



July 2021 Report

Yulara Landfill Services 2021

Voyages Indigenous Tourism Australia Pty Ltd

18 August 2021



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1. Introduction

GHD Pty Ltd was engaged by Voyages Indigenous Tourism Australia Pty Ltd (Voyages) to undertake environmental monitoring at the Yulara Landfill (the Site), approximately 4.1 km northwest of Yulara Township, as shown in Figure 1 (attached).

The Yulara Landfill has operated under consecutive Environment Protection Licences (EPL 16) since 2003 (Appendix A). The current licence (EPL179 - 02) commenced on 1 July 2020 and expires on 30 June 2025. Landfill access was previously unrestricted but is now limited to one operational day per week for Voyages staff and residents, by appointment only.

The monitoring works detailed in this report were implemented in general accordance with the Ongoing Monitoring Plan (OMP), as required by EPL179 - 02, prepared for the Site in May 2016 by Greencap-AAN Pty Ltd. The OMP prescribes a range of landfill gas (LFG) and groundwater monitoring activities.

Monitoring of LFG and groundwater presented in this report was undertaken in July 2021. Previous monitoring was undertaken in October 2020, November 2019 (GHD), June 2019 (GHD), August 2018 (GHD) and November 2017 (Low Ecological Services P/L).

1.1 Objectives

1.1.1 Ongoing Monitoring Plan objectives

The stated objectives of the Yulara Landfill OMP (Greencap 2016) are to:

- Determine baseline environmental conditions at and around the landfill site.
- Determine processes occurring within the landfill, through the monitoring of leachate and LFG composition.
- Determine risks or effects on the environment from the landfill, through the monitoring of groundwater and LFG.
- Check compliance with regulatory requirements in relation to monitoring.
- Identify the need for and extent of remedial/mitigation measures to reduce effects on the environment.

1.1.2 July 2021 monitoring round objectives

GHD has implemented monitoring activities in accordance with the OMP. However, the attainment of overall OMP objectives is currently restricted by the limited amount of environmental data held for the Site and limitations imposed by the landfill monitoring infrastructure of the Site. Therefore, the objectives of the July 2021 monitoring works were to:

- Monitor LFG, leachate and groundwater to add data for the 2021 period.
- Assess any potential environmental and health risks from the landfill.
- Compare the data with previous monitoring data.
- Determine the level of compliance with EPL179 - 02 requirements.
- Contribute to the existing environmental dataset for the Site, which will allow progress towards achievement of OMP objectives.

1.2 Scope of work

The following scope of work was undertaken in the July 2021 landfill monitoring event:

- Surface (above-ground) LFG survey.
- Building (enclosed space) LFG survey.
- Sub-surface LFG survey, utilising existing LFG monitoring wells.

- Gauging of the site monitoring wells using an oil-water interface probe to record depth to groundwater and to assess whether light non-aqueous phase liquid (LNAPL) was present.
- Sampling of groundwater from monitoring wells using HYDRASleeve equipment.
- Laboratory analysis of groundwater samples.
- Comparison of field measurements and analytical results to previous monitoring results and applicable environmental guidelines.
- Preparation of this monitoring report.

1.3 Limitations

This report: has been prepared by GHD for Voyages Indigenous Tourism Australia Pty Ltd and may only be used and relied on by Voyages Indigenous Tourism Australia Pty Ltd for the purpose agreed between GHD and Voyages Indigenous Tourism Australia Pty Ltd as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Voyages Indigenous Tourism Australia Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Site description and setting

2.1 Site details

The Yulara landfill is located off Mala Road and occupies Lot 00248 on Plan L TO94/017B. The site is fenced and is situated on flat terrain surrounded by open shrubland (Greencap, 2016).

2.2 Landfill wastes

Due to its remote location and distance from other waste transfer stations, the Yulara Landfill accepts a variety of municipal and commercial wastes and is permitted to handle and store specific listed wastes. Licence EPL179 - 02 allows the Site to receive putrescible waste, solid inert waste and used tyres for disposal by burial. Listed wastes are defined in Schedule 2 of the *Waste Management and Pollution Control Regulations (2014)*. The licence allows for the handling and storage of the following listed wastes:

- Containers that are contaminated with residues of a listed waste.
- Lead and lead compounds.
- Soils contaminated with a listed waste.
- Waste mineral oils unfit for their original intended use.
- Waste mixtures, or waste emulsions of oil and water, or hydrocarbons and water.

Current landfill operations divide waste into municipal waste, green waste, miscellaneous hard-waste streams (including gas canisters, 40-gallon drums, air-conditioning units, white goods and used tyres), grease, construction materials and steel. Grease is received into designated evaporation ponds within a fenced noxious waste compound, where it is allowed to degrade prior to disposal with other putrescible wastes.

Asbestos containing material (ACM) is not accepted by the landfill. Any ACM generated from upgrade/maintenance works in Yulara is removed for disposal to waste facilities in Alice Springs. Historically, ACM had been collected into a shipping container, which was subsequently buried within the landfill.

2.3 Climate

The Site is located within a desert environment and is subject to average temperatures between 38.5 °C in January to 4.4 °C during July (Bureau of Meteorology 2021).

Rainfall is mainly generated from equatorial troughs moving south during the northern Australia wet season (November to April). Therefore, on average, December is the wettest month (43.2 mm) and August the driest month (5 mm).

Average annual rainfall of 268.4 mm is reported by Yulara Airport (BoM 2021, station 015635). However, rainfall is unpredictable, as shown by annual rainfall totals in Figure 2.1. The 2019, 2020 and 2021 (up to June) rainfall totals remain significantly below the annual average of 268.4 mm. Strong winds, storms and flash flooding events can impact the area, although the occurrence of these events is infrequent (BOM, 2021).

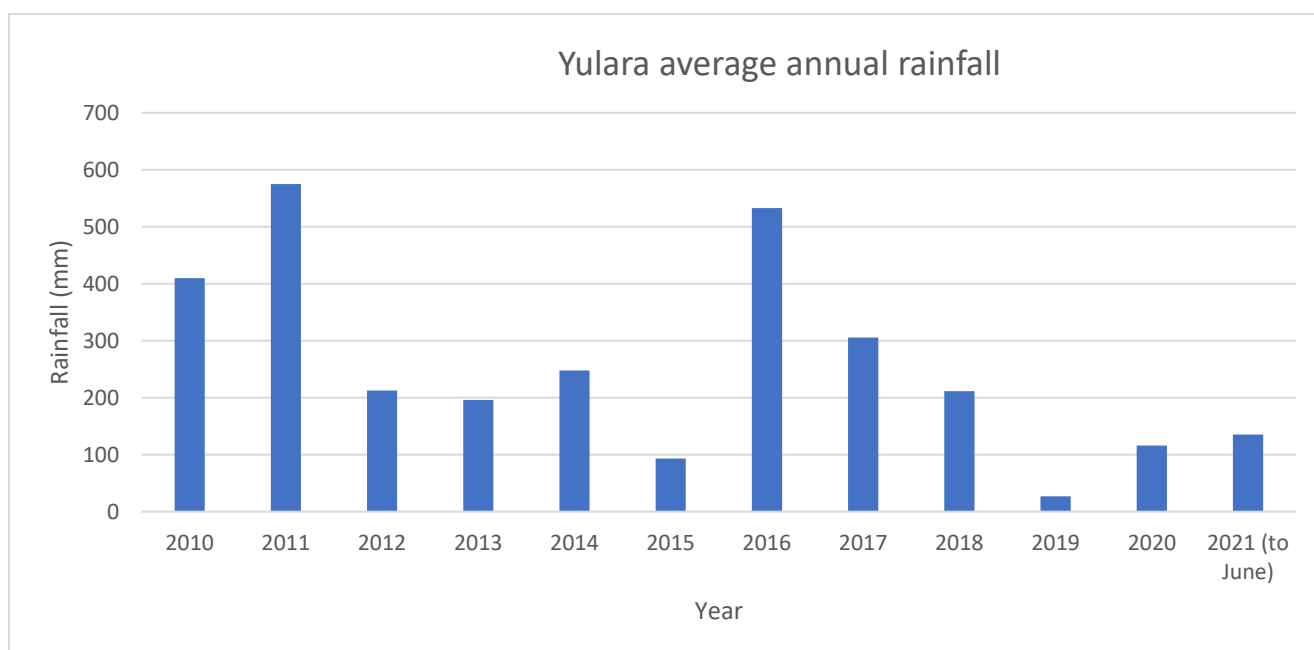


Figure 2.1 Annual rainfall for past decade (mm per calendar year, Yulara Airport)

2.4 Geology

The Site is situated within the Amadeus Basin, which is composed of sediments dating to the Neoproterozoic and Palaeozoic era, overlain by Cainozoic deposits. The Cainozoic deposits are regionally important as they lie within a previous southeast / northwest oriented paleo-valley. The depth of this strata ranges from 27 to 140 mbgl around the Yulara area. The Cainozoic strata are deposition products from the erosion of nearby highland areas and are comprised of sands, silts and clays.

Bore logs for the monitoring wells installed in 2017 describe an approximate 1 m thickness of red sandstone followed by white weathered calcrete to drilled depths of approximately 11 m. In most wells drilled deeper than 11 m, a clay layer was encountered.

2.5 Hydrogeology

The Cainozoic strata host an unconfined aquifer, with groundwater also existing within the Palaeozoic basement strata. In combination, these groundwater units form the Dune Plains Aquifer. Regional groundwater flow is generally northwards, towards the ephemeral salt lake, Lake Amadeus.

Based on trend data from groundwater monitoring since 2017, the depth to permanent groundwater in the vicinity of the landfill is between 12.42 m bgl (MW1D) in the west and 20.89 m bgl (MW3D) in the east. Monitoring bores drilled to less than 12 m bgl have been dry since monitoring began. Further review of drilling records for local monitoring wells and bores suggests that, although groundwater depths in and around Yulara are generally around 20 m bgl, water strikes in the region generally occur around 35-45 m bgl (though the elevation of the ground at the monitoring well locations has not been factored in). It is noted that the Site monitoring wells were installed in March 2017, following unusually heavy rainfall events in December 2016, while in recent years, rainfall totals have been significantly below average.

Based on the groundwater monitoring data and previous desktop assessments undertaken at the Site, local groundwater flow is easterly (Greencap, 2016). While the local and regional groundwater flow directions appear to be different, this is not unusual in a landfill context. Groundwater mounding (from leachate generation) and/or changes to the surface recharge conditions can affect groundwater flow direction on a localised basis.

2.5.1 Beneficial groundwater use

A NR Maps database search for registered bores was undertaken on 05 August 2021 indicating the presence of eight bores on Site for monitoring purposes.

No other bores are registered within a 500 m radius of the Site. The closest production bore (RN012455) is located approximately 1.0 km southeast of the Site and was installed in 1980 to a depth of 145 m. Reports associated with this bore indicate that water was previously for community use, however, the most recent reports from 1992 indicate the casing was in poor condition and that the water was no longer suitable for drinking water supply.

Potable water abstraction for the region is managed by Power and Water Corporation, from a cluster of bores located approximately 5.5 km south and hydraulically up-gradient of the landfill. Therefore, it appears that groundwater, in close proximity to the Site, is not abstracted for potable or other non-potable beneficial uses.

2.5.2 Groundwater dependant ecosystem

The Australian Government Bureau of Meteorology (2021) provides a mapping portal “Groundwater Dependent Ecosystem Atlas” which contains a national inventory of ecosystems that depend on groundwater. For the Northern Territory, this typically includes ecosystems that rely on the surface expression of groundwater such as rivers, wetlands and springs (aquatic ecosystems) and those that rely on subsurface groundwater including vegetation (terrestrial ecosystems). The search results indicate that there are no Groundwater Dependent Ecosystems, aquatic or terrestrial, within a 10 km radius of the Site.

3. Field sampling and monitoring

3.1 General

A total of three pairs of nested groundwater/landfill gas and two individual gas & leachate monitoring wells are installed within the landfill at different depths and consist of three LFG, three groundwater and two gas & leachate wells, see Table 3.1. Layout and monitoring infrastructure are shown in Figure 2.

Table 3.1 Monitoring well details

Location	Well installation record			Well Depth ² (mbTOC)	Monitoring purpose
	Bore No.	Depth ¹ (mbgl)	Screen (mbgl)		
MW1S	19405	4	1-4	4.92	gas
MW1D	19406	12	9-12	12.44	groundwater
MW2S	19403	10	1-10	10.66	gas
MW2D	19404	15	12-15	15.93	groundwater
MW3S	19400	11	2-11	11.97	gas
MW3D	19399	30	15-27	30.45	groundwater
LMW1	19401	6	1.5-6	6.58	gas & leachate
LMW2	19402	8	1-8	8.38	gas & leachate

Notes: 1. – From 'Statement of Bore' forms supplied by Voyages, which record well construction details
 2. – As measured during the July 2021 monitoring round
 mbgl – metres below ground level
 mbTOC – metres below top of casing

Monitoring and sampling methods are provided by the OMP. Although GHD attempted to adhere to the methodology in the OMP as much as possible, the following departures from the OMP are noted in relation to the July 2021 monitoring round:

- Only one monitoring well (MW3D) contained sufficient groundwater to allow samples to be collected and analysed. All other monitoring wells were dry.
- A Laser Inspectra Gas Detector was used instead of a Flame Ionisation Detector (FID) due to complexities associated with shipping an FID unit, which uses compressed hydrogen gas as a fuel source. Both units are designed for flammable atmosphere monitoring and have equivalent methane detection limits (1 part per million). The use of Laser Inspectra Gas Detector is consistent with the previous November 2019, June 2019 and August 2018 monitoring rounds.
- HYDRASleeve groundwater monitoring equipment was utilised which is consistent with both the June and November 2019, and October and November 2020 GMEs. HYDRASleeve sampling methods are non-purge. The equipment was retained in the well for use in future sampling events.

3.2 Groundwater monitoring

Groundwater monitoring methods are summarised in Table 3.2.

Table 3.2 Summary of GME activities

Activity/ Item	Details
Well gauging	All monitoring wells were gauged using an oil/water interface probe to determine the depth to groundwater, the potential presence of LNAPL and the total depth of the well. For wells which contained groundwater, gauging of the well depth had to occur post sampling due to the presence of the HYDRASleeve. Calibration certificates for the equipment used are presented in Appendix B

Activity/ Item	Details
Well sampling method	HYDRASleeves were deployed in each well approximately 1 m below the standing water level, or just off the base of the well. The sleeves which contained water were extracted, and water was collected into sample bottles. Samples for dissolved metals analysis were field filtered into laboratory prepared sample jars. The remaining groundwater was then poured into a sterile bucket and field parameters (pH, dissolved oxygen, turbidity, electrical conductivity, temperature, and redox potential) were measured. Existing HYDRASleeves were in good condition and therefore deployed back into the well. Chain of custody documentation was prepared for sample transfer from the Site to the laboratory. Samples were scheduled for the following analysis: nutrients, chemical oxygen demand (COD), polychlorinated biphenyls (PCB), organochlorine (OC) and organophosphate (OP) pesticides, total dissolved solids (TDS), major ions, dissolved metals, polycyclic aromatic hydrocarbons (PAH), total recoverable hydrocarbons (TRH), and benzene, toluene, ethylbenzene, xylenes (BTEX).
Sample preservation	Samples were placed in laboratory supplied bottles. Samples were stored on ice while on site and in transit to the nominated NATA accredited laboratory.
Decontamination procedure	The interface probe and water quality meter were washed and rinsed with potable water and decontaminated using DECON-90 detergent between locations. Dedicated HYDRASleeves and bailer twine were used at each location.

3.3 Landfill gas monitoring

LFG monitoring methods are summarised in Table 3.3.

Table 3.3 Summary of landfill gas monitoring activities

Activity/ Item	Details
Surface LFG	Surface LFG analysis was undertaken with a calibrated Laser Inspectra Gas Detector on an approximate 50 metre grid across the surface area of the Site. Measurements were taken using a wand with a funnelled inlet held roughly 50 to 100 mm above the ground surface. The Laser Inspectra Gas Detector remained on during sampling of the entire 50 m grid so it was continuously taking readings.
Enclosed spaces within buildings	Potential LFG accumulation within buildings was measured using a handheld GFM430 Landfill Gas Detector. Methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide peak and stable concentrations were measured. Measurements were taken by holding the device in closed, semi-enclosed and confined areas within the buildings where gas was considered most likely to accumulate (see Table 6.4). For consistency, the same locations to those surveyed in previous rounds were used, where possible. However, there have been some changes to the building structures, such as the removal of furniture for the October 2020 monitoring round. The monitoring locations are documented in Appendix C.
Sub surface LFG	Sub surface LFG was recorded using a GFM430 Landfill Gas Detector attached to LFG caps via a compatible brass ferrule. Methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide peak and stable concentrations were recorded. Gas flow rate (initial and stabilised over a 120 second period) and atmospheric pressure were also recorded.

