Zinc: Fluctuations at BPGW07, fluctuating and increasing VWP341.

The following historical maximum values were recorded during the April 2024 monitoring event:

- Ammonia at VWP341(736 µg/L)
- Cobalt at BPGW40 (1.8 µg/L) and at VWP341 (168 µg/L)
- Zinc at VWP341(173 µg/L)

Results of the investigation into each of the exceedances are described in Section 4.1.4.

4.1.4 Trend analysis and trigger exceedance investigation outcomes

Trend analysis

Increasing trends were determined across groundwater surveys 12 and 13, Ammonia (BPGW40, BPGW41, VWP341), Total Nitrogen (BPGW40), Arsenic (BPGW09 and VWP328), Cobalt (VWP341, VWP328 and BPGW40), Zinc (VWP341). Note analytes that with an increasing trend in survey 12 but not survey 13 have not been included in this analysis. Trend graphs represented below are based on sites experiencing exceedances for at least 3 successive monitoring sampling campaigns.

pH

Analysis of pH at the sampling sites over time indicate that the overall pH trend stabilised across the sites from previous reporting period. This is also reflected by no pH exceedances being observed in either sampling survey.

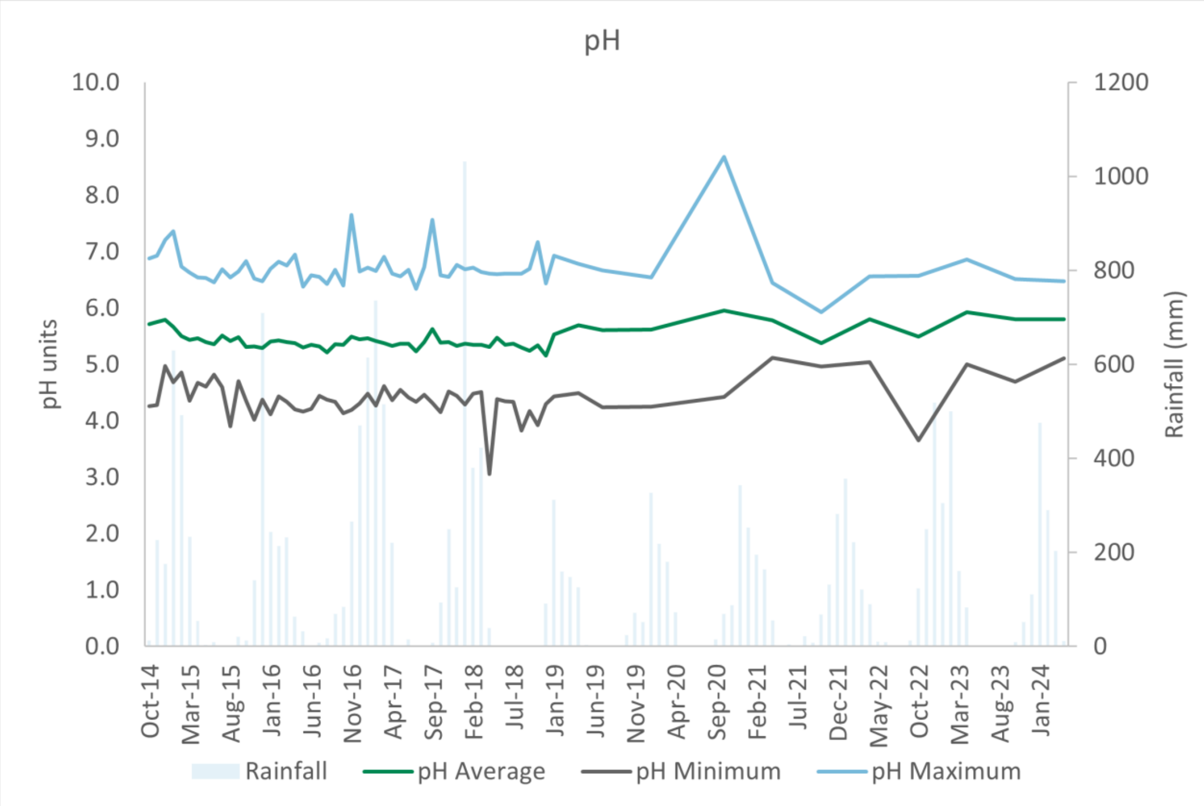


Figure 4-2: average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2024

Ammonia

Ammonia exceedances were recorded at eight and six monitoring bores respectively during the twelfth and thirteenth groundwater monitoring event (BPGW18, BPGW20, BPGW28, BPGW40, BPGW41 and VWP341 for both surveys and BPGW26, BPGW27A for Survey 12). This is the same number of exceedances that were recorded during the previous dry and wet season monitoring events undertaken in October 2022 and April 2023. The ammonia exceedances recorded at BPGW40 may be representative of a long-term increasing trend, while exceedances at BPGW20 represent stable but fluctuating trends. Recorded ammonia values at BPGW26 and BPGW27A fell below trigger exceedance levels during survey 13.

Trend analysis indicates that ammonia concentrations at BPGW41 and VWP341 have increased since 2018 and have stabilised, while concentrations at BPGW18 and BPGW28 are stable but fluctuating, Figure 4-3. BPGW18 and BPGW28 appear to be responding to changing conditions but fluctuate within a stable range.

It is noted that monitoring during the construction stage of the project (2012-2015) identified that ammonia concentrations were regularly recorded above the trigger value of 20 µg/L across the site (AEC Environmental 2015). Investigations into the ammonia trigger exceedances did not determine any potential sources of ammonia on site, no pathway from sources of ammonia on site to groundwater. Therefore the increasing trends are considered to be as a result of natural variation.

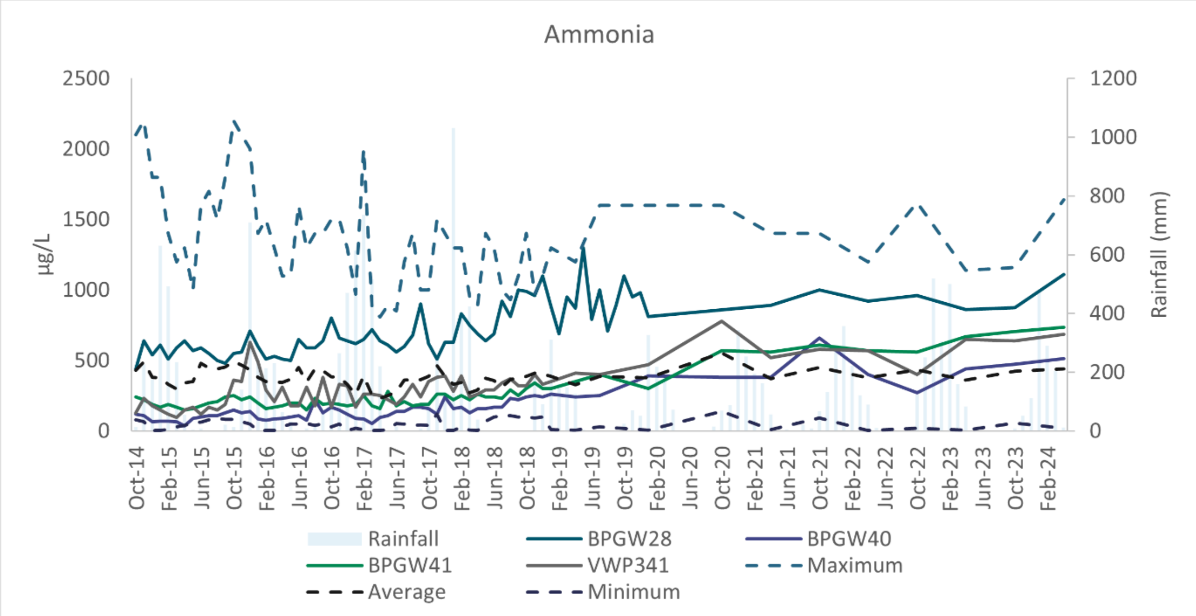


Figure 4-3: Ammonia concentrations at BPGW40, BPGW41 and VWP341, and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2024

Total Nitrogen

Five and three trigger exceedances for total nitrogen were recorded respectively during the twelfth and thirteenth groundwater monitoring events, at bores BPGW26, BPGW27A, BPGW40 and BPGW41 and VWP341.

Trend analysis indicates total nitrogen recorded at BPGW26, BPGW27A, BPGW41 and VWP341 fluctuate each year, and the recent exceedances likely represent stable but fluctuating long-term trends. Nitrogen concentrations at BPGW40 have been elevated since October 2021, Figure 4-4. The April 2024 result at BPGW40 is the sixth consecutive nitrogen exceedance at this site.

A review of Ichthys LNG activities indicates that there have been no activities that may have impacted total nitrogen at these locations. Therefore, total nitrogen trigger exceedances are not considered to be a result of Ichthys LNG operations, however they will continue to be monitored in future surveys.

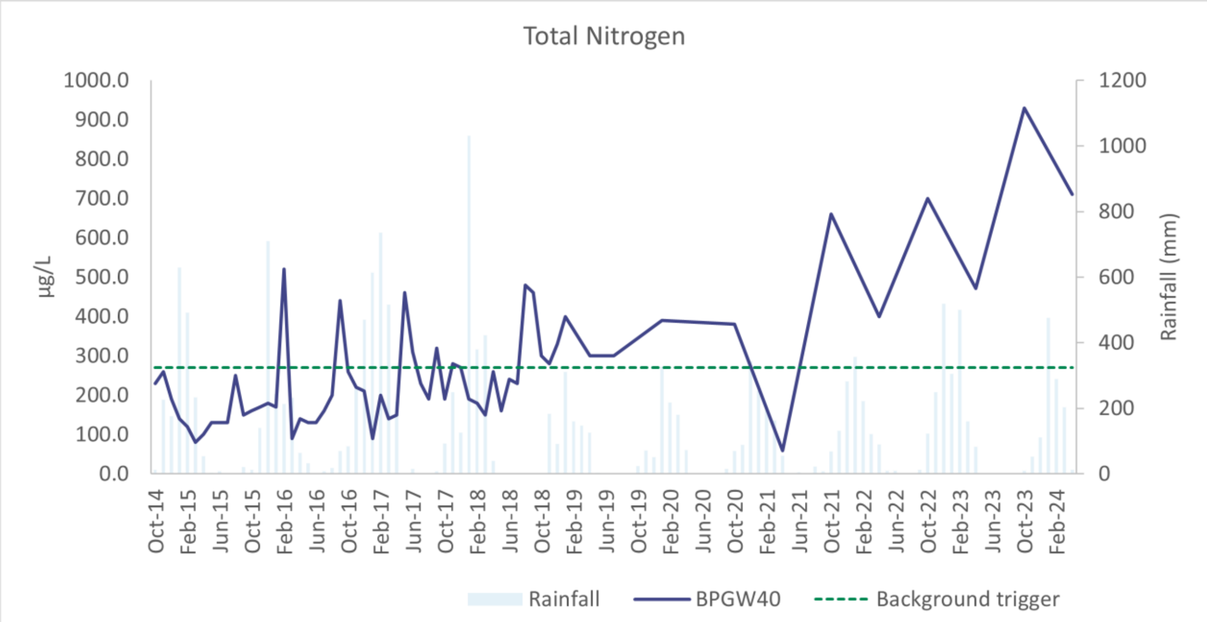


Figure 4-4: Total Nitrogen concentrations recorded at BPGW40 from October 2014 to April 2024

Arsenic

Arsenic concentrations recorded at BPGW09 and VWP328 from October 2014 to April 2024 are displayed below in Figure 4. Arsenic concentrations at BPGW09 and VWP328 fluctuate, with concentration increases correlating with increased rainfall. Arsenic concentrations have increased since the construction period of 2014-2015; however, the long-term trend appears to be stable.

High levels of arsenic are known to occur within the coastal strata of Darwin Harbour and are likely a reflection of local geology rather than anthropogenic sources (Padovan, 2003). The April 2024 exceedance is likely due to seasonal factors.

