



BLACKTIP ANNUAL ENVIRONMENTAL MONITORING REPORT 2021

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REVISION HISTORY

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00	10/03/22	80	Final Issue

CERTIFICATION

I, Mark Easterbrook, Environment Advisor, 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.



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1. EXECUTIVE SUMMARY

The Blacktip Annual Environmental Performance Report 2021 summarises the environmental performance of the Blacktip Yelcherr Gas Plant (YGP) for the reporting period 1 January 2021 to 31 December 2021.

At times this report provides information required for licence anniversary reporting, the Annual Return, with a 10 Feb 2021 to 9 Feb 2022 period. At other times, information is reported in Financial Year terms, based on NGER reporting. Where anniversary or financial year reporting is used, it is clearly marked.

EPL230 remained in force between 1 January 2020 to 30 August 2020. EPL230-01 (the current licence) was issued to Eni on 31 August 2020 as the most recent amendment to the EPL. This report provides feedback according to the latest version of the licence, EPL230-01.

The Report accompanies the Annual Return, which provides a summary of the compliance against the EPL.

Below is a summary of each section of the report and key findings.

Production


- Gas production was 881.4 MSCM.
- Annual Gas production was 673 ktonnes (estimated as per 2020 conversion factor)
- Condensate production was 10,521 tonnes (estimated as per 2020 conversion factor)

Atmospheric Emissions

- Total greenhouse gas emissions from Yelcherr Gas Plant calculated in the latest NGER reporting period were 50,854 tCO₂-e.
- Total volume of gas flared was 2,549 KSCM, with an average daily rate of 6.98 KSCM/d, compared with 11.6 KSCM/d in 2020.
- All pollutant emissions were within the EPL limits.
- No visible smoke was reported (visible for more than 5 minutes in any 2 hours) during the last 12 months.

Liquid waste discharges – produced water

- Annual shellfish and sediment monitoring and offshore produced water monitoring (for model validation) were conducted in May 2021. The results were consistent across the sampling sites, with little variation between the control and monitoring sites, providing confidence that there are no adverse impacts from produced water discharge.
- Non-compliances with trigger values, as defined under Condition 55 in EPL230, occurred on various occasions. These are shown in Table 9.2.

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- Produced water limits for OIW, Mn, Zn, Benzene, Toluene, Ethylbenzene, and Xylene (m+p) (as stipulated in EPL230-01) were exceeded on occasions. These occasions are shown in Table 9.1.
- It was concluded in 2020 that there is no available technology to reduce BTEX to meet the EPL230-01 limits. An EPL Amendment requesting adjustment of the above parameters has been issued. Eni was in the process of providing clarification information at the time of writing.
- All other parameters were below their respective limits and trigger values, and total poly-aromatic hydrocarbon (PAH) was consistently below 0.04 mg/L.

Liquid waste discharges – treated wastewater

- A total of 1.7 ML of treated wastewater effluent was reused for irrigation.
- Non-compliances with trigger values for oil in water, BOD, TSS, and E.coli, as defined under Condition 55 in EPL230, occurred on various occasions. Further details are found in Table 9.2.
- E.coli and BOD were measured above the EPL limit on 15th December 2021. Further details are available in Table 9.1.
- All other measurements were within the EPL limits.

Liquid waste discharges – stormwater

- Non-compliances with the trigger value for oil in water, as defined under Condition 55 in EPL230, occurred on various occasions.
- Oil in water typically ranged between 0 – 3.2 mg/l.
- Annual chemical characterisation was undertaken in January 2022.

Solid waste

- Blacktip operations generated an approximate total of 86 t of hazardous waste, and 23 tonnes of non-hazardous waste.

Groundwater

- A total of 22 ML was abstracted for potable water use.
- All quarterly monitoring results were within the Australian Drinking Water Guidelines and ANZECC guidelines.


Incidents and non-conformances

There were 16 Non-Conformances recorded. These can be found in Table 9.1.

There were 25 cases where Trigger values were exceeded. These are shown in Table 9.2.

Continuous improvement

- Fugitive emissions survey, to monitor for gas leaks across YGP.

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- Carbon Neutrality Plan developed to support a plant wide Energy Efficiency Assessment

Community initiatives

- The Thamarrurr Rangers are involved with a number of activities around the site, but due to COVID restrictions, these have been limited in 2021.

Summary of environmental impact

- Ongoing monitoring continues to indicate no adverse impact from Blacktip operations.
- Eni will continue to monitor its activities and apply continual improvement measures to ensure the impacts from Blacktip operations are continually maintained as ALARP and acceptable.

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2. INTRODUCTION

2.1 Project background

Eni Australia Limited (Eni) is operator of the Blacktip Gas Project in the Northern Territory. The development consists of a small unmanned offshore wellhead platform, a subsea pipeline bringing whole well stream fluid, (i.e. gas, condensate and produced water) to Yelcherr Beach and the Yelcherr Gas Plant (YGP) near Wadeye (Figure 2.1 and Figure 2.2). The processed gas is exported via an onshore export pipeline, by Australian Pipeline Trust, to the customer, Power and Water Corporation.

Blacktip YGP commenced production on 26 August 2009. The operation of the YGP is licensed under the Environmental Protection Licence (EPL), EPL57, issued by the former Department of Natural Resources, Environment, The Arts and Sport (NRETAS) (now Northern Territory Environment Protection Authority (NT EPA)) on 11 August 2009.

EPL230 was issued to Eni on 21 May 2018 and remained in force until 31 August 2020, when EPL230-01 (the current license) was issued to Eni as the most recent amendment to the EPL.

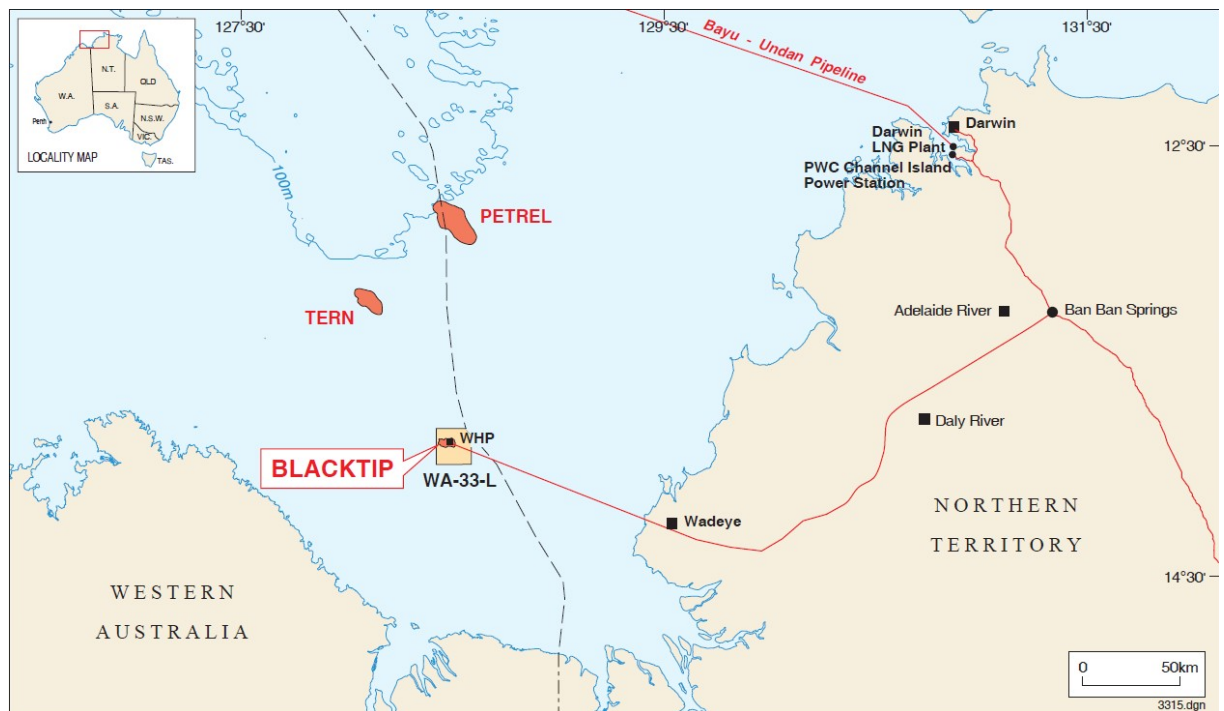



Figure 2.1: Blacktip Field location

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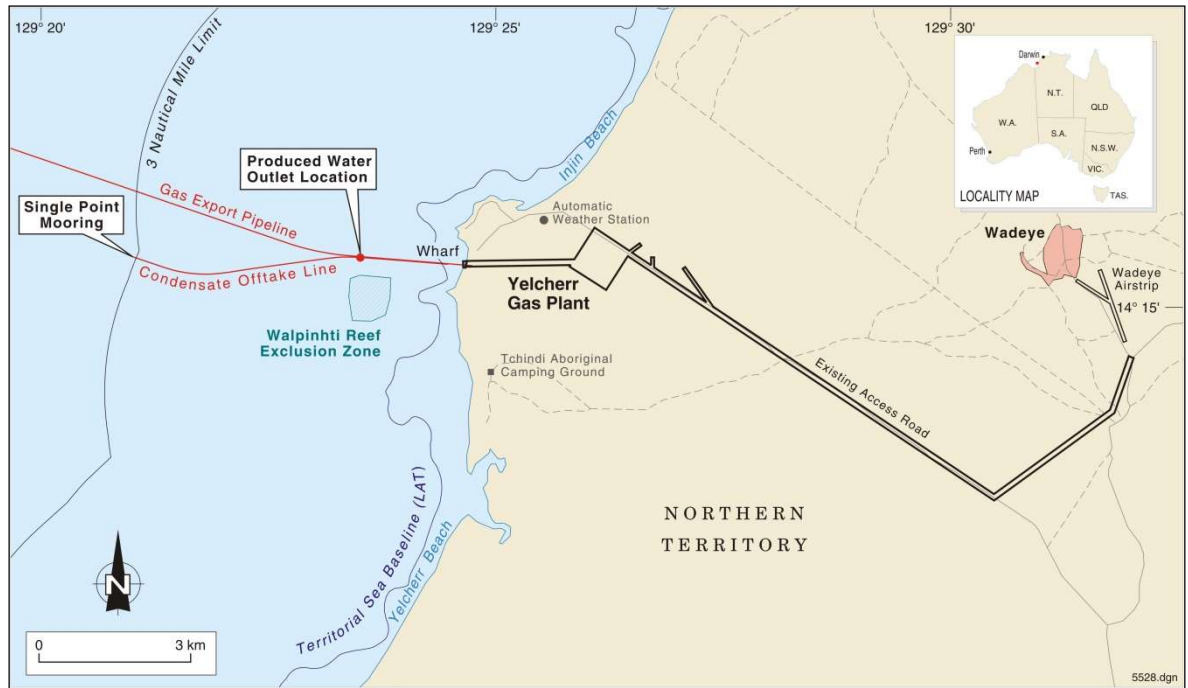



Figure 2.2: Yelcherr Gas Plant and Offshore Pipeline Facilities

2.2 Purpose of the report


This report summarises the environmental performance of the Blacktip YGP for the reporting period 1 January 2021 to 31 December 2021, as required by condition 62 of the EPL.

This report has been prepared in accordance with NT EPA 'Guidance for Reporting on Environmental Monitoring' and the requirements under condition 64 of the EPL, outlined below.

Clause	EPL condition	Section in this report
64.1	include an updated description of gas plant infrastructure and processes	3
64.2	reports on total condensate produced and total gas processed by the gas plant;	4
64.3	reports on the quality of gas received by the plant;	4.4
64.4	includes a tabulation of all monitoring data required as a condition of this licence;	Appendices
64.5	includes a trend analysis and interpretation of all monitoring data required as a condition of this licence;	Various sections and appendices
64.6	includes a long-term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of three years;	Various sections and appendices

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Clause	EPL condition	Section in this report
64.7	reports the total annual emissions for each emission point, as well as for condensate tanks and fugitive emissions.	Appendix A
64.8	reports the frequency and volume of wastewater discharges for the reporting period;	6
64.9	identifies the number of exceedances of trigger values and limits that have occurred during the reporting period, which includes a record of trigger value exceedances in accordance with condition 61;	9
64.10	is prepared in accordance with the requirements of the NT EPA <i>Guideline for Reporting on Environmental Monitoring</i> ;	2.2
64.11	demonstrates continuous improvement in air emissions from the authorised air emissions points identified in Attachment 4;	10
64.12	demonstrates continuous improvement in wastewater quality from the authorised discharge points identified in Attachment 2.	10

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3. OVERVIEW OF YELCHERR GAS PLANT

3.1 General overview

In accordance with condition 64.1 of EPL230-01, this section provides a description of the gas plant infrastructure and processes.

Infrastructure at the YGP includes:

- a gas processing plant consisting of separation, gas dehydration, compression, condensate storage and produced water treatment facilities
- the onshore portion of an 18" carbon steel, multi-phase pipeline bringing produced fluids from the offshore gas field to the YGP, starting from the shore crossing
- the onshore portion of a condensate export pipeline from the condensate storage facilities at the YGP to the shore crossing
- a portion of the onshore gas export pipeline that runs from the gas processing plant to a custody transfer meter at the boundary of the YGP site.

3.2 Plant configuration

After processing, un-odorised natural gas at agreed specifications is delivered to the customer via an onshore export pipeline to a custody transfer meter at the boundary of the YGP, at a maximum delivery rate of 191 TJ/day.

Stabilised condensate is stored on site at the YGP before being exported to the SPM for offload via tankers.

The production life of the field is planned to be 25 years based on initial gas sales contract. The design life of the Blacktip YGP is 30 years.

The entire YGP site occupies an area of 750 m by 750 m, with the main process facility located to the south of the site (occupying an area of approximately 250 m by 380 m) and the accommodation, warehouse, offices and control room to the north (see Figure 3.1). The coordinates of the YGP are shown in Table 3.1.

Table 3.1: YGP Coordinates

Corner	GDA 1994		GDA 1994 MGA Zone 52	
	East	North	mE	mN
W	129°25'52.09"	14°14'33.60"	546 510	8 425 393
N	129°26'05.87"	14°14'13.22"	546 924	8 426 018
E	129°26'26.77"	14°14'26.66"	547 549	8 425 604
S	129°26'12.99"	14°14'47.04"	547 135	8 424 979



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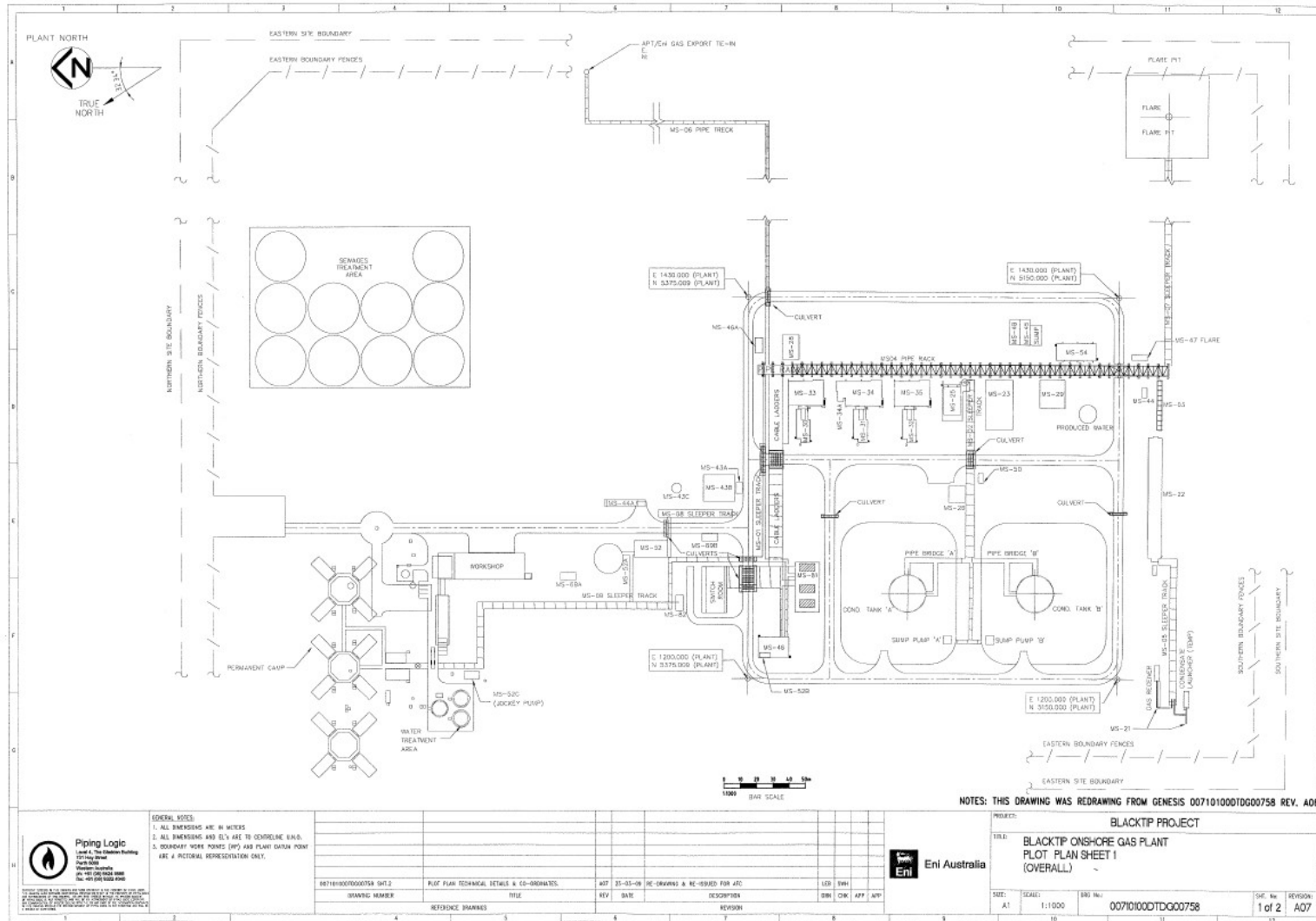




Figure 3.1: Blacktip YGP layout

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3.3 Other facilities

Other key facilities on site include:

- Utilities system – including:
 - Power generation;
 - Compressed air system;
 - Potable water system;
 - Chemical injection;
 - Stormwater drainage;
 - Sewage treatment plant and effluent reuse;
 - Firewater.
- Ancillary buildings – including:
 - Accommodation;
 - Laboratory, workshop and stores;
- Hazardous chemicals storage; and
- Lighting and security.

