



Newtown Closed Landfills

Revised Buffer Distance

Prepared for
City of Greater Geelong
Prepared by
Tonkin & Taylor Pty Ltd
Date
May 2023
Job Number
1002534.2000 v1



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Document control

Title: Newtown Closed Landfills					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
June 2022	0	Draft for client review	S. Peng	T. Kortegast	
May 2023	1	Final	S. Peng	T. Kortegast	T. Kortegast

Distribution:

City of Greater Geelong

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Table of contents

1	Introduction	1
1.1	General	1
1.2	Background	1
1.3	Scope of work	2
1.4	Guidance documents	2
1.5	Previous assessments	2
2	Background information	3
2.1	Landfill information and setting	3
2.2	Surrounding land use	4
2.3	Topography	5
2.4	Geology	6
2.5	Hydrogeology	6
3	Landfill gas monitoring	8
3.1	Assessment criteria	8
3.2	Historical LFG monitoring	8
3.3	Landfill gas monitoring network	8
3.4	Landfill gas monitoring method	9
3.4.1	Landfill gas bores	9
3.4.2	Service pits	9
3.4.3	Surface emissions	9
3.5	Landfill gas monitoring results	10
3.5.1	Landfill gas bores	10
3.5.2	Service pits	12
3.5.3	Surface emissions	12
3.5.4	Weather analysis	12
3.5.5	Discussion	14
4	Amendment to buffer distance	16
4.1	Landfill gas risks	16
4.2	Building protection measures	16
4.3	Revised buffer distances and trigger for assessment	17
5	Applicability	18
Appendix A	Figures	
Appendix B	Bore completion report	
Appendix C	Landfill gas bore monitoring results	
Appendix D	Service pit monitoring results	
Appendix E	Surface emissions monitoring results	
Appendix F	Atmospheric pressure analysis	

1 Introduction

1.1 General

Tonkin & Taylor Pty Ltd (T+T) has been engaged by the City of Greater Geelong (CGG) to conduct further investigation works at a series of closed landfills in west Geelong referred to collectively as the Newtown Closed Landfills. The five closed landfills are:

- Windmill Reserve
- Rotary Centennial Park
- Leach-Wood Gardens
- Marnockvale landfill
- Newtown landfill

In 2019, T+T completed a Landfill Gas Risk Assessment (2019 LFG RA) for these five closed landfill sites. In our report¹, recommendations were made to confirm the risk ratings for each site based on additional targeted monitoring as site specific monitoring data at the time was limited. This report presents the updated data set and revised risk ratings based on the additional data collected since 2019.

1.2 Background

Landfill gas has the potential to pose a risk to surrounding receptors for decades following closure of a landfill, and therefore in the absence of direct landfill gas controls, appropriate buffer distances must be maintained during the landfill post-closure period.

The **Best Practice Environmental Management (BPEM)**² guidance for landfills recommends a 500 m buffer for putrescible waste landfills and a 200 m buffer for landfills that accepted non-putrescible waste. Where the recommended buffer distance is not available, it must be demonstrated that the risks are suitably mitigated, or that the residual risks are acceptable.

Where planning permit applications are made for sites within the buffer distance to the closed landfills, all potential receptors are considered “sensitive” owing to the hazard potentially posed by landfill gas and CGG is required to consider (amongst other things):

- Any significant effects the responsible authority considers the environment may have on the on the proposed use or development.
- Potentially contaminated land is suitable for its intended future use and development, and that contaminated land is used safely.

EPA Victoria has issued guidance to assist local authorities when assessing developments proposed within buffer zones: **Guideline for Assessment Planning Proposal Near Landfills**, EPA Publication 1625. This guideline provides information and advice on assessing planning permit applications and planning scheme amendments that would lead to development near an operating or closed landfill. More specifically, it advises on what level of assessment a planning or responsible authority should require to inform its decision, and recommends a staged, risk-based approach.

Currently, CGG requires all development proposals within 500 m of the Newtown closed landfills to require a landfill gas risk assessment as part of their planning permit conditions.

¹ Landfill Gas Risk Assessment for Closed Landfills, Tender No T1770840, Tonkin & Taylor Pty Ltd, Ref: 1002534.100.v2, August 2019-FINAL.

² Siting, design, operation and rehabilitation of landfills: Best practice environmental management, Publication 788.3< Environment Protection Authority Victoria, August 2015.

This work has been carried out to confirm the initial level of risk assessed in 2019 and recommend a reduction in buffer zone where justified, with the aim being to simplify the regulatory process where this is justified

1.3 Scope of work

The work completed to address the recommendations in the 2019 LFG RA included:

- Two rounds of surface emissions monitoring at the Marnockvale and Newtown Landfills.
- Two rounds of underground services monitoring at the Marnockvale and Newtown Landfills.
- Installation of a total of 31 perimeter landfill gas monitoring bores at the landfills.
- Four rounds of landfill gas monitoring conducted on a weekly basis to gather baseline line monitoring data. This was followed by monthly events.
- Preparation of this LFG RA report.

1.4 Guidance documents

This LFG RA has been carried out with consideration to the guiding principles of the following documents:

- *Closed landfill guidelines*, Publication 1490.1, EPA Victoria, January 2018
- *Assessing Planning Proposals within the buffer of a landfill*, Publication 1642, EPA Victoria October 2017
- *Siting, design, operation and rehabilitation of landfills*, Publication 788.3, EPA Victoria, August 2015 (Landfill BPEM)
- *Landfill gas fugitive emissions monitoring guideline*, Publication 1684, EPA Victoria, February 2018
- *Assessment and management of hazardous ground gases – Contaminated Land Guidelines*, NSW EPA, May 2020
- *Assessing risks posed by hazardous ground gases to buildings*, CIRIA C665, 2007
- *Retrofitting hazardous ground gas protection measures in existing or refurbished buildings*, CIRAI C795, 2020
- *Guidance on the management of landfill gas*, LFTGN 03, UK Environment Agency, September 2004 (LGTFN 03)

1.5 Previous assessments

In the preparation of this LFG RA, the following information has been considered:

- *Closed Former Geelong Landfills – Qualitative Risk Assessment (Draft)*, Meinhardt, May 2009 (herein referred to as the 2009 LFG RA)
- *Basic Quantitative Risk Assessment of Seven Closed Landfills, Greater Geelong Region*, Landserv Environment, 28 December 2011 (herein referred to as the 2011 LFG RA).
- *Landfill Gas Risk Assessment for Closed Landfills*, Tender No T1770840, Tonkin & Taylor Pty Ltd, Ref: 1002534.100.v2, August 2019-FINAL.

2 Background information

Most of the landfills accepted wastes during the 1960's and 1970's, except for Marnockvale which accepted waste until the mid-1980s.

The landfills are in the suburb of Newtown located in the western part of Geelong and are in close proximity to each other, forming an approximately 1.7 km chain of sites on the northern side of the Barwon River (**Figure 2.1**).

The landfills are understood to have been quarries prior to landfilling. The landfills have been capped, but they are unlikely to have been capped to current standards (i.e., as defined in the Landfill BPEM).

2.1 Landfill information and setting

Five closed landfills addressed in this LFG RA include:

- **Windmill landfill (now Windmill Reserve):** This landfill operated during the 1960s and has subsequently been re-developed as a sporting oval.
- **Burnside landfill (now the Rotary Centennial Park):** This landfill operated from 1965 to 1973 and is now a recreational open space which is accessible to the public. It is primarily grassed, with some trees planted.
- **Leachwood Gardens landfill:** This landfill operated between 1965 and 1973 and is now a recreational open space with significant vegetation. It is accessible by the general public.
- **Marnockvale landfill:** This landfill operated between approximately 1984 and 1986 and is now passive open space. It is primarily grassed, with some shrubs/trees located along its north, south and eastern edges.
- **Newtown landfill:** There are currently a number of commercial properties including a car yard, concrete yard and fitness centre located over the mapped footprint of the former landfill.

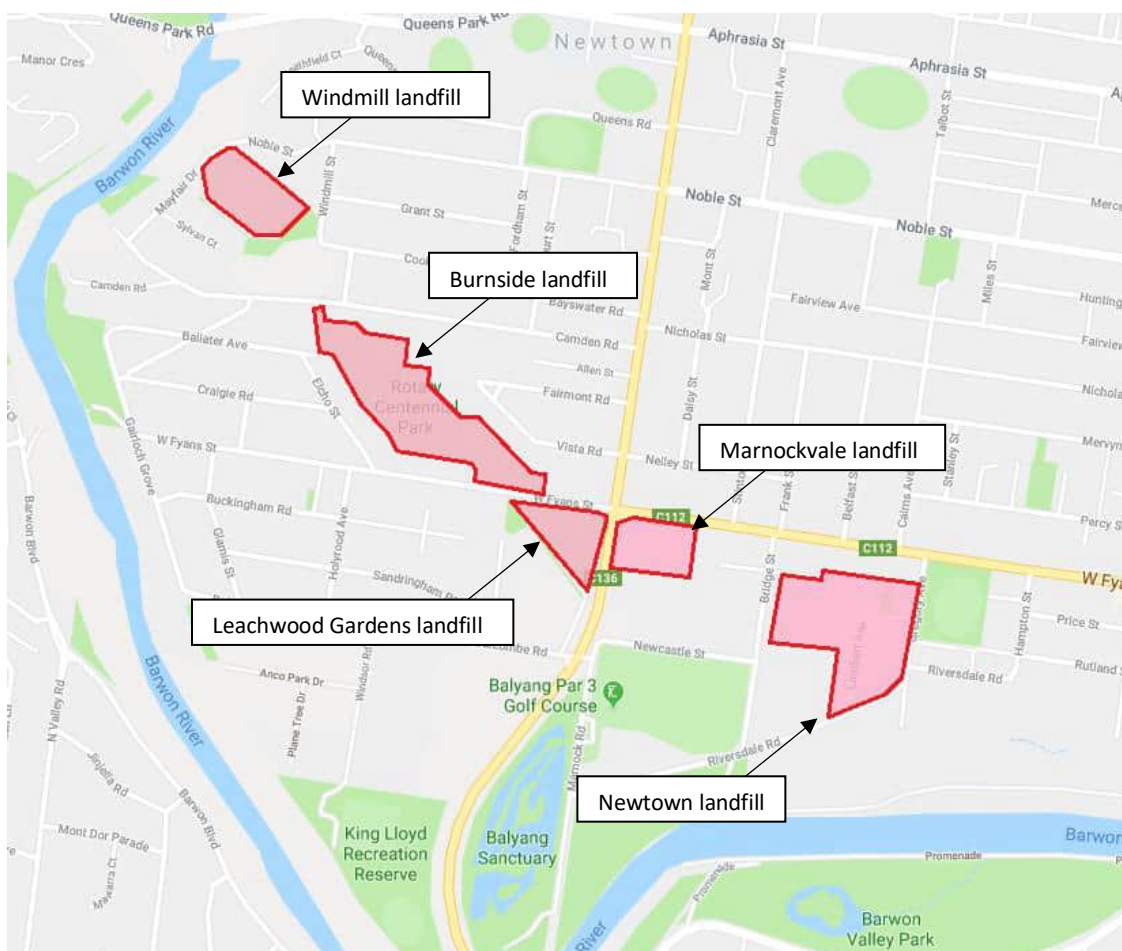


Figure 2.1: Approximate location of closed Newtown landfills (Source: Google Maps)

2.2 Surrounding land use

The suburb of Newtown is bordered to the south and west by Barwon River.

The landfills are surrounded mainly by residential houses and roads, with some open recreational spaces, schools and light commercial premises also within the area. The land uses surrounding each of the landfills are summarised in Table 2.1.

Table 2.1: Summary of surrounding land uses for each landfill site

Site	Direction	Land use
Windmill landfill	North	Residential housing to the northeast followed by Noble Street. To the northwest is past Mayfair Drive then open space and the Barwon River (approximately 70 m away)
	East	Residential housing
	South	Residential housing and Fyan's Park Primary School
	West	Residential housing
Burnside landfill	North	Residential housing with Fyans Park Primary School adjacent the park entrance from Camden Road.
	East	Residential housing with a service station further east (approximately 150 m from the site boundary).

Site	Direction	Land use
	South	Residential housing and West Fyans Road, with the Fyans Park Kindergarten approximately 80 m to the southwest of the landfill. Leachwood Gardens landfill is also adjacent the landfill, on the south side of West Fyans Road. Marnockvale landfill and a mountain bike park are approximately 150 m to the southeast.
	West	Residential housing and Elcho Street, with the Barwon River approximately 600 m to the west.
Leachwood Gardens landfill	North	West Fyans Street with adjacent residential properties (within 50 m) and Burnside landfill. A Caltex petrol station 50 m to the northeast.
	East	Shannon Ave with the adjacent Marnockvale landfill and mountain bike park, with some commercial building further to the east.
	South	Residential housing along with an office building and Balcombe Road further south.
	West	Residential housing.
Marnockvale landfill	North	Residential housing (within 20m) and a service station adjacent to the landfill on the north side of West Fyans Street.
	East	Industrial and commercial development borders the eastern boundary of the park and is possibly within several meters of the old quarry wall (and hence waste). The nearest building is a café, neighbouring a large floor covering store and warehouse. Residential housing approximately 200 m to the east.
	South	A mountain bike park, followed by Newcastle street and the Baylang Golf Course.
	West	Shannon Avenue, with Leachwood Gardens landfill beyond. Residential housing is approximately 70 m southwest of the landfill.
Newtown landfill	North	Residential housing and some light commercial buildings (veterinary clinic and a heating/cooling business). Further north is West Fyans Street.
	East	Gregory Avenue then Friars Park, residential housing and commercial properties.
	South	Industrially zoned premises, including the Geelong YMCA. The Barwon River is approximately 200 m to the south.
	West	Bridge Street and the Baylang Golf Course, open space and a garden supply yard. Further west are the Marnockvale landfill and mountain bike park.

2.3 Topography

The landfills are located within undulating topography which generally slopes from the sites towards the Barwon River. The topography at the landfills has been assessed based on a review of available aerial imagery and observations made during the site visit. A summary of the topography at each landfill is provided in **Table 2.2**.

Table 2.2: Summary of general topography around each landfill site

Site	Summary of topography
Windmill landfill	A sports oval occupies most of the site and sits within an area lower than the surrounding land to the north, south and east. The ground level at the centre of

Site	Summary of topography
	the oval is at 39 m AHD ³ and the surrounding area is approximately 45 to 48 m AHD. The landfill has been re-worked to a relatively flat surface to accommodate the sports oval. To the west of the landfill beyond the landfill boundary, the land falls away towards Barwon River.
Burnside landfill	Burnside landfill grades from northeast to southwest. The landfill is generally around 30 m AHD, rising to approximately 35 m AHD in the north, with higher elevations associated with a ridge running through the site. The southern part of the landfill is lower, with a minimum elevation of approximately 20 m AHD at parts of the southern boundary.
Leachwood Gardens landfill	The landfill falls from north to south. West Fyans Street to the north is approximately 8 m higher than the landfill. From the northern boundary (i.e., below West Fyans Street), the landfill falls from approximately 22m AHD to approximately 7 m AHD at the southern boundary. Shannon Avenue to the east of the site is substantially higher than the site, but grades down to approximately an approximately similar level by Balbombe Road (i.e., the main site access)
Marnockvale landfill	Marnockvale landfill slopes generally from north to south, grading from 29 to 13 m AHD. Grades near the southern boundary of the landfill steepen to blend into the mountain bike park.
Newtown landfill	The site generally grades from north to south from RL 25 m along W Fyans Street and to 10 m AHD along Riversdale Road. There appears to be a trough at the central area of the site located at Lambert Avenue/Gregory Avenue intersection.

2.4 Geology

Based on the 1:250,000 geological map for Queenscliff⁴, the landfills are located within the Newer Volcanic Group, which comprises basaltic lava flows along with minor tuff, scoria and alluvium. These were the materials quarried to form the landfill voids.

No groundwater or landfill gas monitoring wells have been installed at the landfills and there are no cored borelogs available. Therefore detailed site-specific geological information is not available. During the site visit, the exposed rock face along the southern boundary of the Windmill landfill was observed to comprise weathered and jointed basalt, and this is likely typical of the geological setting.

2.5 Hydrogeology

Based on information from the Visualising Victoria's Groundwater (VVG) website⁵, groundwater at the landfills is generally within the range of approximately 8 to 17 m AHD.

The information from VVG indicates groundwater elevations are lower at the Windmill and Newtown landfills (i.e., closest to Barwon River) and highest at Burnside landfill (furthest from Barwon River), suggesting groundwater flow is generally towards the Barwon River. This fits with the topographical and drainage basin setting.

The VVG website also indicates groundwater at the landfills has a salinity range between 3,500 – 7,000 mg/L TDS. The Environmental Reference Standard (ERS) defines groundwater in this range of TDS as Segment C (3,101 – 5,400 mg/L TDS) to Segment D (5,401 – 7,100 mg/L TDS). The following

³ Australian Height Datum

⁴ Douglas J.G and Spenser-Jones, D (1971), *Queenscliff – Geological Survey of Victoria*, No SJ55-9, 1:250,000 series, 1971

⁵ <http://www.vvg.org.au>

environmental values apply to groundwater in Segments C and D (some of which may not apply to the Barwon Heads region):

- Water dependent ecosystems and species;
- Potable mineral water supply (may not apply);
- Agriculture and irrigation;
- Industrial and commercial use;
- Water-based recreation (primary contact recreation);
- Traditional owner cultural values;
- Buildings and structures; and
- Geothermal properties (may not apply).

3 Landfill gas monitoring

3.1 Assessment criteria

The Landfill BPEM defines action levels for landfill gas. The gas action levels relevant to this assessment are summarised in **Table 3.1**.

Table 3.1: Landfill gas action levels

Location		Parameters	Action level and unit
Subsurface geology (at site boundary)		Methane	1 % v/v
		Carbon dioxide	1.5 % v/v above background concentrations
Subsurface services on and adjacent to the landfill site		Methane	10,000 ppm
Buildings/structures on and adjacent to the landfill site		Methane (in air) ¹	5,000 ppm
Final landfill cap	Final surface	Methane (in air) ¹	100 ppm
	Within 50 mm of penetrations		

Notes:

1. Point of measurement is 50 mm above the landfill surface or point of discharge (around penetrations).

3.2 Historical LFG monitoring

As part of the 2011 LFG RA, monitoring was carried out at the Windmill landfill, Burnside landfill and Leachwood Gardens landfill on the following occasions:

- 29 July 2011: Monitoring of buried service pits and surface emissions, although the landfill gas analyser being used (GFM410) was not sensitive enough to measure surface emissions to allow an assessment against the recommended Landfill BPEM action levels which are in parts per million⁶.
- 17 & 18 October 2011: Monitoring of buried service pits (using a GA2000 landfill gas analyser) and surface emissions (using a TVA-1000 flame ionising detector).

The results of the monitoring indicated that there were no exceedances of the recommended Landfill BPEM action levels for buried services (on or adjacent the landfills) or for surface emissions through the landfill cap/cover system.

3.3 Landfill gas monitoring network

A total of 29 landfill gas monitoring bores were installed at the five sites (refer Figures 1 to 5 in **Appendix A**). The installation works occurred between 4 October and 7 October 2021.