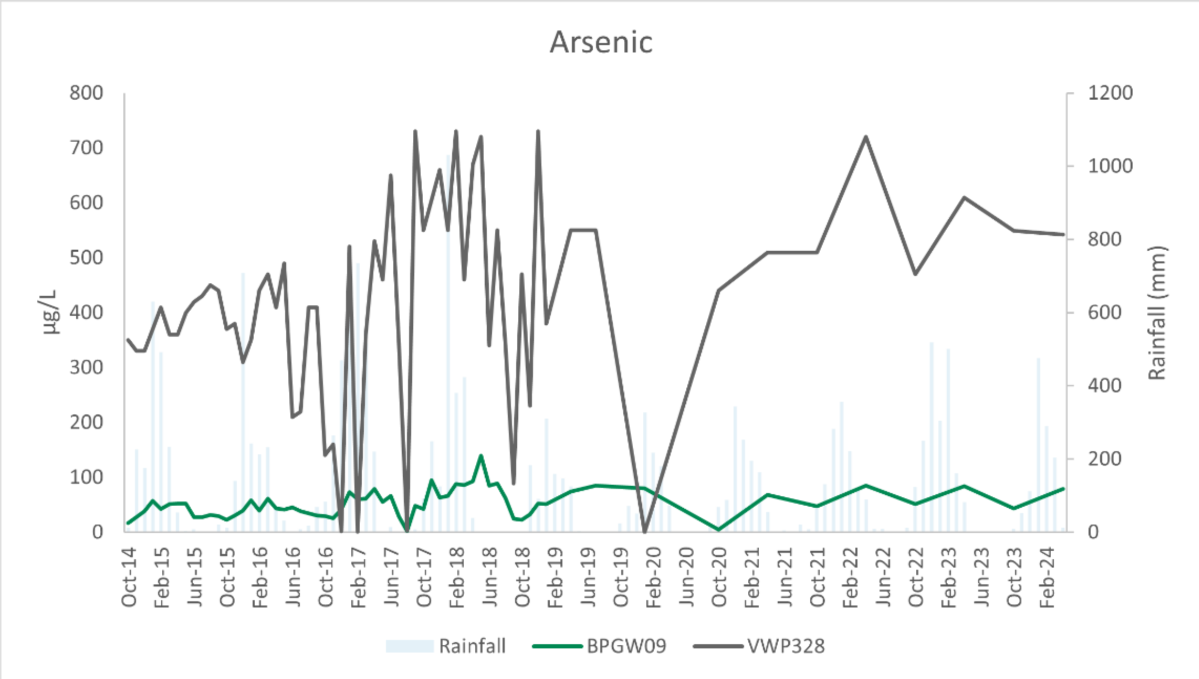


Figure 4-5: Arsenic concentrations recorded at BPGW09 and VWP328 from October 2014 to April 2024

Cobalt

Cobalt concentrations at BPGW40 and VWP341 are increasing, with the April 2024 results representing historical maxima at both bores. Exceedances at BPGW40 appear to be fluctuating seasonally at or just above the trigger value (1 µg/L), with higher trends potentially linked to an increasing rainfall (Figure 4-6), and therefore are likely a result of natural variation. Cobalt concentrations at VWP328 fluctuate but appear to have increased since October 2022.

Figure 4-7 demonstrates that VWP341 cobalt concentrations have consistently trended at the top of cobalt concentrations across operational groundwater bores. Investigations into trigger exceedances did not determine any potential sources of cobalt on site (refer Section 4.1.4), therefore the increasing trends are considered to be likely as a result of natural variation.

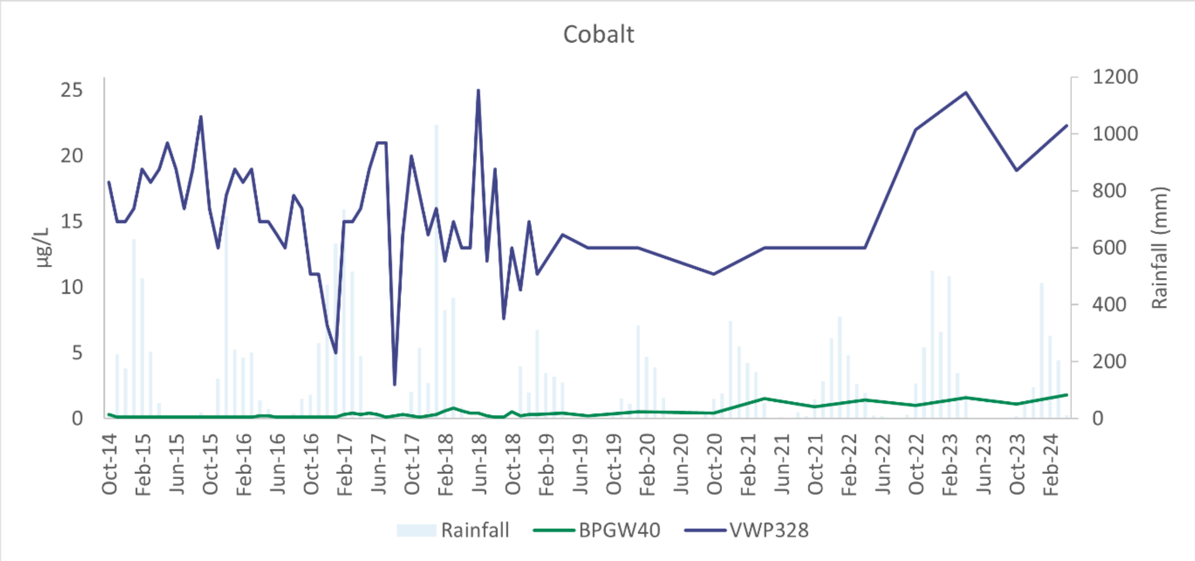


Figure 4-6: Cobalt concentrations recorded at BPGW40 and VWP328 from October 2014 to April 2024

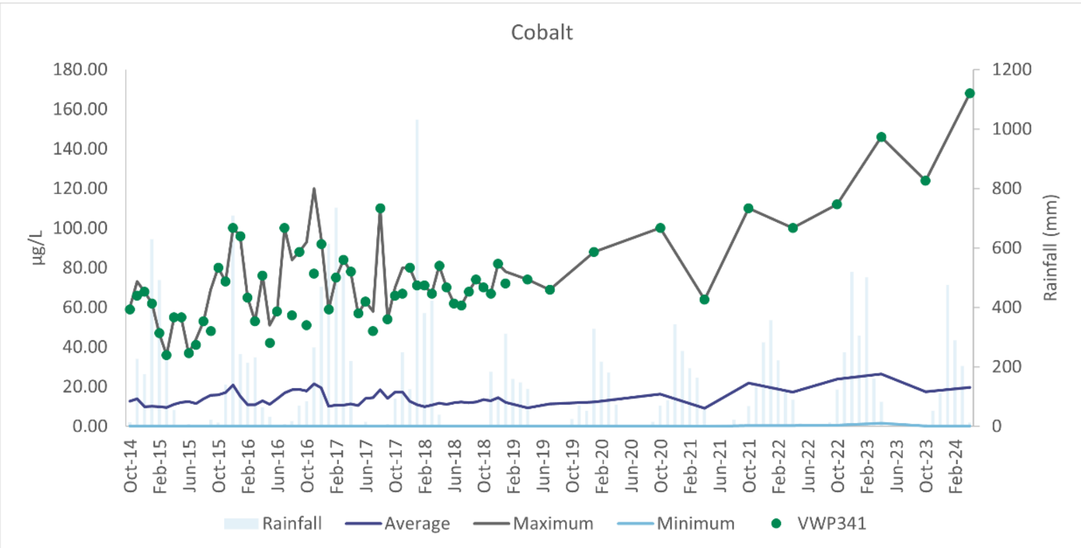


Figure 4-7: Cobalt concentrations recorded at VWP341 and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2024

Zinc

Zinc concentrations frequently fluctuate at VWP341 (Figure 4). These fluctuations do not always appear to be related to seasonal factors, as concentrations peak in both the wet and dry seasons. Zinc concentrations appear to have steadily increased at VWP341 since 2016.

The 173 µg/L of zinc recorded at VWP341 during April 2024 is an historical maximum. Investigations into trigger exceedances did not determine any potential sources of zinc on site (refer Section 4.1.4), therefore the increasing trends are considered to be likely as a result of natural variation.

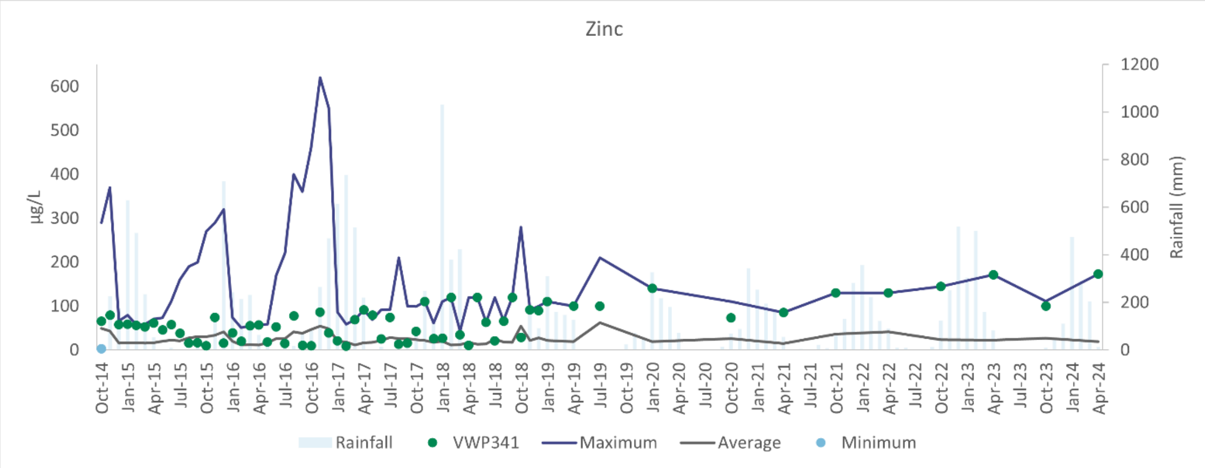


Figure 4-8: Zinc concentrations recorded at VWP341 and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2024

Manganese

Two monitoring bores recorded a trigger exceedance for manganese in the twelfth (BPGW08A and BPGW09) and thirteenth (BPGW09 and VWP341) surveys. Analysis indicates that manganese normally fluctuates over a wide range at BPGW08A and VWP341. Figure 4- shows that manganese concentrations at BPGW09 fluctuate in a similar seasonal pattern, though at much lower concentrations.

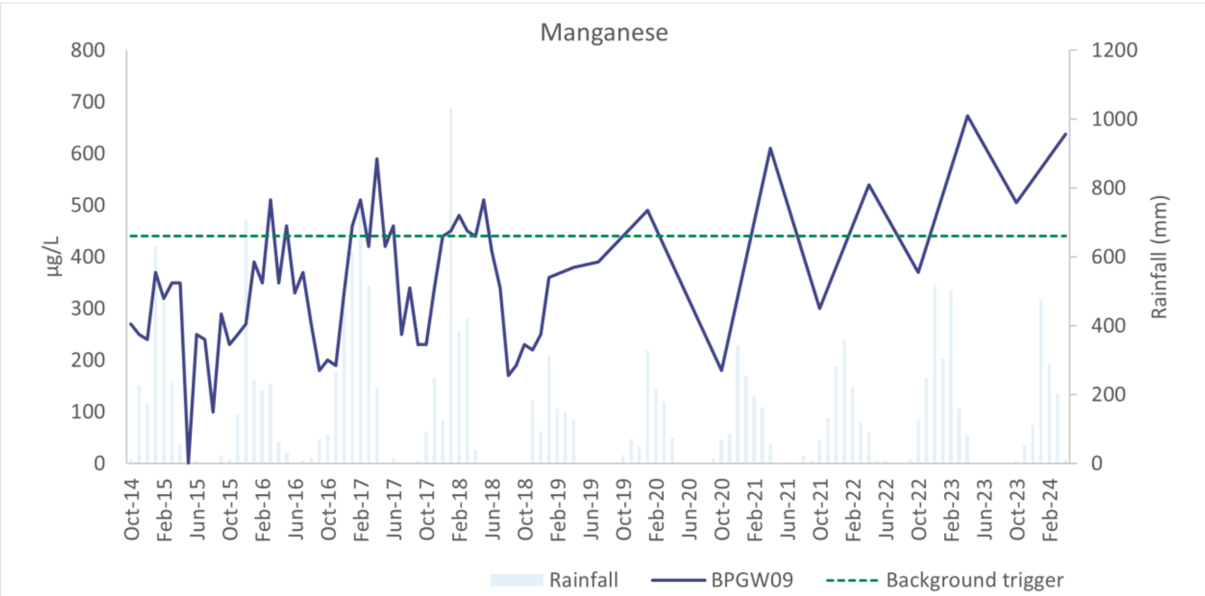


Figure 4-9: Manganese concentrations recorded at BPGW09 from October 2014 to April 2024

Trigger exceedance investigations

In accordance with the receiving environment adaptive management process outlined in Section 7.5 of the OEMP, groundwater trigger exceedances were investigated (i.e. results that exceeded benchmark levels, see Section 4.1.1). A summary of the number of trigger exceedances by survey is provided in Table 4-3 with corresponding investigation reports listed below:

- Groundwater Survey 12 – Trigger Investigation Report (L290-AH-REP-70075)

- Groundwater Survey 13 – Trigger Investigation Report (L290-AH-REP-70111).

Investigations were completed for all trigger exceedances. Investigations considered multiple lines of evidence, such as rainfall, seasonal factors, Ichthys LNG operational activities and any spill events, to determine if increasing trends in groundwater analytes were likely to be as a result of Ichthys LNG.

Investigations completed following the October 2023 and April 2024 monitoring events concluded that the reported trigger exceedances were not as a result of Ichthys LNG operations and were likely natural (e.g. represent seasonal trends and natural variability). Therefore, no further evaluation or management response was required.

Table 4-3: Summary of groundwater trigger exceedances

Date	Month	Physio-chemical	Nutrients	Metals
Survey 12	October	0	21	16
Survey 13	April	0	13	15

4.1.5 Program rationalisation

No changes to groundwater monitoring at Ichthys LNG are proposed, as the current biannual monitoring is appropriate to capture seasonal impacts from unplanned discharges to ground.

5 FLORA, FAUNA, AND HERITAGE

5.1 Mangrove health and intertidal sediment

Mangrove health and intertidal sediments were monitored to detect potential adverse changes in mangrove community health as an indirect result of Ichthys LNG operations. The objectives of biennial mangrove health and intertidal sediment surveys are to:

- informatively monitor mangroves adjacent to Ichthys LNG
- detect changes in intertidal sediment quality attributable to Ichthys LNG.

