Appendix G

Seaford Heights Renewable Energy Facility Desktop Landfill Gas Risk Assessment

Seaford Heights Renewable Energy Facility

Desktop Landfill Gas Risk Assessment

LMS Energy

October 18

Ref No. 20181106R001A

Tonkin CONSULTING

Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
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Contents

Tables

Figures

Appendices

1 Introduction

LMS is proposing to construct and operate a renewable energy facility at the SRWRA landfill. The SRWRA landfill operation is located at 112 Bakewell Drive, Seaford Heights, South Australia, and defined by Certificates of Title (CT) 5299/719, 5299/720, 5479/871, 5696/771, 5822/965, 5822/966 and 5822/967. The site is operated by Southern Region Waste Resource Authority (SRWRA) and currently receives predominately municipal waste from numerous council regions in the south of the Adelaide metropolitan area. The location of the site is shown on Figure 1.1.

The new facility is intended to capture landfill gas from the SRWRA landfill facility and generate energy for transfer to the power grid. The development of the new facility includes the construction of buildings, services trenches and other enclosed spaces which may be subject to landfill gas accumulation and associated risks (such as explosion, fire, asphyxiation, toxicological). The facility is intended to occupy a location on or within close proximity to previously landfilled waste in Zone A of the landfill. The proposed location presents a risk of landfill gas migration and accumulation. Long term geotechnical integrity and management of these landfill gas risks require consideration.

LMS has been requested to undertake a desktop landfill gas risk and landfill cap integrity assessment of the new Seaford Heights Renewable Energy Facility. This request was in response to Environment Protection Authority (EPA) correspondence dated 18 July 2018, based on their assessment of development application 145/V012/18 for the establishment of the facility. This report contains the details of the desktop landfill gas risk and geotechnical stability assessment.

1.1 Objectives

This risk assessment aims to assess the potential for the proposed energy generation facility to impact upon the behaviour of landfill gas generated on site, and for this landfill gas to impact upon human health. Outcomes of this assessment will inform recommendations regarding the monitoring of the landfill gas on site and any further controls that may be required to mitigate risks.

1.2 Scope

This assessment has been limited to the proposed on-site structures and associated services infrastructure which will be accessed by personnel, limited to the workshop, lunchroom and control room. Key risks considered will be asphyxiation and explosive risks (acute risk) and human health risks (WHS/long term). The scope of works undertaken for the desktop landfill gas risk assessment includes:

- Desktop review of previous gas and groundwater monitoring, including details of the gas and groundwater well borelogs.
- Modelling of landfill gas generation for waste disposed in area with proposed development.
- Preparation of a conceptual site model to allow assessment of the landfill gas risk.
- A landfill gas risk assessment for the risk of landfill gas accumulation in / migration into enclosed habitable buildings or structures, i.e. the workshop, lunchroom and control room, within the proposed development footprint.
- Preparation of a landfill gas monitoring program to assess the LFG conditions in enclosed buildings or structures and verify the performance of the implemented landfill gas control measures within the proposed development footprint.

- Preparation of a report describing the desktop studies, including provision of generic recommendations on potential risk treatment and control measures if risks are deemed to be unacceptable.

The scope of works undertaken for the desktop landfill cap integrity assessment includes:

- Desktop review of borehole information (including geotechnical, groundwater and landfill gas) at the site to develop an understanding of the sub-surface profile and thickness of existing cap surface.
- Consider preferential pathways and mitigation measures for landfill gas mitigation through the cap surface given the construction methodology by LMS.

It is assumed that the septic tank and associated services will be constructed in line with current Australian standards and best practices. Consideration of the services entering the building has been made but the design, construction and operation of the tank including the pump system is outside the scope of this investigation.

Hazardous Area Classification and Hazardous Area Design for the gas treatment and utilisation plant and equipment, associated infrastructure and any on-site electrical equipment are not part of this scope of work and remains the responsibility of LMS.

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Data Acknowledgement:
Aerial Image from Google, 2018

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LMS ENERGY

SEAFORD HEIGHTS RENEWABLE ENERGY FACILITY
SITE LOCALITY

Figure 1.1

2 Background Review

2.1 Available documentation and information

The following information was considered during the desk-top review:

- Location (proximity to waste),
- Estimates of waste types and quantities over the filling years (LFG generation potential),
- Landfill cover and lining type,
- Surface water management and infiltration,
- Groundwater levels at the site,
- Subsurface conditions and potential migration pathways,
- Historic and recent LFG monitoring results, for:
  - Subsurface LFG conditions in perimeter wells and underground services onsite,
  - Onsite receptors.

Information from the following resources was used extensively to inform the development of the CSM and the risk assessment process:

- SRWRA Landfill -Landfill Environment Management Plan (LEMP)[1]
- SRWRA Landfill -Perimeter Landfill Gas Annual Monitoring Report 2016/2017[2]
- SRWRA Landfill - Landfill Gas Risk Assessment (2015)[3]
- FMG Geotechnical investigation – Pedler Creek landfill (2017)[4]
- Draft designs for proposed facility:
  - Generator slab on bored pier/timber piles concrete details – SHT 02 – drawing number 18122-40-003, Rev 0, dated 19/03/2018
  - Proposed site expansion control room foundation details - drawing number 40024-CA-008, Rev 0, dated 10/11/2016
  - Power station site layout – drawing number 50043-GA-001, Rev C, dated 10/05/2018
  - Power station site layout – drawing number 50043-GA-001, Rev C, dated 10/05/2018 (colour, no background aerial)
  - Gas Field Layout – drawing number 50043-CA-003, Rev 1, dated 15/06/2017
  - Pedler creek gas well data report, July 2018
- Email correspondence between Tonkin Consulting and LMS.

[1] Tonkin Consulting (2016), Landfill Environment Management Plan. Ref: 20155098FR4A Rev G – April 2016.
[2] Tonkin Consulting (2017), Perimeter Landfill Gas Annual Monitoring Report 2016/2017. Ref: 20155098FL9/ET/BT - October 2017.
[3] Tonkin Consulting (2015). Landfill Gas Risk Assessment SRWRA Landfill -. Ref: 20155098RB1 Rev B – October 2015
[4] FMG Engineering (2017), Geotechnical Investigation – Pedler Creek Landfill, 16 June 2017

2.2 SRWRA Landfill

The SRWRA Landfill site is bounded by agricultural and residential land uses. The City of Onkaparinga development plan indicates that the area to the west and north-west of the site is zoned as residential land use.

The area to the south, east and north-east of the site is zoned as 'Primary Production' and is predominately used for agricultural purposes. There are several low-density residences in the area that have potential to be sensitive receptors for LFG migration.

A buffer zone of approximately 50m exists between the edge of waste and the site boundary to the west of the site.

2.3 Proposed Development

The proposed location and approximate extent of the renewable energy facility is shown on Figure 2.1. The facility is to be constructed on an area which was previously landfilled waste in Zone A of the landfill.

The construction of the renewable energy facility utilising landfill gas power generation comprises:

- engines,
- conditioning skids,
- transformers,
- reactors,
- flares
- an electrical switching unit,
- a control and lunch room,
- a water tank and a sceptic tank
- a workshop,
- covered storage bund,
- bulk oil tanks,
- lighting poles with solar panels, and
- associated infrastructures/services.

The site layout plans are presented in Figure 2.1.

This risk assessment focusses on the risk which LFG poses to habitable areas which are identified as the workshop, lunch room and control room.

It is understood that a building platform layer consisting of compacted fill of 200 mm thickness will be placed across the development site after which another layer of 100mm crushed rock will be placed on top. Each structure being built on top of the platform requires its own structural design. Based on available documentation provided by LMS, it is understood that most of the structures outlined above will be placed on a slab on ground construction.

Draft design documentation shows that a single demountable building will be utilised as both a lunch room and control room and supported by concrete footing beams. The structure will have a 300 mm clear void beneath the steel beams except for the control room conduit pit. No design for the building floor is available. The control room will have a conduit pit which connects the generators with the control infrastructure. The conduit pit will be 900mm below the ground surface with approximately 4-5 electrical conduits entering the pit from the western side. The

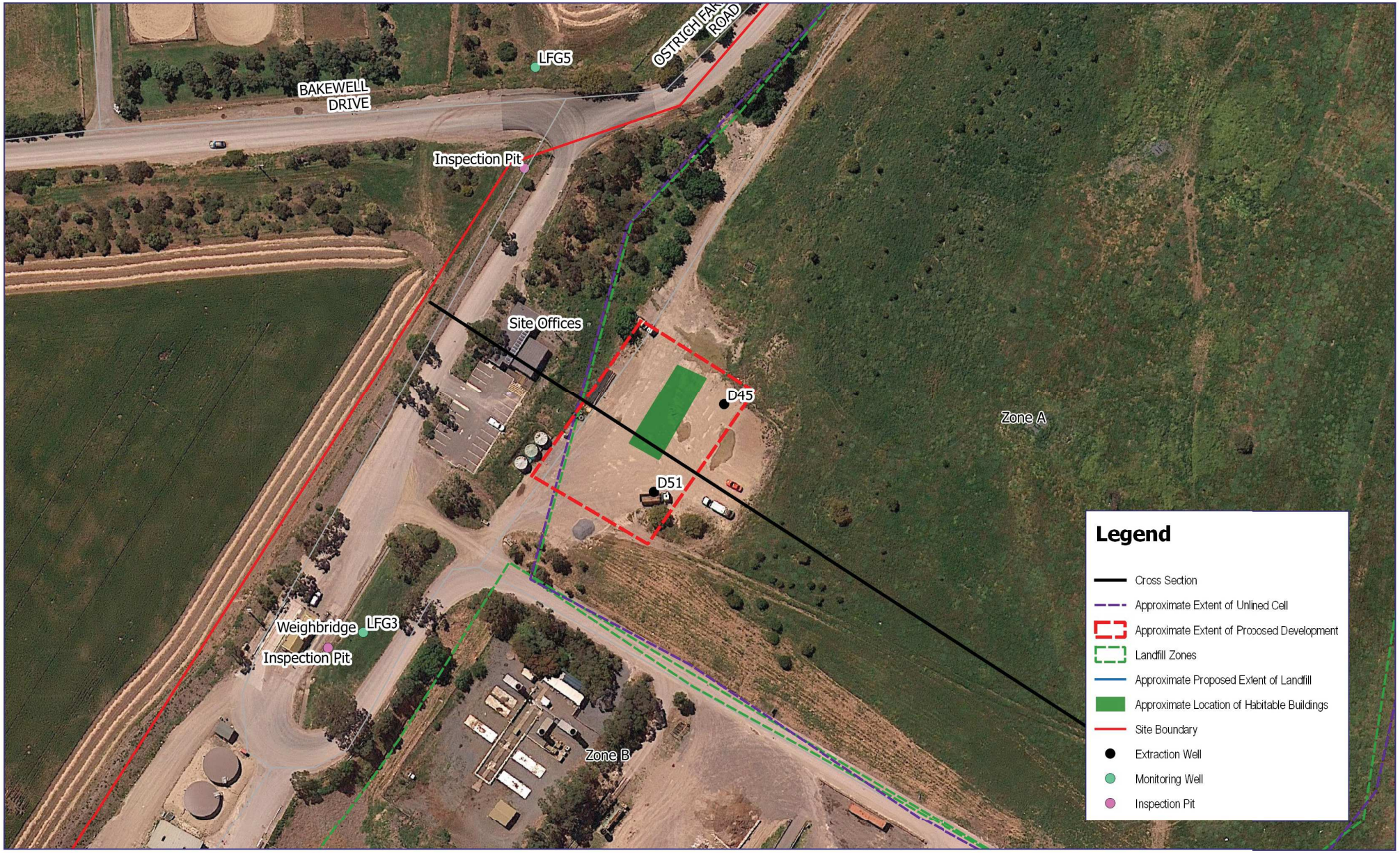
lunch room will have kitchen and toilet facilities. It is assumed the building will have electricity, communication, water and waste water services.

The workshop will be constructed on a slab on ground foundation. The shed will typically be enclosed with a roller door, shed door and a window. It is assumed the shed will have electricity and water services.

A water tank and septic tank with pump will be located in the vicinity to service the control/lunch room and workshop. The location of the services trenches and connections to the building has not been determined yet.

2.4 Operation of the Proposed Renewable Energy Facility

The proposed renewable energy facility will run 24 hours a day, 7 days a week. Operators will be at the site during standard working hours and on-call during other times. Gas extraction is expected to continue approximately 30 years, with the scale of the engines to reduce as required based on gas generation. Gas extraction will continue across all zones of the landfill during this time as per verbal communication with LMS (25/10/18). Maintenance of the facility is unlikely to significantly impact on gas extraction and flaring as there is a level of redundancy built into the system, being three flares. The facility is also serviced by two separate electricity lines. In the instance that there is maintenance or power failure it is expected that the downtime of the facility will be minimal.



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LMS ENERGY

SEAFORD HEIGHTS RENEWABLE ENERGY FACILITY
SITE PLAN

Figure 2.1

2.5 Relevant History

Landfill operations commenced at the SRWRA Landfill site in 1981 and to date the landfill site has accepted up to 250,000 tonnes of waste annually to landfill. This volume includes various types of waste including municipal waste. Based on 2012 records an expected 115,000 tonnes of waste per year will be received as projected works. The estimated remaining lifespan of lined cells in the site is approximately 22 years based on 2014 filling estimates.

It is expected that peak LFG generation has passed for the waste deposited early in the northern portion of the landfill site (Zone A) where the Renewable Energy Facility will be located and the unlined portions of the landfill to the south-west (zone B) which were closed in 1995 and 2000-01 respectively. Based on the modelling information within the LEMP[1], it is assumed that the site received on average approximately 150,000 tonnes of waste annually from 1980 to 2008.

The remaining lined portions of the landfill have been filled more recently or are currently still active. Quarterly LFG licence compliance monitoring has occurred routinely since 2008 and annual monitoring has occurred since 2016; no evidence of lateral migration of LFG has been found to date.

2.6 Landform

The landfill site property covers an area of approximately 88 hectares and consists of a valley falling from an elevation from about 80m AHD in the north east to about 20m AHD in the south west. The valley runs into Pedler Creek, which flows from east to west. The majority of the base of the valley has been used for landfilling. The site slopes from a high point along the western edge, towards the east and the flat area where the facility is to be constructed. Landfilling operations are progressively filling up a valley that was once a tributary of Pedler Creek.

The Development Site is situated on the western edge of the site. The Development Site is situated on a flattened surface, at the interface between natural ground and the filling of waste. The landform slopes to the east, towards the valley.

2.7 Climate

The Adelaide area has a Mediterranean type climate, which is characterised by cool to mid wet winters and extended hot dry summers. Climatic conditions at McLaren Vale are similar to Adelaide but temperatures are marginally lower (approximate elevation of McLaren Vale is 55 m above sea level).

Annual rainfall at McLaren Vale is approximately 505 mm per year, occurring mainly between May and September. Mean daily temperatures range from 28.7°C during summer to 14.8°C during winter. Minimum mean temperatures drop to 8.7°C during winter months. Extreme temperatures of >40°C during summer are not common, and temperatures of <0°C during winter are extremely uncommon.

2.8 Regional Geology and Hydrogeology

The site geology is dominated by Proterozoic bedrock, with minor Quaternary surficial deposits. A variety of rock types occur both as outcrops and in the sub-surface, including sandstones, siltstones, slate, dolomite and calcrete. Hard sandstone units about the north-west and south-east flanks of the site, whilst the central valley has been formed in erodible siltstones and slates. Unconsolidated alluvial deposits include sand / silt / gravel and minor clay mixtures and are located along the valley floor.

Groundwater occurs on the site in two different units:

- Fractured rock aquifer – Proterozoic sedimentary rock with fracture permeability
- Alluvial aquifer – Unconsolidated fluviatile sediments of Pedler Creek and its tributaries.

The Proterozoic units are separated by complex lithological and structural boundaries. Mapping has demonstrated a gradual stratigraphical transition from Reynella Siltstone to Seacliff Sandstone (via the Seacliff Transitional Units), and also the presence of complex structural boundaries such as faults and shear zones. These boundaries have resulted in heterogeneous and anisotropic subsurface conditions in relation to groundwater flow.

The dominant bedrock structures have formed narrow, elongated belts of rock trending NNE-SSW. These are separated by normal, sub-vertical block faults or shear zones. Some mesoscopic fold structures are also present in the less competent units, as indicated by changes of bedding dip and flexural warping. Some secondary rotation of weathered bedding layers has also been observed, apparently due to soil creep on steep slopes.

A major structural boundary is present to the south-east of the site, which has shown evidence of concertina folding plus faulting, resulting in synclinal structure with down throw indicated on the western side.

The primary porosity and permeability in the Proterozoic bedrock appears to be minimal in most rock types found, except in relatively clean sand lenses and laminae of limited extent. Groundwater appears to be present largely in mesoscopic fracture systems, defined by structural boundaries, faults, joint sets and irregular fracture networks. Fluctuations of water level are typical of fractured rock aquifer systems and have been observed at this site. Groundwater level fluctuations are believed to be a seasonal response to recharge from winter rainfall, with a time lag of a few months. Groundwater levels at the site have historically been recorded for the fractured rock aquifer with an elevation from approximately 40 mAHD at the north of the site to 20 mAHD at Pedler Creek, to the south of the site. Perched water has been noted at the site historically on the western boundary with an approximate elevation of 60 mAHD. The perched water aquifer is discontinuous and had low recharge in comparison to the fractured rock aquifer, with the well often purging dry.

2.9 Local Geology

A geotechnical investigation was undertaken at the Development Site by FMG in June 2017. As part of this investigation, 17 boreholes were drilled and the soils encountered logged. The soils generally consisted of gravelly fill overlying refuse fill. The natural geology consists of a thin layer of Clayey Sand and Gravel overlying highly weathered Siltstone/Sandstone bedrock.

In the east of the Development Site the maximum extent of the fill was not encountered in the geotechnical investigation and is to depths greater than 3.2m. The fill is anticipated to increase in thickness from west to east.

In the western portion of the Development Site the waste appears to have been placed directly onto the natural soil/rock horizon. This natural profile was encountered at depths between 0.2 to 0.8m at the very western edge of the investigation area and then dips down to the east, where it was encountered at depths between 1.4 to 2.5m below the waste. Waste was encountered in most boreholes with the exception of those along the western edge. A summary of the material encountered and depths from FMG 2017 has been replicated in Table 2.1 below.

Table 2.1 Summary of Subsurface Conditions

Material	Depth Encountered (m)							
	BH01	BH02	BH03	BH04	BH05	BH06	BH07	BH08
Fill	0 – 1.5+	0 – 1.5+	0 – 1.5+	0 – 1.4+	0 – 3.2+	0 – 0.8	0 – 1.6	0 – 1.3
Natural Soils	NE	NE	NE	NE	NE	0.8 – 2.2	NE	1.3 – 2.4
Rock	NE	NE	NE	NE	NE	2.2 – 3.0+	1.6 – 2.05+	2.4 – 4.0+
	BH09	BH10	BH11	BH12	BH13	BH14	BH15	BH16
Fill	0 – 2.4	0 – 2.5	0 – 1.0+	0 – 3.2+	0 – 1.6	0 – 4.0+	0 – 0.2	0 – 0.5
Natural Soils	NE	NE	NE	NE	NE	NE	0.2 – 1.5	0.5 – 1.0
Rock	2.4 – 4.0+	2.5 – 4.0+	NE	NE	1.6 – 2.15+	NE	1.5 – 4.0+	1.0 – 1.7+

Borehole logs and the location of the boreholes from the geotechnical investigation are presented in full FMG report presented in Appendix B.

2.10 Landfill Cap

Zone A consists of approximately 12.0 ha at the north east end of the site, in which landfilling commenced during the 1980s. This area of the site does not have a constructed liner and leachate collection system.

Landfilling in the northern 2.5 ha section of this zone, was completed prior to 1995 and the final cover layer (including a 1.0 m thick clay soil cap layer) was subsequently placed and vegetation established.

Municipal solid waste was deposited in the southern 9.8 ha section of this zone (with the Development Site) between 1995 and 2000, after which a 300 mm interim cover was placed. Subsequently, soil material has been placed over the interim cover to progress towards the final landform profile. URS Australia Pty Ltd (URS) completed an investigation to determine the extent, thickness and nature of the existing surface material in the northern area of the site in 2005 (Ref; 42656170\R002.doc, 15 November 2005). This investigation reported cover material "*thickness of between 0.8 and 2.6 m across ten test pit locations... soils were observed to typically be a clay fill with variable rock content*". The report also stated that the material had a varying degree of compaction and no record of testing and inspection during the construction phase.

