Council

CHANGE TO THE PURPOSE OF THE WASTE MANAGEMENT RESERVE ACCOUNT

GHD Consultants Report – Mount Barker Landfill Closure Plan

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Shire of Plantagenet

Mount Barker Landfill Closure Plan
Landfill Closure Design Basis

July 2020

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1. Introduction

1.1 Background

The Mount Barker Waste Management Facility (WMF or the site), Mount Barker, is the main waste management facility operated by the Shire of Plantagenet (Shire). The landfill has been in operation since the 1960s with waste disposal activities occurring in the northern portion of the site, covering approximately 16 ha of the total 76 ha of the site (DWER 2014).

The site is licensed under L7026/1997/14 to accept up to 1,000 kL per annual period of liquid waste (Category 61) and up to 10,000 tonnes per annual period of class II or III putrescible landfill waste for burial (Category 64) (DWER 2014), following an approved increase in the licence limit on 11 May 2018. The site receives household, commercial and industrial waste collected by the Shire and its contractors, as well as putrescible, general household, green waste and recyclables from nearby rural residents. Over the last five years, the quantity of solid waste accepted and disposed to landfill has ranged from 3,900 tonnes to 6,800 tonnes.

The Shire intends to expand the landfill to maximise the available airspace and longevity at the site. GHD has been commissioned by the Shire to develop a Closure and Post Closure Plan for the site to provide direction and guidance on the closure of the landfill and post closure requirements.

1.2 Purpose of this report

In order to provide guidance, a number of closure elements including final landform, filling plan and landfill capping profile require confirmation.

This Landfill Closure Design Basis report outlines the findings of a background review and options assessment for the progression and closure of the site, including:

- Final landform
- Filling plan
- Airspace consumption and timing
- Landfill capping profile

Figure 1-1 below outlines how the basis for design relates to the overall iterative preparation process for the Closure and Post Closure Plan.

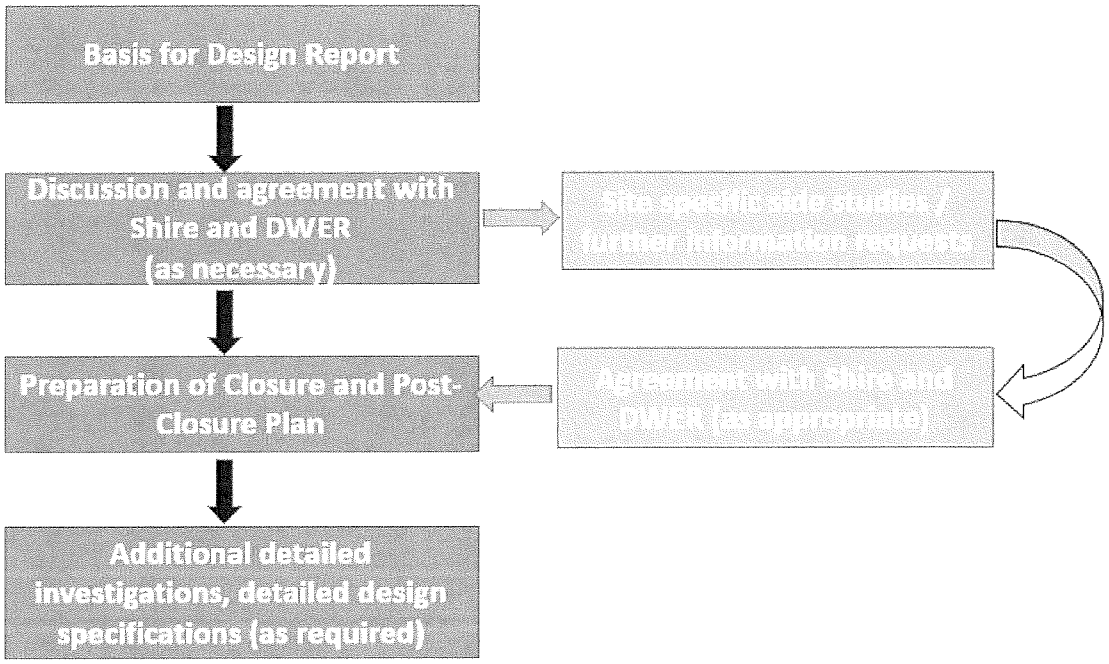

Figure 1-1 CPCP preparation decision making and progression overview

1.3 Scope and limitations

This report: has been prepared by GHD for Shire of Plantagenet and may only be used and relied on by Shire of Plantagenet for the purpose agreed between GHD and the Shire of Plantagenet as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Shire of Plantagenet arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

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

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2. Existing site conditions

GHD's understanding of the existing site conditions for the Mount Barker WMF, based on the background review of desktop and previous information provided, in addition to information obtained through a detailed site inspection by a Senior GHD Environmental Scientist on 14 May 2020, is summarised in this section.

2.1 Location

The site is located at Lot 7546 on Plan 186612, on Crown Reserve 23969 O'Neill Road, Mount Barker, approximately 5 km south west of Mount Barker, as identified on Figure 1, Appendix A.

The land uses of the adjoining sites is as follows:

- North – O'Neill Road, with the adjacent plot of land, densely vegetated with an unnamed waterway running through the centre.
- East – Densely vegetated land with a number of tracks and sporadic cleared areas.
- South – Densely vegetated bushland with some vehicle access tracks and a cleared rural property to the south east. Sleeman Creek is located 50 m south of the landfill.
- West – Agricultural property with a number of surface water bodies between 500 m and 1 km west of the site.

