

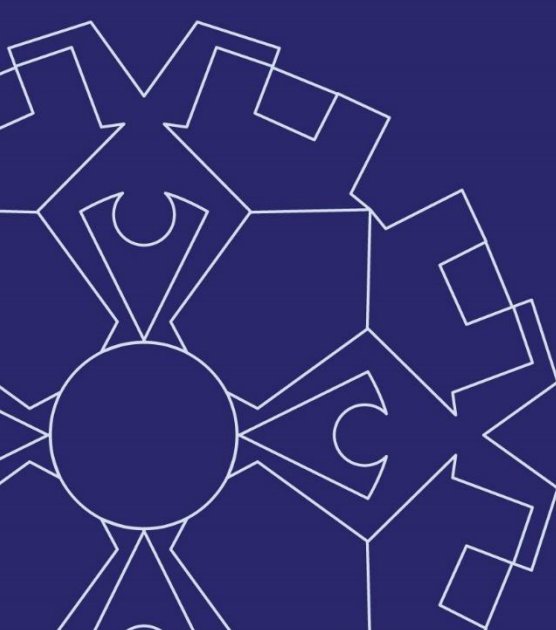


GEOLYSE

**ANNUAL ENVIRONMENTAL MONITORING REPORT
26 AUGUST 2017 – 25 AUGUST 2018**

**PREPARED FOR
OBERON COUNCIL**

OCTOBER 2018



• Civil, Environmental & Structural Engineering • Surveying • Environmental • Planning • Architecture

ANNUAL ENVIRONMENTAL MONITORING REPORT

26 AUGUST 2017 TO 25 AUGUST 2018

OBERON WASTE FACILITY
EPL 20289

PREPARED FOR:

OBERON COUNCIL

OCTOBER 2018



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Report Title:	<i>Annual Environmental Monitoring Report</i>
Project:	<i>Oberon Waste Facility – 26 August 2017 to 25 August 2018</i>
Client:	<i>Oberon Council</i>
Report Ref.:	<i>217505_AEMR_17-18.docx</i>
Status:	<i>Final</i>
Issued:	<i>23 October 2018</i>

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Introduction

1.1 BACKGROUND

The Oberon Waste Facility (OWF) is located in the Oberon Local Government Area and is owned by Oberon Council. The 11 hectare property exists approximately 4 km north of the town of Oberon and comprises Lot 1 DP 350774, Lot 1 DP 598525, Lot 1 DP 844887 and Lot 36 DP 263034. The OWF is accessed via Lowes Mount Road.

The landfill site is approximately 620 metres north-south by 430 metres east-west, with the northern extent of the site narrower than the south (refer **Drawing 05C_EV02**).

The landfill is currently screened by rows of established native trees. The established trees provide visual screening on the northern, eastern and southern boundaries of the landfill. Rows of native trees are also being established on the western side of the site.

The land adjacent to the site is predominantly rural land used for grazing and some cropping, with timber processing also conducted approximately 2.5 km to the south-east.

Landfilling operations at the site are known to have commenced prior to the 1960s, and anecdotal evidence would suggest the site may have been established in the 1940s.

The OWF services the town of Oberon, which has a population of approximately 2,500 people. The landfill receives municipal kerbside waste, municipal delivered waste, commercial and industrial waste and building and demolition waste. It also has facilities for recycling drop off and green waste separation.

1.2 LICENCE REQUIREMENTS

The OWF currently operates under Environment Protection Licence 20289 (EPL 20289), issued under Section 55 of the Protection of the Environment Operations Act 1997 (The Act). This licence governs the design, construction, operation, monitoring and rehabilitation of the facility in accordance with The Act.

Management and operation of the centre is also undertaken in accordance with the Landfill Environmental Management Plan (LEMP) (OSC, 2013).

Section 5 of EPL 20289 provides instructions on environmental monitoring requirements. Specifically, Condition M2.1 describes the requirements to monitor the concentration of pollutants discharged to groundwater, surface water and accumulated building gas.

Annual reporting requirements that are outlined in Condition R1.1 state:

R1.1 “The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:

- a) a Statement of Compliance; and*
- b) a Monitoring and Complaints Summary.*

The deadline for the Annual Return that is outlined in Condition R1.5 states:

The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

Condition R1.8 'Monitoring Report' states:

The licensee must supply, with the Annual Return, a report which provides:

- a) an analysis and interpretation of monitoring results from samples collected at the premises over the reporting period;*
- b) actions to correct any identified adverse trends;*
- c) a summary of the results of landfill gas monitoring undertaken at the premises in accordance with condition M2.2.*
- d) a summary of pollution complaints resulting from activities undertaken at the premises during the reporting period.*
- e) a statement regarding the attainment of the achieved compaction rate of landfilled waste (excluding cover material) in accordance with condition O6.9.*
- f) a statement regarding the remaining disposal capacity (in cubic metres) of the landfill in accordance with condition M6.1.*

This Annual Environmental Management Report (AEMR) is a response to Condition R1.9. The reporting period for this AEMR is from 26 August 2017 to 25 August 2018. Collection of environmental data by Geolyse began at the OWF in November 2013.

1.3 REPORT STRUCTURE

Section 1 presents a brief introduction and background to the report;

Section 2 provides an overview of the environmental monitoring program undertaken at the facility during the reporting period;

Section 3 presents the data and discussion of data collected during the reporting period;

Section 4 presents all monitoring data that falls outside of the scope of environmental monitoring for the annual return year, including records of public complaints and quantities of waste deposited;

Section 5 presents a summary of all monitoring undertaken as described in detail in Section 3 and Section 4; and

Section 6 presents the conclusions and recommendations resulting from monitoring undertaken during the reporting period.

Environmental Monitoring Program

2.1 OVERVIEW

Environmental monitoring undertaken at the OWF during the reporting period included that required for groundwater and surface water. The requirement for accumulated building gas was identified in August 2014 and subsequently commenced in September 2014. This section summarises all environmental monitoring undertaken during the reporting period (**Table 2.1**).

Table 2.1 – 2017-2018 Schedule of Environmental Monitoring

Date	Groundwater (Biannually)	Surface Water (Monthly During Discharge)	Accumulated Building Gas
Sep 2017			✓
Oct 2017			✓
Nov 2017	✓		✓
Dec 2017		✓	✓
Jan 2018		✓	✓
Feb 2018			✓
Mar 2018			✓
Apr 2018			✓
May 2018	✓		✓
Jun 2018			✓
Jul 2018			✓
Aug 2018			✓

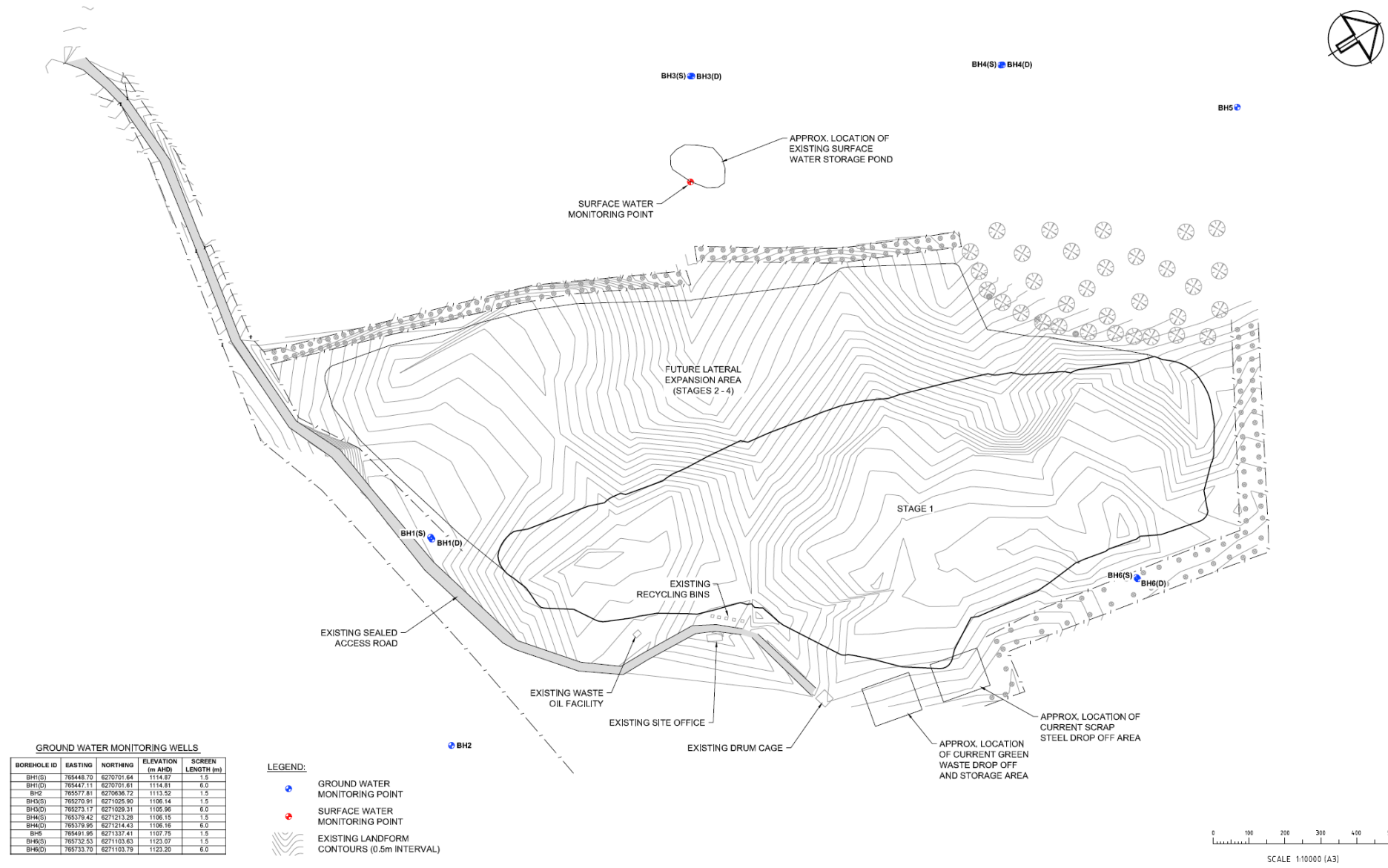
2.2 SURFACE WATER

Surface water monitoring is conducted at EPL Point 1, identified as SW1. The monitoring point is illustrated in **Drawing 05C_EV02**. In accordance with EPL 20289, this point is required to be sampled monthly during discharge. A rising stage sampler is installed to assist with event sample collection.

Table 2.2 identifies the list of surface water parameters and their analysis frequency during the reporting period.

Table 2.2 – Surface Water Monitoring Parameters and Frequency

Discharge Parameter	December 2017	January 2018
Conductivity	✓	✓
Oil & Grease	✓	✓
pH	✓	✓
Total Suspended Solids	✓	✓



Drawing 05C_EV02 – Oberon Landfill Monitoring Points

2.3 GROUNDWATER

The groundwater monitoring network was designed by CMJA (2012) and comprises six shallow (screened 3.5 – 5.0 m) and four deep (screened 24 – 30 m) monitoring wells. **Drawing 05C_EV02** shows the configuration of the groundwater monitoring network. The four deep monitoring wells are installed as pairs to the correspondingly numbered shallow wells.

The groundwater monitoring points are identified as BH1S, BH1D, BH2, BH3S, BH3D, BH4S, BH4D, BH5, BH6S and BH6D, corresponding to EPL Points 2 through 11.