4. Assessment criteria

4.1 Overview

The OMP describes how assessment criteria should be selected, as summarised below.

- Criteria for groundwater and LFG should be adopted based upon the most suitable available (national or territory) or site specific risk based criteria derived at the time of monitoring.
- Criteria for LFG should be adopted from the NT EPA (2013) Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory, unless updated criteria are available.

In addition, the OMP states that exceedances of LFG criteria in the monitoring wells should not be considered a non-conformance against the Environmental Protection Licence for the site.

4.2 Groundwater assessment criteria

In accordance with the OMP, groundwater assessment criteria have been selected based on the primary risk being ecological rather than human health (no abstraction of groundwater or potable use). The criteria are:

- ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments.
- NEPM (2013) Schedule B(1). Guideline on Investigation Levels for Soil and Groundwater. Groundwater Investigation Levels (GIL) – to assess risks to aquatic ecosystems in slightly to moderately disturbed systems (95% species protection level) as updated by Australia and New Zealand Guidelines (ANZG) 2018.

4.3 Landfill gas assessment criteria

NT EPA (2013) recommends that, as a minimum, monitoring of each [LFG] well should be carried out six monthly until well gas concentrations have stabilised below 1% by volume methane and 1.5% by volume carbon dioxide.

In assessing LFG risks posed by the Yulara Landfill operations, MW1S, MW2S and MW3S are considered to represent 'boundary wells', whereas LMW1 and LMW2 locations are effectively representative of landfill core conditions.

In general, it is considered that risk based LFG assessment criteria should only be applied where there is a potential risk to human health. Potential human health risks from LFG are only plausible within occupied buildings at the Site.

5. Field observations and results

5.1 General field observations

Sampling and monitoring activities were undertaken during the morning of 8 July and in the late afternoon of 9 July 2021. The following field observations were made during the monitoring activities and are included on the field sheets in Appendix D:

- Rainfall had not occurred in Yulara since 23 June 2021, therefore Site conditions were dry.
- Temperatures on both sampling days were between 8.4 °C (morning of 8 July) and 20.6 °C (afternoon of 9 July).
- Wind was generally from the north (8 July) and east (9 July), with speeds of 9 km/h and 15 km/h respectively.
- Strong waste oil odours were noted from the grease ponds.
- There was no active putrescible waste pit exposed, except for a pile of pillows, blankets, and curtains.
- There was minimal wind-blown rubbish within and adjacent to the Site.
- The HYDRASleeve of MW2D and MW1D contained no water and therefore could not be sampled. The HYDRASleeves were returned to the wells.

5.2 Atmospheric pressure conditions

Figure 5.1 shows twice daily (9 am and 3 pm) atmospheric pressure recorded at the Yulara Airport weather station from 14 June to 12 July 2021 (and summary climate data for these months are presented in Appendix E).

Declining atmospheric pressure conditions were observed in early July, coinciding with the LFG monitoring dates, indicated by the thick vertical grey line in Figure 5.1. Falling atmospheric pressure represents favourable conditions to undertake LFG measurement, as falling pressure induces gas flow from the landfill.

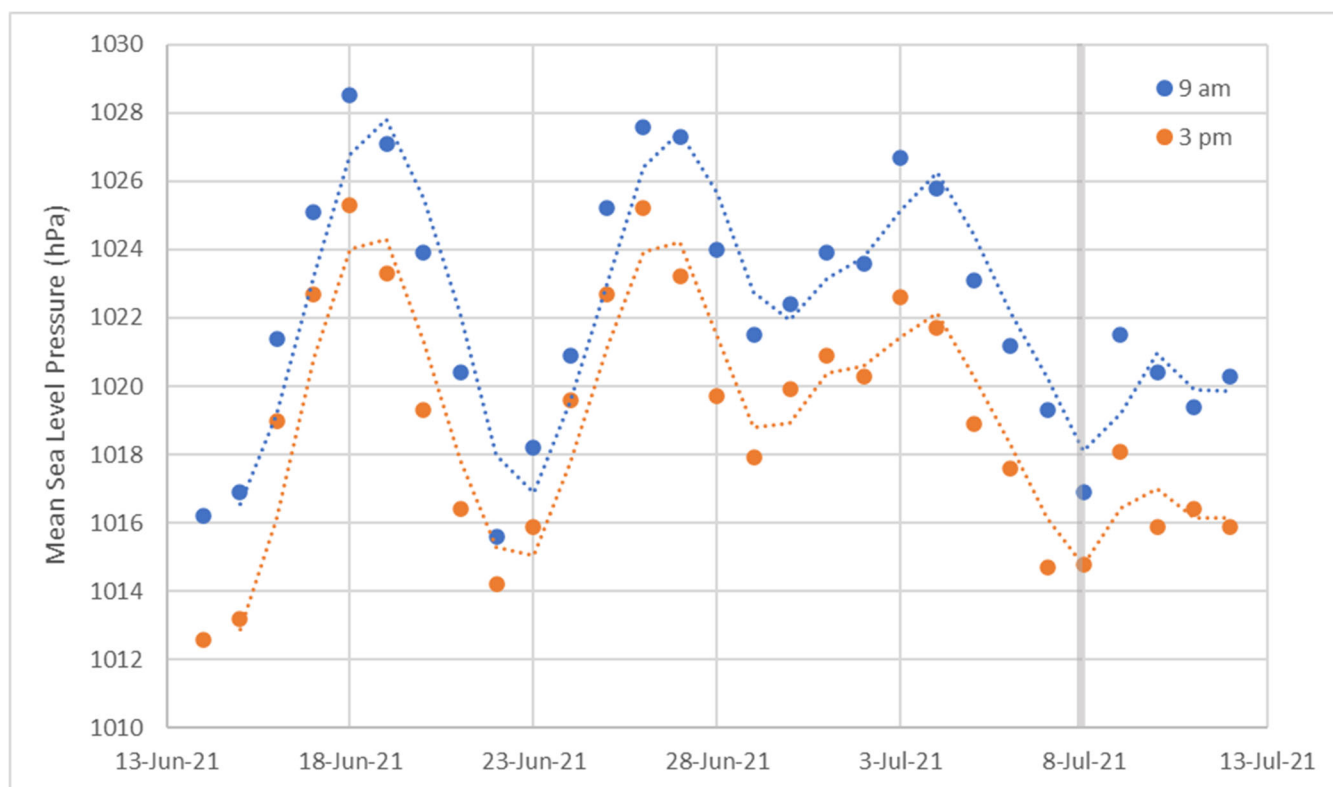


Figure 5.1 Atmospheric pressure 14 June to 12 July 2021 (Yulara Airport)

5.3 Standing water levels

Measurements of SWL are presented in Table 5.1 and are compared to the October 2020 (GHD) November 2019 (GHD), June 2019 (GHD), August 2018 (GHD) and November 2017 (Low Ecological Services) data.

Table 5.1 Standing water level measurements

Location	MW depth (m btoc)	Depth to water (m btoc)						July 2021 Comments
		Jul '21	Oct '20	Nov '19	Jun '19	Aug '18	Nov '17	
MW1S	4.92	Dry	Dry	Dry	Dry	Dry	Dry	No odours
MW1D	12.44	Dry	12.43	12.43	12.42	14.42	Dry	No odours
MW2S	10.66	Dry	Dry	Dry	Dry	Dry	Dry	No odours
MW2D	15.93	Dry	Dry	Dry	Dry	Dry	14.54	No odours
MW3S	11.97	Dry	Dry	Dry	Dry	Dry	Dry	No odours
MW3D	30.45	20.80	20.89	20.72	20.40	19.97	19.54	No odours, no sheen or LNAPL, cloudy, yellow/grey colour.
LMW1	6.58	Dry	Dry	Dry	Dry	Dry	Dry	No odours
LMW2	8.38	Dry	Dry	Dry	Dry	Dry	Dry	No odours

Notes: m btoc - metres below top of casing

From the data presented, it is clear that the depth to groundwater has been gradually increasing since 2017, reflecting the reduction in rainfall over that period.

5.4 Groundwater quality field measurements

Groundwater quality field parameters recorded during sampling are presented in Table 5.2 and are compared to previous monitoring round results.

Groundwater parameters are comparable between the 2020, 2019 and 2018 monitoring events. The July 2021 sample had a low sediment load which is evident by the significant decrease in turbidity.

Landfill leachate is typically acidic and typically depletes oxygen in the sub-surface. The neutral pH, positive redox condition and dissolved oxygen concentrations within groundwater sampled from MW3D therefore suggest no leachate impact at this location.

Table 5.2 Stabilised groundwater quality field parameters

Field parameter	MW3D						MW2D
	July 2021	Oct 20	Nov 19	Jun 19	Aug 18	Nov 17	Nov 17
Technique	HYRDA-sleeve	HYDRA-sleeve	HYDRA-Sleeve	HYDRA-Sleeve	Bailer	Bailer	Bailer
EC (mS/cm)	1867	1671	1969	2109	2073	1540	1800
Temperature (°C)	24.1	26.5	26.1	25.6	23.0	27.10	27.05
Turbidity (NTU)	17.13	2379.8	233.0	1655	2780.5	NA	NA
pH	6.04	7.02	5.99	7.26	7.25	7.57	7.04
DO % Saturation	63.3	68.7	38.6	56.2	56.1	NA	NA
DO (mg/L)	4.99	5.64	3.49	4.38	4.84	NA	NA
Eh (mV) / ORP	-47.8	182.0	15.7	149.5	233.6	NA	-26.7

Notes: NA – data not available or not collected
EC – electrical conductivity
DO – dissolved oxygen

5.5 Groundwater analytical results

During this monitoring event, only one well (MW3D) was sampled due to insufficient water in the other wells.

Chromium (0.002 mg/L), copper (0.015 mg/L) and zinc (0.066 mg/L) were all detected above the adopted (ecological) assessment criteria. All other analytes (for which assessment criteria are available) were either below the criteria or below the laboratory limit of reporting (LOR). However, it is noted that laboratory LOR for OC and OP pesticides were higher than the assessment criteria.

The metals which have exceeded the assessment criteria for the duration of the monitoring are tabulated in Table 5.3 for comparison. Groundwater analytical results are also presented in Appendix F and within the laboratory reports in Appendix G.

Table 5.3 Summary of exceedance of assessment criteria for metals (all monitoring).

Analyte	Assessment criteria	August 2018	June 2019	November 2019	October 2020	July 2021
	mg/L					
Aluminium	0.055	0.24	0.01	<0.01	<0.01	0.02
Chromium	0.001	0.001	0.002	0.001	0.002	0.002
Boron	0.37	-	-	0.87	-	-
Copper	0.0014	<0.001	<0.001	<0.001	<0.001	0.015
Zinc	0.008	<0.005	0.014	0.009	0.005	0.066

Note: exceedances of assessment criteria in bold

5.6 Surface gas survey

As indicated in the field records attached in Appendix D, stabilised ground level methane concentrations recorded during the survey were between 1.0 and 6.6 parts per million (ppm). The two highest concentrations (3.3 and 6.6 ppm) were recorded close to the open pit. The methane concentration of 6.6 ppm is the highest detection since monitoring commenced in 2018.

It is noted that one part of the 50 m grid (numbered 56 on the site plan) was unable to be measured due to its position in the current active waste pit. It was unsafe to enter that area at the time of the monitoring.

Surface LFG results have not been compared to assessment criteria as there is minimal human health risk from LFG emissions in outdoor settings.

Table 5.4 Surface level gas survey results 2018,2019,2020 and 2021

Monitoring round	LFG concentration range (ppm)	
	Lowest	Highest
August 2018	0.8	3.8
June 2019	1.8	3.3
November 2019	0.0*	0.1*
October 2020	0.0	1.3
July 2021	1.0	6.6

* Increased wind speed may have affected results

5.7 Building (enclosed space) landfill gas survey

The results of the survey are presented in Appendix C. In summary, methane and carbon dioxide were not detected in the survey. However, trace amounts of carbon monoxide (1 ppm) and hydrogen sulphide (1 to 2 ppm) were detected under and next to the fridge and under the desk in the small office demountable. Trace amounts (1 ppm) of hydrogen sulphide was also detected under the sink outside of the shed.

The results did not exceed the adopted assessment criteria.

5.8 Sub-surface landfill gas survey

LFG measurements recorded for each monitoring well are presented in Table 5.5. Results for previous monitoring rounds are also presented.

Methane was not detected in any of the monitoring wells. Carbon dioxide was detected in MW3S (3.7 % v/v), LMW1 (3.4 % v/v) and MW2S (0.7 % v/v). There were minor detections of carbon monoxide and hydrogen sulphide. Gas flow rate was zero.

Comparison of methane and carbon dioxide data across the four monitoring rounds indicates a declining trend in concentrations for both gases.

Measured LFG concentrations were below the guideline value of 5% v/v (for boundary wells) adopted in NT EPA landfill guidelines.

Table 5.1 Sub surface landfill gas measurements 2018, 2019, 2020 and 2021

Location	Date	Time	Barometric Pressure (hPa)	Flow rate (L/hr)					Methane (% v/v)		Carbon dioxide (% v/v)		Oxygen (% v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		LEL (%)	
				Seconds																
				0	30	60	90	120	Peak	Stable	Peak	Stable	Low	Stable	Peak	Stable	Peak	Stable	Peak	Stable
MW1S	28/08/2018	0910	955	0.0	1.5	1.2	0.8	0.0	0.0	0.0	0.4	0.4	20.0	19.9	40.0	39.0	11.0	9.0	21	0.0
	19/06/2019	1020	967	4.8	5.1	4.9	4.9	4.8	0.4	0.0	2.3	0.1	17.1	20.9	1.0	0.0	1.0	0.0	0.0	0.0
	05/11/2019	0920	967	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	20.8	20.9	1.0	0.0	0.0	0.0	0.0	0.0
	13/10/2020	1100	965	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	20.1	20.7	0.0	0.0	1.0	2.0	0.0	0.0
	09/07/2021	1710	959	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	21.3	1.0	1.0	1.0	1.0	0.0	0.0
MW2S	28/08/2018	0925	955	2.2	1.3	0.0	0.0	0.0	4.0	0.0	0.9	0.9	19.6	19.9	1.0	0.0	1.0	0.0	34	0.0
	19/06/2019	0840	964	0.1	0.5	0.3	0.1	0.3	0.0	0.0	0.9	0.9	20.1	20.1	0.0	0.0	1.0	0.0	0.0	0.0
	05/11/2019	0930	970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	20.1	20.3	3.0	1.0	2.0	1.0	0.0	0.0
	13/10/2020	0900	966	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	20.3	20.3	0.0	0.0	0.0	1.0	0.0	0.0
	09/07/2021	1640	959	1.3	3.0	0.4	0.0	0.0	0.0	0.0	0.9	0.7	20.7	20.7	1.0	1.0	2.0	2.0	0.0	0.0
MW3S	28/08/2018	1019	955	3.7	3.0	0.4	2.6	5.1	1.4	1.4	7.5	7.5	12.3	12.3	0.0	0.0	3.0	0.0	32.6	32.6
	19/06/2019	0910	964	0.4	0.1	0.2	0.2	0.3	1.3	1.3	6.9	6.9	14.1	14.1	0.0	0.0	0.0	0.0	30.1	30.1
	05/11/2019	0950	966	0.7	0.2	0.6	0.8	0.0	0.7	0.5	5.9	5.9	14.1	14.4	3.0	1.0	2.0	1.0	15.5	15.4
	13/10/2020	0910	966	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	5.0	17.8	14.8	0.0	1.0	0.0	0.0	0.0	0.0
	09/07/2021	1620	959	0.0	0.6	0.3	0.7	0.4	0.0	0.0	3.7	3.7	17.3	17.4	0.0	0.0	2.0	2.0	0.0	0.0
LMW1	28/08/2018	0940	958	3.3	3.7	5.5	5.1	3.7	4.1	3.9	17.3	16.8	0.1	0.1	1.0	0.0	2.0	1.0	93.9	93.8
	19/06/2019	1010	968	5.5	5.4	5.1	5.0	5.4	6	1.8	17.8	17.8	0.0	0.0	1.0	0.0	1.0	0.0	>>>	42.5
	05/11/2019	1015	964	0.1	0.0	0.4	0.0	0.0	1.8	1.8	15.6	15.4	2.5	2.5	4.0	3.0	2.0	1.0	43.2	43.1
	13/10/2020	0920	966	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	8.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0
	09/07/2021	1510	964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	3.4	17.4	17.5	0.0	0.0	2.0	1.0	0.0	0.0
LMW2	28/08/2018	0947	956	3.2	2.4	3.2	3.0	3.9	39.8	39.8	34.2	34.2	0.0	0.0	3.0	0.0	2.0	0.0	>>>	>>>
	19/06/2019	0940	967	6.4	6.0	6.5	7.4	7.2	28.2	28.2	30.3	30.3	0.0	0.0	3.0	3.0	1.0	0.0	>>>	>>>
	05/11/2019	1030	965	0.3	2.5	3.5	3.1	0.0	18.2	18.1	28.7	28.7	0.0	0.0	6.0	3.0	3.0	0.0	>>>	>>>
	13/10/2020	0935	966	0.6	0.0	0.0	0.0	0.0	18.8	15.3	23.2	23.2	0.0	0.1	0.0	0.0	0.0	0.0	>>>	>>>
	09/07/2021	1500	964	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.3	0.0	0.0	2.0	2.0	>>>	>>>

Notes: >>> Above maximum equipment level

6. Quality assurance

Adopted quality control procedures were based on those detailed in the Australian Standard AS4482.1 and NEPM (2013) requirements. Applicable project QA/QC protocols are described below.