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4. PRODUCTION

4.1 Overview

The annual production is provided in Table 4.1.

Blacktip is licensed for a maximum scale of 1,055,300 tonnes of gas and 50,900 tonnes of condensate per annum.

Table 4.1: Overview of production

	2019	2020	2021
Annual gas production (KSCM)	1,031,440	946,762	881,400
Annual gas production (t)	790,083	723,326	673,000
Condensate production (t)	11,927	10,615	10,521
Total production (t)	802,010	733,941	683,521

Notes:

Reporting period is from 1 January – 31 December

4.2 Condensate

Two condensate offtakes occurred in February and August 2021. Volumes were 35,928 bbl and 34,887 bbl respectively.

4.3 Gas production


Daily gas production typically ranged between 2.4 and 2.9 MSCM, with a total of 881 MSCM being produced in 2021, a slight decrease from 2020.

4.4 Gas composition

The reservoir fluid properties and contaminants are shown in Table 4.2 and Table 4.3.

Table 4.2: Blacktip reservoir fluid properties

Component	Percentage
CO ₂	0.62 mol%
N ₂	5.88 mol%
Methane	89.06 mol%
Ethane	2.82 mol%
Propane	1.00 mol%
Ibutane	0.12 mol%
Butane	0.23 mol%
Ipentane	0.06 mol%
Pentane	0.05 mol%

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Component	Percentage
Hexanes	0.02 mol%
Heptanes	0.01 mol%
Octanes	0.02 mol%
Nonanes	0.03 mol%
Decanes	0.04 mol%
Undecanes	0.02 mol%
C ₁₂₊	0.01 mol%

Source: Ref. [3], [5]

Table 4.3: Contaminants in Blacktip Gas

Component	Maximum measured
H ₂ S	3.0 ppmv
Mercaptan	<0.5 ppmv
Mercury	0.2 µg/m ³
Radon	222 Bq/m ³
Argon	0.01 mol%
Oxygen	<0.01 mol%
Helium	0.06 mol%
Hydrogen	0.01 mol%
Benzene	0.002 mol%
Toluene	0.002 mol%
Ethyl Benzene	<0.001 mol%
Xylenes	0.001 mol%

Source: Ref. [3], [5]

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5. ATMOSPHERIC EMISSIONS

5.1 Overview of atmospheric emissions

Major sources of atmospheric emissions from the Blacktip YGP are:

- Export gas turbine compressors;
- Gas engine power generators;
- Flaring; and
- Diesel usage.

Fuel usage for the compressors and gas engines is monitored continuously, as are gas quantities flared. Table 5.1 lists the flow meters used for measuring the various gas streams.

Table 5.1: Gas flow meters

Emission Source	Gas Flow Meter	Reference Number
Turbine Compressor	Compressor A	420.1 FIT 161
	Compressor B	420.1 FIT 261
	Compressor C	420.1 FIT 361
Engine Generators	LP Fuel Gas	420.1 FIT 004
Flare	HP Flare	230.1 FIT 008
	LP Flare	230.1 FIT 002
	Fuel Gas Distribution	420.1 FIT 007

Total greenhouse gas emissions from Yelcherr Gas Plant calculated in the latest NGER reporting period were 50,854 tCO₂-e (Ref. [2]).

The GHG intensities for flaring and total emissions, calculated as the ratio of tCO₂-e emitted to tonnes hydrocarbon produced, are 0.010 and 0.084, respectively as reported via NGER. This compares with industry averages of 0.068 and 0.353, respectively (Ref. [6]).

A summary of GHG emissions from the Blacktip YGP is provided in Table 5.2.


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Table 5.2: Greenhouse gas emissions as reported via NGER (Onshore Gas Plant YGP²)

Production for NGER reporting period ¹	2018-2019	2019-2020	2020-2021
Condensate (t)	11,418	11,753	9,999¹
Natural Gas (t)	625,453	761,069	594,231¹
Total hydrocarbons (t)	636,871	772,822	604,230


Key sources ²	Emissions (t CO ₂ -e)			GHG Intensity (emissions/total HC)			
	2018-2019	2019-2020	2020-2021	2018-2019	2019-2020	2020-2021	Industry average
Flaring	8,298	10,180	5,998	0.013	0.013	0.010	0.068
Compressors	35,254	42,496	40,794	0.055	0.055	0.068	-
Generators – Gas	3,663	3,670	3,692	0.006	0.005	0.006	-
Generators - Diesel	160	97	305	-	-	0.001	-
Kerosene and other petroleum-based oils or greases	4	3	4	-	-	0.000	-
Diesel	71	41	45	-	-	0.000	-
Fugitive emissions	13 ⁽³⁾	14	15	0.000	0.000	0.000	
Wastewater	2	2	1	-	-	0.000	--
Total YGP emissions	47,460	56,503	50,854	0.075	0.073	0.084	0.353

Notes:

¹ Taken from NGER submission 000036_DV_PR.HSE.1155.000, Sheet 29 of 55, WHP NGER Summary table (15/10/21)

² For a complete inventory of GHG sources and emissions from other Eni Australia operations and facilities, refer to the NGER report.

³ Reduction in reported fugitive emissions due to change in estimation methodology.

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5.2 Fuel gas consumption

The two main consumers of high pressure (HP) and low pressure (LP) fuel gas are the gas turbine compressors and power generators. The volume of gas consumed as fuel during the reporting period is summarised in Table 5.3.

Table 5.3: Gas consumption at YGP

	2019	2020	2021
Daily fuel gas consumption (KSCM)	77.7	71.8	76.9
Total annual fuel gas consumption (MSCM)	28.4	26.3	28.1
Emissions (tCO ₂ -e)	57,200	53,200	56,800 ¹

Notes:

Reporting period is from 1 January – 31 December

¹ Emissions number derived using the factor that links Total Annual Flaring and Emissions for 2019 and 2020

For 2019 and 2020 the total equivalent greenhouse gas (GHG) emissions were calculated using equations provided by the *National Greenhouse Accounts Factors for Stationary Energy Emissions* (Ref. [1]), as follows:


$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$

Where:

- E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide), from the fuel type (i), i.e. unprocessed natural gas;
- Q_i is the quantity of fuel type (i) (m³);
- EC_i is the energy factor of the fuel type (i), which is given as 39.3 x 10⁻³ GJ/m³ for natural gas;
- EF_{ijoxecis} the emission factor for each gas type (j), measured in kilograms CO₂-e per gigajoule of fuel type (i).

Gas type	Emission factor (Kg CO ₂ -e/GJ)
CO ₂	51.4
CH ₄	0.1
N ₂ O	0.03

For the 2021 period, a ratio developed from 2019 and 2020 was applied to the 2021 figures. The quotient from Total Annual Fuel Gas and Emissions was calculated. This number was multiplied by the 2021 Total Annual Fuel Gas Consumption to estimate the 2021 Emissions. It was not possible to determine these figures from the 2021 NGER report on file.

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5.3 Flaring

The annual volume of gas flared from the past three years is summarised in Table 5.4.

Table 5.4: Gas flared at YGP

	2019	2020	2021
Daily volume of gas flared (KSCM/d)	12.3	11.6	6.98
Total volume of gas flared (KSCM)	4,484	4,261	2,549
Estimated emissions (t CO ₂ -e) ¹	9,700	9,200	5503 ²

Notes:

Estimate to nearest 100 tonnes.

¹ Reporting period is from 1 January – 31 December

² Calculated by developing a ratio between Total Volume flared and Estimated Emissions for 2019 and 2020 and multiplying this by the 2021 Total volume of gas flared (2.15 x 2,549)

For the 2019 and 2020 period, the Total equivalent greenhouse gas (GHG) emissions for flaring were calculated using equations provided by the *National Greenhouse Accounts Factors for Stationary Energy Emissions* (Ref. [1]), as follows:


$$E_{ij} = Q_i \times EF_{ij}$$

Where:

- E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide) flared (CO₂-e tonnes);
- Q_i is the quantity of fuel type (i) flared (tonnes);
- EF_{ij} is the emission factor for each gas type (i) flared.

Gas type	Emission factor (tonnes CO ₂ -e/tonnes of fuel flared)
CO ₂	2.7
CH ₄	0.1
N ₂ O	0.03

For the 2021 period, a ratio developed from 2019 and 2020 was applied to the 2021 figures. The quotient from Total volume of gas flared and Emissions was calculated. This number was multiplied by the 2021 Total volume of gas flared to estimate the 2021 Emissions. It was not possible to determine these figures from the 2021 NGER report on file.

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5.4 Diesel usage

Diesel usage over the reporting period was 129 m³, of which 12.7 m³ was used for stationary plant, 4 m³ for transport purposes and 112.6 m³ of which was used for stationary energy purposes. This equates to GHG emissions of approximately 350 tonnes CO₂-e. This information is drawn from '2021 ENI NGER Calculation'.

Table 5.5: Annual diesel consumption and GHG emissions

	2019 ¹	2020 ¹	2021 ²
Diesel – stationary energy (m ³)	67	27	125
Diesel – mobile plant and transport (m ³)	11	7	4
Emissions (t CO ₂ -e)	212	92	350

Notes:

¹ Reporting period is from 1 January – 31 December

² Reporting period as per NGER from 1 July to 30 June

Total equivalent greenhouse gas (GHG) emissions for diesel consumption was calculated using equations provided by the *National Greenhouse Accounts Factors for Stationary Energy Emissions* (Ref. [1]), as follows:


$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$

Where:

- E_{ij} is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide) from fuel type (i) (CO₂-e tonnes);
- Q_i is the quantity of fuel type (i) (kilolitres);
- EC_i is the energy content factor of fuel type (i) (GJ/kL)
- EF_{ijoxec} is the emission factor for each gas type (j) for fuel type (i).

Gas type	Emission factor (kg CO ₂ -e/GJ)	
	Diesel fuel combusted for transport energy purposes	Diesel fuel combusted for stationary energy purposes
CO ₂	69.9	69.9
CH ₄	0.1	0.1
N ₂ O	0.5	0.2

Energy content factor for diesel	38.6 GJ/kL
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5.5 Stack emission monitoring

Emissions from the export gas turbine compressors and gas engine power generators are sampled and analysed for a number of air emission parameters.

Stack emission monitoring was undertaken between 25 and 27 September 2021. Monitoring scheduled for June 2020 was deferred due to travel restrictions associated with COVID-19.

A summary of the results is provided in Appendix A.

Key results during the reporting period are as follows:

- All pollutant emissions measured were within the EPL limits.
- No visible smoke was reported (visible for more than 5 minutes in any 2 hours) during the last 12 months.


5.6 Fugitive emission monitoring

During November 2021, a fugitive emissions survey was undertaken at the Blacktip Yelcherr Gas Plant. The following conclusions were drawn:

Classification	Gas Leak	Number of Leaks at Source	
		Preliminary Reading	Validation Reading
	[Concentration/Volume]		
< Minor	< 500 ppm	10	10
Minor	≥ 500 ppm to < 5000 ppm	10	10
Significant	≥ 5000 or LEL% > 10%	7	7
Total		27	27

All leaks were quantified and Tag numbers for the affected equipment was recorded. These leaks are listed in the report Bureau Veritas - ENI Australia - Fugitive Emissions Survey November 2021.

Work orders have been raised for inspection and repair of remaining fugitive emission sources.


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5.7 Pollutant inventory reporting

Eni reports emissions to atmosphere and the environment via the National Pollutant Inventory (NPI) and the National Greenhouse and Energy Reporting Scheme (NGERS).

Eni submitted the annual NPI reporting figures via the NPI Online Reporting System on 31 October 2021.

The annual NGERS reporting figures were submitted to the Department of Climate Change on 31 October 2021. Total emissions from Yelcherr Gas Plant during the 2020-2021 NGER reporting period were 51,249 tCO₂-e.

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6. LIQUID WASTE DISCHARGES

6.1 Produced water

Produced water discharge in this reporting period was 10.5 ML.

Annual shellfish and sediment monitoring and offshore produced water monitoring (for model validation) were conducted in May 2021. The results were consistent across the sampling sites, with little variation between the control and monitoring sites, providing confidence that there are no adverse impacts from produced water discharge.

Key findings from produced water monitoring:

- Non-compliances with trigger values, as defined under Condition 55 in EPL230, occurred on various occasions. These are shown in Table 9.2.
- Produced water limits for OIW, Mn, Zn, Benzene, Toluene, Ethylbenzene, and Xylene (m+p) (as stipulated in EPL230-01) were exceeded on occasions. These occasions are shown in Table 9.1.
- There is no available technology to reduce BTEX to meet the EPL230-01 limits;
- All other parameters were below their respective limits and trigger values;
- Total poly-aromatic hydrocarbon (PAH) was consistently below 0.04 mg/L.

Table 6.1 presents the annual produced water discharges for the past three years.

Table 6.1: Produced water discharge annually

	2019	2020	2021
Volume of PW discharged (m ³)	6,039	5,787	10,503
Number of discharge days	25	22	57

Notes:

Reporting period is from 1 January – 31 December

Due to staff transition the data gathering method for 2021 data may be different to the approach used in 2019 and 2020. However, it has been shown that produced water volumes increased in 2021, hence a significant increase in the number of discharge days is expected.


6.1.1 Discharge and routine monitoring

Produced water is sampled and tested on site prior to discharge to ensure parameters are within the limits stipulated in the EPL

Samples are then taken every 1-2 hours to ensure water quality remains within the licence limits. These samples are tested in the site laboratory.

Non-compliances identified against Condition 55 of EPL230:

- pH was identified slightly above the upper limit of 8.5 on 1 occasion. (8.9 on 16/11/2021). Note on the 13th January 2022 pH was noted as 8.8. Although this Monitoring Report outlines calendar year findings, this was reported in the Annual Return as this communicates Anniversary date findings (February to February).

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- Oil in water was recorded above the oil in water trigger value of 6 mg/L on various occasions.

Key results are as follows:

- All oil in water readings were below the oil in water limit stipulated in the EPL.
- Oil in water ranged between 10 and 20 mg/L.
- pH ranged between 6.9 and 8.9 (with two exceedances at 8.7 and 8.9 (June and November));
- EC ranged between 25 and 57 $\mu\text{s}/\text{cm}$;
- Dissolved oxygen ranged between 5 and 10 mg/L;
- Turbidity ranged between 0.1 and 25 NTU.

6.1.2 Chemical characterisation


EPL230 required quarterly characterisation of PW. Sampling was undertaken on 16 February 2021, 19 May 2021, 15 September 2021 and 20 October 2021. These tests are marked 'Additional Analysis' in the laboratory reports.

The new EPL230-01 requires monthly characterisation for the majority of analysis suites. Sampling was undertaken as required. The EPL230-01, introduced in early 2020 had introduced stringent limits. These were unachievable within the existing plant setup. The new limits were based on the ANZECC 80% species level of protection trigger value, as a conservative measure until the mixing zone is validated.

ANZECC trigger values are default guidelines for physical or chemical stressors in waterways (i.e., in the receiving environment) as opposed to discharge streams, and thus direct comparison of discharge water quality with the guideline values does not consider the mitigating effects of dilution, dispersion and/or biodegradation.

Key results from the chemical characterisation throughout 2021:

- With the exception of BTEX, Mn, Zn and pH (see non-compliances outlined below), all measured readings were below the limits stipulated in the EPL.
- Benzene ranged between 590 – 2,700 $\mu\text{g}/\text{l}$ (limit 2000 $\mu\text{g}/\text{l}$)
- Toluene ranged between 300 – 5,800 $\mu\text{g}/\text{l}$ (limit 330 $\mu\text{g}/\text{l}$)
- Ethylbenzene ranged between 92 – 4,000 $\mu\text{g}/\text{l}$ (limit 160 $\mu\text{g}/\text{l}$)
- Xylene ranged between 350 – 2400 $\mu\text{g}/\text{l}$ (limit 150 $\mu\text{g}/\text{l}$)
- Manganese ranged between 0.1 – 2300 $\mu\text{g}/\text{l}$ (limit 80 $\mu\text{g}/\text{l}$)
- Zinc ranged between 0.1 – 310 $\mu\text{g}/\text{l}$ (limit 43 $\mu\text{g}/\text{l}$)
- pH ranged between 6.9 – 8.9 (limit range between 6.5 and 8.5)
- Total poly-aromatic hydrocarbon (PAH) was consistently below 0.04 mg/L.