The nearest residential dwelling is located approximately 2.5 km north west of the site.

2.2 Environmental setting

2.2.1 Topography

The topography of the landfill and surrounding area gently slopes from 187 mAHD in the north east towards 175 mAHD in the south, as outlined on Figure 2, Appendix A.

The landfill itself ranges in elevation with the highest elevation of 188 mAHD in the central western portion of the landfill and the lowest elevation of 176 mAHD at the toe of the south/south western landfill batters.

2.2.2 Local geology and soils

The surface geology at the site consists of a thin layer of Quaternary coastal sandy deposits over Pallinup siltstone, and Werillup Formation clay, sandstone and limestone of the late Eocene Plantagenet group (Smith 1997). Archean granitoid bedrock of the Yilgarn Craton underlies this formation.

A soil investigation has previously been undertaken in the western portion of the site, adjacent to the transfer station and landfill area, where the Shire intends constructing a new landfill cell (Lynch 2016). Eight test pits were excavated to depths ranging between 2.4 m and 2.8 m. The test pits revealed a layer of coarse sandy material followed by sandy clay loams, clay loams and occasional light to medium clays with a significant portion of gritty angular sands. It was suggested (Lynch 2016) that the sands are formed on either weathered metasediments or deposited from surrounding higher topography.

The clay material from three test pits was sampled for laboratory analysis of various chemical and physical properties. The permeability results from the clay in the area investigated ranged from 4.7×10^{-9} m/s to 1.9×10^{-10} m/s. Results for Cation Exchange Capacity were generally low across all three clay samples, and were dominated by sodium. Therefore, it is likely that the clays are dispersive (Lynch 2016).

2.2.3 Hydrogeology

There are three groundwater monitoring wells located on the site, MW1, MW2 and MW3, as identified on Figure 2, Appendix A. Historical groundwater standing water levels at these wells indicate that local groundwater on the site flows in a southerly direction (Great Southern Bio Logic 2019). The groundwater elevation, measured at the on-site wells generally ranges between 177 mAHD and 180 mAHD up gradient to the landfill (MW1) and between 174 mAHD and 177 mAHD down gradient of the landfill (MW2).

Results from annual groundwater monitoring report (Great Southern Bio Logic 2019) indicate that groundwater levels down gradient of the landfill at MW3 range between 0 m below ground level (mbgl) and 1 mbgl, with groundwater level increasing to the surface and becoming surface water in high rainfall months.

2.2.4 Hydrology

Surface water enters the site from the north east via an unnamed creek and drains through the site through the landfill drainage system, as identified on Figure 2, Appendix A. The drainage system includes a large surface water diversion drain on the northern boundary of the landfill and carries surface water to the west of the landfill footprint where it further drains in a southerly direction via informal drains.

An informal drain is also located along the eastern side of the landfill footprint, to divert both on and off site surface water in a southerly direction.

On-site surface water discharges into localised depressions, and the ephemeral drainage line that flows into the site through the western site boundary, directly south west of the landfill. Surface water exits the site from the south eastern site boundary. Previously, a stream flowed through the landfill area however was diverted to the west of the landfill footprint (Great Southern Bio Logic 2019) when operations began. The original creek bed does not receive any surface water flow however in the wet season does generate minor surface water flows from seepage through the creek bed.

An on-site stormwater pond is located in the south western corner of the landfill, SW2, and sporadically collects surface water runoff from the landfill, however it is understood that the pond does not function properly as there are no formal drains in place to direct runoff towards this pond.

2.3 Site operations

The following site operations are undertaken at the site, as identified on Figure 2, Appendix A:

- Active landfilling of putrescible waste in the southern portion of the landfill footprint. All putrescible waste accepted by members of the public is disposed of in the contained transfer shed to the north of the site, and is disposed of by site operators into the active landfill cell once a week, utilising a mobile compactor and front end loader.
- Active asbestos burial pits to the north west of the landfill, with historical asbestos burial pits located to the east of the landfill footprint.
- Animal burial pits to the north west of the landfill footprint, with historical animal burial pits to the north of the active landfill area.
- Transfer station, including community drop off and tip shop, directly north of the landfill footprint, which accepts recyclables, batteries, white goods, e waste, tyres, oil etc.
- Liquid waste facility, consisting of two lined discharge and evaporation ponds, west of the transfer station.

- Green waste and scrap metal stockpiles directly west of the transfer station and south of the liquid waste facility

Inert waste is stockpiled throughout the landfill footprint, with historical ad hoc inert waste stockpiles to the south of the landfill footprint.

3. Preliminary landfill risk assessment

This section details the existing landfill conditions and identifies potential risks posed to the receiving environment.

3.1 Liner system

The existing landfill footprint was not lined prior to the commencement of landfilling. It is also understood that waste was disposed of on the natural ground level, with no cell excavation occurring.

Based on the soil investigation undertaken in 2016 (Lynch 2016), detailed in Section 2.2.2, the soil beneath the landfill is likely to be sandy underlain by low permeability clays.

3.2 Landfill waste composition

The Shire provided details of accepted waste types and quantities at the Mount Barker Waste Management Facility between March 2015 and February 2020. Solid and liquid wastes disposed within the landfill and liquid waste facility are detailed in Appendix B and described below.