6.1 Laboratory selection

ALS provided the analysis of the primary and blind duplicate samples. ALS are National Association of Testing Authorities (NATA) accredited and are certified by NATA to conduct the specific analyses required.

6.2 Field sampling QA/QC

Groundwater QA/QC samples were collected at the following frequencies: one trip blank consisting of laboratory provided deionised water maintained in a sealed sample bottle per sample shipping container.

6.3 Data quality objectives

The process for establishing Data Quality Objectives (DQO) for site investigations is outlined in Section 5, Schedule B2 of the National Environment Protection Measures Assessment of Site Contamination (ASC NEPM 2013). To minimise the potential for unrepresentative data, Data Quality Indicators (DQIs) including completeness, comparability, representativeness, precision and accuracy were evaluated as described in Table 6.1.

Issues and exceptions associated with the DQIs of the July 2021 monitoring round are noted in footnotes to Table 6.1, but none are judged to have affected the outcomes of the monitoring round to the extent that they have impacted the achievement of project objectives.

Table 6.1 Data Quality Indicators

DQI	Evaluation criteria	Acceptable?
Completeness	All locations proposed to be sampled were sampled.	No ¹
	All field documentation is complete (Appendix D) and correct.	Yes
	Field forms and documentation capture all relevant important information.	Yes
	Samples analysed within appropriate holding times.	Yes
	Appropriate laboratory limits of reporting for comparison to relevant assessment criteria.	Yes
Comparability	Standard practice for groundwater sampling adhered to and in line with the OMP.	Yes
	Field staff were experienced in the sampling of groundwater and appropriately trained.	Yes
	Consistent laboratory use, with consistent analytical methods used.	Yes
Representativeness	Samples collected in a uniform and consistent manner.	Yes
Precision	Sufficient quantities of field blind and split duplicates collected to enable comparison within laboratories.	No ²
	Sufficient quantities of internal laboratory duplicates analysed to enable comparison within laboratories.	Yes
	Relative percentage difference (RPD) calculations show all duplicate sample concentrations are within defined difference limits.	No ²
	Field equipment calibrated by equipment supplier (Appendix B).	Yes
Accuracy	Sufficient quantities of internal laboratory method blanks, surrogate spikes and laboratory control samples analysed to determine laboratory accuracy, with the large majority of samples within defined limits.	Yes

Notes: 1 – Two of the deep groundwater wells were dry and could not be sampled

2. – Insufficient sample volume to collect duplicate samples

7. Discussion

7.1 Groundwater quality

Field measurements of water quality parameters in groundwater from monitoring well MW3D did not indicate leachate impacts. Laboratory analysis of groundwater from MW3D reported chromium, copper and zinc in excess of adopted assessment criteria. However, results for other metals, petroleum hydrocarbons, pesticides, and nutrients did not exceed the laboratory LOR and/or adopted assessment criteria.

There are no records of groundwater wells within 500 m of the Site and the nearest groundwater abstraction bores for potable water are 5.5 km from the Site, indicating that there are no sensitive uses of groundwater that could be reasonably impacted by leachate from the landfill. In addition, the Site is located in a highly evaporative desert environment and the amount of surface water infiltration into the landfill is expected to be low, which will reduce the potential for leachate generation.

It is noted that since groundwater monitoring commenced (2017), only two wells have consistently been sampled, due to other wells being dry. The data generated from the monitoring of only two wells is not sufficient to satisfy the OMP objective of establishing baseline groundwater conditions at and around the landfill Site. There is also insufficient spread of data to adequately assess leachate impacts on groundwater.

7.2 Landfill gas

Measurement within enclosed spaces inside buildings did not detect LFG. There is no evidence for the accumulation of LFG within Site buildings.

Surface monitoring across the landfill did not detect LFG (methane and carbon dioxide), despite the falling atmospheric pressure conditions being conducive for gas release from the landfill. However, there are several other factors which control the release of LFG through the landfill cap, such as cap composition, cap integrity, leachate levels, surrounding infrastructure (alternate flow paths), etc. and these are not assessed as part of the OMP objectives.

Monitoring of LFG within the landfill detected carbon dioxide up to a maximum concentration of 3.7 % v/v. Methane was not detected and there were minor detections of carbon monoxide and hydrogen sulphide. Gas flow rate was zero despite falling atmospheric pressure.

Measured LFG concentrations were below the guideline value of 5% v/v (for boundary wells) adopted in NT EPA landfill guidelines.

The LFG monitoring results are plotted in Figure 7.1 and they indicate a decreasing trend in LFG concentrations.

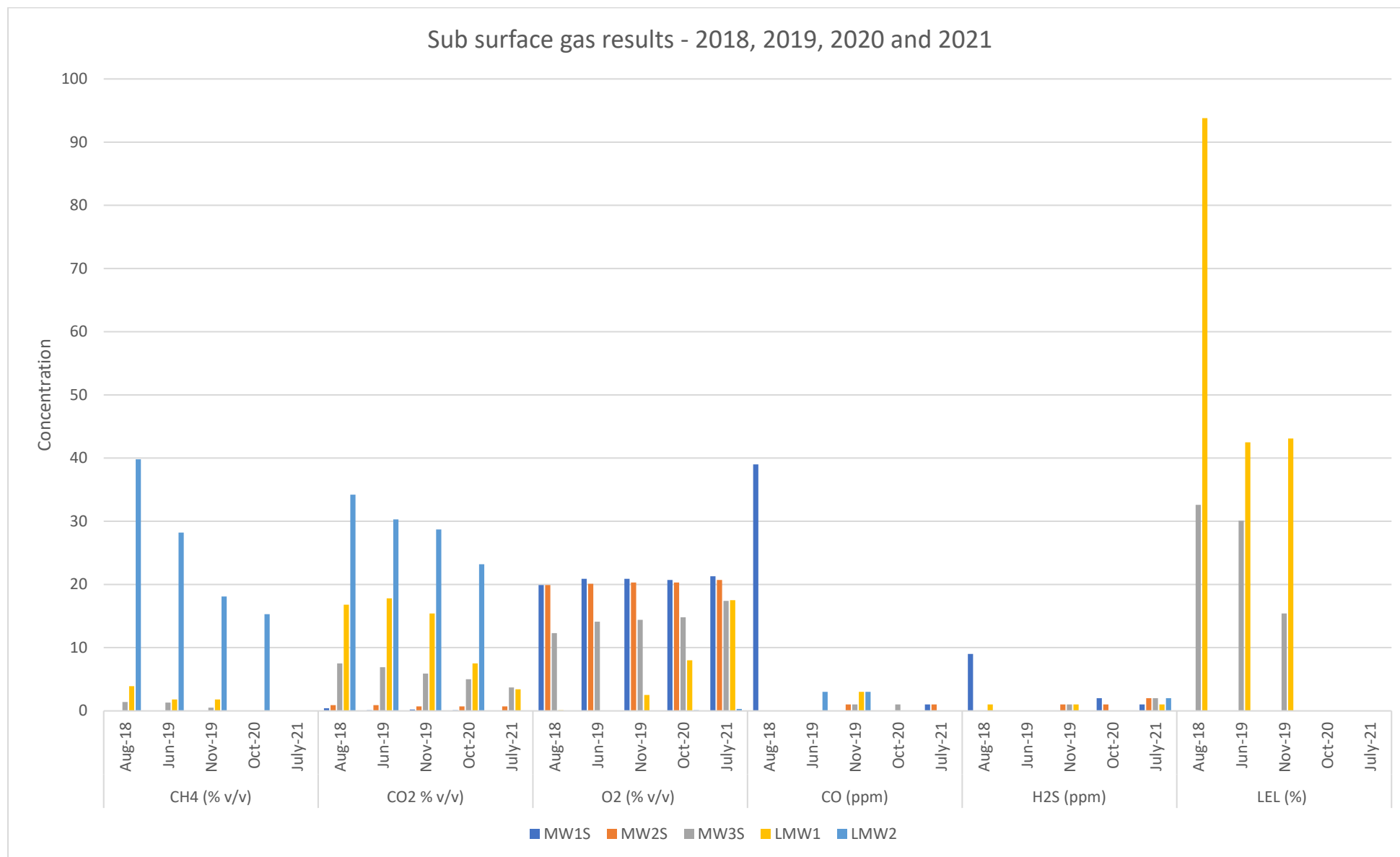


Figure 7.1 Sub surface gas sampling results summary

8. Recommendations

Based on the findings of the July 2021 LFG and groundwater monitoring, the following recommendations are offered for future monitoring of the Site:

- Improvements to the groundwater monitoring network, including the installation of additional, deeper monitoring wells to depths greater than 20 m bgl. This would allow monitoring and sampling of groundwater which occurs deeper than the base of existing monitoring wells.
- HYDRASleeve sampling techniques are recommended for ongoing groundwater sampling in preference to the use of bailers or low-flow sampling pumps. The HYDRASleeves are simple to operate, they allow efficient collection of samples, and they yield representative samples. Sufficient HYDRASleeves have been re-deployed in every well for the next sampling round. Beyond this additional HYDRASleeves for two further sampling rounds have been sourced.
- Existing data set has been successful in establishing baseline building accumulation, surface and subsurface gas conditions, particularly during periods of increasing atmospheric pressures. A review of this data set provides potential justification for a reduction in frequency of monitoring based on:
 - Boundary LFG monitoring locations consistently recording methane concentrations below 5% v/v.
 - Consistently low or no detections of surface methane.
 - Documented subsiding subsurface gas concentrations of methane and carbon dioxide.
 - Limited operation of the landfill with buildings now vacant and not used, with the exception of the main office which is raised above the ground and is considered a low risk for LFG accumulation.
- Attempts should be made to conduct all future LFG monitoring activities under falling atmospheric pressure conditions and during still or light-wind conditions, in order to ensure that worst-case gas generating scenarios are evaluated.
- Attempts should be made to complete sampling after rainfall events to determine the Sites capacity to generate leachate.
- Given the ongoing use of the landfill, the installation of additional LFG monitoring wells could be considered. The location and design of additional LFG monitoring points should take into account the operational history of the landfill, to allow areas of higher gas generation risk to be targeted. Additional boundary monitoring locations should also be considered, although it is noted that lands surrounding the landfill are also owned by Voyages and no change in current land uses or land management practices are foreseen.

9. References

- ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.
- Australian Standard AS5567.11 (1998) Water Quality – Sampling Guidance of Sampling of Groundwaters, 1998
- Bureau of Meteorology (2021) Groundwater Dependent Ecosystems Atlas, <http://www.bom.gov.au/water/groundwater/gde/service/simple-gde.php>
- Bureau of Meteorology (2021) Climate Statistics for Australian Locations – Summary Statistics, <http://reg.bom.gov.au/climate/data/>
- Department of Environment and Natural Resources (2021). Natural Resource Maps, <http://www.nrmaps.nt.gov.au>
- Greencap-NAA Pty Ltd (2016) Ongoing Monitoring Plan: Yulara Landfill, Lot 00248, Yulara NT
- Low Ecological Services P/L (2017), Yulara Landfill Annual Groundwater and Gas Monitoring Report, November 2017
- Northern Territory Environment Protection Authority (2013) Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory

Appendix A

EPL Licence

ENVIRONMENT PROTECTION LICENCE

(Pursuant to section 34 of the *Waste Management and Pollution Control Act*)

Licensee	Voyages Indigenous Tourism Australia Pty Limited
Licence Number	EPL179
Registered Business Address	Lvl 9 179 Elizabeth Street NSW NSW 2000
ACN	146 482 591
ABN	82 146 482 591
Premises Address	Lot 00248 Town of Yulara Plan(s) Lto94/017b (Yulara)
Anniversary Date:	01 October
Commencement Date:	01/10/2015
Expiry Date:	30/09/2020
Scheduled Activity	Operating premises for the disposal of waste by burial that service, or are designed to service, the waste disposal requirements of more than 1000 persons. Collecting, transporting, storing, re-cycling, treating or disposing of a listed waste (as per Table 1) on a commercial or fee for service basis, other than in or for the purpose of a sewage treatment plant. Operating premises, other than a sewage treatment plant, associated with collecting, transporting, storing, re-cycling, treating or disposing of a listed waste (as per Table 1) on a commercial or fee for service basis.
Description	The Yulara landfill receives putrescible, solid and listed waste streams from the Yulara Township that are segregated for storage or disposal by burial at the premises.

Table 1 - Listed Wastes Authorised to be Handled

Listed Waste	Collection	Transport	Storage	Treatment	Recycling	Disposal
Containers that are contaminated with residues of a listed waste	✗	✗	✓	✗	✗	✗
Lead, lead compounds	✗	✗	✓	✗	✗	✗
Soils contaminated with a listed waste	✗	✗	✓	✗	✗	✗
Tyres	✗	✗	✓	✓	✗	✓
Waste mineral oils unfit for their original intended use	✗	✗	✓	✗	✗	✗
Waste mixtures, or waste emulsions, of oil and water or hydrocarbon and water	✗	✗	✓	✗	✗	✗

✓ Activity authorised by this licence

✗ Activity not authorised by this licence

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ATTACHMENTS

There are no attachments

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INFORMATION ABOUT THIS LICENCE

- This licence does not in any way relieve the licence holder from its obligations to comply with the *Waste Management and Pollution Control Act* (**WMPC Act**), including the general environmental duty in section 12 of the **WMPC Act** and the duty to notify of **incidents** causing or threatening to cause **pollution** under section 14 of the **WMPC Act**.

Duration of a licence (section 40, 43 and 45 of the WMPC Act)

- A licence will remain in force until its expiry date or until it is surrendered by the licensee or is suspended or cancelled in accordance with the **WMPC Act**.
- The licensee must notify the Northern Territory Environment Protection Authority (NT EPA) within 14 days after ceasing to conduct **the activity**.
- The licensee may, with the approval of the NT EPA, surrender the licence to the NT EPA.

Amendment or Revocation of a licence (section 37 of the WMPC Act)

- The licensee may apply to amend or revoke a condition of this licence.
- A fee applies and the application must be made using the designated form via **NT EPA Online**.
- The NT EPA may also amend or revoke a condition of this licence as set out in section 38 of the **WMPC Act**.

Transfer of a licence (section 46 of the WMPC Act)

- The licensee can apply to transfer their licence to another person.
- A fee applies and the application must be made via **NT EPA Online**.

Renewal of a licence (section 40 of the WMPC Act and section 3 of the Regulations)

- The licensee may apply for the renewal of their licence not earlier than 90 days, and not later than 30 days, before their licence expires.
- A fee applies and the application must be made via **NT EPA Online**.