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The results are presented in Appendix B.

Non-compliances are summarised below and detailed in Section 9.

Non-compliances identified against Condition 28 of EPL230-01:

- Oil in water was recorded above three times the oil in water trigger value of 6 mg/L on various occasions.
- Oil in water was recorded above the trigger value on three or more consecutive sampling occasions.
- BTEX and Mn were recorded above three times the ANZECC 80% species level of protection trigger value on various occasions.

Non-compliances identified against EPL230-01:

- BTEX, pH, Zn, and Mn were measured above the EPL limits in the months shown in tables below (PW02- Metals, PW02- Environmental Parameters, and PW02- Hydrocarbon).

6.1.3 Annual Marine Monitoring

Eni has an annual commitment, set out in *Produced Water Management Plan 000036_DV_EX.HSE.0381.000_A02*, to undertake sediment and shellfish sampling in the vicinity of the produced water pipeline to monitor any impacts on sediment and biota.

Sampling was undertaken in May 2021 in accordance with the *Australian Government National Assessment Guidelines*. Sampling is typically undertaken at the end of the wet season in May when shellfish are still relatively abundant.


The results were consistent across the sampling sites, with little variation between the control and monitoring sites, providing confidence that there are no adverse impacts from produced water discharge.

6.1.4 Produced water model validation

Eni has a commitment in the Produced Formation Water Plan (000036_DV_PR.HSE.1056.000_04) to validate the near field and far field produced water dispersion model.

Offshore monitoring at the produced water outfall was undertaken in November 2020, for the purposes of validating the produced water dispersion model in accordance with the Produced Formation Water Plan. The study report was delivered on the 25th March 2021. The assessment concluded that within the proposed 50m mixing zone, no laboratory parameters exceeded the ANZG (2018) Marine water 99% toxicant DGVs.

This report was submitted to the NT EPA on 30th April 2021 as support for relaxing the BTEX, Zn, and Mn parameters in the Produced Water Discharge stream. This assessment remained open at time of writing.

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6.2 Treated Wastewater Effluent

Wastewater generated at Blacktip YGP is treated in an ABCO Water System 150 EP. Effluent is reused through an irrigation system to land, and a total of 1.7 ML was discharged over the reporting period.

Table 6.2: Treated wastewater effluent reuse

	2019	2020	2021
Effluent reuse (ML)	2.9	2.2	1.7

Notes:

Reporting period is from 1 January to 31 December.

Data was obtained from the Daily Production Report, using cumulative data for the year.

In accordance with the EPL, treated discharged wastewater is sampled and analysed for constituents monthly by an external laboratory to verify compliance against the contaminant limits.

The results are presented in Appendix C.

Non-compliances identified against EPL230:


- Wastewater effluent Total Suspended Solids (TSS) were measured above the trigger value on three occasions: and
- Wastewater effluent TSS were measured above three times above the relevant trigger value on one occasion each; and

Non-compliances identified against EPL230-01:

- E.Coli was measured above the EPL limit on 20 October

Key results are as follows:

- pH measurements ranged between 4 and 8.5, exceeding the limit on the 20 October 2021 and 13 January 2022.
- TSS ranged from <10 mg/L to 30 mg/L
- BOD ranged from 5 mg/L to 29 mg/L, with one licence exceedance on 15 December 2021.
- E.Coli levels typically ranged from 6/100mL MPN to 162/100mL MPN, with one occurrence above 2420/100ml MPN (15 December 2021).

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6.3 Stormwater

Stormwater discharge to the environment includes cooling water from the fire pump testing and stormwater collected from the process skids. Fire pump cooling water is potable water used in a tubular design heat exchanger, where the other medium is coolant. The cooling water does not come into direct contact with the coolant or any other contamination sources and is discharged to grade at SW-01.

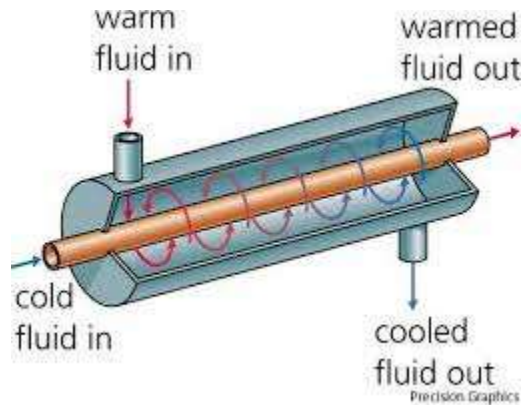



Figure 6.1: Tubular heat exchanger

Process skid stormwater is collected in the Open Drain Sump (ODS) for treatment and sampling prior to manual discharge to grade at SW-03. The ODS typically remains closed for the majority of the dry season and is only opened to grade when rainfall increases during the wet season. Stormwater was discharged from the ODS on only nine occasions in the reporting period.

The results are presented in Appendix D.

The following non-compliances were identified against EPL230:

- Oil in water was measured above trigger value of 1 mg/L on three or more consecutive occasions (Condition 55.1)
- Oil in water was measured above three times the trigger value (Condition 55.2) on two occasions.

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7. SOLID WASTE

Solid waste is managed onsite according to the Blacktip Waste Management Plan (000036_DV_PR.HSE.0832.000).


Domestic waste from the accommodation village and crib room is taken to the local West Daly Regional Shire Council Landfill. General industrial waste and hazardous waste from the plant is transported by a licensed contractor to Darwin for disposal, treatment, recycling, or destruction.

Table 7.1: Waste disposal

	2019	2020	2021
Domestic waste to local landfill (t) <ul style="list-style-type: none"> • Kitchen waste • Accommodation waste • Office waste 	7	4	N/A
Darwin recycling (t) E.g. Scrap metal	6	3	N/A
Darwin disposal – non-hazardous (t) E.g. spent chemicals, cooking oil	17	21	22.7
Darwin disposal – hazardous (t) E.g. waste oil, oily rags, chemical drums and filters	86	54	85.6

Notes:

Reporting period is from 1 January to 31 December.

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8. GROUND WATER

8.1 Ground water use

Groundwater is abstracted for potable water use and ancillary equipment at Yelcherr Gas Plant. The annual groundwater abstraction volumes are summarised in Table 8.1.

There are also two monitoring bores, BH5 and BH7, located at YGP. The location of the abstraction and monitoring bores are shown in Figure 8.1.

Table 8.1: Total annual volume of groundwater abstracted

	2019	2020	2021
Groundwater use (ML)	35.6	16.5	22

Notes:

Reporting period is from 1 January to 31 December.

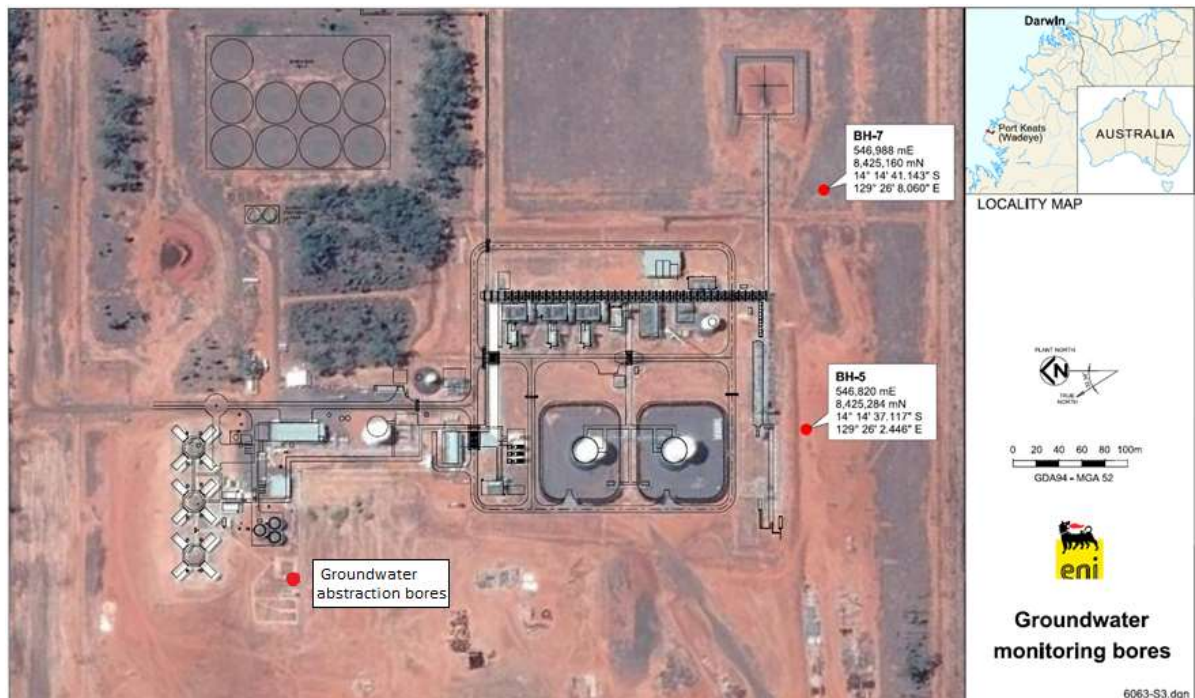



Figure 8.1: Groundwater abstraction and monitoring bores

8.2 Ground water monitoring

Groundwater monitoring was conducted on 16 February 2021, 11 May 2021, 11 August 2021 and 9 November 2021.

The results and trend analysis are presented in Appendix E.

All results were within the Australian Drinking Water Guidelines and ANZECC guidelines for 80% species protection. Quarterly monitoring at both bores measured pH between 4.9 and 7.8.

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Weekly field measurements are also recorded at each groundwater monitoring bore by the Thamarrurr Ranger local indigenous group. The Rangers measure the pH, water level, and electrical conductivity.

8.3 Potable water system upgrade

In June 2019, the potable water system at the accommodation village was upgraded, including laying of new PVC pipework. This resulted in over 60% reduction in groundwater consumption from an average of 150kL/day in 2018 to 45kL/day in 2020.

8.4 Potable water tank replacement

In October 2020, a polyethylene tank was installed to replace the existing leaking potable water tank. The polyethylene tank is expected to be more durable than the existing tank and provide better reliability against leaks and wear and tear.

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9. INCIDENTS AND NON-COMPLIANCES

The Waste Management and Pollution Control Act (NT) and EPL require all non-compliances with the EPL and any potential or actual environmental harm or pollution event to be recorded and reported to NT EPA.

Pollution is defined in the Waste Management and Pollution Control Act (NT) as:

- A contaminant or waste that is emitted, discharged, deposited or disturbed or that escapes; or
- A contaminant or waste, effect or phenomenon, that is present in the environment as a consequence of an emission, discharge, deposition or escape or disturbance of a contaminant or waste.


9.1 Incidents and non-compliances

The Annual Return outlines the compliance assessment against the Environment Licence EPL230 and EPL230-01 as per the Environmental Management Compliance Report 2020 (000036_DV_PR.HSE.1139.000).


Table 9.1 lists the environmental non-compliances recorded between 1 January 2021 and 31 January 2022. These have been raised in the non-compliance register and will be tracked to closure. The 2022 Annual Return is applicable to non-Compliances between 10 February 2021 and 9 February 2022.

Table 9.1: Environmental non-compliances

Date	Condition	Non-compliance
20 Jan 2021	EPL 230-01 Condition 28	The following were detected above the relevant EPL limit: <ul style="list-style-type: none"> • Produced water BTEX • Wastewater E.Coli, pH and TSS <i>This event was reported to NTEPA on 22 February 2021.</i>
16 Feb 2021	EPL 230-01 Condition 28	The following were detected above the relevant EPL limit: <ul style="list-style-type: none"> • Produced water Toluene, Ethylbenzene, Xylene, Mn, Zn. • Wastewater pH and TSS <i>This event was reported to NTEPA on 12 March 2021.</i>
5 Mar 2021	EPL 230-01 Condition 28	The following were detected above the relevant EPL limit: <ul style="list-style-type: none"> • Produced water Toluene, Ethylbenzene, Xylene, Mn. <i>This event was reported to NTEPA on 7 April 2021.</i>
9 Apr 2021	EPL 230-01 Condition 28	The following were detected above the relevant EPL limit: <ul style="list-style-type: none"> • Produced water Toluene, Xylene (m+p), Mn, Zn <i>This event was reported to NTEPA on 1 June 2021.</i>
9 Apr 2021	EPL 230-01 Condition 28	The following were detected below the relevant EPL limit: <ul style="list-style-type: none"> • Wastewater pH <i>This event was reported to NTEPA on 1 June 2021.</i>

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Date	Condition	Non-compliance
12 May 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced water Benzene, Toluene, Xylene (m+p), Zn <p><i>This event was reported to NTEPA on 18 June 2021.</i></p>
12 May 2021	EPL 230-01 Condition 28	<p>The following were detected below the relevant EPL limit:</p> <ul style="list-style-type: none"> Wastewater pH <p><i>This event was reported to NTEPA on 1 June 2021.</i></p>
9 Jun 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced water Benzene, Toluene, Ethylbenzene, Xylene (m+p), Mn, Zn, and pH Wastewater E.coli <p><i>This event was reported to NTEPA on 20 July 2021.</i></p>
4 Aug 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced water Toluene, Xylene (m+p), and Zn, <p><i>This event was reported to NTEPA on 1 October 2021.</i></p>
15 Sept 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced water Toluene, Ethylbenzene, Xylene (m+p), Mn, and Zn, <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>
29 Sept 2021	EPL 230-01 Condition 28	<p>The hose on the produced water skid that connects it to the CETCO unit disconnected.</p> <p>2m³ of Produced Water was lost to ground, at a concentration of approximately 37.6 mg/L oil in water.</p> <p><i>This event was reported to NTEPA on 30 September 2021.</i></p>
19 Oct 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced water Toluene, Ethylbenzene, Xylene (m+p), Zn <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>
20 Oct 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Wastewater Zn and Cu <p>The following were detected below the relevant EPL limit:</p> <ul style="list-style-type: none"> Wastewater pH <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>

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Date	Condition	Non-compliance
16 Nov 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced Water Toluene, Ethylbenzene, Xylene (m+p), Mn, pH <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>
15 Dec 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Wastewater BoD and E.coli <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>
16 Dec 2021	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced Water BoD and E.coli <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>
13 Jan 2022	EPL 230-01 Condition 28	<p>The following were detected below the relevant EPL limit:</p> <ul style="list-style-type: none"> Wastewater pH <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>
13 Jan 2022	EPL 230-01 Condition 28	<p>The following were detected above the relevant EPL limit:</p> <ul style="list-style-type: none"> Produced Water Toluene, Ethylbenzene, Xylene (m+p), Mn, and pH <p><i>This event was not reported to NTEPA</i></p> <p><i>There were resource constraints due to loss of staff member. Effort has been taken to deliver this notification in this Annual Return.</i></p>



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Table 9.2: Trigger value exceedances for the period 1 Jan 2021 to 31 December 2021

The 2022 Annual Return is applicable to non-Compliances between 10 February 2021 and 9 February 2022 and have been included here for completeness


Exceedance	Trigger value	Date and time of occurrence	Date detected and by whom	Actual and potential causes / factors	Risk of environmental harm	Actions undertaken	If no action, why no action was taken
Stormwater (SW-03) OIW measured at 2.9 mg/L	1 mg/L	19/02/2021, 11:00 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	No actions identified that can achieve further reduction.
Stormwater (SW-03) OIW measured at 1.2 mg/L	1 mg/L	20/03/2021, 08:30 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	Oil level (1.2 mg/L) is only slightly above the trigger value (1 mg/L). No actions identified that can achieve further reduction.
Wastewater effluent TSS measured at 30 mg/L	10 mg/L	15-Sep-21	24/02/2022, Mark Easterbrook	Potentially lack of settling time or operational disturbance	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Wastewater effluent BOD measured at 18 mg/L	10 mg/L	15-Sep-21	24/02/2022, Mark Easterbrook	Potentially lack of settling time or operational disturbance	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Produced water OIW measured at 19.4 mg/L	6 mg/L	19-Oct-21	24/02/2022, Mark Easterbrook	Treatment process not designed to treat hydrocarbons to below 6 mg/L.	Intermittent discharge, below OSPAR recommended standard of 30 mg/L and rapid predicted dilution - LOW	Investigate options to further reduce oil in water with treatment vendor - Ongoing	n/a
Produced water TSS measured at 10 mg/L	10 mg/L	19-Oct-21	24/02/2022, Mark Easterbrook	Potentially lack of settling time with flocculant	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Produced water Benzene measured at 1400 µg/l	1300 µg/l	19-Oct-21	24/02/2022, Mark Easterbrook	WWTP not designed to treat Benzene to the levels required	Conservative Benzene parameter	Produced Water dispersion monitoring completed, indications are that dilution is adequate for background marine concentrations. 99% species protection met within the 50m mixing zone	n/a
Wastewater effluent E.Coli measured at 162 / 100 mL MPN	100 / 100 mL MPN	20-Oct-21	24/02/2022, Mark Easterbrook	Recent issues related to DAT tank pumping and chlorine dosing	Low volume of effluent produced intermittent discharge and ongoing groundwater monitoring - LOW	Review WWTP operation with vendor - Ongoing	n/a
Stormwater (SW-03) OIW measured at 3 mg/L	1 mg/L	08/11/2021, 08:30 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	No actions identified that can achieve further reduction.
Stormwater (SW-03) OIW measured at 1.6 mg/L	1 mg/L	25/11/2021, 13:00 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	Oil level (1.6 mg/L) is only slightly above the trigger value (1 mg/L). No actions identified that can achieve further reduction.