The soil profile across and near the Development Site as described in the FMG report has between 0.2m to 2.2m of Sandy Gravel FILL overlying 0.3m to 0.8m of Gravelly Clay FILL. This fill is generally similar to capping material described in previous investigations and is interpreted to represent the landfill cap. The minimum thickness of cover material above the waste was found to be 0.7m at BH03, BH04 and BH11.

It is understood that the development structures will be built on top of the existing cap and additional building platform with only a few elements such as the control room conduit pit, septic tank and the services being underground as well as foundations beams and/or piers. It is also understood that it is proposed that the generators will be supported by a number of piles. These piles will penetrate the existing landfill cap and may create a pathway for landfill gas migration.

2.11 Surface Water Management

Surface water from upstream catchments of the eastern and western boundaries of the landfill site drain to the eastern and western perimeter drains, respectively. The western site perimeter drain discharges to the stormwater detention pond at the western boundary (WD1) and overflows through the cycleway embankment culvert to Pedler Creek. The eastern site perimeter drain (ED1) discharges directly through the cycleway embankment culvert to Pedler Creek.

Surface water runoff from the capped areas of Zone A (the Northern Area), which includes the Development Site, is diverted into ED1 and WD1.

Surface water run-off from Landfill Zone B (see Figure 1.1) is diverted by a swale to the leachate pond (P1).

Further information regarding surface water management on the landfill site is contained within the site's LEMP[1].

2.12 Base and Sideliner Status

Baseliners and sideliners form a barrier to lateral migration of Leachate and LFG, thus reducing the LFG risk to off-site receptors.

The older portions of the landfill, including the Development Site area, where waste filling was concluded pre 2001 were constructed with no liner system. As a result, there is potential for lateral migration of LFG wherever waste comes into contact with the geology below.

2.13 LFG Management

2.13.1 Relevant site history and Landfill Characteristics

Landfill operations commenced at the SRWRA Landfill Site in 1981 and to date the site has accepted up to 250,000 tonnes of waste per year to landfill. This volume includes various types of waste including municipal waste. The lifespan of the landfill is expected to extend to 2037 based upon 2014 filling estimates of a decreased waste volume of 115,000 tonnes/year accepted from 2014.

It is expected that peak LFG generation has passed for the waste deposited early in the northern portion of the landfill which was closed in 1995. LFG modelling has been undertaken for Zone A and Zone B as part of this LFG risk assessment and is presented below.

The remaining lined portions of the landfill have been filled more recently or are currently still active. LFG modelling undertaken by Tonkin Consulting in 2016 as part of the LEMP Update[1] estimated that the LFG generation for the full landfill site peaked in 2011. This took into account the entire site, including active and future cells.

Quarterly licence compliance LFG monitoring at the perimeter of the landfill site occurred routinely between 2008 and 2016. Annual monitoring has occurred since 2016. No evidence of lateral migration of LFG in boundary wells or site receptors has been found to date.

2.13.2 Summary of Historic Investigations

LFG investigations have been undertaken at the site since 2008, with the results from 2008 to 2017 summarised below and in Table 2.2. For further information regarding the results obtained refer to the 2016/17 Perimeter Landfill Gas Annual Reports for 2012/2013[2]. These documents contain insight to these monitoring events and the methodology used.

From 2008 to 2017 LFG monitoring occurred in accordance with the conditions in the superseded LEMP[5] and LFG MP[6]:

- Quarterly monitoring of landfill gas perimeter monitoring wells in accordance with a LFG management plan,
- Quarterly monitoring of the exterior and interior of the gatehouse and other onsite buildings (on-site receptors).

Reported methane concentrations for the perimeter wells (LFG2, LFG3 and LFG5) and onsite receptors in the west of the site (nearest the facility) were low. Reported carbon dioxide concentrations for the perimeter wells were elevated, while onsite receptors were low. Peak methane and carbon dioxide concentrations for the period of 2008 to 2017 are presented in Table 2.2.

Table 2.2 Summary of LFG Monitoring Results for Period 2008-2017

Well ID	Date Installed	Screen Depth Lithology	Location	Peak CH_4 (%v/v)	Peak CO_2 (%v/v)	Peak Flow (L/h)
2*	07/02/08	Sandstone	W of Zone B	0.2	4.2	0.3
3	07/02/08	Siltstone	Adjacent Gatehouse	0.2	3.8	0.5
5	07/02/08	Siltstone	W of Zone A	0.2	2.3	0.3
Gatehouse			NE of Zone B	0.1	0.1	0.5
Weighbridge			NE of Zone B	0.1	0.1	0.4
Service Pits (All)			Various	0.2	0.6	0.6

*LFG 2 has not been sampled since the May 2015 monitoring event due to construction of the Southern Recycling centre resulting in this well becoming inaccessible.

2.13.3 Current Active LFG Management/Extraction

A LFG extraction system including a flare combustion system is currently installed and operational on site. The system removes and disposes of LFG generation by flaring. The LFG extraction system is operated by the LFG contractor who has plans to utilise the extracted gas for energy generation.

There are two extraction wells (D45 and D51) in the vicinity of the Development Site and proposed building structures as shown on Figure 2.1. The gas well data from July 2018 indicates that the system is still extracting methane and carbon dioxide of high concentrations. Methane concentrations at well D45 and D51 were reported at 48% and 42% respectively. Carbon dioxide concentrations at well D45 and D51 were reported at 35% and 32% respectively.

2.13.4 LFG Generation from Zone A and Zone B

Landfill gas modelling for the SRWRA Landfill Operation has been updated by Tonkin Consulting using the Intergovernmental Panel on Climate Change (IPCC) Waste Model. The model was updated from previous iterations included in the SRWRA LEMP Update[1].

The model for this LFG risk assessment has only taken into consideration the gas generation from Zone A and Zone B. Both Zone A and Zone B were filled early in the operation of the site and do not have base or side liners. As Zone A and Zone B do not have sideliners, both these zones have been included in the model due to the potential for LFG to migrate laterally between the two zones. Subsequent cells have included base and sideliners which is considered to

[5] Tonkin Consulting (2014), Landfill Environment Management Plan. Ref: 20130814FR1A Rev E - June 2014.
[6] Tonkin Consulting (2007), Landfill Gas Management Plan. Ref: 20060532RA1 Rev A - February 2007.

minimise the potential for lateral migration of gas towards the Development Site. As these cells are also situated further away from the Development Site and have their own LFG extraction wells, LFG generation by these cells is not considered to impact the conditions at the Development Site and is therefore not taken into account for the LFG modelling for zones A and B.

The model was calculated assuming that the total volume of waste accepted each year was 149,000 tonnes and all waste accepted between 1980 and 2000 was placed in Zone A and Zone B.

The results of the modelling are shown in Figure 2.2 and summarised below:

- Estimated gas generation peaked in 2000 at 17.3 x 10^6 m3/year.
- Gas generation declined following the closing of the landfill cells.
- The current gas generation is estimated at 0.8 x 10^6 m3/year.

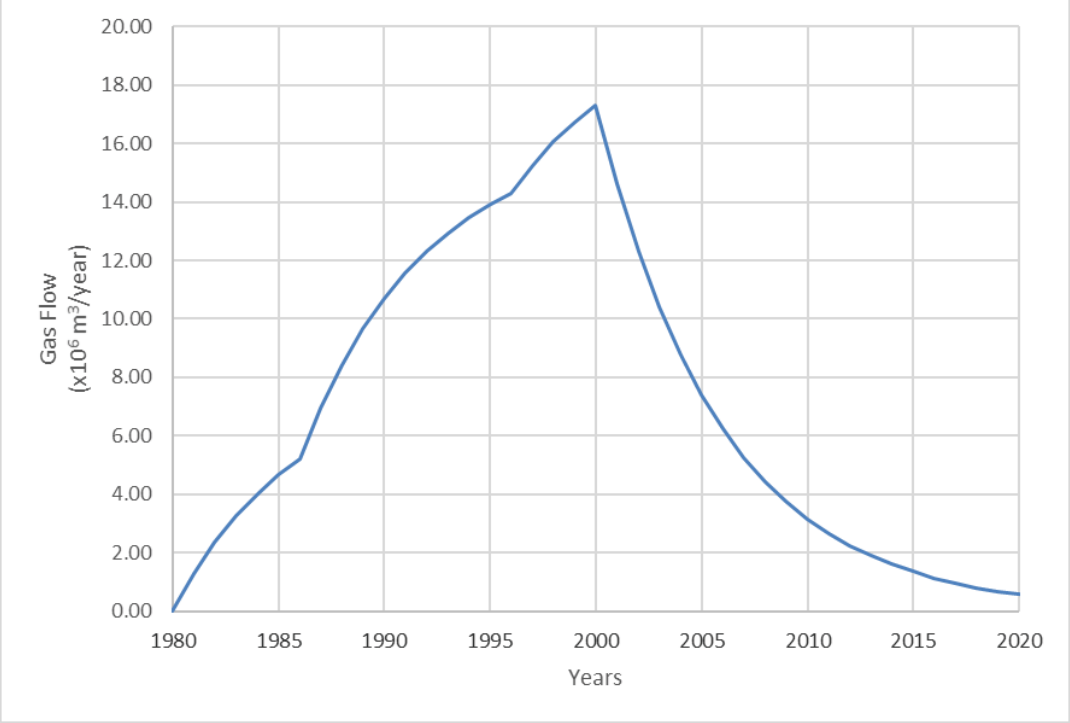

Figure 2.2 Estimated Gas Generation in Zone A and B from 1980 to 2020

The LFG modelling shown in Figure 2.2 was based on the following assumptions:

- The effects of LFG extraction and generation were not taken into account;
- All waste accepted from 1980 to 2000 was placed in Zone A and Zone B;
- The waste composition was assumed to be 100% municipal solid waste as a worst case scenario; and
- Oxidation was not taken into account.

The LFG modelling is purely indicative of possible landfill gas generation for the site. As a result the modelling should not be solely relied upon.

3 Preliminary LFG Conceptual Site Model (CSM)

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments and provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future. The complexity of the CSM should correspond to the scale and complexity of the known or potential contamination impacts. A conceptual cross section of the investigation area is provided in Appendix D.

3.1 Source

The source of the risk is the waste within Zone A and Zone B. Biodegradation of the organic fractions will generate bulk gasses as methane and carbon dioxide (in % v/v) but also contain trace compounds such as carbon monoxide and hydrogen sulphide. Other type of waste materials disposed in the landfill can also release (semi) volatile organic compounds (VOCs) (generally in ppm concentrations).

The proposed facility will be built directly above some of the waste in Zone A as described above. Based on the LFG modelling, LFG production in Zone A and Zone B is decreasing however is still generating LFG as shown on Figure 2.2. Gases from other potential sources such as the septic (if anaerobic system) are considered negligible in comparison to the landfill.

3.2 Pathways

The rate and extent to which the LFG will flow through a material is largely determined by the permeability of the material and the physical properties of the gas concerned. LFG will migrate from areas of high pressure to low pressure and from high concentration to low concentration by diffusion. Potential migration pathways for LFG were considered in the CSM in relation to the proposed development.

3.3 Receptors

The type of receptor, the sensitivity of the receptor, and the nature of the exposure scenario will affect the mitigation controls which are required. The potential for short and long-term exposure, and potential future acute health effects have been considered in the CSM in Table 3.1

In the CSM the receptors have been categorised into two primary categories, site users of habitable buildings and site workers. Site users are considered those that will be working at the facility daily and workers are considered those that will be performing ad hoc tasks such as maintenance or LFG monitoring.

Table 3.1 Preliminary CSM

Possible Risk #	Hazard / Source of Contamination	Receptor	Potential Exposure Pathway
1	Methane (explosive/asphyxiation)	Users of habitable buildings	Pressure driven vertical or lateral migration of methane leading to ingress into on-site enclosed spaces, or emission to the atmosphere at penetrations/exterior of structures in high concentrations
2		Under/Above ground services	Pressure driven vertical migration and ingress into on-site enclosed spaces (pits, trenches, conduits leading into control room pit, switch/distribution boards)
3		Direct exposure during construction or excavating deeper than 0.5m	Pressure driven vertical migration/direct exposure into excavations during construction
4	Carbon dioxide (asphyxiation, acute toxicity)	Users of habitable buildings	Pressure driven vertical or lateral migration of carbon dioxide leading to ingress into on-site enclosed spaces, or emission to the atmosphere at penetrations/exterior of structures in high concentrations
5		Under/Above ground services	Pressure driven vertical migration and ingress into on-site enclosed spaces (pits, trenches, conduits leading into control room pit, switch/distribution boards
6	Hydrogen sulphide and Carbon monoxide (acute toxicity)	Users of habitable buildings	Pressure driven vertical or lateral migration of hydrogen sulphide and carbon monoxide leading to ingress into on-site enclosed spaces, or emission to the atmosphere at penetrations/exterior of structures in high concentrations
7		Under/Above ground services	Pressure driven vertical migration and ingress into on-site enclosed spaces (pits, trenches, conduits leading into control room pit, switch/distribution boards
8		Direct exposure during construction or excavating deeper than 0.5m	Direct exposure during construction or excavating deeper than 0.5m
9	Trace gases – non-methane VOCs (chronic exposure)	Users of habitable buildings	Diffusion of VOCs upwards through the soil through cracks/joints/penetrations in slabs/floors resulting in a low concentration of gas in the indoor air space over long periods of time

3.4 Data Gaps

In developing the CSM the following data gaps were noted:

- Limited data is available for LFG conditions across the Development Site.
    - There are no LFG monitoring wells in the development site.
    - The only LFG data available for the development site is methane and carbon dioxide from extractions wells near the site under active extraction. There is no concentration, pressure and flow data available when the wells are not under active extraction.
    - The extent of influence of the gas extraction field is not known.
    - No data is available for trace compounds such as hydrogen sulphide and carbon monoxide or other VOC's.
- Due to the lack of site specific data as outlined in the two bullet point items above, a semi-quantitative assessment as per the NSW HGG GLs 2012 could not be undertaken at this stage.

4 Qualitative LFG Risk Assessment

The risk analysis presented in this report was undertaken in accordance with the principles of AS/NZS ISO 31000:2009 and NSW EPA Hazardous Ground Gases Guideline 2012 (hereafter: NSW EPA 2012 Guideline) The risk assessment process was undertaken considering a limited number of hazards related to LFG migration and contamination while making reference to all factors contributing to overall risk of these specific hazards. The hazards were defined as impacts to the nearest receptors in each direction considering human health.

The type of analysis chosen for this risk assessment is a qualitative risk analysis. Qualitative risk analysis gives a general indication of the level of risk of harm and uses descriptive scales to describe the magnitude of potential consequences and the likelihood that those consequences will occur. The risk assessment process was undertaken considering potential hazards (defined as impacts to the nearest receptors in each direction) related to the former landfill on human health.

The Source-Pathway-Receptor model was used to divide all risk factors between the risk items:

- Potential hazards posed by the former landfill (Source);
- Potential for hazard migration (Pathway); and
- Presence of human receptors (Receptor).

The risk assessment acknowledges that an active gas extraction is being operated near the site and assumes the use of the site as a renewable energy facility. Given that the extent of influence of the gas extraction field across the development site is not known, the inherent risk has been assessed as if there were no active extraction system whilst the assessment of the residual risk takes the operational landfill gas extraction system into account. If site conditions or use change, this risk assessment should be updated to reflect potential changes to risk.

4.1 Methodology

Risk levels were rated in two stages: (i) inherent (current) and (ii) residual level of risk. The rating levels adopted reflect Tonkin Consulting's degree of belief that a particular event or outcome of harm could occur having been based on a desktop study of the site, limited information on historical operational activities and recent LFG monitoring events undertaken and the available draft development plans for the Renewable Energy Facility.

The inherent risk level includes consideration of the existing risk controls in place (such as cover soil/capping and active LFG extraction system) and considers current and the proposed development and use.

Residual risk is the remaining risk rating once proposed risk treatments are established or implemented to mitigate or control the risk for future use.

4.2 Risk Ratings and Definitions

The completed risk assessment matrix details the rating of the risk factors and potential and likely impacts at the proposed on-site receptors due to potential landfill hazards.

The risk categories assessed are explained below:

- For each risk issue potential consequences concerning human health impact have been considered;
- The desk-top review, including the historic LFG monitoring results and CSM development, is relied upon for rating consequences and the likelihood which determines the 'inherent' level of risk;

- Suggested risk treatments or mitigating actions have been included for each risk issue and these actions form the basis for the LFG monitoring / assessment requirements.
- Commentary has been provided on the residual level of risk after the risk mitigating actions have been implemented for some of the risk issues. It should be noted that the residual level of risk should be re-evaluated on a regular basis, following finalising the development plans and designs, new development at or surrounding the site or after any adverse change in LFG condition identified by monitoring results.

Guiding definitions on likelihood, consequence and levels of risk ratings used are presented in respectively Table 4.1, Table 4.2 and Table 4.3. The matrix used for rating the level of risk is presented in Table 4.4.

Suggested treatments or risk mitigating actions to achieve a reduction to an acceptable level are generally addressed in the *Risk Treatment / Mitigation Action* column of Table 4.4 as well as in in the *Conclusion and Recommendations* section of this assessment.

Table 4.1 Guiding Definitions of Risk Likelihood

Likelihood	Description
Rare (R)	Will only occur in exceptional circumstances
Unlikely (U)	Could occur
Possible (P)	Should occur at some time
Likely (L)	Will probably occur
Almost certain (AC)	Expected to occur

Table 4.2 Guiding Definitions on Level of Consequence

Level of Consequence	Guiding Definition
Insignificant (I)	Negligible Impact – No or only minor injury to human health, infrastructure or the environment. No lost time incident or plant shutdown.
Minor (Min)	Minor Impact – Minor injury leading to lost time incident or inconvenient plant shutdown. Minor damage to infrastructure or environment.
Moderate (Mod)	Significant Impact – Injury or illness possible requiring hospitalisation and lost days at work. Plant shutdown leading to customer dissatisfaction. Short term environmental impact requiring investigation and revised management. Potential litigation.
Major (Maj)	Major Impact – Potentially serious and disabling injury leading to multiple days lost time and prolonged plant shutdown. Short to long term environmental impact requiring remediation. Low profile litigation.
Catastrophic (Cat)	Catastrophic Impact – Disastrous impact to human health leading to severe disabling injury or death. Serious impact to infrastructure and the environment requiring remediation. High profile litigation.

Table 4.3 Guiding Definitions on Level of Risk

Level of Risk	Guiding Definition
Extreme (E)	Intolerable risk – Immediate management attention required, action plans and management responsibility specified
High (H)	Intolerable risk – Management action required within operational plans and procedures
Moderate (M)	Acceptable risk – Manage by specific monitoring or response procedures, with management responsibility specified
Low (L)	Acceptable risk – Manage by routine procedures unlikely to need specific resource allocation

Table 4.4 Matrix for Definition of Level of Risk from Likelihoods & Consequences

	Consequences				
Likelihood	**Insignificant (In)**	**Minor (Min)**	**Moderate (Mod)**	**Major (Maj)**	**Catastrophic (Cat)**
Almost certain	H	H	E	E	E
Likely (L)	M	H	H	E	E
Possible (P)	L	M	H	E	E
Unlikely(U)	L	L	M	H	E
Rare (R)	L	L	M	H	H

4.3 Risk Assessment Outcomes

The risk assessment is presented in Table 4.5.

The inherent risks for the site were ranked as shown. These risks could be considered conservative due to the existing risk management controls currently in place on site including an operating LFG extraction system. Overall a precautionary approach has been taken due to the unknown impact of the system on the LFG conditions and migration at the Development Site and any temporary shutdown or longer term changes to or cessation of the system (refer to the data gap analysis in section 3.4 for more details) and further monitoring data is expected to clarify the actual risk.

Following consideration of the further risk management controls likely to be implemented in the final design and construction of the proposed structures and associated services and future regular gas monitoring and site inspections, the residual risk profile of the site could be seen to drop significantly. There were no individual risk issues that remained intolerable (Moderate or High Risk) and requiring 'further action' apart from regular monitoring and inspection to achieve maintain an acceptable risk rating.

The residual risk level for all the individual risk issues was found to be low. This is supported by the multitude of controls that will be in place, apart from the current active LFG extraction system, such as the cover soil layer, the ventilation and/or gas resistant layers under the structures and detailing of utility services in conjunction with regular gas monitoring and visual inspection of these structures and services to ensure migration does not occur to and/or into on-site structures.