Public Register

- A copy of environment protection licences and any plans for environmental management, required as a condition of an environment protection licence, will be placed on a register in accordance with section 9 of the **WMPC Act**.
- A copy of the **Annual Return** will also be placed on the register.
- The NT EPA makes this register freely available from the NT EPA website.

Cultural Interests

- It is the licensee's responsibility to contact the Aboriginal Areas Protection Authority, appropriate land council or other governing body and ensure that any Authority Certificates required as a result of conducting the licenced activity are obtained and complied with.

RULES FOR INTERPRETING THE CONDITIONS OF THIS LICENCE

ENVIRONMENT PROTECTION LICENCE 179

- Where there is a discrepancy between the conditions of this licence and any plan, standard, guideline or other document referred to in this licence, the conditions of this licence prevail to the extent of the inconsistency.
- Any reference to any standard (Australian or international) in this licence means the relevant parts of the current version of that standard.
- A reference to any guideline or code of practice (or to the relevant parts of any guideline or code of practice) in this licence means the current version of the guideline or code of practice.
- Under section 39 of the **WMPC Act**, any contravention of or failure to comply with this licence by the licensee may be an offence.
- In determining whether the licensee has committed an offence, the licensee may be liable for the conduct of its directors, employees or agents.
- The licensee should ensure that each of its directors, employees, contractors or agents are aware of, and comply with, this licence.
- In this licence, unless the contrary intention appears, words that are defined in the **WMPC Act** are intended to have the meaning given to them in that Act.

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LICENCE CONDITIONS

GENERAL

- 1 The licensee must ensure the contact details recorded in **NT EPA Online** are accurate.
- 2 The licensee must at all times have a **24 hour emergency contact**.
- 3 The licensee must pay the **annual fee** calculated in accordance with the method prescribed in the **Regulations** within 50 **business days** of the anniversary of the commencement date of this licence, for each year or part of a year that this licence is in force.
- 4 The licensee must cause clear and legible signage, in English, to be displayed in a prominent location at each **public entrance** to the **premises** that includes the following details:
 - 4.1 environment protection licence number issued under the **WMPC Act**; and
 - 4.2 **24 hour emergency contact** details.
- 5 The licensee must cause a copy of this licence to be available for inspection by any person, in hard copy form, at the **premises**.
- 6 The licensee must provide to the **NT EPA**, within 10 **business days** of a request, a copy of any document, monitoring data or other information in relation to **the activity**, in the format requested by the **NT EPA**.
- 7 All notices, reports, documents or other correspondence required to be provided as a condition of this licence, unless otherwise specified as a condition of this licence, must be provided in electronic form by uploading the document via **NT EPA Online** (or by e-mailing waste@nt.gov.au).
- 8 The **NT EPA** may require the licensee to revise or amend and resubmit any amended document. Where the **NT EPA** requires a document to be resubmitted the date for the re-submission will be specified and becomes a condition of this licence.
- 9 The licensee must **maintain a Complaint Log** for all complaints received by the licensee in relation to **the activity**.
- 10 The licensee must ensure that the **Complaint Log** includes, for each complaint received by the licensee, the following information:
 - 10.1 the person to whom the complaint was made;
 - 10.2 the person responsible for managing the complaint;
 - 10.3 the date and time of the event(s) that led to the complaint;
 - 10.4 the contact details of the complainant if known, or where no details are provided a note to that effect;
 - 10.5 the nature of the complaint;
 - 10.6 the nature of event(s) giving rise to the complaint;
 - 10.7 prevailing weather conditions at the time relevant to the complaint;
 - 10.8 the action taken in relation to the complaint, including any follow-up contact with the complainant; and
 - 10.9 if no action was taken, why no action was taken.

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- 11 The licensee must implement, **maintain** and follow an **Emergency Response Plan** that addresses procedures for responding to emergencies associated with **the activity** that may cause **environmental harm**.

EARLY SURRENDER OF LICENCE

- 12 Any reports, records or other information required or able to be provided by the licensee under this licence must be submitted to the **NT EPA** prior to the licensee surrendering the licence. If the date on which a report, record or other information is required falls after the date the licensee requests to surrender this licensee, the licensee must provide the report, record or information as far as possible using data available to the licensee up to and including the date the request to surrender the licence is made.

OPERATIONAL

- 13 The licensee must not collect, transport, store, recycle, treat or dispose of **listed waste** other than the **listed waste** specified in Table 1.
- 14 The licensee must ensure any **plant and equipment** used by the licensee in conducting **the activity**:
- 14.1 is reasonably fit for the purpose and use to which it is put;
 - 14.2 is **maintained**;
 - 14.3 is operated by a person trained to use the **plant and equipment**; and
 - 14.4 is operated by, or operated by a person accompanied by, a person trained to handle, store or dispose of **listed waste** in connection with **the activity**.
- 15 The licensee must ensure that **wastewater** generated from washing **plant and equipment** associated with **the activity** does not cause **pollution**.
- 16 The licensee must segregate **waste** received at the **premises** in clearly designated areas for recycling, re-use or disposal.
- 17 The licensee must segregate **waste** generated at the **premises** in clearly designated areas for recycling, re-use or disposal.
- 18 The licensee must ensure that only the following **wastes** are disposed of by burial at the **premises**:
- 18.1 **putrescible waste**;
 - 18.2 **solid inert waste**; and
 - 18.3 **listed waste** as specified for disposal in Table 1.
- 19 The licensee must ensure that **litter**:
- 19.1 is contained within the boundary of the **premises**;
 - 19.2 is not deposited or allowed to accumulate in **stormwater** drain(s), **water** or **leachate** dam(s); and
 - 19.3 does not accumulate along the boundary of the **premises**.
- 20 The licensee must not cause or permit **waste** to be burned.
- 21 The licensee must **maintain** a log of fires occurring at the **premises** including the following information:
- 21.1 the time and date of when the fire was reported;

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- 21.2 the circumstance which ignited the fire;
 - 21.3 the time and date of when the fire ceased and whether it burnt out or was extinguished;
 - 21.4 the location of the fire on the **premises** (e.g. timber stockpile, **putrescible waste**);
 - 21.5 prevailing weather conditions;
 - 21.6 observations made in regard to smoke direction and dispersion;
 - 21.7 the amount of **waste** combusted by the fire; and
 - 21.8 action taken to extinguish the fire.
- 22 The licensee must notify the **NT EPA** of any fires at the **premises** by contacting the Pollution Hotline on telephone number 1800 064 567 as soon as practicable after (and in any case, within 24 hours after) first becoming aware of the fire. The licensee must provide the status of the fire and this licence number when contacting the Pollution Hotline.
- 23 The licensee must cover **waste** in accordance with the ***NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory.***
- 24 The licensee must ensure that all **leachate** is managed in accordance with the ***NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory.***
- 25 The licensee must ensure that neither **leachate** nor **water** pond on the surface of the landfill.
- 26 The licensee must ensure that **leachate** does not **pollute** either **land** or **water**.
- 27 The licensee must implement, **maintain** and follow a **Rehabilitation Plan**.
- 28 Where a **landfill cell** is no longer in use, the licensee must ensure that the **landfill cell** is closed and capped so as to achieve the landfill cap design objectives in the ***NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory.***
- 29 The licensee must:
- 29.1 prepare a **Landfill Closure and Post Closure Plan** in accordance with the ***NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory;***
 - 29.2 ensure the Plan is reviewed by a **qualified person** and they prepare a written report of their review, prior to submission of the Plan to the **NT EPA**; and
 - 29.3 submit the Plan to the **NT EPA**, with a copy of the **qualified person's** review, at least 12 months prior to the forecast closure of the landfill.
- 30 The **NT EPA** may require the licensee to revise or amend and resubmit any **Landfill Closure and Post Closure Plan**. Where the **NT EPA** requires a **Landfill Closure and Post Closure Plan** to be resubmitted the date for the re-submission will be specified and becomes a condition of this licence.
- 31 The licensee must implement, **maintain** and follow the **Landfill Closure and Post Closure Plan**.
- 32 The licensee must ensure that all **listed waste** being transported [to and from or from] the **premises** is transported by a person licenced under section 30 of the **WMPC Act** to transport the **listed waste**.

DISCHARGES AND EMISSIONS

- 33 The licensee must ensure there is no migration or overflow of a **contaminant** or **waste**, which causes or may cause **environmental harm**, beyond the boundary of the **land** on which the **premises** are located. For the avoidance of doubt, this condition is not intended to authorise the **discharge** of a **contaminant** or

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waste to any **land** or **water** which **discharge** has not been specifically authorised by another condition of this licence.

- 34 The licensee must not allow a **contaminant** or **waste**, which causes or may cause **environmental harm**, to enter **water**.
- 35 The licensee must ensure that **stormwater** does not come into contact with a **contaminant** or **waste**, which causes or may cause **environmental harm**.

Emissions to air

- 36 The activity must not cause or release, beyond the boundary of the **premises**:
- 36.1 smoke;
- 36.2 offensive odour;
- 36.3 dust or particulates; or
- 36.4 noise which unreasonably interferes with or is likely to unreasonably interfere with the enjoyment of the area by persons who occupy a place within the area or are otherwise lawfully in the area.

MONITORING

- 37 The licensee must implement, **maintain** and follow the Monitoring Plan from the commencement date of this licence.
- 38 The licensee must ensure that any proposed revisions to the Monitoring Plan (other than typographical changes or revisions to formatting or referencing) are:
- 38.1 reviewed by a **qualified person**, who must produce a written report about their review; and
- 38.2 submitted to the **NT EPA**, in both hard copy and electronic form, [with a complete copy of the **qualified person's** written review], 20 **business days** prior to the proposed implementation date.
- 39 The **NT EPA** may require the licensee to revise or amend and resubmit the Monitoring Plan. Where the **NT EPA** requires a Monitoring Plan to be resubmitted the date for the re-submission will be specified and becomes a condition of this licence.

RECORDING AND REPORTING

- 40 The licensee must **maintain** records of the nature, quantities and source of **waste**, other than **listed waste** received at the **premises** in each successive 12 month period following the commencement date of this licence.
- 41 The licensee must keep and **maintain** records relating to **the activity** undertaken and the **listed waste** handled by the licensee in each successive 12 month period following the commencement of this licence which include:
- 41.1 the date of collection;
- 41.2 the source of the **listed waste**;
- 41.3 the name of the transport company, if not the licensee;
- 41.4 the vehicle registration;
- 41.5 a description of the **listed waste**;

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- 41.6 the quantity of the **listed waste**;
 - 41.7 the final destination of the **listed waste**; and
 - 41.8 whether the **listed waste** was stored, recycled, treated or disposed of.
- 42 The licensee must retain records relating to **waste**, including **listed waste**, as required by the conditions of this licence, for a period of 2 years after the end of the 12 month period to which the record relates.
- 43 The licensee must keep records of all **non-compliances** with this licence. These records must be adequate to enable the licensee to comply with the **non-compliance** notification conditions of this licence.
- 44 The licensee must notify the **NT EPA** of any **non-compliance** with this licence by completing the Non-Compliance Notification via **NT EPA Online**, as soon as practicable after (and in any case within 24 hours after) first becoming aware of the **non-compliance**.
- 45 The licensee must include in the notification of **non-compliance** the following information:
- 45.1 when the **non-compliance** was detected and by whom;
 - 45.2 the date and time of the **non-compliance**;
 - 45.3 the actual and potential causes and contributing factors to the **non-compliance**;
 - 45.4 the risk of **environmental harm** arising from the **non-compliance**;
 - 45.5 the action(s) that have or will be undertaken to mitigate any **environmental harm** arising from the **non-compliance**;
 - 45.6 corrective actions that have or will be undertaken to ensure the **non-compliance** does not reoccur and
 - 45.7 if no action was taken, why no action was taken.
- 46 The licensee must complete an **Annual Return** via **NT EPA Online** within 10 **business days** after each anniversary of the commencement date of this licence, which relates to the preceding 12 month period.
- 47 The **NT EPA** may require the licensee to revise or amend and resubmit any **Annual Return**. Where the **NT EPA** requires an **Annual Return** to be resubmitted the date for the re-submission will be specified and becomes a condition of this licence.
- 48 The licensee must complete and provide to the **NT EPA** a Monitoring Report, as prescribed by this licence, within 10 **business days** after each anniversary of the commencement date of this licence, which relates to the preceding licence period.

END OF LICENCE CONDITIONS

This licence is not valid unless signed below:



William Freeland
Chair NT EPA

Delegate of the Northern Territory
Environment Protection Authority
Dated : 23/05/2016

END NOTES

This licence is a renewal and supercedes EPL16-01 which was issued on 1 October, 2012 and expired on 1 October, 2015.

EPL16-01 was an amendment and superceded EPL16 which was issued on 27 May, 2011.

EPL16 was re-issued on 31 January, 2008 with an expiry date of 30 January, 2012.

EPL16 was first issued on 29 August, 2003 with an expiry date of 29 August, 2007.

The End notes are to assist with historical records.

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DEFINITIONS

All terms in the Licence which are defined in the *Waste Management and Pollution Control Act* have the meaning given in that Act unless otherwise or further defined in this section.

Term	Definition
	In this licence, unless a contrary intention appears:
24 hour emergency contact	the phone number of a person who can be contacted at any time and be capable of responding to and providing information about any incident associated with the activity .
air	includes any layer of the atmosphere.
annual fee	yearly fee payable in respect of the activity as specified in the WMPC Act and the Regulations .
Annual Return	an NT EPA prescribed format for demonstrating and reporting compliance with the conditions of this licence and providing information on waste volumes for the preceding 12 month period.
business days	a day not Saturday, Sunday or a public holiday, in the Northern Territory.
Complaint Log	a register of complaints to be maintained by the Licensee that records the details of each complaint received in relation to the activity .
contaminant	a solid, liquid or gas or any combination of such substances and includes: (a) noise, odour, heat and electromagnetic radiation; (b) a prescribed substance or prescribed class of substances; and (c) a substance having a prescribed property or prescribed class of properties.
discharge	allow a liquid, gas or other substance to flow out from where it has been confined.
disposal schedule	a plan for disposing of asbestos containing material such that asbestos containing material is not stored in perpetuity.
Emergency Response Plan	a written plan documenting the licensee's procedures for responding to emergencies caused by, resulting from or associated with the activity and that may cause environmental harm .
environmental audit	has the meaning given in section 47 of the Act.
environmental harm	(a) any harm to or adverse effect on the environment; or (b) any potential harm (including the risk of harm and future harm) to or potential adverse effect on the environment, of any degree or duration and includes environmental nuisance.
incident	includes: (a) an accident, emergency or malfunction; and (b) a deliberate action, whether or not that action was taken by the person conducting the activity in the course of which the incident occurred.
land	includes water and air on, above or under land .
landfill cell	a purpose built area for the disposal of waste within a landfill.
Landfill Closure and Post	a written plan which specifies the landfill closure and post-closure activities as set

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Closure Plan	out in the <i>NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory</i> .
leachate	any liquid produced by the action of water percolating through waste , and that contains contaminants .
listed waste	a waste included under Schedule 2 of the Regulations .
litter	litter , garbage, rubbish, refuse or waste matter, and includes the body of a dead animal.
maintain	kept in a manner that it does not present or cause a risk of environmental harm or a hazard to persons or property.
material environmental harm	environmental harm that: (a) is not trivial or negligible in nature; (b) consists of an environmental nuisance of a high impact or on a wide scale; (c) results, or is likely to result, in not more than \$50,000 or the prescribed amount (whichever is greater) being spent in taking appropriate action to prevent or minimise the environmental harm or rehabilitate the environment; or (d) results in actual or potential loss or damage to the value of not more than \$50,000 or the prescribed amount (whichever is greater).
non-compliance	failure or refusal to comply, whether by act or omission, with obligations or requirements and includes any exceedance of a licence limit.
non-compliance notification	an NT EPA prescribed format for notifying the NT EPA of a non-compliance .
NT EPA Online	online system for Environment Protection Licence (EPL) and Environment Protection Approval (EPA) lodgement and maintenance.
NT EPA Online Vehicle Register	the vehicle register found at NT EPA Online .
plant and equipment	all material items used in association with the activity , including (but not limited to) storage vessels and containers, pipe work and hosing, vehicles (including vessels), tools, and measuring equipment.
pollute	(a) emit, discharge , deposit, or disturb, directly or indirectly, a contaminant or waste ; or (b) cause, permit, or fail to prevent, directly or indirectly, the emission, discharge , deposition, disturbance or escape of a contaminant or waste .
pollution	(a) a contaminant or waste that is emitted, discharged , deposited or disturbed or that escapes; or (b) a contaminant or waste , effect or phenomenon, that is present in the environment as a consequence of an emission, discharge , deposition, escape or disturbance or a contaminant or waste .
premises	the premises identified in this licence which includes equipment, plant and structures, whether stationary or portable, and the land on which premises are situated.
public entrance	access to the premises that is utilised by the public.
putrescible waste	the component of the waste stream liable to become putrid. For example, organic matter that has the potential to decompose with the formation of malodorous substances, usually refers to vegetative, food and animal products.