3.2.1 Solid waste

It is understood that there are three distinct and separate burial locations for putrescible waste, asbestos and animal waste, respectively. Putrescible waste (excluding green waste) makes up the majority of the landfill waste composition, followed by clean fill, which is used as cover material. Inert waste type 1, green waste and cardboard bales have been disposed of sporadically within the landfill over the last five years. Overall, the quantity of putrescible waste disposed to landfill over the previous five years has ranged from 2,700 tonnes to 3,100 tonnes.

Asbestos material burial at the site each year has varied each year, ranging from 4.8 tonnes between March 2019 and February 2020, to 141.3 tonnes between March 2016 and February 2017.

No data was provided for the likely quantities of animal waste buried on site.

3.2.2 Liquid waste

The annual volume of liquid waste accepted at the site ranged from ~186,900 L (March 2019 – February 2020) to ~472,900 L (March 2016 – February 2017), based on waste acceptance volumes provided by the Shire. The majority of liquid waste accepted was septic tank waste, with the remainder consisting of grease trap waste.

3.3 Capping

Clean fill accepted at the site is used as cover material over waste, and has been placed over the entire landfill footprint as an interim cap. Waste data from 2016/2017 also revealed that green waste received on site had been used as cover material in the past.

It is understood that no final capping profile has been constructed over any portion of the landfill.

3.4 Groundwater

Groundwater at the site is monitored on a bi-annual basis from three monitoring wells located on site, as identified on Figure 2, Appendix A. Groundwater monitoring has been regularly undertaken at all three wells since 2002. Generally, groundwater results at all monitoring wells

have remained consistent, with expected fluctuations and isolated peaks, over time. Concentrations of nutrients and metals at down gradient well, MW3, and cross gradient location, MW2, are consistent with those reported at up gradient monitoring location, MW1.

In the *2019 Annual Water Monitoring Report* (Great Southern Bio Logic 2019), it is suggested that the landfill is not impacting on the down gradient water quality. Further to this, the Shire provided GHD with a detailed groundwater analysis comprising a larger analytical suite of potential contaminants of concern (more than stipulated in the DWER Licence suite), of which these analytes were not above the laboratory limits of reporting.

Notwithstanding this, GHD considers that the interaction between the surface water and the hydrological system is not well understood, and the positioning of the groundwater wells is not conducive in providing any certainty as to the landfill's impact on groundwater quality down hydraulic gradient.

3.5 Surface water

Surface water is monitored on a bi-annual basis from three surface water monitoring locations, as identified on Figure 2, Appendix A. Surface water monitoring has been regularly undertaken at all three locations since 2009. Water quality at upstream location, SW1, and downstream location, SW3, have followed a similar fluctuating trend since monitoring began.

Elevated nutrient (ammonia (as N) and total nitrogen) and metal (chromium, nickel and lead) concentrations have been reported at the on-site stormwater pond, SW2, as surface water runoff from the landfill surface is collected here. Given the lack of leachate management infrastructure at the site, there is potential for leachate to seep from the landfill footprint and enter the stormwater pond. However, it is understood that water from this pond is contained and therefore is unlikely to be representative of impacts that are discharging to the surrounding surface water systems (Great Southern Bio Logic 2019), as these elevated concentrations are not observed at downstream location, SW3.

GHD considers that the surface water receiving environment to the south is the primary environmental receptor of concern with the regards emissions from the site. The limited nature of the surface water monitoring program across different spatial and temporal conditions remains a data gap as to the potential extent of impacts to this area from the landfill mass.

3.6 Leachate

The landfill is unlined and consequently there is no leachate collection system. It is likely that leachate generated from the waste gradually seeps out through the base of the landfill, out of the external batters or at ground level (IW Projects 2013).

The soil underneath and surrounding the landfill has a high clay content making it unlikely for significant leachate migration into the groundwater. Leachate migration is expected to occur slowly and within close proximity to the landfill. As there is no formal leachate collection and management infrastructure at the site, it is likely that leachate emerging at ground level enters the surface water system on the site (IW Projects 2013), as has been evident at the down gradient stormwater pond, SW2, that has shown elevated nutrient and metal concentrations.

3.7 Landfill gas

The *Works Approval Application Supporting Documentation* (IW Projects 2013) prepared for the site stated that, *'there is no evidence that the O'Neill Road landfill is generating noticeable quantities of landfill gas and consequently no active landfill gas extraction system has been constructed'.*

It is understood that no landfill gas monitoring has been undertaken at the site to date.

Based on the age of the landfill (>50 years) and the high percentage of putrescible waste disposed to landfill each year, it is likely that landfill gas is present within the landfill, however the generation rate across the landfill will vary given the disposed waste is at various decomposition stages.

3.8 Liquid waste ponds

Liquid waste accepted at the on-site liquid waste facility is discharged into a system comprising a receival and an evaporation pond, which was constructed in February 2014, under works approval (W4729/2010/1). The works included three stages:

- Stage 1 – Construction of new geomembrane lined liquid waste receival pond
- Stage 2 – Decommissioning and de-hydration of the old receival pond, to enable the removal of sludge material from the redundant clay lined liquid waste pond
- Stage 3 – Construction of a new liquid waste evaporation pond, designed to receive liquid waste flow from the new receival pond.

As detailed in the Shire's licence amendment application to DWER in 2017, the receival and evaporation ponds are connected via a 225 mm diameter pipe, which allows overflow from the receival pond into the evaporation pond.

The receival and evaporation ponds are both lined with a high density polyethylene (HDPE) liner, and have respective design capacities of 1,000 m^3 (100,000 L) and 8,200 m^3 (821,000 L).