Groundwater level measurement and sampling are undertaken on a biannual basis in accordance with EPL 20289. Monitoring commenced in November 2013. The four deep piezometers are sampled annually and the six shallow piezometers are sampled biannually.

The November 2017 biannual monitoring round was able to collect samples from three piezometers, whilst five samples were able to be collected from the May 2018 monitoring round.

Monitoring for the following analytes was able to be undertaken for sample collected throughout the reporting period:

- Alkalinity
- Aluminium
- Arsenic
- Barium
- Benzene
- Cadmium
- Calcium
- Chloride
- Chromium (total)
- Cobalt
- Conductivity
- Copper
- Ethylbenzene
- Fluoride
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nitrogen (Ammonia)
- Nitrogen (Nitrate)
- Nitrogen (Nitrite)
- Organochlorine Pesticides
- Organophosphorus Pesticides
- pH
- Phosphorus (total)
- Polycyclic Aromatic Hydrocarbons
- Potassium
- Sodium
- Standing Water Level
- Sulfate
- Toluene
- Total Dissolved Solids
- Total Organic Carbon
- Total Petroleum Hydrocarbons
- Total Phenolics
- Xylene
- Zinc

Environmental Monitoring Results

3.1 INTRODUCTION

Monitoring results are presented in this section for all environmental monitoring undertaken during the reporting period. The laboratory data are presented, along with an interpretation of trends, variability and anomalies for groundwater and surface water. Any deficiencies in monitoring, environmental incidents and remedial actions undertaken to correct any problems or deficiencies are also discussed.

Monitoring data is summarised in the following figures and in the tables of **Appendix A**. All laboratory reports and chain-of-custody documentation are included in **Appendix B**.

3.2 SURFACE WATER

EPL 20289 requires surface water quality monitoring monthly during discharge from the surface water monitoring point SW1 (EPL point 1). The first discharge event in the reporting period was recorded in December 2017, and a subsequent discharge event was recorded in January 2018.

Samples are collected by Council contractors via rising stage samplers prior to overland flow and any off-site discharge, receiving further filtration through vegetation. All results are presented in **Appendix A, Table A1**.

3.2.1 QUALITY

Surface water pH concentrations are presented in **Figure 1**.

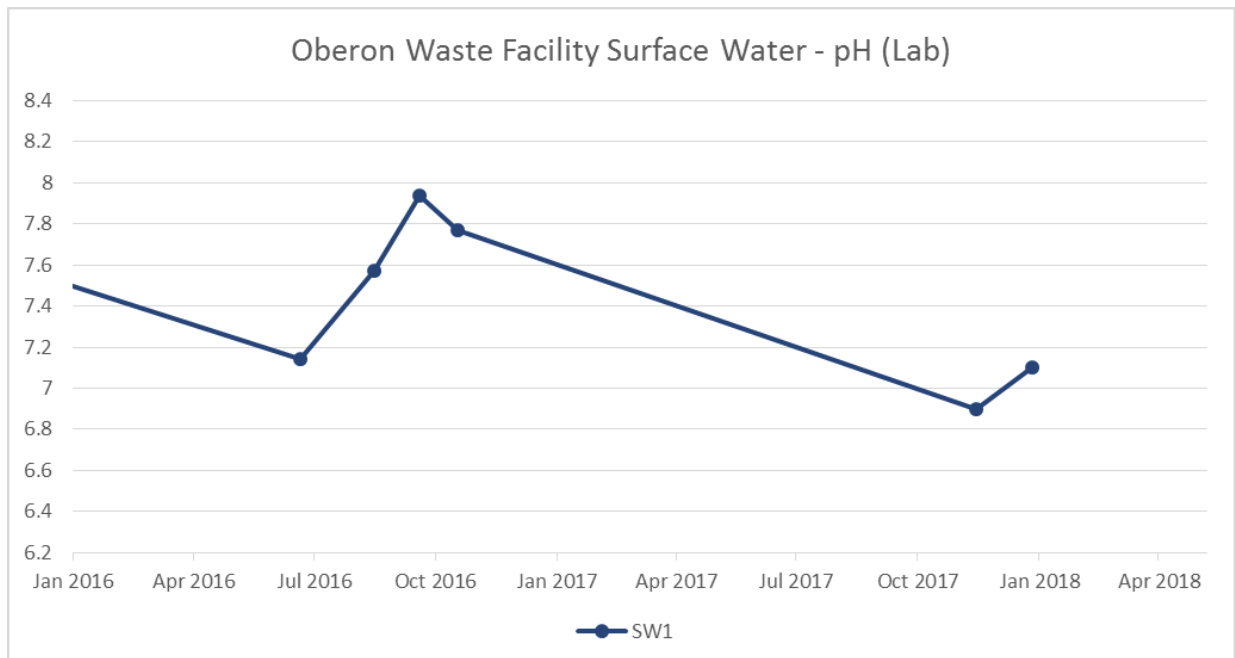


Figure 1: Surface Water pH – OWF, 2017 – 2018

Surface water pH was near-neutral during the measurements recorded in the reporting period, with levels ranging from 6.9 in December 2017 to 7.1 in January 2018. All values were within EPL 100 percentile discharge limit range of 6.5 – 8.5.

Surface water electrical conductivity levels are presented in **Figure 2**.

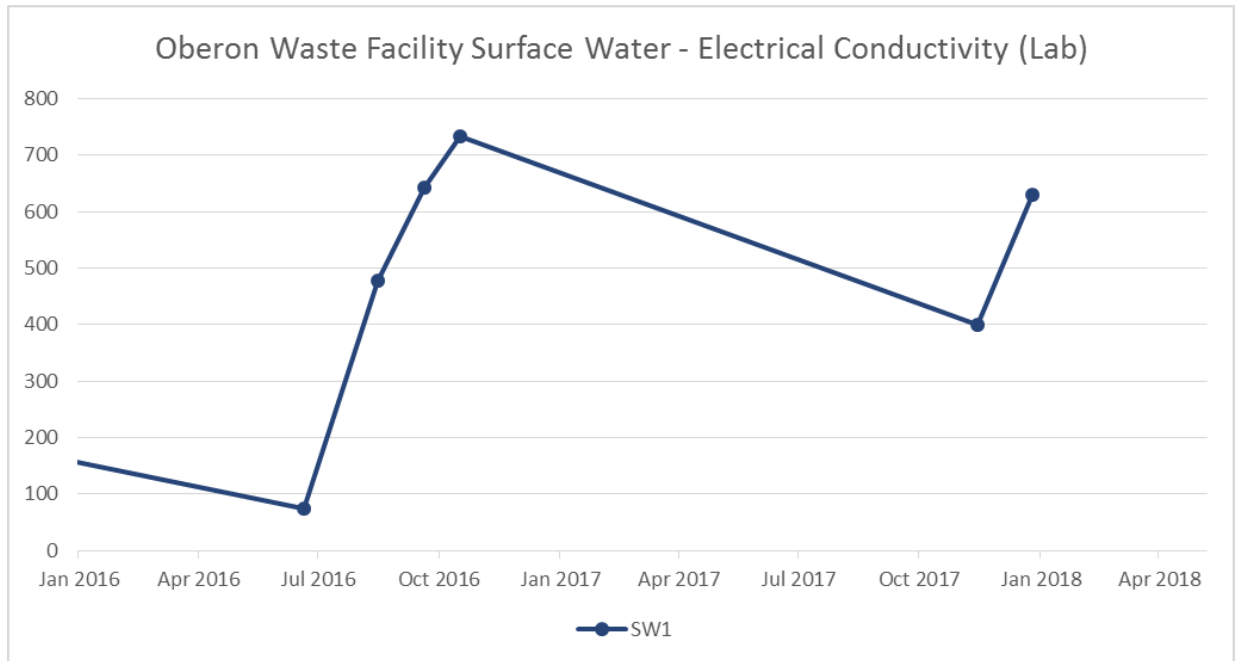


Figure 2: Surface Water EC – OWF, 2017 – 2018

EC levels in the reporting period ranged from 400 µS/cm in December 2017 to 630 µS/cm in January 2018. Corresponding TDS concentrations ranged from 268 mg/L to 422 mg/L, and were considered suitable for consumption by the most susceptible livestock category, poultry (<3000 mg/L, ANZECC & ARMCANZ, 2000).

Surface water total suspended solid (TSS) concentrations are presented in **Figure 3**.

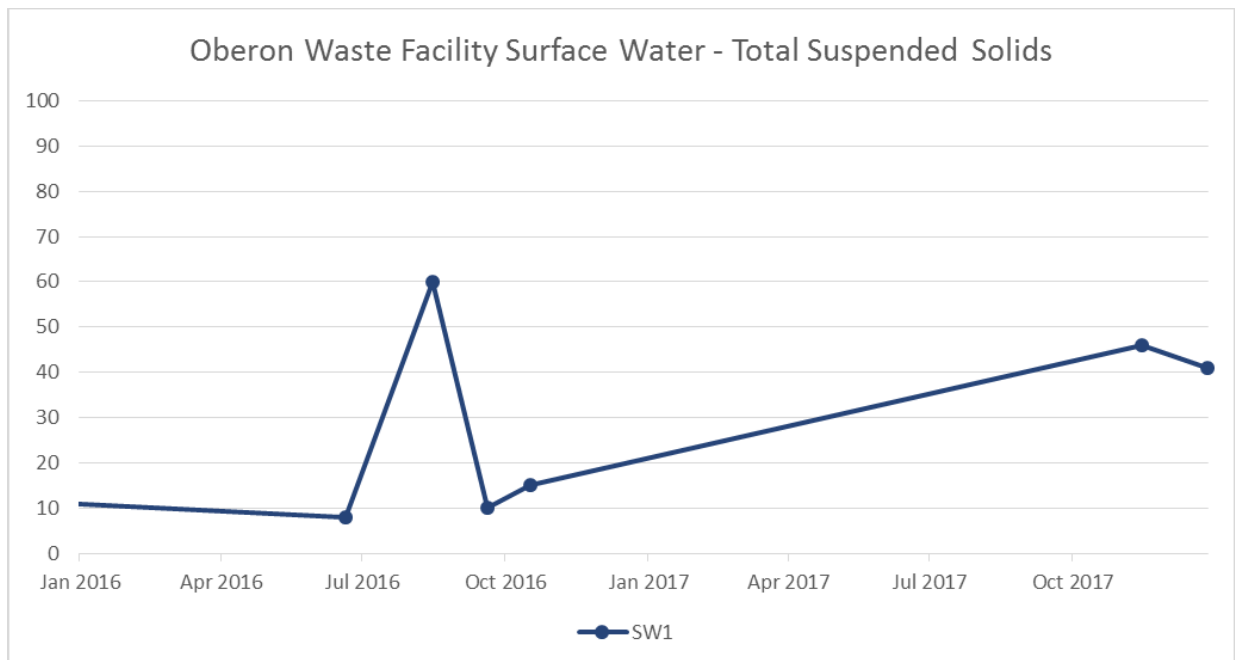


Figure 3: Surface Water TSS – OWF, 2017 – 2018

Total suspended solid results ranged from 46 mg/L in December 2017 to 41 mg/L in January 2018. The EPL 100 percentile limit of 50 mg/L was not exceeded in either discharge event.

Surface water oil and grease levels are presented in **Figure 4**.