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Produced water OIW measured at 19.4 mg/L	6 mg/L	16-Nov-21	24/02/2022, Mark Easterbrook	Treatment process not designed to treat hydrocarbons to below 6 mg/L.	Intermittent discharge, below OSPAR recommended standard of 30 mg/L and rapid predicted dilution - LOW	Investigate options to further reduce oil in water with treatment vendor - Ongoing	n/a
Produced water TSS measured at 10 mg/L	10 mg/L	16-Nov-21	24/02/2022, Mark Easterbrook	Potentially lack of settling time with flocculant	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Produced water Zn measured at 36 mg/L	23 µg/l	16-Nov-21	24/02/2022, Mark Easterbrook	Potential movement of Zn from the reservoir through the process	Following dilution after discharge, the concentration is modelled to be above the 99% species survival rate	Continue to monitor	n/a
Stormwater (SW-03) OIW measured at 3.2 mg/L	1 mg/L	11/12/2021, 13:30 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	No actions identified that can achieve further reduction.
Wastewater effluent TSS measured at 30 mg/L	10 mg/L	15-Dec-21	24/02/2022, Mark Easterbrook	Potentially lack of settling time with flocculant	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Produced water OIW measured at 18.7 mg/L	6 mg/L	16-Dec-21	24/02/2022, Mark Easterbrook	Treatment process not designed to treat hydrocarbons to below 6 mg/L.	Intermittent discharge, below OSPAR recommended standard of 30 mg/L and rapid predicted dilution - LOW	Investigate options to further reduce oil in water with treatment vendor - Ongoing	n/a
Produced water TSS measured at 10 mg/L	10 mg/L	16-Dec-21	24/02/2022, Mark Easterbrook	Potentially lack of settling time with flocculant	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Produced water Zn measured at 36 mg/L	23 µg/l	16-Dec-21	24/02/2022, Mark Easterbrook	Potential movement of Zn from the reservoir through the process	Following dilution after discharge, the concentration is modelled to be above the 99% species survival rate	Continue to monitor	n/a
Produced water Benzene measured at 1600 µg/l	1300 µg/l	16-Dec-21	24/02/2022, Mark Easterbrook	WWTP not designed to treat Benzene to the levels required	Conservative Benzene parameter	Produced Water dispersion monitoring completed, indications are that dilution is adequate for background marine concentrations. 99% species protection met within the 50m mixing zone	n/a
Stormwater (SW-03) OIW measured at 1.6 mg/L	1 mg/L	21/12/2021, 12:00 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	Oil level (1.6 mg/L) is only slightly above the trigger value (1 mg/L). No actions identified that can achieve further reduction.
Stormwater (SW-03) OIW measured at 1.9 mg/L	1 mg/L	09/01/2022, 12:00 CST	25/02/2022, Mark Easterbrook	Treatment process (under/over weir) not designed to treat hydrocarbons to below 1 mg/L.	Intermittent discharge, very low OIW level - LOW	n/a	Oil level (1.9 mg/L) is only slightly above the trigger value (1 mg/L). No actions identified that can achieve further reduction.

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Wastewater effluent TSS measured at 30 mg/L	10 mg/L	13-Jan-22	02/03/2022, Mark Easterbrook	Potentially lack of settling time with flocculant	Intermittent discharge, well-mixed and open receiving environment - LOW	Continue to monitor	n/a
Produced water Zn measured at 36 mg/L	23 µg/l	13-Jan-22	02/03/2022, Mark Easterbrook	Potential movement of Zn from the reservoir through the process	Following dilution after discharge, the concentration is modelled to be above the 99% species survival rate	Continue to monitor	n/a
Produced water Benzene measured at 1900 µg/l	1300 µg/l	13-Jan-22	02/03/2022, Mark Easterbrook	WWTP not designed to treat Benzene to the levels required	Conservative Benzene parameter	Produced Water dispersion monitoring completed, indications are that dilution is adequate for background marine concentrations. 99% species protection met within the 50m mixing zone	n/a
Produced water OIW measured at 8.3 mg/L	6 mg/L	2-Mar-22	03/03/2022, Mark Easterbrook	Treatment process not designed to treat hydrocarbons to below 6 mg/L.	Intermittent discharge, below OSPAR recommended standard of 30 mg/L and rapid predicted dilution - LOW	Accepted the trigger exceedance	n/a

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9.2 Complaints


No complaints were received during the reporting period.

9.3 Audits and inspections

For 3 days, starting the 20th of January 2021, the team underwent a Blacktip EPL EMP Compliance Audit.

The objectives of the audit were:


- Assess compliance with key requirements and intent of the Blacktip Onshore Environmental Management Plan.
- Ensure the EMP is capturing all relevant issues.
- Assess compliance with the conditions of the EPL230-01.
- Provide recommendations to address non-conformances
- The audit identified areas that can be improved to better manage the environmental risks at the YGP, but also overall improvements compared with the last audit. Further details can be found in the document 000036_DV_PR.HSE.1139.000.

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10. CONTINUOUS IMPROVEMENT AND OTHER ACTIVITIES

During the reporting period, Eni engaged in a number of continuous improvement activities including:

- Fugitive emissions survey (November 2021) – a fugitive emissions survey was undertaken to monitor for leaks across the YGP. The survey identified six minor leaks, four of which were repaired immediately.
- Carbon Neutrality Plan 2021 developed. This will support the Energy Efficiency Assessment to be undertaken in 2022.
- Upgrades were investigated for the Blacktip rubbish tip.

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11. COMMUNITY INITIATIVES

Eni and the Thamarrurr Rangers continue to work closely to identify opportunities for local engagement and achieve positive environmental outcomes.


Eni continues to maintain a positive and engaging relationship with the Thamarrurr Rangers, who deliver local environmental monitoring services including

- offshore monitoring of the Single Point Mooring (SPM):
- turtle monitoring
- marine monitoring
- controlled burning,
- groundwater sampling, and
- weed monitoring and spraying.

The SPM monitoring conducted by the Rangers includes inspection of the SPM equipment as well as inspection of the surrounding waters for surface sheen and possible spills. This provides a valuable contribution to the safe offtake of condensate and is an important part of Eni's scheduled maintenance. The Rangers also support the YGP groundwater monitoring, marine monitoring and weed management programs.

The regular monitoring by the rangers allows our site-based personnel to engage with local indigenous community members, providing a greater appreciation of the region and the importance of caring for country.

In 2021, due to the COVID pandemic, Thamarrurr Ranger monitoring activities were suspended periodically.

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12. SUMMARY OF ENVIRONMENTAL IMPACT

This section summarises the environmental impact from the activity during this reporting period. Blacktip Yelcherr Gas Plant has been in operation since 2009. During this time the plant has mostly operated below its full capacity with no major changes to the operations.

Flora and fauna

A firebreak is maintained around the perimeter and the grounds are maintained within the facility. Weed management is ongoing, with monthly weed monitoring and spraying/slashing as required. Otherwise there have been no changes to the overall facility footprint. During the reporting period there have been no reports of injury or death of any fauna.

Marine environment

Annual marine monitoring was conducted in May 2021.

The results indicate compliance with a 50 m mixing zone and that the ANZECC water quality guideline values for 99% species protection are being met at the mixing zone boundary.

Groundwater

Groundwater monitoring indicates no adverse impact from stormwater discharge and groundwater abstraction. The upgrade of the potable water system in 2019 has resulted in dramatic reduction in water consumption of over 50%. Eni will continue to consider measures to use and manage water more efficiently.

Visual amenity and community disturbance


Blacktip has not received any complaints and continues to engage closely with the local community. Eni continues to observe the Land Use agreement and personnel are prohibited from entering culturally sensitive areas.

Atmospheric emissions

Emissions monitoring indicates all emissions concentration limits are within the specified limits. Atmospheric dispersion modelling of NO_x and CO, two exhaust pollutants, predicted concentrations at identified receivers to be very low compared to health-based assessment criteria designed to protect the sensitive receivers in our community. Therefore, the environmental impact associated with emissions is considered low to negligible.


ALARP and acceptable

Eni will continue to monitor its activities and apply continual improvement measures to ensure the impacts from Blacktip operations are continually maintained as ALARP and acceptable.


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13. REFERENCES

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APPENDICES

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APPENDIX A:

AIR EMISSIONS MONITORING PROGRAMME

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Appendix A.1: Summary of stack emission monitoring results from the compressors

	CO	NOx ¹	SOx	Solid particles	VOCs
EPL limit	100 mg/m³	350 mg/m³	100 mg/m³	-	40 mg/m³
12 December 2017					
Compressor A	<3	220	<6	<2	0.27
Compressor B	<3	190	<6	<2	<4
Compressor C	<i>NT</i>	<i>NT</i>	<i>NT</i>	<i>NT</i>	<i>NT</i>
23 August 2018					
Compressor A	<2	340	<i>NT</i>	<i>NT</i>	<0.08
Compressor B	2.5	330	<i>NT</i>	<i>NT</i>	2.1
Compressor C	<i>NT</i>	<i>NT</i>	<i>NT</i>	<i>NT</i>	<i>NT</i>
1 April 2019					
Compressor A	<2	290	7.6	<2	<3
Compressor B	2.9	250	9.1	<3	<4
Compressor C	3.5	250	<6	<2	<3
17 November 2019					
Compressor A	<8	220	<7	7.2	0.48
Compressor B	<8	250	<8	6.9	<4
Compressor C	<8	230	<7	5.6	<3

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	CO	NOx ¹	SOx	Solid particles	VOCs
EPL limit	100 mg/m³	350 mg/m³	100 mg/m³	-	40 mg/m³
June 2020⁶					
Compressor A	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>
Compressor B	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>
Compressor C	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>	<i>NT⁶</i>
5 November 2020					
Compressor A	<3	230	<i>NT</i>	<i>NT</i>	<0.2
Compressor B	<3	210	<i>NT</i>	<i>NT</i>	<0.2
Compressor C	<3	240	<i>NT</i>	<i>NT</i>	0.56
October 2021					
Compressor A	<8	210	<8	27	0.55
Compressor B	<9	230	<8	4.1	0.18
Compressor C	<8	240	<8	20	1.8

Notes:

¹ NOx presented as NO₂ equivalent.


² SOx presented as the cumulative concentration of SO₂ and SO₃.

³ All measurements reported on a dry basis at NTP and corrected to 15% O₂ in accordance with the EPL.

⁴ Measurements above the EPL limit are indicated in red, and measurements above the trigger value are indicated in orange.


⁵ NT = Not tested.

⁶ June 2020 emissions testing was deferred due to COVID travel restrictions.

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Appendix A.2: Summary of stack emission monitoring results from the generators

	CO	NO _x ¹	SO _x	PM	VOCs
EPL limit	1600 mg/m³	2000 mg/m³	100 mg/m³	-	40 mg/m³
9-12 December 2017					
Generator A	1200	1500	1.5	<0.6	0.53
Generator B	1200	1500	<1	<0.5	0.23
Generator C	920	1500	<1	<0.5	0.23
23 August 2018					
Generator A	900	1500	<i>NT</i>	<i>NT</i>	1.6
Generator B	1200	1400	<i>NT</i>	<i>NT</i>	2.7
Generator C	380	1700	<i>NT</i>	<i>NT</i>	1.9
30 March 2019					
Generator A	1100	1500	100 ⁽⁵⁾	<0.7	3.7
Generator B	830	1700	50 ⁽⁵⁾	<0.7	6
Generator C	760	1700	28 ⁽⁵⁾	<0.7	10
17 November 2019					
Generator A	1000	1500	<2	2.1	16
Generator B	760	1400	<2	2.5	21
Generator C	760	1500	<2	7.6	20

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	CO	NOx ¹	SOx	PM	VOCs
EPL limit	1600 mg/m³	2000 mg/m³	100 mg/m³	-	40 mg/m³
June 2020⁷					
Generator A	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>
Generator B	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>
Generator C	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>	<i>NT⁷</i>
5 November 2020					
Generator A	690	1500	<i>NT</i>	<i>NT</i>	0.56
Generator B	680	1500	<i>NT</i>	<i>NT</i>	1.8
Generator C	740	1500	<i>NT</i>	<i>NT</i>	1
October 2021					
Generator A	770	1500	<20	8.9	11
Generator B	750	1500	<20	3.4	36
Generator C⁸	<i>NT⁸</i>	<i>NT⁸</i>	<i>NT⁸</i>	<i>NT⁸</i>	<i>NT⁸</i>

Notes:

¹ NOx presented as NO₂ equivalent.

² SOx presented as the cumulative concentration of SO₂ and SO₃.

³ All measurements reported on a dry basis at NTP and corrected to 15% O₂ in accordance with the EPL.


⁴ Measurements above the EPL limit are indicated in red, and measurements above the trigger value are indicated in orange.

⁵ Emissions sampling provider advised that levels of methane (160-200mg/m³) can cause an interference with the SO₂ cell of the analyser

⁶ NT = Not tested.

⁷ June 2020 emissions testing was deferred due to COVID travel restrictions.

⁸ Gas Engine Generator No.3 (C) was not operational due to unplanned maintenance


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Appendix A.3: Air emissions annual pollutant mass inventory (Source – NPI (Appendix C) and 2021 NGER report)

Atmospheric Emission Points			Annual Pollutant Mass (t)								
Point ID	Description		SO ₂	NO _x	CO	VOC	PM ₁₀	CO ₂	CH ₄	N ₂ O	CO ₂ -e
A01 A02	High Pressure Flare Low Pressure Flare Flare Fuel Gas	2018-2019	0.06	4.4	26	44	0	7,917	11.7	0.3	8,298
		2019-2020	0.08	5.4	32	54	0	9,712	14.4	0.4	10,180
		2020-2021	0.05	3.1	18	31	0	5,664	279	54.5	5,998
A03 A04 A05	Gas Compressor A Gas Compressor B Gas Compressor C	2018-2019	0.2	125	40	1	0.9	35,165	3	0.07	35,254
		2019-2020	0.3	160	48	1	1.1	42,388	3	0.08	42,496
		2020-2021	0.3	172	48	1.2	1.1	40,691	79	23	40,794
A06 A07 A08	Engine Generator A Engine Generator B Engine Generator C	2018-2019	0.03	347	19	4	<0.003	3,653	0.28	0.007	3,663
		2019-2020	0.02	191	19	4	<0.003	3,661	0.28	0.007	3,670
		2020-2021	0.02	130	19.7	4.2	2.7	3,682	7	2	3,691
A09	Emergency Diesel Generator limits	2018-2019	<0.001	3.1	0.8	0.08	0.01	159	0.009	0.002	160
		2019-2020	<0.001	1.9	0.5	0.05	0.06	97	0.006	0.001	97
		2020-2021	0.002	5.9	1.6	0.15	0.1	303	0.43	0.87	305
-	Condensate Tank vents limits	2018-2019	- ²	- ²	- ²	- ²	0	-	-	-	-
		2019-2020	- ²	- ²	- ²	- ²	0	-	-	-	-
		2020-2021	- ²	- ²	- ²	- ²	0	-	-	-	-


¹ SO_x, NO_x and CO figures are as per the NPI reports and associated estimation techniques, and CH₄, N₂O and CO₂ are as per NGER reports and associated estimation techniques.

² Not available or below threshold (i.e. for NPI substances, SO₂, NO_x, CO).

