



Landfill Monitoring Report

May 2023

Yulara Landfill

Voyages Indigenous Tourism Pty Ltd



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TABLE OF CONTENTS

1	INTRODUCTION	1
2	SITE DESCRIPTION	1
3	FIELD SAMPLING AND MONITORING	1
3.1	Groundwater & leachate monitoring	3
3.2	Landfill gas monitoring	3
4	ASSESSMENT CRITERIA.....	3
4.1	Groundwater assessment criteria.....	3
4.2	Landfill gas assessment criteria	4
5	FIELD OBSERVATIONS AND RESULTS.....	4
5.1	Groundwater.....	4
5.1.1	Groundwater field readings	4
5.1.2	Groundwater laboratory results.....	5
5.2	Landfill gas	5
5.2.1	Surface gas survey	5
5.2.2	Enclosed space landfill gas survey	5
5.2.3	Sub surface LFG monitoring	6
6	DISCUSSION	9
6.1	Groundwater.....	9
6.2	Landfill gas	9
7	RECOMMENDATIONS	12
8	REFERENCES	12

Tables

Table 3-1. Monitoring well construction details ¹	1
Table 3-2. Groundwater/leachate well monitoring method	3
Table 3-3. Landfill gas monitoring method.....	3
Table 5-1. Standing water levels to date*	4
Table 5-2. Field water quality parameters to date*	5
Table 5-3. Analytes with guideline values.....	5
Table 5-4. Sub surface gas readings to date	7

Figures

Figure 3-1. Map of landfill monitoring wells	2
Figure 6-1. Subsurface carbon dioxide trend graph	9
Figure 6-2. Subsurface methane trend graph.....	10
Figure 6-3. Subsurface oxygen trend graph	10
Figure 6-4. Subsurface carbon monoxide trend graph	11
Figure 6-5. Subsurface hydrogen sulphide trend graph	11

Appendices

Appendix A	Gas Bore field sheet
Appendix B	Relative Methane field sheet
Appendix C	Gas meter calibration sheet

1 INTRODUCTION

EcOz Environmental Consultants (EcOz) was engaged by Voyages Indigenous Tourism Pty Ltd (Voyages) to conduct groundwater and gas monitoring at the Yulara landfill (the Site) in accordance with the Site's Ongoing Monitoring Plan (OMP). This monitoring had previously been undertaken by Low Ecological Services Pty Ltd and GHD.

The Yulara landfill has been in operation since 2003, with its current Environment Protection Licence (EPL) #179 expiring on 30 June 2025. EcOz organised the field attendance with Voyages' Linda Harper. This report presents the findings of a biannual round of sampling conducted on 16 May 2022.

2 SITE DESCRIPTION

Yulara landfill occupies a roughly 30-acre lot located approximately 4 kilometres west northwest of the Yulara resort township. The site consists of a landfill, recycling, white goods, oil and grease and green waste disposal areas. The surrounding area consists of open scrubland.

More detailed information on Geology, hydrogeology and waste characteristics are provided in the OMP and Landfill Environmental Management Plan.

3 FIELD SAMPLING AND MONITORING

Samples are collected from a total of eight wells throughout the landfill area. These eight wells consist of three sets of nested groundwater/gas monitoring wells and two leachate monitoring wells. The sites are shown in Figure 3-1.

The installation records for the monitoring wells are provided in Table 3-1.

Table 3-1. Monitoring well construction details¹

Site ID	Installation record			Monitoring purpose
	Bore No.	Depth (mbgl)	Screen (mbgl)	
MW1S	19405	4	1-4	Gas
MW1D	19406	12	9-12	Groundwater
MW2S	19403	10	1-10	Gas
MW2D	19404	15	12-15	Groundwater
MW3S	19400	11	2-11	Gas
MW3D	19399	30	15-27	Groundwater
LMW1	19401	6	1.5-6	Gas & leachate
LMW2	19402	8	1-8	Gas & leachate

¹ All information presented taken from GHD November 2021 report.

Sampling was conducted in accordance with the OMP. Where samples were not collected it was due to the lack of sample available (i.e., dry monitoring wells) or instructions from Voyages environmental staff.