It is understood that the Shire maintains a freeboard of at least 500 mm in both the receival and evaporation pond, and immediately cease receipt of all liquid waste deliveries if this freeboard is reached.

3.9 Sensitive receptors

A number of surface water bodies, identified as potential surface water receptors are located to the south west of the site, in the adjacent property including Sleeman Creek that intercepts the western site boundary and runs through the southern portion of the site. During the wet season, it is noted that small tributary creeks form in the southern portion of the site, receiving runoff from the landfill area.

4. Master plan rationale

Based on GHD's understanding of the site, the following aspects are proposed for the progression and closure of the landfill.

4.1 Final landform options

As part of the development of the final landform for the site, the landform needs to be developed cognisant of the following future site considerations:

- The transfer station and liquid waste facility in the northern portion of the site will continue to operate after the closure of the landfill
- Grading and stormwater management need to be adequate to allow stormwater to run off the landform without ponding
- 35 m buffer to the adjoining property to the west and 5 m buffer to the eastern site boundary, as detailed in the Licence
- 100 m buffer between the landfill footprint and a defined surface water body
- Suitable external landfill batters to allow for ease of post closure maintenance and accessibility, and promoting stormwater runoff.
- Sufficient landfill plateaus to allow for future transfer station operations, stockpile areas and future post closure site uses such as a public open space, park or other community recreational area etc.

Based on the above considerations, GHD has prepared three final landform options, included as Figure 3 – Figure 5, Appendix A, for the Shire's consideration. The rationale associated with each landform is outlined below.

Due to the shallow groundwater identified to the south of the current landfill footprint, landfill extension to the south has been excluded from the final landform option development.

Final landform – Option 1

Landform Option 1 is the final landform proposed in the *Works Approval Application Supporting Documentation,* developed by IW Projects for the site in 2013, and has been modelled as it is understood to be the most recent published final landform for the site. The final landform extends past the existing landfill footprint to the west to create an oval footprint. The landform was developed with external batters of 1V:7.5H, which extend to a maximum landfill height of approximately 195 mAHD.

Due to the western expansion of the landfill, it is likely that groundwater monitoring well MW2 will require relocation.

While this landform provided appropriate external landfill batters that allow for ease of post closure maintenance and accessibility, the shallow slope may cause surface water ponding after differential settlement occurs. This landform also does not allow a suitable plateau for post closure uses, unlike Landform Option 2 or Landform Option 3.

Final landform – Option 2

Landform Option 2 was developed to demonstrate the additional airspace available, if the external landfill batters were steepened to 1V:4H as well as providing a useful post-closure plateau.

This final landform extends to the west, similar to Landform Option 1, but also includes the additional footprint to the west of the current transfer station. The landform has been developed with external batters of 1V:4H, which extend to a maximum landfill height of approximately 187 mAHD.

Due to the western expansion of the landfill, it is likely that groundwater monitoring well MW2 will require relocation.

Based on previous investigations undertaken in the western portion of the site (Lynch 2016), directly west of the transfer station, it is understood that this area was historically used as a refuse site, evidence of household waste that has been burnt, in the surface material. It is suggested that this waste was dumped in windrows on the surface before being burned however further investigation is required to confirm this.

Final landform – Option 3

Landform Option 3 was developed to reflect Landform Option 2, however excluded the landfill expansion to the west of the current transfer station. As the topography in this portion of the site is generally flat, minimal airspace will be gained from this expansion, as cell excavation and filling heights are both limited.

By reflecting a similar footprint to Landform Option 1, but steepening the external landfill batters to 1V:4H, and creating a plateau similar to Landfill Option 2, airspace can be maximised, while also providing a useful final landform for post-closure uses.

Due to the western expansion of the landfill, it is likely that groundwater monitoring well MW2 will require location.

4.2 Preliminary landfill filling and closure staging

The objective of preliminary landfill staging is to minimise the disturbed area and optimise site operations. The preliminary landfill staging for the site is outlined below:

1. Landfill expansion to the west of the existing landfill footprint. Expansion will begin in the southern portion of the landfill, moving in a northerly direction to allow for the construction of associated leachate and stormwater management infrastructure. Landfilling will be undertaken to an interim landfill height.
2. Landfilling along the eastern landfill footprint, beginning in the south and progressing in a northerly direction to allow for the construction of associated leachate and stormwater management infrastructure. Landfilling will be undertaken to key into the interim landfill height to the west.
3. Final landfilling across the entire landfill footprint to the proposed final height.
4. Capping and rehabilitation of the finalised landfill areas will be progressively undertaken to distribute capital costs over a number of years, and to minimise the disturbed footprint that requires stormwater management.

Further detail on the proposed landfill staging will be undertaken once confirmation on the final landform has been agreed.

4.3 Landfill liner

Given the high clay content and associated high permeability results reported for the on-site clay material, ranging from 4.7×10^{-9} m/s to 1.9×10^{-10} m/s (Lynch 2016), it is proposed that a compacted clay liner be constructed for any future landfill expansion cells.

The clay liner is to be keyed into the natural ground at the base of the existing landfill, refer Figure 6, Appendix A, to ensure that leachate from the existing landfill can drain seamlessly into the new landfill cell and towards the proposed leachate collection system, detailed in Section 4.6.

It is noted that previous soil investigation also highlighted that the on-site clay material was dominated by sodium and is likely to be dispersive. Further soil testing may be required to determine if the clay material requires ameliorating prior to use as liner material.