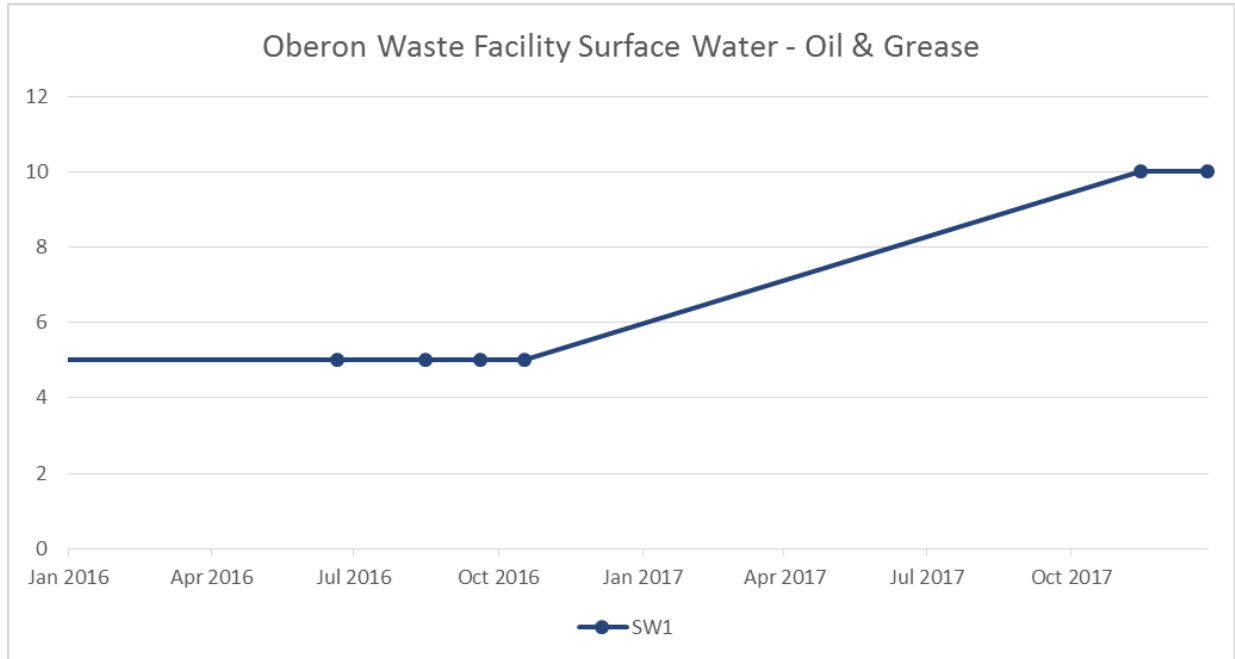


Figure 4: Surface Water Oil & Grease – OWF, 2017 – 2018

Oil and grease was recorded at 10 mg/L in the surface water sample collected in December 2017, and less than the laboratory limit of reporting (LOR) of 10 mg/L in the surface water sample collected in January 2018 (the oil & grease LOR was raised in the January 2018 sampling event due to a lower volume than required being collected in the rising stage sampler).

The EPL 100 percentile discharge limit of 10 mg/L was not exceeded for any sample collected.

3.3 GROUNDWATER

Groundwater monitoring is to consist of biannual water level measurements at all 10 piezometers, with samples being collected twice annually from the shallow piezometers and once annually from the deep piezometers.

Groundwater is intermittently present in the monitoring wells at the facility, and sampling of groundwater cannot consistently be conducted.

The November 2017 biannual monitoring round was able to collect samples from three piezometers, and five samples were able to be collected from the May 2018 monitoring round

3.3.1 GROUNDWATER LEVELS

Groundwater level measurements are presented for all monitoring stations in **Appendix A, Table A2** and are illustrated below in **Figure 5**.

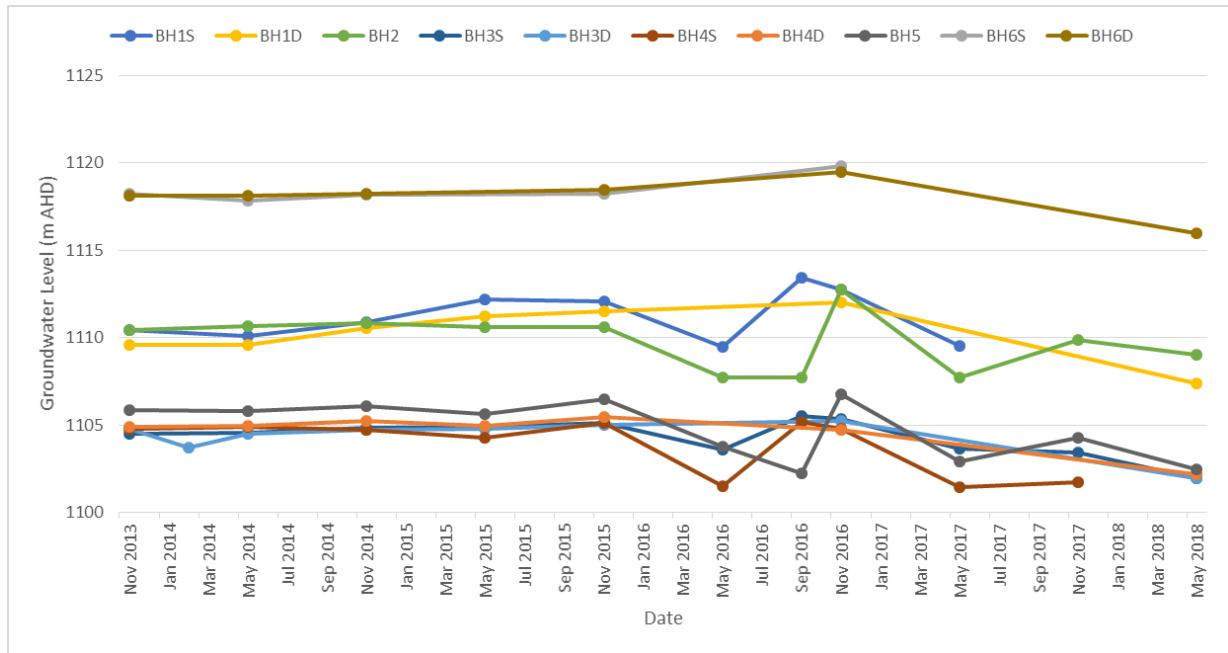


Figure 5: Groundwater Levels – OWF, 2017 – 2018

Comparative reduced groundwater levels indicated that piezometer BH6 is the most up-gradient monitoring point and the western piezometers at BH3 (pair), BH4 (pair) and BH5 are the most down-gradient. The range across the site in November 2017 was observed to be 8.12 m and the range across the site in May 2018 was observed to be 14.06 m. The largest variation recorded between the 2 monitoring rounds in the reporting period (i.e. from November 2017 to May 2017) was a decrease of 1.82 m at BH5, noting that no water was present in piezometers BH1S, BH4S or BH6S in May 2018.

It is noted that monitoring piezometer BH3D (EPL Point 6) was re-established in January 2014 following an inability to sample in November 2013. The piezometer has not been resurveyed following re-establishment and as such the reduced standing water level may be slightly inaccurate.

3.3.2 GROUNDWATER QUALITY

Analytical results for each groundwater monitoring station sampled in the reporting period are presented in **Appendix A, Table A3**.

Physical Parameters

Laboratory measured pH ranged from 5.9 pH units at BH2 (November 2017) to 7.1 pH units at BH5 (November 2017). The pH values of groundwater at BH1D, BH3S, BH4D, BH5 and BH6D were considered suitable for livestock drinking water; within the guideline range of 6.5 to 8.5 pH units (Markwick, 2007).

Electrical conductivity ranged from 100 $\mu\text{S}/\text{cm}$ at BH1D (May 2018) to 1,200 $\mu\text{S}/\text{cm}$ at BH5 (November 2017).

Total dissolved solids were found to range from 89 mg/L at BH1D (May 2018) to 660 mg/L at BH5 (November 2017), and within previously recorded ranges. All values were considered suitable for consumption by the most susceptible livestock category, poultry (<3000 mg/L, ANZECC & ARMCANZ, 2000).

Total alkalinity concentrations ranged from 24 mgCaCO₃/L at BH1D (May 2018) to 460 mgCaCO₃/L at BH5 (November 2017). All values were consistent with historical results, however alkalinity recorded at BH5 (November 2017) exceeded the guideline hardness value for potential fouling of waters (350 mg/L, ANZECC & ARMCANZ, 2000).

Chemical Properties

Exchangeable Ions

Chloride concentrations ranged from 4.7 mg/L at BH4D (May 2018) to 69 mg/L at BH2 (November 2017 and May 2018). All concentrations were significantly lower than the guideline value for irrigation to moderately tolerant crops (700 mg/L, ANZECC & ARMCANZ, 2000).

Sulfate concentrations ranged from below the laboratory LOR of 1 mg/L at BH2 (November 2017 and May 2018), to 160 mg/L at BH5 (November 2017). All concentrations were significantly lower than the 1,000 mg/L guideline value for livestock drinking water (ANZECC & ARMCANZ, 2000).

Fluoride concentrations ranged from below the laboratory LOR of 0.1 mg/L at BH1D (May 2018) and BH2 (May 2018), 0.25 mg/L at BH4D (May 2018). These values are lower than the livestock drinking water guideline value (2.0 mg/L, ANZECC & ARMCANZ, 2000).

Calcium concentrations ranged from 1.4 mg/L at BH2 (November 2017) to 13 mg/L at BH4D (May 2018). All concentrations were significantly lower than the livestock drinking water guideline value of 1,000 mg/L (ANZECC & ARMCANZ, 2000).

Magnesium concentrations ranged from 4 mg/L at BH1D (May 2018) to 74 mg/L at BH5 (November 2017).

Potassium concentrations ranged from 0.3 mg/L at BH2 (November 2017) to 2.9 mg/L at BH1D (May 2018).

Sodium concentrations were recorded to be highest at 5 at 170 mg/L (November 2017), whilst BH1D recorded the lowest sodium concentration in groundwater at 10 mg/L (May 2018). These values are below the guideline for irrigation of moderately tolerant crops (460 mg/L, ANZECC & ARMCANZ, 2000), and the conservative aesthetic guideline for human drinking water (180 mg/L, NHMRC & NRMCC, 2011).

Nutrients

Ammonia was low across the facility, ranging from below the LOR of 0.01 mgN/L at BH3D (May 2018), to 0.07 mgN/L at BH2 (May 2018). All values were below the conservative aesthetic guideline for ammonia in human drinking water (0.41 mgN/L, NHMRC & NRMCC, 2011).

Nitrite was recorded at below the laboratory LOR (<0.01 mgN/L) in all groundwater samples. Results were significantly lower than the livestock drinking water guideline value of 9.12 mgN/L (ANZECC & ARMCANZ, 2000).

Nitrate was lowest at BH3S, below the laboratory LOR of 0.05 mgN/L (November 2017) and most elevated at BH2 at 17.0 mgN/L (November 2017). These results are lower than the livestock drinking water guideline value for nitrate (90.29 mg/L, ANZECC & ARMCANZ, 2000).

Total phosphorus was recorded to range from below the laboratory LOR of 0.02 mg/L at BH1D (May 2018) to 1.7 mg/L at BH3S (November 2017). While all values were below the upper limit of the short-term crop irrigation range, only groundwater sampled from BH1D was considered suitable for long-term irrigation (ANZECC & ARMCANZ, 2000).

Organics

Total organic carbon in groundwater was recorded to range from 0.5 mg/L at BH4D (May 2018), to 7.3 mg/L at BH5 (November 2017).

Total phenolics were not detected in any groundwater sample collected during the reporting period (<0.014 mg/L).

Organochlorine and organophosphorus pesticides were not detected in any annual sample (<0.010 mg/L and <0.014 mg/L respectively).