The locations of the monitoring bores were aimed to inform:

- Landfill gas generation within the waste mass with at least one monitoring bore installed within waste.
- Subsurface lateral migration off-site with bores located around the perimeter of the landfill, at least 20 m beyond the edge of waste where possible. Limitations on monitoring locations included proximity to existing development and buried utility services.

The depth of bores ranged from 1.25 to 3 mbgl, with majority of the bores installed to 3 mbgl. The bores were screen from 1 mbgl to full depth. The landfill gas monitoring bores were installed in

⁶ The GFM410 and GA2000 measures gas concentration in percentage volume.

general accordance with the landfill gas bore design provided in the Landfill BPEM. Helium leak testing was conducted on completion of installation to confirm that the installation was adequate.

The bore completion report and list of monitoring bores is provided in **Appendix B**.

3.4 Landfill gas monitoring method

3.4.1 Landfill gas bores

Landfill gas bores were monitored using a Geotech GA5000 portable landfill gas analyser, in accordance with the procedure described in EPA Publication 1684.

The GA5000 instrument is regularly calibrated, and a calibration check (“bump test”) was also carried out by T+T field personnel, prior to monitoring, using a 60 % v/v methane, 40 % v/v carbon dioxide Spangas calibration standard.

Atmospheric pressure conditions were monitored prior to commencing works to target, where possible, falling barometric pressure. During monitoring, the condition of the landfill gas bores was noted where it could potentially affect the gas readings.

Water levels and total bore depth were measured at each of the bores using an electronic dip meter, following the completion of landfill gas monitoring. The results were recorded as “meters below top of casing” (m TOC).

3.4.2 Service pits

T+T conducted service pit monitoring using an Inspectra Laser. Monitoring was carried out in accordance with general requirements of EPA Publication 1684.

Barometric pressure conditions were monitored prior to commencing works. Air pressure data and windspeed (from a hand-held anemometer) were recorded on the day of monitoring.

3.4.3 Surface emissions

Surface emission monitoring was conducted using an Inspectra Laser portable laser spectrometer.

Monitoring was carried out in accordance with general requirements of EPA Publication 1684⁷. Surface emissions monitoring was carried out on an approximate 50 m x 50 m grid spacing at the closed Marnockvale Landfill.

As the works were limited to public land, surface emissions monitoring at the closed Newtown landfill could not be carried out on a grid pattern. Instead, monitoring was carried at 50 m spacings along the nearest publicly accessible areas adjacent the site and along both sides of Lambert Avenue (which runs through the closed landfill).

Where defects or penetrations were noted in the ground surface (i.e., cracks, dead grass, etc), these locations were also monitored.

Weather conditions were recorded on the day of monitoring including barometric pressure and wind speed at ground level (using a hand-held anemometer).

⁷ EPA (2018), *Landfill gas fugitive emissions monitoring guideline*, Publication 1684, February 2018

3.5 Landfill gas monitoring results

3.5.1 Landfill gas bores

Four baseline monitoring were events (29 Oct 2021 to 16 Nov 2021) were conducted following completion of bore installation. This is proceeded with monthly monitoring events until February 2022 at majority of monitoring bore where no methane had been detected.

At selected locations (R-LFG-03, R-LFG-04), monitoring continued until April 2022 as elevated methane concentrations had been detected. Table 3.3 summarises monitoring results from 2021 to 2022.

Table 3.2: Summary of gas bore monitoring results at Newtown landfills (2021 to 2022)

Gas Bore ID	Location	Max Flow	Methane				Carbon dioxide				Water Levels	
			Peak		Steady		Peak		Steady			
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Windmill Reserve												
W-LFG-02	Within waste ²	0.2	0	0.2	0	0.1	0.1	9.2	0.1	9.2	0	0
W-LFG-03	Perimeter ~16m from waste	0.1	0	0.1	0	0.1	3.1	4.2	3.1	4.2	0	0
Rotary Centennial Reserve												
R-LFG-01	Perimeter ~30m from waste	1	0	0.1	0	0.1	3.4	5.7	3.4	5.7	0	0
R-LFG-02	Perimeter ~23m from waste	0.2	0	0.1	0	0.1	3.3	8.4	3.3	8.4	0	0
R-LFG-03	Perimeter ~18m from waste	0.2	0	12.9	0	12.9	1.6	18.4	1.6	18.4	0	0
R-LFG-04	Perimeter ~14m from waste	0.2	0	10.1	0	10.1	1.9	16.8	1.8	16.8	0	0
R-LFG-05	Perimeter ~9m from waste	0.2	0	0.2	0	0.1	2	8.6	2	8.6	0	0
R-LFG-06	Perimeter ~18m from waste	0.1	0	0.1	0	0.1	3.3	5.3	3.2	5.3	2.52	2.52
R-LFG-07	Within waste ²	0.1	0	0.1	0	0.1	2.1	5.7	2	5.7	0	0
R-LFG-08	Perimeter ~12m from waste	0.2	0	0.1	0	0.1	0.4	2.1	0.4	2.1	0	0
Leach-Wood Gardens												
L-LFG-01	Perimeter ~17m from waste	0.1	0	0.1	0	0.1	10.8	14.8	10.8	14.8	2.8	2.8
L-LFG-02	Perimeter ~22m from waste	0.1	0	0.2	0	0.1	0.4	2.2	0.4	1.8	0	0
L-LFG-03	Within waste ²	0.1	0	0.1	0	0.1	8.5	11.9	8.3	11.9	0	0
L-LFG-04	Perimeter ~7m from waste	0.2	0	0.2	0	0.1	3.4	4.1	3.4	4.1	0	0
L-LFG-05	Perimeter	0.2	0	0	0	0	6.4	9.2	6.3	9.2	2.03	2.66

Gas Bore ID	Location	Max Flow	Methane				Carbon dioxide				Water Levels	
			Peak		Steady		Peak		Steady			
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	~15m from waste											
Marnockvale landfill												
M-LFG-01	Within waste ²	0.1	0	2.7	0	2.7	0.9	13.6	0.8	13.6	1.92	1.92
M-LFG-02	Perimeter ~10m from waste	0.3	0	0.1	0	0.1	1.8	10.6	1.8	10.6	2.67	2.68
M-LFG-03	Perimeter ~23m from waste	14.8	0	0.1	0	0.1	0.3	2.5	0.3	2.5	1.69	2.69
M-LFG-04	Off Site ~39m from waste	6.5	0	0.2	0	0.1	0.6	1.9	0.6	1.9	0	0
M-LFG-05	Off Site ~70m from waste	13.2	0	0.2	0	0.1	0.5	2	0.5	2	2.34	2.35
Newtown landfill												
N-LFG-01	Perimeter ~44m from waste	7.9	0	0.1	0	0.1	3.2	6.7	3.2	6.7	0	0
N-LFG-02	Perimeter ~40m from waste	7.8	0	0.1	0	0.1	2.2	6.7	2.2	6.7	0	1.49
N-LFG-03	Perimeter ~27m from waste	0.2	0	0.1	0	0.1	1.3	2.9	1.3	2.9	0	0
N-LFG-04	Perimeter ~18m from waste	0.3	0	0.1	0	0	6	9.3	5.9	9.3	0	0
N-LFG-05	Within waste ²	0.2	0.8	3	0.8	3	10	15	10	15	2.48	2.54
N-LFG-06	Perimeter ~19m from waste	0.1	0	0.3	0	0.1	4.7	6.8	4.7	6.8	0	0
N-LFG-07	Perimeter ~13m from waste	0.2	0	0.1	0	0.1	7	12.4	7	11.6	0	0
N-LFG-08	Perimeter ~60m from waste	19.6	0	0.1	0	0.1	3	9.7	3	9.7	1.22	1.65
N-LFG-09	Perimeter ~23m from waste	0.2	0	0.1	0	0.1	4.9	9.3	4.8	9.3	2.71	2.71

Note:

1. Readings highlighted in red indicate exceedance of the Landfill BPEM action levels.
2. Monitoring bores located within the waste mass do not monitor potential off-site migration, therefore the Landfill BPEM action levels have not been applied at these locations.

A table of all results are provided in **Appendix C**.

Elevated methane concentrations (i.e., >1 % v/v) were recorded at perimeter monitoring bores R-LFG-03 and R-LFG-04 (at Rotary Centennial Park). However, from December 2021 to April 2022 methane readings dropped to zero. This is further discussed in Section 3.5.5.

Except at monitoring bores M-LFG-03 to M-LFG-05 (at Marnockvale), N-LFG-01 and N-LFG-08, gas flows are negligible to low (i.e., <2 L/hr). Gas flows at M-LFG-03 to M-LFG-05, N-LFG-01 and N-LFG-08 are variable, with higher flows only recorded on one or two occasions at each bore.

Elevated carbon dioxide concentrations (i.e., >1.5 % v/v) have been reported for most bores across the sites, except for a few bores at Marnockvale (M-LFG-03 to M-LFG-05). Elevated carbon dioxide can indicate off-site landfill gas migration however, gas flows at bores with elevated carbon dioxide are mostly negligible to low indicating the movement of gas is insignificant.

The elevated carbon dioxide concentrations could also potentially indicate:

- Diffusive movement of gas at the margin of the landfills, at bores within 20 m of the inferred landfill boundaries (Table 3.3).
- Background sources of carbon dioxide present such as degradation of organic matter in the soil or in structures such as stormwater or sewer pits.

3.5.2 Service pits

Service pit monitoring was conducted on 27 October 2021 and 13 April 2022 at the Marnockvale and Newtown landfills.

The Landfill BPEM sets out an action level of 10,000 ppm for methane concentrations measured in subsurface services on and adjacent to a landfill. Results show that methane levels in all the service pits were below the Landfill BPEM action level, with readings no greater than 3 ppm at Marnockvale landfill or 8 ppm at the Newtown landfill.

Tabulated results and monitoring locations are provided in **Appendix D**.

3.5.3 Surface emissions

Surface emission monitoring was undertaken by a trained T+T field engineer on 27 October 2021 and 13 April 2022.

The Landfill BPEM sets out action levels for methane at 100 ppm, for measured concentrations of methane at the landfill cap and within 50 mm of penetrations through the final cap. No methane concentrations exceeding the Landfill BPEM action level were detected at either of the sites. The results are presented in an aerial figures in **Appendix E**.

3.5.4 Weather analysis

3.5.4.1 Landfill gas bore monitoring

As noted in Section 3.5.1 landfill gas bore monitoring was conducted on 6 to 8 occasions. The number of monitoring events aligns with the number of data points recommended in CIRIA C665 to capture a range of atmospheric pressure conditions.

A review of atmospheric pressure conditions during monitoring has been conducted to determine if worst case conditions have been captured.

The UK EA LFTGN 03 considers that falling atmospheric pressure over a 3 hour period is critical to the rate of gas migration or venting. Based on UK monitoring records, a drop in atmospheric pressure of 5 mbar over 3 hours represents a typical “worst case” scenario⁸. Based on our experience at other sites in Victoria, a reasonably significant pressure drop in the local climate is approximately 4 mbar/hPa over 3 hours.

⁸ LFTGN 03 notes that review of 10 years of data shows that a 5 mbar drop over 3 hours in pressure may occur 6 times in a year, i.e., very rarely.

Appendix F presents the atmospheric pressure readings every 3 hours for each monitoring day. During the 13 January 2022 monitoring event, a pressure drop of approximately 4 mbar occurred. Therefore, the monitoring events have captured a worse case scenario.

3.5.4.2 Surface emissions monitoring and service pit monitoring

Barometric pressure and rainfall data preceding the monitoring event were obtained from the Geelong Bureau of Meteorology (BOM) weather station (BOM Station #87184). The Geelong weather station is located at Geelong Racecourse, approximately 3 km southeast of the closed Newtown landfill.

Figures 3.1 and 3.2 shows barometric pressure and rainfall for the week before, during and after the surface emissions and service pit monitoring events. Ideally, monitoring should be conducted during falling barometric pressure conditions. Surface emissions monitoring should ideally also be carried out after a two-day, rain free period.

The weather data indicates monitoring was carried out during falling barometric pressure conditions on 27 October 2021, towards the end of a falling air pressure trend. While a small amount of rain fell on 25 October 2021 (0.2 mm), there was insufficient rain to impact on the monitoring results. The ground was dry and free of standing water during surface emissions monitoring.

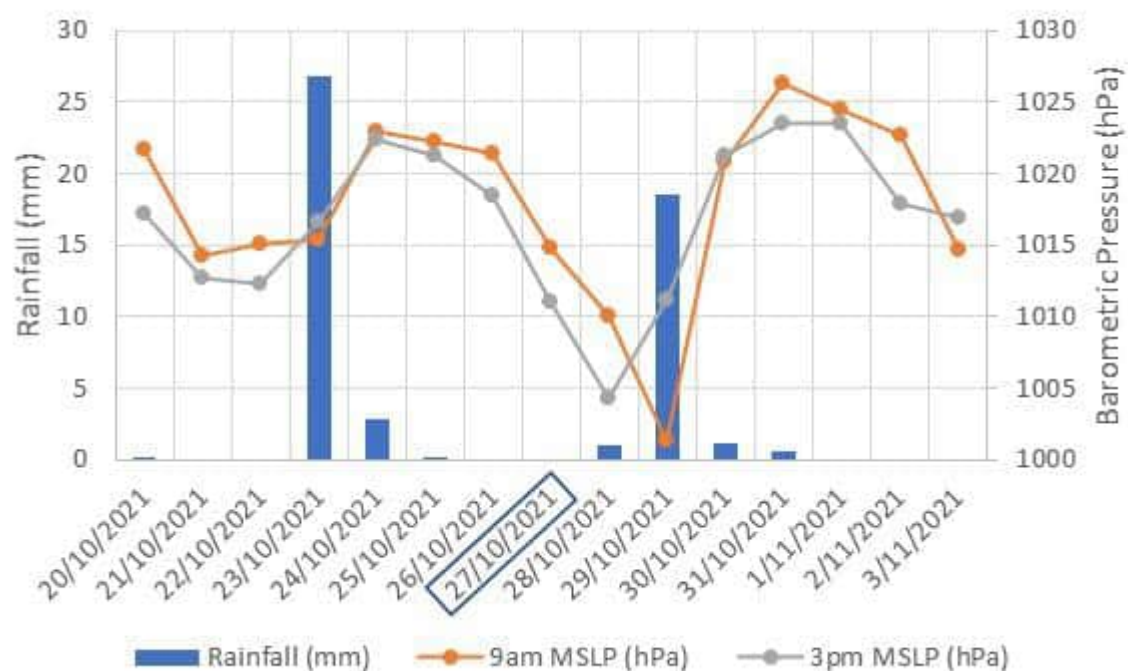


Figure 3.1: Barometric pressure and rainfall trend prior to, during (blue box) and after monitoring on 27 October 2021.

The weather data indicates monitoring was carried out during falling barometric pressure conditions on 13 April 2021, towards the end of a falling air pressure trend. While a small amount of rain fell on 13 April and 14 April (0.2 mm on both days), there was insufficient rain to impact on the monitoring results. The ground was dry and free of standing water during surface emissions monitoring.

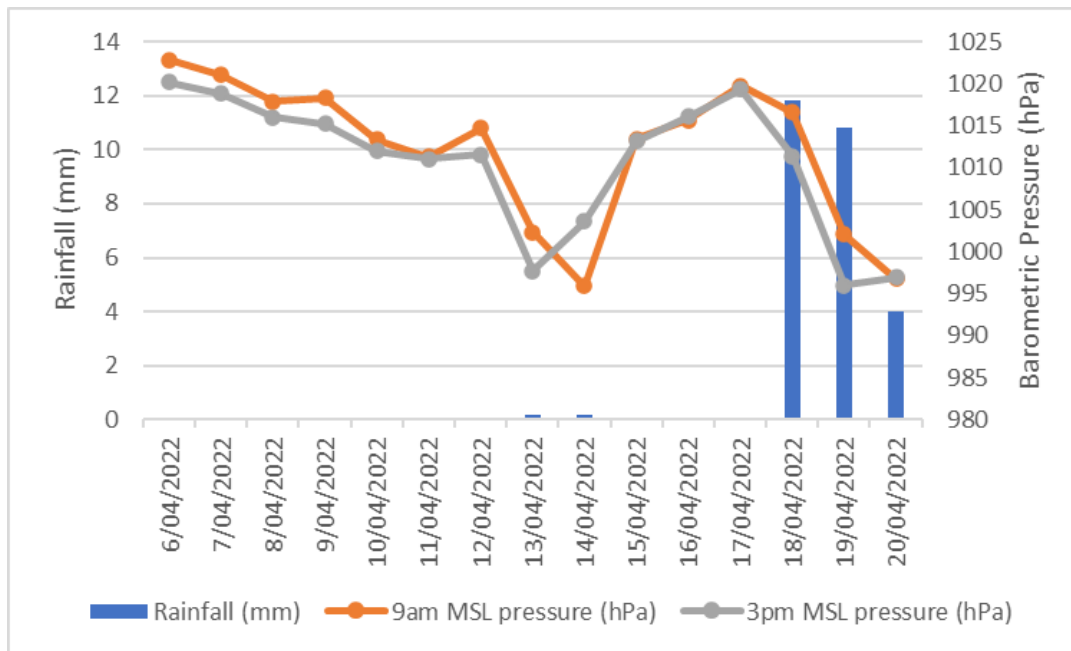


Figure 3.2: Barometric pressure and rainfall trend prior to, during (blue box) and after monitoring on 13 April 2022.

3.5.5 Discussion

Elevated methane concentrations (i.e., >1 % v/v) were recorded at perimeter monitoring bores R-LFG-03 and R-LFG-04 (at Rotary Centennial Park) during the 4 weekly monitoring events in October to November 2021. Due to site limitations, these bores are located approximately 15 m from the edge of waste. There was no room for R-LFG-03 to be placed further away from waste as it is already located abutting the residential fence line (Photo 3.1).



Photograph 3.1: Location of R-LFG-03 at Rotary Centennial Reserve



Photograph 3.2: 27 and 29 Vista Road dwellings.

From December 2021 to April 2022, R-LFG-03 and R-LFG-04 recorded zero methane (steady state readings). This indicates that there is no consistent source of methane, and LFG is sporadic.

The flow readings at R-LFG-03 and R-LFG-04 are negligible (i.e., max. 0.1 L/hr). Therefore, the movement of gas would be limited.

Key parameters in assessing risk are the gas flow and soil gas pressure, which are both negligible, indicating that gas movement is unlikely to be occurring. Without measurable gas movement and gas pressure, this is unlikely to lead to unacceptable accumulation of gas concentrations within the neighbouring dwelling.

Further, we note that the dwelling at 29 Vista Road is of a modern construction and would likely have a concrete floor slab, which is an acceptable form of gas barrier (Photo 2.3).

The dwelling at 27 Vista Road is set back from the fence by about 15 m and is an older style weatherboard dwelling where the floor is raised above ground level on short piles, creating an air void beneath the floor which provide free airflow and this will minimise the risk of landfill gas ingress into habitable spaces.

4 Amendment to buffer distance

4.1 Landfill gas risks

Conceptual site models (CSM) were developed for each landfill site in 2019 including a summary of the estimated volume of the waste and volume of landfill gas generated at each site.

A qualitative risk assessment was completed in 2019 for each site in accordance with the methodology described in LFTGN 03. Based on the understanding of the landfills, the surrounding land uses and preliminary modelling of estimated landfill gas generation, no residual, or unacceptable landfill gas risks were identified.