4.4 Final capping profile

It is understood that the entire current landfill footprint has been capped with an interim profile consisting of the accepted clean fill material.

As part of the progression towards the final landform and landfill closure, progressive final capping is to be undertaken by placing an appropriately designed low permeability cap profile, to minimise surface water infiltration, leachate generation and landfill gas migration.

GHD understands that there is currently no landfill guideline or standard enacted in Western Australia, and that DWER do not specifically endorse other jurisdiction's guidelines, or expect their application to. While DWER's predecessors have historically endorsed BPEM (Victoria EPA 2015) as the primary guidance for assessment of landfill closure aspects, including proposed final cap design, GHD understand that DWER will assess in line with their risk based approach and will not automatically assume that a landfill capping design is acceptable because it may be in line with the BPEM requirements. DWER will need to be convinced that the proposed standards for design and construction are suitable for the particular site/proposal in its environmental setting.

Cognisant of the above, however, GHD is confident that the general requirements for a landfill cap under BPEM are applicable in this instance. BPEM states that the final cap should be:

- Designed to limit water infiltration into the landfill and gas migration through the cap
- Sufficiently graded to prevent water ponding on the cap and minimising infiltration through the cap
- Landfill plateaus are to be graded to at least 5% to adequately shed water
- External landfill batters steeper than 20% require specific stormwater infrastructure to control runoff and minimise cap erosion
- Designed to provide a landform suitable for its intended after use.

The final capping profile for the site should be based on the outcomes of site specific risk assessment to ensure the cap is sufficient to manage risks to the environment and human health. The proposed final capping profile for the site is illustrated in Figure 4-1 and described below.

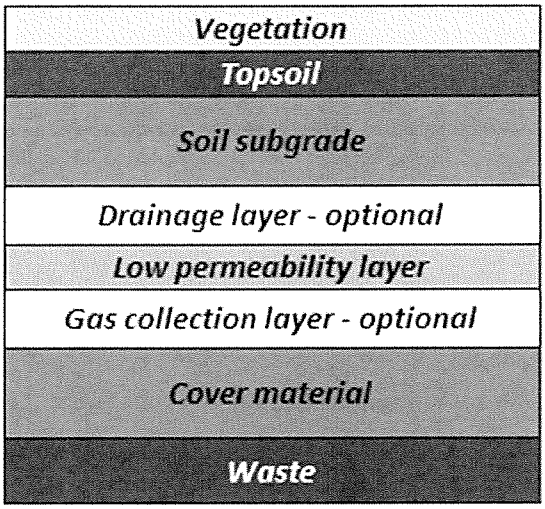

Figure 4-1 Proposed landfill cap design

Top soil

The purpose of the topsoil layer is to establish and sustain grasses, which can assist with maintaining the integrity of the cap, primarily through prevention of erosion.

Soil subgrade

The soil subgrade layer should comprise selected fill material that provides additional support for the topsoil vegetation layer and protect the drainage/low permeability layer from root intrusion.

Drainage layer

The purpose of the drainage layer is to reduce pressure on the low permeability layer by promoting infiltrated water to run off the landform.

This drainage layer is optional and can be excluded from the final cap profile if the final landform is graded in such a way that surface water runoff is promoted.

Low permeability layer

The low permeability layer is to achieve a permeability no greater than 1×10^{-9} m/s to reduce the potential for rainfall infiltration. This low permeability layer can comprise a number of options including:

- Compacted clay layer
- Geosynthetic clay liner (GCL)

Gas collection layer

Dependent on the anticipated landfill gas generation of the site, a gas collection layer can be included in the final cap profile as part of an active landfill gas extraction system.

Further landfill gas investigations at the site are required to determine if this layer is necessary.

Cover material

The cover material is essentially a bearing layer above the waste, which is generally 300 mm thick. This should be sufficiently stable on which to commence placement of the final cap profile.

4.5 Stormwater management

The sediment pond to the south west of the landfill, SW2, is currently within the proposal final landfill footprint, and will therefore require relocation as the landfill progresses. With the preliminary landfill filling proposed to commence in this south western portion of the landfill, priority is to be given to the relocation of this sediment pond and all associated drainage infrastructure. It is proposed that this sediment pond be located further south as identified on Figure 3 to Figure 5, Appendix A.

Preliminary sizing of this sediment pond will be undertaking as part of the CPCP. As the groundwater is known to be shallow in this southern portion of the landfill, additional groundwater investigation will be required to determine the feasibility of constructing a sediment pond in this location, as excavation is likely to be significantly limited.

As part of the construction of the final landfill cap, formal diversion, down batter and toe batter drains will be constructed into the final landform and around the perimeter of the landfill to effectively convey runoff from the landfill to the south where it is discharged off site, while minimising soil and cap erosion. More details on this infrastructure will be provided in the Closure and Post Closure Management Plan, once the final landform has been confirmed and agreed.

4.6 Leachate management

It is expected that leachate generated in the existing landfill infiltrates through the waste to the natural clay material underlying the landfill and travels laterally along this layer. With the construction of the new landfill cells beyond the existing landfill footprint, and the construction of a proposed compacted clay liner, leachate is expected to continue travelling laterally along this clay layer towards the landfill perimeter.

As part of the construction of the compacted clay liner, it is proposed that a sub-surface leachate interception drain be constructed along the perimeter of the clay liner, to capture leachate generated within the landfill and convey it to centralised leachate sump south of the landfill, as identified on Figure 3 to Figure 5, Appendix A, for management. Two preliminary leachate interception drain designs were considered for the site, a gravel trench interception drain and a compacted clay collection drain, as respectively detailed in Figure 6 and Figure 7, Appendix. Given the shallow groundwater, particularly in the southern portion of the site, the compacted clay collection drain is proposed for the site to collect and convey leachate to the leachate sump, as it is located above ground and the landfill liner.