As per the OEMP (L060-AH-PLN-60005), mangrove health and intertidal sediments are monitored biennially. Mangrove health and intertidal sediments were monitored during April 2024 as part of the fifth mangrove monitoring event. Table 5-1 provides a summary of the mangrove health and intertidal sediments survey completed during the reporting period.

Table 5-1: Mangrove health and intertidal sediment monitoring survey details

Survey	Date	Report	INPEX Doc #
5	17—19, 22 April 2024	Mangrove Health and Intertidal Sediments Monitoring: Report No 5	L290-AH-REP-70079

5.1.1 Method overview

The mangrove health and intertidal sediment survey was completed in accordance with the Mangrove Health and Intertidal Sediment Monitoring Plan (L290-AH-PLN-70002). This included monitoring at 9 sites: two control and seven potential impact sites. At each site, a transect from the landward margin of the Hinterland assemblage to the seaward margin of the Tidal Creek assemblage was established during construction phase monitoring. The transects traverse each of the three main Darwin Harbour mangrove assemblages, where present; Hinterland Margin (HM), Tidal Flat (TF) and Tidal Creek (TC). The location of each transect is shown in Figure 5-1**.**

Monitoring at each site is undertaken at fixed quadrats (10 m × 10 m =100m^2) established along each transect. At impact sites, monitoring is undertaken at the fixed quadrat within the most landward assemblage present. The location of impact transects were selected based on their proximity to groundwater sampling locations and their location downstream of potential contamination sources, such as condensate storage tanks. For each control site monitoring is undertaken at three fixed quadrats along transects that were also established during construction phase monitoring, with each quadrat representing a different community assemblage. As such, 13 quadrats (i.e. seven potential impact and six control quadrats) are monitored during each annual survey. Each of the 13 monitoring quadrats is divided into four 5 m × 5 m = 25m^2 subplots formed by the fixed quadrat, four corner posts and a centre post (resulting in a total of 52 subplots).

An overview of the monitoring parameters is presented in Table 5-2**.**

Figure 5-1: Mangrove health and intertidal sediment monitoring locations

Table 5-2: Monitoring parameters, methodologies and associated parameters

Parameter	Methodology	Monitoring Parameters
Mangrove health	• Mangrove canopy cover assessment. • Surveillance photo-monitoring.	• Percentage canopy cover • Observations on mangrove health (e.g. leaf colour).
Sediment quality	• Sediment sampling and laboratory analysis. • In situ sediment measurements for pH and redox.	• Metal and metalloids (Al, Sb, As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) • TPH, TRH, ToC, % Moisture, PSD • pH (measured in field) • Redox (measured in field)

Mangrove Health monitoring

Mangrove canopy cover was measured at each site using established fixed quadrats and using a spherical densitometer (Stickler 1959) to provide an estimate of foliage cover. Three replicate foliage cover measurements were taken within each 5 m × 5 m (25 m^2) subplot formed by the fixed quadrat four corner posts and a centre post in the assemblage adjacent to Ichthys LNG and a subset of transects in high-risk areas. The canopy cover for each quadrat was then calculated by averaging the mean of the foliage cover readings from each subplot. The spherical densiometer was modified to a 17-point densiometer according to the Strickler method (Strickler 1959). The densiometer was placed on the top of a camera tripod and positioned at a height of approximately 1 m above the ground. Measurements were only taken once the bubble level on the densiometer and the tripod were centred.

Mangrove surveillance photo-monitoring was also undertaken in quadrats adjacent to Ichthys LNG to provide a visual record of the communities' appearance and condition (e.g. leaf colour). Repeatable photos were captured facing away from the quadrat centre post towards each of the four corner posts. Photos taken during Survey 5 were compared with photos from the early construction phase (2015) to detect changes in mangrove health over time.

Sediment monitoring

To test for potential changes in sediment composition and sediment quality, two surficial sediment sample were taken from the top 2—5 cm, from within each of the 13 monitoring quadrats. Collected sediments were sent to NATA laboratories, accredited for the relevant analytical suite, for analysis. Laboratory results were then compared to benchmark levels to ascertain whether a trigger exceedance had occurred.

Exceedance of a benchmark level is defined as a measured analyte exceeding its relevant Sediment Quality Guideline Value (SQGV; also referred to default guideline value) as per ANZG (2018) and the same analyte also exceeding the background level for Darwin Harbour sediment. Background levels (i.e. average concentration) were calculated based on intertidal results presented in Darwin Harbour Baseline Sediment Survey 2012 (Munksgaard et al. 2013). Note, where measured metal or metalloids exceeded SQGVs, results (where possible) were normalised for aluminium concentrations based on the methods described in Munksgaard (2013) and Munksgaard et al. (2013) and compared to background levels (i.e. baseline or reference levels). Quality assurance and quality control (QAQC) procedures for intertidal sediment sampling include collection of field split samples, field triplicate samples, field blanks and transport blanks.

Sediments were also tested in-situ for pH and redox potential using a YSI water quality probe.

5.1.2 Results and discussion

Mangrove health monitoring

Canopy cover

Canopy cover can be defined as the per cent forest area occupied by the vertical projection of tree crowns (Paletto & Tossi, 2009). This parameter is considered a useful indicator of environmental stress as leaf defoliation and leaf growth are sensitive to a wide range of environmental indicators. Canopy cover across all sites has remained relatively stable over time (Figure 5-2). Canopy cover data recorded during Survey 5 was slightly higher at control sites (91.6% ±8.7) than at impact sites (90.6 ±10.7).

Canopy cover values recorded during the Survey 5 were generally slightly higher than baseline values (2012-2013), construction phase (2013-2018) and data recorded during April 2021 (Survey 3). Results were similar to values recorded during Survey 4 undertaken in 2022. Variations in mean canopy density between sampling dates at individual sites are relatively minor and were typically in the 5–18 % range, with canopy cover higher in 2024 than during the baseline and construction phase at all sites. This extent of variation, experienced at both impact and control locations, is expected to reflect natural variability and the precision of the sampling technique.

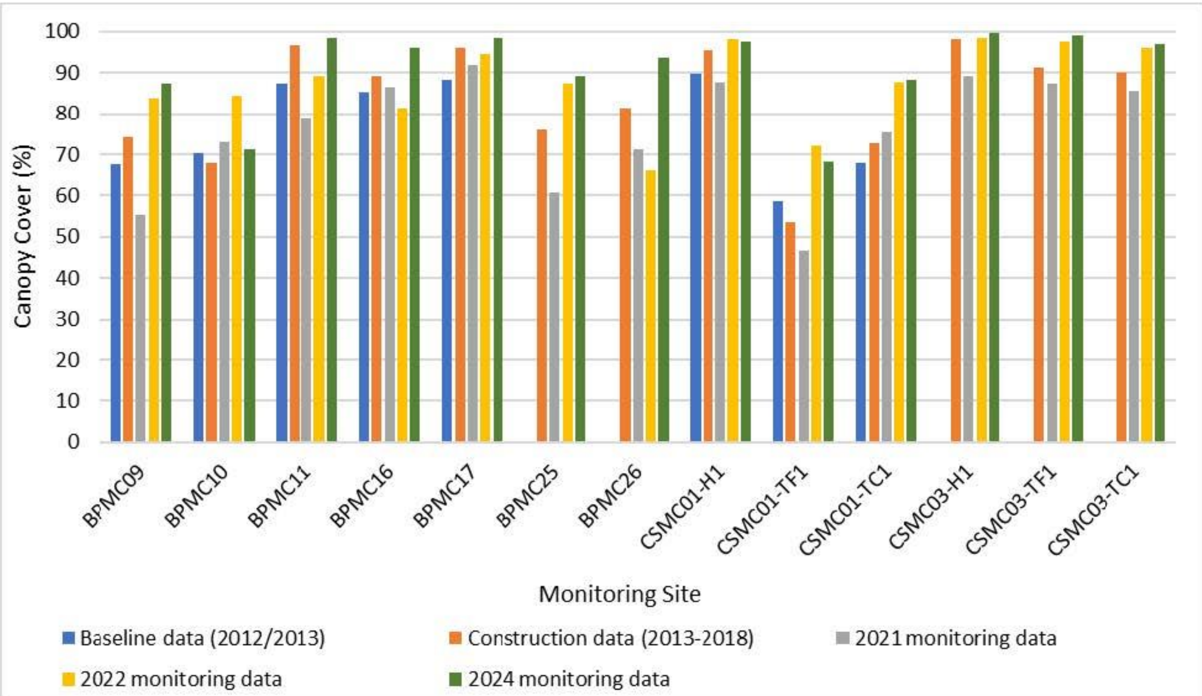


Figure 5-2: Mangrove canopy cover

Table 5-3: Canopy cover results from 2024 and comparison with baseline and construction data

Location	% Canopy cover			Change from baseline data
	Baseline data	Construction data	2024 results (± SD)	
Impact sites				
BPMC09	67.5	74.3	87.3 (21.3)	29.3%
BPMC10	70.3	67.9	71.1 (22.2)	1.1%
BPMC11	87.5	96.7	98.5 (2.6)	12.6%
BPMC16	85.3	89.1	96.1 (6.0)	12.6%
BPMC17	88.3	96.0	98.5 (2.3)	11.6%
BPMC25	NA	75.9	89.2 (13.6)	17.5%
BPMC26	NA	81.5	93.6 (6.6)	14.9%
Mean	**79.8**	**83.1**	**90.6 (10.7)**	**9.0%**
Control sites				
CSMC01 - H	89.8	95.6	97.6 (3.8)	8.6%
CSMC01 -TF	58.5	53.5	68.1 (26.0)	16.5%
CSMC01 -TC	68.0	72.6	88.2 (13.6)	29.8%
CSMC03 - H	NA	98.2	99.5 (1.6)	1.3%
CSMC03 -TF	NA	91.3	99.0 (2.2)	8.5%
CSMC03 -TC	NA	90.1	97.1 (5.1)	7.7%
Mean	**72.1**	**83.6**	**91.6 (8.7)**	**9.5%**

Differences in canopy density between the sites are reflective of different community structures. Typically, the closed forests and woodlands of tidal creek (such as BPMC26) and hinterland margin (BPMC16) assemblages produce relatively high canopy density values (> 95%) compared to the lower and more open canopies within the Ceriops scrubland assemblage which occupies much of the mid-upper tidal flat zone (CSMC01-TF).

Community health

All sites were classified as healthy in 2024 with no signs of deterioration or abnormal stress based on indices of leaf colour, regeneration (i.e. seedlings and saplings), visible vertebrate fauna and infaunal bioturbation.

Sediment monitoring

In-situ sediment measurements

In-situ measurements of pH and redox are displayed below in Table 5-4. In-situ measurements for pH at impact sites ranged from 6.27 to 7.35, with a mean value of 6.88. Measurements of pH at control sites ranged from 6.13 to 7.38 at control sites, with a mean value of 6.64. The range of pH values recorded reflects the conditions experienced by the surface sediments which are well oxygenated and regularly flushed by tidal waters. The results indicate that that mangrove sediments at both impact and control sites range from being slightly alkaline to slightly acidic. Subsurface mangrove soils are typically anaerobic and microbial decomposition takes place through a series of oxygen-reduction (redox) processes. Most mangrove soils are well buffered, having a pH in the range of 6-7, but some have a pH as low as 5 (English et al., 1997).

In-situ measurements for redox potential at impact sites ranged from -7.7 mV to 141.5 mV, with a mean of 72.0. Redox potential at control sites ranged from 48.7 mV to 112.3 mV, with a mean of 93.43 mV. The predominantly positive ORP values indicate that mangrove sediments at monitoring sites in the top 5 cm are oxidising.

Table 5-4: Mangrove sediment in situ monitoring results

Location	Date	pH	ORP (mV) (redox potential)
Impact sites			
BPMC09	18/04/2024	7.02	100.8
BPMC10	22/04/2024	6.64	141.5
BPMC11	17/04/2024	7.09	79.4
BPMC16	17/04/2024	6.92	109.0
BPMC17	17/04/2024	6.27	-7.7
BPMC25	17/04/2024	6.89	85.2
BPMC26	17/04/2024	7.35	-4.1
Mean		**6.88**	**72.0**
Control sites			
CSMC01 - H	19/04/2024	6.20	48.7
CSMC01 -TF	19/04/2024	6.73	112.3
CSMC01 -TC	19/04/2024	6.53	98.7
CSMC03 - H	18/04/2024	6.89	92.8
CSMC03 -TF	18/04/2024	7.38	96.1
CSMC03 -TC	18/04/2024	6.13	112.0
Mean		**6.64**	**93.43**

Sediment chemistry

A summary of the mangrove sediment chemistry results is provided in Table 5-5 and Table 5-6. Elevated arsenic concentrations are consistent with those recorded from the broader Darwin Harbour region and from previous monitoring undertaken during the baseline and construction phases. Elevated concentrations of arsenic in Darwin Harbour sediments have historically been attributed to local geological influence rather than anthropogenic sources (Padovan, 2003; Fortune, 2006).

One Arsenic exceedance was recorded at a control site, with the next highest recording also at a control site. Therefore, the exceedance is unlikely to be due to Ichthys LNG operations, and further investigation was not warranted.

Organic results were below the limit of reporting for all sites but CSMC01-TC (Table 5-6). Given this result (55 mg/kg) was still below the trigger level (280mg/kg) and the result was from a control site, further investigation was not warranted.

Limits of reporting (LOR) in sediment samples were sufficiently low in all samples to capture trigger value exceedances, with the following exception:

- Antimony in BPMC10, which was analysed to a LOR of 10 mg/kg. This is higher than the trigger value of 2 mg/kg required for the mangrove sediment monitoring program.