Polychlorinated biphenyls (PCBs) were not detected in any annual sample (<0.001 mg/L).

Polynuclear aromatic hydrocarbons (PAHs) were not detected in any annual sample (<0.0005 mg/L).

Total petroleum (TPH) and total recoverable hydrocarbons (TRH) were not detected in any annual sample (<0.2 mg/L).

Benzene, toluene, ethylbenzene, xylene and naphthalene (BTEXN) were not detected in any annual sample (BTEX <0.001 mg/L and naphthalene <0.005 mg/L).

Metals

Aluminium was not recorded at concentrations above the laboratory LOR of 5 µg/L at any piezometers. All concentrations were below the long-term crop irrigation value and livestock drinking water guideline value (5 mg/L, ANZECC & ARMCANZ, 2000).

Arsenic concentrations ranged from below the LOR of 1 µg/L at multiple piezometers, to 15 µg/L at BH4D (May 2017). No exceedances of the long-term crop irrigation and livestock drinking water guidelines (respectively 100 µg/L and 500 µg/L, ANZECC & ARMCANZ, 2000) were recorded for arsenic in groundwater.

Barium concentrations in groundwater ranged from 12 µg/L at BH6D (May 2018) to 420 µg/L at BH2 (May 2018). This was lower than the conservative health guideline for human drinking water (2,000 µg/L, NHMRC & NRMMC, 2011).

Cadmium was only detected above the laboratory LOR in groundwater at BH2 at a of 0.0001 µg/L (November 2017), which was below the conservative human health drinking water guideline (0.002 µg/L, NHMRC & NRMMC, 2011) and the long-term crop irrigation and livestock drinking water guidelines (0.01 mg/L, ANZECC & ARMCANZ, 2000).

Chromium was only detected above the laboratory LOR in groundwater at BH2 at a concentration of 0.2 µg/L (May 2018) and was below the conservative human health drinking water guideline (50 µg /L, NHMRC & NRMMC, 2011) and the long-term crop irrigation and livestock drinking water guidelines (10 µg/L, ANZECC & ARMCANZ, 2000).

Copper in groundwater was detected up to 1 µg/L at BH2 (May 2018), which was below the conservative human health drinking water guideline (2,000 µg /L, NHMRC & NRMMC, 2011), and the long-term crop irrigation and livestock drinking water guidelines (respectively 200 µg /L and 400 µg /L, ANZECC & ARMCANZ, 2000).

Cobalt ranged from below the LOR of 1 µg/L at BH3D (May 2018) and BH4D (May 2018), to 2 µg/L at BH1D (May 2018) and BH2 (May 2018). All recorded concentrations of cobalt in groundwater were below the long-term crop irrigation and livestock drinking water guidelines (respectively 50 µg/L and 1,000 µg/L, ANZECC & ARMCANZ, 2000).

Iron was observed to range from below the LOR of 5 µg/L at BH2 (May 2018) to 3,400 µg/L at BH4D (May 2018). While all values were below the short-term irrigation guideline value of 10,000 µg/L, groundwater at piezometers BH1D, BH2 and BH3D were considered suitable for long-term irrigation (ANZECC & ARMCANZ, 2000) based on iron concentrations being below 200 µg/L.

Lead was not detected in groundwater samples from any piezometer at a concentration greater than the laboratory LOR of 1 µg/L. Lead in groundwater was below the long-term crop irrigation and livestock drinking water guidelines (respectively 2,000 µg/L and 100 µg/L, ANZECC & ARMCANZ, 2000) and below the conservative human health drinking water guideline (10 µg/L, NHMRC & NRMMC, 2011).

Manganese concentrations ranged from 3 µg/L at BH3D (May 2018) to 620 µg/L at BH6D (May 2018). Samples collected from monitoring stations BH4D and BH6D exceeded the long-term (<100 years) crop irrigation guideline value of 200 µg/L. All concentrations were below the short-term (<20 years) guideline value of 10,000 µg /L (ANZECC & ARMCANZ, 2000).

Mercury was below the LOR (<0.0001 mg/L) in all groundwater samples and below relevant guideline values.

Zinc concentrations in groundwater ranged from 6 µg/L at BH3D (May 2018), to 26 µg/L at BH2 (May 2018). All recorded zinc concentrations in groundwater were below the conservative human health aesthetic guideline (3,000 µg/L, NHMRC & NRMCC, 2011) and the long-term crop irrigation and livestock drinking water guidelines (respectively 2,000 µg/L and 20,000 µg/L, ANZECC & ARMCANZ, 2000).

3.4 LANDFILL GAS

Monitoring of accumulated building gas was conducted monthly throughout the reporting period. No gas in buildings was detected in in any monitoring event.

Other Monitoring Data

4.1 PUBLIC CONCERNS AND COMPLAINTS

There were no environmental, operational or pollution complaints received for the Oberon Waste Facility during the annual reporting period.

4.2 SOLID WASTE QUANTITIES

The Oberon Waste Facility is licensed to receive general solid waste (non-putrescible and putrescible), waste tyres, and asbestos waste. The total quantity of waste received into the landfill for the reporting period was 10,007.6 tonnes. This quantity is less than the limit set under Licence Condition L3.1, which states that the total amount of general solid waste (putrescible and non-putrescible), asbestos and waste tyres disposed of at the premises must not exceed 15,000 tonnes per annum.

4.3 EFFECTIVE COMPACTION

The licence for Oberon Waste Facility requires a minimum waste compaction of 0.65 t/m³ (EPL Condition O6.9), and is calculated by dividing the tonnage received by the volume utilised. A volumetric survey of the facility at the end of the reporting period was completed, and compared to the volumetric survey conducted at the commencement of the 2016-2017 reporting period. A total of 29,500 m³ of void space was consumed in this 24 month period (refer to **Appendix C**).

In addition to the 10,007.6 tonnes received at the Oberon Waste Facility in the 2017-2018 period, 12,271.8 tonnes of waste were recorded as received in the prior 2016-2017 period, totalling 22,279.4 tonnes of waste received in the period between the two volumetric surveys. Accordingly, the compaction rate has been calculated to be 0.76 tonnes/m³, greater than the minimum requirement of the EPL.

All exposed landfilled waste is generally covered daily to a minimum depth of 150 mm and compacted at the end of each day prior to ceasing operations. Compaction is achieved using a 28 tonne bulldozer and/or a 25 tonne excavator.

Summary

This section provides a summary of the monitoring results presented in **Section 3** and **Section 4**.

5.1 MONITORING

5.1.1 SURFACE WATER

Discharge samples from SW1 as required by to be collected by EPL occurred in December 2017 and January 2018.

No exceedances of the EPL discharge limits (licence condition L2.4) were recorded for TSS, EC, pH or oil & grease.

5.1.2 GROUNDWATER

Comparative reduced groundwater levels indicated that piezometer BH6 is the most up-gradient monitoring point and the western piezometers at BH3 (pair), BH4 (pair) and BH5 are the most down-gradient. The range across the site in November 2017 was observed to be 8.12 m and the range across the site in May 2018 was observed to be 14.06 m. The largest variation recorded between the 2 monitoring rounds in the reporting period (i.e. from November 2017 to May 2017) was a decrease of 1.82 m at BH5, noting that no water was present in piezometers BH1S, BH4S or BH6S in May 2018.

It is noted that monitoring piezometer BH3D (EPL Point 6) was re-established in January 2014 following an inability to sample in November 2013. The piezometer has not been resurveyed following re-establishment and as such the reduced standing water level may be slightly inaccurate.

Organic contaminants, including PCBs, pesticides, phenolics, PAHs and petroleum hydrocarbons, were not detected in any groundwater sample. No significant changes were observed between the monitoring rounds.

5.1.3 LANDFILL GAS

Monitoring of accumulated building gas was conducted monthly throughout the reporting period. No gas in buildings was detected in in any monitoring event.

5.1.4 COMPLAINTS

There were no environmental, operational or pollution complaints received for the Oberon Waste Facility during the annual reporting period.

5.2 SOLID WASTE QUANTITIES

The total quantity of waste received into the landfill for the reporting period was 10,007.6 tonnes. This quantity is below the limit set under Licence Condition L3.1.

5.3 WASTE COMPACTION

A total of 22,279.4 tonnes of waste was received at the Oberon Waste Facility in the period between volumetric surveys conducted in 2016 and 2018, which identified an increase of 29,500 m³ in volume. The compaction rate has been calculated to be 0.76 tonnes/m³, greater than the minimum requirement of the EPL.

All exposed landfilled waste is generally covered daily to a minimum depth of 150 mm and compacted at the end of each day prior to ceasing operations. Compaction is achieved using a 28 tonne bulldozer and/or a 25 tonne excavator.

Conclusion and Recommendations

6.1 CONCLUSION

The results of the groundwater sampling indicated relatively consistent groundwater conditions at the Oberon Waste Facility, indicating little to no evidence of adverse impact arising from the landfill.

No exceedances of the EPL discharge limit for surface water were recorded.

The waste quantity landfilled was below the EPL limit, and the average compaction rate was calculated to be greater than the minimum requirement of the EPL.

6.2 RECOMMENDATIONS

It is recommended that environmental monitoring be continued at the Oberon Waste Facility in accordance with existing monitoring requirements of EPL 20289 and the Oberon Waste Facility LEMP.

References

Australia and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*.

Markwick, G 2007, '*Water requirements for sheep and cattle*', Primefact 326, New South Wales Department of Primary Industries, Australia.

National Health and Medical Research Council and the Natural Resource Management Ministerial Council (NHMRC & NRMMC) 2011, *National Water Quality Management Strategy: Australian Drinking Water Guidelines*, updated 2015.

Oberon Shire Council 2013, *Landfill Environmental Management Plan – Oberon Waste Facility*, Australia.

Appendix A

MONITORING DATA

TABLE A1 - EPL 20289 OBERON WASTE FACILITY- GROUNDWATER GAUGING RESULTS

Definitions:

- Stickup: Height of piezometer pipe above ground surface.
- Ground Elev: Actual elevation of ground at the piezometer relative to an arbitrary datum. All ground elevations are measured to the same datum, hence Piezo GWLs are relative to each other.
- GWL: Actual elevation of groundwater at the piezometer relative to an arbitrary datum.
- Measured: Depth of groundwater measured from the top of the piezometer pipe.
- WLNLM: *Water Level Not Measured (Dry)*