Additional work has been completed to confirm the low risk assessed qualitatively in 2019:

- Landfill gas monitoring bores have been installed within the waste mass and around the perimeter of the landfills, which has confirmed that rate of landfill gas generation is low/minimal and the risk of landfill gas migration is low and acceptable. In most cases, the landfill gas migration is not occurring.
- Landfill gas generation within the landfills are very low with bores installed within waste recording a maximum of 3 %v/v methane only with very low gas flows (maximum of 0.2 L/hr). Other than R-LFG-03 and R-LFG-04 which recorded elevated methane concentrations for a period post installation, the other monitoring bores have consistently recorded zero or negligible methane concentrations. The elevated readings in the two bores have been zero from January to April 2022, and further commentary on risks to immediate receptors are provided in Section 3.5.5.
- Gas flow rates and borehole pressures have also been low indicating that there is negligible subsurface movement of landfill gas.
- Additional service pit and surface emissions monitoring confirm that landfill gas is not migrating within underground services nor being emitted to air.
- In addition, existing developments have been present for several decades without incident.

Based on the above, the age of waste (40 – 50 years) the risk of landfill gas migration from the landfill sites are confirmed to be **low and acceptable**.

4.2 Building protection measures

To inform development controls on or adjacent to the closed landfill sites, gas screening values (GSV) are typically calculated in accordance with the method outlined in BS8485. Based on the GSV, an appropriate Characteristic Situation (CS) can be selected to inform the level of building protection the new development may require. Note that this is screening level assessment is an empirical approach based past projects and experience in the UK by the authors of the British Standard. A level of judgement and experience is required should a future development trigger the need for building protection measures and an experienced professional in landfill and building protection design should be involved.

Note however, that the BS8485 approach is for **new** developments and there is separate guidance on retrofitting ground gas protection measures to **existing** buildings in CIRIA C795. The approach in CIRIA C795 is based on indoor concentrations of methane. Figure 4.1 presented the four risk classes, the limiting value for methane for each class is summarised as follows:

Class 1	>0.5 %v/v methane
Class 2	>0.05 and 0.5 %v/v methane
Class 3	>0.01 and 0.05 %v/v methane
Class 4	<0.01 %v/v methane

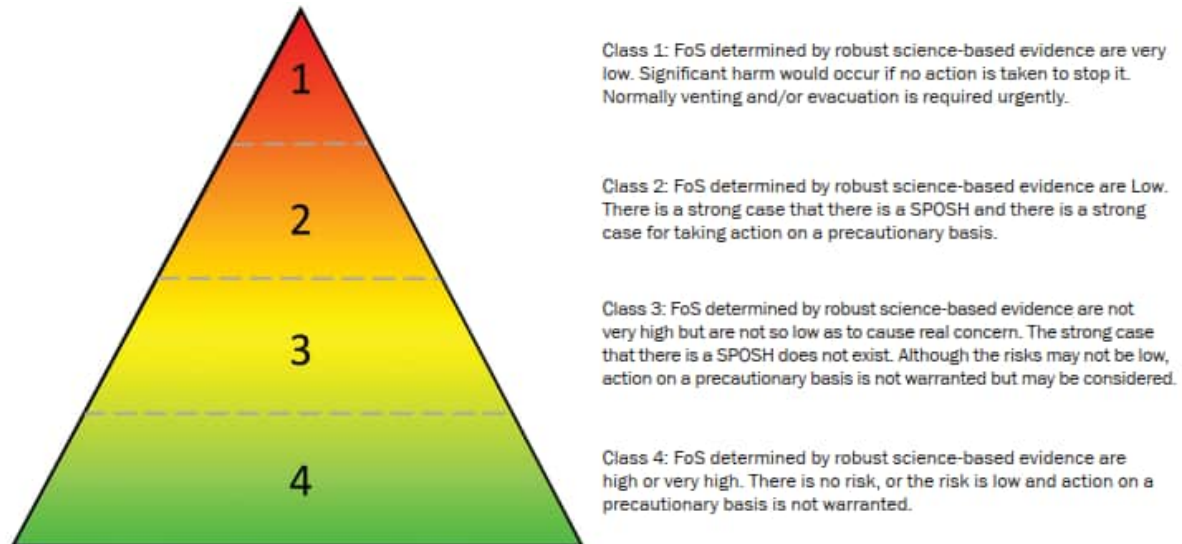


Figure 4.1: Classification of hazardous gasses and vapours (Source: CIRIA C795)

The presence of elevated subsurface gas concentrations does not automatically mean that there is risk to an existing building or its occupiers. The need for retrofitting should not be based solely on monitoring in the ground and more investigation has been undertaken including an assessment of the source-pathway-receptor model to determine if intervention is required. Several lines of evidence shows that the risk to existing buildings on or adjacent to the landfills are low.

In addition to subsurface bore monitoring, surface emissions and service pit monitoring has been conducted which measured methane concentrations well under 100 ppm. This would indicate that indoor concentrations of methane would be well below 100 ppm. Therefore, the developments on and adjacent to the closed landfills can be classified as Class 4 and no further action is needed.

4.3 Revised buffer distances and trigger for assessment

Buffer distances are a control recommended by the Landfill BPEM as a contingency against the possibility of abnormal weather systems or failure of landfill control systems (where in place) resulting in landfill related impacts to neighbouring sensitive receptors. For closed landfills, the buffers are set to manage landfill gas impacts, including the risk of explosion and/or asphyxiation. Landfill gas potential risks remain for at least 30 years post-closure. The closed landfills assessed have been closed for at least 40 – 50 years.

In the absence of waste records, it has been assumed that each of the five landfills accepted putrescible municipal waste (i.e., equivalent to a modern Type 2 landfill). The recommended (default) buffer distances between a Type 2 landfill and the relevant sensitive receptors (i.e., off-site buildings/structures, rivers) are:

- 100 m from surface waters; and
- 500 m from buildings and structures

A summary of the actual separation distances at each landfill to the nearest sensitive receptor is summarised in **Table 2.1**. Based on the additional monitoring conducted at the site and confirmation of risk of impacts to receptors, the recommended triggers to require a landfill gas risk assessment is proposed.

Overall, **the 500 m buffer around the closed landfills can be removed**. This reduction is based on information indicating that landfill gas generation rates at the landfill are minimal and there is insufficient gas pressure to result in ingress into buildings and structures.

The exceptions are:

- If developments are proposed immediately on the landfill i.e., at Newtown landfill; or
- If a garage, utility or other habitable structure to more than 1.5 m below ground, or crawl space is proposed immediately on or adjacent to the closed landfills.

As the extent of waste has not clearly been defined, any excavation within the landfill or near the inferred edges should be conducted with care (e.g., prepare for encountering waste materials, disposal requirements, potential release of landfill gas and odours) and will inform the level of gas protection required.

5 Applicability

This report has been prepared for the exclusive use of our client City of Greater Geelong, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Pty Ltd
Environmental and Engineering Consultants

Report prepared by:

Authorised for Tonkin & Taylor Pty Ltd by:



Sze-Fei Peng
Principal Environmental Engineer



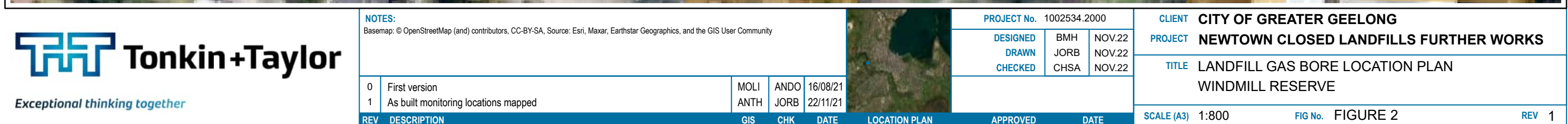
Tony Kortegast
EPA Appointed Auditor (Industrial Facilities), Project Director

SFP
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Appendix A Figures

- **Figure 1 – Windmill Reserve**
- **Figure 2 – Rotary Centennial Park**
- **Figure 3 – Leech-wood Gardens**
- **Figure 4 – Marnockvale**
- **Figure 5 – Newtown**













Appendix B Bore completion report

City of Greater Geelong
Via Email: jtaylor2@geelongcity.vic.gov.au

Attention: Mr. Jack Taylor - Project Engineer (Environment & Waste)

Dear Mr Taylor

Bore Completion Report - Newtown landfill gas bores

1 Introduction

The City of Greater Geelong (Council) engaged Tonkin & Taylor Pty Ltd (T+T) to supervise and log the installation of 31 landfill gas monitoring bores at five closed and rehabilitated landfill sites (the sites) in Newtown, Victoria.

The five closed landfill sites are:

- The closed Windmill Reserve landfill, Mayfair Drive, Newtown, Victoria.
- The closed Rotary Centennial Park landfill (historically the Burnside Landfill), West Fyan's Street, Newtown, Victoria.
- The closed Leach-Wood Gardens landfill, Balcombe Road, Newtown, Victoria.
- The closed Marnockvale landfill (now part of The Hill Mountain Bike Park), Newcastle Street, Newtown.
- The closed Newtown Landfill, Riversdale Road, Newtown, Victoria.

Works were carried out in general accordance with our proposal dated 14 April 2021.

A total of 29 landfill gas monitoring bores were installed at the five sites. One monitoring bore was removed during pre-mobilisation planning and another was not installed due to shallow competent rock (see

Section 4.2).

This report describes the installation of the landfill gas monitoring bores at the sites.

2 Scope of work

The following scope of works was completed:

- Preparation of a site-specific Health and Safety Plan (HSP) prior to the commencement of works. Throughout the works, the HSP was reviewed and, where necessary, updated to address specific risks encountered at each of the sites.
 - Works were carried out in accordance with the HSP developed for the project.

- An initial site visit was carried out to mark out the proposed bore locations and clear each location of buried services (telecommunications, power, gas, water, etc.) by an accredited underground services location.
- Supervision and logging of 29 landfill gas monitoring bores installed at the sites:
 - Bores were targeted to depth of approximately 2 m – 3 m and were logged by an experienced field engineer.
- Helium leak detection testing of the bores, to ensure the bentonite seals were installed correctly and were performing as expected.

3 Environmental Settings

3.1 Site location and setting

The sites are all located in Newtown, located in the western part of Geelong and are close to each other. The sites form an approximately 1.7 km broken chain on the northern side of Barwon River, as shown in Figure 3.1.

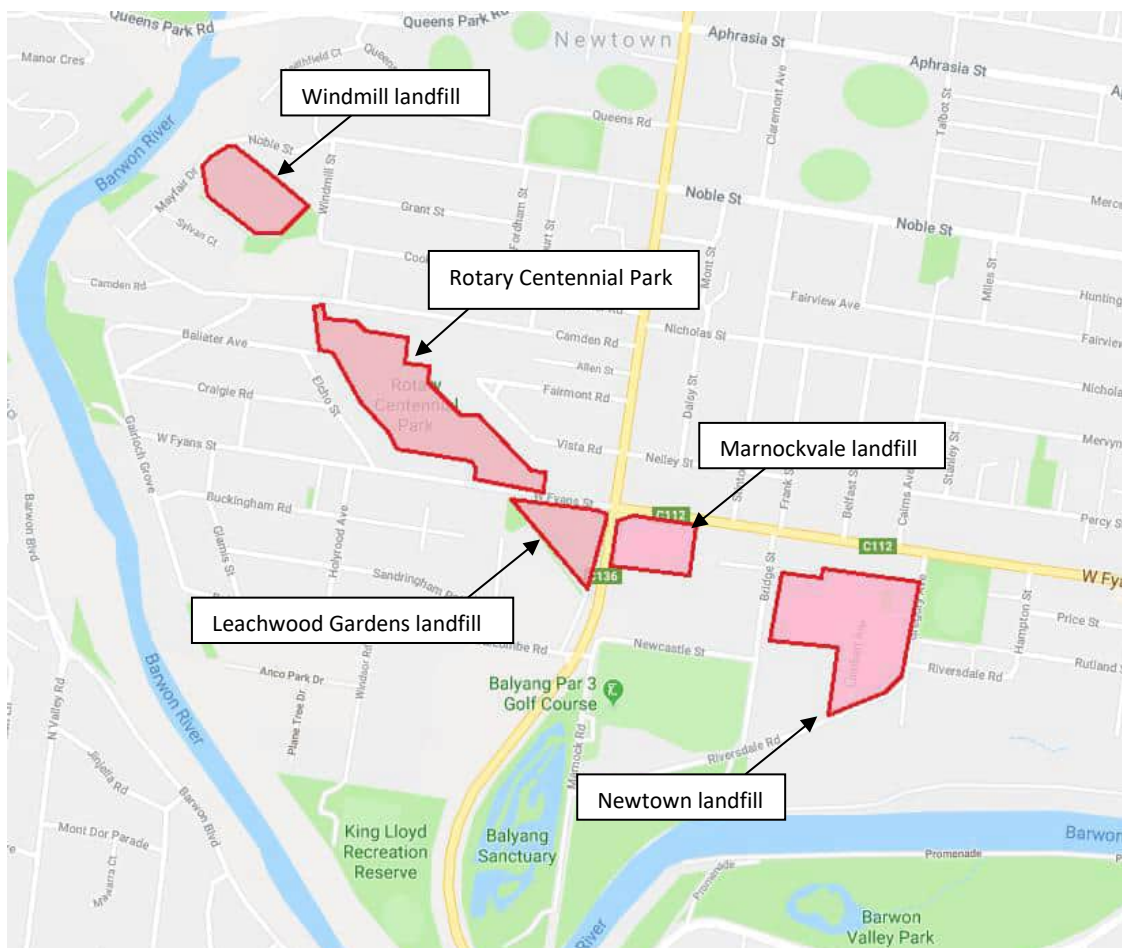


Figure 3.1: Approximate landfill locations (Source: Google Maps, 2018)

The sites are located within generally undulating topography, broadly sloping from the sites down towards Barwon River. A detailed summary of the topography for each site is provided in the 2019 LFGRA¹.

¹ T+T (2019), *Landfill Gas Risk Assessment for Closed Landfills*, Version 2, reference 1002534.100, August 2019.

3.2 Surrounding site use

In general, the surrounding land use primarily comprises residential areas, with some open recreational spaces, schools and light commercial premises.

A detailed summary of the land use surrounding each site 7 is provided in the 2019 LFGRA.

3.3 Geology

Based on the 1:250,000 geological map for Queenscliff², the landfills overlay the Newer Volcanic Group, comprising basaltic lava flows along with minor tuff, scoria and alluvium.

This is consistent with the findings from the drilling, where sandy, silty or clayey soils (fill and/or natural) were encountered at most locations to a maximum depth of 3 m. Basalt was encountered at shallow depths (0.2 m – 2.6 m) in one or more bores at most sites (except Leech-Wood Gardens). Where encountered, the basalt was slightly to extremely weathered.

3.4 Hydrogeology

Based on information from the Visualising Victoria's Groundwater (VVG) website³, groundwater at the landfills is generally within the range of approximately 8 to 17 m AHD.

The information from VVG indicates groundwater elevations are lower at the Windmill and Newtown landfills (i.e. closest to Barwon River) and highest at Burnside landfill (furthest from Barwon River), suggesting groundwater flow is towards Barwon River.

4 Landfill gas monitoring bore installation

4.1 Site inspection and service location

Prior to undertaking site works, a Dial Before You Dig (DBYD) search was carried out on the areas surrounding the sites, to identify any buried utilities services and notify utilities owners of impending site works.

Site visits were carried out on 31 August and 1 September 2021 to mark out drilling locations, based on the locations previously agreed with Council.

Each drilling location was identified on site and scanned by an accredited buried services operator prior to drilling works commencing. Service location was carried out by Geelong Cable Locations, who were engaged on behalf of Council by a third-party consultant, Landserv Environment (Landserv).

Where necessary, bores were moved from the agreed locations to avoid services identified during the site visit. Additional service location was requested and carried out on 4 October, during the bore installation works.

Additional requirements, such as the need for electrical spotters or permitting (to allow installation of bores in the road reserve), were also identified during the site visits. These requirements were communicated to Council and Landserv to be actioned and ready when the drilling works started.

4.2 Drilling methodology

Landfill gas monitoring bore installation occurred between 4 October and 7 October 2021.

² Douglas J.G and Spenser-Jones, D (1971), *Queenscliff – Geological Survey of Victoria*, No SJ55-9, 1:250,000 series, 1971

³ <http://www.vvg.org.au>

The drilling contractor for the works was Urban Drilling (Urban). Urban was engaged on behalf of Council by Landserv.

The first 1 m of each borehole was hand-augered as a measure to prevent damage to buried services. A track mounted drill rig then used solid augers to advance the hole through the soil profile until the target depth was achieved, or where refusal on competent rock occurred.

Except at R-LFG-05 (at Rotary Centennial Park), landfill gas monitoring bores were installed in general accordance with the nominal landfill gas bore design provided in EPA Publication 788.3⁴.

At R-LFG-05, shallow competent rock was encountered at approximately 1 m depth. As there was a nearby potential receptor, the gas bore was installed with a shallow screen and a half meter bentonite seal.

Other key observations of the drilling program are:

- Due to the presence of shallow competent rock at W-LFG-01 (at Windmill Reserve), a monitoring bore was not installed at this location. It was assessed the good data from this monitoring bore would be unlikely and a suitable alternative location could not be found.
- When drilling M-LFG-02 (at Marnockvale), waste was encountered at the original drilling location. An alternative location was found and M-LFG-02 was installed in natural soils several meters to the north of the original drilling location.

The original M-LFG-02 location was re-labelled M-LFG-01 and a monitoring bore was installed at this location. The original M-LFG-01 location was abandoned, due to:

- Difficult terrain preventing drill rig access.
- The limited maximum depth (i.e. 1.0 - 1.5 m) of the portable drilling equipment needed to install M-LFG-01 at its proposed location.

A summary of the groundwater monitoring bore installation is provided in **Table 4.1**.