This raised LOR marginally impacts the integrity for this parameter at the site for this round of intertidal sediment monitoring.

Table 5-5: Summary of inorganic mangrove sediment chemistry

Analyte	**Aluminium**	**Antimony**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Zinc**	**Moisture Content**	**Total Organic Carbon**
Unit	**mg/kg**										**%**	**mg/kg**
LOR	**10**	**1**	**2***	**0.1**	**1**	**1**	**1**	**0.02**	**1**	**5**	**1**	**1000**
Trigger Value	**-**	**2**	**20**	**1.5**	**80**	**65**	**50**	**0.15**	**21**	**200**	**-**	**-**
BPMC09	1,400	<1	5.1	<0.1	6.2	1.7	2.7	<0.02	1.5	9.3	25	33,000
BPMC10	12,000	<10	9.5	<0.4	27	6.4	8.1	<0.1	8.4	65	33	20,000
BPMC11	440	<1	<2	<0.1	3.1	<1	<1	<0.02	<1	<5	15	5,000
BPMC16	1,900	<1	7.9	<0.1	32	1.6	2.7	<0.02	2.9	17	16	5,000
BPMC17	2,200	<1	4.1	<0.1	40	2.1	3.9	<0.02	<1	7.1	24	15,000
BPMC25	3,600	<1	15	<0.1	15	4.6	6.6	<0.02	4.4	34	57	140,000
BPMC26	3,000	<1	13	<0.1	23	3.6	5.6	<0.02	3.5	22	35	76,000
CSMC01-TC	<20	<1	<2	<0.1	<1	<1	<1	<0.02	<1	<5	26	13,000
CSMC01-H	710	<1	4	<0.1	6.5	<1	2.2	<0.02	<1	6.9	18	12,000
CSMC01-TF	<20	<1	<2	<0.1	<1	<1	<1	<0.02	<1	<5	56	78,000
CSMC03-TC	3,900	<1	4.3	<0.1	46	7.5	22	0.02	4.7	17	25	7,000
CSMC03-H	6,200	<1	**33**	<0.1	26	3.4	13	0.02	6.1	20	49	130,000

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Moisture Content	Total Organic Carbon
CSMC03-TF	3,900	<1	20	<0.1	15	3.3	7	<0.02	4.6	11	47	78,000

*Bold value indicates trigger exceedance.

Table 5-6: Summary of organic mangrove sediment chemistry (mg/kg)

Site	TPH C10-C36 (sum of total)	TRH >C10-C40 (sum of total)
Guideline value	**280**	**100**
Background	**n/a**	**n/a**
BPMC09	<50	<100
BPMC10	<50	<100
BPMC11	<50	<100
BPMC16	<50	<100
BPMC17	<50	<100
BPMC25	<50	<100
BPMC26	<50	<100
CSMC01-HM	<50	<100
CSMC01-TF	<50	<100
CSMC01-TC	55	<100
CSMC03-HM	<50	<100
CSMC03-TF	<50	<100
CSMC03-TC	<50	<100

5.1.3 Trigger assessment outcomes

There were no trigger exceedances for the 2024 mangrove health and intertidal sediment survey attributable to Ichthys LNG operations. The one exceedance for arsenic represents a decrease from the five recorded during the 2022 mangrove sediment sampling event (AECOM 2022). Exceedances for arsenic have periodically been recorded at a range of impact and control sites during the baseline and construction monitoring phases (URS 2013a, 2013b).

The single exceedance recorded during Survey 5 represents a decrease from the seven exceedances recorded during Survey 4 in 2022. Five arsenic exceedances and two chromium exceedances were recorded during the 2022 mangrove monitoring event.

5.1.4 Program rationalisation

No further rationalisation is proposed for Mangrove Health and Intertidal Sediments, the next round of monitoring will occur in the 2025/2026 AEMR period.

5.2 Nearshore marine pests

5.2.1 Method overview

Nearshore monitoring is undertaken to assess the presence/absence of invasive marine species at the Ichthys LNG LPG/condensate product loading jetties (Figure 5-3). The two sites located on the product loading jetties have been incorporated in the wider Darwin Harbour program, managed by NT Aquatic Biosecurity Unit, within the Fisheries Division of the Northern Territory Department of Industry, Tourism and Trade (NT DITT). NT DITT provide the artificial settlement units (ASUs; Figure 5-4) for INPEX to deploy at the jetties. Each ASU consists of four settlement plates (back-to-back) and two rope mops.

Photo-monitoring of ASUs is undertaken monthly with ASUs collected and replaced every fourth month (an example of monitoring photographs is shown in Figure 5-5). Collected ASUs and monthly photos of the traps are sent to NT DITT for species identification.

The ASUs were installed in September 2018 with monthly monitoring commencing in October 2018. During the reporting period monthly photo inspections occurred and the traps were collected and provided to NT DITT every four months for identification of species.

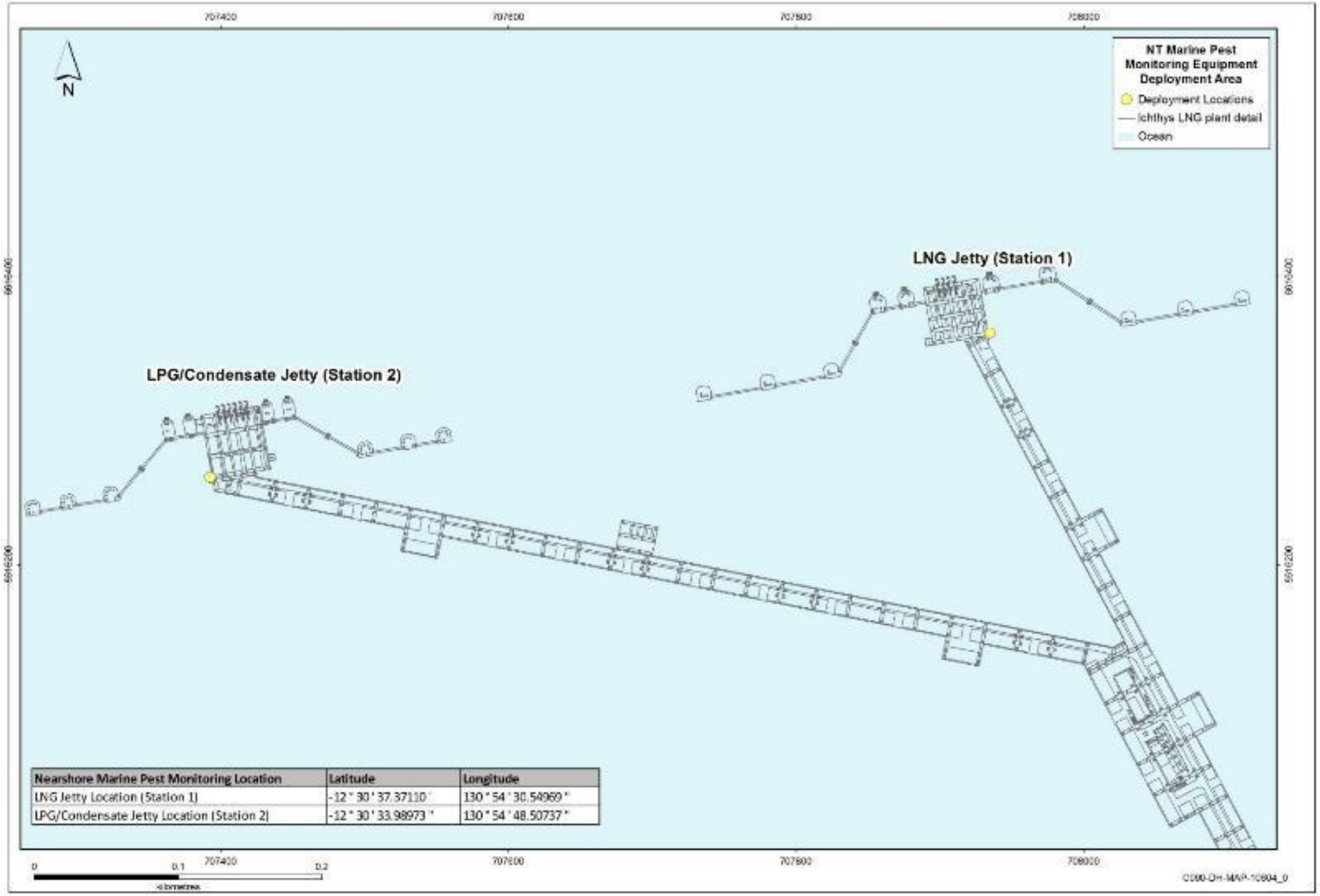


Figure 5-3: Nearshore marine pest monitoring locations

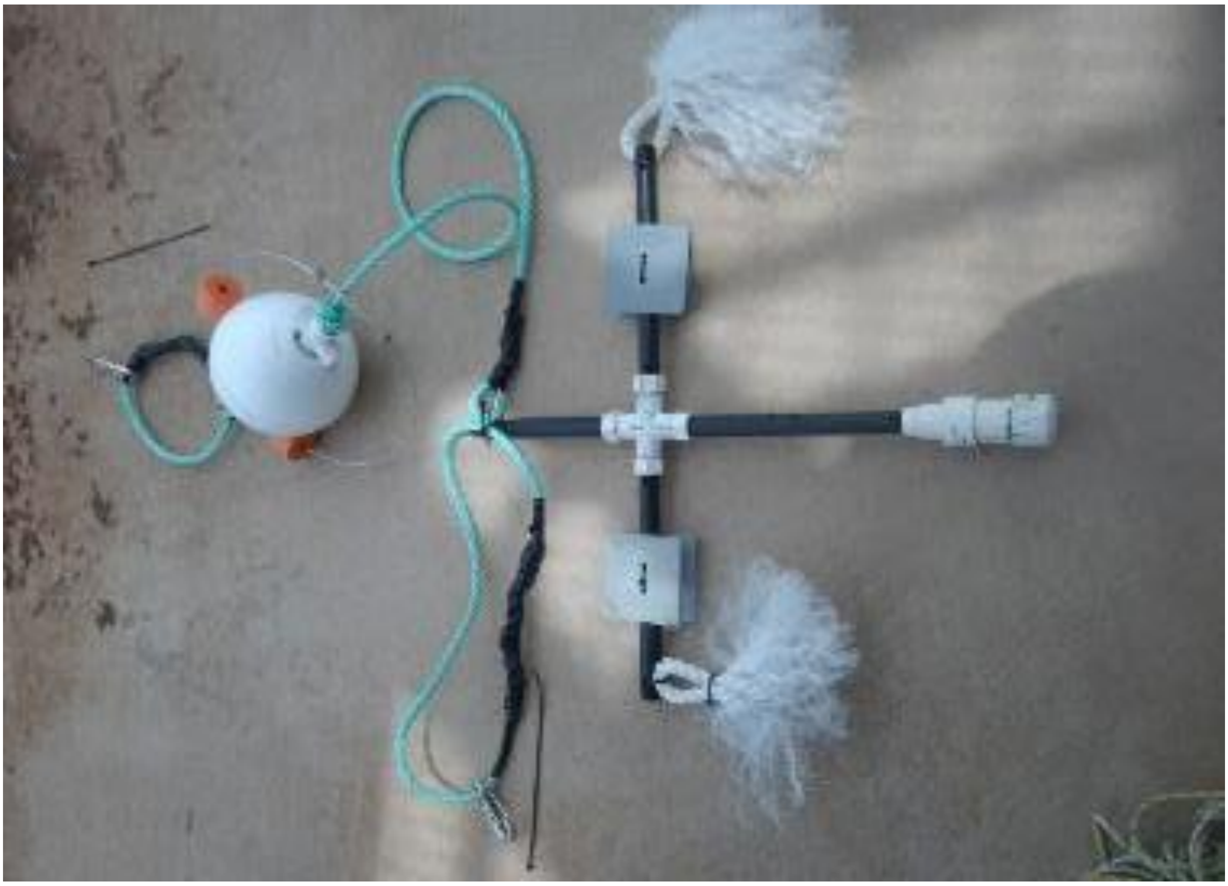


Figure 5-4: Nearshore marine pest ASU

Figure 5-5: Example of monitoring photographs taken during monthly inspection a) rope mop, b) inside the plates and c) plates surface biofouling conditions

5.2.2 Results and discussion

NT DITT examined plates and rope mops on submission every four months, and photos submitted after monthly inspections. NT DITT did not identify any invasive marine species on settlement devices deployed as part of the Darwin Harbour marine pest monitoring program.

5.2.3 Program rationalisation

No change proposed to the marine pest monitoring.

5.3 Introduced terrestrial fauna

Introduced terrestrial fauna may be monitored to determine the presence, location and methods used to control nuisance species.

5.3.1 Method overview

In the event introduced terrestrial fauna are deemed to be a nuisance at Ichthys LNG, INPEX will undertake an annual survey using a third-party licenced pest management contractor.

5.3.2 Results and discussion

During the reporting period there were no reports of introduced terrestrial fauna being deemed a nuisance, as such, no annual survey was undertaken. The routine and ad-hoc pest management programs including baiting and trapping adequately managed introduced terrestrial fauna at Ichthys LNG.

5.3.3 Program rationalisation

No change to the current program is proposed.

5.4 Weed mapping

The key objectives of the weed mapping program are to:

- identify the abundance and spatial distribution of known and new emergent weed populations; and
- inform weed management and control activities.