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qualified person	a person registered under section 68 of the Act.
qualified sampler	a person who has training and experience in obtaining samples from the relevant environmental medium.
Regulations	<i>Waste Management and Pollution Control (Administration) Regulations.</i>
Rehabilitation Plan	a written plan to ensure that the objectives of rehabilitation are achieved as set out in the <i>NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory.</i>
serious environmental harm	environmental harm that is more serious than material environmental harm and includes environmental harm that: (a) is irreversible or otherwise of a high impact or on a wide scale; (b) damages an aspect of the environment that is of a high conservation value, high cultural value or high community value or is of special significance; (c) results or is likely to result in more than \$50,000 or the prescribed amount (whichever is greater) being spent in taking appropriate action to prevent or minimise the environmental harm or rehabilitate the environment; or (d) results in actual or potential loss or damage to the value of more than \$50,000 or the prescribed amount (whichever is greater).
solid inert waste	solid waste that has no active chemical or biological properties. These wastes do not undergo environmentally significant physical, chemical or biological transformation.
stormwater	water flowing over ground surfaces in natural streams and drains as a direct result of rainfall over a catchment and consists primarily of rainfall runoff and any material (soluble or insoluble) mobilised in its flow path.
the activity	the Licenced activity as described on the covering page of this licence.
waste	(a) a solid, a liquid or a gas; or (b) a mixture of such substances, that is or are left over, surplus or an unwanted by-product from any activity (whether or not the substance is of value) and includes a prescribed substance or class of substances.
waste transport certificate	the NT EPA waste tracking documentation used to track listed waste being transported interstate as required in accordance with the <i>National Environment Protection (Movement of Controlled Waste Between States and Territories) Measure.</i>
wastewater	water that contains a contaminant or waste .
water	includes: (a) surface water , ground water and tidal waters ; (b) coastal waters of the Territory, within the meaning of the <i>Coastal Waters (Northern Territory Powers) Act 1980 of the Commonwealth</i> ; and (c) water containing an impurity.
WMPC Act	the Northern Territory <i>Waste Management and Pollution Control Act.</i>

Appendix B

Calibration Certificates

Multi Parameter Water Meter

Instrument YSI Pro DSS
Serial No. 20F1622172



Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH/ORP	✓	
	2. Turbidity	✓	
	3. Conductivity	✓	
	4. D.O	✓	
	5. Temp	✓	
	6. Depth	x	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. EC		2.76mS		329027	2.76mS
2. Temp		18			18.3
3. pH 4		pH 4.00		330734	pH 4.00
4. pH 7		pH 7.00		330737	pH 7.00
6. DO		0.0ppm		10465	0.0ppm
7. ORP		245mV		333082/329762	237.74 mV
8. Turbidity		0NTU		Dist. H2O	9.0NTU
9. Turbidity		100NTU		332244	112NTU
10. Turbidity		1000NTN		20A20030022	1002NTU

Calibrated by:  Joseph Tomas

Calibration date: 6/07/2021

Next calibration due: 5/08/2021

Oil / Water Interface Meter

Instrument Solinst Interface Meter (60M)
Serial No. 313382



Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Compartment	✓	
	Capacity above 7.9v	✓	8.7V
Probe	Cleaned/Decon.	✓	
	Operation	✓	
Connectors	Condition	✓	
		✓	
Tape Check	Cleaned	✓	
Connectors	Checked for cuts	✓	
Instrument Test	At surface level	✓	

Certificate of Calibration

This is to certify that the above instrument has been cleaned and tested.

Calibrated by: _____ **Sandra Sanchez**

Calibration date: 06-Jul-21

Next calibration due: 02-Jan-22

Gas Calibration Certificate



Instrument **GFM430**
Serial No. **11611**
Sensors **CH4, CO2, O2, H2S, CO**

Air-Met Scientific Pty Ltd
 1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
Pump	Operation		
	Filter		
	Flow		
	Valves, Diaphragm		
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	CH4	✓	
	CO2	✓	
	O2	✓	
	H2S	✓	
	CO	✓	
Alarms	Beeper	✓	
	Settings	✓	
Software	Version		
Datalogger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Diffusion mode		Aspirated mode			
Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No	Instrument Reading
O2		20.90%		Fresh Air	20.90%
CO2		40.0%	NIST	998268	39.9%
CH4		60.0%	NIST	998268	60.0%

Calibrated by:

Joseph Tomas

Calibration date:

6/06/2021

Appendix C

Building Gas Accumulation Results

Building gas accumulation results 2018, 2019, 2020 & 2021

Location	Date	CH4 (%)		CO2 (%)		O2 (%)		CO (ppm)		H2S (ppm)	
		Stable	Peak	Stable	Peak	Stable	Minimum	Stable	Peak	Stable	Peak
Building 1 Office: Waste Services Building – The small demountable situated on cinder blocks and beams, raised above the ground by approximately 31 cm.											
Under Fridge	27/08/2018	0.0	0.0	0.0	0.0	20.8	20.8	0.0	2.0	2.0	4.0
	13/10/2020	0.0	0.0	0.0	0.0	21.0	20.9	0.0	0.0	0.0	1.0
	09/07/2021	0.0	0.0	0.0	0.0	21.2	21.0	1.0	1.0	0.0	0.0
Under desk	27/08/2018	0.0	0.0	0.0	0.0	21.1	14.5	0.0	0.0	0.0	1.0
	13/10/2020	0.0	0.0	0.0	0.0	20.9	20.9	0.0	0.0	0.0	0.0
	09/07/2021	0.0	0.0	0.0	0.0	21.1	21.0	0.0	0.0	1.0	2.0
Under chair	27/08/2018	0.0	0.0	0.0	0.0	21.0	19.8	0.0	0.0	2.0	4.0
Within building	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.5	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	20.9	20.6	0.0	1.0	0.0	1.0
	09/07/2021	0.0	0.0	0.0	0.0	21.1	21.0	0.0	0.0	0.0	0.0
Building 2 Storage Shed: Located next to staff office, comprising ground level concrete slab and metal walls (with holes) with grated sections towards the roof											
Under couch	27/08/2018	0.0	0.0	0.0	0.0	21.0	20.7	0.0	1.0	0.0	2.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.5	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	20.9	20.8	0.0	0.0	0.0	2.0
	13/10/2020	Couch removed									
Within equipment on bench	27/08/2018	0.0	0.0	0.0	0.0	21.0	20.7	1.0	3.0	1.0	5.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.5	0.0	1.0	0.0	1.0
	05/11/2019	Equipment removed									
Under bench	27/08/2018	0.0	0.0	0.0	0.0	21.1	20.2	1.0	3.0	1.0	5.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.3	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.2	0.2	20.7	20.1	1.0	4.0	0.0	1.0
	13/10/2020	0.0	0.0	0.0	0.0	21.1	21.0	0.0	0.0	0.0	1.0
	09/07/2021	Bench removed									
Under bunding	13/10/2020	0.0	0.0	0.0	0.0	21.1	21.0	0.0	1.0	0.0	2.0
Under flammable storage cupboard	13/10/2020	0.0	0.0	0.0	0.0	21.1	21.0	0.0	0.0	0.0	1.0
All furniture and items have since been removed and the shed remains empty											
South-east corner	09/07/2021	0.0	0.0	0.0	0.0	21.3	21.3	0.0	0.0	1.0	1.0

Building gas accumulation results 2018, 2019, 2020 & 2021

Location	Date	CH4 (%)		CO2 (%)		O2 (%)		CO (ppm)		H2S (ppm)	
		Stable	Peak	Stable	Peak	Stable	Minimum	Stable	Peak	Stable	Peak
North-east corner	09/07/2021	0.0	0.0	0.0	0.0	21.3	21.3	0.0	0.0	0.0	0.0
Building 3 water tank: Tank on raised steel frame platform, approximately 41 cm above the ground											
Under tank	27/08/2018	0.0	0.0	0.0	0.0	20.9	20.7	0.0	0.0	1.0	3.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.6	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	21.2	21.1	0.0	0.0	1.0	2.0
	13/10/2020	Tank removed									
Building 4 – Southern shed which also contains the Generator cage which is a locked cage on ground level concrete slab –with a Flammable Liquids Danger sign.											
Inside cage in front of generator	27/08/2018	0.0	0.0	0.0	0.0	21.0	20.7	0.0	1.0	1.0	2.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.4	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	21.1	21.1	0.0	0.0	1.0	2.0
	13/10/2020	0.0	0.0	0.0	0.0	21.1	20.8	0.0	1.0	0.0	1.0
	09/07/2021	0.0	0.0	0.0	0.0	21.3	21.3	0.0	0.0	1.0	1.0
Within car	27/08/2018	0.0	0.0	0.0	0.0	21.0	20.7	0.0	1.0	0.0	2.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.6	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	20.9	20.9	0.0	0.0	1.0	2.0
	13/10/2020	Car removed									
Underneath couch	27/08/2018	0.0	0.0	0.0	0.0	21.1	20.8	0.0	1.0	1.0	2.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.7	0.0	1.0	0.0	1.0
	05/11/2019	Couch removed									
Behind AST	13/10/2020	0.0	0.0	0.0	0.0	21.2	21.2	0.0	0.0	0.0	1.0
	AST Removed										
Behind steel barrels in front of generator cage	09/07/2021	0.0	0.0	0.0	0.0	21.3	21.3	0.0	0.0	1.0	4.0
Building 6 Single car garage: Concrete slab at ground level with a single lever type door at one end											
Within building	27/08/2018	0.0	0.0	0.0	0.0	21.2	20.8	0.0	1.0	0.0	2.0
	18/06/2019	0.0	0.0	0.0	0.0	20.9	20.6	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	20.9	20.8	0.0	0.0	1.0	2.0
	13/10/2020	0.0	0.0	0.0	0.0	21.0	21.0	0.0	0.0	0.0	1.0
	09/07/2021	0.0	0.0	0.0	0.0	21.3	21.3	0.0	0.0	1.0	2.0

Building gas accumulation results 2018, 2019, 2020 & 2021

Location	Date	CH4 (%)		CO2 (%)		O2 (%)		CO (ppm)		H2S (ppm)	
		Stable	Peak	Stable	Peak	Stable	Minimum	Stable	Peak	Stable	Peak
Under sink (located outside)	27/08/2018	0.0	0.0	0.0	0.0	21.0	20.8	0.0	1.0	1.0	2.0
	18/06/2019	0.0	0.0	0.0	0.0	21.0	20.8	0.0	1.0	0.0	1.0
	05/11/2019	0.0	0.0	0.0	0.0	21.0	20.9	0.0	0.0	1.0	2.0
	13/10/2020	0.0	0.0	0.0	0.0	21.2	21.0	0.0	0.0	0.0	1.0
	09/07/2021	0.0	0.0	0.0	0.0	21.3	21.1	0.0	0.0	1.0	1.0

Appendix D

Field Sheets



Groundwater Sampling – Field Sheet

Client: <u>Voyages</u>				BORE ID: <u>MW3D</u>					
Project: <u>Yulara Landfill</u>				Job No.: <u>12545902</u>					
Location: <u>Yulara</u>		Casing diameter: <u>50 mm</u>		Date: <u>9/7/2021</u>					
BORE CONSTRUCTION									
Head-works	☐ Flush-mount	☒ Monument	☐ Casing only	☐ Locked	Measurement Point	☐ Top of PVC Casing	Total Depth: <u>30.6</u> m		
BORE DEVELOPMENT									
Method:		Date:		Undertaken By: <u>TM/UA</u>		Vol. Removed: <u>L</u>			
Comments (e.g. sediment content):									
PURGING DETAILS (measurement points in meters below top of casing as indicated above)									
Method:		Water Quality Meter used:				Undertaken By: <u>TM/UA</u>			
Depth to water: <u>20.80</u> m		Water Column: <u>m</u>		Req Purge Vol. 1: <u>L</u>		Flow Rate: <u>L/min</u>			
Presence of LNAPL ☐		Presence of DNAPL ☐		Thickness of NAPL: <u>cm</u>		Depth to NAPL: <u>m</u>			
Pump intake: <u>m</u>									
PURGING MEASUREMENTS ²									
Vol. Purged (L)	Elapsed Time (min)	EC (µS/cm)	Temp. (°C)	Salinity (ppm/mg/L)	pH	DO %Sat	DO (ppm/mg/L)	Ed (mV) ORP	Water Level (m b TOC)
AS 5667.11: 1998 (<+/-)		10%	0.2°C	<u>55.3</u>	10%	10%	10%	-	-
<u>N/A</u>	<u>N/A</u>	<u>1904</u>	<u>25.2</u>	<u>1867</u>	<u>6.08</u>	<u>60.4</u>	<u>4.94</u>	<u>-35.2</u>	
		<u>1867</u>	<u>24.1</u>	<u>17.13</u>	<u>6.04</u>	<u>63.3</u>	<u>4.99</u>	<u>-47.8</u>	
Comments (e.g. condition of headworks, sheen, colour, odour, sediment load):									
<u>- no odour, no sheen, low sediment load, pale / cloudy yellowish / grey colour-</u>									
SAMPLING DETAILS					Sample ID:				
Time:		Vol. Removed: <u>L</u>		No of Sample Containers:					
Type of Sample Containers (i.e. P = Plastic/G = Glass/V = Vial, volume and p = preserved/up = unpreserved):									
Field Filtered ☐		Duplicate Samples ☐		Duplicate Sample ID:					
Comments:									
CoC Number:				Checked by:			Date:		

- 1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID - 2 L/m; 100 mm ID 8 L/m.
- 2 Calibration details to be recorded in the instrument -specific calibration book, or in field notes as required by local procedures.



- 1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID - 2 L/m; 100 mm ID 8 L/m.
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2 Calibration details to be recorded in the instrument-specific calibration book, or in field notes as required by local procedures.



- 1 Bores to be purged dry, until pH, T and EC readings stabilise or a minimum of 3 to 5 times the water column volumes. Water column volumes can be calculated from the following casing volumes per unit length: 40 mm ID - 1 L/m; 50 mm ID - 2 L/m; 100 mm ID 8 L/m.
- 2 Calibration details to be recorded in the instrument-specific calibration book, or in field notes as required by local procedures.

2 Calibration details to be recorded in the instrument-specific calibration book, or in field notes as required by local procedures.