Table 4.1: Landfill gas monitoring bore installation

Bore ID	Coordinates ¹ (UTM54H)	Total Depth m bgl	Backfill m bgl	Blank Casing m bgl	Bentonite Seal m bgl	Gravel Pack m bgl	Screen Interval m bgl
Windmill Reserve							
W-LFG-01	Not Installed (shallow competent rock from 0.4 m bgl)						
W-LFG-02	5772043.25 mN 791287.77 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
W-LFG-03	5772002.35 mN 791269.08 mE	2.8	n/a	0- 1	0 – 1	1 – 2.8	1 – 2.8
Rotary Centennial Park							
R-LFG-01	5771739.07 mN 791572.80 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
R-LFG-02	5771664.97 mN 791664.24 mE	2.05	n/a	0- 1	0 – 1	1 – 2.05	1 – 2.05
R-LFG-03	5771566.23 mN 791780.14 mE	2.2	n/a	0- 1	0 – 1	1 – 2.2	1 – 2.2

⁴ EPA (2015), *Siting, Design, Operation and Rehabilitation of Landfills* in the Best Practice Environmental Management series, Publication 788.3, August 2015

Bore ID	Coordinates ¹ (UTM54H)	Total Depth m bgl	Backfill m bgl	Blank Casing m bgl	Bentonite Seal m bgl	Gravel Pack m bgl	Screen Interval m bgl
R-LFG-04	5771454.62 mN 791878.16 mE	2.1	n/a	0- 1	0 – 1	1 – 2.1	1 – 2.1
R-LFG-05	5771488.67 mN 791723.98 mE	1.25	n/a	0- 0.5	0 – 0.5	0.5 – 1.25	0.5 – 1.25
R-LFG-06	5771533.18 mN 791609.58 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
R-LFG-07	5771631.10 mN 791629.96 mE	2.8	n/a	0- 1	0 – 1	1 – 2.8	1 – 2.8
R-LFG-08	5771641.57 mN 791530.39 mE	2.5	n/a	0- 1	0 – 1	1 – 2.5	1 – 2.5
Leach-Wood Park							
L-LFG-01	5771404.97 mN 791839.86 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
L-LFG-02	5771362.50 mN 791830.09 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
L-LFG-03	5771317.54 mN 791951.48 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
L-LFG-04	5771303.32 mN 791911.39 mE	2.8	n/a	0- 1	0 – 1	1 – 2.8	1 – 2.8
L-LFG-05	5771317.54 mN 791951.48 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
Marnockvale closed landfill							
M-LFG-01	5771353.82 mN 792104.75 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
M-LFG-02	5771357.68 mN 792105.45 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
M-LFG-03	5771344.22 mN 792185.93 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
M-LFG-04	5771339.09 mN 792211.11 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
M-LFG-05	5771331.87 mN 792256.16 mE	2.8	n/a	0- 1	0 – 1	1 – 2.8	1 – 2.8
Newtown closed landfill							
N-LFG-01	5771293.71 mN 792458.19 mE	2.75	n/a	0- 1	0 – 1	1 – 2.75	1 – 2.75
N-LFG-02	5771276.32 mN 792556.31 mE	2.1	n/a	0- 1	0 – 1	1 – 2.1	1 – 2.1
N-LFG-03	5771242.70 mN 792657.39 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
N-LFG-04	5771104.87 mN 792631.89 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
N-LFG-05	5771129.93 mN 792525.77 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3

Bore ID	Coordinates ¹ (UTM54H)	Total Depth m bgl	Backfill m bgl	Blank Casing m bgl	Bentonite Seal m bgl	Gravel Pack m bgl	Screen Interval m bgl
N-LFG-06	5770992.44 mN 792590.03 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
N-LFG-07	5770949.10 mN 792469.93 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
N-LFG-08	5771066.95 mN 792291.11 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3
N-LFG-09	5771239.97 mN 792328.39 mE	3	n/a	0- 1	0 – 1	1 - 3	1 – 3

Note:

1. Bore coordinates were obtained from a handheld GPS.

Figures showing the locations of the landfill gas monitoring bores at each site are provided in **Appendix A**. Bore installation logs are provided in **Appendix B**. Photographs showing the installed location of each bore are provided in **Appendix C**.

4.3 Helium leak detection testing

Helium leak testing was conducted by T+T at each landfill gas monitoring bore to verify the integrity of the bentonite seals. A sealed shroud was placed over the standing pipe and cap and flooded with helium. The bore atmosphere was then purged using a GA5000 gas analyser, and the exhaust measured for helium using a GasCheck G3.

The results of the leak detection testing indicated all the bores had good seals, with helium concentrations in the bore atmosphere (i.e. as measured from the GA5000 exhaust) ≤ 600 ppm (i.e. $\leq 0.06\%$ v/v).

Helium leak test results are provided in **Appendix D**.

5 Applicability

This report has been prepared for the exclusive use of our City of Greater Geelong, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Pty Ltd

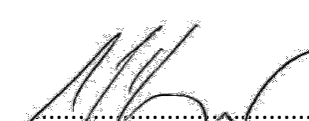
Environmental and Engineering Consultants

Report prepared by:

Authorised for Tonkin & Taylor Pty Ltd by:



Ben Hart
Senior Environmental Engineer



Tony Kortegast
Project Director

BMH

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Appendix A: Figures











Appendix B: Bore construction logs

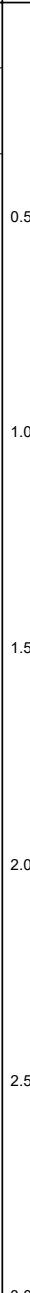
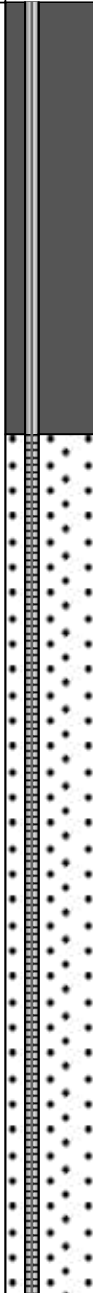
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

L-LFG-01

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771404.97 mN (UTM54H) 791839.86 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Newer Volcanic Group	Fill	HA		FILL	0.00m: Sandy GRAVEL, well graded, fine to medium grained, subrounded, brown-grey. Sand, fine to medium grained.		D							Bentonite	
		HA		0.15m: Silty SAND, fine to medium grained, light-brown, dry.											
	HA		ML	0.35m: SILT with sand trace gravel, black. Sand, fine to medium grained; gravel, fine to medium grained, subrounded.											
SA															
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

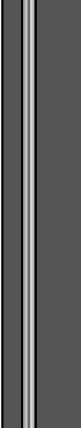
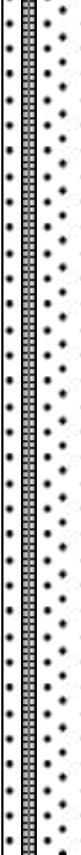
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

L-LFG-02

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771362.50 mN (UTM54H) 791830.09 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Sandy CLAY, low plasticity, black. Sand, fine to medium grained; trace organics.	0.5	M								Bentonite	
				0.03m: CLAY trace gravel, high plasticity, black/brown. Gravel, fine to medium grained, subrounded.										<i>[Piezo 1] Plain (impervious) pipe</i>	
Newer Volcanic Group	SA		CI	1.50m: CLAY with gravel, medium plasticity, light-brown, grey. Gravel, fine to medium grained, subrounded.	2.0	D								Gravel <10mm	
				2.50m: Sandy CLAY, medium plasticity, light-brown. Sand, fine to medium grained.										<i>[Piezo 1] Slotted pipe</i>	
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

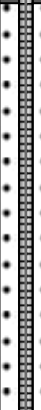
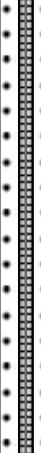
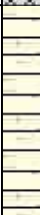
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

L-LFG-03

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771317.54 mN (UTM54H) 791951.48 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Sandy CLAY, low plasticity, black. Sand, fine to medium grained; trace of organic materials.		D								Bentonite	
	HA			0.30m: Sandy CLAY trace gravel, medium plasticity, light-brown. Sand, fine to medium grained; gravel, fine to medium grained.	0.5									[Piezo 1] Plain (impervious) pipe	
	SA				1.0 1.5 2.0									Gravel <10mm [Piezo 1] Slotted pipe	
Newer Volcanic Group	SA		CL	2.50m: CLAY with sand & gravel, low plasticity, brown, light-brown. Sand, fine to coarse grained, gravel, fine to medium grained.	2.5										
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

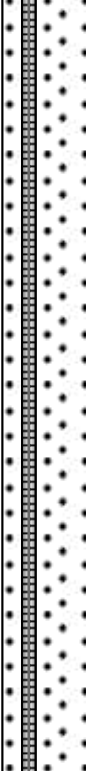
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

L-LFG-04

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771303.32 mN (UTM54H) 791911.39 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Mulch	0.5 1.0 1.5 2.0 2.5 3.0	M							 	Bentonite	
	HA			0.20m: CLAY with gravel, high plasticity, black. Gravel, fine to medium grained.								<i>[Piezo 1] Plain (impervious) pipe</i>			
	SA														
Newer Volcanics	SA		CH	2.50m: Gravelly CLAY, high plasticity, light-brown-grey-brown. Gravel, fine to medium grained, subrounded.											
				2.8m: Target depth											

NOTES: Piezometer 1: Tip at 2.8m.

Hole Depth
2.8m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

L-LFG-05

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771317.54 mN (UTM54H) 791951.48 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS						
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)	
Fill	HA		FILL	0.00m: Sandy CLAY, low plasticity, black, brown, firm. Sand, fine to coarse grained.		M								Bentonite		
	HA			0.20m: Silty sandy GRAVEL, fine to medium grained, grey-brown. Sand, fine to coarse grained.	0.5	D								[Piezo 1] Plain (impervious) pipe		
	HA			0.70m: Sandy CLAY, low plasticity, brown-black, moist, firm. Sand, fine to coarse grained; trace of organic material.	1.0	M										
	SA															
	SA			1.30m: Clayey SAND, low plasticity, fine to medium grained, light-brown.	1.5											Gravel <10mm
Newer Volcanic Group	SA		CI	1.60m: CLAY, medium plasticity, light-brown.	2.0									[Piezo 1] Slotted pipe		
				3m: Target depth	3.0											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

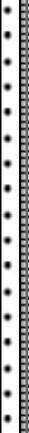
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

M-LFG-01

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771353.82 mN (UTM54H) 792104.75 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 05/10/2021 FINISH DATE: 05/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS				
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)	
Fill	HA		FILL	0.00m: CLAY, high plasticity, brown-black. Trace of organic material.	0.5	M								Bentonite		
	SA					1.0								<i>[Piezo 1] Plain (impervious) pipe</i>		
	SA			1.50m: CLAY, medium plasticity, light-brown. Waste encountered .	1.5										Gravel <10mm	
	SA			2.00m: Clayey SAND, fine to coarse grained, light-brown.	2.0										<i>[Piezo 1] Slotted pipe</i>	
				3m: Target depth	3.0											

NOTES: **Piezometer 1:** Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

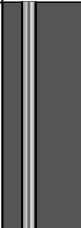
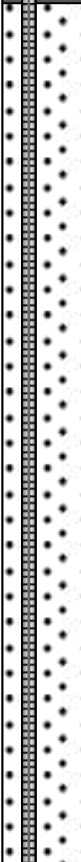
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

M-LFG-02

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771357.68 mN (UTM54H) 792105.45 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 05/10/2021 FINISH DATE: 05/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: CLAY trace gravel, medium plasticity, brown-grey. Gravel, fine to medium grained, subrounded.	0.5	M								Bentonite	
	SA													Gravel <10mm	
					1.0										
					1.5										
					2.0									[Piezo 1] Slotted pipe	
					2.5										
					3.0										
				3m: Target depth											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771353.62 mN (UTM54H) 792106.19 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 05/10/2021 FINISH DATE: 05/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: CLAY trace sand, medium plasticity, brown-balck. Sand, fine to coarse grained; Trace of organic material.	0.5	M								Drill cuttings	
	SA			1.0											
	SA			1.5											
				1.60m: CLAY, medium plasticity, light-brown. Waste material encountered.	2.0										
				2m: Target depth	2.5										
					3.0										

NOTES:

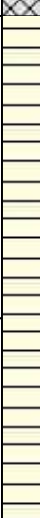
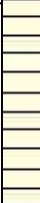
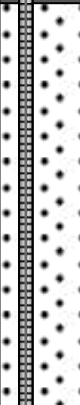
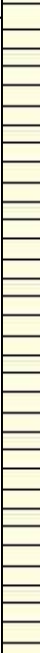
Hole Depth
2m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771344.22 mN (UTM54H) 792185.93 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 05/10/2021 FINISH DATE: 05/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS					
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
	RC		P	0.00m: Concrete.										Bentonite	
	HA		FILL	0.13m: Clayey GRAVEL, fine to medium grained, subrounded, brown-light brown.		M									
Newer Volcanic Group	HA		CH	0.30m: CLAY, high plasticity, brown-light brown.	0.5									[Piezo 1] Plain (impervious) pipe	
	SA				1.0									Gravel <10mm	
	SA			1.50m: CLAY, high plasticity, brown-light brown.	1.5									[Piezo 1] Slotted pipe	
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

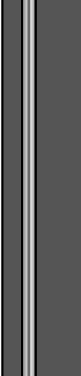
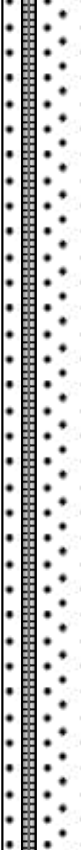
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

M-LFG-04

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771339.09 mN (UTM54H) 792211.11 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 05/10/2021 FINISH DATE: 05/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	RC		P	0.00m: Concrete										Bentonite	
	HA		FILL	0.12m: Sandy GRAVEL, poorly graded, fine to coarse grained, subrounded, brown-light brown. Sand, fine to coarse grained.	D									[Piezo 1] Plain (impervious) pipe	
	HA			0.22m: Gravelly CLAY, high plasticity, brown-light brown. Gravel, fine to medium grained, subrounded.	M										
	SA				0.5										
Newer Volcanic Group	SA		CH	1.30m: CLAY trace sand, high plasticity, light-brown. Sand, fine to medium grained.	1.0									Gravel <10mm 	

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771331.87 mN (UTM54H) 792256.16 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 05/10/2021 FINISH DATE: 05/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS					
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	RC		P	0.00m: Concrete									 <		

NOTES: Piezometer 1: Tip at 2.8m.

Hole Depth
2.8m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

N-LFG-01

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771293.71 mN (UTM54H) 792458.19 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 06/10/2021 FINISH DATE: 06/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Newer Volcanic Group	Fill	RC		P	0.00m: Concrete pavement.	0.5 									

NOTES: Piezometer 1: Tip at 2.75m.

Hole Depth
2.75m

Scale 1:18

Rev.: A

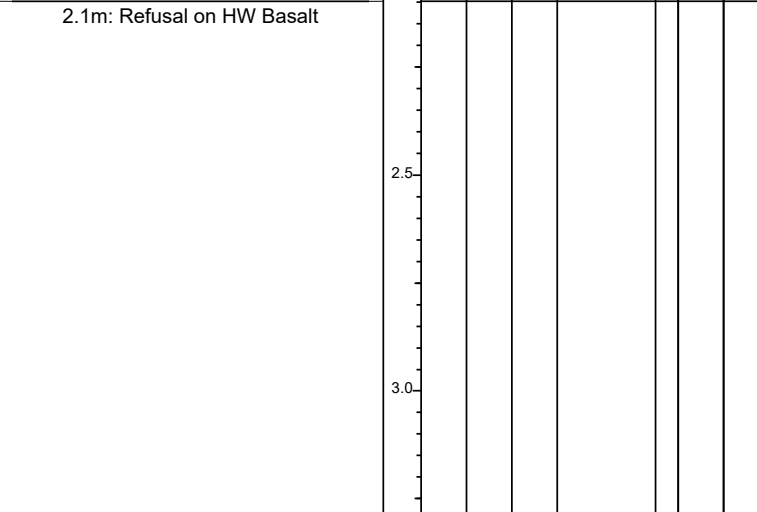
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

N-LFG-02

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771276.32 mN (UTM54H) 792556.31 mE	METHOD: SA	START DATE: 06/10/2021
R.L.:	EQUIPMENT: Hanjin D&B	FINISH DATE: 06/10/2021
DATUM:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Newer Volcanic Group	Fill	RC		P	0.00m: Concrete pavement.	M 0.5 1.0 1.5 2.0 2.5 3.0								Bentonite 	

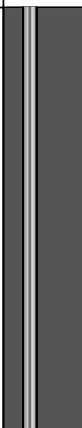
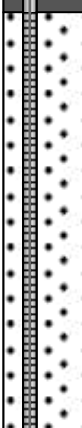
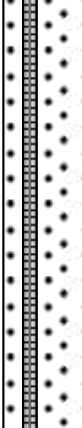
NOTES: Piezometer 1: Tip at 2.1m.

Hole Depth
2.1m

Scale 1:18

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771242.70 mN (UTM54H) 792657.39 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS							
GEOLOGICAL UNIT		METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)	
Fill	HA		CI		0.00m: Sandy CLAY, medium plasticity, black-brown. Sand, fine to coarse grained.		D							   	Bentonite		
Newer Volcanic Group	HA				0.20m: Gravelly CLAY, medium plasticity, brown, light-brown. Gravel, fine to medium grained, subrounded.	0.5										[Piezo 1] Plain (impervious) pipe	
	SA					1.0	M										Gravel <10mm
	SA		HW		2.00m: BASALT, grey-brown, Highly Weathered, recovered as fine to medium angular-sub, angular gravel.	2.0									[Piezo 1] Slotted pipe		
					3m: Target depth	3.0											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

N-LFG-04

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771104.87 mN (UTM54H) 792631.89 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 04/10/2021 FINISH DATE: 04/10/2021
R.L.:	TECHNICIAN: Joel and Brodie	LOGGED BY: ALJF
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		GW	0.00m: Sandy GRAVEL, fine to medium grained, subrounded to subangular, grey-brown. Sand, fine to coarse grained. 0.10m: Gravelly SILT, low plasticity, light brown. Gravel, fine to medium grained, subrounded.	0.5	D								Bentonite	
	HA		ML											[Piezo 1] Plain (impervious) pipe	
	SA				1.0									Gravel <10mm	
					1.5									[Piezo 1] Slotted pipe	
					2.0										
					2.5										
					3.0										
				3m: Target depth											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

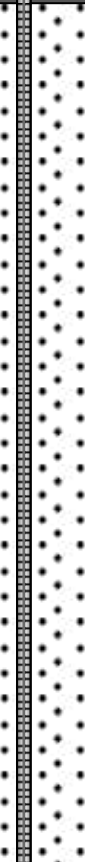
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

N-LFG-05

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771129.93 mN (UTM54H) 792525.77 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 06/10/2021 FINISH DATE: 06/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Gravelly SAND with clay, fine to coarse grained, brown/dark grey. Gravel, fine to medium grained, angular to subangular; Clay, low plasticity.	0.5	M								Bentonite [Piezo 1] Plain (impervious) pipe	
	HA			0.80m: Silty CLAY with sand & gravel, medium plasticity, brown/dark grey. Sand, fine to medium grained, gravel, fine to medium grained, angular to subangular; with glass.	1.0										
	SA														
	SA		FILL	1.20m: Clayey SILT, low plasticity, dark grey. With sand, clay, glass, plastic and ceramic fragments (landfill waste materials).	1.5									Gravel <10mm [Piezo 1] Slotted pipe	
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

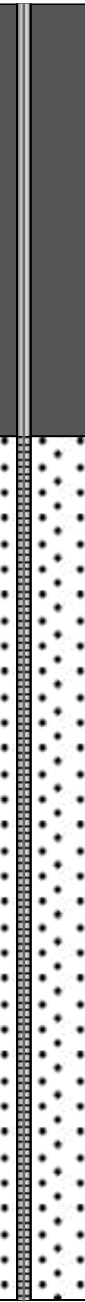
Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5770992.44 mN (UTM54H) 792590.03 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 06/10/2021 FINISH DATE: 06/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS					
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Gravelly SAND, fine to medium grained, brown/grey. Gravel, fine to medium grained, angular to subangular.	0.5	M								Bentonite	
	HA			0.80m: Silty CLAY with sand, low plasticity, grey/orange/brown (mottled). Sand, fine to medium grained.	1.0									[Piezo 1] Plain (impervious) pipe	
	SA				2.0									Gravel <10mm	
Alluvium	SA		SM	2.40m: Silty SAND, fine to medium grained, brown/grey.	2.5										
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