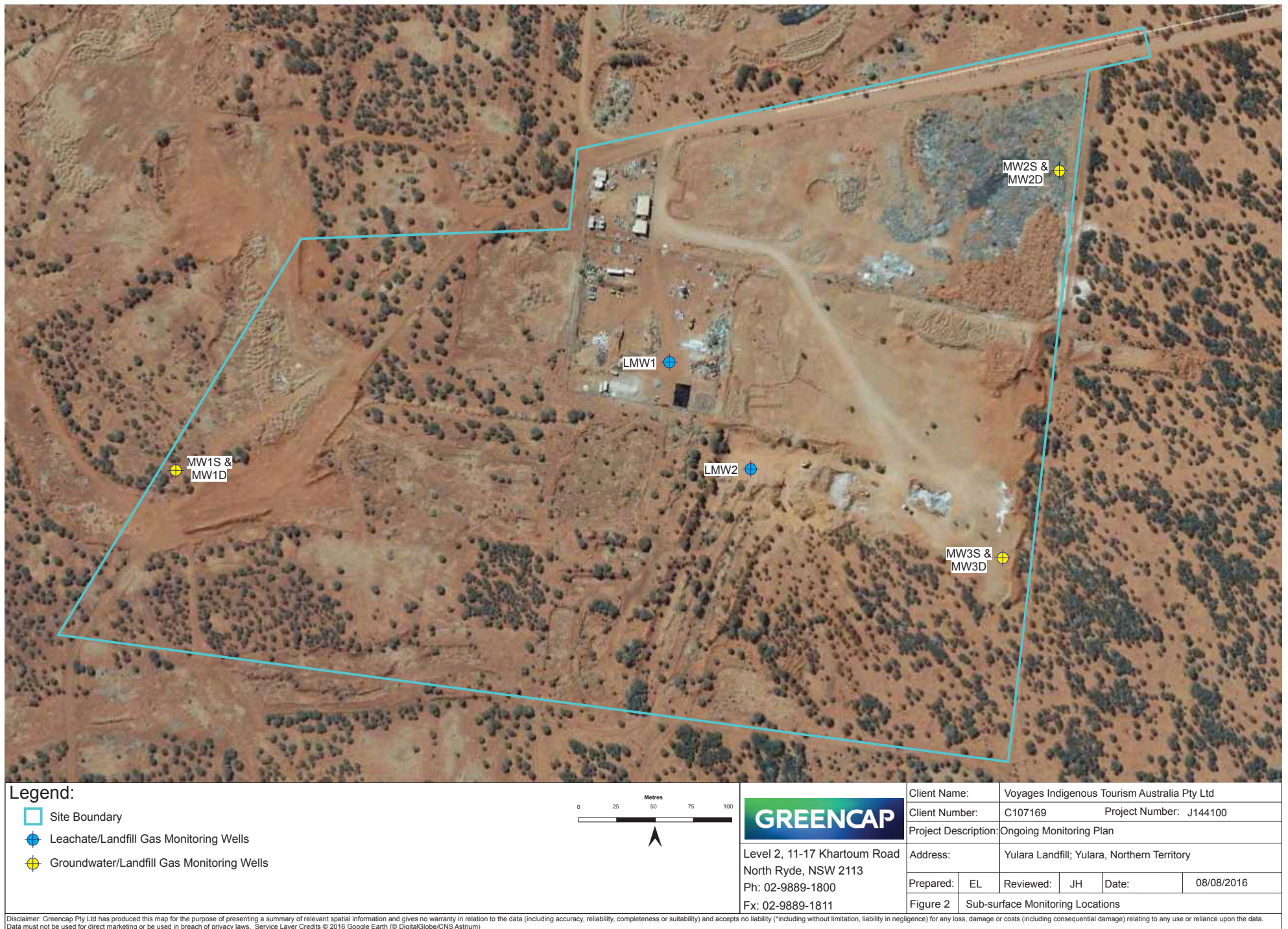


Figure 3-1 Map of landfill monitoring wells

3.1 Groundwater & leachate monitoring

EcOz sampling methods are provided in Table 3-2, based off the OMP and methodology used in previous monitoring rounds.

Table 3-2. Groundwater/leachate well monitoring method

Activity/Item	Details
Well sampling method	A dip meter was used to measure the standing water level (SWL)/presence of water in each monitoring well. An oil/water interface probe was used to assess whether light non-aqueous phase liquid (LNAPL) was present. For those wells which had water, HYDRASleeves were deployed between the SWL and bottom of the screen before being retrieved, and water being transferred to sample bottles. Remaining sample was deposited in a sterile jug and field parameters taken with calibrated water quality meters. A chain of custody (CoC) was prepared for the sample and placed in the Esky with samples ready for shipping.
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 dip meter and water quality meters were washed and rinsed with demineralised water and decontaminated using DECON-90 detergent between locations. The HYDRASleeve was disposed of after sampling, with a new sleeve placed in the monitoring well.

3.2 Landfill gas monitoring

Landfill gas (LFG) sampling methods are provided in Table 3-3 based off the OMP and methodology used in previous monitoring rounds.

Table 3-3. Landfill gas monitoring method

Activity/Item	Details
Surface gases	Surface LFG readings were taken with a calibrated Laser Portable Gas Leak Detector, with the intake held approximately 50-100mm above the ground. The meter was sampling throughout the whole event.
Enclosed space sampling	As with previous monitoring events, no enclosed space gas monitoring was undertaken due to lack of building use and access. No measurements taken.
Sub surface LFG	Sub surface LFG was recorded with a calibrated GA500 portable gas meter, attached to LFG well caps. The gas meter measured methane (CH₄), carbon dioxide (CO₂), oxygen (O₂), carbon monoxide (CO), hydrogen sulphide(H₂S) and Balance.

4 ASSESSMENT CRITERIA

4.1 Groundwater assessment criteria

The groundwater results were assessed against the following:

- 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.

- ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments.

4.2 Landfill gas assessment criteria

LFG monitoring results are assessed against the NT EPAs *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites* (2013).

5 FIELD OBSERVATIONS AND RESULTS

5.1 Groundwater

During the May 2023 monitoring round, all bores were dry and thus not sampled.

5.1.1 Groundwater field readings

The standing water levels and field parameters of all monitoring events to date are presented in Table 5-1 and Table 5-2 below. The field readings are generally consistent with previous monitoring events, with neutral pH and a similar EC. ORP readings indicate a lack of leachate penetration into the groundwater, as discussed in the previous report. A copy of the field sheets are provided in Appendix A.

Table 5-1. Standing water levels to date*

Site ID	Depth to water (m btoc)									May 2023 Comments
	Nov-17	Aug-18	Jun-19	Nov-19	Oct-20	Jul-21	Nov-21	May-22	May-23	
MW1S	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	No odours
MW1D	Dry	14.42	12.42	12.43	12.43	Dry	Dry	Dry	Dry	No odours
MW2S	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	No odours
MW2D	14.54	Dry	Dry	Dry	Dry	Dry	Dry	14.54	Dry	No odours
MW3S	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	No odours
MW3D	19.54	19.97	20.40	20.72	20.89	20.80	20.87	20.85	Dry	No odours
LMW1	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	No odours
LMW2	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	No odours

*Bore depth and historic data provided to EcOz in previous GHD report.

Table 5-2. Field water quality parameters to date*

Parameter	Unit	MW3D								May-23	MW2D Nov 17
		Nov-17	Aug-18	Jun-19	Nov-19	Oct-20	Jul-21	Nov-21	May-22		
EC	µS/cm^	1540	2073	2109	1969	1671	1867	1915	1724	-	1800
Temperature	°C	27.1	23	25.6	26.1	26.5	24.1	26	23.6	-	27.05
Turbidity	NTU	N/A	2780.5	1655	233	2379.8	17.13	N/A ⁺	238	-	N/A
pH		7.57	7.25	7.26	5.99	7.02	6.04	7.34	6.81	-	7.04
DO	% sat	N/A	56.1	56.2	38.6	68.7	63.3	65.7	45.8	-	N/A
Salinity	Ppt	-	-	-	-	-	-	-	0.9	-	-
TDS	mg/L	-	-	-	-	-	-	-	1121	-	-
ORP	mV	N/A	233.6	149.5	15.7	182	-47.8	163.5	266	-	-26.7

*Historic data (prior to May 2023) provided to EcOz in GHD report.