Date	BH1S		BH1D		BH2		BH3S		BH3D		BH4S		BH4D		BH5		BH6S		BH6D	
	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)
19-Nov-13	4.41	1110.46	5.20	1109.61	3.06	1110.46	1.63	1104.51	1.18	1104.78	1.40	1104.75	1.27	1104.89	1.89	1105.86	4.83	1118.24	5.06	1118.14
25-Feb-14	-		-		-		-		2.28	1103.68	-		-		-					
12-May-14	4.80	1110.07	5.20	1109.61	2.85	1110.67	1.58	1104.56	1.48	1104.48	1.26	1104.89	1.23	1104.93	1.97	1105.78	5.20	1117.87	5.07	1118.13
5-Nov-14	3.99	1110.88	4.28	1110.53	2.72	1110.80	1.31	1104.83	1.24	1104.72	1.43	1104.72	0.92	1105.24	1.66	1106.09	4.90	1118.17	4.94	1118.26
6-May-15	2.67	1112.20	3.58	1111.23	2.90	1110.62	1.27	1104.87	1.18	1104.78	1.91	1104.24	1.21	1104.95	2.11	1105.64	5.87		WLNLM	
23-Nov-15	2.82	1112.05	3.33	1111.48	2.90	1110.62	1.04	1105.10	0.94	1105.02	1.05	1105.10	0.70	1105.46	1.30	1106.45	4.83	1118.24	4.73	1118.47
19-May-16	5.42	1109.45	WLNLM		5.80	1107.72	2.55	1103.59	WLNLM		4.65	1101.50	WLNLM		3.97	1103.78	5.87		WLNLM	
5-Sep-16	1.46	1113.41	WLNLM		5.80	1107.72	0.61	1105.53	WLNLM		0.97	1105.18	WLNLM		5.50	1102.25	5.87		WLNLM	
7-Nov-16	2.14	1112.73	2.80	1112.01	0.74	1112.78	0.82	1105.32	0.76	1105.20	1.35	1104.80	1.45	1104.71	0.99	1106.76	3.22	1119.85	3.72	1119.48
17-May-17	5.37	1109.50	WLNLM		5.80	1107.72	2.51	1103.63	WLNLM		4.73	1101.42	WLNLM		4.87	1102.88	5.87		WLNLM	
13-Nov-17	5.50		WLNLM		3.68	1109.84	2.71	1103.43	WLNLM		4.43	1101.72	WLNLM		3.47	1104.28	5.87		WLNLM	
28-May-18	WLNLM		7.42	1107.39	4.50	1109.02	4.22	1101.92	4.01	1101.95	WLNLM		4.00	1102.16	5.29	1102.46	WLNLM		7.22	1115.98

TABLE A2: OBERON WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS, SURFACE WATER



				Sample ID	SW1	SW1
					Sample Date	5/12/2017
Group	Analyte	LOR	Units	Criteria	PS	PS
Physical Parameters	pH (Lab)	-	No unit	6.0 - 8.5	6.9	7.1
	Electrical Conductivity (Lab)	2	µS/cm	-	400	630
	Total Suspended Solids	5	mg/L	50	46	41
	Oil & Grease	5	mg/L	10	10	-
	Oil & Grease	10	mg/L	10	-	< 10

mg/L milligrams per litre
 µS/cm microsiemens per centimetre
 LOR limit of reporting
 PS primary sample
 Criteria Criteria adopted from *Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Australian and New Zealand Guidelines for Fresh and Marine Water Quality - 'Primary Industries: Water quality for irrigation and general water use', 2000*
 and/or
 NSW EPA Environment Protection Licence 20289 'Limit Conditions - L2.4 Water and/or Land Concentration

within criteria
 criteria exceeded

TABLE A3: OBERON WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS, GROUNDWATER



Group	Analyte	LOR	Units	Criteria	Sample ID	BH1D	BH2	BH2	BH3D	BH3S	BH4D	BH5	BH6D
					Sample Date	28/05/2018	13/11/2017	28/05/2018	28/05/2018	13/11/2017	28/05/2018	13/11/2017	28/05/2018
					PS	PS	PS	PS	PS	PS	PS	PS	
Physical Parameters	pH (Lab)	-	No unit	6.0 - 8.5	6	5.9	6.1	6.3	6.7	6.7	6.7	7.1	6.9
	Electrical Conductivity (Lab)	2	µS/cm		100	470	470	180	590	220	1200	1200	220
	Total Dissolved Solids	10	mg/L	3000	89	300	310	150	360	150	660	660	140
Alkalinity	Total Alkalinity as CaCO3	5	mg/L	350	24	56	57	74	250	110	460	99	
Anions	Chloride	1	mg/L	350	11	69	69	13	32	4.7	36	11	
	Fluoride	0.1	mg/L	1	<0.1	-	<0.1	0.16	-	0.25	-	0.11	
	Sulfate (SO4)	1	mg/L	-	9.1	<1	<1	6.6	10	4.5	160	3.3	
Cations	Calcium (Ca)	0.2	mg/L	1000	2.8	1.4	3	4.8	5.1	13	12	5.1	
	Magnesium (Mg)	0.1	mg/L	-	4	39	40	13	16	14	74	19	
	Potassium (K)	0.1	mg/L	-	2.9	0.3	0.5	1.5	0.5	1.4	0.9	2.6	
	Sodium (Na)	0.5	mg/L	230	10	16	18	15	100	13	170	12	
Forms of Carbon	Total Organic Carbon	0.2	mg/L	-	0.6	1	1.7	0.6	4.9	0.5	7.3	1.2	
Nutrients	Ammonia (NH3) as N	0.01	mg/L	-	0.01	0.04	0.07	<0.01	0.02	0.02	0.02	0.02	
	Nitrate (NO3) as N	0.05	mg/L	-	-	-	-	<0.05	-	-	-	-	
	Nitrate (NO3) as N	0.005	mg/L	-	0.077	17	16	0.067	-	0.02	3	0.087	
	Nitrite (NO2) as N	0.005	mg/L	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
	Total Phosphorus	0.02	mg/L	0.05	<0.02	0.69	1.5	0.08	1.7	0.26	0.06	0.33	
Trace Metals	Mercury (Hg)	0.0001	mg/L	2	<0.0001	-	<0.0001	<0.0001	-	<0.0001	-	<0.0001	
	Aluminium (Al)	5	µg/L	5000	<5	-	<5	<5	-	<5	-	<5	
	Arsenic (As)	1	µg/L	100	<1	-	<1	<1	-	15	-	9	
	Barium (Ba)	1	µg/L	-	170	-	420	68	-	22	-	12	
	Cadmium (Cd)	0.1	µg/L	10	<0.1	-	0.2	<0.1	-	<0.1	-	<0.1	
	Chromium (Cr)	1	µg/L	100	<1	-	<1	<1	-	<1	-	<1	
	Cobalt (Co)	1	µg/L	50	2	-	2	<1	-	<1	-	1	
	Copper (Cu)	1	µg/L	200	<1	-	1	<1	-	<1	-	<1	
	Iron (Fe)	5	µg/L	200	6	-	<5	6	-	3400	-	2300	
	Lead (Pb)	1	µg/L	2000	<1	-	<1	<1	-	<1	-	<1	
	Manganese (Mn)	1	µg/L	200	23	-	100	3	-	560	-	620	
	Zinc (Zn)	5	µg/L	2000	17	-	26	6	-	17	-	6	
	OC Pesticides	Aldrin	0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1
		Alpha BHC	0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1
Alpha Chlordane		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Alpha Endosulfan		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Beta BHC		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Beta Endosulfan		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Delta BHC		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Dieldrin		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Endosulfan sulphate		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Endrin		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Endrin aldehyde		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Endrin ketone		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Heptachlor		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Heptachlor epoxide		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Hexachlorobenzene (HCB)		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Lindane (gamma BHC)		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Methoxychlor		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
p,p'-DDD		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
p,p'-DDE		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
p,p'-DDT		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
o,p'-DDE		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
Gamma Chlordane		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
trans-Nonachlor		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
o,p'-DDD		0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1	
o,p'-DDT	0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1		
Isodrin	0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1		
Mirex	0.1	µg/L	-	<0.1	-	<0.1	<0.1	-	<0.1	-	<0.1		
OP Pesticides	Dichlorvos	0.5	µg/L	-	<0.5	-	<0.5	<0.5	-	<0.5	-	<0.5	
	Dimethoate	0.5	µg/L	-	<0.5	-	<0.5	<0.5	-	<0.5	-	<0.5	
	Ethion	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Malathion	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Diazinon (Dimpylate)	0.5	µg/L	-	<0.5	-	<0.5	<0.5	-	<0.5	-	<0.5	
	Chlorpyrifos (Chlorpyrifos Ethyl)	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Parathion-ethyl (Parathion)	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Bromophos Ethyl	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Azinphos-methyl	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Fenitrothion	0.2	µg/L	-	<0.2	-	<0.2	<0.2	-	<0.2	-	<0.2	
	Methidathion	0.5	µg/L	-	<0.5	-	<0.5	<0.5	-	<0.5	-	<0.5	

TABLE A3: OBERON WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS, GROUNDWATER



Group	Analyte	LOR	Units	Criteria	Sample ID	BH1D	BH2	BH2	BH3D	BH3S	BH4D	BH5	BH6D
					Sample Date	28/05/2018	13/11/2017	28/05/2018	28/05/2018	13/11/2017	28/05/2018	13/11/2017	28/05/2018
					PS	PS	PS	PS	PS	PS	PS	PS	PS
Phenolics	Total Phenols	0.01	mg/L	-	< 0.01	-	< 0.01	< 0.01	< 0.01	-	< 0.01	-	< 0.01
Polynuclear Aromatic Hydrocarbons	Acenaphthene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Acenaphthylene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Anthracene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Benzo(a)anthracene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Benzo(a)pyrene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Benzo(b&j)fluoranthene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Benzo(ghi)perylene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Benzo(k)fluoranthene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Chrysene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Dibenzo(ah)anthracene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Fluoranthene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Fluorene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Indeno(1,2,3-cd)pyrene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Naphthalene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Phenanthrene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	Pyrene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
	2-methylnaphthalene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1
1-methylnaphthalene	0.1	µg/L	-	< 0.1	-	< 0.1	< 0.1	< 0.1	-	< 0.1	-	< 0.1	
Total PAHs	1	µg/L	-	< 1	-	< 1	< 1	< 1	-	< 1	-	< 1	
BTEXN Analytes	Benzene (F0)	0.5	µg/L	-	< 0.5	-	< 0.5	< 0.5	< 0.5	-	< 0.5	-	< 0.5
	Toluene	0.5	µg/L	-	< 0.5	-	< 0.5	< 0.5	< 0.5	-	< 0.5	-	< 0.5
	Ethylbenzene	0.5	µg/L	-	< 0.5	-	< 0.5	< 0.5	< 0.5	-	< 0.5	-	< 0.5
	meta- & para-Xylene	1	µg/L	-	< 1	-	< 1	< 1	< 1	-	< 1	-	< 1
	ortho-Xylene	0.5	µg/L	-	< 0.5	-	< 0.5	< 0.5	< 0.5	-	< 0.5	-	< 0.5
	Total Xylenes	1.5	µg/L	-	< 1.5	-	< 1.5	< 1.5	< 1.5	-	< 1.5	-	< 1.5
	Sum of BTEX	3	µg/L	-	< 3	-	< 3	< 3	< 3	-	< 3	-	< 3
	Naphthalene	0.5	µg/L	-	< 0.5	-	< 0.5	< 0.5	< 0.5	-	< 0.5	-	< 0.5
Total Petroleum Hydrocarbons	TRH C6-C9	40	µg/L	-	< 40	-	< 40	< 40	< 40	-	< 40	-	< 40
	TRH C10-C14	50	µg/L	-	< 50	-	< 50	< 50	< 50	-	< 50	-	< 50
	TRH C15-C28	200	µg/L	-	< 200	-	< 200	< 200	< 200	-	< 200	-	< 200
	TRH C29-C36	200	µg/L	-	< 200	-	< 200	< 200	< 200	-	< 200	-	< 200
	TRH C10-C36	450	µg/L	-	< 450	-	< 450	< 450	< 450	-	< 450	-	< 450
	TRH C37-C40	200	µg/L	-	< 200	-	< 200	< 200	< 200	-	< 200	-	< 200
Total Recoverable Hydrocarbons	Benzene (F0)	0.5	µg/L	-	< 0.5	-	< 0.5	< 0.5	< 0.5	-	< 0.5	-	< 0.5
	TRH C6-C10	50	µg/L	-	< 50	-	< 50	< 50	< 50	-	< 50	-	< 50
	TRH C6-C10 less BTEX (F1)	50	µg/L	-	< 50	-	< 50	< 50	< 50	-	< 50	-	< 50
	TRH >C10-C16 (F2)	60	µg/L	-	< 60	-	< 60	< 60	< 60	-	< 60	-	< 60
	TRH >C10-C16 less Naphthalene (F2)	60	µg/L	-	< 60	-	< 60	< 60	< 60	-	< 60	-	< 60
	TRH >C16-C34 (F3)	500	µg/L	-	< 500	-	< 500	< 500	< 500	-	< 500	-	< 500
	TRH >C34-C40 (F4)	500	µg/L	-	< 500	-	< 500	< 500	< 500	-	< 500	-	< 500
	TRH C10-C40	650	µg/L	-	< 650	-	< 650	< 650	< 650	-	< 650	-	< 650

mg/L milligrams per litre
 µS/cm microsiemens per centimetre
 LOR limit of reporting
 PS primary sample
 Criteria Criteria adopted from Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Australian and New Zealand Guidelines for Fresh and Marine Water Quality - 'Primary Industries: Water quality for irrigation and general water use', 2000

and/or
 NSW EPA Environment Protection Licence 20289 'Limit Conditions - L2.4 Water and/or Land Concentration Limits', 2013
 within criteria
 criteria exceeded