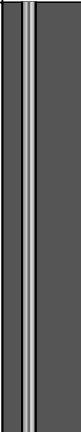
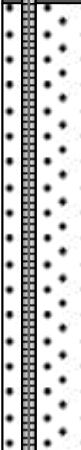
Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5770949.10 mN (UTM54H) 792469.93 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 06/10/2021 FINISH DATE: 06/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Sandy SILT, low plasticity, dark grey/brown. Sand, fine to medium grained; With metal wire, gravel, glass, and brick and concrete fragments below 0.50m.	0.5	M								Bentonite	
	SA													[Piezo 1] Plain (impervious) pipe	
					1.0									Gravel <10mm	
					1.5										
					2.0									[Piezo 1] Slotted pipe	
					2.5										
					3.0										
				3m: Target depth											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

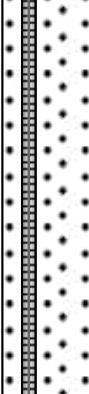
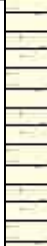
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

N-LFG-08

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771066.95 mN (UTM54H) 792291.11 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 06/10/2021 FINISH DATE: 06/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Silty CLAY, high plasticity, dark grey/brown.	0.5	M								Bentonite	
	SA			2.40m: Sandy CLAY, low plasticity, brown/grey.	1.0									Gravel <10mm	
Alluvium	SA		CL	3m: Target depth	2.5										
					3.0										

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

N-LFG-09

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771239.97 mN (UTM54H) 792328.39 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 06/10/2021 FINISH DATE: 06/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SILT, low plasticity, dark grey.	0.5	M								Bentonite	
	HA			0.20m: Silty CLAY trace gravel, medium plasticity, dark grey. Gravel, fine to medium grained, subangular to subrounded.										[Piezo 1] Plain (impervious) pipe	
Alluvium	HA		CL	0.90m: Sandy CLAY, low plasticity, orange brown/red/grey. Sand, fine to medium grained.	1.0									Gravel <10mm	
	SA													[Piezo 1] Slotted pipe	
					1.5										
					2.0										
					2.5										
					3.0										
				3m: Target depth											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

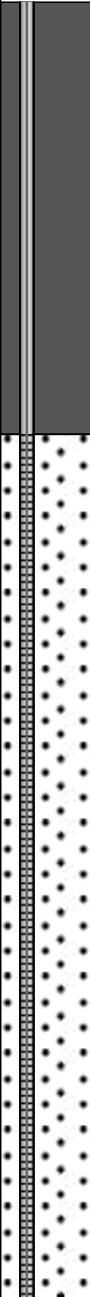
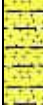
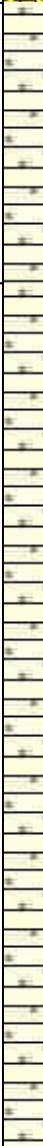
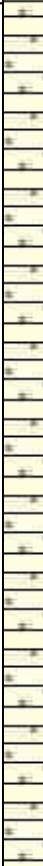
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-01

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771739.07 mN (UTM54H) 791572.80 mE	METHOD: SA	START DATE: 07/10/2021
R.L.:	EQUIPMENT: Hanjin D&B	FINISH DATE: 07/10/2021
DATUM:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Newer Volcanic Group	HA		FILL	0.00m: Clayey SILT with sand & gravel, low plasticity, dark grey/brown. Sand, fine to medium grained, gravel, fine grained, angular to subangular. 0.10m: Clayey SAND, fine to medium grained, light brown/grey.		M								Bentonite	
	HA		SC												
	HA		CL	0.35m: Silty CLAY with sand & gravel, low plasticity, light brown/grey. Sand, fine to medium grained, gravel, fine to medium grained, subangular to rounded.	0.5										
	SA				1.0									Gravel <10mm	
					1.5										
					2.0									[Piezo 1] Slotted pipe	
					2.5										
					3.0										
				3m: Target depth											

NOTES: Piezometer 1: Tip at 3m.

Hole Depth
3m

Scale 1:18

Rev.: A

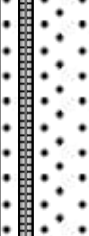
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-02

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771664.97 mN (UTM54H) 791664.24 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 07/10/2021 FINISH DATE: 07/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SAND with gravel, fine to medium grained, dark brown/dark grey. Gravel, fine to coarse grained, angular to subangular; Basalt boulder at 0.90 - 1.10m.	0.5	M								Bentonite	
	SA				1.0									Gravel <10mm	
Newer Volcanic Group	SA		HW	1.40m: BASALT, grey, highly weathered. Recovered as fine particles.	1.5									[Piezo 1] Slotted pipe	
				2.05m: Target depth	2.0										
					2.5										
					3.0										

NOTES: Piezometer 1: Tip at 2.05m.

Hole Depth
2.05m

Scale 1:18

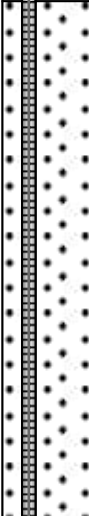
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-03

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771566.23 mN (UTM54H) 791780.14 mE	METHOD: SA	START DATE: 07/10/2021
R.L.:	EQUIPMENT: Hanjin D&B	FINISH DATE: 07/10/2021
DATUM:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SILT with sand, low plasticity, dark grey/light brown. Sand, fine to medium grained.		M								Bentonite	
	HA		0.10m: Silty CLAY with sand & gravel, medium plasticity, brown/grey (mottled). Sand, fine to medium grained, gravel, fine grained, subrounded to rounded.	[Piezo 1] Plain (impervious) pipe											
Newer Volcanic Group			HW	0.50m: BASALT, grey, highly weathered. Recovered as fine particles. Zones of silty clay/extremely weathered basalt rock.	0.5									Gravel <10mm	
	SA					1.0								[Piezo 1] Slotted pipe	
				2.2m: Target depth											
					2.5										
					3.0										

NOTES: Piezometer 1: Tip at 2.2m.

Hole Depth
2.2m

Scale 1:18

Rev.: A

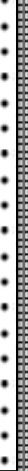
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-04

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771454.62 mN (UTM54H) 791878.16 mE	METHOD: SA	START DATE: 07/10/2021
R.L.:	EQUIPMENT: Hanjin D&B	FINISH DATE: 07/10/2021
DATUM:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SILT with sand, low plasticity, brown/grey. Sand, fine to medium grained.	0.5	M								Bentonite	
	HA			0.15m: Silty CLAY with gravel, medium plasticity, dark grey/brown (mottled). Gravel, fine to medium grained, angular to subangular.										[Piezo 1] Plain (impervious) pipe	
Newer Volcanic Group	SA		HW	0.90m: BASALT, grey, highly weathered. Recovered as fine particles.	1.0									Gravel <10mm	
					1.5									[Piezo 1] Slotted pipe	
				2.1m: Target depth	2.0										
					2.5										
					3.0										

NOTES: Piezometer 1: Tip at 2.1m.

Hole Depth
2.1m

Scale 1:18

BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-05

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771488.67 mN (UTM54H) 791723.98 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 07/10/2021 FINISH DATE: 07/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
Fill	HA		FILL	0.00m: Clayey SILT with sand & gravel, low plasticity, dark grey. Sand, fine to medium grained, gravel, fine to medium grained, angular to subangular; Trace glass and brick fragments.	0.5	M								Bentonite [Piezo 1] Plain (impervious) pipe																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

NOTES: Piezometer 1: Tip at 1.25m.

Hole Depth
1.25m

Scale 1:18

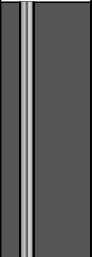
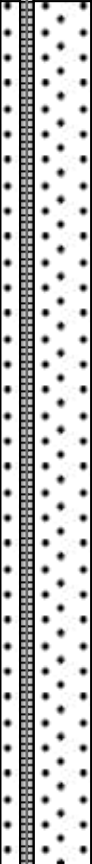
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-06

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771533.18 mN (UTM54H) 791609.58 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 07/10/2021 FINISH DATE: 07/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS					
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SILT with sand & gravel, low plasticity, brown/grey. Sand, fine grained, gravel, fine to medium grained, angular to subrounded.	0.5	M								Bentonite [Piezo 1] Plain (impervious) pipe	
	HA		0.60m: Silty CLAY with sand & gravel, low plasticity, brown/grey. Sand, fine to medium grained, gravel, fine to medium grained, angular to subrounded; Trace glass and brick fragments.	1.0											
	SA														
	SA		1.30m: Silty CLAY with sand, medium plasticity, grey/brown. Sand, fine to medium grained.	1.5											
	SA			2.20m: Silty CLAY with sand & gravel, low plasticity, brown/grey. Sand, fine to medium grained, gravel, fine to medium grained, angular to subrounded.	2.5									Gravel <10mm [Piezo 1] Slotted pipe	
				3m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 3m.

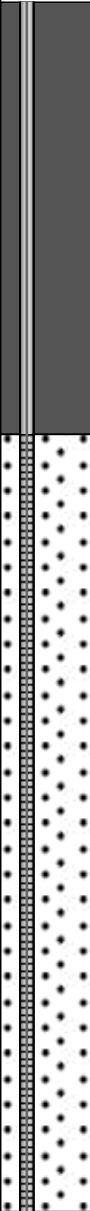
Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771631.10 mN (UTM54H) 791629.96 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 07/10/2021 FINISH DATE: 07/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SILT with sand & gravel, low plasticity, brown/grey. Sand, fine to medium grained, gravel, fine to coarse grained, angular to subangular.		M								Bentonite	
	HA			0.30m: Silty CLAY with sand & gravel, medium plasticity, brown/grey. Sand, fine to medium grained, gravel, fine to coarse grained, angular to subangular.	0.5									<i>[Piezo 1] Plain (impervious) pipe</i>	
Newer Volcanic Group	SA		HW	0.70m: BASALT, grey, highly weathered. Recovered as fine particles.	1.0									Gravel <10mm	
	SA		MW	1.40m: BASALT, grey, moderately weathered. Interbedded with extremely weathered basalt rock and silty clay (brown, medium plasticity).	1.5								<i>[Piezo 1] Slotted pipe</i>		
				2.8m: Target depth	3.0										

NOTES: Piezometer 1: Tip at 2.8m.

Hole Depth
2.8m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

R-LFG-08

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5771641.57 mN (UTM54H) 791530.39 mE	METHOD: SA	START DATE: 07/10/2021
R.L.:	EQUIPMENT: Hanjin D&B	FINISH DATE: 07/10/2021
DATUM:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG													INSTRUMENT DETAILS		
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Clayey SILT with sand & gravel, low plasticity, dark grey/brown. Sand, fine to medium grained, gravel, fine to medium grained, angular to subrounded.	0.5	M								Bentonite	
	HA			0.20m: Silty CLAY trace sand & gravel, high plasticity, dark grey/brown. Sand, fine to medium grained, gravel, fine grained, subrounded to rounded.										[Piezo 1] Plain (impervious) pipe	
Newer Volcanic Group	SA		XW	1.70m: BASALT, grey, extremely weathered.	1.0									Gravel <10mm	
	SA		MW	2.10m: BASALT, grey, moderately weathered. Recovered as fine particles.	1.5							[Piezo 1] Slotted pipe			
				2.5m: Target depth	2.5										
					3.0										

NOTES: Piezometer 1: Tip at 2.5m.

Hole Depth
2.5m

Scale 1:18

Rev.: A

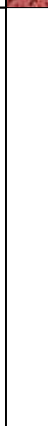
BOREHOLE INSTRUMENTATION LOG

INVESTIGATION Id.:

W-LFG-01

SHEET: 1 OF 1

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5772073.94 mN (UTM54H) 791262.69 mE	METHOD: SA	START DATE: 07/10/2021
R.L.:	EQUIPMENT: Hanjin D&B	FINISH DATE: 07/10/2021
DATUM:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG											INSTRUMENT DETAILS				
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMETER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Sandy SILT with gravel, low plasticity, dark grey/brown. Gravel, fine to medium grained, angular to subangular; With brick fragments. Basalt boulder at 0.20-0.30m.		M									
			SA		ML	0.30m: Clayey SILT, low plasticity, dark grey.									
			SA		SW	0.40m: BASALT, grey, slightly weathered. Recovered as fine particles.	0.5								
Newer Volcanic Group	SA			1m: Refusal on SW Basalt	1.0										
					1.5										
					2.0										
					2.5										
					3.0										

NOTES:

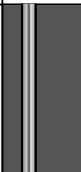
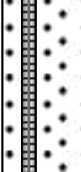
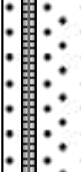
Hole Depth
1m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5772043.25 mN (UTM54H) 791287.77 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 07/10/2021 FINISH DATE: 07/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG												INSTRUMENT DETAILS			
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Sandy SILT with gravel, low plasticity, brown/grey. Sand, fine to medium grained; gravel, fine to coarse grained, angular to subangular.		M								Bentonite	
	HA		0.40m: Sandy CLAY with gravel, low plasticity, brown/grey/orange brown. Sand, fine to medium grained; gravel, fine to medium grained, angular to subangular.	0.5								[Piezo 1] Plain (impervious) pipe			
	SA				1.0									Gravel <10mm	
				1.5											
					2.0									[Piezo 1] Slotted pipe	
					2.5										
					3.0										
				3m: Target depth											

NOTES: **Piezometer 1:** Tip at 3m.

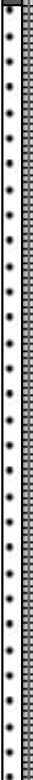
Hole Depth
3m

Scale 1:18

Rev.: A

BOREHOLE INSTRUMENTATION LOG

PROJECT: Newtown Gas Bores	LOCATION: Newtown, Geelong	JOB No.: 1002534.2000
CO-ORDINATES: 5772002.35 mN (UTM54H) 791269.08 mE	METHOD: SA EQUIPMENT: Hanjin D&B	START DATE: 07/10/2021 FINISH DATE: 07/10/2021
R.L.:	TECHNICIAN: Joel and Clancy	LOGGED BY: RDG
DATUM:	CONTRACTOR: Urban Drilling	CHECKED BY: BMH

SUMMARY LOG										INSTRUMENT DETAILS					
GEOLOGICAL UNIT	METHOD	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	DEPTH (m)	MOISTURE	CONSISTENCY / RELATIVE DENSITY	ROCK STRENGTH	SAMPLES TESTS	SAMPLES	DCP Dynamic Cone Penetrometer	DRILLING WATER LEVEL	INSTALLATION GRAPHIC LOG	INSTALLATION DATA TYPE OF MONITORING INSTALLED PIEZOMEWTER DETAILS INCLINOMETER DETAILS ETC	RL (m)
Fill	HA		FILL	0.00m: Gravelly SAND, fine to medium grained, dark grey/brown. Gravel, fine to medium grained, angular to subangular.		M								Bentonite	
Newer Volcanic Group	SA		HW	0.20m: BASALT, grey, highly weathered. Recovered as fine particles. Zones of extremely weathered basalt rock.	0.5									[Piezo 1] Plain (impervious) pipe	
					1.0								Gravel <10mm [Piezo 1] Slotted pipe		
				2.8m: Target depth	3.0										

NOTES: **Piezometer 1:** Tip at 2.8m.

Hole Depth
2.8m

Scale 1:18

Rev.: A

Appendix C: Bore location photographs



Photograph C.1: W-LFG-02 installed location (Windmill Reserve)



Photograph C.2: W-LFG-03 installed location (Windmill Reserve)



Photograph C.3: R-LFG-01 installed location (Rotary Centennial Park)



Photograph C.4: R-LFG-02 installed location (Rotary Centennial Park)



Photograph C.5: R-LFG-03 installed location (Rotary Centennial Park)



Photograph C.6: R-LFG-04 installed location (Rotary Centennial Park)



Photograph C.7: R-LFG-05 installed location (Rotary Centennial Park)



Photograph C.8: R-LFG-06 installed location (Rotary Centennial Park)



Photograph C.9: R-LFG-07 installed location (Rotary Centennial Park)



Photograph C.10: R-LFG-08 installed location (Rotary Centennial Park)



Photograph C.11: L-LFG-01 installed location (Leech-Wood Gardens)



Photograph C.12: L-LFG-02 installed location (Leech-Wood Gardens)



Photograph C.13: L-FG-03 installed location (Leech-Wood Gardens)



Photograph C.14: L-FG-04 installed location (Leech-Wood Gardens)



Photograph C.15: L-LFG-05 installed location (Leech-Wood Gardens)



Photograph C.16: M-LFG-01 installed location (Marnockvale closed landfill)



Photograph C.17: M-LFG-02 installed location (Marnockvale closed landfill)



Photograph C.18: M-LFG-03 installed location (Marnockvale closed landfill)



Photograph C.19: M-LFG-04 installed location (Marnockvale closed landfill)



Photograph C.20: M-LFG-05 installed location (Marnockvale closed landfill)



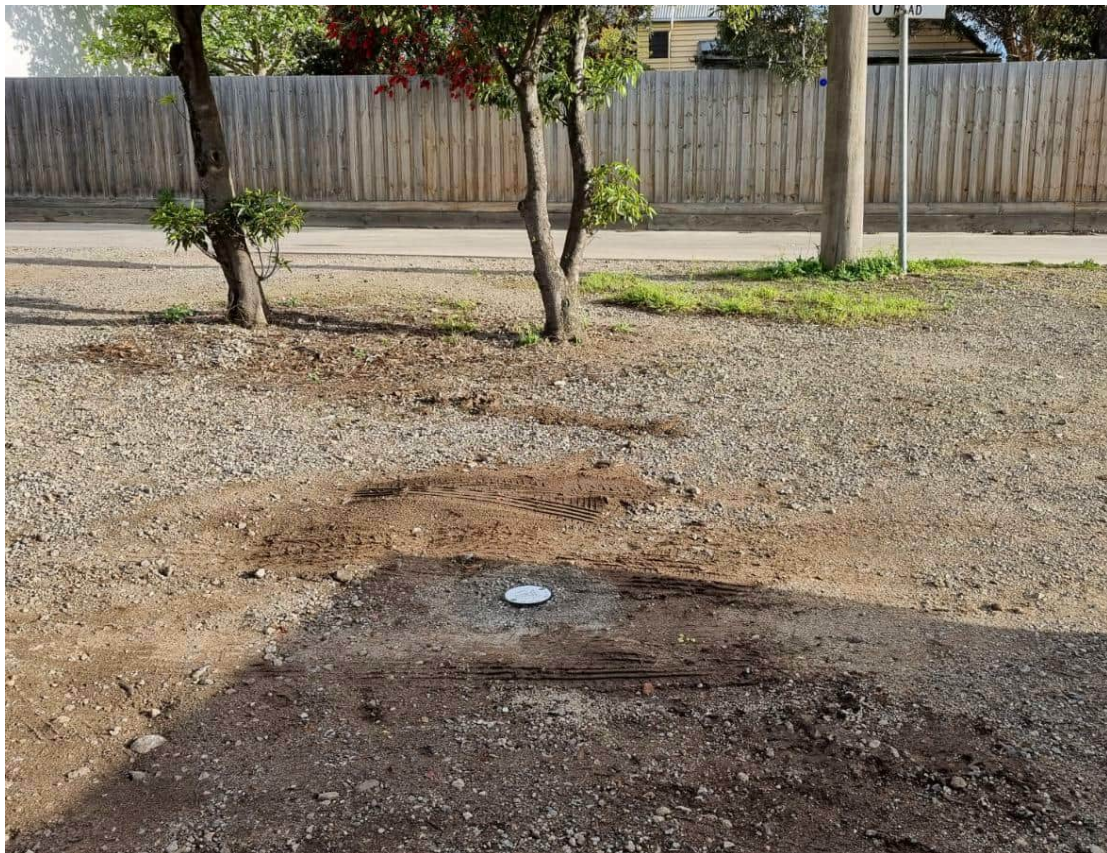
Photograph C.21: N-LFG-01 installed location (Newtown closed landfill)