⁺ Please note that information provided to EcOz recorded EC in values that appear to be in mS/cm though reported as µS/cm.

5.1.2 Groundwater laboratory results

Historic laboratory results from MW3D comparing analytes against guideline values are provided in Table 5-3 where exceedances are highlighted in red.

Table 5-3. Analytes with guideline values

Analyte	Guideline value	Unit	Aug 18	Jun 19	Nov 19	Oct 20	Jul21	Nov 21	May 22	May 23
Aluminium	0.055	mg/L	0.24	0.01	<0.01	<0.01	0.02	0.02	<0.01	-
Chromium	0.001	mg/L	0.001	0.002	0.001	0.002	0.002	0.002	0.002	-
Boron	0.37	mg/L	-	-	0.87	-	-	-	0.77	-
Copper	0.0014	mg/L	<0.001	<0.001	<0.001	<0.001	0.015	0.012	<0.001	-
Zinc	0.008	mg/L	<0.005	0.014	0.009	0.005	0.066	0.051	<0.005	-
Selenium	0.005	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	-

5.2 Landfill gas

5.2.1 Surface gas survey

LFG levels were generally low, with most values recorded between 0 to 0.1 ppm. One location (34, located adjacent to an oil waste pit) recorded a slightly higher maximum methane reading of 0.3 ppm. The field readings are provided in a table in **Error! Reference source not found.** The Yulara Landfill was inactive while sampling which provided access to all required sampling sites.

5.2.2 Enclosed space landfill gas survey

EcOz was informed via discussions with Linda and other Voyages employees that the onsite buildings were no longer in use and ongoing monitoring was not required. Given the consistently non or low levels of gas recorded in previous reports and the gradual reduction in sample sites that was already evident from previous reports, no readings were taken.

5.2.3 Sub surface LFG monitoring

LFG measurements are presented in Table 5-4 alongside historic data as provided in previous reports.

Methane was detected in both LMW1 and LMW2. The LMW1 reading peaked at 0.2% before stabilizing at 0% while the LMW2 reading both peaked and stabilized at 1%.

Carbon dioxide was detected in each of the bores sampled. Both peak and stable concentration readings in MWS1, MWS2 and MWS3 were very low at 0.3%, 0.8% and 0.1% respectively. LMW1 peaked at 3.5% before stabilizing at 3.3%. LMW2 peaked and stabilized at 20.6% which is consistent with historic data for this site.

Carbon monoxide was only detected in LMW2 at a very low concentration of 1ppm. Hydrogen sulphide was not detected at any site which is consistent with previous monitoring rounds.

Flow rate was low neutral at all sites with readings ranging between 0.0 and 0.2L/hr. This is generally consistent with previous monitoring events.

Table 5-4. Sub surface gas readings to date

Site ID	Date	Time	Barometric pressure (mPa)	Flow rate (L/hr)					Methane (%)		Carbon dioxide (%)		Oxygen (%)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)	
				0	30	60	90	120	Peak	Stable	Peak	Stable	Peak	Stable	Peak	Stable	Peak	Stable
MW1S	28/08/2018	910	955	0	1.5	1.2	0.8	0	0	0	0.4	0.4	20	19.9	40	39	11	9
	19/06/2019	1020	967	4.8	5.1	4.9	4.9	4.8	0.4	0	2.3	0.1	17.1	20.9	1	0	1	0
	05/11/2019	920	967	0	0	0	0	0	0	0	0.2	0.2	20.8	20.9	1	0	0	0
	13/10/2020	1100	965	0	0	0	0	0	0	0	0.1	0.1	20.1	20.7	0	0	1	2
	09/07/2021	1710	959	0	0	0	0	0	0	0	0	0	21.3	21.3	1	1	1	1
	23/1/2021	1200	952	0	0	0	0	0	0	0	0	0	20.1	20.4	4	4	1	1
	17/05/2022	0830	963	0	0	0	0	0	0	0	0	0	21.3	21.1	1	1	1	1
	16/05/2023	10:30	968	0	0	0	0	0	0	0	0.3	0.3	20.7	20.6	0	0	0	0
MW2S	28/08/2018	925	955	2.2	1.3	0	0	0	4	0	0.9	0.9	19.6	19.9	1	0	1	0
	19/06/2019	840	964	0.1	0.5	0.3	0.1	0.3	0	0	0.9	0.9	20.1	20.1	0	0	1	0
	05/11/2019	930	970	0	0	0	0	0	0	0	0.7	0.7	20.1	20.3	3	1	2	1
	13/10/2020	900	966	0	0	0	0	0	0	0	0.7	0.7	20.3	20.3	0	0	0	1
	09/07/2021	1640	959	1.3	3	0.4	0	0	0	0	0.9	0.7	20.7	20.7	1	1	2	2
	23/1/2021	829	955	0	0.5	0.6	0.5	0.5	0	0	0	0	20	20.1	3	3	0	0
	17/05/2022	0930	965	0	0	0	0	0	0	0	0.1	0.1	20.2	20.1	2	1	0	0
	16/05/2023	11:00	968	0	0	0.1	0.1	0.1	0	0	0.8	0.8	20.2	20.2	0	0	0	0
MW3S	28/08/2018	1019	955	3.7	3	0.4	2.6	5.1	1.4	1.4	7.5	7.5	12.3	12.3	0	0	3	0
	19/06/2019	910	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
	05/11/2019	950	966	0.7	0.2	0.6	0.8	0	0.7	0.5	5.9	5.9	14.1	14.4	3	1	2	1
	13/10/2020	910	966	0	0	0	0	0	0	0	5.8	5	17.8	14.8	0	1	0	0
	09/07/2021	1620	959	0	0.6	0.3	0.7	0.4	0	0	3.7	3.7	17.3	17.4	0	0	2	2
	23/1/2021	850	955	0	0.3	0.2	0.4	0.3	0	0	0	0	20.7	21.4	3	3	1	1
	17/05/2022	0730	964	0	0	0	0	0	0	0	0	0	20.9	20.5	2	2	1	1
	16/05/2023	8:45	967	0	0.1	0.1	0.1	0.1	0	0	0.1	0.1	21.3	21.2	0	0	0	0