Client: Voyages.
 Project: _____
 Project No.: _____
 Site: yubara Landfill

Made By: _____
 Checked By: _____

Date: 9/7

Instrument Type: _____

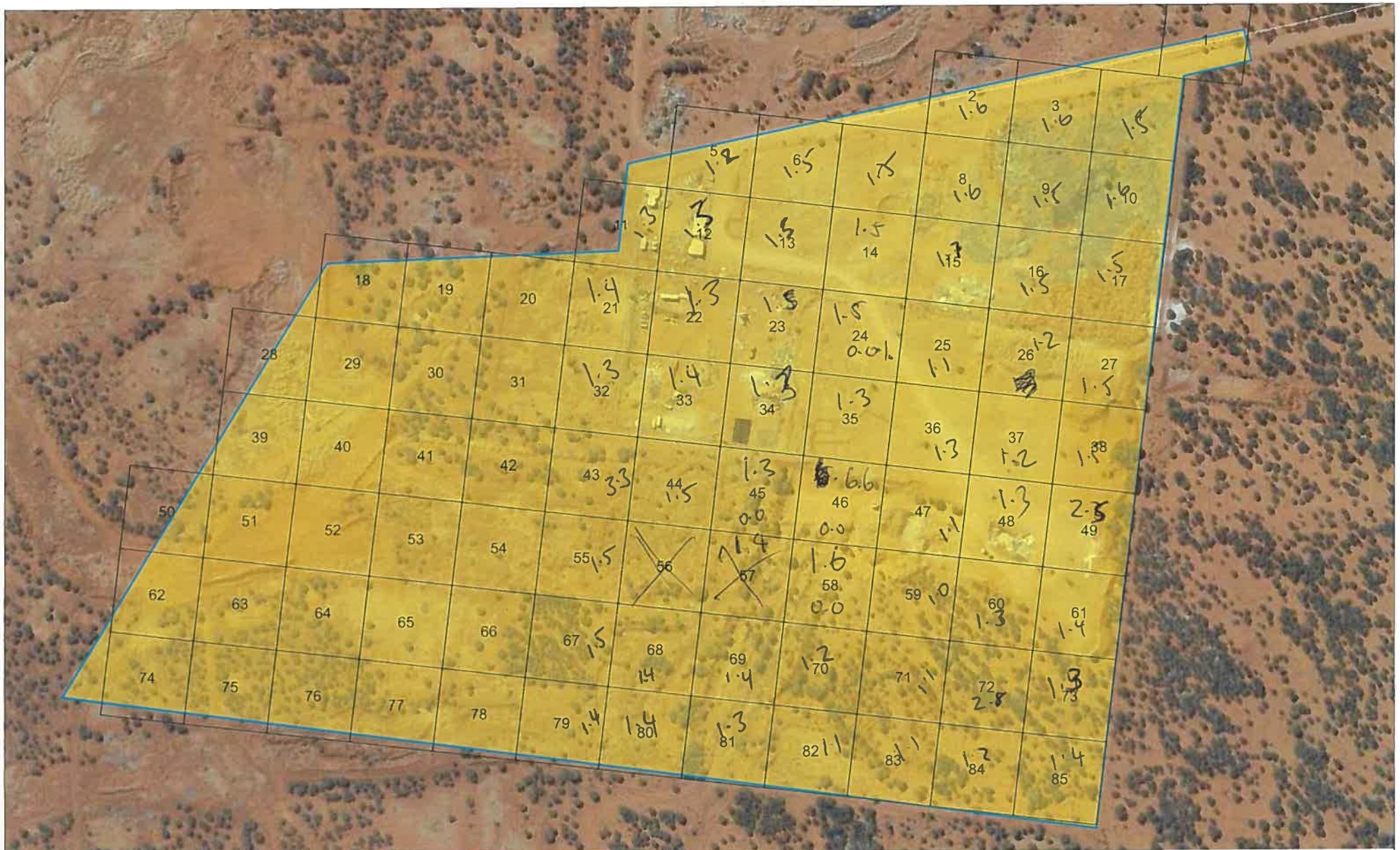
Location	Flow Rate (L/hr)					CH4 (%v/v)		CO2 (%v/v)		O2 (%v/v)		CO (ppm)	H2S (ppm)	Barometric Pressure (mBar)	Water Level (m BTOC)	Depth of Well (m BTOC)	Comments (Odour, visual, etc.)	Time
	0 sec	30 sec	60 sec	90 sec	120 sec	Peak	Stable	Peak	Stable	Lowest	Stable							
LMW2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0	2	964			LEL: 0	3:05 pm
LMW1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	17.5	0	2	964			LEL: 0	3:10 pm
MW35	0.0	0.6	0.0	0.7	0.4	0.0	0.0	3.7	3.7	17.3	17.4	0	2	959			LEL: 0	
MW28	1.3	3.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	20.7	20.7	1	2	959			LEL: 0	
MW21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3		1	1				LEL: 0	5:10 pm

Weather Observations
 Barometric Pressure: _____
 Rainfall: _____
 Temperature: _____
 Notes: _____

Ground Conditions
 Vegetation Stress: _____
 Visual Contamination: _____
 Soil Moisture: Dry
 Notes: _____

NOTES
 MAKE SURE YOU PURGE THE GA METER BETWEEN HOLES.
 HAVE YOU SWITCHED THE SAMPLE TUBE OVER TO THE FLOW PORT BEFORE MEASURING FLOW?

[illegible]



Legend:

- Site Boundary
- Surface Gas Monitoring Grid Area



GREENCAP

Level 2, 11-17 Khartoum Road
North Ryde, NSW 2113
Ph: 02-9889-1800
Fx: 02-9889-1811

Client Name:		Voyages Indigenous Tourism Australia Pty Ltd			
Client Number:		C107169		Project Number: J144100	
Project Description: Ongoing Monitoring Plan					
Address:		Yulara Landfill: Yulara, Northern Territory			
Prepared:	EL	Reviewed:	JH	Date:	08/08/2016
Figure 3	Surface Gas Monitoring Grid				

Disclaimer: Greencap Pty Ltd has produced this map for the purpose of presenting a summary of relevant spatial information and gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws. Service Layer Credits © 2016 Google Earth (© DigitalGlobe/CNS Astrum)

Appendix E

Yulara Daily Weather Observations

Uluru / Ayers Rock, Northern Territory

July 2021 Daily Weather Observations

Observations from Yulara Airport.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	6.8	22.7	0			E	24	11:04	11.3	73		S	13	1023.9	21.7	28		SE	11	1020.9
2	Fr	5.8	21.3	0			SE	28	11:10	10.6	66		SSW	15	1023.6	20.7	27		S	13	1020.3
3	Sa	3.2	16.3	0			E	31	09:52	8.4	73		ESE	13	1026.7	15.2	42		ENE	11	1022.6
4	Su	2.8	16.7	0			E	37	10:32	7.5	60		ESE	17	1025.8	16.1	31		ENE	17	1021.7
5	Mo	5.6	16.1	0			SE	48	05:40	7.3	59	8	SE	9	1023.1	15.9	30	7	ESE	9	1018.9
6	Tu	-0.3	19.9	0			ENE	20	15:19	6.2	61		SSE	11	1021.2	19.2	22		SE	9	1017.6
7	We	6.2	21.2	0			NW	20	15:39	9.1	43	7	ESE	11	1019.3	20.7	14	3	NW	11	1014.7
8	Th	1.8	23.0	0			W	41	15:18	8.4	45		S	9	1016.9	22.4	23		W	20	1014.8
9	Fr	0.6	21.1	0			ENE	28	12:51	8.9	51		SSE	6	1021.5	20.6	20		ENE	15	1018.1
10	Sa	8.0	26.0	0			NE	30	13:15	12.5	39		E	19	1020.4	24.9	14		NNE	13	1015.9
11	Su	9.6	26.0	0			WSW	48	19:00	14.1	34	2	SSW	11	1019.4	25.1	15		W	24	1016.4
12	Mo	6.2	25.4	0			E	33	11:28	13.1	48		SE	11	1020.3	23.9	21		NE	7	1015.9
13	Tu	9.1	30.2	0			NW	57	16:13	13.9	45		SE	6	1014.7	29.5	19	1	NW	37	1009.8
14	We	13.8	19.8	0.4			NNW	28	16:47	18.5	83	8	WSW	7	1011.8	16.9	97	8	NNW	13	1010.0
15	Th	6.2	21.9	1.2			WNW	50	14:10	11.4	86		NW	7	1013.6	21.0	29		W	31	1011.0
16	Fr	5.2	19.5	0			SW	37	15:15	10.6	50		SW	9	1020.2	18.6	22		SSW	17	1018.0
17	Sa	3.5	20.0	0			SSE	24	12:08	9.7	52		S	9	1021.6	19.3	32		WSW	7	1018.0
18	Su	5.6	21.5	0			E	26	11:49	11.2	62		ESE	13	1021.4	19.8	32		NE	7	1017.1
19	Mo	4.8	23.8	0			SSE	20	15:35	10.2	65	8	SSE	9	1022.0	23.1	25		E	9	1018.6
20	Tu	9.6	26.0	0			SE	28	17:26	15.0	44		SSE	7	1022.3	25.3	20		S	13	1019.4
21	We	8.9	27.1	0			N	33	15:36	13.8	45		ESE	15	1021.5	26.2	21		NNW	17	1015.2
22	Th	12.2	25.0	0			WNW	61	13:06	19.2	30		NW	20	1011.3	24.1	26		W	33	1008.3
23	Fr	5.5	20.9	0			WNW	43	16:05	10.9	65		S	15	1015.8	19.5	27		W	20	1011.6
24	Sa	1.9	22.3	0			SW	33	10:37	10.5	50			Calm	1019.3	21.3	23		W	15	1017.3
25	Su	2.3	20.5	0			E	26	10:42	9.9	55		SSE	11	1022.6	20.1	25	6	SE	6	1019.1
26	Mo	5.4	26.4	0			NNW	41	14:48	13.5	41		ESE	9	1018.9	25.5	12		NNW	24	1013.9
27	Tu	4.6	29.4	0			NNW	67	14:13	16.6	23		NW	17	1012.8	28.7	16		WNW	37	1008.5
28	We	15.1	26.5	0			N	35	15:49	16.9	53	8	SSW	2	1014.7	26.0	29		WNW	9	1012.9
29	Th	8.3	27.5	0			W	46	12:31	13.3	60		S	9	1016.4	26.7	25		WNW	19	1012.0
30	Fr	11.5	28.3	0			W	54	14:56	15.9	54		NNW	9	1014.0	27.4	22		WNW	39	1010.3
31	Sa	8.2	28.4	0			WNW	65	12:58	15.9	51		NW	9	1013.5	27.6	25		WNW	37	1010.0
Statistics for July 2021																					
Mean		6.4	23.2							12.1	53	6		10	1019.0	22.4	26	5		17	1015.4
Lowest		-0.3	16.1							6.2	23	2		Calm	1011.3	15.2	12	1	SE	6	1008.3
Highest		15.1	30.2	1.2			NNW	67		19.2	86	8	NW	20	1026.7	29.5	97	8	WNW	39	1022.6
Total				1.6																	

Observations were drawn from Yulara Airport (station 015635)

Yulara Airport is about 20 kilometres away from Uluru. Some cloud observations are from automated equipment; these are somewhat different to those made by a human observer and may not appear every day.

IDCJDW8056.202107 Prepared at 13:04 UTC on 14 Aug 2021

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Users of this product are deemed to have read the information and accepted the conditions described in the notes at

<http://www.bom.gov.au/climate/dwo/IDCJDW0000.pdf>

Appendix F

Groundwater Analytical Results



Appendix F - Table 1
Groundwater Analytical Results

Yulara Landfill Monitoring
July 2021

Location Code				MW3D				
Date				28/08/2018	19/06/2019	4/11/2019	13/10/2020	8/07/2021
Field ID				MW3D	MW3D	MW3D	MW3D	MW3D_210708
Lab Report Number				ES1825612	ES1919395	ES1936534	ES2036321	ES2125709
	Unit	EQL	NEPM 2013 Table 1C GILs, Fresh Waters - use ANZG 2018 values					
Boron (calculated as H3BO3) (filtered)	mg/L	0.3		-	-	4.97	-	-
Inorganics								
Total Suspended Solids	mg/L	5		1,220	695	-	-	147
COD	mg/L	10		104	1,550	<10	<10	<10
Acidity & Alkalinity								
Alkalinity (Carbonate as CaCO3)	mg/L	1		19	<1	<1	<1	<1
Alkalinity (Bicarbonate as CaCO3)	mg/L	1		184	185	197	183	186
Alkalinity (Hydroxide as CaCO3)	mg/L	1		<1	<1	<1	<1	<1
Alkalinity (total as CaCO3)	mg/L	1		202	185	197	183	186
Major Ions								
Calcium (filtered)	mg/L	1		78	76	82	82	84
Magnesium (filtered)	mg/L	1		45	49	48	48	47
Potassium (filtered)	mg/L	1		30	29	33	33	33
Sodium (filtered)	mg/L	1		215	209	222	228	229
Chloride	mg/L	1		263	300	334	292	271
Sulfate (filtered)	mg/L	1		215	217	241	230	228
Cations Total	meq/L	0.01		17.7	-	18.5	18.8	18.9
Anions Total	meq/L	0.01		15.9	-	18.4	16.7	16.1
Ionic Balance	%	0.01		5.30	-	0.45	5.98	7.88
Minor Ions								
Bromine (filtered)	mg/L	0.1		-	-	1.8	-	-
Iodine (filtered)	mg/L	0.1		-	-	0.4	-	-
Nutrients								
Ammonia as N	mg/L	0.01	0.9 ^{#4}	0.04	<0.01	-	-	0.03
Nitrate (as N)	mg/L	0.01		41.4	43.0	45.0	41.0	43.3
Nitrite (as N)	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen (Total Oxidised) (as N)	mg/L	0.01		41.4	43.0	45.0	41.0	43.3
Nitrogen (Total)	mg/L	0.1		41.4	44.0	-	-	45.7
Kjeldahl Nitrogen Total	mg/L	0.1		<0.1	1.0	-	-	2.4
Reactive Phosphorus as P	mg/L	0.01		0.02	0.02	0.02	0.02	0.02
Phosphorus (Total)	mg/L	0.01		0.17	0.15	0.02	0.03	0.05
Organic Indicators								
Dissolved Organic Carbon	mg/L	1		<1	2	2	<1	<1
Metals								
Aluminium (filtered)	mg/L	0.01	0.055	0.24	0.01	<0.01	<0.01	0.02
Antimony (filtered)	mg/L	0.001		-	-	<0.001	-	-
Arsenic (filtered)	mg/L	0.001		0.001	<0.001	<0.001	<0.001	<0.001
Barium (filtered)	mg/L	0.001		-	-	0.030	-	-
Beryllium (filtered)	mg/L	0.001		-	-	<0.001	-	-
Boron (filtered)	mg/L	0.05	0.37 ^{#5}	-	-	0.87	-	-
Cadmium (filtered)	mg/L	0.0001	0.0002 ^{#6}	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (III+VI) (filtered)	mg/L	0.001	0.001 ^{#5}	0.001	0.002	0.001	0.002	0.002
Cobalt (filtered)	mg/L	0.001		-	-	<0.001	-	-
Copper (filtered)	mg/L	0.001	0.0014 ^{#6}	<0.001	<0.001	<0.001	<0.001	0.015
Iron (filtered)	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05
Lead (filtered)	mg/L	0.001	0.0034 ^{#6}	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium (filtered)	mg/L	0.001		-	-	0.020	-	-
Manganese (filtered)	mg/L	0.001	1.9 ^{#5}	<0.001	<0.001	0.003	<0.001	0.004
Mercury (filtered)	mg/L	0.0001	0.00006 ^{#7}	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum (filtered)	mg/L	0.001		-	-	<0.001	-	-
Nickel (filtered)	mg/L	0.001	0.011 ^{#6}	<0.001	<0.001	0.005	<0.001	0.005
Selenium (filtered)	mg/L	0.01	0.005 ^{#7}	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (filtered)	mg/L	0.001		-	-	<0.001	-	-
Tin (filtered)	mg/L	0.001		-	-	<0.001	-	-
Vanadium (filtered)	mg/L	0.01		-	-	<0.01	-	-
Zinc (filtered)	mg/L	0.005	0.008 ^{#6}	<0.005	0.014	0.009	0.005	0.066
BTEXN								
Benzene	µg/L	1	950	-	<1	<1	<1	<1
Toluene	µg/L	2		-	<2	<2	<2	<2
Ethylbenzene	µg/L	2		-	<2	<2	<2	<2
Xylene (o)	µg/L	2	350	-	<2	<2	<2	<2
Xylene (m & p)	µg/L	2	200 ^{#8}	-	<2	<2	<2	<2
Xylene Total	µg/L	2		-	<2	<2	<2	<2
BTEX (Sum of Total) - Lab Calc	µg/L	1		-	<1	<1	<1	<1
Naphthalene	µg/L	1	16	-	<1.0	<1.0	<1.0	<1.0
TRH - NEPM 2013								
F1 (C6-C10 minus BTEX)	µg/L	20		-	<20	<20	<20	<20
C6-C10 Fraction	µg/L	20		-	<20	<20	<20	<20
F2 (>C10-C16 minus Naphthalene)	µg/L	100		-	<100	<100	<100	<100
>C10-C16 Fraction	µg/L	100		-	<100	<100	<100	<100
F3 (>C16-C34 Fraction)	µg/L	100		-	<100	<100	<100	<100
F4 (>C34-C40 Fraction)	µg/L	100		-	<100	<100	<100	<100
>C10-C40 (Sum of Total)	µg/L	100		-	<100	<100	<100	<100
TRH - NEPM 1999								
C6-C9 Fraction	µg/L	20		-	<20	<20	<20	<20
C10-C14 Fraction	µg/L	50		-	<50	<50	<50	<50
C15-C28 Fraction	µg/L	100		-	<100	<100	<100	<100
C29-C36 Fraction	µg/L	50		-	<50	<50	<50	<50
C10-C36 (Sum of Total)	µg/L	50		-	<50	<50	<50	<50