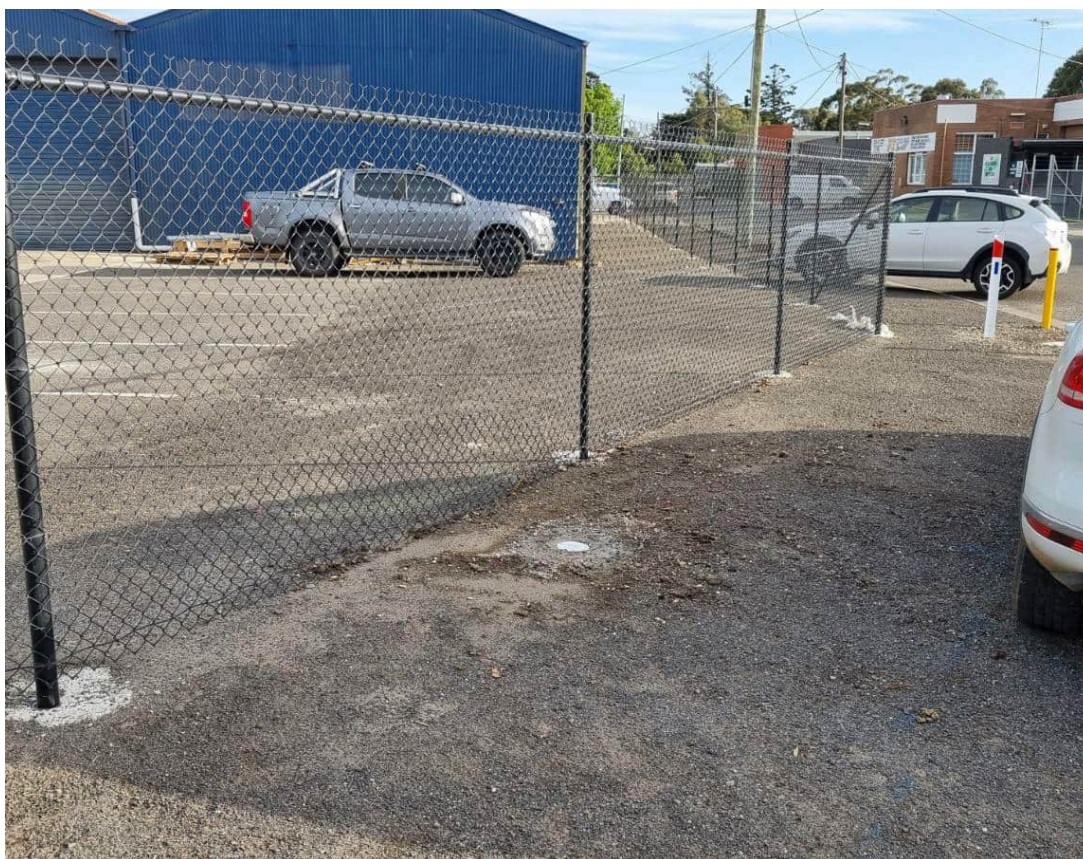
Photograph C.22: N-LFG-02 installed location (Newtown closed landfill)



Photograph C.23: N-LFG-03 installed location (Newtown closed landfill)



Photograph C.24: N-LFG-04 installed location (Newtown closed landfill)



Photograph C.25: N-LFG-05 installed location (Newtown closed landfill)



Photograph C.26: N-LFG-06 installed location (Newtown closed landfill)



Photograph C.27: N-LFG-07 installed location (Newtown closed landfill)



Photograph C.28: N-LFG-08 installed location (Newtown closed landfill)



Photograph C.29: N-LFG-09 installed location (Newtown closed landfill)

Appendix D: Helium leak detection testing

Appendix C Landfill gas bore monitoring results

Gas Bore ID	Location	Date	Flow Rate (L/h)	Atmospheric Pressure (mbar)	Bore Pressure (mbar)	Peak Reading (%)			Pump Time (s)	Steady State Reading (%)			Pump Time (s)	CO (ppm)	H2S (ppm)	Balance (%)	Water Level Gauging		Depths of Well (mbtoc)	Comments
						CH4	CO2	O2		CH4	CO2	O2					Top of Casing (m)	Water Level (mbtoc)		
M-LFG-01	Landfill Cell	28/10/2021	0.1	1003	-0.07	0.0	8.6	7.6	35	0.0	8.6	7.6	180	1	0	83.7	-0.15	Dry	2.712	
		3/11/2021	0.1	1025	0.10	0.0	8.9	4.6	40	0.0	8.9	4.6	180	1	0	86.5		Dry	2.710	
		10/11/2021	0.0	1011	-0.05	0.1	12.0	0.9	40	0.1	12.0	0.8	140	0	0	87.1		Dry	2.685	
		16/11/2021	0.0	1020	0.03	2.7	13.6	0.0	70	2.7	13.6	0.0	180	2	0	83.8		Dry	2.710	
		6/12/2021	0.1	1006	-0.07	1.2	12.2	7.2	95	1.2	12.2	7.2	180	3	0	79.4		Dry	2.714	
		13/01/2022	0.0	1013	0.17	0.0	0.9	19.7	60	0.0	0.8	19.7	120	0	3	79.5				
		16/02/2022	0.0	1011	0.12	0.0	2.6	18.5	35	0.0	2.6	18.5	180	0	0	78.9	-0.147	1.925	2.590	
		22/03/2022	0.1	1007	0.08	0.0	2.5	19.5	30	0.0	2.5	19.5	180	0	0	78.1		Dry	2.600	
		13/04/2022	0.1	1022	-0.05	0.0	3.1	18.0	50	0.0	2.7	18.0	115	0	0	79.3	-0.12	Dry	2.705	
M-LFG-02	Perimeter	28/10/2021	0.1	1002	-0.05	0.0	8.1	6.0	45	0.0	8.1	6.0	180	1	0	85.9	-0.156	Dry	2.689	
		3/11/2021	0.3	1025	-0.12	0.0	8.7	3.5	40	0.0	8.7	3.5	180	1	0	87.8			2.672	2.696
		10/11/2021	0.0	1009	0.00	0.1	10.3	1.8	30	0.1	10.3	1.7	140	0	0	87.9		Dry	2.666	
		16/11/2021	0.0	1019	0.02	0.1	10.6	0.2	60	0.1	10.6	0.2	180	2	1	89.2		Dry	2.597	
		6/12/2021	0.1	1006	-0.03	0.0	9.4	9.9	45	0.0	9.4	9.9	180	1	0	80.8			2.678	2.695
		13/01/2022	0.0	1013	0.02	0.0	3.0	18.2	80	0.0	3.0	18.3	140	0	3	78.8				
		16/02/2022	0.1	1011	0.85	0.0	1.8	19.5	20	0.0	1.8	19.5	180	0	0	78.7	-0.115	Dry	2.721	
M-LFG-03	Perimeter	28/10/2021	0.1	1002	-0.05	0.0	0.3	20.0	45	0.0	0.3	20.0	180	2	0	79.7	-0.116	2.694	2.789	
		3/11/2021	7.7	1025	0.14	0.0	0.3	18.8	35	0.0	0.3	18.8	180	0	0	80.9		Dry	2.701	
		10/11/2021	0.0	1008	0.05	0.1	0.8	16.8	15	0.1	0.5	17.8	120	0	0	81.6			2.092	2.675
		16/11/2021	14.8	1019	0.15	0.0	0.5	17.4	35	0.0	0.5	17.4	180	0	0	82.0			1.722	2.697
		6/12/2021	-18.4	1007	-2.95	0.1	0.6	14.8	50	0.0	0.6	14.8	180	0	0	84.6			1.696	2.695
		13/01/2022	-0.7	1013	0.10	0.0	1.3	12.6	60	0.0	1.2	13.0	120	0	3	85.8				
		16/02/2022	0.1	1011	0.17	0.0	2.5	18.6	30	0.0	2.5	18.6	180	1	0	79.0	-0.114	2.076	2.782	
M-LFG-04	Off Site (~30m from waste)	28/10/2021	0.1	1002	0.02	0.0	0.6	18.4	20	0.0	0.6	18.4	180	1	0	81.0	-0.147	Dry	2.737	
		3/11/2021	6.5	1025	-2.68	0.0	0.6	16.7	30	0.0	0.6	16.7	180	0	0	82.7		Dry	2.742	
		10/11/2021	0.1	1009	0.45	0.2	0.9	16.4	40	0.1	0.9	16.4	140	0	0	82.7		Dry	2.624	
		16/11/2021	-16.5	1019	-16.42	0.0	1.0	15.6	50	0.0	1.0	15.6	180	0	0	83.4		Dry	2.740	
		6/12/2021	5.4	1007	1.05	0.0	1.0	13.7	40	0.0	1.0	13.7	180	0	0	85.3		Dry	2.737	
		13/01/2022	-8.3	1013	0.03	0.0	1.2	11.5	70	0.0	1.2	11.5	140	0	3	87.2				
		16/02/2022	-13.3	1011	-12.49	0.0	1.9	7.5	25	0.0	1.9	7.5	180	0	0	90.6	-0.143	Dry	2.638	
M-LFG-05	Off Site (~50m from waste)	28/10/2021	7.1	1002	0.10	0.1	0.5	16.5	45	0.0	0.5	16.5	180	2	0	83.0	-0.124	Dry	2.562	CH4 dropped to 0.0 afdter 100s
		3/11/2021	13.2	1025	0.15	0.2	0.5	15.1	35	0.0	0.5	15.1	180	1	0	84.3		Dry	2.564	
		10/11/2021	0.7	1009	2.08	0.1	0.7	14.2	30	0.1	0.7	14.0	140	0	0	85.1		Dry	2.540	
		16/11/2021	-15.3	1019	-12.36	0.0	1.0	12.6	45	0.0	0.9	12.6	180	1	0	86.5			2.34	2.565
		6/12/2021	10.5	1007	0.67	0.0	1.2	9.1	40	0.0	1.0	9.1	180	1	0	89.9			2.356	2.561
		13/01/2022	-7.6	1014	0.35	0.0	1.4	8.0	40	0.0	1.4	7.6	120	0	3	90.6				
		16/02/2022	-9.8	1011	3.50	0.0	2.0	5.0	25	0.0	2.0	5.0	180	0	1	93.0	-0.13	Dry	2.557	

Gas Bore ID	Location	Date	Flow Rate (L/h)	Atmospheric Pressure (mbar)	Bore Pressure (mbar)	Peak Reading (%)			Pump Time (s)	Steady State Reading (%)			Pump Time (s)	CO (ppm)	H2S (ppm)	Balance (%)	Water Level Gauging		Depths of Well (mbtoc)	
						CH4	CO2	O2		CH4	CO2	O2					Top of Casing (m)	Water Level (mbtoc)		
Comments																				
N-LFG-01	Off Site (~40m from waste)	28/10/2021	0.2	1003	0.12	0.0	3.2	12.8	45	0.0	3.2	14.8	180	2	0	82.0	-0.138	Dry	2.537	
		3/11/2021	-3.9	1025	0.09	0.0	3.4	14.3	35	0.0	3.4	14.3	180	0	0	82.3		Dry	2.650	
		10/11/2021	0.0	1009	0.05	0.1	4.0	13.2	65	0.1	4.0	13.2	120	0	0	82.8		Dry	2.522	
		16/11/2021	7.9	1020	0.05	0.0	4.3	13.1	40	0.0	4.3	13.1	180	0	0	82.7		Dry	2.546	
		6/12/2021	-9.4	1007	-7.04	0.0	4.6	11.5	40	0.0	4.6	11.5	180	1	0	83.9		Dry	2.543	
		13/01/2022	-2.6	1014	-0.03	0.0	5.0	11.4	30	0.0	4.4	12.4	140	0	3	83.2				
		16/02/2022	3.2	1012	0.02	0.0	6.7	9.1	30	0.0	6.7	9.1	180	0	0	84.2	-0.142	Dry	2.640	
N-LFG-02	Off Site (~40m from waste)	28/10/2021	1.4	1003	0.14	0.0	2.2	14.5	35	0.0	2.2	14.5	180	1	0	83.3	-0.134	1.322	1.795	
		3/11/2021	-3.6	1026	0.24	0.0	2.7	13.3	30	0.0	2.7	13.3	180	1	0	84.0				
		10/11/2021	0.0	1009	0.05	0.1	3.3	12.7	30	0.1	3.3	12.7	150	0	0	83.9		1.188	1.753	
		16/11/2021	-15.0	1020	3.90	0.0	3.5	13.2	45	0.0	3.5	13.2	180	0	0	83.3			1.146	1.774
		6/12/2021	-15.2	1007	-11.10	0.0	4.3	11.6	35	0.0	4.3	11.6	180	1	0	84.1		1.2	1.371	
		13/01/2022	-0.9	1014	0.09	0.0	5.8	9.4	60	0.0	5.6	9.8	120	0	2	84.5				
		16/02/2022	7.8	1012	0.05	0.0	6.7	8.5	30	0.0	6.7	8.5	180	1	0	84.8	-0.124	1.498	1.771	
N-LFG-03	Off Site (~20m from waste)	28/10/2021	0.2	1004	-0.07	0.0	1.4	17.7	30	0.0	1.3	17.7	180	0	0	81.0	-0.098	Dry	2.470	
		3/11/2021	0.1	1027	0.07	0.0	1.8	17.0	40	0.0	1.8	17.0	180	0	0	81.2		Dry	2.450	
		10/11/2021	0.0	1009	-0.03	0.1	2.2	17.4	40	0.1	2.2	17.4	120	0	0	80.3		Dry	2.450	
		16/11/2021	0.0	1021	-0.14	0.0	2.3	16.2	35	0.0	2.3	16.2	180	0	0	81.5		Dry	2.462	
		6/12/2021	0.0	1008	0.02	0.0	2.9	18.1	45	0.0	2.9	18.1	180	0	0	78.9		Dry	2.466	
		13/01/2022	0.0	1013	0.00	0.0	2.1	18.1	60	0.0	2.1	18.1	130	0	1	79.8				
		16/02/2022	0.0	1012	-0.03	0.0	2.2	19.1	35	0.0	2.2	19.1	180	0	0	78.7	-0.098	Dry	2.454	
N-LFG-04	Off Site (~20m from waste)	13/04/2022	0.0	1022	0.07	0.0	1.3	19.8	45	0.0	1.3	19.8	120	0	0	78.9				
		28/10/2021	0.1	1006	0.15	0.0	7.4	12.8	20	0.0	7.4	12.8	180	1	0	79.8				No water level gauging conducted
		3/11/2021																		Access was blocked by parked vehicle, despite several attempts to monitor well
		10/11/2021																		Access was blocked by parked vehicle, despite several attempts to monitor well
		16/11/2021	0.1	1020	-0.07	0.0	9.3	9.8	35	0.0	9.3	9.8	180	0	0	80.9	-0.102	Dry	2.205	
		6/12/2021	0.3	1010	0.19	0.0	7.4	14.1	40	0.0	7.4	14.1	180	0	0	78.5		Dry	2.179	
		13/01/2022	0.0	1013	0.03	0.1	6.0	15.9	110	0.0	5.9	15.9	100	0	0	78.1				
N-LFG-05	Landfill Cell	16/02/2022	0.0	1012	-0.14	0.0	6.2	15.5	30	0.0	6.2	15.5	180	0	0	78.3	-0.105	Dry	2.178	
		28/10/2021	0.1	1003	-0.07	1.2	10.3	0.0	55	1.2	10.3	0.0	180	1	0	88.5	-0.173	Dry	2.644	
		3/11/2021	0.0	1026	0.09	0.8	10.0	0.0	55	0.8	10.0	0.0	180	1	0	89.2		2.547	2.717	
		10/11/2021	0.0	1009	0.05	1.2	10.6	0.2	30	1.2	10.6	0.1	140	0	0	88.1		2.523	2.630	
		16/11/2021	0.1	1022	-0.09	1.1	10.2	0.0	60	1.1	10.2	0.0	180	1	0	88.6		2.482	2.640	
		6/12/2021	0.0	1009	-0.09	1.0	11.2	0.1	60	1.0	11.2	0.1	180	3	1	87.8		Dry	2.620	
		13/01/2022	0.0	1014	0.02	1.3	13.0	1.1	120	1.3	13.0	1.1	140	1	0	84.7				
N-LFG-06	Off Site (~20m from waste)	16/02/2022	0.1	1013	0.12	2.7	14.5	0.0	35	2.7	14.5	0.0	180	1	1	82.8	-0.171	Dry	2.608	
		22/03/2022	0.2	1007	0.04	3.0	15.0	0.3	35	3.0	15.0	0.3	160	0	0	81.8		Dry	2.521	
		13/04/2022	0.0	1022	0.05	2.9	13.2	0.5	20	2.9	13.2	0.5	65	0	0	83.4		Dry	2.614	
		28/10/2021	0.0	1003	0.05	0.0	5.5	12.0	35	0.0	5.5	12.0	180	0	0	82.4	-0.15	Dry	2.580	
		3/11/2021	0.1	1027	-0.02	0.0	5.4	13.0	35	0.0	5.4	13.0	180	0	0	81.6		Dry	2.605	
		10/11/2021	0.0	1010	-0.10	0.3	6.0	11.0	30	0.1	5.9	10.9	140	0	0	83.0		Dry	2.577	
		16/11/2021	0.1	1021	0.12	0.0	4.7	13.9	45	0.0	4.7	13.9	180	0	0	81.4		Dry	2.608	
N-LFG-07	Off Site (~20m from waste)	6/12/2021	0.1	1009	-0.12	0.0	6.2	9.7	30	0.0	6.2	9.7	180	1	1	84.1		Dry	2.634	
		13/01/2022	0.0	1013	0.00	0.0	5.6	13.4	130	0.0	5.6	13.4	150	1	0	81.0				
		16/02/2022	0.1	1013	-0.10	0.0	6.8	10.1	30	0.0	6.8	10.1	180	1	0	83.1	-0.139	Dry	2.576	
		28/10/2021	0.2	1009	0.02	0.0	9.7	9.3	45	0.0	9.7	9.3	180	1	1	80.9	-0.14	Dry	2.800	
		3/11/2021	0.1	1027	0.22	0.0	10.2	8.4	35	0.0	10.2	8.4	180	1	0	81.4		Dry	2.780	
		10/11/2021	0.0	1010	-0.02	0.1	11.3	7.7	35	0.1	11.3	7.7	150	0	0	81.0		Dry	2.720	
		16/11/2021	0.1	1022	0.02	0.0	11.6	5.7	40	0.0	11.6	5.7	180	1	0	82.6		Dry	2.786	
N-LFG-08	Off Site (~60m from waste)	6/12/2021	0.0	1008	0.02	0.0	12.4	9.7	40	0.0	7.4	14.1	180	1	0	77.9		Dry	2.782	
		13/01/2022	-1.0	1013	0.03	0.0	7.0	14.4	100	0.0	7.0	14.4	130	0	0	78.6				
		16/02/2022	0.1	1014	-0.17	0.0	9.9	11.4	30	0.0	9.9	11.4	180	0	0	78.6	-0.129	Dry	2.778	
		28/10/2021	0.2	1009	0.07	0.0	3.0	18.4	25	0.0	3.0	18.4	180	1	1	78.6	-0.17	1.355	2.620	
		3/11/2021	19.6	1028	-3.38	0.0	3.5	16.5	40	0.0	3.4	16.5	180	1	0	80.1		1.32	2.626	
		10/11/2021	0.0	1010	0.03	0.1	4.4	14.2	30	0.1	4.4	14.2	150	0	0	81.3		1.281	2.612	
		16/11/2021	-14.3	1022	-0.48	0.0	5.4	11.2	45	0.0	5.3	11.2	180	0	0	83.5		1.227	2.632	
N-LFG-09	Off Site (~20m from waste)	6/12/2021	0.1	1009	0.03	0.0	8.6	3.4	45	0.0	8.6	3.4	180	2	0	88.0		1.39	2.728	
		13/01/2022	-1.0	1014	0.14	0.0	5.7	15.9	50	0.0	5.7	15.8	130	0	1	78.3				
		16/02/2022	0.1	1013	0.00	0.0	9.7	12.0	30	0.0	9.7	12.0	180	1	0	78.2	-0.146	1.652	2.725	
		28/10/2021	0.0	1006	0.00	0.0	5.8	0.2	35	0.0	5.4	0.8	180	2	0	93.8	-0.112	Dry	2.200	
		3/11/2021	0.0	1028	0.12	0.0	6.2	0.2	40	0.0	6.2	0.2	180	3	0	93.6		Dry	2.707	
		10/11/2021	0.0	1011	0.15	0.1	7.1	0.1	30	0.1	7.1	0.1	160	1	0	92.7		2.718	2.768	
		16/11/2021	0.2	1021	0.10	0.0	7.8	0.1	50	0.0	7.8	0.1	180	1	0	92.1		Dry	2.709	
N-LFG-09	Off Site (~20m from waste)	6/12/2021	0.0	1007	0.10	0.0	9.3	0.3	50	0.0	9.3	0.3	180	3	0	90.4		Dry	2.702	
		13/01/2022	-	1013	-0.16	0.0	4.9	16.3	80	0.0	4.8	16.4	140	0	1	78.8				unable to read Flow rate from notes
		16/02/2022	0.0	1012	0.07	0.0	8.1	12.9	25	0.0	8.1	12.9	180	0	0	79.1	-0.09	Dry	2.697	