Site ID	Date	Time	Barometric pressure (mPa)	Flow rate (L/hr)					Methane (%)		Carbon dioxide (%)		Oxygen (%)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)	
				0	30	60	90	120	Peak	Stable	Peak	Stable	Peak	Stable	Peak	Stable	Peak	Stable
LMW1	28/08/2018	940	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	2	1
	19/06/2019	1010	968	5.5	5.4	5.1	5	5.4	6	1.8	17.8	17.8	0	0	1	0	1	0
	05/11/2019	1015	964	0.1	0	0.4	0	0	1.8	1.8	15.6	15.4	2.5	2.5	4	3	2	1
	13/10/2020	920	966	0	0	0	0	0	0	0	7.5	7.5	8	8	0	0	0	0
	09/07/2021	1510	964	0	0	0	0	0	0	0	3.4	3.4	17.4	17.5	0	0	2	1
	23/1/2021	1130	954	0	0	0	0	0	0	0	0	0	20.4	20.6	3	3	1	1
	17/05/2022	0800	963	0	0	0	0	0	0	0	0	0	21.2	21.1	0	0	0	0
	16/05/2023	9:45	967	0.1	0.1	0.1	0.2	0.2	0.2	0	3.5	3.3	18.3	17.3	0	0	0	0
LMW2	28/08/2018	947	956	3.2	2.4	3.2	3	3.9	39.8	39.8	34.2	34.2	0	0	3	0	2	0
	19/06/2019	940	967	6.4	6	6.5	7.4	7.2	28.2	28.2	30.3	30.3	0	0	3	3	1	0
	05/11/2019	1030	965	0.3	2.5	3.5	3.1	0	18.2	18.1	28.7	28.7	0	0	6	3	3	0
	13/10/2020	935	966	0.6	0	0	0	0	18.8	15.3	23.2	23.2	0	0.1	0	0	0	0
	09/07/2021	1500	964	0	0	0	0	0	0	0	0.1	0	0.2	0.3	0	0	2	2
	23/1/2021	905	954	0	0	0	0	0	0	0	0	0	20.7	20.7	3	3	1	1
	17/05/2022	0815	964	0	0	0	0	0	0	0	0	0	21.1	21.0	2	2	1	1
	16/05/2023	9:30	967	0.1	0.1	0.1	0.1	0.1	1	1	20.6	20.6	0.9	0.9	1	0	0	0

6 DISCUSSION

6.1 Groundwater

No groundwater samples were collected during this round as the MW3D bore was reportedly dry. It is considered likely that the dry result was due to either field equipment malfunction (i.e., dip meter not reacting on contact with water), or field crew error as the bore has never been dry in previous monitoring rounds. The November sampling event will confirm whether there was an error in sampling or if the groundwater level has dropped. It is noted that no trigger for such a significant drop in the water table is currently known.

6.2 Landfill gas

As mentioned in Section 5.2.2 no sampling was conducted in the buildings on site as they are no longer in use. Previous monitoring events had not found any indication of a significant build-up of LFGs in buildings.

Surface gas monitoring detected very low concentrations of methane gas (0.1 ppm) at approximately half of the sites, with the highest concentrations of 0.3 ppm recorded at site 34.

Sub-surface monitoring detected Carbon dioxide in concentrations below the guideline values (2%) at sites MW1S (0.3%), MW2S (0.8%) and MW3S (0.1%) however, LMW1 (20.6%) and LMW2 (3.3%) were both found to have exceeded the guideline values.

Hydrogen sulphide was not detected at any sites, while carbon monoxide was only detected at LMW2, with a maximum concentration of 1 ppm.

Subsurface LFGs at each of the monitoring wells did not exceed the methane guideline value of 1%,

Subsurface LFG results continue to suggest a reducing trend as discussed in the previous report from GHD. These results are provided in Figure 6-1 to Figure 6-5 below.