Appendix B

LABORATORY REPORTS

CLIENT DETAILS

Contact **Brendan Stuart**
 Client **GEOLYSE PTY LIMITED**
 Address **PO BOX 1963
 NSW 2800**

Telephone **61 2 68841525**
 Facsimile **(Not specified)**
 Email **bstuart@geolyse.com**

Project **217505 - Oberon WF**
 Order Number **(Not specified)**
 Samples **3**

LABORATORY DETAILS

Manager **Huong Crawford**
 Laboratory **SGS Alexandria Environmental**
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 Alexandria NSW 2015**

Telephone **+61 2 8594 0400**
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 Email **au.environmental.sydney@sgs.com**

SGS Reference **SE172656 R0**
 Date Received **16 Nov 2017**
 Date Reported **23 Nov 2017**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

Ion Chromatography - The Limit of Reporting (LOR) has been raised for NO3-N due to high conductivity of the sample requiring dilution.

SIGNATORIES



Dong Liang
 Metals/Inorganics Team Leader



Huong Crawford
 Production Manager



Kamrul Ahsan
 Senior Chemist



Shane McDermott
 Inorganic/Metals Chemist

Parameter	Units	LOR	SE172656.001	SE172656.002	SE172656.003
Sample Number			SE172656.001	SE172656.002	SE172656.003
Sample Matrix			Water	Water	Water
Sample Date			13 Nov 2017	13 Nov 2017	13 Nov 2017
Sample Name			BH2	BH3(S)	BH5

Anions by Ion Chromatography in Water Method: AN245 Tested: 17/11/2017

Chloride	mg/L	1	69	32	36
Nitrate Nitrogen, NO3-N	mg/L	0.005	17	<0.050†	3.0
Sulfate, SO4	mg/L	1	<1.0	10	160

Alkalinity Method: AN135 Tested: 17/11/2017

Total Alkalinity as CaCO3	mg/L	5	56	250	460
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 21/11/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	300	360	660
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Forms of Carbon Method: AN190 Tested: 22/11/2017

Total Organic Carbon as NPOC	mg/L	0.2	1.0	4.9	7.3
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pH in water Method: AN101 Tested: 17/11/2017

pH**	No unit	-	5.9	6.7	7.1
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 17/11/2017

Conductivity @ 25 C	µS/cm	2	470	590	1200
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Parameter	Units	LOR	SE172656.001	SE172656.002	SE172656.003
Sample Number			SE172656.001	SE172656.002	SE172656.003
Sample Matrix			Water	Water	Water
Sample Date			13 Nov 2017	13 Nov 2017	13 Nov 2017
Sample Name			BH2	BH3(S)	BH5

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 20/11/2017

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.04	0.02	0.02
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Nitrite in Water Method: AN277 Tested: 20/11/2017

Nitrite Nitrogen, NO ₂ as N	mg/L	0.005	<0.005	<0.005	<0.005
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Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/11/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.69	1.7	0.06
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 21/11/2017

Calcium, Ca	mg/L	0.2	1.4	5.1	12
Magnesium, Mg	mg/L	0.1	39	16	74
Potassium, K	mg/L	0.1	0.3	0.5	0.9
Sodium, Na	mg/L	0.5	16	100	170

MB blank results are compared to the Limit of Reporting
 LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
 DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB136716	mg/L	5	<5	0 - 4%	97%

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB136751	mg/L	0.01	<0.01	6 - 71%	108%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Chloride	LB136719	mg/L	1	<0.05	0 - 1%	95%	
Nitrate Nitrogen, NO ₃ -N	LB136719	mg/L	0.005	<0.005	1%	96%	100%
Sulfate, SO ₄	LB136719	mg/L	1	<1.0	0 - 1%	93%	

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB136692	µS/cm	2	<2	1%	100%

Forms of Carbon Method: ME-(AU)-[ENV]AN190

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Organic Carbon as NPOC	LB136971	mg/L	0.2	<0.2	1%	97%	95%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB136868	mg/L	0.2	<0.2	2 - 3%	95%	106%
Magnesium, Mg	LB136868	mg/L	0.1	<0.1	1 - 2%	95%	
Potassium, K	LB136868	mg/L	0.1	<0.1	2 - 6%	93%	123%
Sodium, Na	LB136868	mg/L	0.5	<0.5	1 - 6%	98%	89%

MB blank results are compared to the Limit of Reporting
 LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
 DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Nitrite in Water Method: ME-(AU)-[ENV]AN277

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB136751	mg/L	0.005	<0.005	100%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB136692	No unit	-	1 - 3%	99%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB136828	mg/L	10	<10	5%	98%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB136855	mg/L	0.02	<0.02	22%	108%	108%

METHOD

METHODOLOGY SUMMARY

AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN190	TOC and DOC in Water: A homogenised micro portion of sample is injected into a heated reaction chamber packed with an oxidative catalyst that converts organic carbon to carbon dioxide. The CO ₂ is measured using a non-dispersive infrared detector. The process is fully automated in a commercially available analyser. If required a sugar value can be calculated from the TOC result. Reference APHA 5310 B.
AN190	Chemical oxygen demand can be calculated/estimated based on the O ₂ /C relation as 2.67*NPOC (TOC). This is an estimate only and the factor will vary with sample matrix so results should be interpreted with caution.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO ₂ , NO ₃ and SO ₄ are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K ₂ SO ₄ and CuSO ₄ . All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.

METHOD

METHODOLOGY SUMMARY

Calculation

Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported . APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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Project **217505 - Oberson WF**
 Order Number **(Not specified)**
 Samples **1**

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SGS Reference **SE173460 R0**
 Date Received **07 Dec 2017**
 Date Reported **08 Dec 2017**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES



Dong Liang
Metals/Inorganics Team Leader

Sample Number SE173460.001
 Sample Matrix Water
 Sample Date 05 Dec 2017
 Sample Name SW1

Parameter	Units	LOR
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pH in water Method: AN101 Tested: 8/12/2017

pH**	No unit	-	6.9
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 8/12/2017

Conductivity @ 25 C	µS/cm	2	400
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Oil and Grease in Water Method: AN185 Tested: 8/12/2017

Oil and Grease	mg/L	5	10
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Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 8/12/2017

Total Suspended Solids Dried at 103-105°C	mg/L	5	46
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MB blank results are compared to the Limit of Reporting
 LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
 DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB138226	µS/cm	2	<2	0%	103%

Oil and Grease in Water Method: ME-(AU)-[ENV]AN185

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Oil and Grease	LB138160	mg/L	5	<5	105%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	LCS %Recovery
pH**	LB138226	No unit	-	99%

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB138202	mg/L	5	<5	97%

METHOD

METHODOLOGY SUMMARY

AN101

pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.

AN106

Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as $\mu\text{mhos/cm}$ or $\mu\text{S/cm}$ @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.

AN114

Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114

AN185

Gravimetric Oil & Grease and Hydrocarbons: A known volume of sample is extracted using an organic solvent and the solvent layer with dissolved oils and greases is transferred to a pre-weighed beaker. The solvent is evaporated over low heating and the beaker reweighed. The concentration of oil and grease is determined by the increase in mass of the collection beaker per volume of sample extracted. O&G is suitable for lubricating oils and other high boiling point products but is not suitable for volatiles. Reference APHA 5520 B. Internal Reference AN185

FOOTNOTES

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*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

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Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

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Project **217505 - Oberon WF**
 Order Number **(Not specified)**
 Samples **1**

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SGS Reference **SE174464 R0**
 Date Received **18 Jan 2018**
 Date Reported **19 Jan 2018**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

Oil and Grease - LOR raised due to insufficient sample provided.

SIGNATORIES



Dong Liang
Metals/Inorganics Team Leader

Sample Number SE174464.001
 Sample Matrix Water
 Sample Date 16 Jan 2018
 Sample Name SW1

Parameter	Units	LOR
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pH in water Method: AN101 Tested: 18/1/2018

pH**	No unit	-	7.1
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 18/1/2018

Conductivity @ 25 C	µS/cm	2	630
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Oil and Grease in Water Method: AN185 Tested: 19/1/2018

Oil and Grease	mg/L	5	<10 †
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Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 19/1/2018

Total Suspended Solids Dried at 103-105°C	mg/L	5	41
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MB blank results are compared to the Limit of Reporting
 LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
 DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Conductivity @ 25 C	LB139813	µS/cm	2	<2	103%

Oil and Grease in Water Method: ME-(AU)-[ENV]AN185

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Oil and Grease	LB139828	mg/L	5	<5	104%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	LCS %Recovery
pH**	LB139813	No unit	-	99%

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB139831	mg/L	5	<5	15%	97%

METHOD

METHODOLOGY SUMMARY

AN101

pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.

AN106

Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as $\mu\text{mhos/cm}$ or $\mu\text{S/cm}$ @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.