Gas Bore ID	Location	Date	Flow Rate (L/h)	Atmospheric Pressure (mbar)	Bore Pressure (mbar)	Peak Reading (%)			Pump Time (s)	Steady State Reading (%)			Pump Time (s)	CO (ppm)	H2S (ppm)	Balance (%)	Water Level Gauging		Depth of Well (mbtoc)	Comments	
						CH4	CO2	O2		CH4	CO2	O2					Top of Casing (m)	Water Level (mbtoc)			
R-LFG-01	Perimeter	29/10/2021	0.0	1006	-0.09	0.0	4.6	11.4	25	0.0	4.6	11.4	180	0	0	84.0	-0.18	Dry	2.465		
		3/11/2021	0.8	1014	0.02	0.0	4.9	11.5	40	0.0	4.9	11.5	180	0	0	83.6		Dry	2.557		
		10/11/2021	0.0	1010	0.14	0.1	5.5	11.8	30	0.1	5.5	11.8	120	0	0	82.6		Dry	2.447		
		16/11/2021	0.1	1018	0.21	0.0	5.4	10.2	35	0.0	5.4	10.2	180	0	0	84.5		Dry	2.560		
		6/12/2021	1.0	1005	0.07	0.0	5.7	13.9	45	0.0	5.7	13.9	180	1	0	80.4		Dry	2.458		
		13/01/2022	0.1	1012	0.02	0.0	3.4	17.7	80	0.0	3.4	17.7	120	0	5	78.8					
		16/02/2022	0.1	1001	0.10	0.0	4.5	15.3	30	0.0	4.5	15.3	180	0	0	80.2	-0.166	Dry	2.557		
R-LFG-02	Perimeter	29/10/2021	0.0	1007	-0.12	0.0	8.4	6.6	45	0.0	8.4	6.6	180	1	0	85.0	-0.151	Dry	1.810		
		3/11/2021	0.0	1013	-0.05	0.0	6.1	9.9	30	0.0	6.1	9.9	180	0	0	83.9		Dry	1.910		
		10/11/2021	0.0	1009	0.07	0.1	7.5	10.0	50	0.1	7.5	10.0	140	0	0	82.3		Dry	1.788		
		16/11/2021	0.2	1018	-0.15	0.0	7.4	8.2	35	0.0	7.4	8.2	180	0	0	84.4		Dry	1.811		
		6/12/2021	0.1	1005	0.02	0.1	5.5	10.9	45	0.0	5.5	10.9	180	1	0	83.7		Dry	1.810		
		13/01/2022	0.0	1011	0.03	0.0	3.3	15.5	70	0.0	3.3	15.5	140	0	6	81.2					
		16/02/2022	0.1	1010	-0.05	0.1	4.1	17.7	30	0.0	4.1	17.7	180	0	0	78.2	-0.122	Dry	1.808		
R-LFG-03	Perimeter	29/10/2021	0.0	1003	0.14	12.4	17.0	0.1	55	12.4	17.0	0.1	180	2	0	70.5	-0.146	Dry	1.892		
		3/11/2021	0.0	1014	0.07	0.0	12.9	17.3	0.0	65	12.9	17.3	0.0	180	1	0	69.8		Dry	1.889	
		10/11/2021	0.0	1009	0.00	0.0	10.2	18.4	0.1	40	10.2	18.4	0.0	180	0	0	71.4		Dry	1.697	
		16/11/2021	0.1	1018	-0.09	0.0	11.7	17.6	0.0	65	11.7	17.6	0.0	180	3	0	70.7		Dry	1.889	
		6/12/2021	0.2	1005	0.03	0.1	12.4	9.2	50	0.1	12.4	9.2	180	3	0	78.4		Dry	1.987		
		13/01/2022	0.0	1011	0.03	0.0	3.6	17.6	30	0.0	3.6	17.6	130	0	6	78.8					
		16/02/2022	0.1	1009	-0.07	0.1	2.5	19.3	25	0.1	2.5	19.3	180	0	0	78.1	-0.101	Dry	1.980	SEM around bore had <2ppm methane.	
		22/03/2022	0.2	1005	0.09	0.0	2.1	20.4	110	0.0	2.1	20.4	180	0	0	77.5		Dry	1.808		
		13/04/2022	0.1	1022	0.00	0.0	3.6	1.6	19.3	45	0.0	1.6	19.3	100	0	0	79.1	-0.11	Dry	1.887	
R-LFG-04	Perimeter	29/10/2021	0.0	1003	-0.02	8.3	15.8	0.1	65	8.3	15.8	0.1	180	1	0	76.0	-0.152	Dry	1.756		
		3/11/2021	0.0	1014	0.02	9.5	16.0	0.0	55	9.5	16.0	0.0	180	3	0	74.6		Dry	2.571		
		10/11/2021	0.0	1009	-0.05	9.5	16.8	0.0	60	9.5	16.8	0.0	140	1	0	73.7		Dry	1.632		
		16/11/2021	0.1	1018	0.05	10.1	16.3	0.0	55	10.1	16.3	0.0	180	3	0	73.6		Dry	1.766		
		6/12/2021	0.0	999	0.02	0.0	12.9	3.2	55	0.0	12.9	3.2	180	4	0	83.9		Dry	1.758		
		13/01/2022	0.0	1011	0.03	0.0	3.8	16.1	80	0.0	3.8	16.1	170	0	6	80.1					
		16/02/2022	0.0	1009	0.03	0.0	2.4	18.9	25	0.0	2.3	18.9	180	0	0	78.8	-0.112	Dry	1.653		
		22/03/2021	0.2	1005	0.09	0.0	2.7	19.6	90	0.0	2.7	19.6	175	0	0	22.7		Dry	1.602	SEM around bore had <2ppm methane.	
		13/04/2022	0.0	1022	0.03	0.0	1.9	18.8	40	0.0	1.8	18.9	90	0	0	79.3	-0.11	Dry	1.657		
R-LFG-05	Perimeter	29/10/2021	0.1	1006	0.03	0.0	6.8	10.3	30	0.0	6.8	10.4	180	0	0	82.8	-0.132	Dry	1.110		
		3/11/2021	0.1	1016	0.05	0.0	7.3	11.6	35	0.0	7.3	11.6	180	0	0	81.1		Dry	1.106		
		10/11/2021	0.0	1009	0.00	0.2	8.6	9.9	30	0.1	8.6	9.9	130	0	0	81.4		Dry	0.987		
		16/11/2021	0.1	1020	-0.02	0.0	8.4	5.3	30	0.0	8.4	5.3	180	1	0	86.3		Dry	1.010		
		6/12/2021	0.2	1006	0.00	0.0	5.8	17.0	40	0.0	5.8	17.0	180	0	0	77.2		Dry	1.110		
		13/01/2022	0.0	1011	0.05	0.0	2.0	18.6	30	0.0	2.0	18.7	120	0	5	79.3					
		16/02/2022	0.0	1012	-0.07	0.0	2.5	18.9	25	0.0	2.5	18.9	180	0	0	78.6	-0.113	Dry	1.004		
R-LFG-06	Perimeter	29/10/2021	0.1	1007	0.03	0.0	3.2	14.8	35	0.0	3.2	14.9	180	0	0	81.8	-0.147	Dry	2.654		
		3/11/2021	0.0	1016	0.02	0.0	3.4	12.8	55	0.0	3.4	12.8	180	0	0	83.7		Dry	2.646		
		10/11/2021	0.0	1010	0.09	0.1	3.7	11.1	45	0.1	3.7	11.1	120	0	0	85.1		Dry	2.628		
		16/11/2021	0.0	1020	-0.21	0.0	3.8	9.9	40	0.0	3.8	9.9	180	1	0	86.3		Dry	2.650		
		6/12/2021	-1.9	1006	0.09	0.0	3.8	8.8	40	0.0	3.8	8.8	180	1	0	87.4		Dry	2.648		
		13/01/2022								no access- fence/ construction											
		16/02/2022	0.0	1010	0.05	0.0	5.3	15.0	30	0.0	5.3	15.0	180	0	0	79.7	-0.128	2.518	2.640		
R-LFG-07	Landfill Cell	29/10/2021	0.1	1007	-0.21	0.0	4.3	14.1	35	0.0	4.3	14.1	180	0	0	81.6	-0.16	Dry	2.240		
		3/11/2021	0.0	1014	-0.02	0.0	4.7	13.5	40	0.0	4.7	13.5	180	0	0	81.7		Dry	2.370		
		10/11/2021	0.0	1011	0.00	0.1	5.3	13.5	6	0.1	5.3	13.5	120	0	0	81.1		Dry	2.265		
		16/11/2021	0.0	1018	-0.02	0.0	5.7	9.8	40	0.0	5.7	9.8	180	1	0	84.5		Dry	2.290		
		6/12/2021	0.1	1005	0.12	0.0	4.9	17.2	40	0.0	4.9	17.2	180	0	0	77.9		Dry	2.284		
		13/01/2022	0.0	1013	-0.03	0.0	2.1	18.8	60	0.0	2.0	18.8	130	0	5	79.0					
		16/02/2022	0.1	1009	0.03	0.1	2.7	19.0	35	0.1	2.7	19.0	180	0	0	78.3	-0.153	Dry	2.282		
R-LFG-08	Perimeter	29/10/2021	0.0	1007	-0.05	0.0	1.7	18.2	30	0.0	1.7	18.2	180	0	0	80.0	-0.165	Dry	1.877		
		3/11/2021	0.2	1015	0.00	0.0	1.8	18.6	45	0.0	1.8	18.6	180	0	0	79.6		Dry	1.871		
		10/11/2021	0.1	1010	0.00	0.1	2.0	18.6	30	0.1	1.9	18.6	140	0	0	79.4		Dry	1.850		
		16/11/2021	0.1	1019	-0.03	0.0	2.1	17.4	45	0.0	2.1	17.4	180	0	0	80.5		Dry	1.873		
		6/12/2021	0.1	1006	-0.03	0.0	1.7	19.1	35	0.0	1.7	19.5	180	0	0	78.8		Dry	1.868		
		13/01/2022	0.0	1012	0.00	0.0	0.4	19.8	70	0.0	0.4	20.1	130	0	5	79.5					
		16/02/2022	0.0	1011	-0.12	0.0	0.8	20.0	20	0.0	0.8	20.0	180	0	0	79.2	-0.152	Dry	1.867		

Gas Bore ID	Location	Date	Flow Rate (L/h)	Atmospheric Pressure (mbar)	Bore Pressure (mbar)	Peak Reading (%)			Pump Time (s)	Steady State Reading (%)			Pump Time (s)	CO (ppm)	H2S (ppm)	Balance (%)	Water Level Gauging		Depths of Well (mbtoc)						
						CH4	CO2	O2		CH4	CO2	O2					Top of Casing (m)	Water Level (mbtoc)							
W-LFG-01										Bore not installed - shallow competent rock encountered.															Comments
W-LFG-02	Landfill Cell	29/10/2021	0.0	1008	0.02	0.0	0.1	20.7	25	0.0	0.1	21.0	180	0	0	78.9	-0.069	Dry	2.825		Broken gattic and cap				
		3/11/2021	0.1	1024	-0.07	0.0	7.3	10.4	45	0.0	7.3	10.4	180	0	0	82.3		Dry	2.600						
		10/11/2021	0.0	1009	0.55	0.2	9.2	8.9	32	0.1	9.2	8.9	150	0	0	81.8		Dry	2.565						
		16/11/2021	0.2	1016	-0.07	0.0	9.2	8.8	30	0.0	9.2	8.8	180	1	0	81.9		Dry	2.576						
		6/12/2021	0.1	1004	-0.09	0.0	9.0	12.1	45	0.0	9.0	12.1	180	1	0	78.9		Dry	2.568						
		13/01/2022	0.0	1014	0.03	0.0	6.4	16.1	40	0.0	6.4	16.1	170	0	4	78.6									
		16/02/2022	0.0	1010	0.05	0.0	6.5	16.0	30	0.0	6.5	16.0	180	0	0	77.5	-0.113	Dry	2.570						
W-LFG-03	Perimeter	29/10/2021	0.1	1008	0.07	0.0	3.9	16.2	25	0.0	3.9	16.2	180	0	0	79.9	-0.136	Dry	2.332		Swapped well cap to W-LFG-02				
		3/11/2021	0.0	1013	0.19	0.0	4.0	15.8	35	0.0	4.0	15.8	180	0	0	80.2		Dry	2.328						
		10/11/2021	0.0	1008	-0.03	0.1	3.6	16.7	25	0.1	3.4	16.7	140	0	0	79.7		Dry	2.310		New cap installed				
		16/11/2021	0.0	1018	-0.02	0.0	4.2	15.7	35	0.0	4.2	15.7	180	0	0	80.0		Dry	2.325						
		6/12/2021	0.1	1003	-0.02	0.0	4.2	16.0	35	0.0	4.2	16.0	180	0	0	79.8		Dry	2.33						
		13/01/2022	0.0	1011	0.00	0.0	3.1	16.9	50	0.0	3.1	16.9	120	0	3	80.0									
		16/02/2022	0.0	1008	0.14	0.0	3.6	16.8	25	0.0	3.5	16.8	180	0	2	79.7	-0.127	Dry	2.322						

Gas Bore ID	Location	Date	Flow Rate (L/h)	Atmospheric Pressure (mbar)	Bore Pressure (mbar)	Peak Reading (%)			Pump Time (s)	Steady State Reading (%)			Pump Time (s)	CO (ppm)	H2S (ppm)	Balance (%)	Water Level Gauging		Depths of Well (mbtoc)	Comments
						CH4	CO2	O2		CH4	CO2	O2					Top of Casing (m)	Water Level (mbtoc)		
L-LFG-01	Perimeter	29/10/2021	0.0	1013	-0.10	0.0	11.2	9.0	40	0.0	11.2	9.0	180	0	0	79.8	-0.147	Dry	2.852	
		3/11/2021	0.1	1025	0.09	0.0	10.8	8.6	35	0.0	10.8	8.6	180	0	0	80.6		Dry	2.940	
		10/11/2021	0.0	1008	-0.05	0.1	12.4	7.5	40	0.1	12.4	7.5	150	0	0	80.0		Dry	2.828	
		16/11/2021	0.1	1019	0.00	0.0	12.5	6.1	30	0.0	12.5	6.1	180	1	0	81.4		2.845	2.850	
		6/12/2021	0.1	1006	-0.09	0.0	14.8	6.9	50	0.0	14.8	6.9	180	1	0	78.3		Dry	2.935	
		13/01/2022	0.0	1015	0.03	0.0	12.0	10.3	30	0.0	11.9	10.3	140	0	3	77.8				
		16/02/2022	0.0	1010	-0.14	0.0	13.4	9.8	30	0.0	13.4	9.8	180	0	0	76.8	-0.145	Dry	2.846	
L-LFG-02	Perimeter	29/10/2021	0.0	1014	-0.07	0.0	1.6	17.5	30	0.0	1.4	18.3	180	0	0	80.3	-0.12	Dry	2.752	
		3/11/2021	0.1	1026	0.02	0.0	1.6	18.7	35	0.0	1.3	19.6	180	0	0	79.1		Dry	2.753	
		10/11/2021	0.0	1009	0.02	0.2	2.2	18.3	20	0.1	1.7	19.4	140	0	0	79.0		Dry	2.798	
		16/11/2021	0.0	1021	0.10	0.0	1.9	17.4	35	0.0	1.8	17.6	180	0	0	80.7		Dry	2.753	
		6/12/2021	0.1	1007	0.54	0.0	2.1	18.2	45	0.0	1.4	19.7	180	0	0	78.8		Dry	2.753	
		13/01/2022	0.1	1015	0.03	0.0	0.4	20.0	70	0.0	0.4	20.4	130	0	3	79.2				
		16/02/2022	0.1	1011	0.19	0.0	1.0	19.1	30	0.0	1.0	19.1	180	0	0	80.0	-0.097	Dry	2.751	
L-LFG-03	Landfill Cell	29/10/2021	0.1	1014	0.03	0.0	10.8	9.1	45	0.0	10.8	9.2	180	0	0	80.1	-0.097	Dry	2.742	Loose gatic
		3/11/2021	0.0	1027	-0.07	0.1	9.7	9.5	40	0.1	9.7	9.5	180	0	0	80.7		Dry	2.735	Loose gatic
		10/11/2021	0.0	1011	0.00	0.1	11.9	7.5	30	0.1	11.9	7.5	150	0	0	80.6		Dry	2.787	
		16/11/2021	0.1	1020	0.05	0.0	9.5	11.7	35	0.0	9.5	11.7	180	1	0	78.8		Dry	2.735	
		6/12/2021	0.0	1007	-0.07	0.0	10.7	9.8	45	0.0	10.7	9.8	180	1	0	79.6		Dry	2.736	
		13/01/2022	0.0	1013	0.03	0.0	8.5	11.9	40	0.0	8.3	12.2	140	0	3	79.6				
		16/02/2022	0.0	1011	0.00	0.0	8.5	11.4	25	0.0	8.5	11.4	180	0	0	80.0	-0.086	Dry	2.730	
L-LFG-04	Perimeter	29/10/2021	0.2	1012	-0.03	0.0	3.7	17.8	30	0.0	3.7	17.8	180	0	0	78.4	-0.149	Dry	2.688	
		3/11/2021	0.1	1027	-0.14	0.2	3.4	17.8	45	0.0	3.4	17.8	180	0	0	78.7		Dry	2.687	
		10/11/2021	0.0	1011	0.02	0.1	4.1	17.2	40	0.1	4.1	17.2	140	0	0	78.6		Dry	2.755	
		16/11/2021	0.1	1020	0.07	0.0	3.9	16.8	30	0.0	3.9	16.8	180	0	0	79.3		Dry	2.685	
		6/12/2021	0.0	1009	-0.03	0.0	4.0	17.1	35	0.0	4.0	17.1	180	0	0	78.9		Dry	2.681	
		13/01/2022	0.1	1015	0.02	0.0	3.7	17.9	60	0.0	3.7	17.9	140	0	4	78.4				
		16/02/2022	0.0	1012	0.00	0.0	3.7	17.5	30	0.0	3.7	17.6	180	0	0	78.7	-0.136	Dry	2.678	
L-LFG-05	Perimeter	29/10/2021	0.1	1010	-0.05	0.0	6.4	13.7	30	0.0	6.3	13.7	180	0	0	80.0	-0.115	Dry	2.834	
		3/11/2021	0.1	1028	-0.07	0.0	6.8	12.2	35	0.0	6.8	12.2	180	0	0	81.1		Dry	2.745	
		10/11/2021	0.0	1010	0.00	0.0	8.2	11.5	30	0.0	8.2	11.5	120	0	0	80.3		Dry	2.716	
		16/11/2021	0.2	1022	-0.09	0.0	7.6	12.2	40	0.0	7.6	12.2	180	1	0	80.2		Dry	2.835	
		6/12/2021	0.0	1008	0.30	0.0	7.6	13.9	50	0.0	7.5	13.9	180	0	0	78.6		2.66	2.737	
		13/01/2022	0.0	1013	0.02	0.0	7.4	14.9	70	0.0	7.2	15.1	160	0	3	77.7				
		16/02/2022	0.1	1013	0.03	0.0	9.2	13.0	30	0.0	9.2	13.0	180	0	0	77.8	-0.104	2.032	2.828	