Appendix F - Table 1
Groundwater Analytical Results

Yulara Landfill Monitoring
July 2021

Location Code				MW3D				
Date				28/08/2018	19/06/2019	4/11/2019	13/10/2020	8/07/2021
Field ID				MW3D	MW3D	MW3D	MW3D	MW3D_210708
Lab Report Number				ES1825612	ES1919395	ES1936534	ES2036321	ES2125709
	Unit	EQL	NEPM 2013 Table 1C GILs, Fresh Waters - use ANZG 2018 values					
PAHs - standard 16								
Acenaphthene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Anthracene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Benzo[b+]fluoranthene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Benzo(g,h,i)perylene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Dibenz(a,h)anthracene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Fluorene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Indeno(1,2,3-c,d)pyrene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Phenanthrene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	1		-	<1.0	<1.0	<1.0	<1.0
Sum of standard 16 PAHs	µg/L	0.5		-	<0.5	<0.5	-	-
PAHs (Sum of total) - Lab calc	µg/L	0.5		-	-	-	<0.5	<0.5
Total 8 PAHs (as BaP TEQ)(zero LOR) - Lab Calc	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
OC Pesticides								
4,4'-DDE	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
a-BHC	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Aldrin	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Aldrin + Dieldrin	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
b-BHC	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Chlordane	µg/L	0.5	0.03 ^{#7}	-	<0.5	<0.5	<0.5	<0.5
Chlordane (cis)	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Chlordane (trans)	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
d-BHC	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
4,4 DDD	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
4,4 DDT	µg/L	2	0.006 ^{#7}	-	<2.0	<2.0	<2.0	<2.0
DDT+DDE+DDD - Lab Calc	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Dieldrin	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Endosulfan I (alpha)	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Endosulfan II (beta)	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Endosulfan Sulfate	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Endrin	µg/L	0.5	0.01 ^{#7}	-	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Endrin ketone	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
g-BHC (Lindane)	µg/L	0.5	0.2	-	<0.5	<0.5	<0.5	<0.5
Heptachlor	µg/L	0.5	0.01 ^{#7}	-	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Methoxychlor	µg/L	2		-	<2.0	<2.0	<2.0	<2.0
OP Pesticides								
Azinphos methyl	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Carbophenothion	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	µg/L	0.5	0.01 ^{#7}	-	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Diazinon	µg/L	0.5	0.01	-	<0.5	<0.5	<0.5	<0.5
Dichlorvos	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	0.15	-	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Fenamiphos	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Fenthion	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Malathion	µg/L	0.5	0.05	-	<0.5	<0.5	<0.5	<0.5
Methyl parathion	µg/L	2		-	<2.0	<2.0	<2.0	<2.0
Monocrotophos	µg/L	2		-	<2.0	<2.0	<2.0	<2.0
Parathion	µg/L	2	0.004 ^{#5}	-	<2.0	<2.0	<2.0	<2.0
Pirimphos-ethyl	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Prothiofos	µg/L	0.5		-	<0.5	<0.5	<0.5	<0.5
Alcohols								
Propanol	µg/L	50		-	-	-	-	-
Ethanol	µg/L	50	1,400	-	-	-	-	-
Solvents								
1-Butanol	µg/L	50		-	-	-	-	-
PCBs								
PCBs (Total)	µg/L	1		-	<1	<1	<1	<1
VOCs								
Isobutanol	µg/L	50		-	-	-	-	-
Iso-propanol	µg/L	50		-	-	-	-	-

Comments

#1 Not specifically guideline value: >500mg/L can have purgative effects

#2 Guideline value calculated by dividing Nitrate (as Nitrate) value (50 mg/L) by 4.427

#3 Guideline value calculated by dividing Nitrite (as Nitrite) value (30 mg/L) by molecular weight (3.2967033).

#4 For changes in GIL with pH refer to ANZECC & ARMCANZ (2000). Figure may not protect key species from chronic toxicity, refer ANZECC & ARMC

#5 Figure may not protect key species from chronic toxicity, refer to ANZECC & ARMCANZ (2000) for further guidance.

#6 Values calculated using hardness of 30 mg/L CaCO₃. Refer ANZECC & ARMCANZ (2000) for site specific hardness guidance

#7 Chemical for which possible bioaccumulation and secondary poisoning effects should be considered, refer to ANZECC & ARMCANZ (2000) for fur

#8 Measurement based on value for p-Xylene

Environmental Standards

National Health and Medical Research Council, March 2021, ADWG 2011 Recreational (v3.6 updated 2021)

NEPM reference ANZECC, since updated to ANZG, NEPM 2013 Table 1C GILs, Fresh Waters - use ANZG 2018 values

Appendix G

Laboratory Reports

CHAIN OF CUSTODY

ALS Laboratory:
please tick →

ADALADE 21 Burns Road Poorska SA 5095
 Ph: 08 8359 0890 E: adelaide@aloglobal.com

BRISBANE 32 Shand Street Stawell QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@asglobal.com

DGLADSTONE 46 Callemondah Drive Clinton QLD 4680
 Ph: 07 7471 5600 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740
 Ph: 07 4944 0177 E: mackay@alsglobal.com

IMEI, BOURNE 2-4 Westall Road Springvale VIC 3171
Ph. 03 8549 9600 E: samples.ins@bourne.com.au

DMUDGE 27 Sydney Road Mudgee NSW 2850
Ph: 02 6372 6735 E: mudgee.mail@airglobal.com

NEWCASTLE 5/585 Maitland Rd Mayfield West NSW 2304
Ph: 02 404 2500 E: samples.newcastle@alsglobal.com

UNOWRA 4/13 Garry Place North Nowra NSW 2541
Ph: 024423 2063 E: nowra@aisglobal.com

PERTH 10 Hood Way Malaga WA 6095
Ph: 08 9209 7655 E: samples.perth@alsglobal.com


SYDNEY 277-280 Woodpark Road Smithfield NSW 2164
 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

LITOWNSVILLE 14-15 Desma Court Bonle QLD 4816
Ph: 07 4796 0600 E. townsville.environmental@aisglobal.com

WOLLONGONG 99 Kenny Street Wollongong NSW 2500
Ph: 02 4225 5125 E: portkembla@aalsglobal.com

CLIENT: GHD		TURNAROUND REQUIREMENTS : ☐ Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: <i>Boston</i>		(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):		Custody Seal intact? ☐ Yes ☐ No ☐ N/A Free ice / frozen ice bricks present upon receipt? ☐ Yes ☐ No ☐ N/A Random Sample Temperature on Receipt: ☐ C ☐ F Other comment:	
PROJECT: 12545902		ALS QUOTE NO.: SY/017/21		COC SEQUENCE NUMBER (Circle)	
ORDER NUMBER:				COC: 1 2 3 4 5 6 7	
PROJECT MANAGER: Tim Murphy		CONTACT PH: 0499056068		OF: 1 2 3 4 5 6 7	
SAMPLER: Tim Murphy/Vasillea Milsom		SAMPLER MOBILE: 0499056068		RELINQUISHED BY:	
COC emailed to ALS? (YES / NO)		EDD FORMAT (or default):		RECEIVED BY: <i>FAZ</i>	
Email Reports to (will default to PM if no other addresses are listed):				DATE/TIME:	
Email Invoice to (will default to PM if no other addresses are listed):		8/7/2021		13/7/24 7:40L	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

[illegible]

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic

V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

Environmental Division
Sydney
Work Order Reference
ES2125709



Telephone : + 61-2-8784 8555

CERTIFICATE OF ANALYSIS

Work Order : **ES2125709**
Client : **GHD PTY LTD**
Contact : **MR TIM MURPHY**
Address : **Level 7 24 Mitchell Street**
DARWIN NT, AUSTRALIA 0800
Telephone : **+61 08 89820151**
Project : **12545902**
Order number : **----**
C-O-C number : **----**
Sampler : **TIM MURPHY, Vassillea Milsom**
Site : **----**
Quote number : **SY/016/21B**
No. of samples received : **2**
No. of samples analysed : **2**

Page : 1 of 8
Laboratory : Environmental Division Sydney
Contact : Sarah Mathew
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61-2-8784 8555
Date Samples Received : 13-Jul-2021 07:10
Date Analysis Commenced : 13-Jul-2021
Issue Date : 20-Jul-2021 13:29



Accreditation No. 825
 Accredited for compliance with
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075 (SIM): Where reported, Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenzo(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW3D_210708	trip blank	----	----	----
Sampling date / time				08-Jul-2021 00:00	14-Apr-2021 00:00	----	----	----	
Compound	CAS Number	LOR	Unit	ES2125709-001	ES2125709-002	-----	-----	-----	
				Result	Result	----	----	----	
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)		----	5	mg/L	147	----	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	186	----	----	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	186	----	----	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric		14808-79-8	1	mg/L	228	----	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride		16887-00-6	1	mg/L	271	----	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	84	----	----	----	----	
Magnesium	7439-95-4	1	mg/L	47	----	----	----	----	
Sodium	7440-23-5	1	mg/L	229	----	----	----	----	
Potassium	7440-09-7	1	mg/L	33	----	----	----	----	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	0.02	----	----	----	----	
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----	
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----	
Chromium	7440-47-3	0.001	mg/L	0.002	----	----	----	----	
Copper	7440-50-8	0.001	mg/L	0.015	----	----	----	----	
Nickel	7440-02-0	0.001	mg/L	0.005	----	----	----	----	
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----	
Zinc	7440-66-6	0.005	mg/L	0.066	----	----	----	----	
Manganese	7439-96-5	0.001	mg/L	0.004	----	----	----	----	
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----	
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----	
EG035F: Dissolved Mercury by FIMS									
Mercury		7439-97-6	0.0001	mg/L	<0.0001	----	----	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N		7664-41-7	0.01	mg/L	0.03	----	----	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N		14797-65-0	0.01	mg/L	<0.01	----	----	----	
EK058G: Nitrate as N by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW3D_210708	trip blank	----	----	----
Sampling date / time					08-Jul-2021 00:00	14-Apr-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES2125709-001	ES2125709-002	-----	-----	-----
					Result	Result	----	----	----
EK058G: Nitrate as N by Discrete Analyser - Continued									
Nitrate as N	14797-55-8	0.01	mg/L		43.3	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		43.3	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.4	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		45.7	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.05	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.02	----	----	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		16.1	----	----	----	----
ø Total Cations	----	0.01	meq/L		18.9	----	----	----	----
ø Ionic Balance	----	0.01	%		7.88	----	----	----	----
EP002: Dissolved Organic Carbon (DOC)									
Dissolved Organic Carbon	----	1	mg/L		<1	----	----	----	----
EP026SP: Chemical Oxygen Demand (Spectrophotometric)									
Chemical Oxygen Demand	----	10	mg/L		<10	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
^ Total Polychlorinated biphenyls	----	1	µg/L		<1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				MW3D_210708	trip blank	----	----	----
Sampling date / time				08-Jul-2021 00:00	14-Apr-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES2125709-001	ES2125709-002	-----	-----	-----
				Result	Result	----	----	----

EP068A: Organochlorine Pesticides (OC) - Continued

Dieldrin	60-57-1	0.5	µg/L	<0.5	----	----	----	----
4,4'-DDE	72-55-9	0.5	µg/L	<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L	<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	----	----	----	----
4,4'-DDD	72-54-8	0.5	µg/L	<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	----	----	----	----
4,4'-DDT	50-29-3	2.0	µg/L	<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L	<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.5	µg/L	<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	----	----	----	----

EP068B: Organophosphorus Pesticides (OP)

Dichlorvos	62-73-7	0.5	µg/L	<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L	<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L	<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L	<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L	<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L	<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L	<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L	<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L	<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L	<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	----	----	----	----

EP075(SIM)B: Polynuclear Aromatic Hydrocarbons



Analytical Results

Sub-Matrix: WATER
 (Matrix: WATER)

Sample ID

				MW3D_210708	trip blank	----	----	----
Sampling date / time				08-Jul-2021 00:00	14-Apr-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES2125709-001	ES2125709-002	-----	-----	-----
				Result	Result	----	----	----

EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued

Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a,h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g,h,i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	----	----	----	----

EP080/071: Total Petroleum Hydrocarbons

C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	----	----	----	----

EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions

C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	----	----	----	----

EP080: BTEXN



Analytical Results

Sub-Matrix: **WATER**
 (Matrix: **WATER**)

Sample ID

				MW3D_210708	trip blank	----	----	----
Sampling date / time				08-Jul-2021 00:00	14-Apr-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES2125709-001	ES2125709-002	-----	-----	-----
				Result	Result	----	----	----
EP080: BTEXN - Continued								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ Total Xylenes	----	2	µg/L	<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L	<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	1	%	87.2	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.5	%	82.3	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.5	%	87.3	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	26.5	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	58.3	----	----	----	----
2,4,6-Tribromophenol	118-79-6	1.0	%	44.2	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	68.0	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	68.3	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	76.8	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	2	%	110	111	----	----	----
Toluene-D8	2037-26-5	2	%	106	108	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	106	108	----	----	----



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	45	134
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	67	111
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	67	111
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2,4,6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: ES2125709	Page	: 1 of 10
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR TIM MURPHY	Contact	: Sarah Mathew
Address	: Level 7 24 Mitchell Street DARWIN NT, AUSTRALIA 0800	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 08 89820151	Telephone	: +61-2-8784 8555
Project	: 12545902	Date Samples Received	: 13-Jul-2021
Order number	: ----	Date Analysis Commenced	: 13-Jul-2021
C-O-C number	: ----	Issue Date	: 20-Jul-2021
Sampler	: TIM MURPHY, Vasillea Milsom		
Site	: ----		
Quote number	: SY/016/21B		
No. of samples received	: 2		
No. of samples analysed	: 2		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA025: Total Suspended Solids dried at 104 ± 2°C (QC Lot: 3794965)									
ES2125572-001	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	132	137	3.5	0% - 20%
ES2125655-010	Anonymous	EA025H: Suspended Solids (SS)	----	5	mg/L	22	21	0.0	No Limit
ED037P: Alkalinity by PC Titrator (QC Lot: 3797809)									
ES2125886-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	142	144	1.7	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	142	144	1.7	0% - 20%
ES2125202-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	73	79	7.3	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	73	79	7.3	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3789796)									
ES2125204-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 3789797)									
ES2125204-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	4	5	0.0	No Limit
ES2125803-004	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1	1	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 3792618)									
ES2124337-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	46	46	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	29	30	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	53	54	3.3	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
ES2124845-010	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	27900	27300	2.3	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	5510	5300	4.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	43100	41200	4.5	0% - 20%

Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED093F: Dissolved Major Cations (QC Lot: 3792618) - continued									
ES2124845-010	Anonymous	ED093F: Potassium	7440-09-7	1	mg/L	1090	1080	1.0	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 3792616)									
ES2124337-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.0	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.0	No Limit
ES2124845-010	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0014	0.0013	0.0	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	0.0	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.030	0.032	7.5	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.105	0.105	0.0	0% - 50%
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	210	201	4.4	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.062	0.062	0.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	2.93	3.02	2.8	0% - 20%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.10	<0.10	0.0	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.10	<0.10	0.0	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	282	279	0.9	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 3792619)									
ES2124845-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
ES2124845-009	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.0	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3795159)									
ES2124845-010	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	124	123	0.8	0% - 20%
ES2125418-005	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.04	0.04	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3789795)									
ES2125204-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3795160)									
ES2124845-010	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<1.00	2.00	66.7	No Limit
ES2125418-005	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	1.54	1.54	0.0	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3795156)									
ES2124845-010	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	141	127	10.0	0% - 50%
ES2125418-006	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.8	0.8	0.0	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3795157)									



Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3795157) - continued									
ES2125719-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.03	0.04	47.8	No Limit
ES2125723-009	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.11	0.13	16.4	0% - 50%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3789799)									
ES2125609-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.11	0.11	0.0	0% - 50%
ES2125803-004	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EP002: Dissolved Organic Carbon (DOC) (QC Lot: 3793073)									
ES2124845-010	Anonymous	EP002: Dissolved Organic Carbon	----	1	mg/L	140	138	1.3	0% - 20%
ES2125782-036	Anonymous	EP002: Dissolved Organic Carbon	----	1	mg/L	255	253	0.9	0% - 20%
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QC Lot: 3800379)									
EP2107937-001	Anonymous	EP026SP: Chemical Oxygen Demand	----	10	mg/L	<10	<10	0.0	No Limit
ES2125709-001	MW3D_210708	EP026SP: Chemical Oxygen Demand	----	10	mg/L	<10	<10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3790760)									
ES2124845-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
ES2124845-011	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3790760)									
ES2124845-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
ES2124845-011	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 3790760)									
ES2124845-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
ES2124845-011	Anonymous	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.0	No Limit
			106-42-3						
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
	Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
<5	150 mg/L	103	83.0	129
<5	1000 mg/L	101	82.0	110
<5	463 mg/L	86.8	83.0	118
----	200 mg/L	95.2	81.0	111
----	50 mg/L	101	80.0	120
<1	25 mg/L	100	82.0	122
<1	500 mg/L	107	82.0	122
<1	50 mg/L	103	80.9	127
<1	1000 mg/L	101	80.9	127
<1	50 mg/L	102	80.0	114
<1	50 mg/L	102	90.0	116
<1	50 mg/L	98.6	82.0	120
<1	50 mg/L	96.2	85.0	113
<0.01	0.5 mg/L	99.0	80.0	116
<0.001	0.1 mg/L	93.4	85.0	114
<0.0001	0.1 mg/L	98.6	84.0	110
<0.001	0.1 mg/L	97.4	85.0	111
<0.001	0.1 mg/L	94.9	81.0	111
<0.001	0.1 mg/L	98.7	83.0	111
<0.001	0.1 mg/L	97.4	82.0	110
<0.001	0.1 mg/L	92.7	82.0	112
<0.01	0.1 mg/L	94.1	85.0	115
<0.005	0.1 mg/L	95.1	81.0	117
<0.05	0.5 mg/L	104	82.0	112
<0.0001	0.01 mg/L	91.7	83.0	105
<0.01	1 mg/L	95.9	90.0	114



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3789795) - continued								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	102	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3795160)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	97.8	91.0	113
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3795156)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	90.0	69.0	101
				<0.1	1 mg/L	101	70.0	118
				<0.1	5 mg/L	97.2	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3795157)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	97.2	71.0	101
				<0.01	0.442 mg/L	103	72.0	108
				<0.01	1 mg/L	105	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3789799)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	104	85.0	117
EP002: Dissolved Organic Carbon (DOC) (QCLot: 3793073)								
EP002: Dissolved Organic Carbon	----	1	mg/L	<1	10 mg/L	97.6	71.0	121
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QCLot: 3800379)								
EP026SP: Chemical Oxygen Demand	----	10	mg/L	<10	50 mg/L	100	82.0	112
				<10	500 mg/L	98.3	83.0	113
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 3789247)								
EP066: Total Polychlorinated biphenyls	----	1	µg/L	<1	10 µg/L	104	68.9	113
EP068A: Organochlorine Pesticides (OC) (QCLot: 3789245)								
EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	5 µg/L	88.3	64.9	107
EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	5 µg/L	80.5	58.3	111
EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	5 µg/L	92.6	69.0	117
EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	5 µg/L	84.6	70.0	112
EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	5 µg/L	94.6	68.9	110
EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	5 µg/L	89.5	65.2	108
EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	5 µg/L	91.2	65.8	109
EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	5 µg/L	92.2	67.1	107
EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	5 µg/L	90.6	64.1	110
EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	5 µg/L	92.3	66.7	112
EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	5 µg/L	91.8	63.2	111
EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	5 µg/L	94.2	65.2	113
EP068: 4,4`-DDE	72-55-9	0.5	µg/L	<0.5	5 µg/L	92.0	66.0	112
EP068: Endrin	72-20-8	0.5	µg/L	<0.5	5 µg/L	102	65.2	113
EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	5 µg/L	98.0	67.3	114
EP068: 4,4`-DDD	72-54-8	0.5	µg/L	<0.5	5 µg/L	91.6	72.0	122
EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	5 µg/L	82.2	66.9	109



Sub-Matrix: **WATER**

Method: Compound				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%)	
							Low	High
CAS Number	LOR	Unit	Result					
EP068A: Organochlorine Pesticides (OC) (QCLot: 3789245) - continued								
EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	5 µg/L	89.6	65.2	112
EP068: 4,4'-DDT	50-29-3	2	µg/L	<2.0	5 µg/L	90.2	65.2	112
EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	5 µg/L	91.3	63.8	110
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	5 µg/L	95.3	61.1	114
EP068B: Organophosphorus Pesticides (OP) (QCLot: 3789245)								
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	75.9	65.6	114
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	90.6	63.7	113
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	24.6	19.7	48.0
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	89.9	69.5	110
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	84.7	71.1	110
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	93.6	77.0	119
EP068: Parathion-methyl	298-00-0	2	µg/L	<2.0	5 µg/L	91.9	70.0	124
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	102	68.4	116
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	91.1	68.6	112
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	93.3	75.0	119
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	90.2	67.0	121
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	93.8	69.0	121
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	97.5	71.8	110
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	92.7	67.5	112
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	103	64.1	116
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	91.1	67.8	114
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	92.8	74.0	120
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	97.9	66.2	114
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	103	51.6	128
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 3789246)								
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	74.0	50.0	94.0
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	79.7	63.6	114
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	79.4	62.2	113
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	90.1	63.9	115
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	83.2	62.6	116
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	78.6	64.3	116
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	83.6	63.6	118
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	83.7	63.1	118
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	94.0	64.1	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	92.4	62.5	116
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2	1	µg/L	<1.0	5 µg/L	91.8	61.7	119
	205-82-3							
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	100	63.0	115
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	96.8	63.3	117



Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result			Low	High
EP075(SIM): Polynuclear Aromatic Hydrocarbons (QCLot: 3789246) - continued								
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	95.3	59.9	118
EP075(SIM): Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	94.2	61.2	117
EP075(SIM): Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	87.3	59.1	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3789244)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	400 µg/L	68.7	55.8	112
EP071: C15 - C28 Fraction	----	100	µg/L	<100	600 µg/L	79.6	71.6	113
EP071: C29 - C36 Fraction	----	50	µg/L	<50	400 µg/L	78.8	56.0	121
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3790760)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	82.9	75.0	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3789244)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	500 µg/L	81.6	57.9	119
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	700 µg/L	76.7	62.5	110
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	300 µg/L	70.2	61.5	121
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3790760)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	84.3	75.0	127
EP080: BTEXN (QCLot: 3790760)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	89.0	70.0	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	92.7	69.0	123
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	94.7	70.0	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	92.5	69.0	121
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	99.7	72.0	122
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	97.3	70.0	120

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery(%) MS	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number			Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3789796)							
ES2125204-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	90.4	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 3789797)							
ES2125204-001	Anonymous	ED045G: Chloride	16887-00-6	50 mg/L	99.1	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 3792616)							
ES2124845-002	Anonymous	EG020A-F: Arsenic	7440-38-2	1.25 mg/L	108	70.0	130



Sub-Matrix: **WATER**

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 3792616) - continued							
ES2124845-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.3125 mg/L	115	70.0	130
		EG020A-F: Chromium	7440-47-3	1.25 mg/L	115	70.0	130
		EG020A-F: Copper	7440-50-8	1.25 mg/L	110	70.0	130
		EG020A-F: Lead	7439-92-1	1.25 mg/L	108	70.0	130
		EG020A-F: Manganese	7439-96-5	1.25 mg/L	114	70.0	130
		EG020A-F: Nickel	7440-02-0	1.25 mg/L	108	70.0	130
		EG020A-F: Zinc	7440-66-6	1.25 mg/L	112	70.0	130
EG035F: Dissolved Mercury by FIMS (QCLot: 3792619)							
ES2124845-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	96.3	70.0	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 3795159)							
ES2124845-010	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	# Not Determined	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 3789795)							
ES2125204-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	103	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3795160)							
ES2124845-010	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	96.6	70.0	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 3795156)							
ES2125349-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	95.5	70.0	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3795157)							
ES2125720-001	Anonymous	EK067G: Total Phosphorus as P	----	10 mg/L	108	70.0	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3789799)							
ES2125609-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	90.9	70.0	130
EP002: Dissolved Organic Carbon (DOC) (QCLot: 3793073)							
ES2125709-001	MW3D_210708	EP002: Dissolved Organic Carbon	----	100 mg/L	110	70.0	130
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QCLot: 3800379)							
EP2107937-001	Anonymous	EP026SP: Chemical Oxygen Demand	----	291 mg/L	100	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3790760)							
ES2124845-001	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	101	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3790760)							
ES2124845-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	98.9	70.0	130
EP080: BTEXN (QCLot: 3790760)							
ES2124845-001	Anonymous	EP080: Benzene	71-43-2	25 µg/L	95.1	70.0	130
		EP080: Toluene	108-88-3	25 µg/L	96.1	70.0	130
		EP080: Ethylbenzene	100-41-4	25 µg/L	101	70.0	130



Sub-Matrix: WATER

Laboratory sample ID Sample ID Method: Compound CAS Number				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
				Concentration	MS	Low	High
EP080: BTEXN (QCLot: 3790760) - continued							
ES2124845-001	Anonymous	EP080: meta- & para-Xylene	108-38-3	25 µg/L	98.0	70.0	130
			106-42-3				
		EP080: ortho-Xylene	95-47-6	25 µg/L	103	70.0	130
		EP080: Naphthalene	91-20-3	25 µg/L	103	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2125709	Page	: 1 of 11
Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR TIM MURPHY	Telephone	: +61-2-8784 8555
Project	: 12545902	Date Samples Received	: 13-Jul-2021
Site	: ----	Issue Date	: 20-Jul-2021
Sampler	: TIM MURPHY, Vasillea Milsom	No. of samples received	: 2
Order number	: ----	No. of samples analysed	: 2

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK055G: Ammonia as N by Discrete Analyser	ES2124845--010	Anonymous	Ammonia as N	7664-41-7	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural MW3D_210708		----	----	----	13-Jul-2021	10-Jul-2021	3
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural MW3D_210708		----	----	----	13-Jul-2021	10-Jul-2021	3
EP080/071: Total Petroleum Hydrocarbons							
Amber VOC Vial - Sulfuric Acid trip blank		14-Jul-2021	28-Apr-2021	77	14-Jul-2021	28-Apr-2021	77
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber VOC Vial - Sulfuric Acid trip blank		14-Jul-2021	28-Apr-2021	77	14-Jul-2021	28-Apr-2021	77
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid trip blank		14-Jul-2021	28-Apr-2021	77	14-Jul-2021	28-Apr-2021	77

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	2	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	0	2	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	2	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	5	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	0	2	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	5	0.00	5.00	NEPM 2013 B3 & ALS QC Standard



Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA025: Total Suspended Solids dried at 104 ± 2°C							
Clear Plastic Bottle - Natural (EA025H) MW3D_210708	08-Jul-2021	----	----	----	15-Jul-2021	15-Jul-2021	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) MW3D_210708	08-Jul-2021	----	----	----	17-Jul-2021	22-Jul-2021	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) MW3D_210708	08-Jul-2021	----	----	----	13-Jul-2021	05-Aug-2021	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) MW3D_210708	08-Jul-2021	----	----	----	13-Jul-2021	05-Aug-2021	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) MW3D_210708	08-Jul-2021	----	----	----	15-Jul-2021	05-Aug-2021	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020A-F) MW3D_210708	08-Jul-2021	----	----	----	15-Jul-2021	04-Jan-2022	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F) MW3D_210708	08-Jul-2021	----	----	----	15-Jul-2021	05-Aug-2021	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) MW3D_210708	08-Jul-2021	----	----	----	16-Jul-2021	05-Aug-2021	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) MW3D_210708	08-Jul-2021	----	----	----	13-Jul-2021	10-Jul-2021	✗
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) MW3D_210708	08-Jul-2021	----	----	----	16-Jul-2021	05-Aug-2021	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) MW3D_210708	08-Jul-2021	16-Jul-2021	05-Aug-2021	✓	16-Jul-2021	05-Aug-2021	✓



Matrix: **WATER**

Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) MW3D_210708	08-Jul-2021	16-Jul-2021	05-Aug-2021	✓	16-Jul-2021	05-Aug-2021	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) MW3D_210708	08-Jul-2021	----	----	----	13-Jul-2021	10-Jul-2021	✗
EP002: Dissolved Organic Carbon (DOC)							
Amber DOC Filtered- Sulfuric Preserved (EP002) MW3D_210708	08-Jul-2021	----	----	----	15-Jul-2021	05-Aug-2021	✓
EP026SP: Chemical Oxygen Demand (Spectrophotometric)							
Clear Plastic Bottle - Sulfuric Acid (EP026SP) MW3D_210708	08-Jul-2021	----	----	----	20-Jul-2021	05-Aug-2021	✓
EP066: Polychlorinated Biphenyls (PCB)							
Amber Glass Bottle - Unpreserved (EP066) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	16-Jul-2021	23-Aug-2021	✓
EP068A: Organochlorine Pesticides (OC)							
Amber Glass Bottle - Unpreserved (EP068) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	16-Jul-2021	23-Aug-2021	✓
EP068B: Organophosphorus Pesticides (OP)							
Amber Glass Bottle - Unpreserved (EP068) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	16-Jul-2021	23-Aug-2021	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	16-Jul-2021	23-Aug-2021	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber DOC Filtered- Sulfuric Preserved (EP080) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	14-Jul-2021	15-Jul-2021	✓
Amber Glass Bottle - Unpreserved (EP071) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	16-Jul-2021	23-Aug-2021	✓
Amber VOC Vial - Sulfuric Acid (EP080) trip blank	14-Apr-2021	14-Jul-2021	28-Apr-2021	✗	14-Jul-2021	28-Apr-2021	✗
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber DOC Filtered- Sulfuric Preserved (EP080) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	14-Jul-2021	15-Jul-2021	✓
Amber Glass Bottle - Unpreserved (EP071) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✓	16-Jul-2021	23-Aug-2021	✓
Amber VOC Vial - Sulfuric Acid (EP080) trip blank	14-Apr-2021	14-Jul-2021	28-Apr-2021	✗	14-Jul-2021	28-Apr-2021	✗



Matrix: **WATER** Evaluation: ✖ = Holding time breach ; ✔ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN							
Amber DOC Filtered- Sulfuric Preserved (EP080) MW3D_210708	08-Jul-2021	14-Jul-2021	15-Jul-2021	✔	14-Jul-2021	15-Jul-2021	✔
Amber VOC Vial - Sulfuric Acid (EP080) trip blank	14-Apr-2021	14-Jul-2021	28-Apr-2021	✘	14-Jul-2021	28-Apr-2021	✘



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	10	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	2	14	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	4	25.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	2	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	2	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	2	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	8	25.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	3	33.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	5	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	10	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	3	66.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
Analytical Methods		QC	Regular	Actual	Expected	Evaluation	
Laboratory Control Samples (LCS) - Continued							
Suspended Solids (High Level)	EA025H	3	20	15.00	15.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	3	20	15.00	15.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	3	20	15.00	15.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	10	10.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	3	33.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	10	10.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Organic Carbon	EP002	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	4	25.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	2	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	0	2	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	0	2	0.00	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	3	33.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

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Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Matrix Spikes (MS) - Continued							
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	5	0.00	5.00	✘	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	1	20	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of 'non-filterable' residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA seal method 2 017-1-L
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3).
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM Schedule B(3)



Analytical Methods	Method	Matrix	Method Descriptions
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM Schedule B(3)
Total Nitrogen as N (TKN + No _x) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO ₃ -. This method is compliant with NEPM Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al, Zhang et al. This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO ₄ DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)
Dissolved Organic Carbon	EP002	WATER	In house: Referenced to APHA 5310 B. This method is compliant with NEPM Schedule B(3). Samples are combusted at high temperature in the presence of an oxidative catalyst. The evolved carbon dioxide is quantified using an IR detector.
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	WATER	In house: Referenced to APHA 5220 D. Samples are digested with a known excess of an acidic potassium dichromate solution using silver sulfate as a catalyst. The chromium is reduced from the Cr (VI) oxidation state to the Cr (III) state by the oxygen present in the organic material. Both of these chromium species are coloured and absorb in the visible region of (400nm & 600nm) the spectrum. The oxidisable organic matter can be calculated in terms of oxygen equivalents.
Polychlorinated Biphenyls (PCB)	EP066	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270 Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)

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<i>Analytical Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.



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