Table 4.5 Qualitative Landfill Gas Risk Assessment of the Proposed Renewable Energy Facility

		Inherent Risk (evaluation of existing condition)				Residual Risk (assuming treatment / mitigation action undertaken)			
Aspect	**Building/ Location**	**Hazard / Risk**	**L**	**C**	**RR**	**Risk Treatment / Mitigation Action**	**L**	**C**	**RR**
Landfill gas (LFG)	Control/Lunch room	Explosion / Fire – site personnel, utility workers/ consultants Migration of LFG from waste below or adjacent to the buildings to underside of building floor or through man-made services and into the buildings through floor cracks, joints and/or penetrations resulting in a risk of accumulation of methane and the potential development of an explosive/flammable atmosphere within (enclosed spaces in) the buildings.	P	Cat	E	Operation of active landfill gas extraction system with extraction wells located near the site. Provision of min 0.5m soil cover as a diffusive barrier, a methane oxidation layer and a separation layer between the waste material (if present) and: • the underside of proposed structure, • service trenches. Ensure passive subfloor ventilation of very good performance to prevent accumulation of gas beneath the floor and control room pit as well as flooring that will prohibit the migration of gas through the floor and any joints, e.g.: • Installation of a proprietary gas-resistant membrane to reasonable levels of workmanship under independent construction quality assurance with integrity testing and independent validation immediately under workshop slab and lunch/control room floor, • Selection of flooring that provides an equal or better level of gas resistance approved by a suitably qualified person and the EPA. Ensure that the control room pit is a gastight structure as well as the interface between the control room pit and floor. Minimise the number of services extending under the building and penetrations through the slab/floor: • all services entering/leaving the building envelope from above the ground (e.g. power, water, waste water, telecoms, etc) outside of the building.	U	Min	L

						• where services are required to enter through the floor because no alternatives exist i.e. for the control room conduits, install the services either into concrete and/or seal penetrations around the conduits effectively whilst ensuring accessibility for inspection and maintenance. • ventilate conduits/sleeves entering the building envelope from above ground as well as enclosures such as electrical switchboards and install accessible gastight seals/cable glands where pipes and cables (and conduits in case of pits) are entering the building envelope/switchboard/utility pits. LFG monitoring and visual inspection program to confirm continued effectiveness of mitigation actions and need for maintenance/replacement/additional actions.			
	Workshop	Explosion / Fire – site personnel, utility workers/ consultants Migration of LFG from waste below or adjacent to the buildings to underside of building slabs or through man-made services and into the buildings through slab cracks and/or penetrations resulting in a risk of accumulation of methane and the potential development of an explosive/flammable atmosphere within (enclosed spaces in) the buildings.	P	Cat	E	Operation of active landfill gas extraction system with extraction wells located near the site. Provision of min 0.5m soil cover as a diffusive barrier, a methane oxidation layer and a separation layer between the waste material (if present) and: • the underside of proposed structure, • service trenches. Installation of a proprietary gas-resistant membrane to reasonable levels of workmanship under independent construction quality assurance with integrity testing and independent validation immediately under slab. Design and construction of reinforced slab cast in-situ or post-tensioned suspended slab with minimal joints and services penetrations. Slab to be appropriate for the existing in-situ subgrade to deal with differential settlement and cracking and prevent ingress of LFG. Remove any joints where possible (to be assessed by structural engineer) by constructing with a single pour or seal effectively if joints cannot be avoided. Minimise the number of services extending under the building and penetrations through the slab/floor: • all services entering/leaving the building envelope from above the ground (e.g. power, water, waste water, telecoms, etc) outside of the building.			

						• where services are required to enter through the floor because no alternatives exist (not identified at this stage) seal penetrations around the conduit effectively to prevent ingress of gas whilst ensuring accessibility for inspection and maintenance. • ventilate conduits/sleeves entering the building envelope from above ground as well as enclosures such as electrical switchboards and install accessible gastight seals and cable glands where pipes (and conduits in case of pits) and cables respectively are entering the building envelope/switchboard/utility pits. LFG monitoring and visual inspection program to confirm continued effectiveness of mitigation actions and need for maintenance/replacement/additional actions.			
	Control/Lunch room	Human exposure (asphyxiation, acute toxicity, chronic exposure) - site personnel. Migration of LFG from waste below or adjacent to the shed to underside of shed slab and into the shed through cracks and/or penetrations resulting in: a. asphyxiating concentrations, and/or b. poisonous concentrations, and/or c. a low concentration of gas in the indoor respirable space over long periods of time.	P	Mod	H	See risk treatment and mitigation actions above.	U	Min	L
	Workshop	Human exposure (asphyxiation, acute toxicity,				See risk treatment and mitigation actions above			

		chronic exposure) - site workers. Migration of LFG from waste below or adjacent to the shed to underside of shed slab and into the shed through cracks and/or penetrations resulting in: a. asphyxiating concentrations, and/or b. poisonous concentrations, and/or a low concentration of gas in the indoor respirable space over long periods of time.							
	Utility services (exterior of buildings)	Impact to onsite utility workers/consultants for regular (maintenance/monitoring) works occurring outside of habitable enclosed spaces (excluding construction, trenching, drilling etc works deeper than 0.5m) Migration of LFG into man made sub-surface service trenches and into non-habitable enclosed spaces such as utility pits, electrical switch boards, light poles etc. resulting in WH&S risks such as asphyxiation, explosion or acute toxicity.	P	Mod	H	Operation of active landfill gas extraction system with extraction wells located near the site. Avoid the use of service trenches where ever possible. Make use of a building common services trench to facilitate the installation and monitoring/maintenance of gas protection measures and minimise contact with waste for utility workers when future maintenance is required. Provision of min 0.5m soil cover as a diffusive barrier, a methane oxidation layer and a separation layer between the waste material (if present) and service trenches. Ventilate conduits/sleeves/switchboards and install gastight seals/cable glands where pipes/conduits/cables are entering enclosed spaces such as switchboard and utility pits. No intrusive earth works and maintenance/monitoring works to proceed without a WH&S management plan addressing LFG risks. Ensure there is clear access to maintain and repair gas mitigation controls without potential gas accumulation risks.	U	Min	L

		Impact to onsite workers for construction/ trenching/drilling works deeper than 0.5m. Migration of LFG into man made excavations etcetera resulting in WH&S risks such as asphyxiation, explosion or acute toxicity.	AC	Maj	E	No intrusive earth works and maintenance/monitoring works to proceed without a WH&S management plan addressing LFG risks.	U	Min	L

5 Conclusion and Recommendations

5.1 Conclusions

Following the desktop review of available information for the current site conditions and the proposed development a qualitative landfill gas risk assessment was conducted. The proposed development is located on a section of the landfill where there is an interface between the natural lithology and waste and a large portion of the development will be on top buried waste covered with a soil capping layer of minimum 0.7 m. It is expected that through appropriate planning and piling techniques the interface between the piles and landfill cap will present a negligible pathway for landfill gas migration. Potential minor gas emissions due to the interface between the piles and cover soils will be managed through the recommended LFG mitigation measures.

A risk assessment was conducted to identify the source, potential pathways and potential receptors of LFG migration. The risk assessment identified a number of potential risks to users of the site and suggested risk treatments or mitigating measures. These proposed measures are considered preliminary due to the lack of data specific to the development location as identified in the data gaps section.

The risk assessment and subsequent mitigation measures have been developed assuming the operation of an active gas extraction system near the site and the use of the site as a renewable energy facility. If site conditions, gas management and/or use change, this risk assessment should be updated to reflect potential changes to risk.

5.2 Recommendations

Based on the desktop risk assessment the following recommendations have been made:

- Discuss the outcome of the LFG risk assessment with the SA EPA to determine the best approach towards design and implementation of the control measures;
- Undertake site specific data collection to provide additional information to update the CSM, allow a semi-quantitative level 2 risk assessment for bulk and trace ground gases to be undertaken in accordance with the NSW EPA *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases* (2012), review the proposed landfill gas control measures, undertake detailed design and implement measures; or
- Undertake detailed design and implement landfill gas controls and mitigation measures for a worst case scenario;
- Consider LFG protection measures during design of new site infrastructure;
- Undertake a regular landfill gas monitoring and inspection program as outlined below.

5.2.1 LFG Monitoring Program

Landfill gas monitoring should occur at practical completion for the construction of the structures and landfill gas control measures and subsequently at 3 monthly intervals. Points where there is potential for gas accumulation to occur should be monitored, including but not limited to:

- Interior of buildings
- Subfloor void/ventilation layers
- Switch/Distribution boards and other electrical enclosures
- Entry point of services to the buildings
- Service pits

In addition to monitoring of potential accumulation points and pathways the interior and exterior of the habitable buildings and associated utility services should be inspected for degradation of protection measures and potential pathways. The interior of buildings should be inspected for elements including but not limited to:

- Cracks in slabs and/or walls;
- Deterioration of gas tight seals;
- Condition and gas tight seal of flooring.

The exterior of buildings should be inspected for things including but not limited to:

- Cracking of surface cover;
- Settlement around the buildings;
- Seals around penetrations through cover soils.

After a year of quarterly monitoring the sampling frequency should be reviewed.

Appendix A

EPA Letter

Environment Protection Authority
GPO Box 2607 Adelaide SA 5001
211 Victoria Square Adelaide SA 5000
T (08) 8204 2004
Country areas 1800 623 445

South Australia

EPA Reference: 34395

18th July 2018

Mr Oliver Scheidegger
79 King William Road
UNLEY SA 5061

compliance@lms.com.au

Dear Mr Scheidegger,

Development Application Information Request

Development Application Number	**145/V012/18**
Applicant	**LMS Energy Pty Ltd**
Location	**Q192, Q193 DP116986, Hundred Willunga, 112 Bakewell Drive, McLaren Vale, SA 5171.**
Proposal	**Construction of a renewable energy facility utilising landfill gas power generation comprised engines, conditioning skids, three transformers, three reactors, switching unit, control room, coverage storage, bund workshop, shed, 10,000 litre water tank and lightning poles with solar panels.**
Information required within 3 months from date of this letter.	

The above mentioned development application was referred to the Environment Protection Authority (EPA) by the State Commission Assessment Panel (SCAP), in accordance with section 49 of the *Development Act 1993*.

Its understood the proposal seeks the construction of a renewable energy facility utilising landfill gas power generation comprised engines, conditioning skids, three transformers, three reactors, switching unit, control room, coverage storage, bund workshop, shed, 10,000 litre water tank and lightning poles with solar panels.

As the proposal involves the construction of buildings in an area that may be affected by landfill gas, potential risks associated with the accumulation of gas under the building footprints or within service trenches or other confined places needs to be assessed. The current risk assessment and monitoring framework in place for the site may be altered by the layout of the extraction infrastructure, design and operation.

Furthermore, the proposed energy facility power station is located on a historical landfill area and within the extent of final capping identified for the site. It must therefore be demonstrated that the integrity of the final cap is not compromised by the location of infrastructure, including weight and settlement of waste in the landfill and the landfill cell base and sideliners. An Engineers report is required to confirm the suitability of building and plant infrastructure that is proposed to be located on the landfill cap.

The information provided to the EPA is therefore insufficient to undertake an environmental assessment. Therefore, as provided for by section 49(7b) of the Development Act, the EPA requires the following additional information before it gives its response.

1. Provide a landfill gas risk assessment that has been prepared by a suitably qualified consultant in accordance with Table 1 of the EPA's guideline *Landfill gas and development near landfills 2012* (which can be found here at https://www.epa.sa.gov.au/files/47793_info_landfill_gas.pdf). This assessment should include details of a landfill gas accumulation monitoring program to ensure that gas is not accumulating at dangerous levels in enclosed buildings or structures associated with the proposed development.
2. Provide an Engineer's report to assess the geotechnical stability of the proposed location of plant, buildings and equipment on the landfill cell integrity. The report should include consideration of the layout of the extraction infrastructure, design and operation of the gas extraction works on the integrity of the landfill cell base and sideliners.

The Planning Report prepared by URPS states that an air quality report is to be supplied to the EPA by Katestone as part of the referral, however this report has not been provided. The proposal includes 'fuel burning' which is to be assessed against the EPA's *Environment Protection (Air Quality) Policy 2016* (which can be found here at https://www.epa.sa.gov.au/data_and_publications/standards_and_laws/air_quality). The report should, as a minimum:

3. Provide details which demonstrate that any oxides of nitrogen, carbon monoxide and fine particulate material arising from either power generation or flare operation will be adequately dispersed as per the requirements of the Environment Protection (Air Quality) Policy
4. Provide further details which clearly describe the operation of the Gas Conditioning Skids, including how any wastewater that may arise from "gas conditioning" would be managed
5. Provide a locality map that identifies all sensitive receivers (ie dwellings/offices etc) within 500 metres and their distances from the proposed power station
6. Identify all potential emission pollutants and their emission rates under a worst-case scenario (ie. maximum emission rates) as well as typical operating conditions
7. Provide an air dispersion modelling report for all the pollutants of concern (eg. NO_2, SO_2, CO, PM2.5 and PM10), for a worst-case scenario and typical operation, based on robust and defensible emission rate data and undertaken by a suitably qualified and experienced air quality modeller
8. Provide appropriately derived background levels for all modelled pollutants

The plans (Power Station Site Layout drawing number 50043-GA-001 revision C) note bulk oil tanks and a covered storage bund area. However no further details have been provided.

9. Provide details of the proposed storage tanks, including individual tank capacities and appropriate bunding (having regard to the EPA Guideline *Bunding and spill management* http://www.epa.sa.gov.au/files/47717_guide_bunding.pdf)
10. Provide details of the bunding proposed to collect spills including the location, height and volume to contain a spill in having regard to the flammable liquid sections of the guidelines

The further information must be supplied within 3 months of the date of this letter. Failure to comply with this request may result in the EPA advising the planning authority to refuse the application.

Please send the further information, labelled with your Development Application Number, to both the Environment Protection Authority and the planning authority at the addresses provided below. Please ensure correspondence is marked attention to Client Services Officer.

All information must be forwarded to:

Client Services Officer
Development Applications
Science and Assessment Division
Environment Protection Authority
GPO Box 2607
ADELAIDE SA 5001
DX 228
epa.planning@sa.gov.au

Janine Philbey
Planning Officer
State Commission Assessment Panel
L5
50 FLINDERS Street
ADELAIDE, SA 5000
janine.philbey@sa.gov.au

Please direct all enquiries to Robert De Zeeuw on telephone (08) 8204 1112 or facsimile (08) 8124 4673 or email epa.planning@sa.gov.au

Early attention to this matter would be appreciated.

Yours faithfully

Hayley Riggs
Delegate
ENVIRONMENT PROTECTION AUTHORITY

cc: *Planning Authority:* State Commission Assessment Panel
Attention: Janine Philbey

Appendix B

FMG Geotechnical Report

fmg ENGINEERING incorporating BURNS HAMILTON

CIVIL I STRUCTURAL I ENVIRONMENTAL I GEOTECHNICAL I BUILDING ASSESSMENT & FORENSIC I SOIL & MATERIAL TESTING I HOUSING I COMMERCIAL I PROJECT MANAGEMENT

Geotechnical Investigation

JOB NUMBER:	S35819 - 255991
CLIENT:	LMS Energy Pty Ltd
SITE:	Pedler Creek Landfill - Wheaton Road, MCLAREN VALE, SA 5171
DATE:	16/06/2017
REVISION:	0

Document Status

Rev No.	Status	Author	Reviewer			Approved for Issue		
			Name	Signature	Date	Name	Signature	Date
0	FINAL	Anthony Rayner	Richard Atkinson		20/06/17	Richard Atkinson		20/06/17

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Table of Contents

1. Introduction

FMG Engineering has been commissioned to undertake a geotechnical investigation at the Pedler Creek Landfill - Wheaton Road, MCLAREN VALE, SA 5171. The approximate site extents are shown below in figure 1.

Figure 1 Approximate site extents

1.1. Purpose of this Investigation

We understand from the documents and discussions provided that the proposed development comprises:

- A Gas Power Plant

We have been provided with the following drawings on which we have based this assumption.

- No drawings have been provided however we understand that up to four 3m x 12m concrete slabs will be required to house the power plant engines as well as axillary infrastructure.

Our Investigation and Report is to include the following:

- A site topographical description
- Regional geological description including regolith and geomorphology, if applicable
- Subsurface observations made during the investigation
- Shrink-swell site classification to AS2870-2011
- Earthquake site classification to AS1170.4-2007
- Groundwater observations made during the investigation
- A borehole location plan
- A description of envisaged geotechnical issues
- Recommendations on footing types, depth, stiffness, founding stratum & bearing pressures
- Settlement estimates
- General geotechnical recommendations pertaining to construction
- Bore logs including field test results

Our Report does not provide specific footing details. Footings should be designed by a Structural Engineer based on the geotechnical parameters provided in this Report.

1.2. Proposed Investigation

In order to achieve the purpose as stated above, the proposed investigation comprises:

- Excavation of boreholes to a depth of 4m or refusal (whichever comes first) as required
- Logging of boreholes via the visual tactile method in accordance with AS1726 (1993)
- Preparation of a geotechnical report presenting investigation findings

2. Investigation Site

2.1. Surface Conditions

The site investigation area is located at the Pedler Creek Landfill, within a laydown area which is located adjacent to old landfill mounds. The site is relatively flat and clear where the investigation was undertaken. The western edge abuts an embankment approximately 5m high on top of which the new office building is located. To the north and south small to medium sized trees are scattered over earth bunds. A water fill station consisting of three poly tanks, is built into the southern end of the western embankment.

Surrounding site conditions comprise:

- North: Old landfill / forested slope
- East: Old landfill site
- South: Existing landfill and power station
- West: Office building and entrance to landfill

2.2. Regional Geology

The DSD online GIS database SARIG indicates that the regional near surface geology across the entire site to be comprised of the Reynella Siltstone, consisting of Siltstone; red, gritty and potentially glacigenic.

A thin layer of colluvium may also overlie the site, consisting of; heterogeneous material of variable grain size accumulated on slopes by gravity, creep, sheet flow, rainwash, mudflows or solifluction.

Fieldwork undertaken in this investigation generally confirmed the above geology.

2.3. Historical Geotechnical Data

No historical geotechnical information has been made available to FMG Engineering at the time of this investigation, however anecdotal evidence suggests the natural surface profile dips steeply to the east forming the western bank of the old Pedler Creek. Old landfill operations are then interpreted to have filled onto the natural surface from the base of the creek up to the existing levels currently present at the site, with the depth to the natural surface increasing from west to east.

3. Investigation Methodology

Boreholes were drilled using a Rockmaster 4WD Mounted Drill Rig owned and operated by SPK Geodrill Pty Ltd.

Thick walled tubes were used to recover relatively continuous cores. Tubes were progressed by pushing the tube against the weight of the vehicle, by a high-frequency hydraulic hammer, and rotation of the tubes.

Holes were terminated either at target depth or when high resistance was encountered to push tubes. Recovered samples were placed in trays and logged on site by an experienced geotechnical engineer.

Visual tactile logging was carried out in accordance with AS1726.

All soil cores were returned to the boreholes after logging and photographing and a bentonite cap placed in the boreholes.

4. Results

Field work was undertaken on 16/06/2017 and comprised:

- Excavation of sixteen (16) boreholes from depths between 1.0 to 4.0m.

Borehole/test locations are shown on the site plan included in Appendix A. Borelogs and test results are included in Appendix B.

A summary of achieved depths is shown in Table 1.

Table 1 - Summary of achieved depths

Test	Depth Range Achieved (m)	Test	Depth Range Achieved (m)
BH1	0 – 1.5	BH2	0 – 1.5
BH3	0 – 1.5	BH4	0 – 1.4
BH5	0 – 3.2	BH6	0 – 3.0
BH7	0 – 2.05	BH8	0 – 4.0
BH9	0 – 4.0	BH10	0 – 4.0
BH11	0 – 1.0	BH12	0 – 3.2
BH13	0 – 2.15	BH14	0 – 4.0
BH15	0 – 4.0	BH16	0 – 1.7

4.1. Summary of Subsurface Conditions

A description of the materials encountered during the investigation is included in the borehole logs included in Appendix B and a generalised summary can be found below.

A generalised report of the soil profile begins with between 0.2m to 2.2m of Sandy Gravel FILL overlying 0.3m to 0.8m of Gravelly Clay FILL. This Fill is interpreted to represent the old landfill cap and is commonly underlain by REFUSE FILL up to 1.5m+ thick.

In the eastern portion of the site the base of the fill was not encountered and the fill extended to depths greater than 3.2m. It is anticipated the fill increases in thickness from west to east.

In the western portion of the site the Refuse Fill appears to have been placed directly onto the natural soil/rock horizon. This natural profile was encountered at depths between 0.2 to 0.8m at the very western edge of the investigation area and then dips down to the east, where it was encountered at depths between 1.4 to 2.5m below the refuse/fill.