Design of the leachate sump, including all supporting infrastructure (pumps, storage tanks etc), will need to be carefully considered as the sump may potentially be constructed into the groundwater.

From this sump, it is proposed that leachate is either routinely transferred up to the liquid ponds in the north of the site for evaporation or discharged into a new leachate evaporation pond, as proposed on Figure 3 to Figure 5, Appendix A. The disposal of leachate to the existing liquid ponds would be dependent on the permissibility of mixing landfill leachate with the septic tank and grease trap waste. There is also a possibility of recirculating the leachate back into the landfill mass while the landfill is operational.

The future quantity of leachate requiring management is unknown as no leachate infrastructure has been constructed on site. With the construction of a leachate interception drain as part of the landfill progression, leachate generated on site will be captured in this system and collected in the leachate sump. Sizing of the proposed leachate evaporation pond will be undertaken as part of the CPCP and will be designed based on a number of assumptions. Surface water management around the leachate evaporation pond will be critical to ensure upstream runoff is

diverted around the pond, and appropriate spillway and collection infrastructure is in place in the evident of overflow or pond failure.

With the introduction of the leachate interception drain, progressive capping will require enforcement on site to ensure that inactive landfill areas are appropriated capped with an interim material to minimise surface water infiltration into the landfill, and increasing the quantity of leachate requiring management.

4.7 Landfill gas management

It is understood that no landfill gas monitoring has been undertaken at the site to date and therefore it is unknown to what extent landfill gas (LFG) is currently being generated. Based on the existing interim clean fill cap, it is likely that any landfill gas generated at the site passively vents vertically from the landfill through the cap.

As part of the landfill closure, a final landfill cap consisting of a low permeability layer will be constructed over the entire landfill footprint, which will prevent landfill gas from passively venting through the cap and potentially directing it to migrate laterally off site. While operating a transfer station at the site, landfill gas has the potential to accumulate in and/or under on-site buildings.

Therefore, in order to inform the landfill gas management requirements for the site, a preliminary landfill gas assessment is recommended for the site to identify the presence, volumes and composition of landfill gas, as well as the pathways of landfill gas emissions, both surface and sub-surface, and the associated site specific landfill gas risks to the surrounding environment.

4.8 Monitoring requirements

It is important that a routine monitoring and inspection program be established to ensure that the integrity of the site infrastructure is maintained and demonstrate that the site is not presenting an unacceptable risk to the surrounding environment.

A summary of the proposed monitoring and inspection program to be included in the Closure and Post Closure Management Plan for the site is as follows:

- Landfill cap: inspection of the interim and final landfill cap to identify integrity failures such as vegetation loss, cap erosion and settlement/surface water ponding
- Stormwater management: inspection of all diversion bunds and drains to identify integrity or operational failures such as blockages from debris build-up, cracks and silt build-up
- Landfill gas monitoring: Routine landfill gas surface emission monitoring to assess the landfill cap integrity and monitoring in or under on-site buildings. It is expected that the installation of perimeter soil gas wells be recommended to identify the potential lateral migration of landfill gas off site.
- Groundwater monitoring: Routine groundwater monitoring up, cross and down gradient of the landfill, to observe trends and identify potential landfill impact. It is expected that additional groundwater monitoring wells will be recommended to appropriately assess potential down gradient contamination.
- Surface water monitoring: Routine surface water monitoring upstream, on-site and downstream of the landfill, to observe trends and identify potential landfill impact. It is expected that additional surface water monitoring locations will be identified as formal drains and ponds are constructed, to appropriately assess potential downstream contamination.

- Leachate monitoring: Routine leachate monitoring from the proposed leachate sump to characterise on-site leachate quality and potential contaminants of concern.

5. Airspace consumption and timing

5.1 Airspace consumption

A review of the waste data provided by the Shire between March 2015 and February 2020 estimated that between 2,800 and 4,800 tonnes of solid waste is disposed to landfill each year, excluding clean fill that is used as cover material and asbestos containing material. Asbestos material accepted on site is disposed of in a separate asbestos burial pit and is not considered as part of the landfill airspace consumption rate calculations. From 2019, inert waste type 1 accepted on site has been stockpiled and not disposed of to landfill, which has resulted in a landfill disposal rate of approximately 2,900 tonnes and 3,000 tonnes in 2020 and 2019, respectively.

While the site is licenced to dispose up to 10,000 tonnes per annum, an annual airspace consumption rate of 3,500 tonnes has been chosen as a conservative yet realistic disposal rate for the site.

To convert the waste tonnage to an airspace volume, a 0.65 tonne/m^3 compaction rate was used based on discussions with site operators and typical compaction rates for mobile compactors and front end loaders. The annual airspace consumption rate for the site is summarised in Table 5-1, which includes the rate inclusion of soil day cover (usually accounts for an additional 30%).

Table 5-1 Annual waste airspace consumption rate

Annual waste landfilled (tonnes)	Annual airspace consumption (m^3)	Annual airspace consumption, including soil day cover (m^3)
3,500	5,400	7,000

Population growth data, sourced from the Western Australian sub region population projections (Western Australian Planning Commission 2019), revealed the projected annual growth rates for the Shire of Plantagenet included in Table 5-2 below.