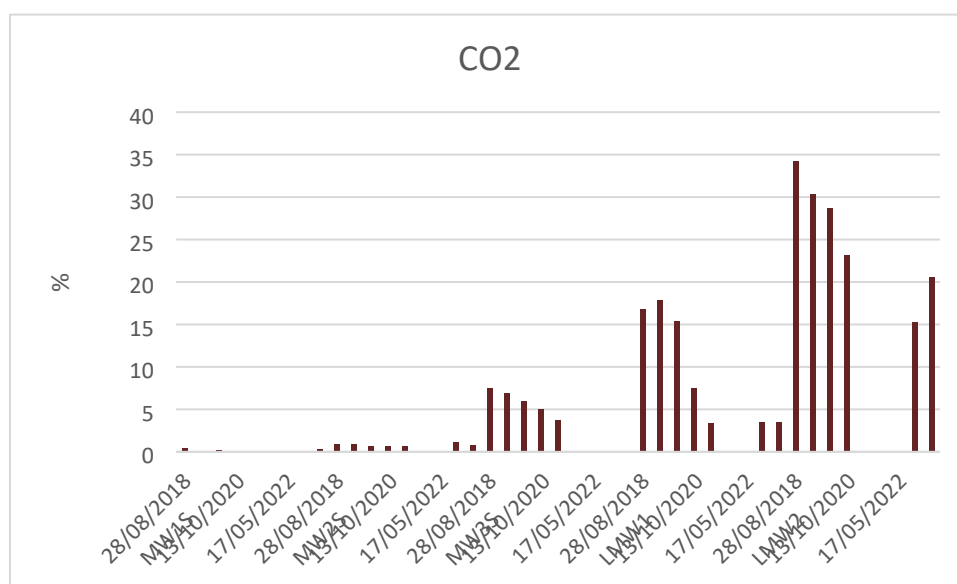
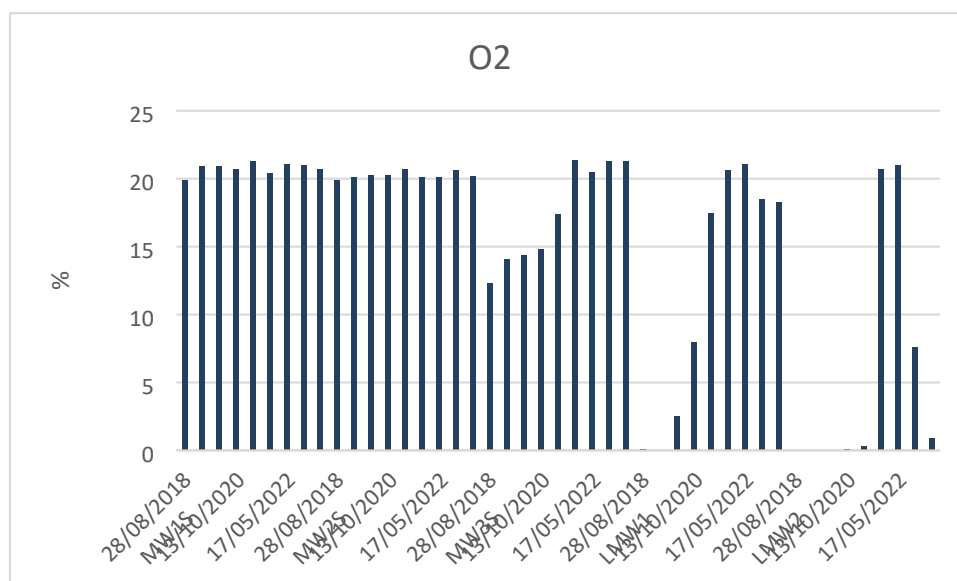
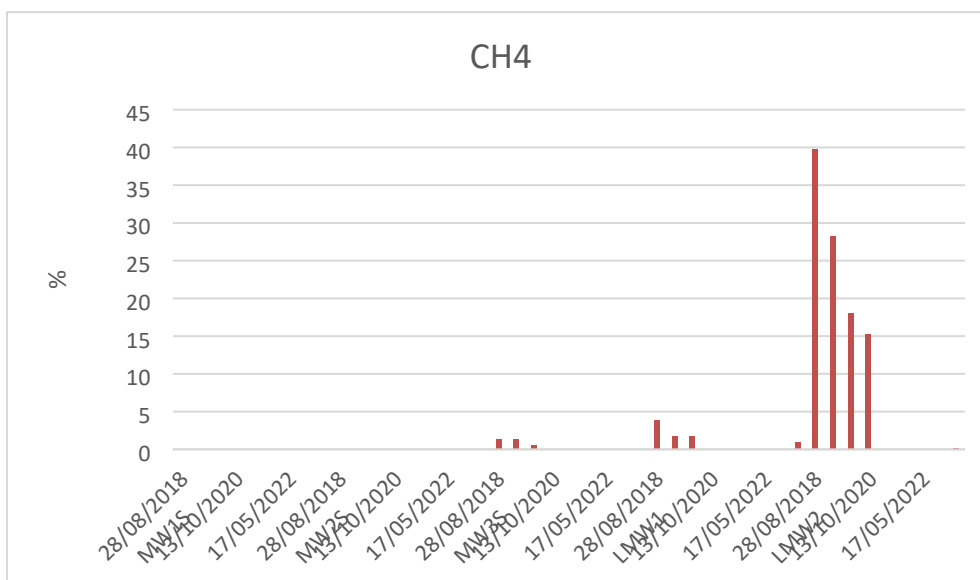
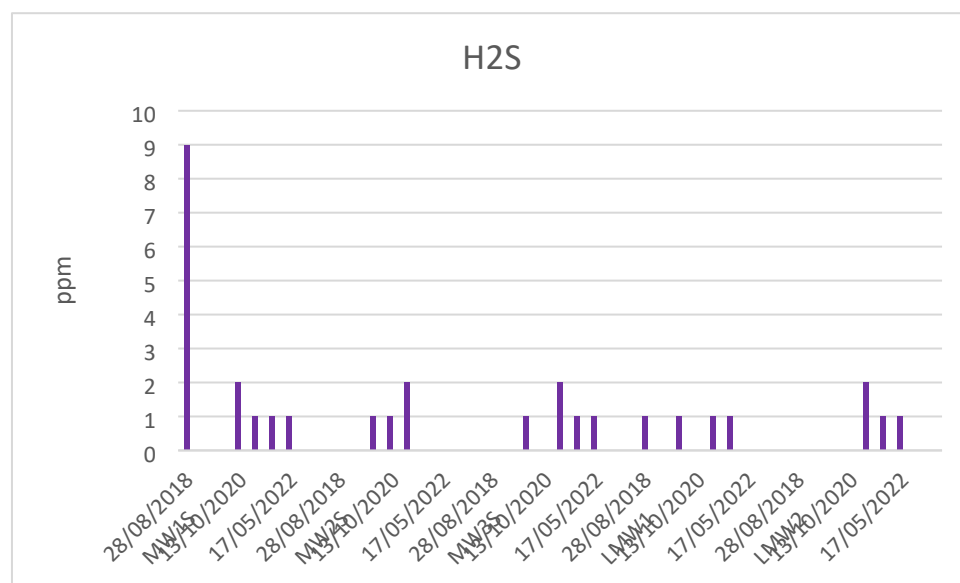
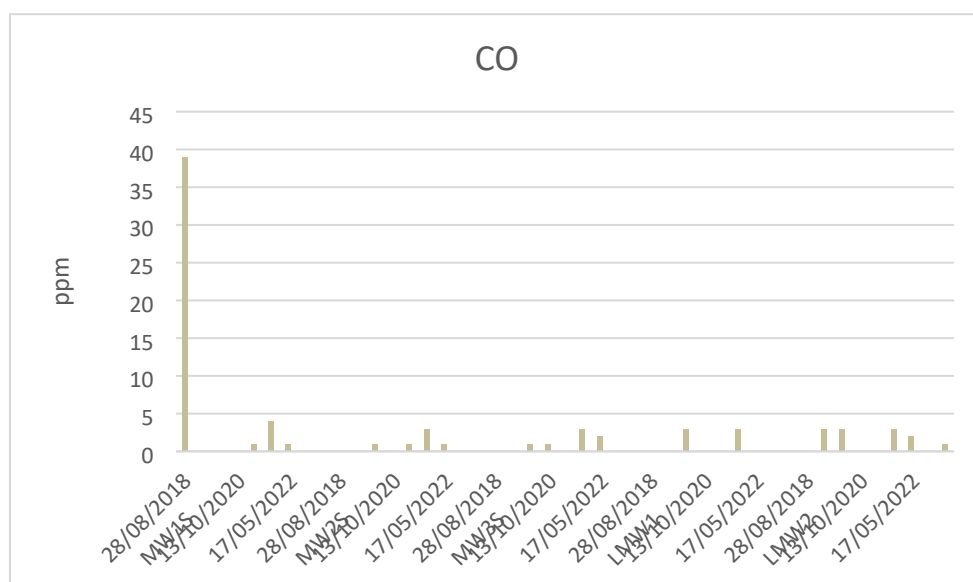