Appendix D Service pit monitoring results

Table D1: Marnockvale service pits, April 2022 results

Monitoring point reference	Methane (ppm)		Service Pit Type	Monitoring point reference	Methane (ppm) NOTE 1		Service Pit Type
	Peak	Steady			Peak	Steady NOTE 2	
1	1.5	1.4	Stormwater (SW)	22	1.4	1.3	E
2	1.3	1.2	SW	23	1.3	1.2	SW
3	0.8	0.2	SW	24	1.4	1.3	SW
4	1.3	1.3	Communications (C)	25	1.5	1.4	E
5	1.4	1.3	SW	26	1.5	1.4	Water (W)
6	1.4	1.3	C	27	2.6	1.5	SW
7	1.3	1.4	SW	28	1.6	1.3	Sewer (S)
8	1.2	1.2	C	29	1.4	1.4	S
9	1.2	1.2	SW	30	1.5	1.4	C
10	1.3	1.3	SW	31	1.4	1.4	SW
11	1.2	1.1	Electrical (E)	32	1.4	1.4	E
12	1.1	1.0	Electrical (E)	33	1.9	1.7	E
13	0.8	0.7	Monitoring Well (MW)	34	1.7	1.6	C
14	0.9	0.7	E	35	1.7	1.7	C
15	0.8	0.7	E	36	1.7	1.6	SW
16	1.2	1.2	SW	37	1.5	1.5	C
17	1.2	1.2	E	38	1.6	1.6	W
18	1.1	1.1	E	39	1.6	1.6	SW
19	1.2	1.2	E	40	1.6	1.5	SW
20	1.3	1.2	E	41	1.5	1.4	C
21	1.4	1.3	E				

Table D2: Marnockvale service pits, October 2021 results

Monitoring point reference	Methane (ppm)		Service Pit Type	Monitoring point reference	Methane (ppm) NOTE 1		Service Pit Type
	Peak	Steady			Peak	Steady NOTE 2	
1	1.3	1.3	Stormwater (SW)	22	1.0	1.0	E
2	1.4	1.4	SW	23	1.1	1.0	SW
3	1.4	1.4	SW	24	1.6	1.6	SW
4	1.4	1.4	Communications (C)	25	1.7	1.6	E
5	1.4	1.4	SW	26	1.4	1.4	Water (W)
6	1.4	1.4	C	27	1.5	1.4	SW
7	1.5	1.5	SW	28	1.2	1.2	Sewer (S)
8	1.6	1.5	C	29	1.3	1.2	S
9	1.7	1.7	SW	30	1.4	1.4	C
10	1.5	1.5	SW	31	1.4	1.4	SW
11	1.7	1.7	Electrical (E)	32	1.4	1.4	E
12	1.5	1.5	Electrical (E)	33	1.3	1.3	E
13	1.3	1.3	Monitoring Well (MW)	34	1.6	1.3	C
14	1.1	1.1	E	35	1.2	1.2	C
15	1.1	1.1	E	36	1.3	1.3	SW
16	1.0	0.9	SW	37	1.2	1.1	C
17	0.9	0.9	E	38	1.2	1.2	W
18	1.0	0.9	E	39	1.2	1.1	SW
19	1.0	1.0	E	40	1.1	1.0	SW
20	1.1	1.0	E	41	0.9	0.9	C
21	1.1	1.0	E				

Table D3: Newtown service pits, April 2022 results

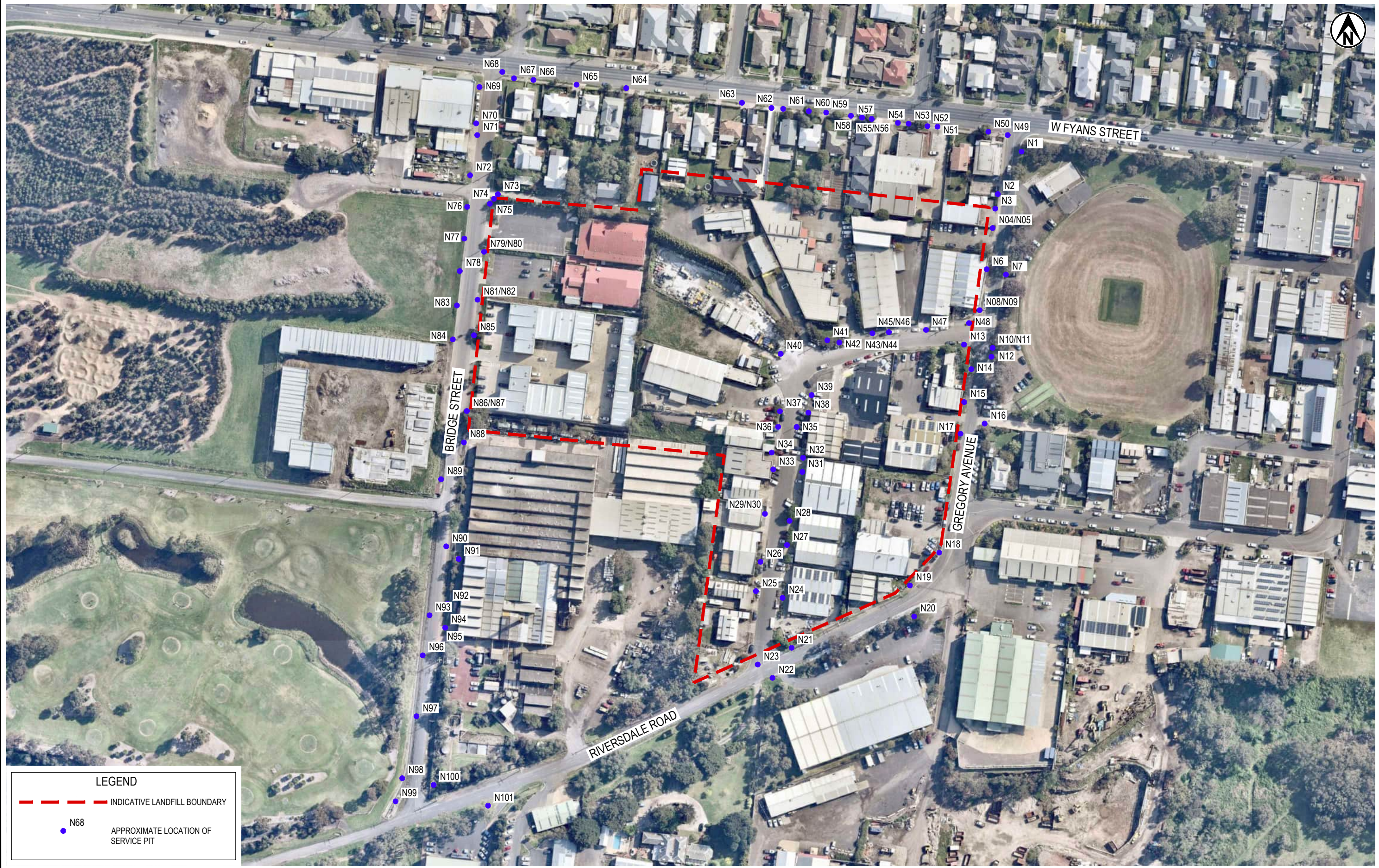
Monitoring point reference	Methane (ppm)		Comment	Monitoring point reference	Methane (ppm)		Comment
	Peak	Steady			Peak	Steady	
1	1.1	1.0	Stormwater (SW)	52	1.8	1.7	C
2	1.0	1.0	Communications (C)	53	1.7	1.7	SW
3	1.0	1.0	Unknown (Unk)	54	1.9	1.7	C
4	1.0	0.9	SW	55	1.8	1.8	C
5	1.0	0.9	SW	56	1.7	1.7	E
6	1.0	0.9	SW	57	1.7	1.7	C
7	1.0	0.9	SW	58	1.2	1.2	SW
8	1.0	1.0	SW	59	1.7	1.7	C
9	1.0	1.0	C	60	1.7	1.6	C
10	0.7	0.6	SW	61	1.6	1.6	E
11	0.7	0.8	Hydrant (H)	62	1.7	1.7	C
12	0.6	0.5	SW	63	1.7	1.7	C
13	0.7	0.6	C	64	1.5	1.1	C
14	0.8	0.8	SW	65	1.3	1.1	C
15	0.8	0.8	SW	66	1.4	1.3	C
16	1.0	1.0	SW	67	8.0	5.7	C
17	1.1	1.0	C	68	1.2	1.1	W
18	1.4	1.4	Water (W)	69	1.2	1.1	SW
19	1.4	1.3	C	70	1.2	1.2	S
20	1.3	1.3	Sewer (S) (Valve)	71	1.2	1.1	SW
21	1.6	1.5	SW	72	1.0	1.0	C
22	1.4	1.4	SW (Culvert)	73	0.9	0.8	SW
23	2.5	2.5	SW	74	1.0	1.0	W
24	1.5	1.5	SW	75	1.0	1.0	SW
25	1.5	1.5	SW	76	0.9	0.9	SW
26	1.5	1.5	SW	77	1.0	0.9	SW
27	1.5	1.5	W	78	0.9	0.9	SW
28	1.5	1.5	W	79	1.0	1.0	E
29	1.5	1.5	W	80	0.9	0.9	C
30	1.5	1.4	SW	81	0.9	0.9	SW
31	8.0	7.6	W	82	0.9	0.7	C
32	0.0	0.0	W	83	0.9	0.9	SW
33	0.0	0.0	W	84	0.9	0.9	SW
34	1.4	1.4	W	85	1.0	1.0	SW
35	1.5	1.5	SW	86	1.1	1.0	S
36	1.4	1.4	SW	87	1.2	1.1	SW
37	1.5	1.4	SW	88	1.2	1.1	SW
38	1.3	1.3	SW	89	1.2	1.1	SW (Culvert)
39	1.4	1.3	Unk	90	1.2	1.1	W
40	1.8	1.5	SW	91	2	1.9	SW
41	1.4	1.3	C	92	1.3	1.2	SW
42	1.4	1.4	C	93	1	0.9	W

Monitoring point reference	Methane (ppm)		Comment	Monitoring point reference	Methane (ppm)		Comment
	Peak	Steady			Peak	Steady	
43	1.4	1.4	SW	94	1	1	SW (Culvert)
44	1.5	1.5	SW	95	1	1	W
45	1.5	1.5	C	96	1	0.9	S
46	1.4	1.4	H	97	1	0.9	S
47	1.4	1.3	SW	98	3	2.2	S
48	1.7	1.7	SW	99	1.5	1.4	SW
49	1.8	1.7	SW	100	1.4	1.4	SW
50	1.8	1.7	C	101	1.4	1.3	SW (Culvert)
51	1.7	1.6	W				

Table D4: Newtown service pits, October 2021 results

Monitoring point reference	Methane (ppm)		Comment	Monitoring point reference	Methane (ppm)		Comment
	Peak	Steady			Peak	Steady	
1	1.5	1.5	Stormwater (SW)	52	1.1	1.1	C
2	1.7	1.6	Communications (C)	53	1.2	1.2	SW
3	2.1	2.0	Unknown (Unk)	54	1.1	1.0	C
4	1.8	1.8	SW	55	1.1	1.1	C
5	1.8	1.8	SW	56	1.3	1.2	E
6	1.6	1.6	SW	57	1.5	1.3	C
7	1.6	1.6	SW	58	1.3	1.3	SW
8	1.8	1.7	SW	59	1.5	1.5	C
9	1.7	1.7	C	60	1.5	1.5	C
10	1.4	1.4	SW	61	1.8	1.7	E
11	1.7	1.6	Hydrant (H)	62	1.8	1.7	C
12	1.4	1.4	SW	63	1.4	1.8	C
13	1.4	1.4	C	64	1.7	1.6	C
14	1.4	1.4	SW	65	1.8	1.7	C
15	1.4	1.3	SW	66	1.9	1.7	C
16	1.3	1.3	SW	67	1.6	1.5	C
17	1.3	1.3	C	68	1.4	1.4	W
18	1.3	1.3	Water (W)	69	1.4	1.4	SW
19	1.5	1.5	C	70	1.2	1.1	S
20	1.9	1.7	Sewer (S) (Valve)	71	1.1	1.1	SW
21	1.6	1.5	SW	72	1.0	1.0	C

Monitoring point reference	Methane (ppm)		Comment	Monitoring point reference	Methane (ppm)		Comment
	Peak	Steady			Peak	Steady	
22	1.6	1.6	SW (Culvert)	73	1.0	0.9	SW
23	1.6	1.6	SW	74	1.0	0.9	W
24	1.8	1.8	SW	75	1.0	1.0	SW
25	1.6	1.6	SW	76	0.9	0.8	SW
26	1.6	1.6	SW	77	1.1	1.1	SW
27	1.5	1.5	W	78	1.4	1.3	SW
28	1.5	1.4	W	79	1.1	1.1	E
29	1.3	1.3	W	80	3.9	2.6	C
30	1.3	1.3	SW	81	1.5	1.4	SW
31	1.2	1.1	W	82	1.4	1.3	C
32	1.1	1.1	W	83	1.4	1.4	SW
33	1.2	1.1	W	84	1.5	1.4	SW
34	1.2	1.2	W	85	1.4	1.4	SW
35	1.1	1.0	SW	86	1.2	1.2	S
36	1.1	1.0	SW	87	1.3	1.3	SW
37	1.1	1.1	SW	88	1.3	1.3	SW
38	1.3	1.2	SW	89	1.2	1.1	SW (Culvert)
39	1.5	1.5	Unk	90	1.1	1.1	W
40	1.6	1.5	SW	91	1.1	1.1	SW
41	1.6	1.6	C	92	1.2	1.2	SW
42	1.6	1.6	C	93	1.1	1.1	W
43	1.7	1.6	SW	94	1	1	SW (Culvert)
44	1.6	1.6	SW	95	1.2	1.1	W
45	1.6	1.6	C	96	1.1	1.1	S
46	1.8	1.7	H	97	1.1	1.1	S
47	1.8	1.7	SW	98	1	1	S
48	1.7	1.7	SW	99	1.1	1	SW
49	1.4	1.3	SW	100	1.1	1	SW
50	1.3	1.2	C	101	1	1	SW (Culvert)
51	1.0	0.9	W				



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NOTES:

1. AERIAL IMAGE SOURCED FROM NEARMAP. COPYRIGHT NEARMAP PTY LTD. IMAGERY DATE: 06/10/2021.

A3 SCALE 1:2000

0

20

40

60

80

100 (m)

PROJECT No.

1002534.2000

DESIGNED

BMH

Nov.21

DRAWN

KMJA

Nov.21

CHECKED

APPROVED

DATE

CLIENT

CITY OF GREATER GEELONG

PROJECT

NEWTOWN CLOSED LANDFILLS FURTHER WORKS

TITLE

SERVICE PIT MONITORING LOCATIONS - OCTOBER 2021
NEWTOWN CLOSED LANDFILL

SCALE (A3)

1:2000

FIG No.

FIGURE 03

REV

1



Appendix E Surface emissions monitoring results









Appendix F Atmospheric pressure analysis

Newtown Closed Landfills - Landfill gas bore monitoring

	Atmospheric Pressure (mbar)															
Hour	28/10/2021	Difference	3/11/2021	Difference	10/11/2021	Difference	16/11/2021	Difference	6/12/2021	Difference	13/01/2022	Difference	16/02/2022	Difference	13/04/2022	Difference
Hr 0	1025.4		1015.6		1011.4		1015.7		1016.9		1017.7		1019.3		1023.6	
Hr 3	1024.3	-1.1	1013.6	-2	1010.3	-1.1	1015.5	-0.2	1014.5	-2.4	1016.4	-1.3	1016.6	-2.7	1022.6	-1
Hr 6	1024.2	-0.1	1013.5	-0.1	1010.7	0.4	1017.1	1.6	1013.9	-0.6	1016.1	-0.3	1015.1	-1.5	1023.1	0.5
Hr 9	1024.8	0.6	1014.7	1.2	1011.9	1.2	1019.4	2.3	1014	0.1	1016.1	0	1015.1	0	1024.6	1.5
Hr 12	1023.1	-1.7	1016.4	1.7	1011.3	-0.6	1020.6	1.2	1011.5	-2.5	1014.1	-2	1013.3	-1.8	1023.7	-0.9
Hr 15	1021.6	-1.5	1016.9	0.5	1009.8	-1.5	1021	0.4	1009.2	-2.3	1010	-4.1	1010.9	-2.4	1022.4	-1.3
Hr 18	1021.2	-0.4	1016.5	-0.4	1009.1	-0.7	1021.6	0.6	1007.1	-2.1	1007.7	-2.3	1009.3	-1.6	1022.2	-0.2
Hr 21	1022.2	1	1020.3	3.8	1010.6	1.5	1022.9	1.3	1009.4	2.3	1009.1	1.4	1009.8	0.5	1022.5	0.3