Weed surveys are undertaken annually at the end of the wet season (nominally in April). Table 5-7 provides a summary of surveys completed during the reporting period.

Table 5-7: Weed survey details

Survey	Date	Report	INPEX Doc #
Survey 9	May 2024	Weed Management Report No. 9	L290-AH-REP-70078

5.4.1 Method overview

Weed surveys were performed in accordance with the INPEX LNG Weed Mapping and Vegetation Surveillance Monitoring Plan (L290-AH-PLN-70001). The area surveyed is shown in Figure 5-6. Parameters monitored during the weed surveys are listed in

Table 5-8. Where identification of a species was not possible in the field, a voucher sample, together with photographs were taken to facilitate post survey identification.

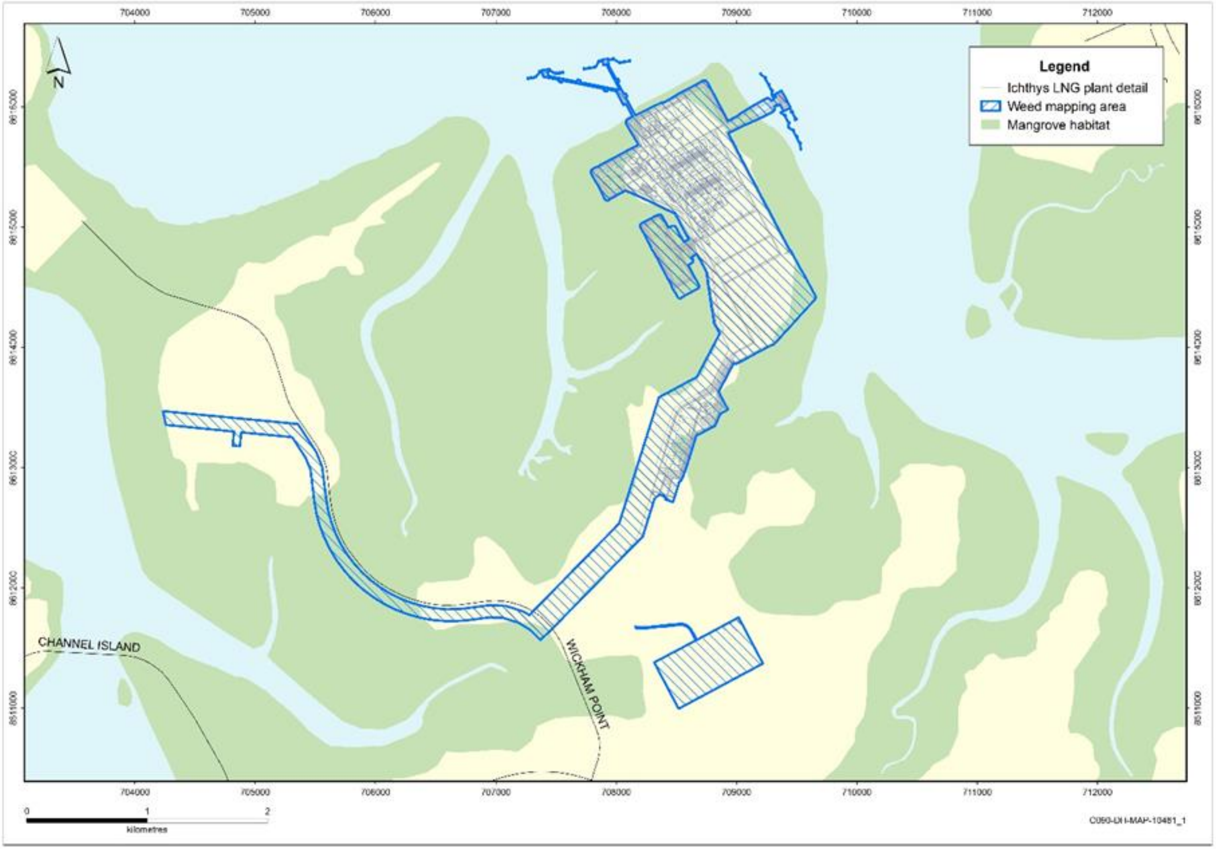


Figure 5-6: Weed survey area

Table 5-8: Weed survey parameters

Key Parameter	Descriptor
Weed names	Scientific and common names
Physical locations	Coordinates of localised outbreaks, polygons for larger occurrences
Abundance	Individual numbers and/or percentage cover, enabling comparison with previous and historic monitoring events
Date	Date of data collection for future and historic comparison

5.4.2 Results and discussion

Survey 9: May 2024

The results of the 2024 weed survey show an increase in the density and distribution of gamba grass and hyptis across the site since the 2023 survey. The increased population is most evident within the GEP corridor, which have increased from 1,682 m^2 to 7,090 m^2. Dense thickets of gamba grass also remain within Section 1888.

No other new declared or non-declared weed species were recorded at Ichthys LNG during the reporting period. Declared weed species previously identified during weed surveys include:

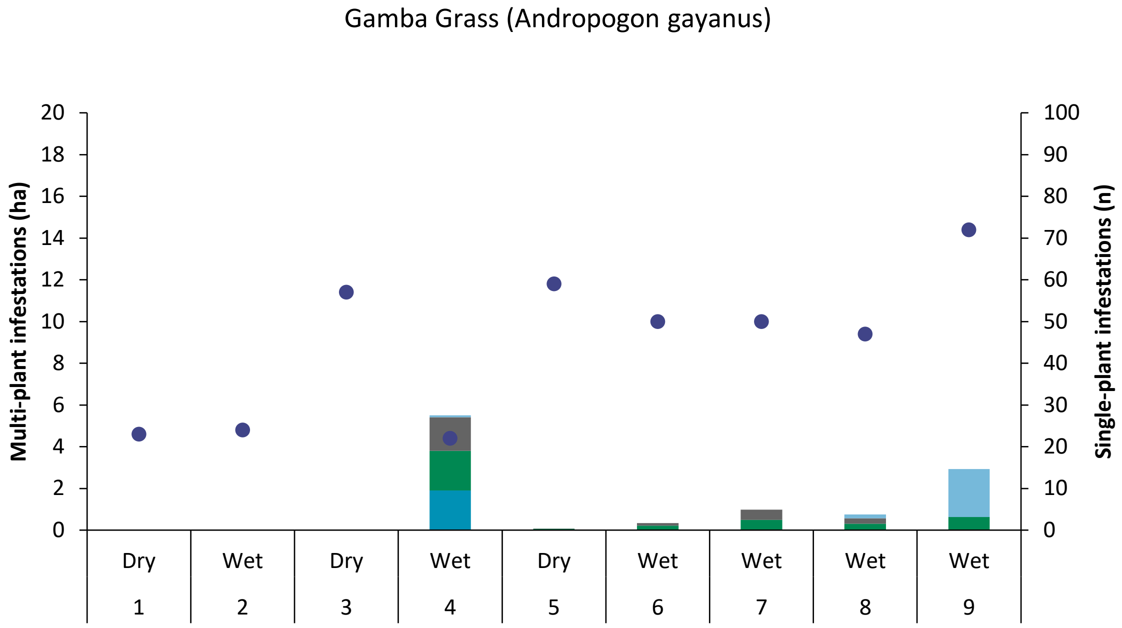
- perennial mission grass (not detected in 2024)
- neem tree (not detected in 2024)
- flannel weed
- lantana
- sicklepod
- gamba grass
- hyptis/horehound.

Weeds identified during the weed mapping surveys were communicated to the weed management contractor and managed accordingly (see Section 5.5).

Declared weed infestation trend analysis

A trend analysis for weed results from all surveys was completed (Figure 5-7). Gamba grass and hyptis infestations have significantly increased during the 2023-2024 wet season. There has been an increase in both individual gamba grass and hyptis plants and multi-plant infestations (Survey 9 compared to Survey 8).

Notably, no perennial mission grass was recorded in Survey 9. Patches of this species are a very high priority for control.



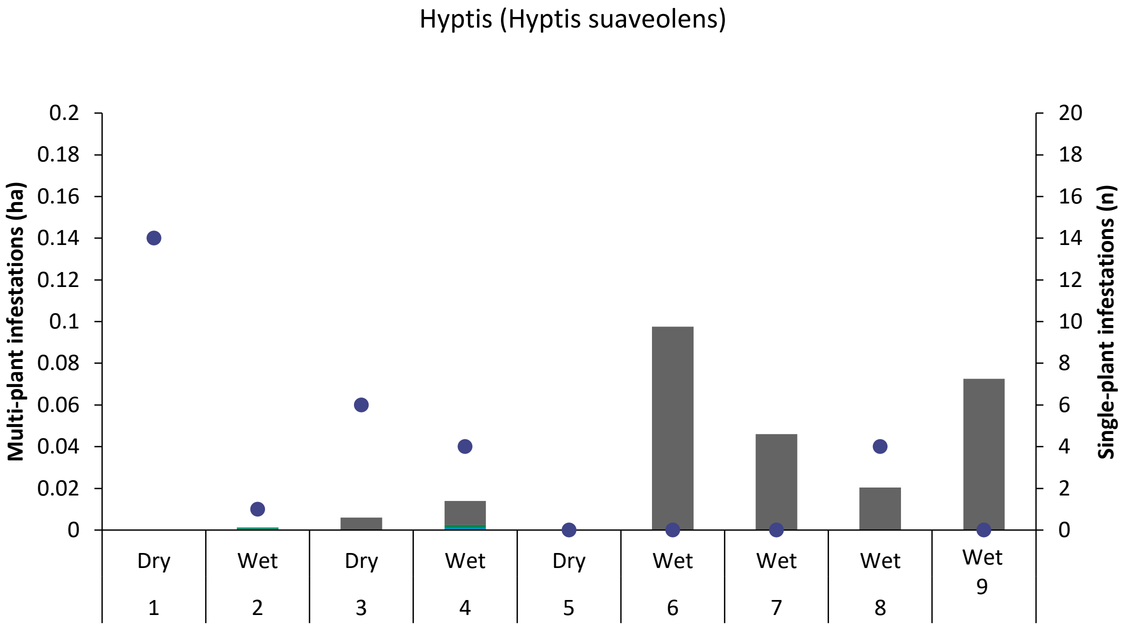


Figure 5-7: Comparison of declared weed infestations between AEMR reporting periods

5.4.3 Program rationalisation

No changes to weed surveys is proposed. The current annual weed surveys will still allow INPEX to fulfil its commitments under the OEMP and *Weeds Management Act* (NT).

5.5 Weed management

5.5.1 Method overview

Weed control at the site was undertaken and managed by a weed management contractor during the reporting period. Vegetation control at the site occurred along the fence lines, drains, inside the facility and along the GEP corridor, including the Section 1888 laydown yard. Weed control is carried out at set intervals of December, February and April during the reporting period. Methods of control include spray application of herbicides, boom spray, quick-spray handguns, and backpacks for the 2023/2024 reporting period. The first weed control work order is actioned in the financial year reporting period is in December. Weed controls are implemented on the recommendations proposed in the survey conducted in Q2 of the previous reporting period.

Total vegetation and woody weed control was undertaken through hand pulling and slashing along the GEP corridor.

5.5.2 Results and discussion

Overall weed management measures undertaken did not result in reduced weed load, particularly in the GEP corridor and Section 1888. Therefore, it is recommended that a gamba grass treatment program is implemented in Section 1888, GEP corridor, the operations area and the production area immediately following each wet season until it has been sufficiently controlled. This may take several years of concentrated controlled effort to see a reduced population of gamba grass across the entire site. A weed maintenance strategy has been developed for onshore, guided by maintenance work instructions (MWIs) that are divided into three separate work orders to balance the required resources to execute the proposed weed control measures. Weed management resources are initiated in the months of February, April and December to action the recommended control measures.

5.5.3 Program rationalisation

No changes are proposed to weed management at Ichthys LNG.

5.6 Vegetation rehabilitation monitoring

The key objectives of the vegetation rehabilitation monitoring are to:

- monitor native vegetation recovery; and
- provide management advice to ensure the establishment of stable, self-sustaining vegetation communities.

In accordance with the OEMP, vegetation rehabilitation is now biennial (every two years). Vegetation rehabilitation monitoring was undertaken in the previous monitoring period, and therefore did not occur in the 2023/24 reporting period.

5.6.1 Program rationalisation

No program rationalisation was proposed for vegetation rehabilitation surveillance from the previously conducted vegetation surveillance Survey 4. The next proposed survey will occur in 2025.

5.7 Cultural heritage

The objective of cultural heritage surveys is to determine if there has been any interference to cultural heritage sites as a result of Ichthys LNG operations.

5.7.1 Method overview

Visually inspections of cultural heritage sites will be undertaken when required at a frequency determined by the Larrakia Advisory Committee.

5.7.2 Results and discussion

No inspections of heritage site were required during the reporting period. No heritage breaches occurred within the reporting period.

6 WASTE REDUCTION MEASURES

Following the activation of EPL228 in September 2018, the OEMP and supporting waste management documentation were implemented. This involved management of waste in accordance with the INPEX waste management processes and the waste control hierarchy (Figure 6-1).