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APPENDIX B:

PRODUCED WATER MONITORING


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Routine produced water discharge sampling and analysis

	Volume	pH	EC	DO	Temp	Turbidity	OIW
Equipment	Flowmeter	PC2700	PC2700	HACH DR900	PC2700	HACH 2100Q	Horiba
Units	m ³	pH	µs/cm	mg/L	°C	NTU	mg/L
EPL Trigger Value	-	-	-	-	-	-	6
EPL Limit	-	6.5-8.5	-	-	-	-	25
3 January 2021	95.4	8	27.79	1.21	34	105	4.3
12 January 2021	205	6.853	26.12	3.7	30.4	33.8	7.9
24 January 2021	210.1	7.3	29	1.3	29	50.4	12.6
2 February 2021	174.3	8.2	33.51	4.2	29.9	16	10.2
16 February 2021	327.5	7.9	26.9	0.69	27	18.6	8.4
22 February 2021	167	8.5	33	8.1	22	1.72	0.3
5 March 2021	219	8					5.8
14 March 2021	204.5	7.85	42.2	5.8	29.4	1.7	0.4
22 March 2021	139.4	6.63	41.67	4.1	26.5	4.95	3.4
30 March 2021	261.6	7.1	11.5	2	29	1.18	0
9 April 2021	381.3	8.3	48.67	1.06	30.7	12.2	1.2
23 April 2021	236	7.4	49.7	0.63	31	2.96	18.1
28 April 2021	61	7.43	52.2	4.6	29.3	16.2	12.1
10 May 2021	314.7	7.66	5	4	28	2.68	6.8
22 May 2021	165.9	8.497	52.67	2.6	26.2	12.2	14.9
27 May 2021	142.9	8.41	55.1	6	27.4	1.28	2.1
30 May 2021	158.4	8.48	133.1	3.4	25.9	18.9	7.8
3 June 2021	134.5	8.29	558.8	7.2	28.2	26.3	17.4
8 June 2021	152.5	8.4	56.4	4.8	25	0.92	2.6
13 June 2021	135.8	8.4	57.45	2.8	26.5	1.78	4.1
19 June 2021	162.1	8.4	57.6	0.17	29	3.65	4.8
24 June 2021	157.22	8.2	57.5	0.49	25.6	4.83	2.4
29 June 2021	141.2	7.21	59.72	1.16	29	3.37	1
9 July 2021	238	8.261	58.2	4.6	28.5	12.7	10.2
18 July 2021	190.7	7.54	59.8	3.2	27.7	15.8	16.7
28 July 2021	285.8	8.42	61.2	6.2	28.1	32.9	8.1
3 August 2021	70.55	8.46	61.3	NA ⁵	27.9	25.4	17.1

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	Volume	pH	EC	DO	Temp	Turbidity	OIW
Equipment	Flowmeter	PC2700	PC2700	HACH DR900	PC2700	HACH 2100Q	Horiba
Units	m ³	pH	µs/cm	mg/L	°C	NTU	mg/L
EPL Trigger Value	-	-	-	-	-	-	6
EPL Limit	-	6.5-8.5	-	-	-	-	25
4 August 2021	272.7	8.32	62.3	NA ⁵	28.6	4.7	1
9 August 2021	102	8.15	58.5	NA ⁵	27.2	3.06	0.8
13 August 2021	138.1	8.16	58.3	NA ⁵	29.5	1.2	2.3
16 August 2021	137	8.34					4.6
21 August 2021	153.8	8.14	57.6	NA ⁵	29.8	3.9	15.3
24 August 2021	92.8	8.4	56.5	NA ⁵	27	18.2	12.1
28 August 2021	99.8	8.4	59.9	NA ⁵	28.7	21.6	0.5
30 August 2021	62.5	8.15	57.4	NA ⁵	30	19.7	15
3 September 2021	70.7	8.48	57.4	NA ⁵	26.3	6.1	2
10 September 2021	81.4	8.06	56.59	NA ⁵	28.4	10.8	0.8
27 September 2021	259.8	7.51	43.5	NA ⁵	29	16.5	7.5
6 October 2021	177.4	8.14	33.7	NA ⁵	29.7	3.83	4.2
9 October 2021	135.5	7.93	35.2	3.7	29.6	18.8	9.9
11 October 2021	154.2	8.06					6.8
21 October 2021	223.7	6.6	44.5	1.8	28	16.1	13.5
24 October 2021	138.3	8.1	33.7	4.1	31	9.84	13
28 October 2021	134.4	8.3	31.9	NA	28.9	3.81	10.1
31 October 2021	96.91	8.4	33.8	1.2	25.2	41.2	14.5
6 November 2021	124.1	8.1	55	0.6	29	29.9	11.9
16 November 2021	346.2	7.742	0.92	301	27.4	15.1	4.9
18 November 2021	219.2	7.04	35.8	3.7	29.6	18.8	18.1
22 November 2021	136.7	6.51	56	129	32	25	19
26 November 2020	120.1	7.74	59.9	2.7	30.7	15.6	13.2
29 November 2021	126.5	7.8	56	3.3	28	26	12.9
4 December 2021	107.9	7.72	1087	8.0	29.2	4.45	17.8
11 December 2021	65.4	6.8	58	21	16.2	16.2	9.9
16 December 2021	137.34	7.66	61.1	NA	33.6	16.7	18.6
19 December 2021	90.6	6.7	38.22	NA	38.1	7.16	7.0

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	Volume	pH	EC	DO	Temp	Turbidity	OIW
Equipment	Flowmeter	PC2700	PC2700	HACH DR900	PC2700	HACH 2100Q	Horiba
Units	m ³	pH	µs/cm	mg/L	°C	NTU	mg/L
EPL Trigger Value	-	-	-	-	-	-	6
EPL Limit	-	6.5-8.5	-	-	-	-	25
22 December 2021	114.6	8.338	61.34	NA	31.2	22.7	8.6
26 December 2021	174	8.44	61.8	8.3	30	10.1	1.7
29 December 2021	158	8.38	632.9	4.1	26	0.71	4.2
Total	9773						

Notes:


¹ This table lists the discharges between 1 January- 31 December.

² Values above the EPL limit are shown in **red** text. Values above the trigger value are shown in **orange** text.

³ All routine analyses conducted in the site laboratory

⁴ Invalid value recorded

⁵ During August and September the ampules required to take the Dissolved Oxygen measurements were unavailable

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Produced water sampling and analysis

	Unit	Frequency	ANZE CC 80%	EPL230-01 limit	Trigger value	20 Jan 2021	16 Feb 2021	5 Mar 2021	9 Apr 2021	12 May 2021	9 June 2021	9 July 2021	4 Aug 2021	15 Sept 2021	19 Oct 2021	16 Nov 2021	16 Dec 2021
ENVIRONMENTAL PARAMETERS																	
pH	-	On discharge	-	6.5-8.5	-	6.9	7.7	8.2	8.0	8.0	8.7	8	8.3	7.8	8.1	8.9	8.1
EC	µs/cm	On discharge	-	-	-	25300	28000	36000	45500	50700	54,200	56,000	57	52,100	38,100	25,600	57,400
Turbidity	NTU	On discharge	-	-	-	9	12	3	25	<1	3	43	7	<1	9	16	4
DO	mg/L	On discharge	-	-	-	7	7	8	8	7	10	6	10	10	8	7	5
OIW	mg/L	On discharge	-	25	6	20.1	16.2	13.8	11.5	12.8	10.5	7.2	18.1	18.9	19.4	18.9	18.7
TSS	mg/L	Monthly	-	50	10	30	50	<10	<10	<10	<10	30	<10	<10	10	20	10
TDS	mg/L	Quarterly	-	-	-	16400	1800	2.34%	31600	35700	38,200	36,500	41,200	37,700	28,200	17,500	40,300
BOD	mg/L	Quarterly	-	-	-	8.2	84.2	91.8	80.4	93.2	98.7	51.7	98.9	82.7	27.6	83	69.8
TOC	mg/L	Quarterly	-	-	-	509	509	473	361	451	451	761	854	607	1,220	666	966
COD	mg/L	Quarterly	-	-	-	1980	1880	2000	1820	2140	2,720	3,360	3,340	2,600	4,100	2,280	3,780
NUTRIENTS																	
NOx-N	mg/L	Quarterly	-	-	-	NT	<0.005	NT	NT	NT	NT	NT	0.01	0.009	0.006	<0.005	
NO3-N	mg/L	Quarterly	-	-	-	NT	<0.005	NT	NT	NT	NT	NT	<0.005	0.006	<0.005	<0.005	
NO2-N	mg/L	Quarterly	-	-	-	NT	<0.005	NT	NT	NT	NT	NT	0.015	<0.005	<0.005	<0.005	
Ammoniacal N	mg/L	Quarterly	1.7	-	-	NT	16.8	NT	NT	NT	NT	NT	29	9.0	18	11	
TP	mg/L	Quarterly	-	-	-	NT	0.045	NT	NT	NT	NT	NT	<0.05	<0.05	<0.05	<0.05	
TN	mg/L	Quarterly	-	-	-	NT	16.8	NT	NT	NT	NT	NT	31	16	22	13	
HYDROCARBONS																	
vTRH(C6-10)/BTEX																	
TRH C6-C9	µg/L	-	-	-	-	14000	18000	12000	7700	19000	18,000	23,000	3000	7,600	16,000	12,000	11,000
TRH C6-C10	µg/L	-	-	-	-	17000	22000	13000	8100	22000	19,000	24,000	3500	8,400	17,000	16,000	11,000



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	Unit	Frequency	ANZE CC 80%	EPL230-01 limit	Trigger value	20 Jan 2021	16 Feb 2021	5 Mar 2021	9 Apr 2021	12 May 2021	9 June 2021	9 July 2021	4 Aug 2021	15 Sept 2021	19 Oct 2021	16 Nov 2021	16 Dec 2021
TRH C6-C10 less BTEX	µg/L	-	-	-	-	8100	14000	6500	3500	10000	7,000	12,000	65	3,700	8,700	12,000	4,700
Benzene	µg/L	Monthly	1300	2000 ⁽⁶⁾	1300	1700	1800	1400	1900	2500	2,700	2,900	1,400	880	1,400	590	1,600
Toluene	µg/L	Monthly	330	330 ⁽⁶⁾	-	4500	3700	3000	2000	5800	5,500	6,300	1400	2,300	3,700	1,900	3,300
Ethylbenzene	µg/L	Monthly	160	160 ⁽⁶⁾	-	440	4000	300	120	540	620	460	92	250	520	290	300
m+p-xylene	µg/L	Monthly	150	150 ⁽⁶⁾	-	1700	1700	1300	430	2200	2,400	1,700	350	930	2,000	1,000	1,100
o-xylene	µg/L	Monthly	-	-	-	600	600	490	160	740	830	580	130	350	690	330	400
naphthalene	µg/L	Monthly	120	120 ⁽⁶⁾	-	44	36	25	<10	39	<100	42	<10	21	64	33	40
svTRH (C10-C40)																	
TRH C10-C14	µg/L	-	-	-	-	59000	59000	43000	50000	47000	52,000	55,000	34,000	51,000	68,000	22,000	63,000
TRH C15-C28	µg/L	-	-	-	-	7800	3600	6400	4800	4900	5,400	4,800	4,100	5,700	7,300	3,000	6,100
TRH C29-C36	µg/L	-	-	-	-	<100	<100	<100	<100	<1	<100	<100	<100	<100	<100	<100	<100
TRH >C10-C16	µg/L	-	-	-	-	12000	8000	11000	8200	9700	8,800	8,400	6,800	8,400	12,000	5,000	9,000
TRH >C10-C16 less Napth	µg/L	-	-	-	-	12000	8000	11000	8200	9600	8,800	8,300	6,800	8,400	12,000	4,900	9,000
TRH >C16-C34	µg/L	-	-	-	-	1900	480	1600	900	490	1,300	1,100	750	1,300	1,900	790	800
TRH >C34-C40	µg/L	-	-	-	-	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Aromatic & Aliphatic TPH																	
TPH >C16-C35 Aliphatic	µg/L	Monthly	-	-	-	100	<100	<100	<1000	<500	<200	500	<100	<100	110	<100	<100
TPH >C35 Aliphatic	µg/L	Monthly	-	-	-	<100	<100	<100	<1000	<500	<200	<100	<100	<100	<100	<100	<100
TPH C16-C35 Aromatic	µg/L	Monthly	-	-	-	<50	<50	50	<500	<500	<100	NT	6300	1,000	920	400	2,300
Polycyclic Aromatic Hydrocarbons																	
Naphthalene	µg/L	Monthly	120	120 ⁽⁶⁾	-	12	26	20	<1	17	4	26	3	<1	29	18	30



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	Unit	Frequency EPL230-01 ⁶	ANZE CC 80%	EPL230-01 limit	Trigger value	20 Jan 2021	16 Feb 2021	5 Mar 2021	9 Apr 2021	12 May 2021	9 June 2021	9 July 2021	4 Aug 2021	15 Sept 2021	19 Oct 2021	16 Nov 2021	16 Dec 2021
Acenaphthylen e	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<10
Acenaphthene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Fluorene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	1	<1	<1
Phenanthrene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Anthracene	µg/L	Monthly	7	7 ⁽⁶⁾	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	Monthly	2	2 ⁽⁶⁾	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pyrene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chrysene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	-	-	-	-	<0.1	<1	<1	<2	<1	<2	<2	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	Monthly	0.7	0.7 ⁽⁷⁾	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	-	-	-	-	<0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	-	-	-	-	<0.1	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Total +ve PAHs	µg/L	Monthly	-	-	-	0.1	26	20	72	17	3.7	26	0	0	30	18	30
PHENOLS																	
Phenol	µg/L	Monthly	1200	1200 ⁽⁷⁾	-	1800	<1	400	380	610	560	510	300	640	790	140	500



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2-Chlorophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	<1	<1	<1	<1	<1	<10	<1	<1	<1
4-Chloro-3-Methylphenol	µg/L	Quarterly	-	-	-	<5	<5	<50	<50	<5	<5	<5	<5	<50	<5	<5	<5
2-Methylphenol (O-Cresol)	µg/L	Quarterly	-	-	-	1400	540	580	960	1000	910	860	490	1000	1500	380	1100
3/4-Methylphenol(m/p-Cresol)	µg/L	Quarterly	-	-	-	2100	460	400	560	860	730	700	410	660	1200	210	490
2-Nitrophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	<1	<1	<1	<1	<1	<10	<1	<1	<1
2,4-Dimethylphenol	µg/L	Quarterly	-	-	-	<1	380	400	370	780	660	600	350	610	<1	89	780
2,4-Dichlorophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	<1	<1	<1	<1	<1	<10	<1	<1	<1
2,6-Dichlorophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	<1	<1	<5	<5	<5	<10	<1	<1	<1
2,4,5-Trichlorophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	<1	<1	910	860	490	<10	<1	<1	<1
2,4,6-Trichlorophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	<1	<1	730	700	410	<10	<1	<1	<1
2,4-Dinitrophenol	µg/L	Quarterly	-	-	-	<20	<20	<200	<20	<20	<1	<1	<1	<200	<20	<20	<20
4-Nitrophenol	µg/L	Quarterly	-	-	-	<20	<20	<200	<20	<20	660	600	350	<200	<20	<20	<20



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	Unit	Frequency	ANZE CC 80%	EPL230-01 limit	Trigger value	20 Jan 2021	16 Feb 2021	5 Mar 2021	9 Apr 2021	12 May 2021	9 June 2021	9 July 2021	4 Aug 2021	15 Sept 2021	19 Oct 2021	16 Nov 2021	16 Dec 2021
2,3,4,6-Tetrachlorophenol	µg/L	Quarterly	-	-	-	<1	<1	<10	0	<1	<1	<1	<1	<10	<1	<1	<1
2-methyl-4,6-Dinitrophenol	µg/L	Quarterly	-	-	-	<10	<10	<100	<10	<10	<10	<10	<10	<100	<10	<10	<10
Pentachlorophenol	µg/L	Quarterly	55	55 ⁽⁷⁾	-	<5	<5	<50	<5	<5	<5	<5	<5	<50	<5	<5	<5
MBA	µg/L	Quarterly	-	-	-	NT	NT	NT	NT	NT	NT	NT	NT			<0.1	<0.1
METALS																	
Al	µg/L	Quarterly	-	-	-	20	<10	40	20	180	50	60	10	<10	120	<0.1	20
Ar	µg/L	Quarterly	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.01	<1
Ba	µg/L	Quarterly	-	-	-	48000	59000	90000	110000	97000	110,000	140,000	150,000	140,000	75,000	57	110,000
Be	µg/L	Quarterly	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.01	<0.5
B	µg/L	Quarterly	-	-	-	780	1400	1200	1400	1500	1,900	1,800	1,900	2,100	1,100	1	2,200
Cd	µg/L	Quarterly	36	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.002	<0.1
Co	µg/L	Quarterly	150	-	-	<1	<1	<1	<1	<1	1	<1	<1	2	<1	<0.01	<1
Cu	µg/L	Quarterly	8	8 ⁽⁷⁾	2 ⁽⁷⁾	4	5	<1	<1	<1	<1	<1	<1	<1	<1	<0.1	<1
Cr	µg/L	Quarterly	176	-	-	<1	2	1	1	2	4	3	2	4	1	na	5
Fe	µg/L	Quarterly	-	-	-	1800	2000	510	2700	380	2,000	3,500	2,400	340,000	790	3	410
Hg	µg/L	Quarterly	1.4	-	-	0.66	1.1	0.63	0.60	0.21	0.28	0.3	0.32	3	1.4	<0.01	<0.05
Mg	µg/L	Quarterly	-	-	-	83 ⁽⁴⁾	150 ⁽⁴⁾	NT	110 ⁽⁴⁾	140 ⁽⁴⁾	NT	NT	NT			22	40
Mn	µg/L	Monthly	80	80 ⁽⁷⁾	-	20	230	190	340	31	180	290	250	2300	30	0.1	27
Mo	µg/L	Quarterly	-	-	-	<1	2	<1	<1	1	<1	<1	<1	<1	2	<0.005	1
Pb	µg/L	Quarterly	12	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.05	<1
Ni	µg/L	Quarterly	560	-	-	5	5	7	6	5	4	5	5	24	5	<0.1	<1
Se	µg/L	Quarterly	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<0.05	1

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	Unit	Frequency	ANZE CC 80%	EPL230-01 limit	Trigger value	20 Jan 2021	16 Feb 2021	5 Mar 2021	9 Apr 2021	12 May 2021	9 June 2021	9 July 2021	4 Aug 2021	15 Sept 2021	19 Oct 2021	16 Nov 2021	16 Dec 2021
Sn	µg/L	Quarterly	-	-	-	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<0.01	<1
Zn	µg/L	Monthly	43	43 ⁽⁷⁾	23 ⁽⁷⁾	36	310	37	55	46	44	43	52	60	73	<0.1	36
RADIUM																	
Ra-226	mBq/L	Annual	-	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT		
Ra-228	mBq/L	Annual	-	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT		

¹ Trigger value for 80% species protection from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1. Updated values (2018) have been used where available.