The natural geology consists of a thin, patchy cover of colluvial soil comprised predominantly of Clayey SAND and GRAVEL overlying extremely to highly weathered Siltstone/Sandstone bedrock which increased in strength with depth. The strength of the rock has been estimated from the drilling resistance and time taken to penetrate the rock.

The natural subsurface conditions encountered in the boreholes are considered to be consistent with the regional geology.

4.1.1. Groundwater

Groundwater was not observed during drilling however it should be noted that the occurrence of groundwater may vary seasonally with rainfall intensity and duration.

4.1.2. Summarised Soil Profile Depths

Table 2 outlines a summary of subsurface conditions.

Table 2 - Summary of subsurface conditions

Material	Depth Encountered (m)									
	BH1	**BH2**	**BH3**	**BH4**	**BH5**	**BH6**	**BH7**	**BH8**	**BH9**	**BH10**
Fill	0 – 1.5+	0 – 1.5+	0 – 1.5+	0 – 1.4+	0 – 3.2+	0 – 0.8	0 – 1.6	0 – 1.3	0 – 2.4	0 – 2.5
Natural Soils	NE	NE	NE	NE	NE	0.8 – 2.2	NE	1.3 – 2.4	NE	NE
Rock	NE	NE	NE	NE	NE	2.2 – 3.0+	1.6 – 2.05+	2.4 – 4.0+	2.4 – 4.0+	2.5 – 4.0+
	BH11	**BH12**	**BH13**	**BH14**	**BH15**	**BH16**				
Fill	0 – 1.0+	0 – 3.2+	0 – 1.6	0 – 4.0+	0 – 0.2	0 – 0.5				
Natural Soils	NE	NE	NE	NE	0.2 – 1.5	0.5 – 1.0				
Rock	NE	NE	1.6 – 2.15+	NE	1.5 – 4.0+	1.0 – 1.7+				

4.2. Site Classification

Free swell Y_s values have been calculated in accordance with AS2870-2011. Although AS2870-2011 is considered appropriate for this application the design should be based on engineering principles.

The site in its current condition is classified as CLASS **P** (problem site) due to the presence of fill and trees on adjacent land and **S-D** due to soil reactivity.

Based on calculations for the soil swell (Y_s) values in accordance with AS2870-2011 “Residential Slabs and Footings”, a characteristic surface movement, is approximately 10mm (to the nearest 5mm). Taking into account the effects of trees in accordance with 2870-2011, the total characteristic surface movement is expected to be approximately 15mm.

It must be emphasised that in classifying this site, FMG Engineering did not place sole reliance on the borelog as a means of being an absolute representation of all subsurface features existing at this site. The following have also been taken into consideration.

- The broad experience of FMG Engineering.
- Well established and relevant local knowledge of the general behavioural characteristics of foundation soils in the vicinity of the site.
- Specific geotechnical reports and classification on adjacent sites which were referred to.
- FMG Engineering’s vast experience relating to past performance of existing structures in the general area.
- Published geological maps.
- Engineering assessment of the likely characteristic surface movement (Y_s) based on estimated I_{ps} values as noted on the borelog. I_{ps} values are based on Shrink Swell tests (I_{ss}) carried out in a laboratory on similar soils to this site.
- It can occasionally be difficult to distinguish between natural soil and controlled FILL during testing. **It is also impossible to distinguish between uncontrolled FILL and controlled FILL without appropriate information**. It shall be the Client's responsibility to determine

whether any controlled FILL exists on the site, and to provide FMG with the relevant Certificate(s) at the time of our engagement, prior to the fieldwork being carried out. FMG takes no responsibility for any additional costs which may be incurred due the presence of Controlled FILL which is not detected during our testing, and which is instead logged as either (uncontrolled) FILL or natural soil.

5. Geotechnical Comments

5.1. Design Considerations

Based on our observations from the field investigation it appears the eastern portion of the site contains deep fill from of old landfill operations. The depth to suitable founding material is anticipated to be at a significant depth below the current surface over the entire eastern portion of the site. The existing fill is considered not suitable to support the proposed development.

It is therefore our recommendation to confine the proposed power station construction to the western edge of the site. Based on the field investigation, approximately 0.2 to 2.5m of fill overlies firm natural ground along the western edge of the site (from the toe of the existing embankment out 15m to the east, as shown in figure 2 below). The depth to the natural surface increases to the east as the old natural surface is interpreted to dip down toward Pedler Creek.

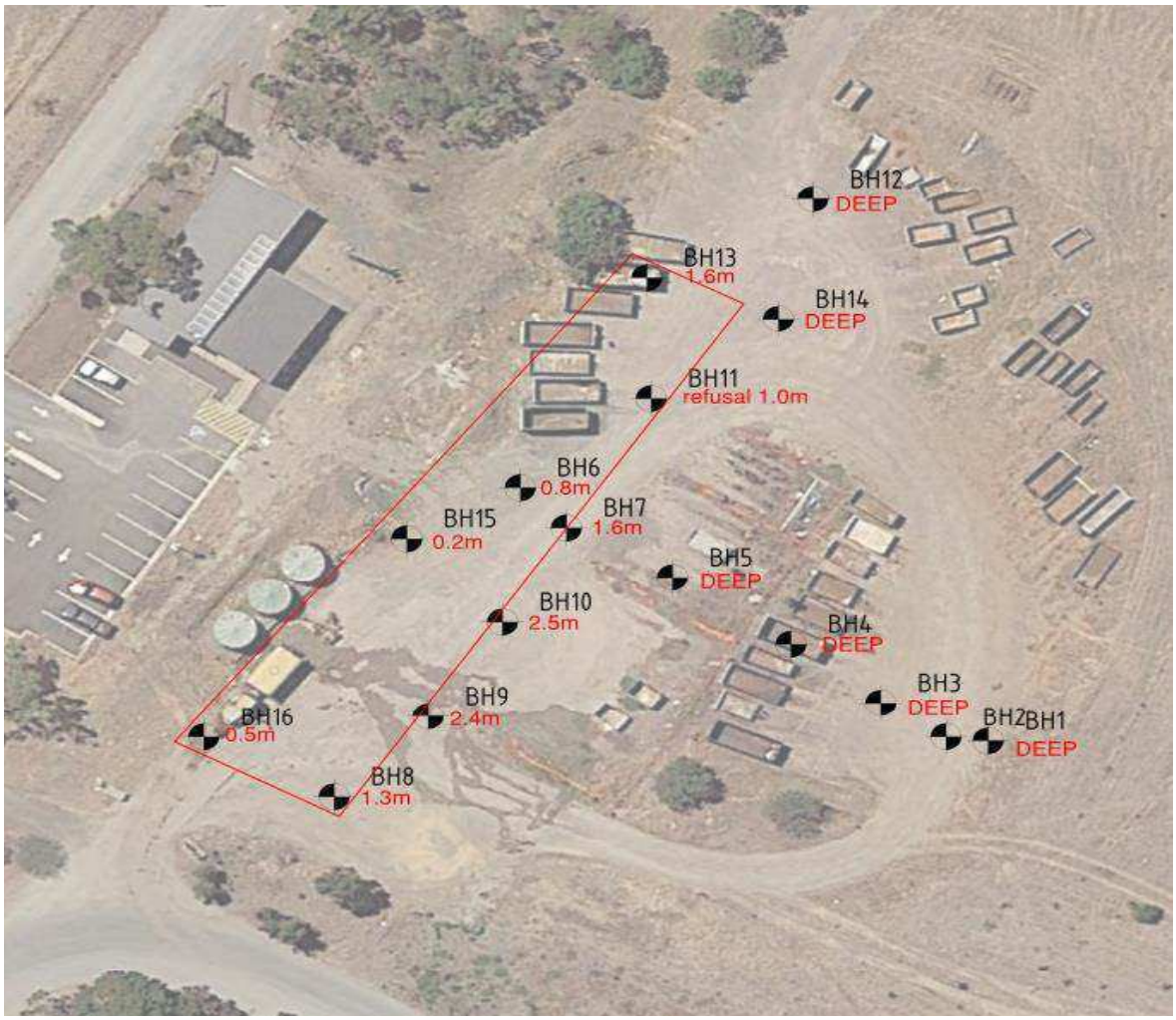

Figure 2 - Summary of depth to natural

5.1.1. Surface Footings in the Western Portion of the Site

Where surface footings are required they need to penetrate the fill and be founded on firm natural soils. Due to the varying depth of fill across the western portion of the site (0.2 – 2.5m), the founding depths will vary significantly from west to east. Surface footings also need to be designed to withstand the expected shrink swell movements outlined in Section 4.2.

Along the western edge of the site traditional surface footings are expected to be suitable for construction. In this case, footings would typically be founded within the natural colluvial soil or extremely weathered Siltstone/Sandstone.

Square or rectangular pad footings with a length to breadth ratio of 2 or less, embedded at least 0.8m into the ground into firm natural soil, may be proportioned on an allowable bearing pressure of 150kPa.

Strip footings with a length to breadth ratio of 2 or more, embedded at least 0.8m into the ground into firm natural soil, may be proportioned on an allowable bearing pressure of 125kPa.

Further to the east, shallow piers are recommended where the depth to fill exceeds 1.0m. These can be readily constructed by excavating to depth using conventional bucket excavators. Piers founded onto the weathered Sandstone/Siltstone at depths between 1.0m and 2.5m may be proportioned on an allowable bearing pressure of 300kPa.

In assessing the allowable bearing strength we have assumed a factor of safety of 2.5. The ultimate geotechnical capacity ($R_{d,ug}$), may be estimated at 2.5 times the recommended maximum allowable bearing pressure.

Under transient and short term loads, such as wind and earthquakes, the maximum allowable bearing pressure may be increased by 25%.

The elastic (immediate) settlement of square or rectangular spread footings founded on the weathered Siltstone/Sandstone, up to about 3m wide is unlikely to exceed 20mm, when uniformly loaded to the maximum allowable bearing pressure.

Differential settlement resulting from soil variability beneath footings of similar size and applied bearing pressures is not likely to exceed 10mm.

The long term settlement is unlikely to exceed the elastic settlements by more than 40%. It is expected that a majority of the settlement will occur during construction, with only relatively small total and differential settlements expected after construction.

Where settlements of the above magnitude are not acceptable, lower bearing pressures would need to be used. For design purposes, it may be assumed that for a given footing size the above settlements will be directly proportional to the bearing pressure for bearing pressures up to the allowable.

It is recommended that tie beams be provided between individual spread footings to assist in reducing differential movements.

Consideration could also be given to providing a structural connection between the floor slabs and the footings to reduce the potential for differential movement between the floor slab and footings.

It is recommended that the base of all footings are inspected prior to pour of concrete to confirm the provided allowable bearing pressures, as a change in moisture content, particularly caused from ponding of storm water, can negatively impact these pressures considerably.

5.1.2. Safe Batter Angles

Recommended safe batter angles for the soils present on site are provided in Table 3.

Table 3 - Recommended safe batter angles

Soil / Rock Type	Safe Batter Slope Angles (°)	
	Short Term	Long Term
Non engineered fill	30	25
Natural Colluvium	35	30
Siltstone/Sandstone	55+	45

Temporary batter faces must be protected against moisture content changes and scour and erosion by the use of a diversion drains, shotcrete facing or PVC membrane. It is emphasised that all batter slopes should be inspected by a suitably qualified geotechnical engineer.

5.1.3. Earthquake Site Class

Using the Classification System presented in AS1170.4-2007 “Structural design actions Part 4: Earthquake actions in Australia”, it is assessed that the following should be adopted

- Site sub-soil class: “D_e” (i.e. Rock).
- Hazard Factor (Z): 0.10

5.2. Construction Considerations

5.2.1. Scheduling of Earthworks

During the wetter months of the year, particularly during winter and spring when evaporation rates are low, it is anticipated that it will be difficult to conduct earthworks at the site due to the exposure of clayey fill. Where possible all earthworks should be scheduled during the drier months of the year.

5.2.2. Working Platform & Trafficability

The trafficability of the site would not be expected to significantly worsen during or following periods of wet weather where the surface is not sealed. However if trafficability of the site requires improvement, a working platform or access track comprised of compacted Class 3 recycled rubble could be placed. This could then be incorporated into the permanent works, since a Class 3 rubble would contain sufficient fines and thus have sufficiently low permeability that it would not act as a collection medium for surface run-off or perched groundwater and so cause problems with softening and swelling of the underlying reactive clays.

5.2.3. Site Conditions

Excavation within FILL material and SAND based soils may experience short term instability and shoring and/or over excavation may be required.

5.2.4. Excavation Potential

All surface soils and fill encountered are expected to be readily excavated using conventional earthmoving equipment such as bucket type excavators.

The underlying Siltstone/Sandstone is expected to provide high resistance to conventional earth moving equipment. If excavation of rock is required specialist equipment such as hydraulic rock breakers may be required.

5.2.5. Control of Surface Water and Perched Groundwater

Surface Water

The crest, soil face and toe areas of all slopes and the foundations to all footings and the subgrades to all pavements should be kept well drained at all times, to control the potential for weakening and/or swelling of the surficial soils. Surface water drainage infrastructure such as channels and sumps, should be lined to prevent infiltration of water. This is particularly important at and behind the crests of slopes, and at and behind the tops of retaining walls.

However, sub-surface drains consisting of sand or gravel filled trenches or blankets should not be used below footings or pavements, because they could act as discharge locations for perched water, and because any drainage water that comes into contact with the surrounding, slightly clayey soils could result in wetting and softening. For the same reasons, sand or gravel backfilling to service trenches should also be avoided, unless suitable cut-offs are provided.

Groundwater

No groundwater was encountered during the investigation however it is possible that shallow perched water may be encountered. The presence and the level of a perched water table could change over time because perched water is derived from local infiltration of water into the sub-surface soil profile, such as by recharge of surface water run-off into the ground below unsealed areas in the general vicinity following prolonged or heavy rainfall, or by leaking services such as water supply pipes, sewage pipes or storm water pipes and pits, or by excessive irrigation of grassed or other landscaped areas.

Perched water can be difficult to detect by vertical boreholes because of its generally irregular and limited distribution in plan. Perched water, if present, would generally be expected in one or more of the following locations:

- Within the surficial fill or near surface natural soils, due to the water ponding on top of very low permeability rock below
- Within joints and other structural defects in the rock

Should perched water be encountered in an excavation, the use of one or more pumped sumps is expected to be able to adequately control inflow of perched groundwater into the excavation.

5.2.6. Construction Phase Inspections

It is recommended that excavations and fills, retention systems and any engineered slope constructions, pile footings, and roads and other pavements be inspected at appropriate stages of their construction by an experienced geotechnical engineer. This is in order to verify that the actual ground conditions are consistent with the advice and recommendations given in this report.

6. Important Notes about the Interpretation and Use of this Geotechnical Report

These notes are offered to help in the interpretation of your Geotechnical Report.

The level of investigation and degree of certainty required is dependent upon the complexity of the proposed construction.

Should a more conclusive assessment be required regarding the subsoil conditions at the property, FMG Engineering can arrange to undertake a more detailed study including further sampling and laboratory testing. There will always be uncertainties arising from the practical limitations of the extent and nature of site testing and localised changes in soil conditions may not be found in any cause.

This report should be read as a whole. Borelogs should not be separated from the body of the report and interpreted independently. The whole of this report should be provided to contractors in order to provide the best available information to the contractors. To avoid any misinterpretation of the contents of the report consult the geotechnical engineer for any queries or proposed changes or unexpected conditions.

6.1. The Limitations of a Geotechnical Investigation

Although the information provided by a geotechnical investigation can reduce exposure to such risks, no geotechnical investigation, however diligently carried out, can eliminate them. Even a rigorous professional assessment may fail to detect all subsoil and ground water variations on a site. The geology of the site may make predicting changes difficult.

A geotechnical investigation is based upon a unique set of project conditions.

Your report should not be used:

- When the nature of the proposed development or use is changed, for example if a residential development is proposed instead of a commercial one;
- When the size or configuration of the proposed development is altered;
- When the location or orientation of the proposed structure is modified;
- When there is a change of ownership; or
- For application to an adjacent site.

The circumstances about a particular development or contract may require a specified approach to the assessment of soil and groundwater conditions.

To help avoid costly problems, refer to your consultant to determine how any factors which have changed subsequent to the date of the report may affect our recommendations.

6.2. Geotechnical ‘Findings’ are Professional Estimates

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing is interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions and the nature and homogeneity of subsurface conditions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration programme, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise its impact. For this reason, owners should retain the services of their consultants through the development stage, to identify variations, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site or during the tender process.

A report prepared for the purposes of the geotechnical engineer's direct client may not meet the objectives of a third party or contractor. Consult the geotechnical engineer for guidance in the application of the report to your purposes.

6.3. Unforeseen Conditions

Should conditions encountered on site be markedly different from those anticipated and described in this report then FMG Engineering should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows reinterpretation and assessment of the implications for future work.

6.4. Safety in Design

This Geotechnical Report presents factual information about the soil conditions at the subject site. This may be used for design purposes. At the time that this report was prepared, FMG Engineering were not informed of the details at the proposed building (workplace) to be constructed. Consequently, FMG Engineering have not carried out a Preliminary Hazard Analysis nor been able to consider Safety in Design for the proposed development. It is the responsibility of the designer to use the information contained within this report when undertaking a Safety in Design assessment for the specific development.

Please contact FMG Engineering if Safety in Design analysis is required as the project develops.

Appendix A

Site Plan

REV	DESCRIPTION	DATE	INIT	APP
A	FINAL ISSUE	16.06.2017	AJR	NB

SIGNATURE

CONTRACTORS MUST SET OUT ALL WORK AND VERIFY ALL CONDITIONS, LEVELS AND DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF ANY WORK OR MAKING OF ANY SHOP DRAWINGS.
ALL WORK MUST BE EXECUTED IN ACCORDANCE WITH THE RULES, REGULATIONS, BY LAWS AND REQUIREMENTS OF ALL AUTHORITIES HAVING JURISDICTION OVER ANY PART OF THE WORK.
THIS DRAWING IS NOT TO BE USED FOR DIMENSIONAL SETOUT.

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CIVIL | STRUCTURAL | ENVIRONMENTAL | GEOTECHNICAL | BUILDING ASSESSMENT & FORENSIC | SOIL & MATERIAL TESTING | HOUSING | COMMERCIAL | PROJECT MANAGEMENT | SURVEY

CLIENT: LMS Energy
TITLE: GEOTECHNICAL INVESTIGATION
SITE ADDRESS: Pedler Creek Landfill, Wheaton Road, McLaren Vale, SA
DRAWING TITLE: SITE INVESTIGATION LOCATION PLAN

DESIGNED: AJR	DRAWN: AJR
CHECKED: NB	No. OF SHEETS: 1/1
SCALE: NTS @ A4	DATE STARTED: 16/06/2017
SITE ID & JOB No.: S35819/255991	REV.: A
DRAWING No.: BH1	

Appendix B

Borelogs

Borehole No.

BH01

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272678.00 mE , 6101740.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered					FILL	FILL SANDY GRAVEL: grey yellow blue; gravel, angular, up to 30mm; moist; loose; trace plastic.	M	L	0.3%		FILL
							FILL	FILL SANDY CLAY: grey brown orange; of low plasticity; with gravel; gravel, angular, up to 10mm; moist; firm.	M	F	1%		FILL
				83	1		FILL	WASTE FILL (DOMESTIC REFUSE) GRAVELLY SAND: black orange; of low plasticity; with clay; gravel, angular, up to 20mm; moist; firm; hydrocarbon odour. Hole Terminated at 1.50m - Target depth	M	F	0.5%		FILL
				82	2								
				81	3								

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH02

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272674.00 mE , 6101740.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL GRAVEL: grey brown; of low plasticity, trace clay / sand; gravel, angular, up to 50mm; moist; loose.	M	L	0.3%		FILL
							FILL	FILL CLAY: grey brown; of medium plasticity; with gravel; gravel, angular, up to 10mm; moist; firm.	M	F	1.5%		FILL
							FILL	FILL GRAVELLY CLAY: pale grey; of low to medium plasticity; gravel, sub-rounded to angular, up to 5mm; moist; firm.	M	F	1%		FILL
							FILL	WASTE FILL (DOMESTIC REFUSE) GRAVELLY SAND: black grey; of low plasticity; with clay; gravel, angular, up to 10mm; moist; firm; strong odour.	M	F	0.5%		FILL
				82	2			Hole Terminated at 1.50m - Target depth					
				81	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

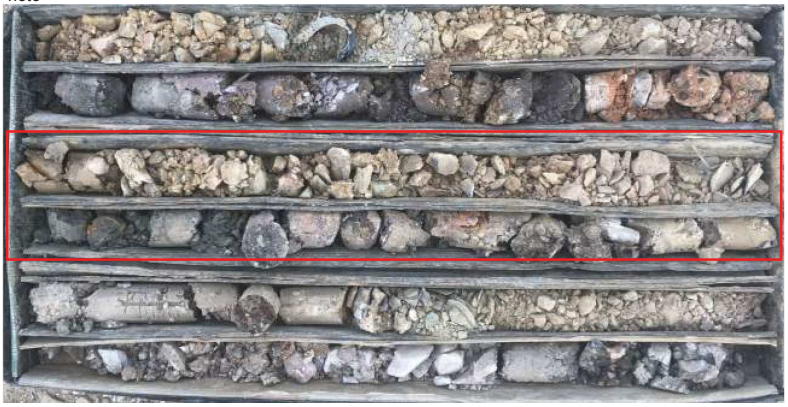
Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to
refusal

Photo



Borehole No.