AN114

Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114

AN185

Gravimetric Oil & Grease and Hydrocarbons: A known volume of sample is extracted using an organic solvent and the solvent layer with dissolved oils and greases is transferred to a pre-weighed beaker. The solvent is evaporated over low heating and the beaker reweighed. The concentration of oil and grease is determined by the increase in mass of the collection beaker per volume of sample extracted. O&G is suitable for lubricating oils and other high boiling point products but is not suitable for volatiles. Reference APHA 5520 B. Internal Reference AN185

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

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Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
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Project **217505 - Oberon WF**
 Order Number **(Not specified)**
 Samples **5**

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SGS Reference **SE179733 R0**
 Date Received **30 May 2018**
 Date Reported **06 Jun 2018**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

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Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Number			SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Matrix			Water	Water	Water	Water
Sample Date			28 May 2018	28 May 2018	28 May 2018	28 May 2018
Sample Name			BH2	BH1(D)	BH3(D)	BH4(D)

VOCs in Water Method: AN433 Tested: 31/5/2018

Monocyclic Aromatic Hydrocarbons

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5

Polycyclic VOCs

Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
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Surrogates

Dibromofluoromethane (Surrogate)	%	-	115	123	101	117
d4-1,2-dichloroethane (Surrogate)	%	-	113	118	111	109
d8-toluene (Surrogate)	%	-	90	110	102	104
Bromofluorobenzene (Surrogate)	%	-	94	96	82	84

Totals

Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	<3	<3	<3

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 31/5/2018

TRH C6-C10	µg/L	50	<50	<50	<50	<50
TRH C6-C9	µg/L	40	<40	<40	<40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	115	123	101	117
d4-1,2-dichloroethane (Surrogate)	%	-	113	118	111	109
d8-toluene (Surrogate)	%	-	90	110	102	104
Bromofluorobenzene (Surrogate)	%	-	94	96	82	84

VPH F Bands

Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50

Parameter	Units	LOR	Sample Number	SE179733.001	SE179733.002	SE179733.003	SE179733.004
			Sample Matrix	Water	Water	Water	Water
			Sample Date	28 May 2018	28 May 2018	28 May 2018	28 May 2018
			Sample Name	BH2	BH1(D)	BH3(D)	BH4(D)

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 1/6/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
TRH C10-C14	µg/L	50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200
TRH C10-C36	µg/L	450	<450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650	<650

TRH F Bands

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
TRH >C10-C16	µg/L	60	<60	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500

PAH (Polynuclear Aromatic Hydrocarbons) in Water Method: AN420 Tested: 1/6/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Naphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Total PAH (18)	µg/L	1	<1	<1	<1	<1

Surrogates

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
d5-nitrobenzene (Surrogate)	%	-	48	64	52	52
2-fluorobiphenyl (Surrogate)	%	-	58	78	58	72
d14-p-terphenyl (Surrogate)	%	-	68	86	60	86

OC Pesticides in Water Method: AN420 Tested: 1/6/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Number			SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Matrix			Water	Water	Water	Water
Sample Date			28 May 2018	28 May 2018	28 May 2018	28 May 2018
Sample Name			BH2	BH1(D)	BH3(D)	BH4(D)

OC Pesticides in Water Method: AN420 Tested: 1/6/2018 (continued)

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1	<0.1

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	90	107	98	105
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OP Pesticides in Water Method: AN420 Tested: 1/6/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2

Surrogates

2-fluorobiphenyl (Surrogate)	%	-	58	78	58	72
d14-p-terphenyl (Surrogate)	%	-	68	86	60	86

Total Phenolics in Water Method: AN289 Tested: 1/6/2018

Total Phenols	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
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pH in water Method: AN101 Tested: 30/5/2018

pH**	No unit	-	6.1	6.0	6.3	6.7
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Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Number			SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Matrix			Water	Water	Water	Water
Sample Date			28 May 2018	28 May 2018	28 May 2018	28 May 2018
Sample Name			BH2	BH1(D)	BH3(D)	BH4(D)

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 30/5/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Conductivity @ 25 C	µS/cm	2	470	100	180	220

Anions by Ion Chromatography in Water Method: AN245 Tested: 31/5/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Chloride	mg/L	1	69	11	13	4.7
Sulfate, SO4	mg/L	1	<1.0	9.1	6.6	4.5
Fluoride	mg/L	0.1	<0.10	<0.10	0.16	0.25
Nitrate Nitrogen, NO3-N	mg/L	0.005	16	0.077	0.067	0.020

Alkalinity Method: AN135 Tested: 30/5/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Total Alkalinity as CaCO3	mg/L	5	57	24	74	110

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 31/5/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Total Dissolved Solids Dried at 175-185°C	mg/L	10	310	89	150	150

Forms of Carbon Method: AN190 Tested: 31/5/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Total Organic Carbon as NPOC	mg/L	0.2	1.7	0.6	0.6	0.5

Nitrite in Water Method: AN277 Tested: 30/5/2018

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Parameter	Units	LOR	SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Number			SE179733.001	SE179733.002	SE179733.003	SE179733.004
Sample Matrix			Water	Water	Water	Water
Sample Date			28 May 2018	28 May 2018	28 May 2018	28 May 2018
Sample Name			BH2	BH1(D)	BH3(D)	BH4(D)

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 31/5/2018

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	1.5	<0.02	0.08	0.26
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Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 30/5/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.07	0.01	<0.01	0.02
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 1/6/2018

Calcium, Ca	mg/L	0.2	3.0	2.8	4.8	13
Magnesium, Mg	mg/L	0.1	40	4.0	13	14
Potassium, K	mg/L	0.1	0.5	2.9	1.5	1.4
Sodium, Na	mg/L	0.5	18	10	15	13

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 31/5/2018

Aluminium, Al	µg/L	5	<5	<5	<5	<5
Arsenic, As	µg/L	1	<1	<1	<1	15
Barium, Ba	µg/L	1	420	170	68	22
Cadmium, Cd	µg/L	0.1	0.2	<0.1	<0.1	<0.1
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Cobalt, Co	µg/L	1	2	2	<1	<1
Copper, Cu	µg/L	1	1	<1	<1	<1
Iron, Fe	µg/L	5	<5	6	6	3400
Lead, Pb	µg/L	1	<1	<1	<1	<1
Manganese, Mn	µg/L	1	100	23	3	560
Zinc, Zn	µg/L	5	26	17	6	17

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 4/6/2018

Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
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Sample Number SE179733.005
 Sample Matrix Water
 Sample Date 28 May 2018
 Sample Name BH6(D)

Parameter Units LOR

VOCs in Water Method: AN433 Tested: 31/5/2018

Monocyclic Aromatic Hydrocarbons

Benzene	µg/L	0.5	<0.5
Toluene	µg/L	0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5
m/p-xylene	µg/L	1	<1
o-xylene	µg/L	0.5	<0.5

Polycyclic VOCs

Naphthalene	µg/L	0.5	<0.5
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Surrogates

Dibromofluoromethane (Surrogate)	%	-	100
d4-1,2-dichloroethane (Surrogate)	%	-	112
d8-toluene (Surrogate)	%	-	96
Bromofluorobenzene (Surrogate)	%	-	85

Totals

Total Xylenes	µg/L	1.5	<1.5
Total BTEX	µg/L	3	<3

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 31/5/2018

TRH C6-C10	µg/L	50	<50
TRH C6-C9	µg/L	40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	100
d4-1,2-dichloroethane (Surrogate)	%	-	112
d8-toluene (Surrogate)	%	-	96
Bromofluorobenzene (Surrogate)	%	-	85

Sample Number	SE179733.005	
Sample Matrix	Water	
Sample Date	28 May 2018	
Sample Name	BH6(D)	
Parameter	Units	LOR

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 31/5/2018 (continued)

VPH F Bands

Benzene (F0)	µg/L	0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 1/6/2018

TRH C10-C14	µg/L	50	<50
TRH C15-C28	µg/L	200	<200
TRH C29-C36	µg/L	200	<200
TRH C37-C40	µg/L	200	<200
TRH C10-C36	µg/L	450	<450
TRH C10-C40	µg/L	650	<650

TRH F Bands

TRH >C10-C16	µg/L	60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60
TRH >C16-C34 (F3)	µg/L	500	<500
TRH >C34-C40 (F4)	µg/L	500	<500

PAH (Polynuclear Aromatic Hydrocarbons) in Water Method: AN420 Tested: 1/6/2018

Naphthalene	µg/L	0.1	<0.1
2-methylnaphthalene	µg/L	0.1	<0.1
1-methylnaphthalene	µg/L	0.1	<0.1
Acenaphthylene	µg/L	0.1	<0.1
Acenaphthene	µg/L	0.1	<0.1
Fluorene	µg/L	0.1	<0.1
Phenanthrene	µg/L	0.1	<0.1
Anthracene	µg/L	0.1	<0.1
Fluoranthene	µg/L	0.1	<0.1
Pyrene	µg/L	0.1	<0.1
Benzo(a)anthracene	µg/L	0.1	<0.1
Chrysene	µg/L	0.1	<0.1
Benzo(b&j)fluoranthene	µg/L	0.1	<0.1
Benzo(k)fluoranthene	µg/L	0.1	<0.1
Benzo(a)pyrene	µg/L	0.1	<0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.1	<0.1
Dibenzo(ah)anthracene	µg/L	0.1	<0.1
Benzo(ghi)perylene	µg/L	0.1	<0.1
Total PAH (18)	µg/L	1	<1

Sample Number SE179733.005
 Sample Matrix Water
 Sample Date 28 May 2018
 Sample Name BH6(D)

Parameter **Units** **LOR**
PAH (Polynuclear Aromatic Hydrocarbons) in Water Method: AN420 Tested: 1/6/2018 (continued)

Surrogates

Parameter	Units	LOR	Value
d5-nitrobenzene (Surrogate)	%	-	50
2-fluorobiphenyl (Surrogate)	%	-	56
d14-p-terphenyl (Surrogate)	%	-	56

OC Pesticides in Water Method: AN420 Tested: 1/6/2018

Parameter	Units	LOR	Value
Hexachlorobenzene (HCB)	µg/L	0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1
Heptachlor	µg/L	0.1	<0.1
Aldrin	µg/L	0.1	<0.1
Beta BHC	µg/L	0.1	<0.1
Delta BHC	µg/L	0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1
Dieldrin	µg/L	0.1	<0.1
Endrin	µg/L	0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1
Isodrin	µg/L	0.1	<0.1
Mirex	µg/L	0.1	<0.1

Surrogates

Parameter	Units	LOR	Value
Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	100

Sample Number SE179733.005
 Sample Matrix Water
 Sample Date 28 May 2018
 Sample Name BH6(D)

Parameter Units LOR

OP Pesticides in Water Method: AN420 Tested: 1/6/2018

Dichlorvos	µg/L	0.5	<0.5
Dimethoate	µg/L	0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2
Malathion	µg/L	0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2
Methidathion	µg/L	0.5	<0.5
Ethion	µg/L	0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2

Surrogates

2-fluorobiphenyl (Surrogate)	%	-	56
d14-p-terphenyl (Surrogate)	%	-	56

Total Phenolics in Water Method: AN289 Tested: 1/6/2018

Total Phenols	mg/L	0.01	<0.01
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pH in water Method: AN101 Tested: 30/5/2018

pH**	No unit	-	6.9
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 30/5/2018

Conductivity @ 25 C	µS/cm	2	220
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Sample Number SE179733.005
 Sample Matrix Water
 Sample Date 28 May 2018
 Sample Name BH6(D)

Parameter Units LOR

Anions by Ion Chromatography in Water Method: AN245 Tested: 31/5/2018

Chloride	mg/L	1	11
Sulfate, SO4	mg/L	1	3.3
Fluoride	mg/L	0.1	0.11
Nitrate Nitrogen, NO3-N	mg/L	0.005	0.087

Alkalinity Method: AN135 Tested: 30/5/2018

Total Alkalinity as CaCO3	mg/L	5	99
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 31/5/2018

Total Dissolved Solids Dried at 175-185°C	mg/L	10	140
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Forms of Carbon Method: AN190 Tested: 31/5/2018

Total Organic Carbon as NPOC	mg/L	0.2	1.2
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Nitrite in Water Method: AN277 Tested: 30/5/2018

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005
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Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 31/5/2018

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.33
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Sample Number	SE179733.005	
Sample Matrix	Water	
Sample Date	28 May 2018	
Sample Name	BH6(D)	
Parameter	Units	LOR

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 30/5/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.02
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 1/6/2018

Calcium, Ca	mg/L	0.2	5.1
Magnesium, Mg	mg/L	0.1	19
Potassium, K	mg/L	0.1	2.6
Sodium, Na	mg/L	0.5	12

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 31/5/2018

Aluminium, Al	µg/L	5	<5
Arsenic, As	µg/L	1	9
Barium, Ba	µg/L	1	12
Cadmium, Cd	µg/L	0.1	<0.1
Chromium, Cr	µg/L	1	<1
Cobalt, Co	µg/L	1	1
Copper, Cu	µg/L	1	<1
Iron, Fe	µg/L	5	2300
Lead, Pb	µg/L	1	<1
Manganese, Mn	µg/L	1	620
Zinc, Zn	µg/L	5	6