Figure 6-1. Subsurface carbon dioxide trend graph





7 RECOMMENDATIONS

The lack of groundwater samples since monitoring began indicates insufficient depth of monitoring bores (i.e., aquifer is located below bores maximum depth). Bores with a greater depth will need to be installed if more samples are to be collected.

Current activities do not appear to be having any significant effect on contamination levels when compared with historic data, therefore no new activities are recommended.

Consideration of the following is recommended going forward:

- Further landfill gas monitoring wells may be installed as the waste facility expands. This would include new boundary wells as the site expands and new monitoring wells in locations where LFGs are likely to be present (e.g., previous burial pits)
- Removal of enclosed area gas testing from monitoring plan if buildings/enclosed spaces are no longer in use.
- Conduct sampling (where possible and/or convenient) after significant rainfall event to ascertain water infiltration to groundwater.
- Attempt to conduct sampling during falling atmospheric pressure conditions (with the understanding that given the remote location and cost of travel this cannot always be achieved)

Biannual monitoring (pre and post wet season) should continue as outlined in the OMP.

8 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.

Northern Territory Environment Protection Authority (2013) Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory

GHD Pty Ltd (2021) Yulara Landfill services 2021, November 2021 Report

Greencap-NAA Pty Ltd (2016) Ongoing Monitoring Plan: Yulara Landfill, Lot 00248, Yulara NT

APPENDIX A GAS BORE FIELD SHEET

Site ID	Date	Time	Barometric Pressure (mPa)	Flow rate (L/hr)					Methane (%)		Carbon dioxide (%)		Oxygen (%)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)	
				0	30	60	90	120	Peak	Stable	Peak	Stable	Peak	Stable	Peak	Stable	Peak	Stable
MW1S	16.5	10:30	968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	20.7	20.6	0	0	0	0
MW2S	16.5	11:00	968	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.8	0.8	20.2	20.2	0	0	0	0
MW3S	16.5	08:45	1023967	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	21.3	21.2	0	0	0	0
LMW1	16.5	09:30	967	0.1	0.1	0.1	0.1	0.1	1.0	1.0	20.6	20.6	0.9	0.9	1	0	0	0
LMW2	16.5	09:45	967	0.1	0.1	0.1	0.2	0.2	0.2	0.0	3.5	3.3	18.3	17.3	0	0	0	0

LMW2

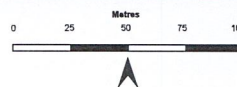
LMW1

APPENDIX B RELATIVE METHANE FIELD SHEET



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 Aerialium)

APPENDIX C GAS METER CALIBRATION SHEET

Gas Verification Certificate



Air-Met Scientific Pty Ltd
1300 137 067

Instrument **Huber Laser**
Serial No. **19254.18**
Sensors **Laser**

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	Laser	✓	Low	High	TWA	STEL
		✓		40ppm		
		✓				
		✓				
		✓				
		✓				
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
Laser		500ppm CH ₄	NIST	BE85775	501.00 ppm

Bump Test by: _____

Trent Chase

Date:

2/5/23

Gas Calibration Certificate



Instrument **GA5000**
 Serial No. **G505871**
 Sensors **CH4, CO2, O2, CO, H2S**

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	O2	✓	
	CH4	✓	
	CO2	✓	
	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		Fresh Air	NIST	Atmosphere	20.8 %
H2S		25ppm H2S	NIST	BC383163	25.0 ppm
CO		100ppm CO	NIST	BC383163	96.0 ppm
CH4		2.5% CH4	NIST	BC383163	2.5 %
CH4		60% CH4	NIST	BC462719	60 %
CO2		40% CO2	NIST	BC462719	40 %

Calibrated by:

Jeremy Callado

Calibration date: 8/05/2023

Next calibration due: 4/11/2023

CERTIFICATION OF CALIBRATION



Issued by: QED Environmental Systems Ltd.

Calibration certificate number **19254 H-07052**
Instrument **Laser One** Serial Number **19254**

Description of the calibration procedure:

The calibration is verified with certified gas bottle. The maximum error of the instrument as specified in the datasheet.