BH03

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272668.00 mE , 6101743.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL GRAVEL: grey yellow brown, trace clay / sand; gravel, angular, up to 50mm; moist; loose.	M	L	0%		FILL
							FILL	FILL GRAVELLY CLAY: dark brown orange; of low plasticity; gravel, sub-rounded to angular, up to 10mm; moist; firm.	M	F	1%		FILL
							FILL	WASTE FILL (DOMESTIC REFUSE) GRAVELLY SAND: black grey; of low plasticity; with clay; moist; firm.	M	F	0.5%		FILL
							FILL	FILL GRAVEL: pale grey; of low plasticity; with clay / sand; gravel, angular, up to 50mm; dry; loose. Hole Terminated at 1.50m - Target depth	D	L	0.3%		FILL
				82	2								
				81	3								

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

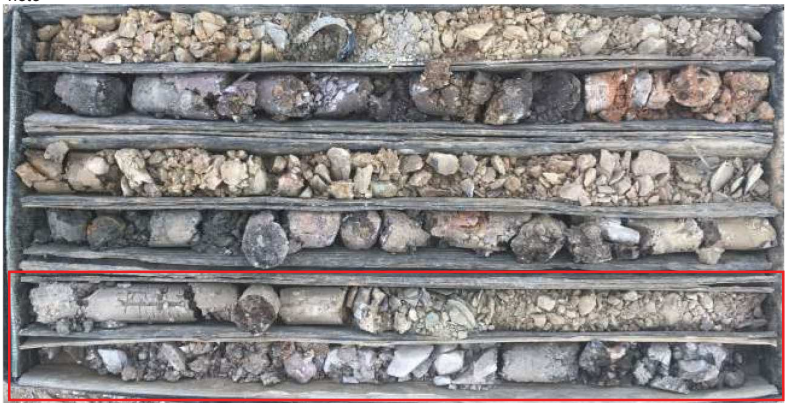
Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo



Borehole No.

BH04

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272659.00 mE , 6101749.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL SANDY GRAVEL: grey brown orange; gravel, angular, up to 20mm; sand, fine to coarse grained; dry; loose.	D	L	0%		FILL
							FILL	FILL GRAVEL: brown grey; with clay / sand; gravel, sub-rounded to angular, up to 30mm; moist; loose.	M	L	0.3%		FILL
							FILL	WASTE FILL (DOMESTIC REFUSE) GRAVELLY CLAY: grey brown orange yellow black; of low plasticity; with sand; gravel, angular, up to 40mm; moist; firm. Hole Terminated at 1.40m - Refusal	M	F	1%		FILL
				82	2								
				81	3								

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH05

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272648.00 mE , 6101756.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL SANDY GRAVEL: grey brown orange; gravel, angular, up to 20mm; dry; loose.	D	L	0.5%		FILL
							FILL	FILL GRAVEL: brown grey; of low plasticity; with clay / sand; gravel, sub-rounded to sub-angular, up to 30mm; moist; loose.	M	L	0%		FILL
							FILL	FILL GRAVELLY CLAY: brown purple grey; of low plasticity; gravel, angular, up to 40mm; moist; firm.	M	F	0.5%		FILL
							FILL	FILL SAND: brown yellow orange; with clay / gravel; gravel, angular, up to 10mm; moist; loose.	M	L	0%		FILL
				82	2	C/L		inferred loose fill (refuse) falling out of tube			0%		
				81	3	C/L		Hole Terminated at 3.20m - Collapse					

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance range to refusal

Photo

Borehole No.

BH06

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272635.00 mE , 6101765.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL SANDY GRAVEL: brown light purple; of low to medium plasticity; with clay, trace cobbles; gravel, angular, up to 50mm; cobbles, up to 63mm; dry to moist; loose.	D to M	L	0.5%		FILL
							FILL	FILL SANDY GRAVEL: grey blue; gravel, angular, up to 5mm; sand, fine to coarse grained; moist; loose.	M	L	0%		FILL
							SM	CLAYEY SILTY SAND: cream brown orange; of low plasticity; with gravel; sand, medium grained; gravel, angular, up to 20mm, sandstone; moist; medium dense.	M	MD	0.5%		COLLUVIUM
				82	2		GW	SANDY GRAVEL: grey yellow orange; gravel, angular, up to 50mm; sand, medium to coarse grained; moist; dense; (highly weathered sandstone).	M	D	0%		EXTREMELY WEATHERED ROCI
								Highly weathered; orange red; SANDSTONE; moderately strong; recovered as fragmented pieces with sand to 20mm			0%		BEDROCK
				81	3			Hole Terminated at 3.00m - Refusal					

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance
range to refusal

Photo

Borehole No.

BH07

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272639.00 mE , 6101761.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL GRAVEL: grey brown; gravel, angular, up to 50mm; dry; loose.	D	L	0%		FILL
							FILL	FILL GRAVELLY CLAY: pale purple grey; of low to medium plasticity; gravel, angular, up to 20mm; moist; firm.	M	F	1%		FILL
						C/L C C/L		inferred loose refuse fill			0%		
							FILL	WASTE FILL (DOMESTIC REFUSE): black; moist; loose; strong odour.	M	L	0%		FILL
				82	2			Highly weathered; cream yellow orange; SANDSTONE; moderately strong; recovered as fragmented pieces with sand Hole Terminated at 2.05m - Refusal			0%		BEDROCK
				81	3								

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH08

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272617.00 mE , 6101732.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	83.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		82	1		FILL	FILL SANDY GRAVEL: pale purple brown; dry; loose.	D	L	0%		FILL
							FILL	FILL SANDY CLAY: pale purple grey; of low plasticity; moist; firm.	M	F	1%		FILL
							FILL	FILL SANDY GRAVEL: pale grey brown; gravel, angular, up to 20mm; dry; loose.	D	L	0%		FILL
							FILL	FILL GRAVELLY CLAY: grey brown orange yellow; of low plasticity; gravel, angular, up to 20mm; moist; firm to stiff.	M	F to St	1%		FILL
							SC	CLAYEY SILTY SAND: brown; of low plasticity; sand, fine grained; moist; medium dense.	M	MD	0.5%		COLLUVIUM
				81	2		SC	CLAYEY SAND: grey cream yellow; of low plasticity; with gravel; sand, fine to medium grained; gravel, angular, up to 10mm; moist; dense; extremely weathered sandstone.	M	D	0.5%		EXTREMELY WEATHERED ROCI
				80	3			Highly weathered; pale grey yellow orange red; SANDSTONE; moderately strong; recovered as fragmented pieces			0.3%		BEDROCK
								Hole Terminated at 4.00m - Target depth					

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance
range to
refusal

Photo

Borehole No.

BH09

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272626.00 mE , 6101741.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	83.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		82	1		FILL	FILL GRAVEL: pale purple brown; of low plasticity; with clay; gravel, angular, up to 60mm; dry; loose to firm; trace rubbish.	D	L to F	0.3%		FILL
				81	2		FILL	WASTE FILL (DOMESTIC REFUSE): black; moist; loose.	M	L	0%		FILL
				80	3			Highly weathered; cream orange yellow red; SILTSTONE; moderately strong; recovered as fragmented pieces, with clay			0.3%		BEDROCK
								Hole Terminated at 4.00m - Target depth					

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH10

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272632.00 mE , 6101750.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	83.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		82	1		FILL	FILL GRAVEL: pale grey brown; of low plasticity; with clay; gravel, angular, up to 60mm; dry to moist; loose; trace rubbish.	D to M	L	0%		FILL
				81	2		FILL	FILL SILTY CLAY: brown black; of low plasticity; moist; soft; organic.	M	S	1%		FILL
				80	3			Highly weathered; pale grey yellow orange; SILTSTONE; moderately strong; recovered as fragmented pieces, trace clay Hole Terminated at 4.00m - Target depth			0.3%		BEDROCK

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH11

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272645.00 mE , 6101775.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered					FILL	FILL GRAVEL: pale grey brown; with clay; gravel, angular, up to 60mm; dry; loose; trace rubbish.	D	L	0%		FILL
							FILL	FILL GRAVELLY CLAY: grey yellow; of low plasticity; gravel, angular, up to 30mm; moist; firm.	M	F	1%		FILL
							FILL	WASTE FILL (DOMESTIC REFUSE) SANDY GRAVEL: black; moist; loose; strong odour.	M	L	0%		FILL
							FILL		D	H	0%		FILL
				83	1			CONCRETE COBBLES: grey; dry; hard; inferred based on refusal.					
								Hole Terminated at 1.00m - Refusal					
				82	2								
				81	3								

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance
range to refusal

Photo

NO PHOTO

Borehole No.

BH12

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272659.00 mE , 6101795.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered					FILL	FILL SANDY GRAVEL: grey brown; of low plasticity; with clay; gravel, angular, up to 30mm; moist; loose.	M	L	0.3%		FILL
							FILL	FILL GRAVELLY CLAY: pale grey brown; of low to medium plasticity; gravel, angular, up to 35mm; moist; firm to stiff.	M	F to St	1%		FILL
				83	1		FILL	FILL SANDY GRAVEL: pale grey yellow; of low plasticity; with clay / silt; gravel, angular, up to 60mm; dry; loose; trace plastic / rubbish.	D	L	0.5%		FILL
				82	2		FILL	WASTE FILL (DOMESTIC REFUSE): black; dry; loose; strong odour; poor recovery.	D	L	0%		FILL
				81	3			Hole Terminated at 3.20m - Collapse					

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH13

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272645.00 mE , 6101787.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL GRAVELLY CLAY: grey brown yellow red; of low plasticity; gravel, angular, up to 60mm; moist; loose to firm.	M	L to F	1%		FILL
							FILL	FILL SANDY GRAVEL: grey blue; gravel, angular, up to 5mm; moist; loose.	M	L	0%		FILL
				82	2			Highly weathered; pale yellow orange; SILTSTONE; moderately strong; recovered as clayey sandy gravel Hole Terminated at 2.15m - Refusal			0.3%		BEDROCK
				81	3								

Method
PT - Push tube

Consistency / Relative Density
VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition
D - Dry
M - Moist
W - Wet

Water
Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Plastic Limit
> PL
= PL
< PL

Penetration
No resistance
range to refusal

Photo

Borehole No.

BH14

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272656.00 mE , 6101783.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL SANDY GRAVEL: brown; gravel, sub-rounded to angular, up to 20mm; moist; loose.	M	L	0%		FILL
							FILL	FILL CLAYEY SAND: grey brown; of low plasticity; with gravel; gravel, angular, up to 40mm; moist; loose to medium dense.	M	L to MD	0.5%		FILL
							FILL	FILL SAND: yellow; sand, medium grained; moist; loose; with rubbish.	M	L	0%		FILL
				82	2		FILL	FILL GRAVELLY CLAY: grey brown; of low plasticity; gravel, angular, up to 40mm; moist; firm.	M	F	1%		FILL
							FILL	WASTE FILL (DOMESTIC REFUSE): black; moist; loose; strong odour; poor recovery.	M	L	0%		FILL
				81	3	C/L C/L C/L C/L C/L		inferred loose refuse fill Hole Terminated at 4.00m - Target depth			0%		

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH15

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272623.00 mE , 6101760.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL SANDY GRAVEL: grey brown; gravel, angular, up to 30mm; dry; loose.	D	L	0%		FILL
							GW	CLAYEY SANDY GRAVEL: grey yellow orange red; of low plasticity; gravel, angular, up to 30mm, sandstone; moist; firm; extremely weathered sandstone.	M	F	0.5%		COLLUVIUM
				82	2			Completely weathered; yellow orange; SANDSTONE; moderately strong; recovered as clayey sand with gravel, angular to 40mm			0.5%		EXTREMELY WEATHERED ROCI
				81	3			Completely weathered; brown yellow orange red; SANDSTONE; weak; recovered as sand with gravel, angular to 30mm Hole Terminated at 4.00m - Target depth			0%		EXTREMELY WEATHERED ROCI

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borehole No.

BH16

Page 1 of 1

Engineering Log - Borehole

Project No.: 255991

Client:	LMS Energy	Commenced:	15/06/2017
Project Name:	Pedler Creek Landfill	Completed:	15/06/2017
Hole Location:	See Site Plan	Logged By:	AR
Hole Position:	272605.00 mE , 6101739.00 mN Coordinate System: MGA94 UTM 54H	Checked By:	NB
Drill Model:	Rockmaster	RL Surface:	84.00m
Drill Operator:	SPK GeoDrill Pty Ltd Hole Diameter: 50mm	Datum:	AHD

Drilling Information						Soil Description							Observations
Method	Penetration	Water	Samples Tests Remarks	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	Moisture Condition	Consistency / Relative Density	Estimated Ipt	Pocket Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
PT		Groundwater Not Encountered		83	1		FILL	FILL SANDY GRAVEL: blue grey brown; dry; loose.	D	L	0%		FILL
							FILL	FILL CLAY: brown; of low plasticity; with gravel; moist; very stiff.	M	VSt	1%		FILL
							SC	CLAYEY SAND: pale grey yellow; with gravel; sand, fine to medium grained; gravel, angular, up to 30mm, siltstone; moist; medium dense to dense; extremely weathered sandstone / siltstone.	M	MD to D	0.5%		COLLUVIUM
								Completely weathered; grey white; SILTSTONE; moderately strong; recovered as clayey silt			0.5%		EXTREMELY WEATHERED ROCI
								Highly weathered; pale yellow; SILTSTONE; moderately strong; recovered as fragmented pieces			0%		BEDROCK
				82	2			Hole Terminated at 1.70m - Refusal					
				81	3								

Method

PT - Push tube

Consistency / Relative Density

VS - Very Soft
S - Soft
F - Firm
Vst - Very Stiff
H - Hard
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Samples and Tests

U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
PP - Pocket Penetrometer

Moisture Condition

D - Dry
M - Moist
W - Wet

Water

Level (Date)
Inflow
Partial Loss
Complete Loss

Classification Symbols and Soil Descriptions

Based on Unified Soil Classification System

Plastic Limit

> PL
= PL
< PL

Penetration

No resistance range to refusal

Photo

Borelogs and Laboratory Test Results

Soil Description Notes

The dominant soil constituents are given in capital letters followed by secondary textures. The dominant feature is determined from the Unified Soil Classification System and a soil symbol is used to define a soil layer as follows:

USC Symbol	Symbol Meaning
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
MH	Silty of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peaty soil

The appropriate symbols are selected on the results of visual examination, field tests and available laboratory tests, such as, sieve analysis, liquid limit and plasticity index.

Plasticity

The potential for undergoing change in volume with moisture change is assessed from its degree of plasticity. The classification of the degree of plasticity in terms of the Liquid Limit (%) is as follows:

Description of Plasticity	Liquid Limit (%)
Low	<35
Medium	>35 - <50
High	>50

Condition

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are fixed by the shear strength of the soil as observed visually by the pocket penetrometer values and resistance to deformation to hand moulding.

Relative density terms such as very loose, loose, medium, dense and very dense are used to describe silt and sandy materials, and these are usually based on resistance to drilling penetration. Other condition terms, such as friable, powdery or crumbly may also be used.

Moisture Content

For cohesive soils, the following code is used:

Symbol	Plastic Condition	Moisture Condition
MC≈LL	Moisture content near the liquid limit	Moist to wet
MC<LL	Moisture content less than liquid limit	Moist to wet
MC>PL	Moisture content greater than plastic limit	Damp to moist
MC≈PL	Moisture content near the plastic limit	Damp to moist
MC<≈PL	Moisture content less than or equal to plastic limit	Dry to damp to moist
MC<PL	Moisture content less than plastic limit	Dry to damp
MC«PL	Moisture content much less than plastic limit	Dry

For cohesionless soils, the following code is used:

Moisture Condition	Degree of Saturation
Dry	0
Humid	1 to 25
Damp	25 to 50
Moist	50 to 75
Wet	75 to 99
Saturated	100

Cohesive Consistency – Pocket Penetrometer (PP)

The instrument is used in the field or the laboratory to provide approximate determination of unconfined compressive strength of cohesive soils. The values are recorded in kPa, as follows:

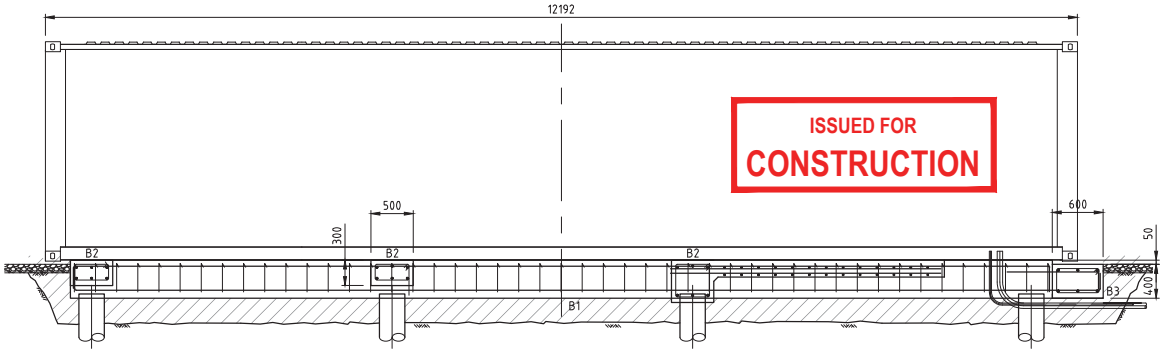
Strength	Symbol	Readings (kPa)
Very soft	VS	<25
Soft	S	25 to 50
Firm	F	50 to 100
Stiff	St	100 to 200
Very stiff	VSt	200 to 400
Hard	H	>400

ENGINEERING
incorporating
BURNS HAMILTON

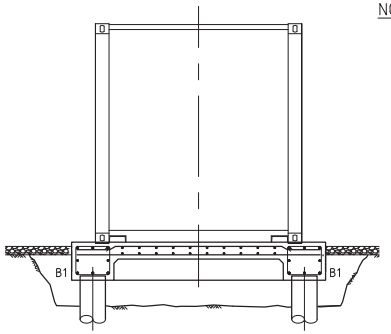
Appendix C

LMS Supplied Information

ISSUED FOR CONSTRUCTION



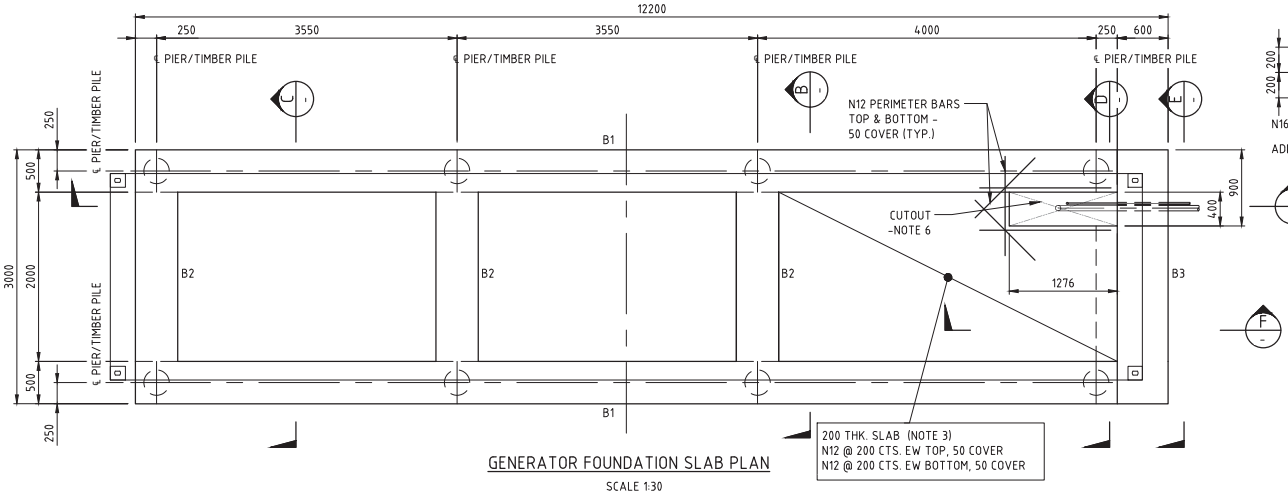
SECTION A
SCALE 1:30



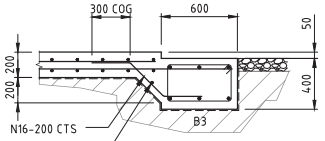
SECTION B
SCALE 1:30

NOTES:

1. FOR GENERAL CIVIL AND CONCRETE NOTES REFER TO DRG. 18122-40-001. THIS FOUNDATION IS DESIGNED FOR 27t MAX. WEIGHT, FOR JENBACHER PLANT CONTAINER STYLE GENERATORS.
2. IN-SITU CONCRETE SHALL BE GRADE N32 (f'c=32 MPa @ 28 DAYS).
3. TOP OF CONCRETE AND LOCATION OF THE GENERATOR SLAB TO BE DETERMINED BY LMS ENERGY. CONTRACTOR SHALL NOT COMMENCE WORK UNTIL LOCATION AND TOP OF CONCRETE OF THE SLAB IS SET.
4. SUBGRADE AT ALL SLAB LOCATIONS SHALL BE PREPARED AS PER DRG: 18122-40-001 (SECTION B3,4,5,10 & 11) FOR SLABS FOUND DIRECTLY ON GRADE.
5. CARE SHALL BE TAKEN BY THE CONTRACTOR IN LIAISON WITH LMS ENERGY SITE REPRESENTATIVE WHEN EXCAVATING STEEP BATTERS. EXCAVATION NOT TO EXTEND 500mm BEYOND THE PERIMETER OF FOUNDATION SLAB EXTENTS.
6. LOCATION OF CUT OUTS IN SLAB SHOWN INDICATIVELY ONLY. ACTUAL LOCATION AND SIZE OF THE CUT OUTS TO BE SITE DETERMINED. CONTRACTOR TO BOX AROUND CUT OUT AS PER LMS ENERGY REQUIREMENTS UPON INSTALLATION OF CONDUITS.
7. 4.5m PILE DEPTH IN FINE GRAINED SOILS IS EXPECTED IN GENERAL AS PER GEOTECHNICAL REPORT (WYNDHAM REF GEOTECHNICAL INVESTIGATION" DATED NOV/2014, T&T REF: 4539.000R1). IF ROCK IS ENCOUNTERED (COULD BE HIGHLY WEATHERED BASALT ROCK), TRUNCATE THE PILE BUT, SLOT THE BASE OF THE PILE 300mm INTO THE ROCK AS A MINIMUM. OVERALL LENGTH OF THE PIER SHALL BE 5000mm OR INCREASED/DECREASED UNTIL BASALT ROCK IS ENCOUNTERED AND PILE SHALL BE SLOT INTO ROCK (MIN. 300mm SLOT). INSTALLATION OF PIER TO COMPLY WITH AS 2159.
8. MIN. PILE DEPTH OF 5.0m WITH MIN. 0.5m INTO NATURAL SILTY CLAY AT DRYSDALE SITE AS PER GEOTECHNICAL REPORT FROM CHADWICK T&T PVT. LTD (DOC NO. 405056.000r1).
9. SUITABILITY OF TIMBER PILES AT WYNDHAM & DRYSDALE SITES SHALL BE CONFIRMED AND APPROVED BY RELEVANT GEOTECHNICAL ENGINEER FOR EACH SITE. AS GEOTECHNICAL REPORTS FOR THESE SITES, GENERALLY RECOMMEND USE OF BORED PIERS.



GENERATOR FOUNDATION SLAB PLAN
SCALE 1:30



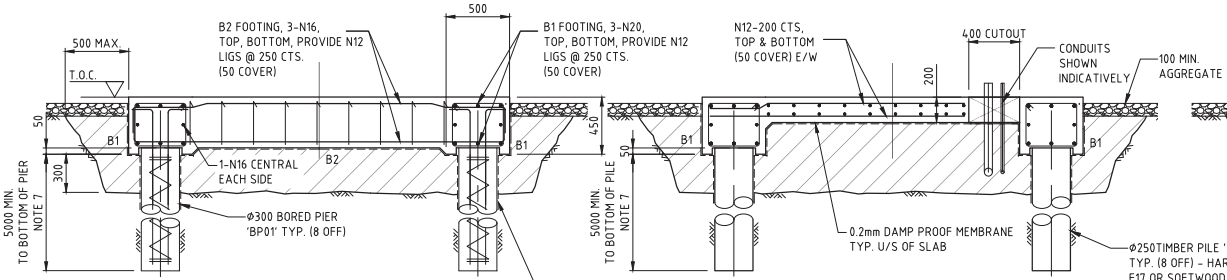
SECTION F
SCALE 1:30

TABLE 1.0

SITE LOCATION	SOIL TYPE CLASSIFICATION AS PER AS2870-2011	MIN. EXCAVATION "H"(mm)
OTHER SITES	M	800
COPPING SITE	H1	1000
WYNDHAM SITE & DRYSDALE SITE	P	BORED PIERS AND/OR TIMBER PILES (NOTE 7 , 8 & 9)

BORED PIER/TIMBER PILE LIST

ITEM	DESCRIPTION	QUANTITY	WORKING LOAD AXIAL (KN)	WORKING LOAD LATERAL (KN)	NOTES
BP01	ϕ300mm CONCRETE BORED PIERS	8	125	13	NOTE 7,8
TP01	ϕ250mm TIMBER PILES	8	125	13	NOTE 9



SECTION C
SCALE 1:20

OPTION 1 – BORED PIER DETAILS

SECTION D
SCALE 1:20

OPTION 2 – TIMBER PILE DETAILS

SECTION E
SCALE 1:20

DESIGN IN PROGRESS

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION
0	19/03/18	GPA	NKB	AM	IIK	ISSUED FOR CONSTRUCTION

REVISIONS

DRAWING NUMBER	DESCRIPTION
18122-40-002	CONCRETE DETAILS - SHT 01
18122-40-001	CIVIL & CONCRETE GENERAL NOTES

REFERENCE DRAWINGS

LMS ENERGY

DRAWN:	GPA
DATE:	08/03/18
DESIGN:	NKB
DATE:	08/03/18
APPRVD:	IIK
DATE:	08/03/18
A.B.N.	39 059 428 474

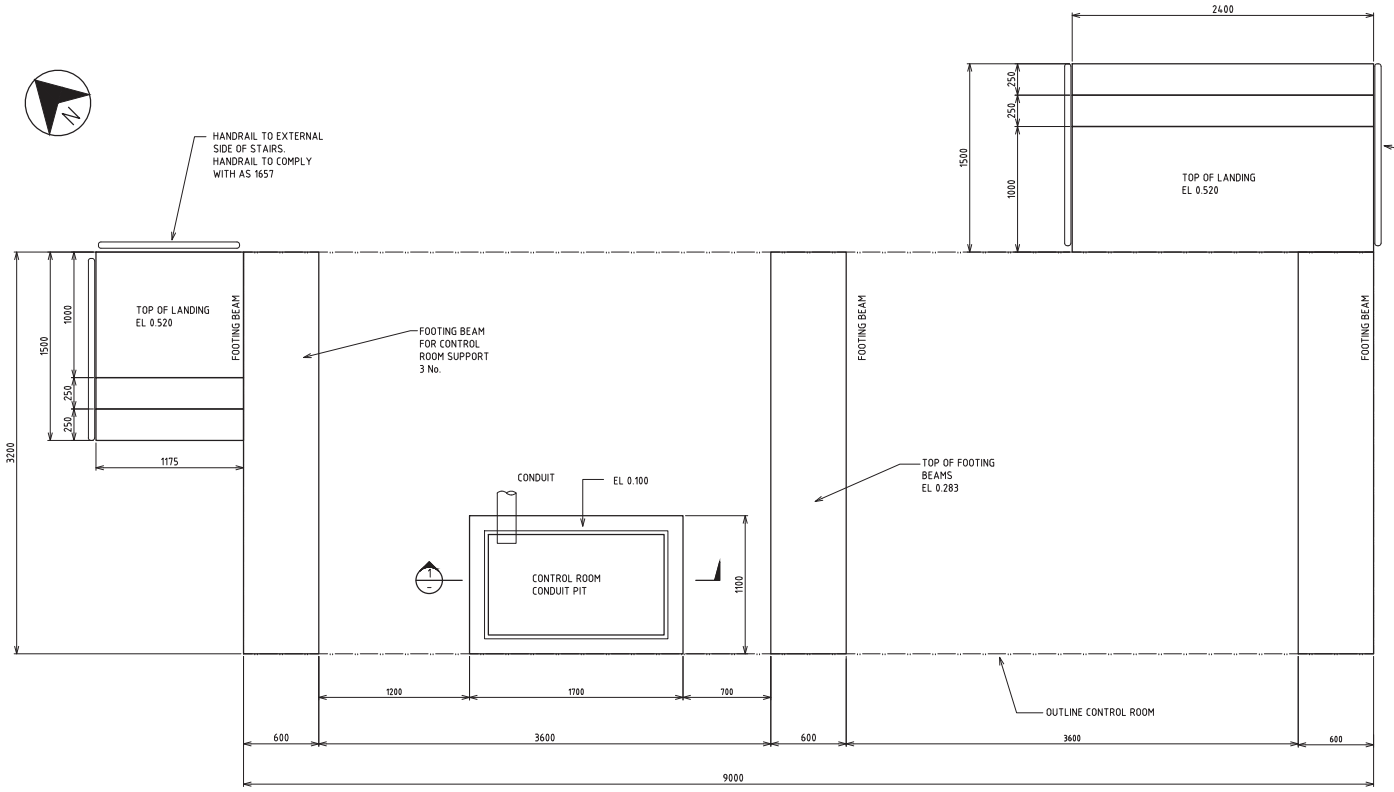
GE JENBACHER PLANTS

GENERATOR SLAB ON BORED PIERS/TIMBER PILES CONCRETE DETAILS – SHT 02

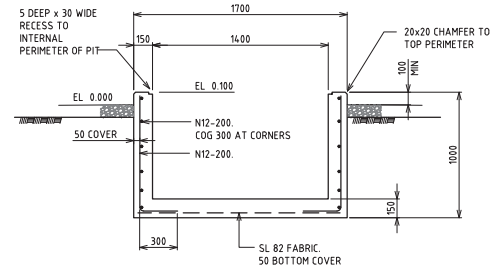
SCALE	DRAWING NUMBER	PAGE	SIZE	REV
1:50, 1:20	18122-40-003	1 OF 2	A1	0

LAST PLOTTED TIME: xx PLOTTED DATE: xx LAST MODIFIED TIME: xx MODIFIED DATE: xx

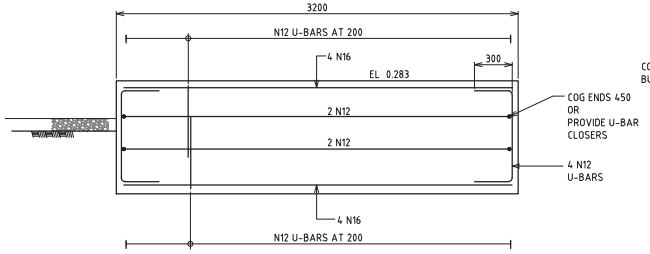
NOTES.
1. GENERAL NOTES - REFER TO DRG No 40024-CA-008
2. CONCRETE GRADE N32
3. COVER TO REINFORCEMENT AS NOTED
4. FOUNDATIONS TO BE CAST ON FILL HAVING A MIN SAFE BEARING CAPACITY OF 75 kPa. REFER TO THE LMS ENGINEER FOR APPROVAL PRIOR TO LAYING OF REINFORCEMENT AND CASTING CONCRETE.
5. REFER TO DRG No 40024-CA-012 FOR SITE PREPARATION NOTES.



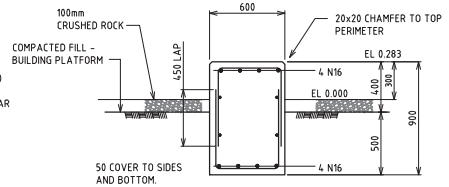
CONTROL ROOM FOOTINGS - PLAN - (ITEM 5)
SCALE 1:20



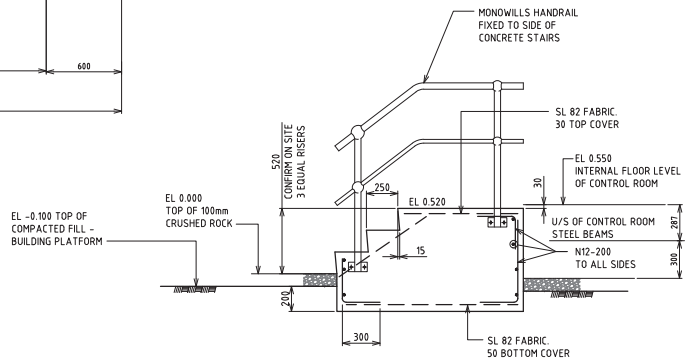
Section 1
Scale 1:20



FOOTING BEAM - ELEVATION
SCALE 1:20



FOOTING BEAM - SECTION
SCALE 1:20



STAIR - SECTION
SCALE 1:20

FACET
CONSULTING ENGINEERS
CIVIL STRUCTURAL FACADE ENGINEERS
TELEPHONE 07) 3867 1055
FAX 07) 3857 7599
1 LOGUE ROAD, WOOLLOONGABBA
BRISBANE QLD. 4178.

APPROVED FOR CONSTRUCTION

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION
0	10.11.2016	KJ	GW	DM	DM	ISSUED FOR CONSTRUCTION

REVISIONS

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION

REVISIONS

DRAWING NUMBER	DESCRIPTION

REFERENCE DRAWINGS

LMS ENERGY

DRAWN:	KJ
DATE:	NOV 2016
DESIGN:	GW
DATE:	07.11.16
APPRVD:	DM
DATE:	07.11.16
A.B.N. 39 059 428 474	

LAST PLOTTED TIME: PLOTTED DATE: LAST MODIFIED TIME: MODIFIED DATE:

STAPYLTON RENEWABLE ENERGY FACILITY

PROPOSED SITE EXPANSION
CONTROL ROOM FOUNDATION DETAILS

SCALE	DRAWING NUMBER	PAGE	SIZE	REV
1:20	40024-CA-008	4 OF 5	A1	0

LEGEND

———	PIPEWORK ABOVE GROUND
~~	PIPEWORK BELOW GROUND
- - - - -	2m CHAINWIRE FENCE
CP	CABLE PIT
GM	GENERATOR MODULE
LP	LIGHTNING POLE
T1	TELEPHONE LINE ISOLATION UNIT
T2	TELEPHONE LINE ISOLATION UNIT

N

2 1 0 2 4 6 8m

SCALE 1:100 FOR A1
SCALE 1:200 FOR A3

DESIGN IN PROGRESS

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION
C	10/05/18	JRH	JRH			REVISED TRANSFORMER LOCATION
B	18/04/18	JRH	JRH	DGM	DGM	REVISED BASED ON GEOTECH
A	26/04/17	OS	DGM			DIP – ORIGINAL ISSUE

REVISIONS

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION

REVISIONS

DRAWING NUMBER	DESCRIPTION

REFERENCE DRAWINGS

LMS ENERGY

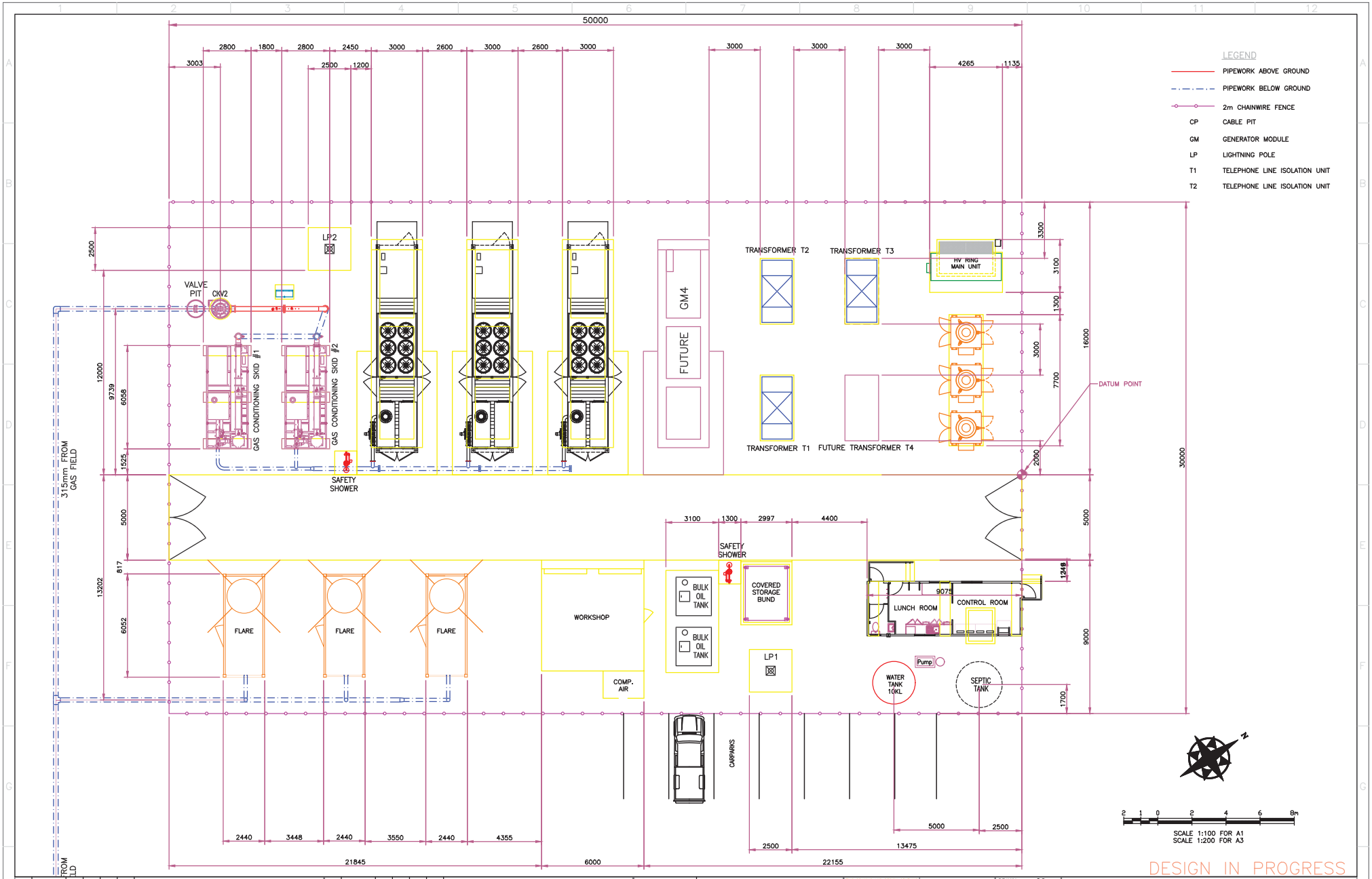
DRAWN:	OS
DATE:	26/04/17
DESIGN:	DGM
DATE:	26/04/17
APPRVD:	
DATE:	
A.B.N. 39 059 428 474	

LAST PLOTTED TIME: PLOTTED DATE: LAST MODIFIED TIME: MODIFIED DATE:

SEAFORD HEIGHTS RENEWABLE ENERGY FACILITY

POWER STATION
SITE LAYOUT

SCALE	DRAWING NUMBER	PAGE	SIZE	REV
1:200	50043–GA–001	2 of 2	A1	C



DESIGN IN PROGRESS

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION
C	10/05/18	JRH	JRH			REVISED TRANSFORMER LOCATION
B	18/04/18	JRH	JRH	DGM	DGM	REVISED BASED ON GEOTECH
A	26/04/17	OS	DGM			DIP – ORIGINAL ISSUE