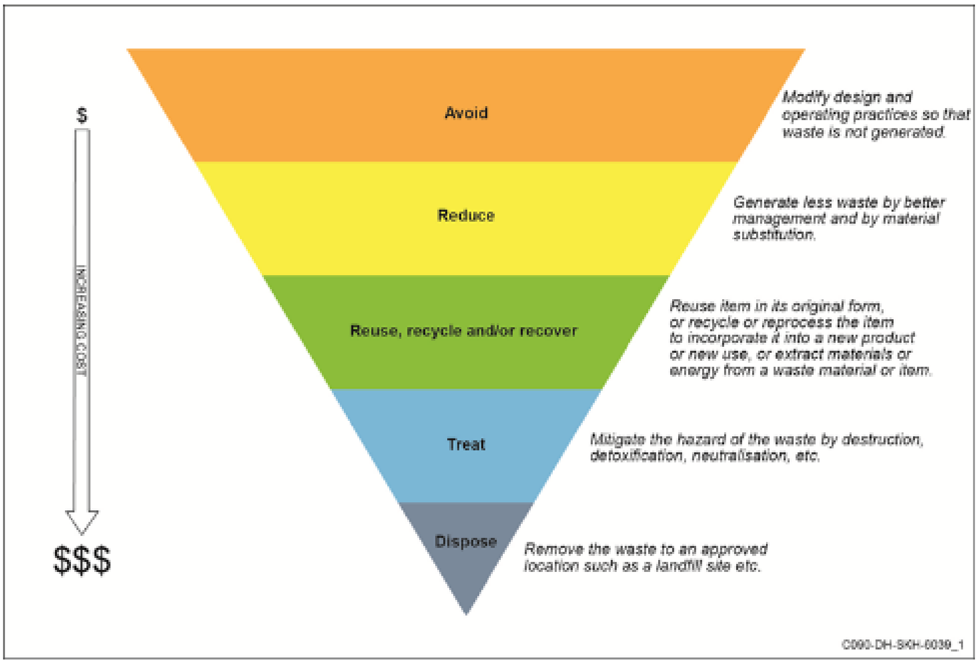


Figure 6-1: INPEX waste control hierarchy

Waste streams at the site are categorised into four broad classes (which include both liquid and solid waste, as outlined in section 3.8.7 of the OEMP):

- recyclable (non-hazardous) waste
- non-recyclable (non-hazardous) waste
- recyclable (hazardous) waste
- non-recyclable (hazardous) waste.

Note, the onsite treatment of wastewater and disposal via the onsite evaporation basin are excluded from reportable waste data (refer to Table 6-1), and only records from licenced waste contractors are used for this waste section.

Solid waste segregation measures involved the placement of various recyclable and non-recyclable waste receptacles around Ichthys LNG, while liquid wastes were segregated into recyclable and non-recyclable streams and then disposed of offsite to suitable treatment and disposal facilities following classification by waste contractors. The expected waste generated by onsite activities and subsequent control measures are detailed further and in INPEX's Onshore Environmental Management Plan L060-AH-PLN-60005 section 3.8.7

Table 6-1 presents a comparison of the waste streams from the 2020/2021, 2021/2022 and 2022/2023 reporting periods against the current reporting period (2023/2024).

Table 6-1: Waste stream data comparison

Waste Stream	2020-2021 (tonnes)	2021-2022 (tonnes)	2022-2023 (tonnes)	2023-2024 (tonnes)
Recyclable / non-hazardous	304.4	1126.4	459.7	181.9
Recyclable / hazardous	6.4	10.4	15.7	3.9
Non-recyclable / non-hazardous	2413.1	2090.5	4328.3	2395.6
Non-recyclable / hazardous	925.5	626.0	1196.1	363.9

The reporting period 2021/2022 provided an anomality in waste classified as recyclables/non-hazardous as it captured the processing of recyclable steel associated with remedial works onsite during that period. This is reflected when comparing the 2021/2022 and 2022/2023 reporting period data in the table above. The reporting period 2023/2024 saw a decrease in comparison to 2022/2023 across all 4 waste categories,. The 2023/2024 reporting period experienced an overall decrease in comparison with the 2022/2023 reporting period, mainly due to the waste generated during the July /August 2022 shutdown.

The 2020/2021 reporting period serves as a reliable baseline reference after the initial few years of startup from 2018. Not considering any major event such as a shutdown, 2020/2021 provides a datum point in which each reporting period can be directly compared. The 2023/2024 reporting period has seen a reduction in comparison to 2020/2021 across the four waste streams. The main waste reduction measure implemented during this reporting period (i.e. reduce waste being disposed or treated offsite) was through the use of the onsite evaporation basin. The evaporation basin is designed to handle low level chemical and hydrocarbon contaminated water generated at Ichthys LNG, while inter-site transfers to the wastewater treatment plants took place. Approximately 4,018 tonnes of liquid waste were transferred to the evaporation basin and 6,465 tonnes of wastewater transferred to the various water treatment plants during the reporting period, which resulted in this liquid waste not being taken offsite for treatment and disposal.

Site wide waste reduction initiatives are implemented via the Waste Management Standard (0000-AH-STD-600047) which applies to all waste streams onsite. For the 2023/2024 reporting period, measures were put in place to minimise the amount of liquid waste being generated at Ichthys LNG. This included the capture and storage of chemical waste streams to avoid the mixture of waste streams and rainwater runoff from Ichthys LNG. This prevents the generation of large volumes of wastewater predominately in the AGRU of each LNG train, where amine is used as a solvent to extract acid gases (including carbon dioxide).

The incumbent waste contractor Cleanaway undertook a waste audit during the Q3 2023 period. The provided report looked at waste measures across the entire business with a focus on potential waste reduction measures such as dehydration of food wastes via a proposed dehydrator. Proposed dehydration measure suggests an overall decrease in tonnage associated with food waste by 85% and associated transportation reduction. Proposal is at review at the time of writing due to waste contractor contract 5-year review.

Although not directly related to solid and liquid waste, energy recovery occurs through the use of the waste heat recovery systems. Heat recovery units are located on the GE Frame 7 gas turbine stacks, which capture the heat of the turbine exhaust and then transfer the energy to the site heating medium system. A similar heat transfer method is also used in the CCPP, where the exhaust heat from the GE Frame 6 turbine stacks used to generate steam, which is then transferred into energy in the steam turbines. Use of the waste heat recovery systems reduce the overall fuel consumption and air emissions.

The 2022/2023 AEMR incorrectly reported 5,168 tonnes of liquid waste transferred to the evaporation basin and 652 of wastewater transferred to various water treatment plants onsite due to an administration error. The correct figures are 4,331.5 tonnes of liquid waste transferred to the evaporation basin and 2012.5 tonnes of wastewater transferred to various water treatment plants onsite.

7 PROGRAM RATIONALISATION AND FUTURE SURVEYS SUMMARY

There were no proposed recommendations for changes to monitoring programs and future monitoring will be undertaken in accordance with the current OEMP and EPL228. The proposed next survey dates are outlined below in Table 7-1.

Table 7-1: Survey forecast for future monitoring periods

Survey/Data Collection Scope	Frequency	Previous Survey	Next Survey
Commingled treated effluent	Monthly	June 2023-2024	July 2024 – June 2025
Harbour sediment	Biennial	July 2022	July 2024
Total emissions to air	Annual	June 2024	June 2025
Point source emissions to air	Annual	November 2023	October 2024
Dark smoke events	Ad-hoc	n/a	n/a
Groundwater quality	Bi-annual	April 2024	October 2024 April 2025
Mangrove health and intertidal sediments	Biennial	April 2024	April 2026
Nearshore marine pests	Monthly	June 2024	July 2024 – June 2025
Introduced terrestrial fauna	Annual	June 2024	April 2025
Weed mapping	Annual	April 2024	April 2025
Weed management	Annual – as required	June 2024	~April 2025
Vegetation rehabilitation monitoring	Biennial	June 2023	June 2025
Cultural heritage	Ad-hoc	n/a	n/a

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ANZECC/ARMCANZ—*see* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

ANZG—*see* Australian and New Zealand Governments and Australian State and Territory Governments

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APPENDIX A: NT GUIDELINE FOR ENVIRONMENTAL REPORTING

NT Guideline for Environmental Reporting	NT Guideline Information	AEMR Reference
Title page	The title page should include: • report name • reporting period (e.g., October 2014–October 2015) • date of submission • version number • where relevant, licence/approval number, or reference to other document the report is being submitted in relation to (e.g., environmental impact statement, pollution abatement notice) • details of report author, including company details.	Title page and Section 1.
Executive summary	The executive summary should succinctly summarise each section of the report, and in particular, the findings of the report.	Executive summary.
Monitoring objective	The monitoring objective(s) should be clearly stated in order to enable the results of monitoring to be assessed in the context of the objectives. Note, where monitoring is linked to a licence or approval, the objectives of monitoring: • may already be specified in an approved monitoring plan, or • may simply be the specific conditions on monitoring included in the • licence/approval that state monitoring point locations, analytes, analysis type, frequency, and limits/trigger values.	Each section includes a subsection with monitoring objectives for each monitoring program.
Monitoring method	*Where there is an approved monitoring plan* Provide details of the approved plan (title, version number, date of submission). *Where there is not an approved monitoring plan* Provide details including: • current map showing sampling locations (including control/reference sites), discharge/emission points, major infrastructure, sensitive environmental receptors, key, scale bar and north arrow • a description of the receiving environment, including environmentally sensitive receptors and significant features • a description of sampling and analysis methods, including detail on reasons for selection of sampling locations (e.g., random stratified), assumptions and deviations from standard sampling/analysis methods1	Each section includes a subsection with monitoring methods for each monitoring program.

NT Guideline for Environmental Reporting	NT Guideline Information	AEMR Reference
	• factors that may affect variability in monitoring results (e.g., tidal movement, climate, fauna migration, peak production months).	

Monitoring results–presentation	The clear and concise presentation of monitoring results is a critical component of a monitoring report.
	When presenting results, it is important to ensure that:
	• current results are presented in a table and graph
	• results are presented along with:
	  • units
	  • assessment criteria (e.g., limits/trigger values specified in licences/approvals, or in relevant standards or guidelines)
	  • analysis type (e.g., for filtered/unfiltered with filter pore size, five-day or
	  • three-day biological oxygen demand, wet or dry weights)
	  • analytical methods
	  • limit of reporting (LOR), or level of precision for results obtained from
	  • field instruments
	  • measures of uncertainty
	• necessary calculations have been made, to compare data with assessment
	• criteria (e.g., calculation of medians, means, running averages and loads)
	• modification calculations (such as for hardness) have been made using the modifying parameter recorded at the time of sampling
	• all results that exceed the assessment criteria are clearly highlighted
	• summary of previous results (sufficient to highlight trends – usually a minimum of 2–5 years data) is included.
		Each section includes a subsection with monitoring results and discussion for each monitoring program.

Monitoring results–quality assurance/ quality control (QA/QC) evaluation	Results presented in the monitoring report should be reviewed for data completeness, accuracy, and precision. Some typical QA/QC questions include: • for completeness – were all samples taken at the correct location and frequency? • for quality control – _ were all samples collected, preserved in accordance with the specified sampling method or standard sampling methods? • were calibration checks made and were results within an acceptable range? • was analysis undertaken in accordance with relevant national standards (such as accredited under the National Association of Testing Authorities)?	Monitoring plans (referenced in the method overview section) include QA/QC processes.

NT Guideline for Environmental Reporting	NT Guideline Information	AEMR Reference
Discussion and interpretation of results	This section should include: • discussion of results in context with the monitoring objective(s) • discussion of results where assessment criteria were exceeded, including likely cause of exceedances and likelihood of further exceedances • discussion of trends (consideration of spatial and temporal trends in comparison to previous monitoring data) • discussion of anomalous results, including likely cause • statistical analysis where appropriate • a table of non-conformances with monitoring method.	Each section includes a subsection with monitoring results and discussion for each monitoring program
Conclusion and proposed actions	In this section the submitter of an environmental monitoring report must confirm that the report is true and accurate. Where the report relates to a licence/approval, confirmation must be provided by a person(s) authorised to legally represent the holder of the licence/approval. The wording for this section should be: *I [NAME AND POSITION], have reviewed this report and I confirm that to the best of my knowledge and ability all the information provided in the report is true and accurate.* Note: significant penalties may apply where it is demonstrated that false or misleading information has been supplied to the NT EPA.	APPENDIX B:
Abbreviations	Use of abbreviation should be minimised. However, if they are used to improve readability, this section should specify all abbreviations used in the report.	Throughout AEMR
References	If information (facts, findings etc.) from external documents is to be included in the report, the information must be referenced. If references are from documents that are not freely available (e.g., internal reports, mine management plans) then such documents will need to be provided to the NT EPA on request.	Throughout AEMR
Appendices	Appendices should be used for information that is too detailed or distracting to be included in the main body of the report (such as raw data tables, laboratory reports, QA/QC data).	Appendices

APPENDIX B: EPL228 AEMR 2023-2024 CERTIFICATION

B.1 INPEX

INPEX	I, Tetsuhiro Murayama (President Director, Ichthys LNG Pty Ltd, Australia) confirm that to the best of my knowledge and ability all the information provided in the *EPL228 Annual Environmental Monitoring Report 2023-2024* (L060-AH-REP-70061) is true and accurate.
Name	Tetsuhiro Murayama
Position	President Director, Ichthys LNG Pty Ltd
Signature	
Date	

B.2 Qualified Professional

APPENDIX C: COMMINGLED TREATED EFFLUENT (750-SC-003) LABORATORY RESULTS

C.1 Monthly sampling results for 750-SC-003

Shaded purple cells with bold text indicate a trigger exceedance associated with subsequent discharge via jetty outfall. These are further described in Table 2-4