Gas verification from **0-1000ppm CH4**

Full scale (ppm)	Gas concentration (ppm)	Response 1 (ppm)	Response 2 (ppm)	Response 3 (ppm)	Average response (ppm)	Maximum error (ppm)	Maximum error (% F.s.)	Maximum error %
1000	0.0	0	0	0	0.00	0.00	0.00	0.00
1000	3	3.1	3.1	3.1	3.10	0.10	0.01	0.01
1000	10.3	10.3	10.3	10.3	10.30	0.00	0.00	0.00
1000	102.0	101	101	101	101.00	1.00	0.10	0.10
1000	1001	1000	1000	1000	1000.00	1.00	0.10	0.10

Uncertainty	0.10	%
Max % error	0.10	% FS

Gas verification from **0-100% vol CH4**

Full scale (%vol)	Gas concentration (%vol)	Response 1 (%vol)	Response 2 (%vol)	Response 3 (%vol)	Average response (%vol)	Maximum error (%vol)	Maximum error (% F.s.)	Maximum error %
100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.00	2.20	2.20	2.20	2.20	2.20	0.00	0.00	0.00
100.00	5.00	5.00	5.00	5.00	5.00	0.00	0.00	0.00
100.00	15.00	15.00	15.00	15.00	15.00	0.00	0.00	0.00
100.00	50.00	49.90	49.90	49.90	49.90	0.10	0.10	0.10
100.00	100.00	99.90	99.90	99.90	99.90	0.10	0.10	0.10

Uncertainty	0.10	%
Max % error	0.10	% FS

Gas verification from **0-100% CH4 LEL (0-4.4% VOL)**

Full scale (%vol)	Gas concentration (LEL%)	Response 1 (LEL%)	Response 2 (LEL%)	Response 3 (LEL%)	Average response (%vol)	Maximum error (LEL%)	Maximum error (% F.s.)	Maximum error %
100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.00	2.00	0.00	2.00	2.00	1.33	2.00	2.00	2.00
100.00	50.00	0.00	0.00	0.00	0.00	50.00	50.00	50.00

Uncertainty	50.00	%
Max % error	50.00	% FS

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Registered in England and Wales 1898734

CERTIFICATION OF CALIBRATION



Issued by: QED Environmental Systems Ltd.

Environmental conditions during calibration

Temp.	19.9	C
Pressure	1009	mBar

Gas bottles used for calibration

Gas	Cylinder number	Expiry date	Gas
N2	S1261680T	16/05/2024	N2
3 ppm	131394SG	21/11/2025	CH4
10 ppm	119779SG	11/04/2024	CH4
100 ppm	S1385429W	18/01/2026	CH4
1000 ppm	1490137	23/08/2026	CH4
1.0% Vol	S1198415S	10/04/2024	CH4
2.2% vol	S1672767FF	18/07/2026	CH4
5.0% vol	217147	03/12/2024	CH4
15% vol	269223	07/11/2023	CH4
50% vol	189051SG	23/02/2024	CH4
100% vol	S1182097S	15/11/2025	CH4

Calibration results: Pass

Next scheduled calibration: 28/02/2025

Calibration date: 28/02/2022

Issued by: Laura McBride

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Page 2 of 2

CERTIFICATION OF CALIBRATION



Date Of Calibration: 15-Nov-2022

Certificate Number: G505871_2/31608

Issued by: QED Environmental Systems Ltd.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Calibrations marked 'Non-UKAS Accredited results' on this certificate have been included for completeness.

Non-UKAS accredited results after adjustment:

Barometer (mbar)	
Reference	Instrument Reading
983	983

Additional Gas Cells		
Gas	Certified Gas (ppm)	Instrument Reading (ppm)
CO	505	505
H ₂ S	260	260

Internal Flow	
Applied (l/hr)	Instrument Reading (l/hr)
5	5.2
10	10.1

Date of Issue : 16-Nov-2022

Approved by Signatory

Laura McBride

Laboratory Inspection

End of Certificate

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Calibration Instance:114 IGC Instance:114

Page 2 of 2 | LP015GIUKAS-2.5

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Registered in England and Wales 1898734

CERTIFICATION OF CALIBRATION



Date Of Calibration: 15-Nov-2022

Certificate Number: G505871_2/31608

Issued by: QED Environmental Systems Ltd.

Customer: Thermo Fisher Scientific Australia PTY L
5 Caribbean Drive PO Box 9092 Scoresby
VIC 3179 AUSTRALIA

Description: Gas Analyser

Model: GA5000

Serial Number: G505871

UKAS Accredited results:

Results after adjustment :

Methane (CH ₄)		
Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
5.0	5.0	0.072
15.0	15.0	0.13
60.0	59.9	0.42

Carbon Dioxide (CO ₂)		
Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
5.0	4.9	0.074
15.0	14.9	0.13
40.0	40.1	0.29

Oxygen (O ₂)		
Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
21.2	21.3	0.25

The inwards assessment was carried out 31-Aug-2022.

The maximum adjustment is larger than the specification limit.

Inwards assessment data is available if requested.

All concentrations are molar.

CH₄, CO₂ readings recorded at : 31.8 °C ± 2.5 °C

O₂ readings recorded at : 23.0 °C ± 2.5 °C

Barometric Pressure : 0983 mbar ± 4 mbar

Method of Test : The analyser is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure LP004.

Instrument has passed calibration as the measurement result is within the specification limit. The specification limit takes into account the measurement uncertainty.

The results relate only to the item calibrated

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Calibration Instance:114 IGC Instance:114

Page 1 of 2 | LP015GIUKAS-2.5

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Instrument Service Report

Page 1 of 3

Unit Type: <i>Laser One</i>	Part Number:	Date:	Next Service Due:	Customer Name:
Serial Number: <i>19254</i>		<i>01-Mar-2022</i>	<i>28-Feb-2025</i>	<i>Thermo Fisher Scientific Australia Pty</i>

Actions/Investigation Description	Result	Comments
Serial Number Check	Yes	
Battery Requires Replacing	No	No battery with unit
Service history of instrument reviewed	Yes	
Instrument turns on	Pass	
Backlight operates correctly	Yes	
External visual inspection performed	Pass	
Internal visual inspection performed	Pass	
Case assembly closed and screws tightened to correct torque	Yes	
Check instrument for visible damages /defects	Pass	
Inwards assessment stage reviewed	Yes	
Buzzer working correctly	Pass	
Software version correct	Pass	Had update
Functionality check e.g. LEDs, , Keypad, Display and Buzzer test	Pass	
Flow is > 0.6 L/min	Pass	
Flow fail test	Pass	
Rattle Test	Pass	
Change external anti-water filter	Complete	