REVISIONS

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION

REVISIONS

DRAWING NUMBER	DESCRIPTION

REFERENCE DRAWINGS

LMS ENERGY

DRAWN:	OS
DATE:	26/04/17
DESIGN:	DGM
DATE:	26/04/17
APPRVD:	
DATE:	
A.B.N.	39 059 428 474

SEAFORD HEIGHTS RENEWABLE ENERGY FACILITY

POWER STATION SITE LAYOUT

SCALE	DRAWING NUMBER	PAGE	SIZE	REV
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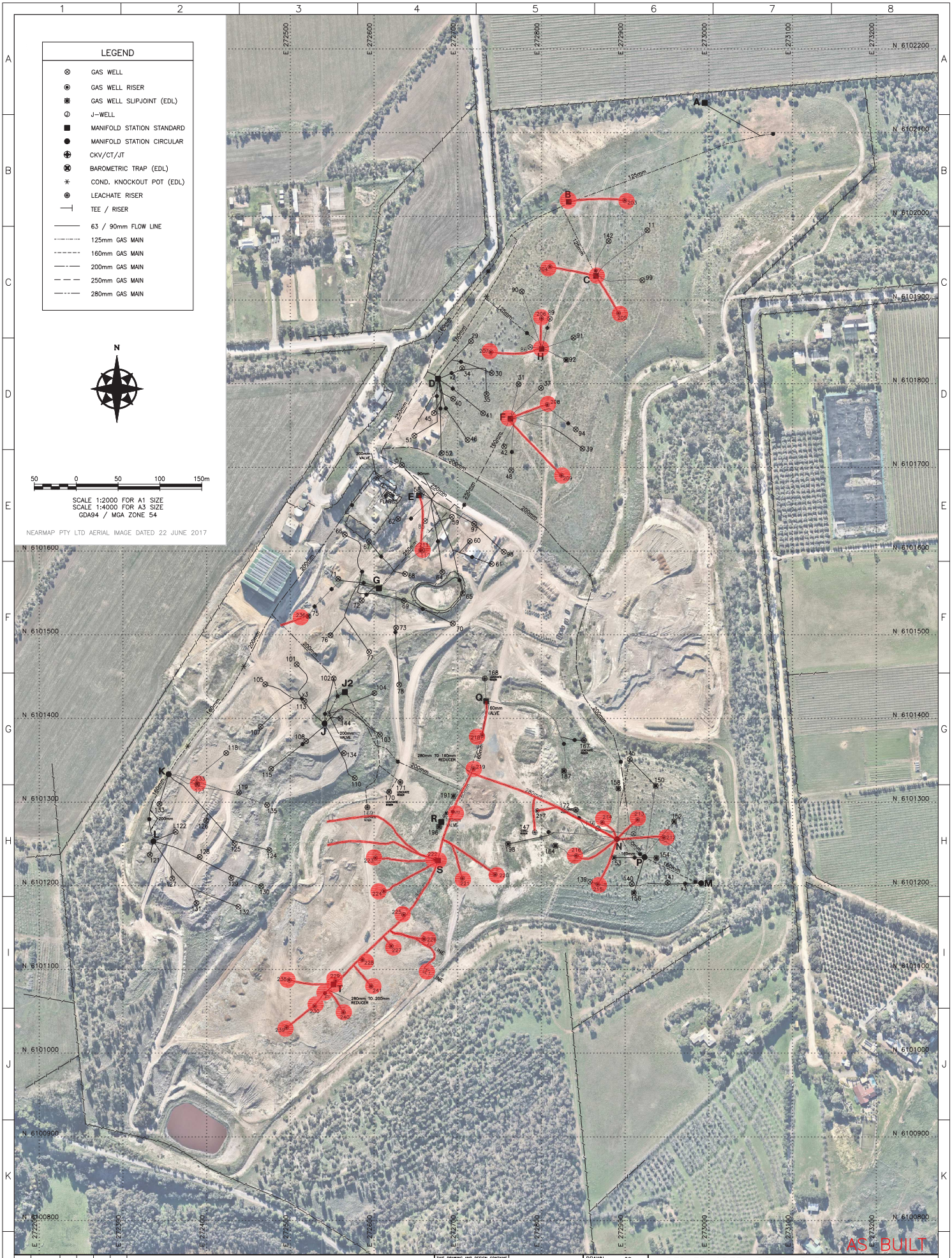
LAST PLOTTED TIME: PLOTTED DATE: LAST MODIFIED TIME: MODIFIED DATE:



No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION
						REVISIONS
1	15/06/17	OS	GF	GF	GF	WELLS 203-209, 211-230, 236 & 238-241 ADDED. STN'S S & T ADDED. 46 WELLS REMOVED.
0	14/12/16	OS	–	–	GF	GAS FIELD LAYOUT AS PER EDL DRAWING

LMS ENERGY

DRAWN:	OS
DATE:	14/12/16
DESIGN:	–
DATE:	–
APPRVD:	GF
DATE:	14/12/16
A.B.N. 39 059 428 474	

PEDLER CREEK RENEWABLE ENERGY FACILITY

GAS FIELD LAYOUT

SCALE	DRAWING NUMBER	PAGE	SIZE	REV
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LAST PLOTTED TIME: PLOTTED DATE: LAST MODIFIED TIME: MODIFIED DATE:

CO-ORDINATES				
DESCRIPTION	LOCATION	EASTING	NORTHING	DATE
A STATION	-	272995.633	6102135.577	-
B STATION	REBUILT	272832.791	6102017.364	Apr-17
C STATION	REBUILT	272865.422	6101928.892	Apr-17
D STATION	-	272676.730	6101805.830	-
E STATION	-	272653.989	6101666.485	-
F STATION	REBUILT	272765.821	6101759.681	Apr-17
G STATION	-	272606.249	6101555.530	-
H STATION	REBUILT	272800.635	6101841.518	Apr-17
I STATION	NO STATION	-	-	-
J STATION	-	272541.208	6101393.987	-
J2 STATION	-	272565.570	6101431.524	-
K STATION	-	272354.904	6101333.216	-
L STATION	-	272336.803	6101253.103	-
M STATION	-	272991.113	6101203.000	-
N STATION	-	272890.490	6101255.716	-
O STATION	NO STATION	-	-	-
P STATION	-	272923.459	6101234.109	-
Q STATION	-	272735.622	6101422.553	-
R STATION	-	272680.761	6101276.467	-
S STATION	-	272676.934	6101230.136	Apr-17
T STATION	-	272552.120	6101082.206	Apr-17
JW1	REMOVED	-	-	-
1	REMOVED	-	-	-
2	REMOVED	-	-	-
3	REMOVED	-	-	-
4	REMOVED	-	-	-
5	REMOVED	-	-	-
6	REMOVED	-	-	-
7	REMOVED	-	-	-
8	REMOVED	-	-	-
9	REMOVED	-	-	-
10	REMOVED	-	-	-
11	C STATION	272926.790	6101983.222	-
12	REMOVED	-	-	-
13	REMOVED	-	-	-
14	REMOVED	-	-	-
15	REMOVED	-	-	-
16	-	NO WELL	NO WELL	-
17	REMOVED	-	-	-
18	REMOVED	-	-	-
19	REMOVED	-	-	-
20	-	NO WELL	NO WELL	-
21	-	NO WELL	NO WELL	-
22	REMOVED	-	-	-
23	REMOVED	-	-	-
24	REMOVED	-	-	-
25	-	NO WELL	NO WELL	-
26	REMOVED	-	-	-
27	REMOVED	-	-	-
28	REMOVED	-	-	-
29	D STATION	272716.193	6101850.735	-
30	D STATION	272740.869	6101812.540	-
31	F STATION	272772.940	6101799.221	-
32	REMOVED	-	-	-
33	REMOVED	-	-	-
34	D STATION	272705.631	6101818.389	-
35	D STATION	272734.674	6101787.642	-
36	-	NO WELL	NO WELL	-
37	F STATION	272799.747	6101794.714	-
38	REMOVED	-	-	-
39	F STATION	272849.301	6101722.378	-
40	D STATION	272694.876	6101781.860	-
41	D STATION	272730.650	6101764.637	-
42	F STATION	272755.803	6101724.891	-
43	REMOVED	-	-	-
44	REMOVED	-	-	-
45	D STATION	272671.769	6101764.707	-
46	D STATION	272712.019	6101732.703	-
47	REMOVED	-	-	-
48	F STATION	272764.406	6101696.297	-
49	REMOVED	-	-	-
50	REMOVED	-	-	-
51	D STATION	272648.438	6101737.867	-
52	D STATION	272681.097	6101716.840	-
53	REMOVED	-	-	-
54	REMOVED	-	-	-
55	REMOVED	-	-	-
56	-	NO WELL	NO WELL	-
57	E STATION	272633.709	6101702.731	-
58	E STATION	272657.522	6101668.835	-
59	E STATION	272693.208	6101640.857	-
60	E STATION	272714.613	6101611.711	-
61	E STATION	272740.834	6101584.318	-
62	E STATION	272628.995	6101638.448	-
63	REMOVED	-	-	-
64	E STATION	272681.990	6101574.751	-
65	E STATION	272706.283	6101549.252	-
66	G STATION	272565.368	6101619.489	-
67	G STATION	272594.169	6101611.505	-
68	G STATION	272637.392	6101572.722	-
69	G STATION	272635.911	6101540.512	-
70	G STATION	272694.447	6101513.293	-
71	G STATION	272557.315	6101566.769	-
72	G STATION	272585.634	6101540.891	-
73	G STATION	272626.621	6101508.338	-
74	-	NO WELL	NO WELL	-
75	G STATION	272521.972	6101521.896	-
76	G STATION	272548.196	6101499.184	-
77	G STATION	272594.445	6101479.603	-
78	G STATION	272630.338	6101440.235	-
79	-	NO WELL	NO WELL	-
80	-	NO WELL	NO WELL	-
81	-	NO WELL	NO WELL	-
82	-	NO WELL	NO WELL	-

CO-ORDINATES				
DESCRIPTION	LOCATION	EASTING	NORTHING	DATE
83	-	NO WELL	NO WELL	-
84	-	NO WELL	NO WELL	-
85	E STATION	272661.342	6101635.695	-
86	H STATION	272786.947	6101843.509	-
87	REMOVED	-	-	-
88	REMOVED	-	-	-
89	H STATION	272810.415	6101877.646	-
90	H STATION	272776.762	6101910.132	-
91	H STATION	272838.633	6101854.867	-
92	H STATION	272829.787	6101828.264	-
93	REMOVED	-	-	-
94	F STATION	272841.214	6101745.300	-
95	REMOVED	-	-	-
96	-	NO WELL	NO WELL	-
97	E STATION	272719.842	6101632.564	-
98	E STATION	272755.286	6101599.118	-
99	C STATION	272920.911	6101923.586	-
100	REMOVED	-	-	-
101	J STATION	272507.933	6101464.497	-
102	J STATION	272552.188	6101447.633	-
103	J STATION	272607.350	6101380.806	-
104	J STATION	272600.848	6101430.153	-
105	J STATION	272470.460	6101440.684	-
106	-	NO WELL	NO WELL	-
107	J STATION	272464.713	6101390.028	-
108	J STATION	272519.221	6101372.856	-
109	-	NO WELL	NO WELL	-
110	J STATION	272577.240	6101328.639	-
111	REMOVED	-	-	-
112	G STATION	272657.900	6101601.008	-
113	J STATION	272517.122	6101420.656	-
114	REMOVED	-	-	-
115	J STATION	272477.376	6101339.753	-
116	-	NO WELL	NO WELL	-
117	-	NO WELL	NO WELL	-
118	K STATION	272423.763	6101358.611	-
119	K STATION	272438.817	6101311.483	-
120	REMOVED	-	-	-
121	L STATION	272332.604	6101237.102	-
L122	L STATION	272363.265	6101264.424	-
C122	REMOVED	-	-	-
123	K STATION	272389.212	6101320.825	-
124	K STATION	272475.312	6101242.471	-
125	K STATION	272433.775	6101250.524	-
126	K STATION	272399.810	6101277.880	-
127	L STATION	272359.238	6101208.677	-
128	L STATION	272392.000	6101234.417	-
129	L STATION	272429.682	6101208.954	-
130	L STATION	272465.675	6101199.490	-
131	L STATION	272388.145	6101179.288	-
132	L STATION	272438.251	6101174.954	-
133	K STATION	272343.926	6101297.736	-
134	J STATION	272564.369	6101358.336	-
135	K STATION	272472.559	6101296.256	-
136	M STATION	272867.642	6101268.382	-
137	M STATION	272910.313	6101262.085	-
138	REMOVED	-	-	-
139	M STATION	272858.283	6101204.721	-
140	M STATION	272908.283	6101202.001	-
141	M STATION	272950.953	6101203.515	-
142	C STATION	272880.581	6101970.318	-
143	REMOVED	-	-	-
144	J STATION	272560.034	6101399.871	-
145	P STATION	272905.701	6101351.246	-
146	-	NO WELL	NO WELL	-
147	N STATION	272794.343	6101267.076	-
148	-	NO WELL	NO WELL	-
149	-	NO WELL	NO WELL	-
150	P STATION	272936.827	6101319.468	-
151	REMOVED	-	-	-
152	P STATION	272958.833	6101276.643	-
153	P STATION	272887.121	6101233.696	-
154	P STATION	272937.568	6101233.212	-
155	REMOVED	-	-	-
156	P STATION	272910.587	6101191.505	-
157	REMOVED	-	-	-
158	N STATION	272892.213	6101316.145	-
159	-	NO WELL	NO WELL	-
160	-	NO WELL	NO WELL	-
161	REMOVED	-	-	-
162	REMOVED	-	-	-
163	-	NO WELL	NO WELL	-
164	N STATION	272817.056	6101247.871	-
165	REMOVED	-	-	-
166	REMOVED	-	-	-
167	Q STATION	272851.123	6101373.822	-
168	Q STATION	272732.608	6101447.602	-
169	J2 STATION	272592.345	6101293.710	-
170	J2 STATION	272618.293	6101312.017	-
171	J2 STATION	272631.715	6101323.855	-
172	N STATION	272841.282	6101290.955	-
173	-	NO WELL	NO WELL	-
174	-	NO WELL	NO WELL	-
175	-	NO WELL	NO WELL	-
176	-	NO WELL	NO WELL	-
177	-	NO WELL	NO WELL	-
178	-	NO WELL	NO WELL	-
179	-	NO WELL	NO WELL	-
180	-	NO WELL	NO WELL	-
181	-	NO WELL	NO WELL	-
182	REMOVED	-	-	-
183	-	NO WELL	NO WELL	-
184	-	NO WELL	NO WELL	-
185	R STATION	272717.469	6101339.751	-

CO-ORDINATES				
DESCRIPTION	LOCATION	EASTING	NORTHING	DATE
186	-	NO WELL	NO WELL	-
187	Q STATION	272827.037	6101337.274	-
188	-	NO WELL	NO WELL	-
189	-	NO WELL	NO WELL	-
190	-	NO WELL	NO WELL	-
191	R STATION	272695.170	6101307.198	-
192	-	NO WELL	NO WELL	-
193	REMOVED	-	-	-
194	-	NO WELL	NO WELL	-
195	-	NO WELL	NO WELL	-
196	R STATION	272677.893	6101270.517	-
197	R STATION	272672.731	6101231.284	-
198	N STATION	272760.413	6101249.939	-
199	R STATION	272705.424	6101208.642	-
200	REMOVED	-	-	-
201	-	NO WELL	NO WELL	-
202	-	NO WELL	NO WELL	-
203	B STATION	272899.689	6102018.897	Apr-17
204	C STATION	272810.504	6101939.582	Apr-17
205	C STATION	272892.312	6101884.364	Apr-17
206	H STATION	272800.415	6101877.723	Apr-17
207	H STATION	272739.827	6101837.680	Apr-17
208	F STATION	272807.091	6101774.711	Apr-17
209	F STATION	272824.045	6101690.360	Apr-17
210	-	NO WELL	NO WELL	-
211	E STATION	272655.743	6101601.109	Apr-17
212	N STATION	272946.474	6101257.819	Apr-17
213	N STATION	272915.122	6101278.836	Apr-17
214	N STATION	272873.026	6101275.684	Apr-17
215	N STATION	272867.588	6101201.750	Apr-17
216	N STATION	272841.912	6101235.940	Apr-17
217	N STATION	272795.288	6101289.672	Apr-17
218	160mm MAIN	272734.295	6101420.811	Apr-17
219	280mm MAIN	272718.995	6101339.699	Apr-17
220	280mm MAIN	272744.835	6101213.523	Apr-17
221	280mm MAIN	272705.764	6101208.885	Apr-17
222	S STATION	272673.270	6101231.151	Apr-17
223	S STATION	272602.028	6101233.226	Apr-17
224	S STATION	272612.158	6101193.550	Apr-17
225	280mm MAIN	272635.676	6101165.459	Apr-17
226	280mm MAIN	272659.783	6101136.345	Apr-17
227	280mm MAIN	272620.846	6101128.076	Apr-17
228	280mm MAIN	272586.256	6101111.622	Apr-17
229	T STATION	272554.293	6101086.369	Apr-17
230	T STATION	272529.248	6101056.403	Apr-17
231	-	NO WELL	NO WELL	-
232	-	NO WELL	NO WELL	-
233	NOT CONN'CTED	272388.987	6101321.768	Apr-17
234	-	NO WELL	NO WELL	-
235	-	NO WELL	NO WELL	-
236	200mm MAIN	272521.576	6101522.450	Apr-17
237	-	NO WELL	NO WELL	-
238	T STATION	272499.011	6101087.395	Apr-17
239	T STATION	272495.950	6101030.733	Apr-17
240	T STATION	272563.716	6101048.708	Apr-17
241	280mm MAIN	272596.671	6101079.890	Apr-17

AS BUILT

No	DATE	DRN	DESN	CHKD	APP	DESCRIPTION
REVISIONS						
1	15/06/17	OS	GF	GF	GF	WELLS 203-209, 211-230, 236 & 238-241 ADDED. STN'S S & T ADDED. 46 WELLS REMOVED.
0	14/12/16	OS	–	–	GF	GAS FIELD LAYOUT AS PER EDL DRAWING

LMS ENERGY

DRAWN:	OS
DATE:	14/12/16
DESIGN:	–
DATE:	–
APPRVD:	GF
DATE:	14/12/16
A.B.N. 39 059 428 474	

PEDLER CREEK RENEWABLE ENERGY FACILITY

GAS FIELD LAYOUT

SCALE	DRAWING NUMBER	PAGE	SIZE	REV
1:2000	50043-CA-003	2 OF 2	A1	1

LAST PLOTTED TIME: PLOTTED DATE: LAST MODIFIED TIME: MODIFIED DATE:

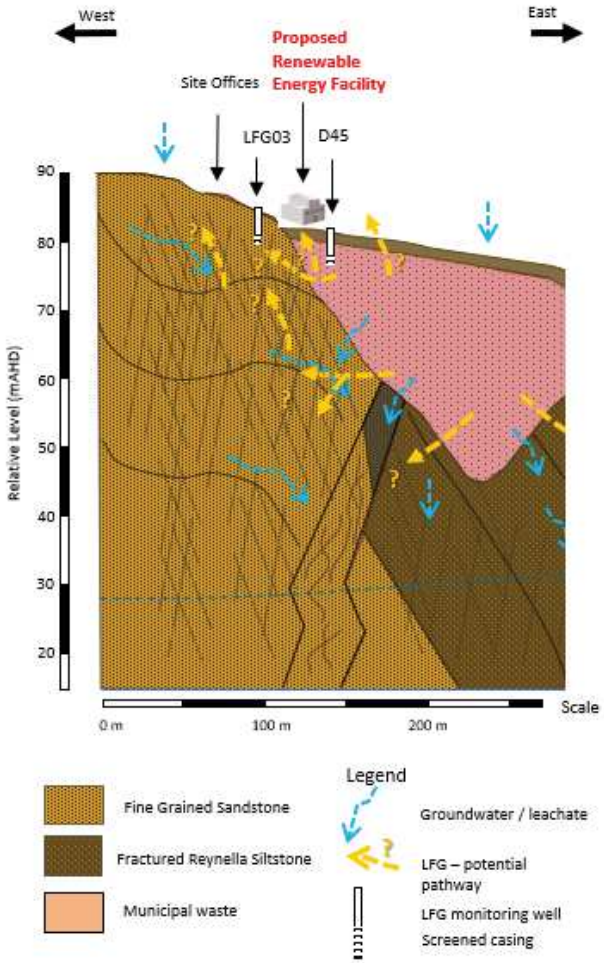
Pedler Creek Gas Well Data

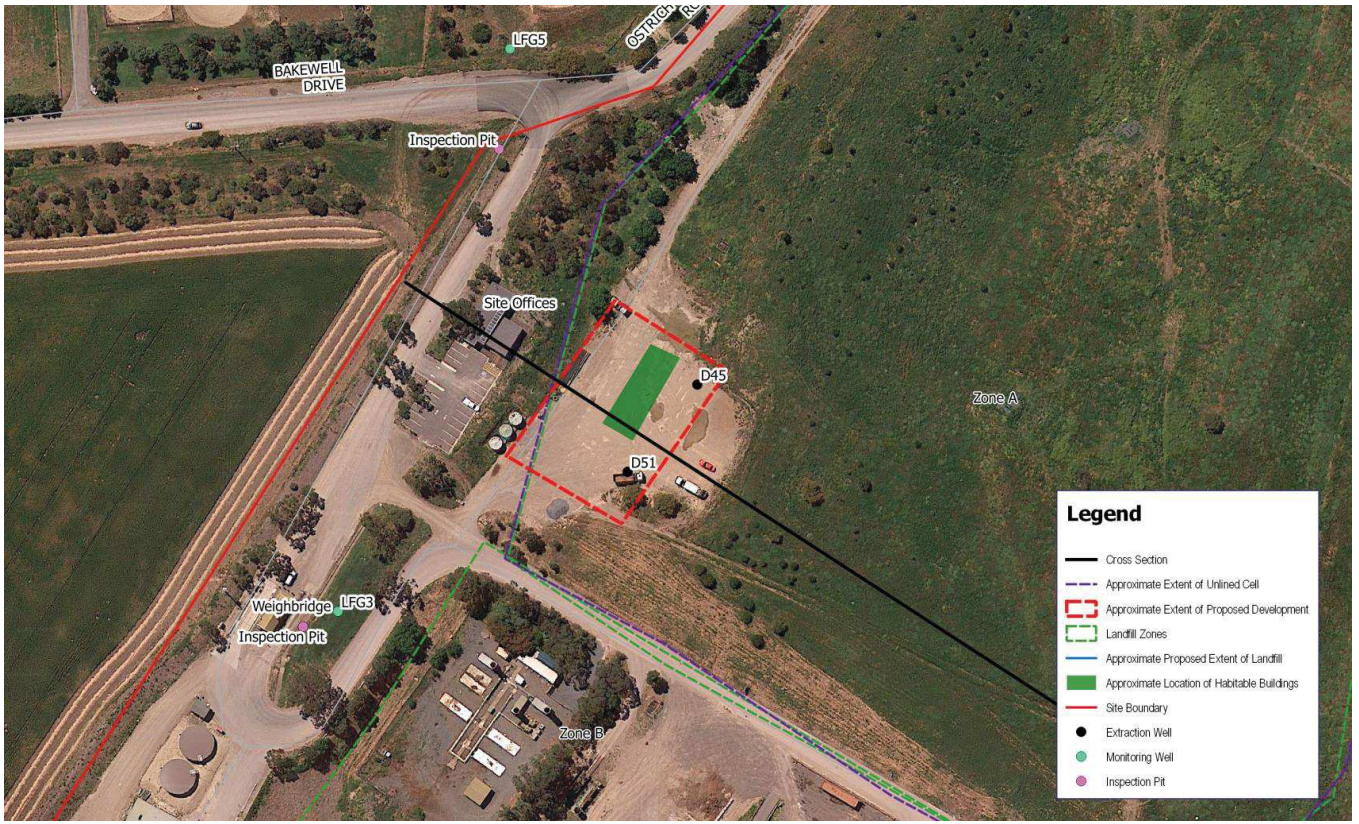
July 2018

Well	Pressure (Pa)	Valve Opening (%)	Flow (m3/h)	Adj. Flow (m3/h)	CH4 (%)	CO2 (%)	O2 (%)	Bal. Gas (%)	Comments
B									
B203	-25	10	4.6		20	21	2	57	
C									
C11	-3200	100	3.7		42	26		32	
C99	-64	10	4.1		23	20		57	
C142	-39	10	4.6		20	18	2	60	
C204	-13	10	6.4	4.5	10	19		71	
C205	-3200	50	5.7		46	28		26	
D									
D29	-8000		1.8				18	82	Broke hand valve
D30		Closed							BHV
D34	-20		0.5		35	28		37	BHV
D35		Closed							BHV
D40		Closed							BHV
D41	-10000		6.1		56	30		14	Over -10000BHV
D45	-3000		1.4		48	35		17	BHV
D46	-168		19.9		40	29		31	BHV
D51	-5000	10	1.8		42	32		26	
D52		Closed							BHV
F									
F31	-1400	10	2.1		46	28		26	
F37	-24	10	2.1		36	27		37	
F39	-300	15	4.7		32	22		46	
F42	-500	10	2.1		26	22		52	
F48	-2034	15	2.1		42	28		30	
F94	-1900	50	2.2		45	24		31	
F208	-26	10	2.1		34	29		37	
F209	-16	10	3.7		48	32		20	
H									
H86		Closed							
H87	-50	10	4.8		50	29		21	
H89	-10000	100	2.2		45	30		25	
H90		100	Blocked						
H91	-10000	100	7		43	29		28	
H92		Closed							
H206	-50	10	4.6		31	25		44	
H207	-40	10	2.1		30	23		47	

Appendix D

CSM Cross Section


West
East
Proposed
Renewable
Energy Facility
Site Offices
LFG03
D45
Relative Level (mAHD)
90
80
70
60
50
40
30
20
0 m
100 m
200 m
Scale
Legend
Fine Grained Sandstone
Fractured Reynella Siltstone
Municipal waste
Groundwater / leachate
LFG – potential pathway
LFG monitoring well
Screened casing


BAKEWELL DRIVE
LFG5
Inspection Pit
Site Offices
D45
D51
Zone A
Zone B
Weighbridge
LFG3
Inspection Pit
Legend
Cross Section
Approximate Extent of Unlined Cell
Approximate Extent of Proposed Development
Landfill Zones
Approximate Proposed Extent of Landfill
Approximate Location of Habitable Buildings
Site Boundary
Extraction Well
Monitoring Well
Inspection Pit

Appendix H

Email and attachments from LMS Energy to the EPA

Simon Channon

From: Oliver Scheidegger
Sent: Tuesday, 28 August 2018 10:51 AM
To: 'Philbey, Janine (DPTI)' <Janine.Philbey@sa.gov.au>
Cc: 'epa.planning@sa.gov.au' <epa.planning@sa.gov.au>
Subject: Seaford Heights Renewable Energy Facility - Information Request

Hi Janine,

This is a partial response to the attached information request dated 18 July 2018.

Points 1-2 – an assessment has been commissioned and report will be forwarded once completed

Points 3-8 – please find the attached air quality assessment report
Note point 4 – the operation of the gas conditioning skids is to both create vacuum pressure to extract landfill gas and to condense moisture out of the landfill gas. All collected condensate is returned to the landfill cells.

Point 9 – Bulk oil tank will be selected based on required operational size, but may be either one single 4,500 L tank or two smaller 2,000 L tanks. Petro Industrial will be the supplier of the tank(s). See details in the attached brochure.

Point 10 – No flammable liquids will be stored within the storage bund. The selected storage bund will likely be similar to the 10ft Royal Wolf bund as detailed in the attached brochure. A number of 200L oil drums and one 1,000 L coolant tank would be stored in the bund.

Please let me know if you require any further info on the above points, and I will forward the landfill gas risk assessment when this is completed.

Regards,
Oliver

PETRO INDUSTRIAL

PETRO CUBE

Self Bunded & Baffled

More than just product...

PETRO CUBE

Why choose a PETRO Cube?

Environmentally Responsible Storage

- 110% Secondary Contained Self Bunded Tank
- All fittings, hoses, pumps, nozzles, dispensing points are located within the bunded area.

Approved for Transport

- PETRO Cubes are IBCs in accordance with Australian Code for the Transport of Dangerous Goods by Road & Rail clause 1.2.1.2.7.
- PETRO Cubes are tested to the UN recommendations on the transportation of Dangerous Goods, 13th Edition, and meet the requirements of the Australian Code for the Transport of Dangerous Goods by Road & Rail section 6.5.
- PETRO Cubes comply with the Federal Office of Road Safety Specifications for Intermediate Bulk Containers for the Transport of Dangerous Goods.

All the Standards are Covered

- AS1940 / 2004 + AS1692 Designed and Approved
- United Nationals UN31AY packaging approval
- ADG Designed and Approved
- PPG2 / PPG26 Approved
- 110% Secondary Contained (Self Bunded)

What's under the lid?

Removable lid for ease of maintenance

Crane Lifting Lugs
* Lift only when empty

Stackable 3 x high when empty; 2 x high when full

Inner tank can be removed for maintenance

Fully lockable lid on gas struts

110% Secondary Containment

Generator hose suction + return ports

Internal bunded lockable pump / dispensing housing

4 x way forklift pockets

Fully baffled - UN31AY Approved: can be transported with liquid

Tank can feed and return from up to 3 generators at once

Dispensing equipment can be locked away in a bunded area - even when in use

Self bunded design - AS1940/AS1692 Approved

More than just product...

PETRO CUBE
Self Bunded & Baffled

Size Range
450, 950, 2000, 3000, 4500, 6300, 7000L and 14000 Litre Capacity.

Features and Benefits
- UN31 A /Y Approved for Transport of Dangerous Goods
- AS1692 / AS1940 Approved for Static Storage
- Self Bunded (Double Wall) Design
- 110% Secondary Containment
- Inner Tank can be Removed for Maintenance / Cleaning
- Field Proven Design
- Diesel / Petrol / Lubricants

Usage
- Site Static Storage
- Delivery
- Storage
- Transport
- Decanting

- Self Bunded Tanks with UN31A/Y approval for the transport of Dangerous Goods by Road, Rail and Sea, Packaging Groups II & III.
- PETRO Cubes are fabricated from high grade mild steel. An inner tank contains the initial volume of liquid.
- In the unlikely event that this tank develops a leak the outer tank will prevent the liquid from escaping into the environment.
- The bunded tank has a capacity of 110% of volume. All seams are robot welded to exacting standards.
- PETRO Cube is designed with an easy removable steel inner tank for maintenance and inspection.

PETRO Cubes are available in a range of capacities, ideal for transportation by either truck or shipping container and suit most hydrocarbons storage and transport requirements.

- Robotic welded seams guarantee lasting high quality.
- The ultimate in quality at very affordable prices.
- Meet strict quality standards, are PPG2 compliant and EU approved.
- Three (3) year guarantee.
- Manufactured in heavy duty steel.
- All pumps, connections and hoses are housed and can be locked within the bund, even in use!
- Colour is RAL9010 Pure White.
- Can be stacked 3 high when empty and 2 high when full.
- 6300L, 7000L and 14000L models are supplied with Overfill Protection Valve / Anti Syphon Valve and Overfill Alarm Unit.

PETRO Cube
Features at a Glance
- 3 year guarantee
- Heavy duty steel
- Pumps / connections / hoses housed in bund, which can be locked even when in use!
- Stackable - 3-high empty / 2-high when full
- Robotic welded seams
- Approved for transport of dangerous goods and / or static storage
- Bunded tank capacity 110% of volume
- Easily removable steel inner tank for maintenance and cleaning
- Suitable for Diesel / Petrol / Lubricants

Model	Weight (kg)	Height (mm)	Length (mm)	Width (mm)
450L	380	750	1300	1000
950L	680	1235	1670	1050
2000L	980	1235	2550	1130
3000L	1150	1235	2550	1650
4500L	1650	1235	3000	2000
6300L	2150	1235	3560	2166
7000L	2500	1300	3000	2400
14000L	4500	1300	6000	2400

Dimensions and capacities are nominal only. Alternative capacities available on request.
Note: 6300L Cube in Australia - safe fill level is 5900L; 7000L Cube in Australia - safe fill level is 6400L; 14000L Cube in Australia - safe fill level is 13000L.

More than just product...

SELF BUNDED FUEL TRAILERS

950L | 1250L | 1500L | 2000L | 3000L

Size Range

950L | 1250L | 1500L | 2000L | 3000L Capacity

Features and Benefits

- Tandem Axle 16" or 17" wheels (depending upon trailer capacity)
- Heavy duty off road design
- 100 x 50 x 3mm / 75 x 50 x 3mm / 50 x 50 x 2.5 RHS Steel Construction
- Full Box Section Chassis
- Draw Bar 1650 Long (3mm)
- Draw Bar Welded to the Suspension
- Checker Plate Mudguards with Front and Rear Steps
- Hot Dipped Galvanized
- Ride master Suspension
- 65mm Square Axles 4000kg
- 6 Stud Landcruiser Hubs
- 235/75/16 tyres
- White Sunrasia Style Rims
- Spare Wheel
- Spare Wheel Bracket
- Quick Release Coupling
- Swing Away Jockey Wheel 10"
- LED strobe light - site identification light - able to raise and lower as required. Will turn on when vehicle headlights are turned on
- Rear Drop Legs
- Lights to ADR's
- 12/24 volt LED Lights
- Electric Brakes
- 4.9kg fire extinguisher with HD mounting
- Fill / Dip Point located at rear of the unit. Galvanised, grated step for access to fill / dip point
- Tank module UN approved as IBC - roll over spill protection provided (pressure vacuum vent). Primary tank / secondary tank design. Secondary tank 110% capacity of primary tank
- Trailer supplied unregistered - design suitable for registration Australia wide
- tank. Primary tank contents level indicator supplied.
- Choice of pump styles including 12V DC | 24V DC | Diesel Driven | Petrol Driven

PETRO Self Bunded Fuel Trailers
Features at a Glance

- Heavy duty, off road design
- RHS Steel construction
- UN approved as IBC; roll-over spill protection design
- Suitable for Aus-wide registration
- Removable tank for easy maintenance
- Choice of pumping styles
- Easily removable steel inner tank for maintenance and cleaning
- Electric brakes
- Primary tank fully baffled with removable lid
- Secondary tank 110% capacity of primary tank

More than just product...

PETRO HIRE

Short Term Rental / Long Term Lease/ Option to Buy

- Short Term Rental
- Long Term Lease
- Option to Buy

Why Rent?
Do your business a favour. Don't Buy.

If you're buying capital equipment or machinery, paying upfront can put a serious dent in your cash reserves. And what are you left with in five years? Usually a seriously depreciated asset that isn't much use any more.

When compared to buying equipment outright, leasing helps preserve cash for projects and expenditure that offer better business returns or represent a more efficient use of capital and resources.

When it comes to expenditure, businesses should invest as little as possible in depreciating assets and as much as possible in appreciating assets. Renting provides a compelling option to keep the cost of depreciating assets down and pass obsolescence risk to a third party.

A common financial methodology for deciding if taking an asset on rental is more economic than buying is to compare and select the lowest net present value of the after tax cash flows of each alternative.

Off Balance Sheet Funding.
In most cases, rental payments don't appear as balance sheet liabilities. The monthly rentals are treated as an operating expense and are generally considered 100% tax deductible. Not only that, as an expense item, these payments may fall outside of annual capital budget allocations and the arrangement may result in improved balance sheet ratios. Naturally, you should check with your accountant or legal advisor first.

Rent the Full Package.
You can bundle the cost of all ancillary equipment into your rental or lease. Pumps, meters, electronic tank gauging, electronic fluids management systems, in fact all PETRO Industrial accessory lines can be included in the one transaction.

Cash is still King
When you rent or lease your equipment you get to keep your cash for better things. It takes the strain off your cash flow and when working with your accountant or legal advisor, usually results in a 100% tax break and a healthier balance sheet. Better still, it means you don't have to compromise on quality You can afford the right equipment for the job.

We Take the Residual Value Risk.
PETRO Industrial rental pricing builds the future expected resale value of assets into the pricing to keep your rental payments low.
The future resale value risk is assumed by PETRO Industrial, not you. What's more the costs of disposing of the asset at the end of the lease including environmentally friendly recycling of the assets (including potentially hazardous components) is also assumed by PETRO Industrial.

More than just product...

PETRO CUBE
Accessories

Hand Pump

Mounted within bunded housing with handle protruding through outer wall for ease of use.

Pump 55lpm

12V / 24V or 240V - mounted either within bund or in lockable enclosure on top of the tank.

Pump 90lpm

12V / 24V or 240V - mounted either within bund or in lockable enclosure on top of the tank.

Cube Pump 70lpm

240V AC - mounted on top of tank. Lockable design.

Pump 76lpm or 110lpm

12V / 24V / 240V - pump | meter | hose | auto nozzle kit - suitable for Flammable Liquids + Diesel.

Pump 120lpm

Petrol Driven Pump - mounted in lockable enclosure on top of the tank.

Pump 600lpm

Diesel Driven Pump - mounted in lockable enclosure on top of the tank.

Digital Meter 1”

Can be nozzle mounted or mounted inside the bund

Mechanical Meter 1”

Mounted inside the bund.

PETRO CUBE
Accessories

Fuel Security System

Economical Key Tag Fuel Security System with emergency stop.

Electronic Fluids Management System

Record date | time | qty fuel dispensed | vehicle + personnel details

Pump (240V or 12V) c/w Electronic Fluids Management System

Can accept vehicle registration numbers and odometer readings.

Hose

PETRO supply a full range of quality hose with a variety of end connection options.

Quick Connect Fittings

Male + Female available in a variety of sizes.

Foot Valves / Non Return Valves

Full range of suction and return line fittings.

Trailers

Suitable for both on and off road use. Designed for registration Australia-wide.

Spill Response Kit

Enretech sorbents for cleaning spills on workshop floors, refuelling areas, marinas, water.

Filtration

Particulate and hydrosorb filtration options to keep your fuel clean.

CONTACT PETRO

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NEED DANGEROUS GOODS STORAGE?

STORE HAZARDOUS CHEMICALS, LIQUIDS & FLAMMABLES

IN A SECURE ROYAL WOLF CLASS 3 DANGEROUS GOODS CONTAINER

Portable and robust, Royal Wolf Dangerous Goods storage units are perfect for storing paint, thinners, oils, diesel, chemicals and Class 3 flammables.

With a bunded floor, galvanised grate flooring, lockable stainless steel valve, internal door release and ventilation, they provide safe, secure storage for hazardous class 3 liquids.

Call us today for a fast and easy quote on hiring or purchasing a quality new build or refurbished Royal Wolf Dangerous Goods unit perfect for your needs.

1300 651 700

royalwolf.com.au

YOU CAN DO ANYTHING IN A ROYAL WOLF

ROYAL WOLF

INNOVATIVE DESIGN • QUALITY MANUFACTURE

ROYAL WOLF DANGEROUS GOODS CONTAINERS PROVIDING THE ULTIMATE IN HIGH END SAFETY WITH:

- Double doors for easy access
- Internal emergency door release
- Bunded floor — galvanised grate flooring
- Lockable stainless steel valve in bunded wall
- Compliant venting
- Relevant signage supplied
- Shelves optional

Portable and strong, Royal Wolf Dangerous Goods storage containers are available with flexible rental and purchase options and have the additional benefit of being delivered direct to your site.

Class 3 Dangerous and Hazardous Goods containers (DG's) are available in three convenient sizes and are fully compliant with Australian Standard 1940-2017*.
(*Certificates of compliance can be supplied upon request.)

8FT DG CONTAINER

With a small footprint, this container is the ideal solution for storage in limited spaces. It is able to be repositioned using a standard forklift.
The dimensions are:

External		Internal	
Length	2.30m	Length	2.14m
Width	2.30m	Width	2.24m
Height	2.25m	Height	1.80m**
Weight	1,320kg		

Certified to Store:

4,500 L (Max Package Size: 25 L Packages)
3,780 L (Max Package Size: 205 L Drums)
2,600 L (Max Package Size: 500 L Drums)

Closed Flammable and Combustible Liquid (Class 3) (PG I, II or III) packages²

**Clearance through doors.

10FT DG CONTAINER

This container is a two pallet wide and high cube.
The dimensions are:

External		Internal	
Length	2.99m	Length	2.84m
Width	2.44m	Width	2.37m
Height	2.90m	Height	2.45m**
Weight	1,715kg		

Certified to Store:

6,060 L (Max Package Size: 25 L Packages)
5,340 L (Max Package Size: 205 L Drums)
4,160 L (Max Package Size: 500 L Drums)
2,160 L (Max Package Size: 1000 L IBC²)

Closed Flammable and Combustible Liquid (Class 3) (PG I, II or III) packages²

20FT DG CONTAINER

With double side door access and end doors, this two pallet wide and high cube.
The dimensions are:

External		Internal	
Length	6.06m	Length	5.90m
Width	2.44m	Width	2.29m
Height	2.90m	Height	2.48m**
Weight	3,350kg		

Certified to Store:

9,500 L (Max Package Size: 25 L Packages)
8,780 L (Max Package Size: 205 L Drums)
5,200 L (Max Package Size: 1000 L IBC²)

Closed Flammable and Combustible Liquid (Class 3) (PG I, II or III) packages²

ROYAL WOLF

1300 651 700
royalwolf.com.au

YOU CAN DO ANYTHING IN A ROYAL WOLF