Table 5-2 Shire of Plantagenet population growth rates

Year	Average annual growth rate from 2016 (%)
2021	0.1
2026	0.15
2031	0.13

Considering the low average annual population growth rate projected for the Shire, a consistent airspace consumption rate has been used.

It is important to note that the airspace consumption does not include consideration of changes in waste management practices over the next 10-15 years. Changes in recycling and resource recovery initiatives or markets, as well as changes in landfill operational practices, such as the use of alternative daily cover, may significantly impact this airspace consumption estimate. Settlement of the existing waste material has also not been considered. Natural disasters or other unforeseeable events can also impact on the volume of available airspace.

5.2 Preliminary timing

Based on the airspace consumption rate detailed in Table 5-1, preliminary timings for the three final landform options detailed in Section 4.1 has been estimated below in Table 5-3.

Table 5-3 Mount Barker WMF preliminary timing

Final landform option	Airspace available (m^3)	Operational life (years) @ 3,500 tonnes/year
Option 1	89,500	12.8
Option 2	291,400	41.6
Option 3	220,300	31.5

6. Recommendations

Prior to the development of the Closure and Post Closure Plan for the Mount Barker Waste Management Facility, GHD proposes to discuss the design basis report with the Shire and confirm all landfill aspects including preferred final landform, filling plan and final capping profile.

In order to inform the closure and post closure management of the site, it is recommended that the following investigations be undertaken at the site:

- **Groundwater investigation** – to better understand the geology and groundwater level directly south and west of the existing landfill footprint to appropriately assess the feasibility of designing and constructing future sediment and leachate evaporation ponds in these areas. It is anticipated that this intrusive investigation would include a number of investigative push tube drills and the installation of additional groundwater monitoring wells.
- **Surface water investigation** – to better understand the interaction between surface water and groundwater to the south of the landfill. It is anticipated that this investigation would include additional groundwater and surface water monitoring, including first flush monitoring on site. A comparison of survey levels between the creek and groundwater levels will also be undertaken.
- **Landfill gas assessment** – undertaking an initial landfill gas monitoring event to identify the presence, extent and hot spots of landfill gas surface emissions, and the associated site specific landfill gas risk to the surrounding environment. Further to this, a landfill gas generation model could be prepared for the site to ballpark the potential landfill gas generation rates at the site now and in the future.
- **Clearing permits** – given the proposed final landform extents to the west of the existing landfill footprint, the Shire will be required to obtain a clearing permit to clear mature trees and vegetation within the proposed landfill footprint. It is anticipated that this process will include a flora and fauna survey, and preparation of the clearing permit form and application submission. It is noted that a clearing permit will be required in conjunction with the works approval application.