Instrument Service Report

<u>Unit Type:</u> Laser One	<u>Part Number:</u>	<u>Date:</u>	<u>Next Service Due:</u>	<u>Customer Name:</u>
Serial Number: 19254		01-Mar-2022	28-Feb-2025	Thermo Fisher Scientific Australia Pty

Actions/Investigation Description	Result	Comments
Bluetooth	Pass	
Flow is > 0.6 L/min	Pass	
Instrument turns on	Pass	
As Received Gas Check Performed	Pass	synth air = 2.5 3ppm=2.8 10ppm=9.9 100ppm=105 5%=4.8 15%=14.4 50%=49.9 100=98.3
Keypad/dial test	Pass	
Cable Comms test	Pass	No battery with unit
LEDs checked	Pass	
Laser Bench Realignment & Optimization	Retest Passed	Instrument doesn't read high gases from 5% due to extra Zero on 2.2 % calibration table. This has been corected and the instrument reads the full range from 0-100%.
Full Calibration	Pass	Instrument passed calibration. Next calibration date 25/2/2023
Verification of Instrument	Pass	PASS

Customer Comments
Annual calibration

Instrument Service Report

Page 3 of 3

Unit Type: GA5000	Part Number: GA5KB0C0-100	Date: 16-Nov-2022	Next Service Due: 15-Nov-2025	Customer Name: Thermo Fisher Scientific Australia PTY L
Serial Number: G505871				
Actions/Investigation Description	Result	Comments		
Verification of Instrument				

Customer Comments

3 yearly calibration

General Comments/Feedback

Thank you for returning your gas analyser to the QED Service Centre for full service and calibration. We are pleased to inform you that the analyser was received and fully assessed by one of our experienced Service Engineers and no significant faults or issues were observed during the assessment. Our extensive service was carried out, and any necessary components replaced. The analyser has successfully passed all of our rigorous testing and quality checks and has been calibrated using our bespoke, state of the art calibration facility.

For further information about how to get the best use from your instrument please visit our YouTube channel <http://www.youtube.com/GeotechTV> and on our Website <https://qedenv.com>

We have replaced the battery because it is over 2 years old. This is in accordance to the battery cell manufacturer's recommendation.

The O2 electrochemical sensor has been replaced due to it being over 3 years old in accordance with the manufacturer's recommendations, and also as a proactive measure based on our experience of the typical lifetime of this type of sensor.

The CO & H2S electrochemical sensor has been replaced due it being over 2 years old in accordance with the manufacturer's recommendations, and also as a proactive measure based on our experience of the typical lifetime of this type of sensor.

We are pleased to inform you that we have installed the latest version of firmware on your gas analyser, so you will be able to benefit from the latest features and improvements.

If you require any further assistance with your instrument please email our Technical Support Team at technical@qedenv.co.uk or call us on +44 (0) 333 800 0088 (Monday to Thursday 08.30 - 17.00 & Friday 08.30 - 15.30) UK time zone.

Service Details: Service Scheme	☐	Service Engineer:	Calibration Engineer:	Approved By:	Signature:
Standard Service	☒	Ricky Cottrill	Suk Balrey	Laura McBride	



Instrument Service Report

Page 1 of 3

Unit Type: GA5000	Part Number: GA5KB0C0-100	Date: 16-Nov-2022	Next Service Due: 15-Nov-2025	Customer Name: Thermo Fisher Scientific Australia PTY L
Serial Number: G505871				

Actions/Investigation Description	Result	Comments
Serial Number Check	Yes	
Battery Requires Replacing	Yes	Battery replaced
Internal Flow Calibrated	Yes	
Full Automatic Calibration	Pass	
Serial Comms Test (USB)	Pass	
Service history of instrument reviewed	Yes	
Inwards gas check data reviewed	Yes	
Instrument turns on	Pass	
Backlight operates correctly	Yes	
External visual inspection performed	Pass	
Internal visual inspection performed	Pass	
All screws tightened to correct torque	Yes	
All connectors are secure	Pass	
Check diagnostic channels	Pass	
Case compression test	Pass	
Impact and stability test	Pass	
Pressure transducer test(s) as per user operation	Pass	



Instrument Service Report

<u>Unit Type:</u> GA5000	<u>Part Number:</u>	<u>Date:</u>	<u>Next Service Due:</u>	<u>Customer Name:</u>
<u>Serial Number:</u> G505871	GA5KB0C0-100	16-Nov-2022	15-Nov-2025	Thermo Fisher Scientific Australia PTY L
Actions/Investigation Description	Result	Comments		
Final visual inspection on instrument	Pass			
Case assembly closed and screws tightened to correct torque	Yes			
PTFE filters replaced	Yes			
Pump flow greater than 550 ml/min	Pass			
Automated instrument pressure system test (leak test)	Pass			
Pump vacuum greater than -400 mb and flow fails	Pass			
GPS function test	NA			
Temperature probe tested	Pass			
Anemometer tested	Pass			
Chemical gas sensors calibrated – refer to Calibration Certificate	Retest Passed			
Check main PCB and sensor PCB have the latest software	Yes			
Transducers calibrated	Pass			
As Received Chemical Cell Gas Assessment Performed (CAL16)	Yes			
As Received Gas Assessment Performed (CAL01 or CAL02)	Yes			
Chemical sensor(s) replacement over 2yrs UK and 21mths overseas.	Yes	CO & H2S Cells replaced		
O2 sensor replacement over 3yrs UK, 33mths overseas	Pass	O2 Cell replaced		

Instrument Service Report

Unit Type: Laser One

Part Number:

Date:

Next Service Due:

Customer Name:

Serial Number: 19254

01-Mar-2022

28-Feb-2025

Thermo Fisher Scientific Australia Pty

Service Details: Service Scheme

☐

Standard Service

☒

Service Engineer:

Gary Sharma

Calibration Engineer:

Sabin Neagu

Approved By:

Signature:

Laura McBride

ATM





EcOz Environmental Consultants

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