² Values above the EPL limit are shown in red text. Values above the trigger value or ANZECC 80% species protection guideline value are shown in orange text.

³ All analyses conducted at an external laboratory with NATA accreditation or to NATA standards.


⁴ Sample taken from slugcatcher sample point.

⁵ Sample taken on 21 October 2020 but no produced water discharge.

⁶ In force from 31 August 2020. EPL230-01 was issued on 31 August 2020. The previous EPL230 limits and monitoring requirements remained in force until EPL230-01 was issued.


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APPENDIX C: WWTP SAMPLING


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Treated wastewater effluent monitoring results


Date sampled	Unit	Frequency	EPL limit	Trigger value	20 Jan 2021	17 Feb 2021	10 Mar 2021	14 Apr 2021	12 May 2021	9 June 2021	14 Jul 2021	11 Aug 2021	15 Sep 2021	20 Oct 2021	9 Nov 2021	15 Dec 2021
BACTERIOLOGICAL																
Total coliforms	/100mL MPN	M	-	-	>2420	2420	>2420	>2420	105	>2420	9	980	1200	>2420	>816	>2420
E Coli	/100mL MPN	M	1000	100	>2420	7	15	141	1	>2420	770	1,300	205	>2420	>2420	>2420
Enterococci	/100mL MPN	M			>2420	248	>2420	1	22	1050	<1	<1	<1	162	36	>2420
ENVIRONMENTAL PARAMETERS																
pH	-	M	6.5-8.5	-	6.4	6.4	6.7	6.0	5.3	7.1	6.3	6.9	7.5	6.4	6.7	6.6
EC	µs/cm	M	-	-	843	674	811	862	955	1,040	938	973	1430	890	728	862
Turbidity	NTU	NR	-	-	210	1	<1	2	2	13	<1	8	23	3	5	12
DO	mg/L	NR	-	-	4	5	5	8	7	9	7	7	8	5	7	1
OIW	mg/L	M	10	6	1.5	2.1	3.2	2.3	3.4	4.2	2.1	6.9	5.9	8.1	8	7.1
TSS	mg/L	M	30	10	400	10	<10	<10	<10	30	<10	10	30	<10	<10	30
TDS	mg/L	M	-	-	500	380	528	500	560	560	520	580	840	510	420	420
BOD	mg/L	M	20	10	11.2	3.6	6.7	5.2	2.3	25.4	2.4	4.1	18	6	9.7	29.8
TOC	mg/L	M	-	-	17	11	18	10	12	29	8	13	31	11	13	17
COD	mg/L	NR	-	-	180	20	60	40	20	80	<20	40	80	40	40	140
NUTRIENTS																
NOx-N	mg/L	NR	-	-	27	18	16	19	28	19	25	25	13	28	13.2	<0.005
NO3-N	mg/L	NR	-	-	27	18	16	19	28	18	25	25	12	28	13.2	<0.005
NO2-N	mg/L	NR	-	-	0.13	0.016	0.026	0.036	0.029	0.53	0.023	0.059	0.34	0.02	0.065	<0.005
Ammoniacal N	mg/L	M	-	-	2.5	1.2	2.9	2.5	2.8	16	3.9	2.7	12	3.5	4.73	8.66
TP	mg/L	M	-	-	25	0.1	0.3	0.2	0.3	2.1	0.1	0.8	2.7	1.5	1.98	1.26
TN	mg/L	M	-	-	66	21	18	28	25	46	30	29	25	37	17.9	10.9
HYDROCARBONS																
TRHC6-C9	µg/L	Q	-	-	NT	<10	NT	<10	NT	NT	<10	<10	NT	<10	<10	NT

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Date sampled	Unit	Frequency	EPL limit	Trigger value	20 Jan 2021	17 Feb 2021	10 Mar 2021	14 Apr 2021	12 May 2021	9 June 2021	14 Jul 2021	11 Aug 2021	15 Sep 2021	20 Oct 2021	9 Nov 2021	15 Dec 2021
TRHC6-C10	µg/L	Q	-	-	NT	<10	NT	<10	NT	NT	<10	<10	NT	<10	<10	NT
TRHC6-C10 less BTEX (F1)	µg/L	Q	-	-	NT	<10	NT	<10	NT	NT	<10	<10	NT	<10	<10	NT
Benzene	µg/L	Q	-	-	NT	<1	NT	<1	NT	NT	<1	<1	NT	<1	<1	NT
Toluene	µg/L	Q	-	-	NT	<1	NT	1	NT	NT	1	1	NT	<1	<1	NT
Ethylbenzene	µg/L	Q	-	-	NT	<1	NT	<1	NT	NT	<1	<1	NT	<1	<1	NT
m+p xylene	µg/L	Q	-	-	NT	<2	NT	<2	NT	NT	<2	<2	NT	<2	<2	NT
o-xylene	µg/L	Q	-	-	NT	<1	NT	<1	NT	NT	<1	<1	NT	<1	<1	NT
Naphthalene	µg/L	Q	-	-	NT	<1	NT	<1	NT	NT	<1	<1	NT	<1	<1	NT
TRH C10-C14	µg/L	Q	-	-	NT	<50	NT	<50	NT	NT	<50	<50	NT	<50	<50	NT
TRH C15-C28	µg/L	Q	-	-	NT	<100	NT	<100	NT	NT	<100	<100	NT	<100	<100	NT
TRH C29-C36	µg/L	Q	-	-	NT	<100	NT	<100	NT	NT	<100	<100	NT	<100	<100	NT
TRH >C10-C16	µg/L	Q	-	-	NT	<50	NT	<50	NT	NT	<50	<50	NT	NT	NT	NT
TRH >C10-C16 less Napth	µg/L	Q	-	-	NT	<50	NT	<50	NT	<50	<50	NT	<50	<50	NT	72
TRH >C16-C34	µg/L	Q	-	-	NT	<100	NT	<100	NT	<100	<100	NT	<100	<100	NT	<100
TRH >C34-C40	µg/L	Q	-	-	NT	<100	NT	<100	NT	<100	<100	NT	<100	<100	NT	<100
>C16-C35 Aliphatic	µg/L	Q	-	-	NT	n/a	NT	n/a	NT	NT	NT	NT	NT	<100	NT	<100
>C35 Aliphatic	µg/L	Q	-	-	NT	n/a	NT	n/a	NT	NT	NT	NT	NT	<100	NT	<100
C16-C35 Aromatic	µg/L	Q	-	-	NT	n/a	NT	n/a	NT	NT	NT	NT	NT	NT	<50	NT
Total PAH	µg/L	A	-	-	NT	NIL	NT	NIL	NT	NT	NIL	NIL	NT	NT	NIL	NT

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Date sampled	Unit	Frequency	EPL limit	Trigger value	20 Jan 2021	17 Feb 2021	10 Mar 2021	14 Apr 2021	12 May 2021	9 June 2021	14 Jul 2021	11 Aug 2021	15 Sep 2021	20 Oct 2021	9 Nov 2021	15 Dec 2021
METALS																
Al	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	210	NT	NT
Ar	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	NT	NT
Ba	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	59	NT	NT
Be	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<0.5	NT	NT
B	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	90	NT	NT
Cd	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.4	NT	NT
Co	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	NT	NT
Cu	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	13	NT	NT
Cr	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	33	NT	NT
Cr III	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Cr IV	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Fe	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	33	NT	NT
Hg	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<0.05	NT	NT
Mg	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	48	NT	NT
Mn	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	NT	NT
Mo	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	NT	NT
Pb	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	11	NT	NT
Ni	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	NT	NT
Se	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	NT	NT
Sn	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	210	NT	NT
Zn	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	110	NT	NT
Sr	µg/L	A	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	48	NT	NT

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† Out of holding time for bacteriological analysis. Note: COVID travel restrictions from May – September 2020 resulted in temporary changes to the site charter flight schedule and samples could not be transported to the laboratory within the holding time. This could result in elevated bacteriological levels. Where samples outside of holding time but with results within the EPL limits, the original bacteriological level is assumed to be also within the EPL limits.

¹ Trigger value for 80% species protection from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1. Updated values (2018) have been used where available. Exceedance of three times or more the ANZECC 80% species level of protection trigger value was a non-compliance under EPL230 Condition 55.

² Values above the EPL limit are shown in **red** text. Values above the trigger value or ANZECC 80% species protection guideline value are shown in **orange** text.



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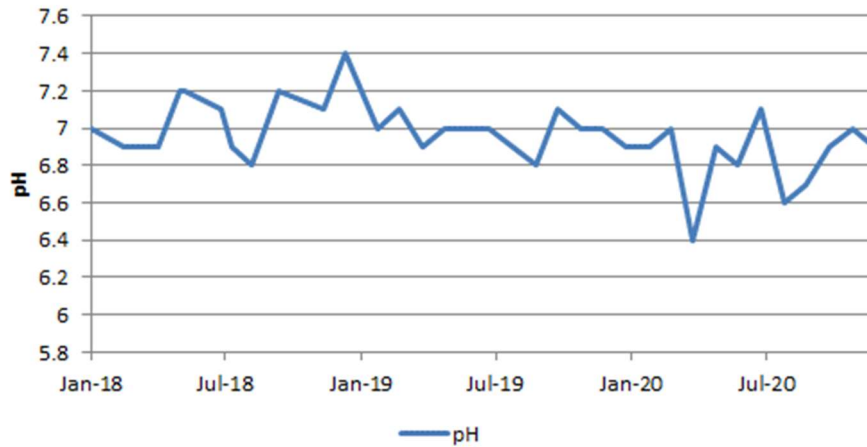
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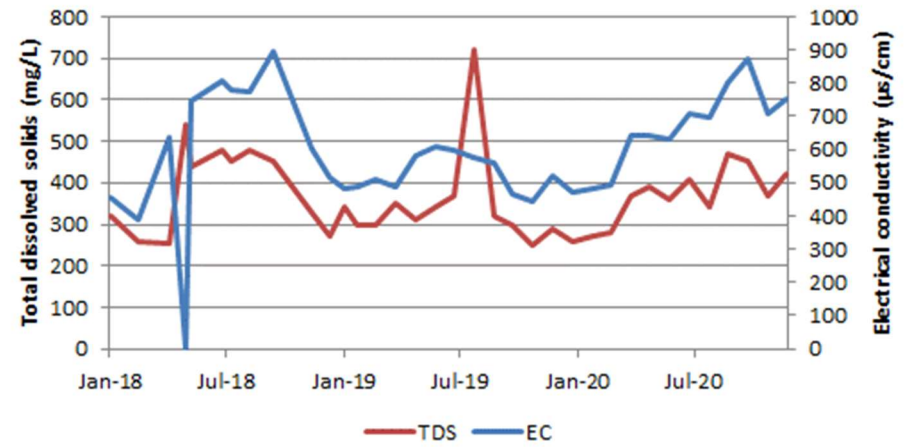
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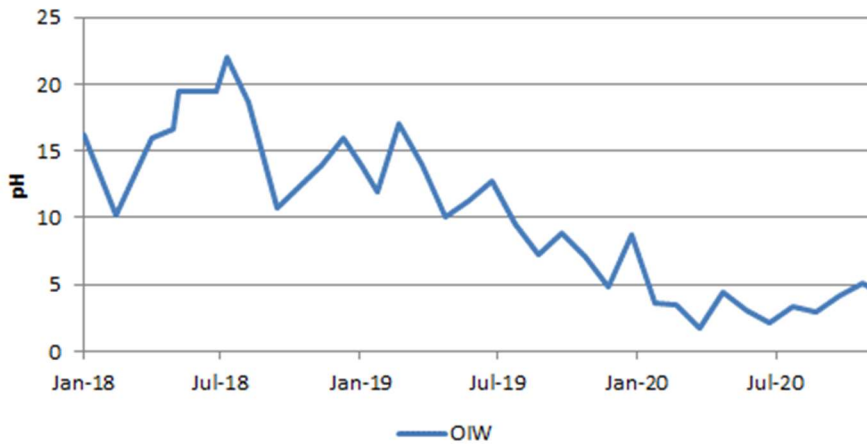
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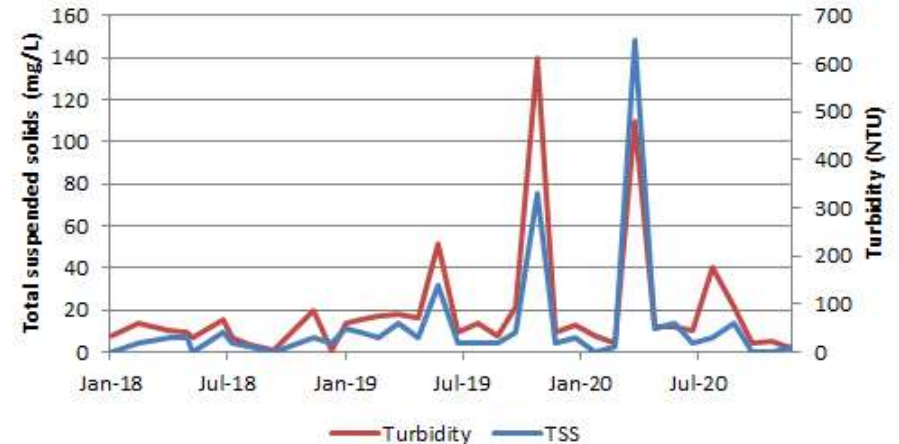
Wastewater - EC & TDS



Wastewater - OIW



Wastewater - Turbidity & TSS





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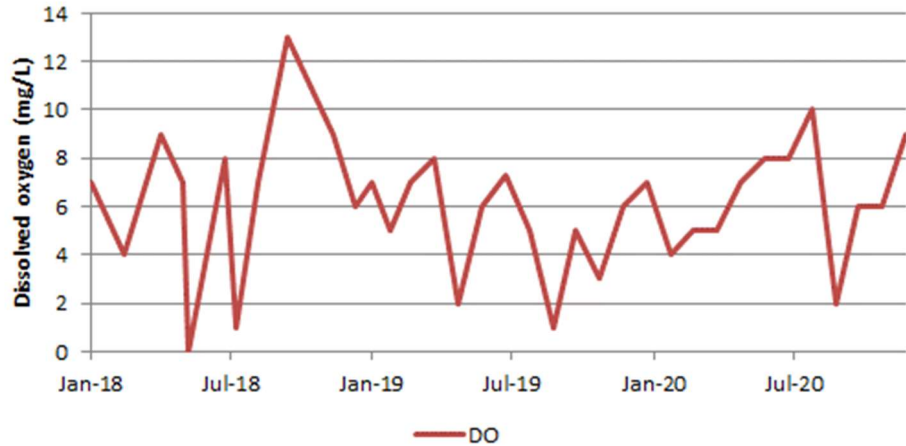
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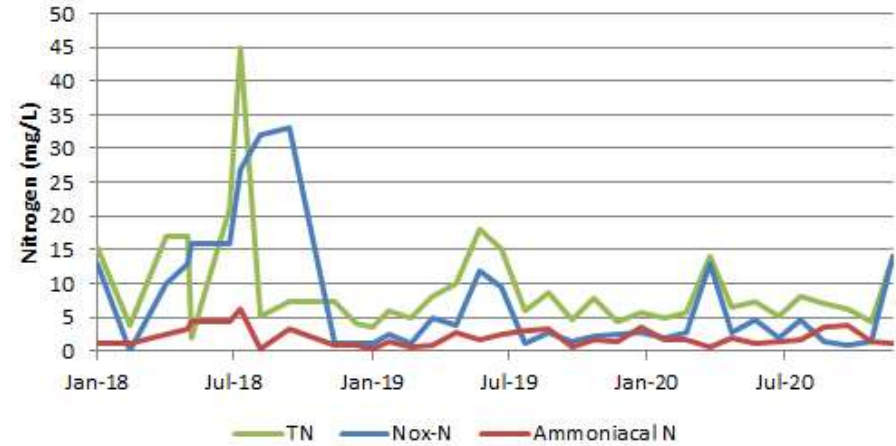
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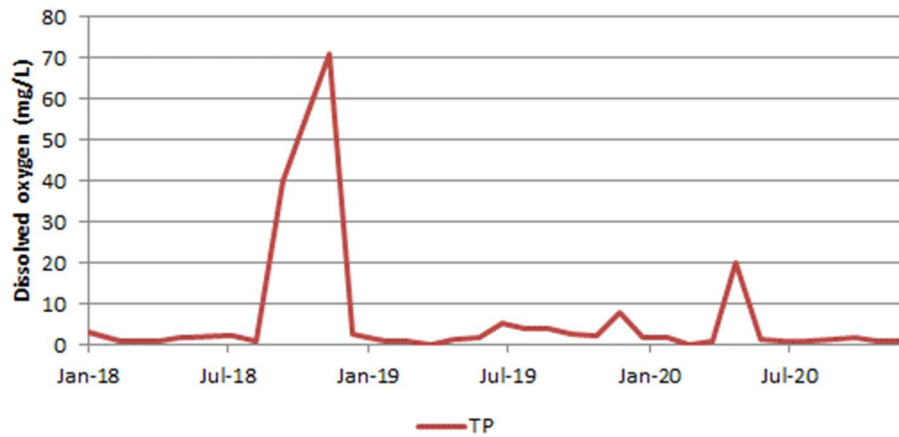
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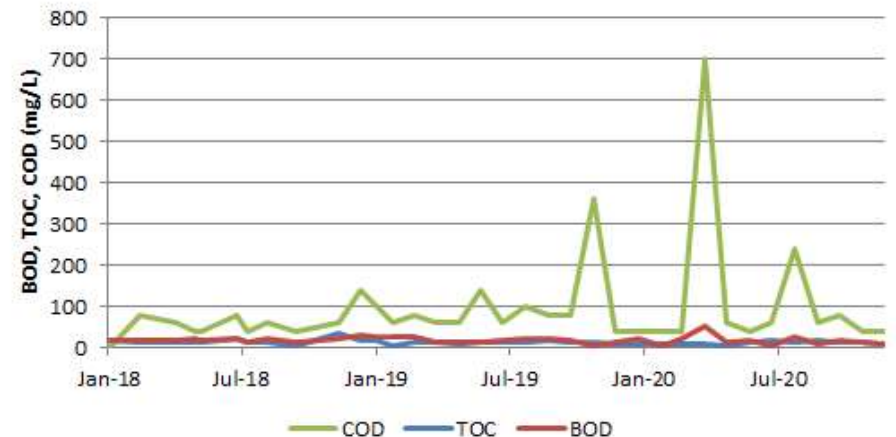
Wastewater - N