Date	TIME	LIMS Sample ID	pH	Electrical conductivity	Temperature	Turbidity	Dissolved oxygen	TPH as oil & grease	TRH (C6-C10)	TRH (C10-C40)	TSS	BOD	COD	Free Chlorine	Ammonia	Total nitrogen	Total phosphorus	Filterable Reactive Phosphorus	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Enterococci	E coli	Thermotolerant/Faecal coliforms	Anionic surfactants	aMDEA	Glycol (MEG)	Glycol (TEG)
Unit			pH units	µS/cm	°C	NTU	%	mg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg N/L	mg N/L	mg P/L	mg P/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	cfu/ 100mL	cfu/ 100mL	cfu/ 100mL	mg/L	mg/L	mg/L	mg/L
Discharge limit			6-9	n/a	35	n/a	n/a	6	n/a	n/a	10	20	125	2	n/a	10	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	400	n/a	n/a	n/a	n/a
18/07/2023	7:45	L2303366001	8	174	26.5	1	84	<1	<20	<100	<5	<2	9	0.03	3	3	0.6	<0.5	<0.1	<1	<1	<1	<0.1	<1	<1	23	33	26	28	<0.1	<5	<5	<5
8/08/2023	8:10	L2303790001	8.1	373	27.8	1.0	73	2	<20	<100	< 5	<2	9	0.04	8	8	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	<0.1	<1	74	4	6	18	<0.1	< 5	< 5	< 5
5/09/2023	8:50	L2304269001	7.9	390	28.9	1.0	68	< 1	<20	<100	< 5	<2	15	0.04	6	7	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	<0.1	<1	146	13	1	49	<0.1	< 5	< 5	< 5
17/10/2023	8:15	L2304825001	8.5	363	30.7	3.5	84	< 1	<20	<100	< 5	<2	14	0.03	7	**7**	0.8	0.6	<0.1	<1	3	<1	<0.1	<0.1	<1	202	<1	<1	14	<0.1	< 5	< 5	< 5
14/11/2023	8:55	L2305379001	8.2	380	31.7	1.0	79	< 1	<20	<100	< 5	<2	16	0.02	8	10	< 0.5	< 0.5	<0.1	<1	<1	<1	<0.1	<0.1	<1	214	8	5	10	<0.1	< 5	< 5	< 5
12/12/2023	7:55	L2305821001	7.9	347	31.0	1.5	63	< 1	<20	<100	< 5	5	16	0.03	< 2	< 2	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	<0.1	<1	458	1	3	10	<0.1	< 5	< 5	< 5
8/01/2024	8:10	L2400119001	8.3	472	30.9	2.0	60	1	<20	<100	< 5	7	12	0.05	12	**12**	< 0.5	< 0.5	<0.1	<1	<1	<1	<0.1	<0.1	<1	77	70	10	230	<0.1	< 5	< 5	< 5
19/01/2024	8:10	L2400305001													<2	< 2																	
13/02/2024	8:08	L2400723001	7.8	268	27.2	3.5	73	< 1	<20	<100	< 5	<2	14	< 0.02	4	4	< 0.5	< 0.5	<0.1	<1	1	<1	<0.1	<0.1	<1	194	42	6	270	<0.1			
16/02/2024	8:15	L2400815001																													<5	<5	<5
12/03/2024	8:50	L2401242001	7.6	358	28.6	3.5	59	< 1	<20	<100	**60**		15	0.03	< 2	2	< 0.5	< 0.5													< 5	< 5	< 5
12/03/2024	9:15	L2401325001									<5																						
14/03/2024	8:45	L2401314001							<20	<100		<2							<0.1	<1	1	<1	<0.1	<0.1	<1	212	60	28	140	0.3			
9/04/2023	8:35	L2401805001														2																	
15/04/2024	8:50	L2401929001	7.8	354	30.4	4.5	80	< 1	<20	<100	9	7	23	0.04	2	3	0.5	< 0.5	<0.1	<1	3	<1	<0.1	<0.1	<1	85	18	4	35	<0.1	< 5	< 5	< 5
23/04/2023	10:45	L2402482001														5																	
8/05/2023	8:41	L2402279001														3																	
15/05/2024	8:22	L2402370001	7.7	366	29.0	1.0	72	< 1	<20	<100	< 5	4	13	0.03	< 2	5	1.7	1.5	0.2	<1	6	<1	<0.1	<0.1	<1	87	2	1	100	<0.1	< 5	< 5	< 5
23/05/2023	15:45	L2402482001														8																	
5/06/2023	8:45	L2400279001														4																	
11/06/2024	8:35	L2402901001	8.0	396	26.3	2.0	78	< 1	<20	<100	< 5	2	12	0.06	< 2	8	0.6	< 0.5	<0.1	<1	9	<1	<0.1	<0.1	<1	40	<1	<1	51	<0.1	< 5	< 5	< 5
19/06/2024	11:25	L2403330001														9																	

APPENDIX D: AUTHORISED STATIONARY SOURCE EMISSION RELEASE RESULTS

D.1 Stationary source emission test results by Ektimo

Sampling Point Number	Sampling Location Number	Date/Time	LIMS Number	NO_x as NO_2 - Concentration Target		NO_x as NO_2 - Concentration Limit		NOx as NO_2 -Measured Concentration		CO Measured Concentration		Temperature	Efflux velocity	Volumetric flow rate
				mg/Nm³	ppm	mg/Nm³	ppm	mg/Nm³	ppmv	mg/m³	ppm	ºC	m/s	m³/min
LNG Refrigerant Compressor Driver Gas Turbines (GE Frame 7s)				**50 @ 15%O2 dry**	**25 @ 15%O2 dry**	**70**	**35 @ 15%O2 dry**	**LNG Refrigerant Compressor Driver Gas Turbines (GE Frame 7s)**						
A1	L-641-A-001	02/11/2023 09:56	L2302642001					50	24	50	40	170	24	15000
A2	L-642-A-001	02/11/2023 13:19	L2302644001					15	7.2	12	9.6	169	24	15000
A3	L-641-A-002	03/11/2023 12:11	L2302643001					6.7	3.3	13	10	176	24	15000
A4	L-642-A-002	04/11/2023 09:22	L2302645001					11	5.3	37	30	174	24	15000
CCPP Gas Turbine Generators (GE Frame 6s, 38MW) - HRSG stack								**CCPP Gas Turbine Generators (GE Frame 6s, 38MW) - HRSG stack**						
A5-1	L-780-GT-001	-	-					-	-	-	-	-	-	-
A6-1	L-780-GT-002	-	-					-	-	-	-	-	-	-
A7-1	L-780-GT-003	-	-					-	-	-	-	-	-	-
A8-1	L-780-GT-004	-	-					-	-	-	-	-	-	-
A9-1	L-780-GT-005	-	-					-	-	-	-	-	-	-
A5-2	L-630-F-001	01/11/2023 13:27	L2302646001	**150 @15%O2 dry**	**75 @15%O2 dry**	**350**	**175 @15%O2 dry**	12	6	49	39	201	22	7300
A6-2	L-630-F-002	01/11/2023 13:10	L2302647001					9.4	4.6	140	110	213	25	7900
A7-2	L-630-F-003	-	-					-	-	-	-	-	-	-
A8-2	L-630-F-004	01/11/2023 10:47	L2302649001					9.2	4.5	60	48	220	23	7300
A9-2	L-630-F-005	01/11/2023 09:56	L2302650001					10	5.1	59	47	220	23	7200

Sampling Point Number	Sampling Location Number	Date/Time	LIMS Number	NO_x as NO_2 - Concentration Target		NO_x as NO_2 - Concentration Limit		NOx as NO_2 -Measured Concentration		CO Measured Concentration		Temperature	Efflux velocity	Volumetric flow rate
				mg/Nm³	ppm	mg/Nm³	ppm	mg/Nm^3	ppmv	mg/m³	ppm	ºC	m/s	m³/min
AGRU Incinerators				**320 @3%O2 dry**	**160 @3%O2 dry**	**350**	**175 @3%O2 dry**	**AGRU Incinerators**						
A13-1	L-551-FT-031	-	-					-	-	-	-	-	-	-
A14-1	L-552-FT-031	-	-					-	-	-	-	-	-	-
Heating medium furnaces				**160 @3%O2 dry**	**80 @3%O2 dry**	**350**	**175 @3%O2 dry**	**Heating medium furnaces**						
A15	L-640-A-001-A	03/11/2023 10:01	L2302640001					140	70	69	55	157	4.1	700
A16	L-640-A-001-B	03/11/2023 09:54	L2302639001					130	61	63	50	159	4.2	720

D.2 Monthly Feed Gas Sampling Test Results Reported by the INPEX Laboratory

Date	LIMS number	Hydrogen Sulfide (H_2S)	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Mercury
	Unit	ppmV	ppmV	ppmV	ppmV	ppmV	ppmV	µg/Nm³
A13-2 (L-551-SC-003) AGRU Hot Vent - LNG Train1, prior to release at A3								
24/07/2023 11:00	L2303336001	160	<30	<30	<30	<30	<30	NA
14/08/2023 12:08	L2303891001	150	<30	<30	<30	<30	<30	NA
29/09/2023 15:15	L2304357001	140	<30	<30	<30	<30	<30	NA
30/10/2023 12:15	L2304953001	140	110	80	<30	<30	<30	NA
12/11/2023 10:15	L2305345001	140	90	60	<30	<30	<30	NA
13/12/2023 09:25	L2305795001	160	100	70	<30	<30	<30	NA
02/01/2024 12:21	L2400015001	NA	210	160	<30	<30	<30	NA
20/01/2024 13:48	L2400113001	140	220	180	<30	<30	<30	NA
13/02/2024 14:20	L2400694001	140	80	50	<30	<30	<30	NA
04/03/2024 13:30	L2401098001	140	110	70	<30	<30	<30	NA
13/04/2024 16:45	L2401785001	140	200	130	<30	<30	<30	NA
20/05/2024 14:20	L2402356001	150	240	180	<30	<30	<30	NA
24/07/2023 11:00	L2303336001	160	<30	<30	<30	<30	<30	NA
11/06/2024 11:31	L2402868001	140	130	70	<30	<30	<30	NA
A13-3 (L-541-SC-001) Feed gas to AGRU – LNG Train 1 – prior to release at A3								
31/07/2023 13:00	L2303469001	NA	NA	NA	NA	NA	NA	< 0.005
25/08/2023 11:10	L2304017001	NA	NA	NA	NA	NA	NA	< 0.005
28/09/2023 14:40	L2304486001	NA	NA	NA	NA	NA	NA	< 0.005
07/11/2023 07:10	L2304907001	NA	NA	NA	NA	NA	NA	< 0.005
17/11/2023 10:30	L2305471001	NA	NA	NA	NA	NA	NA	< 0.005
15/12/2023 09:00	L2305986001	NA	NA	NA	NA	NA	NA	< 0.005

Date	LIMS number	Hydrogen Sulfide (H_2S)	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Mercury
	Unit	ppmV	ppmV	ppmV	ppmV	ppmV	ppmV	µg/Nm³
15/01/2024 07:20	L2400238001	NA	NA	NA	NA	NA	NA	< 0.005
19/02/2024 09:15	L2400867001	NA	NA	NA	NA	NA	NA	< 0.005
21/03/2024 12:55	L2401410001	NA	NA	NA	NA	NA	NA	< 0.005
24/04/2024 12:55	L2401914001	NA	NA	NA	NA	NA	NA	< 0.005
May-24	no sample	NA	NA	NA	NA	NA	NA	NA
Jun-24	no sample	NA	NA	NA	NA	NA	NA	NA
A14-2 (L-552-SC-003) AGRU hot Vent Train2, prior to release at A4								
24/07/2023 14:20	L2303337001	140	< 30	< 30	< 30	< 30	< 30	NA
30/09/2023 14:00	L2304358001	140	50	30	< 30	< 30	< 30	NA
31/10/2023 13:02	L2304954001	140	120	70	< 30	< 30	< 30	NA
12/11/2023 14:55	L2305347001	140	150	110	< 30	< 30	< 30	NA
13/12/2023 13:45	L2305796001	140	150	100	< 30	< 30	< 30	NA
01/01/2024 12:51	L2400016001	NA	150	110	< 30	< 30	< 30	NA
23/01/2024 15:38	L2400114001	140	170	130	< 30	< 30	< 30	NA
13/02/2024 10:45	L2400695001	160	90	60	< 30	< 30	< 30	NA
08/03/2024 13:50	L2401144001	120	100	80	< 30	< 30	< 30	NA
10/04/2024 15:45	L2401786001	140	150	120	< 30	< 30	< 30	NA
19/05/2024 15:27	L2402357001	120	220	150	< 30	< 30	< 30	NA
11/06/2024 14:27	L2402869001	140	190	120	< 30	< 30	< 30	NA
A14-3 (L-542-SC-001) Feed gas to AGRU – LNG Train 2 – prior to release at A4								
25/07/2023 14:00	L2303468001	NA	NA	NA	NA	NA	NA	< 0.005
28/08/2023 09:10	L2304016001	NA	NA	NA	NA	NA	NA	< 0.005
27/09/2023 15:40	L2304485001	NA	NA	NA	NA	NA	NA	< 0.005
Oct-23	no sample	NA	NA	NA	NA	NA	NA	NA