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 4/6/2018

Mercury	mg/L	0.0001	<0.0001
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MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB148977	mg/L	5	<5	2%	107%

Ammonia Nitrogen by Discrete Analyser (AquaKem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB148975	mg/L	0.01	<0.01	14%	99%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride	LB149015	mg/L	1	<0.05	0 - 2%	92%
Sulfate, SO ₄	LB149015	mg/L	1	<1.0	1%	91%
Fluoride	LB149015	mg/L	0.1	<0.10	5%	99%
Nitrate Nitrogen, NO ₃ -N	LB149015	mg/L	0.005	<0.005	4%	89%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB148976	µS/cm	2	<2	1%	98%

Forms of Carbon Method: ME-(AU)-[ENV]AN190

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Organic Carbon as NPOC	LB149045	mg/L	0.2	<0.2	4%	91%	95%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB149248	mg/L	0.0001	<0.0001	0 - 26%	84%	85%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Calcium, Ca	LB149136	mg/L	0.2	<0.2	0%	104%
Magnesium, Mg	LB149136	mg/L	0.1	<0.1	1%	100%
Potassium, K	LB149136	mg/L	0.1	<0.1		102%
Sodium, Na	LB149136	mg/L	0.5	<0.5		114%

Nitrite in Water Method: ME-(AU)-[ENV]AN277

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB148975	mg/L	0.005	<0.005	3%	96%

OC Pesticides in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Hexachlorobenzene (HCB)	LB149129	µg/L	0.1	<0.1	0%	NA
Alpha BHC	LB149129	µg/L	0.1	<0.1	0%	NA
Lindane (gamma BHC)	LB149129	µg/L	0.1	<0.1	0%	NA
Heptachlor	LB149129	µg/L	0.1	<0.1	0%	77%
Aldrin	LB149129	µg/L	0.1	<0.1	0%	78%
Beta BHC	LB149129	µg/L	0.1	<0.1	0%	NA
Delta BHC	LB149129	µg/L	0.1	<0.1	0%	75%
Heptachlor epoxide	LB149129	µg/L	0.1	<0.1	0%	NA
o,p'-DDE	LB149129	µg/L	0.1	<0.1	0%	NA
Alpha Endosulfan	LB149129	µg/L	0.1	<0.1	0%	NA
Gamma Chlordane	LB149129	µg/L	0.1	<0.1	0%	NA
Alpha Chlordane	LB149129	µg/L	0.1	<0.1	0%	NA
trans-Nonachlor	LB149129	µg/L	0.1	<0.1	0%	NA
p,p'-DDE	LB149129	µg/L	0.1	<0.1	0%	NA
Dieldrin	LB149129	µg/L	0.1	<0.1	0%	82%
Endrin	LB149129	µg/L	0.1	<0.1	0%	116%
o,p'-DDD	LB149129	µg/L	0.1	<0.1	0%	NA
o,p'-DDT	LB149129	µg/L	0.1	<0.1	0%	NA
Beta Endosulfan	LB149129	µg/L	0.1	<0.1	0%	NA
p,p'-DDD	LB149129	µg/L	0.1	<0.1	0%	NA
p,p'-DDT	LB149129	µg/L	0.1	<0.1	0%	78%
Endosulfan sulphate	LB149129	µg/L	0.1	<0.1	0%	NA
Endrin aldehyde	LB149129	µg/L	0.1	<0.1	0%	NA
Methoxychlor	LB149129	µg/L	0.1	<0.1	0%	NA
Endrin ketone	LB149129	µg/L	0.1	<0.1	0%	NA
Isodrin	LB149129	µg/L	0.1	<0.1	0%	NA
Mirex	LB149129	µg/L	0.1	<0.1	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Tetrachloro-m-xylene (TCMX) (Surrogate)	LB149129	%	-	80%	1%	85%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

OP Pesticides in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Dichlorvos	LB149129	µg/L	0.5	<0.5	0%	103%
Dimethoate	LB149129	µg/L	0.5	<0.5	0%	NA
Diazinon (Dimpylate)	LB149129	µg/L	0.5	<0.5	0%	99%
Fenitrothion	LB149129	µg/L	0.2	<0.2	0%	NA
Malathion	LB149129	µg/L	0.2	<0.2	0%	NA
Chlorpyrifos (Chlorpyrifos Ethyl)	LB149129	µg/L	0.2	<0.2	0%	91%
Parathion-ethyl (Parathion)	LB149129	µg/L	0.2	<0.2	0%	NA
Bromophos Ethyl	LB149129	µg/L	0.2	<0.2	0%	NA
Methidathion	LB149129	µg/L	0.5	<0.5	0%	NA
Ethion	LB149129	µg/L	0.2	<0.2	0%	86%
Azinphos-methyl	LB149129	µg/L	0.2	<0.2	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
2-fluorobiphenyl (Surrogate)	LB149129	%	-	82%	12%	76%
d14-p-terphenyl (Surrogate)	LB149129	%	-	98%	8%	88%

PAH (Polynuclear Aromatic Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Naphthalene	LB149129	µg/L	0.1	<0.1	0%	71%	74%
2-methylnaphthalene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
1-methylnaphthalene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Acenaphthylene	LB149129	µg/L	0.1	<0.1	0%	75%	82%
Acenaphthene	LB149129	µg/L	0.1	<0.1	0%	72%	83%
Fluorene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Phenanthrene	LB149129	µg/L	0.1	<0.1	0%	82%	94%
Anthracene	LB149129	µg/L	0.1	<0.1	0%	73%	91%
Fluoranthene	LB149129	µg/L	0.1	<0.1	0%	85%	95%
Pyrene	LB149129	µg/L	0.1	<0.1	0%	82%	105%
Benzo(a)anthracene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Chrysene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Benzo(b&j)fluoranthene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Benzo(k)fluoranthene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Benzo(a)pyrene	LB149129	µg/L	0.1	<0.1	0%	94%	113%
Indeno(1,2,3-cd)pyrene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Dibenzo(ah)anthracene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Benzo(ghi)perylene	LB149129	µg/L	0.1	<0.1	0%	NA	NA
Total PAH (18)	LB149129	µg/L	1	<1			

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
d5-nitrobenzene (Surrogate)	LB149129	%	-	68%	13 - 20%	68%	54%
2-fluorobiphenyl (Surrogate)	LB149129	%	-	82%	12 - 21%	76%	58%
d14-p-terphenyl (Surrogate)	LB149129	%	-	98%	8 - 13%	88%	78%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB148976	No unit	-	1%	100%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB149091	mg/L	10	<10	1 - 7%	88%

Total Phenolics in Water Method: ME-(AU)-[ENV]AN289

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phenols	LB149111	mg/L	0.01	<0.01	0%	100%	96%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB149029	mg/L	0.02	<0.02	6%	106 - 107%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB149005	µg/L	5	<5	0 - 8%	107%	102%
Arsenic, As	LB149005	µg/L	1	<1	0 - 1%	105%	109%
Barium, Ba	LB149005	µg/L	1	<1	1%	119%	100%
Cadmium, Cd	LB149005	µg/L	0.1	<0.1	0%	108%	107%
Chromium, Cr	LB149005	µg/L	1	<1	0%	111%	105%
Cobalt, Co	LB149005	µg/L	1	<1	0 - 1%	111%	102%
Copper, Cu	LB149005	µg/L	1	<1	0%	107%	98%
Iron, Fe	LB149005	µg/L	5	<5	1 - 3%	114%	109%
Lead, Pb	LB149005	µg/L	1	<1	0%	114%	106%
Manganese, Mn	LB149005	µg/L	1	<1	0 - 1%	107%	101%
Zinc, Zn	LB149005	µg/L	5	<5	0 - 13%	104%	72%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

TRH (Total Recoverable Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN403

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH C10-C14	LB149129	µg/L	50	<50	0 - 28%	80%
TRH C15-C28	LB149129	µg/L	200	<200	0%	86%
TRH C29-C36	LB149129	µg/L	200	<200	0%	93%
TRH C37-C40	LB149129	µg/L	200	<200	0%	NA
TRH C10-C36	LB149129	µg/L	450	<450	0%	NA
TRH C10-C40	LB149129	µg/L	650	<650	0%	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH >C10-C16	LB149129	µg/L	60	<60	0%	81%
TRH >C10-C16 - Naphthalene (F2)	LB149129	µg/L	60	<60	0%	NA
TRH >C16-C34 (F3)	LB149129	µg/L	500	<500	0%	94%
TRH >C34-C40 (F4)	LB149129	µg/L	500	<500	0%	95%

VOCs in Water Method: ME-(AU)-[ENV]AN433

Monocyclic Aromatic Hydrocarbons

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Benzene	LB149098	µg/L	0.5	<0.5	0%	113%	96%
Toluene	LB149098	µg/L	0.5	<0.5	0%	113%	123%
Ethylbenzene	LB149098	µg/L	0.5	<0.5	0%	113%	102%
m/p-xylene	LB149098	µg/L	1	<1	0%	113%	99%
o-xylene	LB149098	µg/L	0.5	<0.5	0%	113%	97%

Polycyclic VOCs

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Naphthalene	LB149098	µg/L	0.5	<0.5	0%	NA	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Dibromofluoromethane (Surrogate)	LB149098	%	-	106%	4%	89%	88%
d4-1,2-dichloroethane (Surrogate)	LB149098	%	-	106%	3%	92%	101%
d8-toluene (Surrogate)	LB149098	%	-	105%	0%	97%	107%
Bromofluorobenzene (Surrogate)	LB149098	%	-	86%	10%	106%	100%

Totals

Parameter	QC Reference	Units	LOR	MB
Total Xylenes	LB149098	µg/L	1.5	<1.5
Total BTEX	LB149098	µg/L	3	<3

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Volatile Petroleum Hydrocarbons in Water Method: ME-(AU)-[ENV]AN433

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
TRH C6-C10	LB149098	µg/L	50	<50	0%	96%	75%
TRH C6-C9	LB149098	µg/L	40	<40	0%	91%	70%

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Dibromofluoromethane (Surrogate)	LB149098	%	-	106%	4%	89%	88%
d4-1,2-dichloroethane (Surrogate)	LB149098	%	-	106%	3%	92%	101%
d8-toluene (Surrogate)	LB149098	%	-	105%	0%	97%	107%
Bromofluorobenzene (Surrogate)	LB149098	%	-	86%	10%	106%	100%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Benzene (F0)	LB149098	µg/L	0.5	<0.5	0%	NA	NA
TRH C6-C10 minus BTEX (F1)	LB149098	µg/L	50	<50	0%	94%	67%

METHOD

METHODOLOGY SUMMARY

AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN190	TOC and DOC in Water: A homogenised micro portion of sample is injected into a heated reaction chamber packed with an oxidative catalyst that converts organic carbon to carbon dioxide. The CO ₂ is measured using a non-dispersive infrared detector. The process is fully automated in a commercially available analyser. If required a sugar value can be calculated from the TOC result. Reference APHA 5310 B.
AN190	Chemical oxygen demand can be calculated/estimated based on the O ₂ /C relation as 2.67*NPOC (TOC). This is an estimate only and the factor will vary with sample matrix so results should be interpreted with caution.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO ₂ , NO ₃ and SO ₄ are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K ₂ SO ₄ and CuSO ₄ . All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.

METHOD

METHODOLOGY SUMMARY

AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). Where F2 is corrected for Naphthalene, the VOC data for Naphthalene is used.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoverable Hydrocarbons - Silica (TRH-Silica) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC's are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported . APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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