Wastewater - TP



Wastewater - C





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Validity
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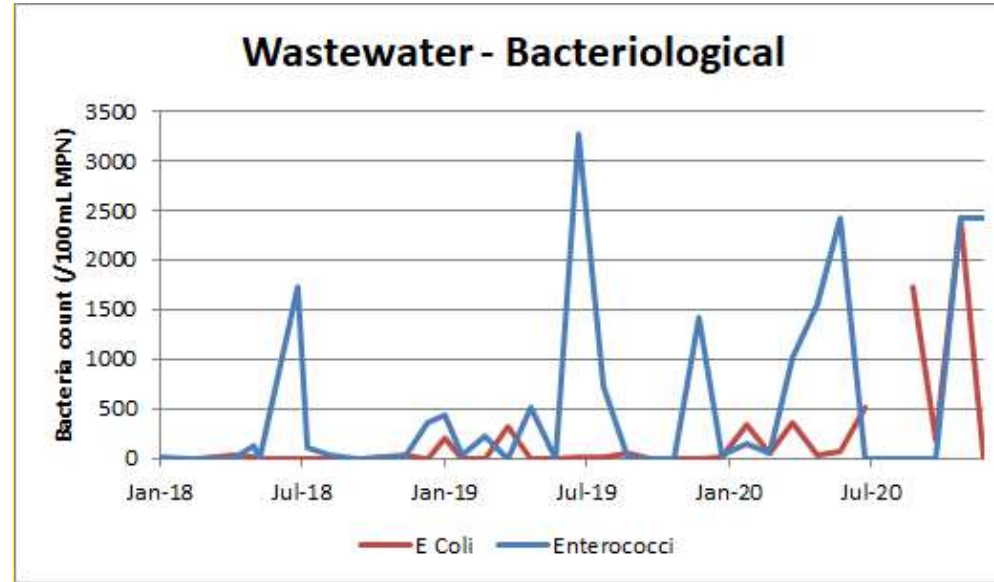
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APPENDIX D:

STORMWATER MONITORING

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Utilities stormwater discharge monitoring (SW-01)

	Utilities Stormwater (SW-01)		
	pH	EC	OIW
Units	pH	µs/cm	mg/L
Trigger value	-	-	1
Limit	-	-	6
ANZECC³	-	-	-
7 February 2021	5.89	107.1	2.1
15 February 2021	5.54	102.3	2.4
15 March 2021	5.73	87.5	0
21 March 2021	5.68	82.5	0
18 May 2021	6.374	90.23	0
30 May 2021	5.8	123.7	0
20 June 2021	5.61	105.4	0
11 July 2021	6.23	103.9	2.9
1 August 2021	5.81	92.6	0
6 September 2021	5.95	92.3	0
12 September 2021	6.53	119.7	0.9
21 November 2021	6.2	103.8	5.6
20 December 2021	6.24	103.1	1.5

Notes:


¹ This table summarises the discharge monitoring between 1 January 2020 – 31 December 2020.

² NT = not tested.

³ Trigger value for 80% species protection from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1. Updated values (2018) have been used where available.

⁴ Values above the EPL limit are shown in red text. Values above the trigger value or outside the ANZECC 80% species protection guideline value are shown in orange text.

⁵ All routine analyses conducted in the site laboratory, using the PC700 bench meter for pH and EC, and the Horiba OCMA500 with Florisil solvent for oil in water, unless otherwise stated

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Open drains sump stormwater discharge monitoring (SW-03)

	Open Drains Sump (SW-03)		
	pH	EC	OIW
Units	pH	µs/cm	mg/L
Trigger value	-	-	1
Limit	-	-	6
ANZECC³	-	-	-
2 January 2021	6.34	144.4	1
23 January 2021	5.85	182.1	5.2
31 January 2021	6.87	123	5.4
19 February 2021	6.3	161	2.9
11 March 2021	6.1	123	0.1
20 March 2021	5.98	63.1	1.2
8 November 2021	7.03	1.705	3
25 November 2021	7.017	522	1.6
11 December 2021	6.7	161.2	3.2
21 December 2021	6.65	280.4	1.6

Notes:


¹ This table summarises the discharge monitoring between 1 January 2020 – 31 December 2020. There was no discharge between April and October 2020.

² NT = not tested.

³ Trigger value for 80% species protection from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1. Updated values (2018) have been used where available.


⁴ Values above the EPL limit are shown in red text. Values above the trigger value or outside ANZECC 80% species protection guideline value are shown in orange text.

⁵ All routine analyses conducted in the site laboratory, using the PC700 bench meter for pH and EC, and the Horiba OCMA500 with Florisil solvent for oil in water, unless otherwise stated

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Annual stormwater monitoring

	Unit	ANZECC 80% species protection	EPL limit	Trigger value	SW-03 10 Jan 2020	SW-03 20 Jan 2021
ENVIRONMENTAL PARAMETERS						
pH	-	-	-	-	5.9	5.7
EC	µs/cm	-	-	-	195	145
Turbidity	NTU	-	-	-	5	24
DO	mg/L	-	-	-	7	6
OIW	mg/L	-	6	1	6	2.3
TSS	mg/L	-	-	-	10	40
TDS	mg/L	-	-	-	140	100
BOD	mg/L	-	-	-	16.3	48.2
TOC	mg/L	-	-	-	29	48
COD	mg/L	-	-	-	100	180
vTRH(C6-10)/BTEX						
TRH C6-C9	µg/L	-	-	-	23	<200
TRH C6-C10	µg/L	-	-	-	53	<200
TRH C6-C10 less BTEX	µg/L	-	-	-	39	<200
Benzene	µg/L	1300	-	-	1400	<10
Toluene	µg/L	330	-	-	1400	<10
Ethylbenzene	µg/L	160	-	-	1	<10
m+p-xylene	µg/L	150	-	-	4	<20
o-xylene	µg/L	-	-	-	1	<10
naphthalene	µg/L	120	-	-	<1	<10
svTRH (C10-C40)						
TRH C10-C14	µg/L	-	-	-	150	3400
TRH C15-C28	µg/L	-	-	-	270	510
TRH C29-C36	µg/L	-	-	-	<100	140
TRH >C10-C16	µg/L	-	-	-	200	1200
TRH >C10-C16 less Naph	µg/L	-	-	-	200	1200
TRH >C16-C34	µg/L	-	-	-	250	480
TRH >C34-C40	µg/L	-	-	-	100	<100
Aromatic & Aliphatic TPH						
TPH >C16-C35 Aliphatic	µg/L	-	-	-	<100	<100
TPH >C35 Aliphatic	µg/L	-	-	-	<100	<100
TPH C16-C35 Aromatic	µg/L	-	-	-	<50	99
Polycyclic Aromatic Hydrocarbons						
Naphthalene	µg/L	120	-	-	<1	0.1
Acenaphthylene	µg/L	-	-	-	<1	<1
Acenaphthene	µg/L	-	-	-	<1	<1
Fluorene	µg/L	-	-	-	5	5

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	Unit	ANZECC 80% species protection	EPL limit	Trigger value	SW-03 10 Jan 2020	SW-03 20 Jan 2021
Phenanthrene	µg/L	-	-	-	1	1
Anthracene	µg/L	7	-	-	<1	<1
Fluoranthene	µg/L	2	-	-	<1	<1
Pyrene	µg/L	-	-	-	<1	<1
Benzo(a)anthracene	µg/L	-	-	-	<1	<1
Chrysene	µg/L	-	-	-	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	-	-	-	<2	<2
Benzo(a)pyrene	µg/L	0.7	-	-	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	-	-	-	<1	<1
Dibenzo(a,h)anthracene	µg/L	-	-	-	<1	<1
Benzo(g,h,i)perylene	µg/L	-	-	-	<1	<1
Benzo(a)pyrene TEQ	µg/L	-	-	-	<5	<5
Total +ve PAHs	µg/L	-	-	-	NIL	0.1
METALS						
Al	µg/L	-	-	-	360	60
Ar	µg/L	-	-	-	<1	<1
Ba	µg/L	-	-	-	120	1200
Be	µg/L	-	-	-	<0.5	<0.5
B	µg/L	-	-	-	30	60
Cd	µg/L	36	-	-	3.5	7
Co	µg/L	150	-	-	<1	<1
Cu	µg/L	8	-	-	<1	12
Cr	µg/L	176	-	-	3	<1
Fe	µg/L	-	-	-	2200	2000
Hg	µg/L	1.4	-	-	<0.05	<0.5
Mg	µg/L	-	-	-	<0.5	46
Mn	µg/L	80	-	-	61	<1
Mo	µg/L	-	-	-	<1	3
Pb	µg/L	12	-	-	<1	12
Ni	µg/L	560	-	-	7	<1
Se	µg/L	-	-	-	<1	<1
Sn	µg/L	-	-	-	<1	920
Sr	µg/L	-	-	-	NT	NT
Zn	µg/L	43	-	-	570	920

Notes:


¹ This table summarises the discharge monitoring between 1 January 2021 – 31 December 2021.

² NT = not tested.

³ Trigger value for 80% species protection from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1. Updated values (2018) have been used where available.


⁴ Values above the EPL limit are shown in red text. Values above the trigger value or outside ANZECC 80% species protection guideline value are shown in orange text.

⁵ All routine analyses conducted in the site laboratory

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APPENDIX E:

GROUNDWATER MONITORING

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Quarterly groundwater monitoring data

Parameter	Test method	Units	ADWG6 1	ANZECC ²	Date sampled		16 February 2021		11 May 2021		9 August 2021		9 November 2021	
					BH5	BH7	BH5	BH7	BH5	BH7	BH5	BH7		
pH	ASTM D1287	-	6.5-8.5	-	4.9	5.6	5.2	5.8	5.1	5.6	7.8	7.6		
EC	APHA 2510	mS/cm	-	-	83	49	63	47	69	42	138	138		
Turbidity	Turb1	NTU	5	-	14	370	37	1470	28	200	290	>1000		
DO	HACH	mg/L	-	-	3.5	5.7	9	9	8	8	8	8		
DO³	HACH	% sat	85%	-							89%	102%		
OIW	Turner TD3100	mg/L	-	-	3.5	4.2	2.7	3.4	8	7	8.9	11.2		
TSS	APHA 2540 D	mg/L	-	-	160	340	100	460	20	80	210	630		
TDS	APHA 2540 C	mg/L	600	-	70	120	50	30	60	30	60	50		
BOD	APHA 5210	mg/L	-	-	5.3	6.4	35	2.5	6	8	3.1	2.8		
TOC	APHA 5310 B	mg/L	-	-	1	2	1	2	2	2	2	2		
COD	WCL_13	mg/L	-	-	<20	<20	140	<20	<20	<20	<20	<20		
NOx	APHA No2B	mg/L	-	-	1.96	1.66	2.58	1.67	2.35	1.45	2.66	1.52		
Nitrate	APHA No2B	mg/L	50 ⁽⁴⁾	-	1.96	1.66	2.58	1.67	2.35	1.45	2.66	1.51		
Nitrite	APHA No2B	mg/L	3 ⁽⁴⁾	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005		
Ammonia	APHA 4500	mg/L	0.5	1.7	0.025	0.020	0.025	0.015	<0.045	0.01	0.025	0.02		
Total P	ICP-AES	mg/L	-	-	<0.01	0.015	0.020	1.92	0.01	0.015	0.01	0.02		

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Parameter	Test method	Units	ADWG6 ₁	ANZECC ²	Date sampled		16 February 2021		11 May 2021		9 August 2021		9 November 2021	
					BH5	BH7	BH5	BH7	BH5	BH7	BH5	BH7		
Total N	APHA no2B	mg/L	-	-	2.71	2.29	2.85	0.035	2.41	1.51	3.03	1.55		
Tot. Coliform	AS4276.21-2005	/100ml MPN	-	-	3	14	28	<1			<1	<1		
E. coli	AS4276.21-2005	/100ml MPN	0 ⁽⁴⁾	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HCC	AS4276.3.1-2007	CFU/mL	-	-	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Enterococci	AS4276.21-2005	/100ml MPN			225	228	20	35	219	11	770	77		


† Out of holding time.

¹ Aesthetic water quality criteria from the Australian Drinking Water Guidelines 6 (2011) version 3.2 (ADWG6).

² Trigger value for 80% species protection from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1. Updated values (2018) have been used where available.

³ Estimated based on water temperature of 28°C and atmospheric pressure.

⁴ Health water quality criteria (adult) from ADWG6, as there is no aesthetic criteria.

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Trends of key quarterly groundwater monitoring parameters

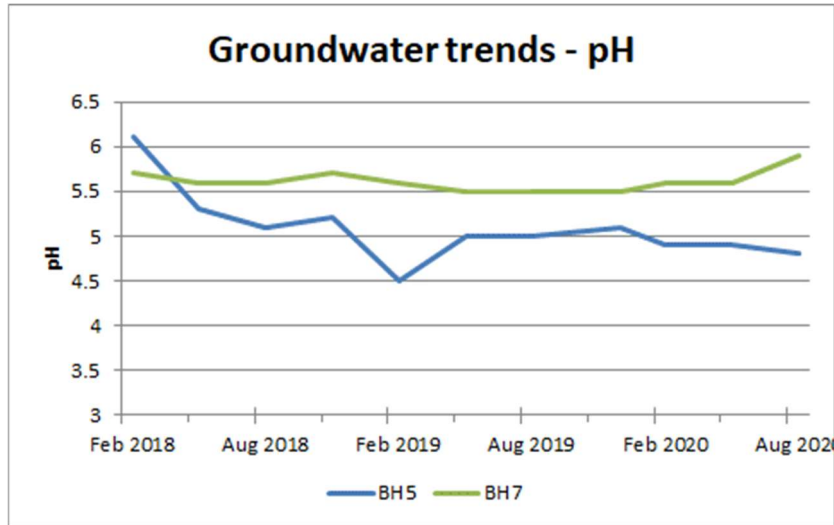


Figure F.1: Groundwater trends – pH

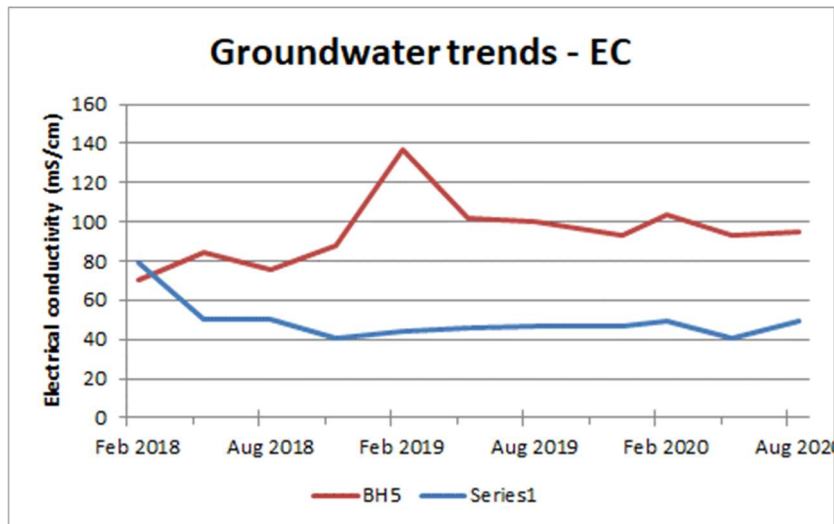


Figure F.2: Groundwater trends – EC

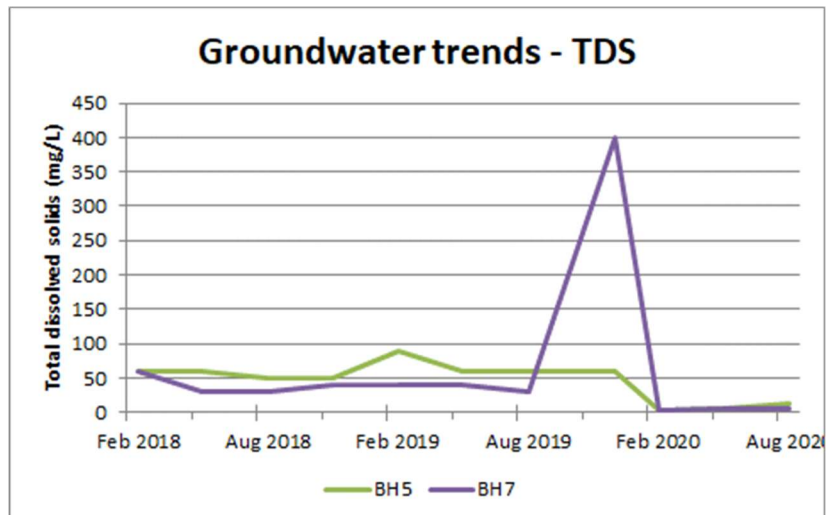



Figure F.3: Groundwater trends – TDS

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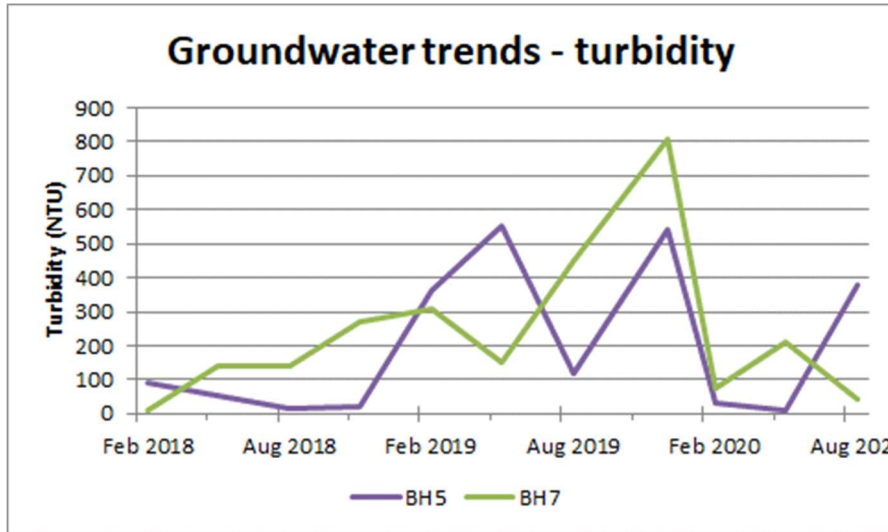