Date	LIMS number	Hydrogen Sulfide (H_2S)	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Mercury
	Unit	ppmV	ppmV	ppmV	ppmV	ppmV	ppmV	µg/Nm³
11/11/2023 10:45	L2304906001	NA	NA	NA	NA	NA	NA	< 0.005
27/11/2023 17:05	L2305470001	NA	NA	NA	NA	NA	NA	< 0.005
15/12/2023 10:15	L2305985001	NA	NA	NA	NA	NA	NA	< 0.005
21/03/2024 12:30	L2401409001	NA	NA	NA	NA	NA	NA	< 0.005
17/04/2024 09:00	L2401913001	NA	NA	NA	NA	NA	NA	< 0.005
22/05/2024 09:15	L2402428001	10	120	110	<30	<30	<30	< 0.005
03/06/2024 10:10	L2402460001	NA	NA	NA	NA	NA	NA	< 0.005
18/06/2024 09:40	L2402999001	NA	NA	NA	NA	NA	NA	< 0.005

APPENDIX E: GROUNDWATER QUALITY MONITORING DATA

Table E-8-1: Groundwater sampling results for all sites, Groundwater Surveys 12 and 13

Monitoring Round	LocCode	Sampled Date-Time	Ammonia as N	Nitrogen (Total)	Oxides of Nitrogen	Phosphate total (P)	Reactive Phosphorus as P	TSS	TDS	Aluminium (Filtered)	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (hexavalent) (Filtered)	Chromium (Trivalent) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Silver (Filtered)	Vanadium (Filtered)	Zinc (Filtered)	Benzene	Ethylbenzene	Toluene	Xylene Total	TRH C6-C40	Biological oxygen demand (BOD)	E. coli	Dissolved Oxygen (%)	EC (field)	pH (Field)	Redox	Temp
Units	n/a	n/a	mg/l	mg/l																										MPN/ 100mL	% sat	uS/cm	pH_Units	mV	°C
Operations Survey 12	BPGW01	10/10/2023	0.057	0.21	0.095	0.046	0.017	-	1,430	0.238	0.0021	0.00227	<0.001	<0.001	0.0261	0.0013	0.0074	0.703	<0.00004	0.0187	0.0005	<0.0002	0.111	<1	<2	<2	<2	<100	-	-	19.9	3,000	4.69	135.8	30.3
	BPGW07	10/10/2023	0.489	0.81	0.039	0.042	0.017	-	67,100	0.008	0.0142	0.0003	<0.001	<0.01	0.0167	<0.001	0.0009	0.793	<0.00004	0.0189	<0.0001	<0.0005	0.05	<1	<2	<2	<2	<100	-	-	23.2	96,564	5.85	61.2	31.1
	BPGW08A	10/10/2023	0.123	0.17	<0.02	0.04	0.035	-	10,700	0.073	0.0144	0.00051	<0.001	<0.001	0.0564	0.0013	0.0033	4.16	<0.00004	0.0317	<0.0001	0.0005	0.048	<1	<2	<2	<2	<100	-	-	16.3	17,117	4.86	138.7	31.5
	BPGW09	10/10/2023	0.386	0.62	<0.02	<0.01	0.009	-	81,000	<0.005	0.0438	<0.0002	0.002	<0.01	0.0025	<0.001	<0.0002	0.505	<0.00004	0.0013	<0.0001	<0.0005	0.01	<1	<2	<2	<2	<100	-	-	30.2	112,692	6.21	-15.9	30.9
	BPGW18	12/10/2023	0.416	0.57	0.157	0.058	0.005	-	51,800	0.011	0.0029	<0.0002	<0.001	<0.01	<0.0002	<0.001	0.0002	0.178	<0.00004	<0.0005	<0.0001	<0.0005	0.016	<1	<2	<2	<2	<100	-	-	28.3	71,145	6.15	-26.4	30
	BPGW19A	11/10/2023	1.16	2.04	0.078	0.012	0.011	-	56,000	0.021	0.0013	<0.00005	<0.001	0.001	<0.0001	0.0014	<0.0001	0.0388	<0.00004	<0.0005	<0.0001	0.0033	0.002	<1	<2	<2	<2	<100	2.1	<1	3.8	71,895	6.06	-241.5	31.9
	BPGW20	12/10/2023	0.134	0.03	0.31	0.018	0.006	-	930	<0.005	0.0035	<0.00005	<0.001	<0.001	0.0037	<0.0005	<0.0001	0.0583	<0.00004	0.002	<0.0001	0.0002	0.011	<1	<2	<2	<2	<100	-	-	14.8	1,516	5.48	39.4	33
	BPGW26	11/10/2023	0.309	0.5	<0.02	<0.005	0.004	-	6,050	<0.005	0.004	0.00005	<0.001	<0.001	0.0097	<0.0005	0.0002	2.99	<0.00004	0.001	<0.0001	0.0002	0.008	<1	<2	<2	<2	<100	-	-	4.3	10,178	5.32	73.6	32.2
	BPGW27A	11/10/2023	0.308	0.35	<0.02	0.005	0.005	-	1,440	<0.005	0.0016	<0.00005	<0.001	<0.001	0.0019	0.0008	<0.0001	0.0233	<0.00004	<0.0005	<0.0001	<0.0002	0.006	<1	<2	<2	<2	<100	2.7	<1	5.3	2,565	5.25	57.5	33.4
	BPGW28	12/10/2023	0.876	0.9	0.178	0.076	<0.001	-	74,200	<0.005	0.0152	<0.00005	<0.001	<0.01	0.0002	<0.0005	<0.0001	0.0692	<0.00004	0.0006	<0.0001	0.001	0.003	<1	<2	<2	<2	<100	-	-	16.3	99,575	6.47	-43.1	30.9
	BPGW38A	11/10/2023	0.072	0.09	0.008	0.009	0.009	-	1,050	<0.005	0.0006	0.00401	<0.001	<0.001	0.0006	<0.0005	0.0001	0.0232	<0.00004	<0.0005	<0.0001	0.0003	0.01	<1	<2	<2	<2	<100	-	-	8.1	1,915	5.89	70.2	32.5
	BPGW40	11/10/2023	0.475	0.93	<0.02	<0.025	0.008	-	2,930	<0.005	0.0061	<0.00005	<0.001	<0.001	0.0011	<0.0005	<0.0001	0.132	<0.00004	<0.0005	<0.0001	<0.0002	0.005	<1	<2	<2	<2	<100	-	-	3.9	4,888	6.07	-40	30.9
	BPGW41	12/10/2023	0.704	0.58	0.126	0.027	0.003	-	11,800	0.005	0.0063	<0.00005	<0.001	<0.001	0.0001	0.0008	<0.0001	0.0142	<0.00004	0.0007	<0.0001	0.0006	0.014	<1	<2	<2	<2	<100	-	-	39.1	19,105	6.51	-51.3	29.9
	VWP328	12/10/2023	0.227	0.12	<0.02	<0.005	0.004	-	87,900	<0.005	0.549	<0.0002	<0.001	<0.01	0.0189	<0.001	0.0003	0.409	<0.00004	0.0027	<0.0001	<0.0005	0.007	<1	<2	<2	<2	<100	-	-	49.6	94,583	5.98	-18.9	31.1
	VWP341	10/10/2023	0.638	0.9	<0.02	0.023	0.005	-	2,260	0.006	0.0071	<0.00005	<0.001	<0.001	0.124	<0.0005	0.0002	1.67	<0.00004	0.014	0.0005	0.0003	0.1	<1	<2	<2	<2	<100	-	-	19.8	4,489	5.6	45.8	32.6
Operations Survey 13	BPGW01	2/04/2024	0.02	0.12	0.008	0.029	0.004	-	57	0.044	0.004	<0.00005	<0.001	<0.001	0.0024	<0.0005	0.0002	0.177	<0.00004	0.0006	<0.0001	0.00025	0.004	<1	<2	<2	<2	<100	-	-	2.23	120	5.27	120.2	29.6
	BPGW07	2/04/2024	0.029	0.6	0.003	0.037	0.035	-	68,000	<0.005	0.0148	0.0004	<0.001	<0.001	0.0228	0.002	0.0013	0.971	<0.00004	0.0238	<0.0001	0.0011	0.05	<1	<2	<2	<2	<100	-	-	1.95	96,126	5.69	110.2	30.9
	BPGW08A	2/04/2024	0.114	0.18	<0.002	0.037	0.014	-	3,490	0.005	0.0306	<0.00005	<0.001	<0.001	0.0606	<0.0005	<0.0001	3.26	<0.00004	0.0236	<0.0001	0.00025	0.011	<1	<2	<2	<2	<100	-	-	2.4	6,437	5.57	108.5	31.2
	BPGW09	2/04/2024	0.341	0.4	<0.02	0.017	0.013	-	108,000	<0.005	0.0787	<0.0002	<0.001	0.001	0.0056	<0.001	0.0003	0.638	<0.00004	0.0013	<0.0001	0.00138	<0.005	<1	<2	<2	<2	<100	-	-	1.8	39,675	6	67.3	30.7
	BPGW18	4/04/2024	0.554	0.64	<0.02	0.05	0.001	-	53,500	0.005	0.0107	<0.0002	0.001	<0.01	<0.0002	<0.001	<0.0002	0.0803	<0.00004	0.0015	<0.0001	0.00118	<0.005	<1	<2	<2	<2	<100	-	-	2.49	84,079	6.1	6.2	30.2

Monitoring Round	LocCode	Sampled Date-Time	Ammonia as N	Nitrogen (Total)	Oxides of Nitrogen	Phosphate total (P)	Reactive Phosphorus as P	TSS	TDS	Aluminium (Filtered)	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (hexavalent) (Filtered)	Chromium (Trivalent) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Silver (Filtered)	Vanadium (Filtered)	Zinc (Filtered)	Benzene	Ethylbenzene	Toluene	Xylene Total	TRH C6-C40	Biological oxygen demand (BOD)	E. coli	Dissolved Oxygen (%)	EC (field)	pH (Field)	Redox	Temp
	BPGW19A	4/04/2024	1.64	1.96	<0.02	0.058	0.005	-	56,600	0.014	0.0056	<0.0002	0.002	<0.01	<0.0002	<0.001	<0.0002	0.0497	<0.00004	<0.0005	<0.0001	0.0044	0.009	<1	<2	<2	<2	<100	<1	<1	2.17	87,273	6.03	40	30.8
	BPGW20	3/04/2024	0.104	0.13	<0.002	0.007	0.005	-	442	0.005	0.002	<0.00005	<0.001	<0.001	0.0012	<0.0005	<0.0001	0.0208	<0.00004	0.0009	<0.0001	0.00025	0.003	<1	<2	<2	<2	<100	-	-	2.62	1,142	5.46	57.6	32.9
	BPGW26	4/04/2024	0.188	0.22	<0.002	0.032	0.005	-	4,670	<0.005	0.0028	<0.00005	<0.001	<0.001	0.0073	<0.0005	<0.0001	2.12	<0.00004	0.001	<0.0001	0.00025	0.004	<1	<2	<2	<2	<100	-	-	3.07	10,034	5.38	103	31.6
	BPGW27A	4/04/2024	0.182	0.18	<0.002	0.006	<0.001	-	1,260	<0.005	0.0007	<0.00005	<0.001	<0.001	0.0017	<0.0005	<0.0001	0.0249	<0.00004	0.0005	<0.0001	0.00025	0.003	<1	<2	<2	<2	<100	<1	<1	2.68	2,811	5.11	119.6	33
	BPGW28	3/04/2024	1.11	1.28	<0.02	0.024	0.007	-	78,700	0.023	0.003	<0.0002	<0.001	<0.001	<0.0002	<0.001	0.0005	0.2	<0.00004	<0.0005	<0.0001	0.00188	<0.005	<1	<2	<2	<2	<100	-	-	2.94	117,280	6.38	17.1	30.9
	BPGW38A	3/04/2024	0.04	0.48	0.412	0.02	0.003	-	197	0.005	<0.0002	0.00017	<0.001	<0.001	<0.0001	<0.0005	<0.0001	0.0005	<0.00004	<0.0005	<0.0001	0.00025	0.002	<1	<2	<2	<2	<100	-	-	3.74	4,513	6.11	106	31.5
	BPGW40	3/04/2024	0.514	0.71	<0.02	0.017	0.01	-	2,510	0.008	0.0077	<0.00005	<0.001	<0.001	0.0018	<0.0005	<0.0001	0.154	<0.00004	<0.0005	<0.0001	0.00025	0.003	<1	<2	<2	<2	<100	-	-	2.68	5,186	5.95	46.8	30.4
	BPGW41	3/04/2024	0.736	0.97	<0.02	0.012	<0.01	-	12,900	0.019	0.0046	<0.00005	<0.001	<0.001	<0.0001	<0.0005	<0.0001	0.0155	<0.00004	<0.0005	<0.0001	0.0007	0.001	<1	<2	<2	<2	<100	-	-	2.91	23,167	6.48	29.8	29.8
	VWP328	4/04/2024	0.326	0.48	<0.02	<0.005	0.001	-	73,000	<0.005	0.542	<0.0002	<0.01	<0.01	0.0223	<0.001	<0.0002	0.387	<0.00004	0.003	<0.0001	0.0009	0.006	<1	<2	<2	<2	<100	-	-	2.62	112,575	5.85	1.7	30.8
	VWP341	2/04/2024	0.685	0.7	<0.002	0.015	0.004	-	1,800	0.016	0.0056	<0.00005	<0.001	<0.001	0.168	<0.0005	0.0001	2.67	<0.00004	0.0165	<0.0001	0.00025	0.173	<1	<2	<2	<2	<100	-	-	2.95	3,711	5.46	82.9	33.1