Figure F.4: Groundwater trends – turbidity

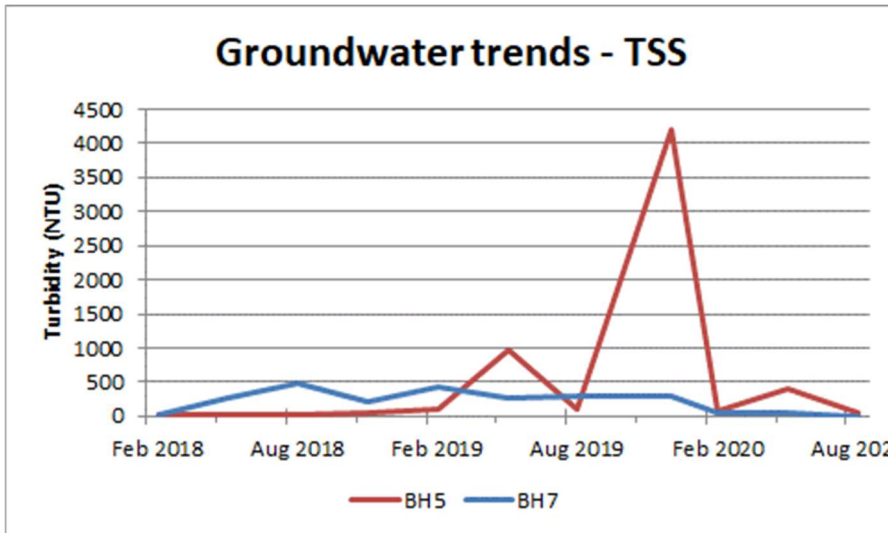


Figure F.5: Groundwater trends – total suspended solids

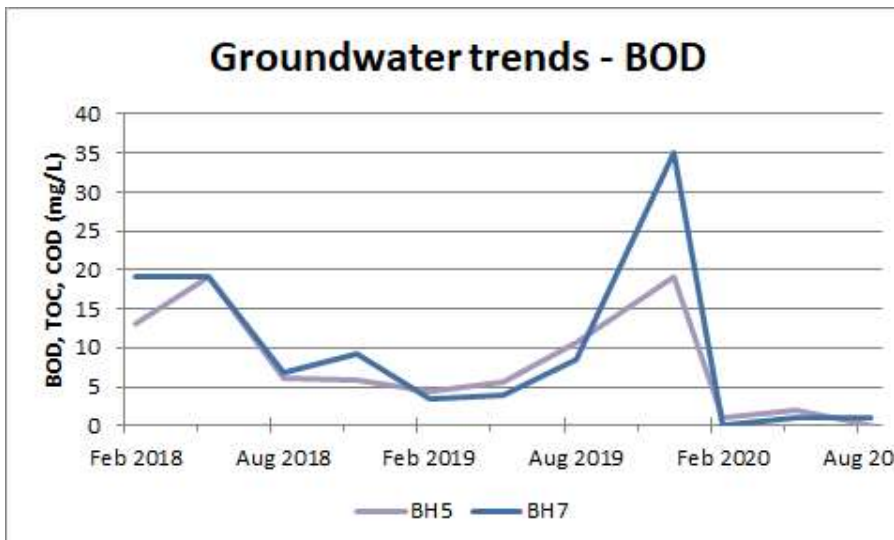



Figure F.6: Groundwater trends – biochemical oxygen demand

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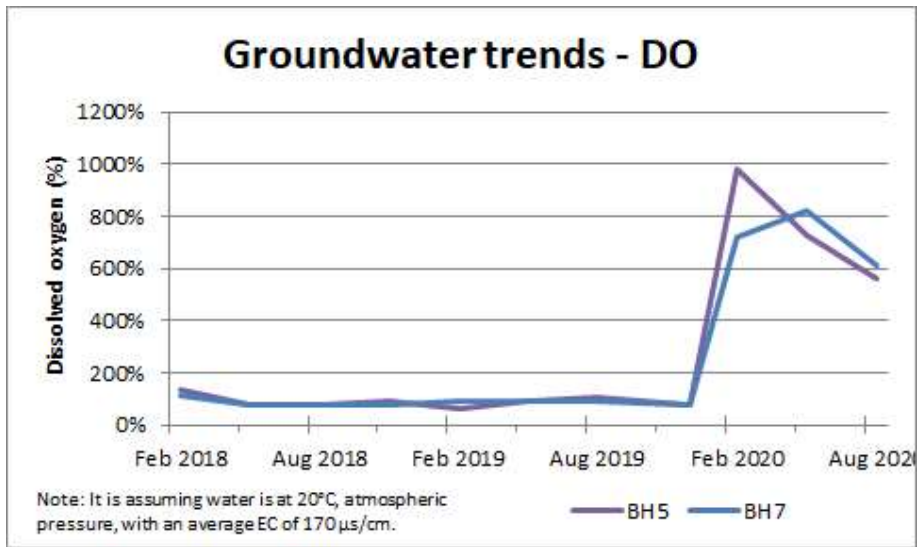


Figure F.7: Groundwater trends – dissolved oxygen

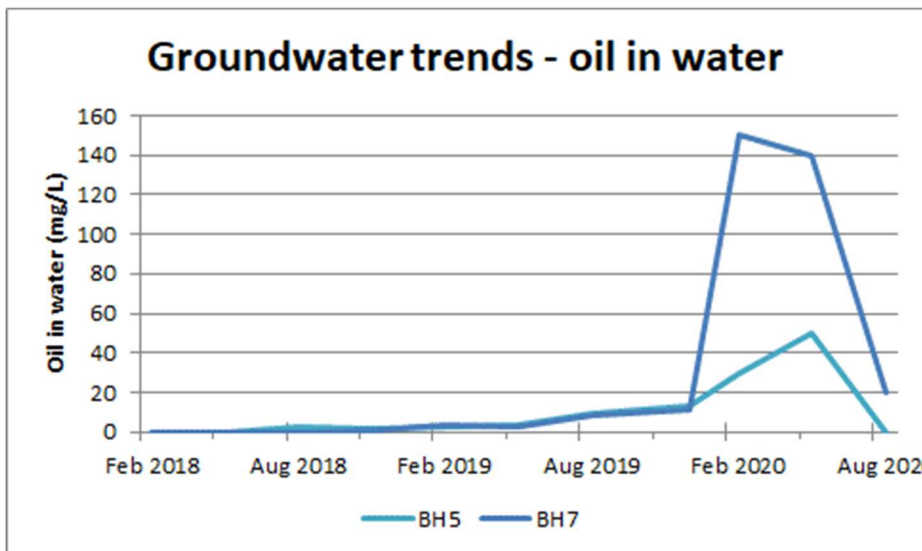


Figure F.8: Groundwater trends – oil in water

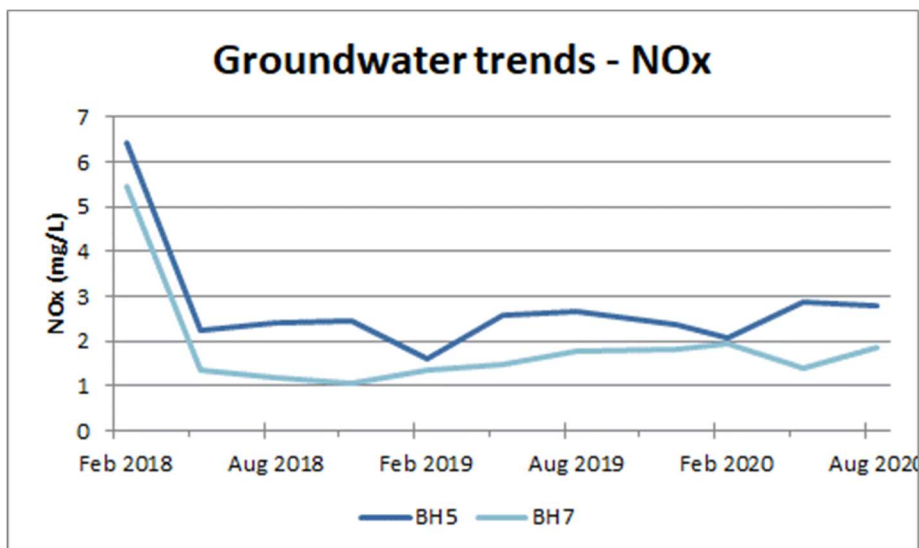


Figure F.9: Groundwater trends – NOx

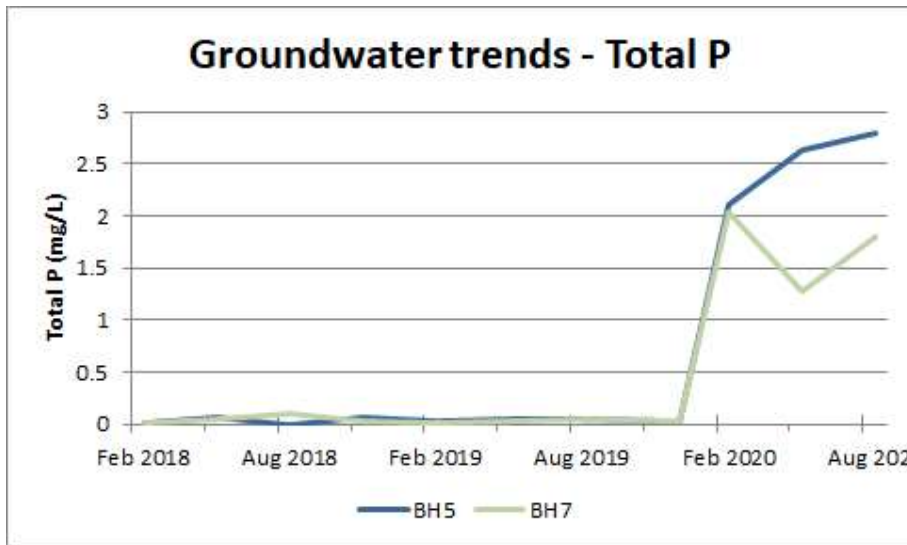


Figure F.10: Groundwater trends – Total P

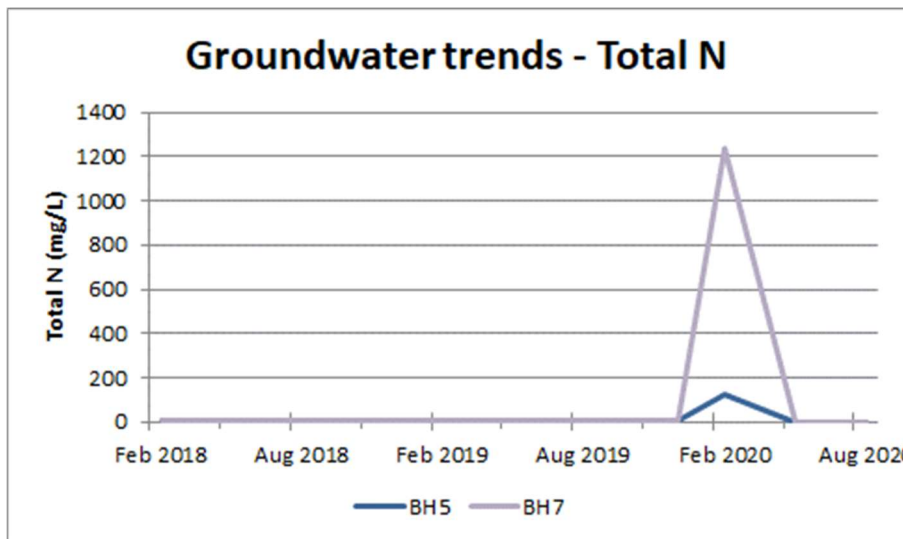


Figure F.11: Groundwater trends – Total N

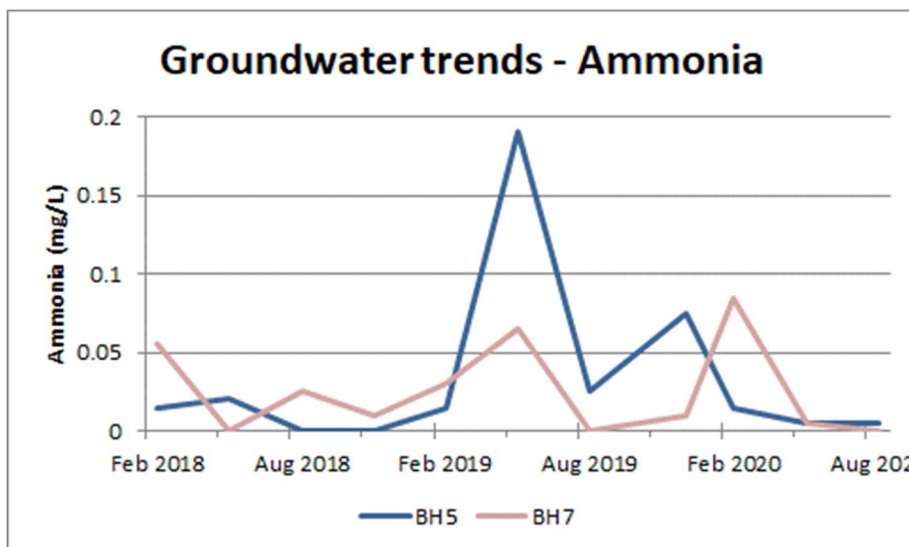



Figure F.12: Groundwater trends – Ammonia

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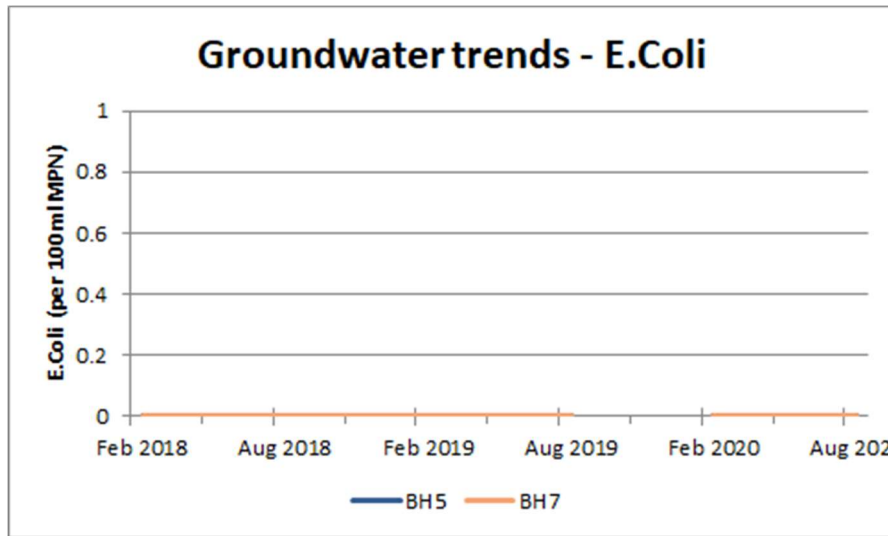


Figure F.13: Groundwater trends – E.Coli