7. References

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Appendices

Appendix A – Figures

Figure 1 – Site locality

Figure 2 – Existing site conditions

Figure 3 – Final Landform – Option 1

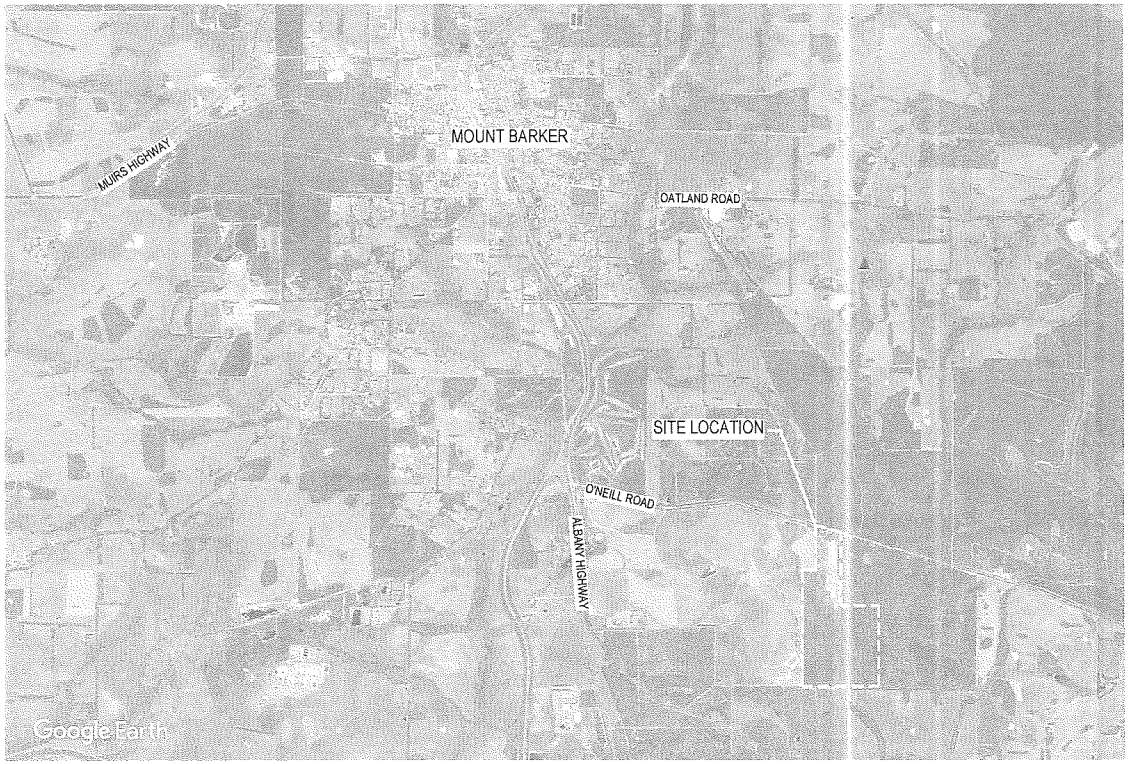
Figure 4 – Final Landform – Option 2

Figure 5 – Final Landform – Option 3

Figure 6 – General leachate and surface water arrangement – Option 1

Figure 7 – General leachate and surface water arrangement – Option 2

SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL
12521104



LOCALITY PLAN
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DRAWING LIST

DRAWING No.	TITLE
12521104-FIG01	SITE LOCALITY MAP
12521104-FIG02	EXISTING SITE CONDITIONS
12521104-FIG03	FINAL LANDFORM OPTION 1
12521104-FIG04	FINAL LANDFORM OPTION 2
12521104-FIG05	FINAL LANDFORM OPTION 3
12521104-FIG06	TYPICAL SECTION - DRAIN OPTION 1
12521104-FIG07	TYPICAL SECTION - DRAIN OPTION 2

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SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

SITE LOCALITY PLAN

Job Number 12531104
Revision A
Date JULY 2020

Figure 01

166 Stirling Terrace Albany WA 6330 T 61 8 9840 5100 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

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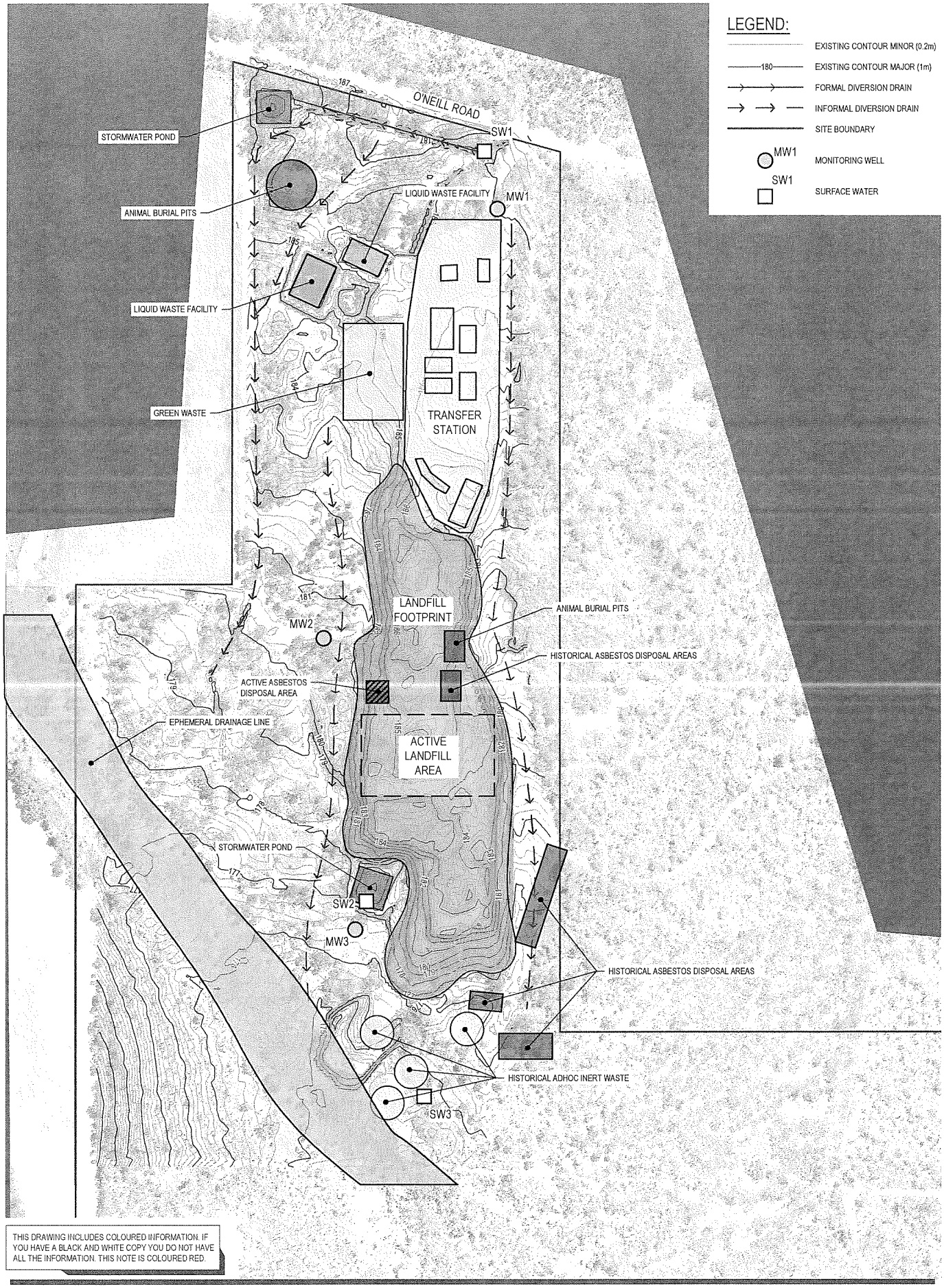

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0 20 40 60 80 100m

SCALE 1:2000 AT ORIGINAL SIZE

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SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

EXISTING SITE CONDITIONS

Job Number 12531104
Revision A
Date JULY 2020

Figure 02

166 Stirling Terrace Albany WA 6330 T 61 8 9840 5100 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

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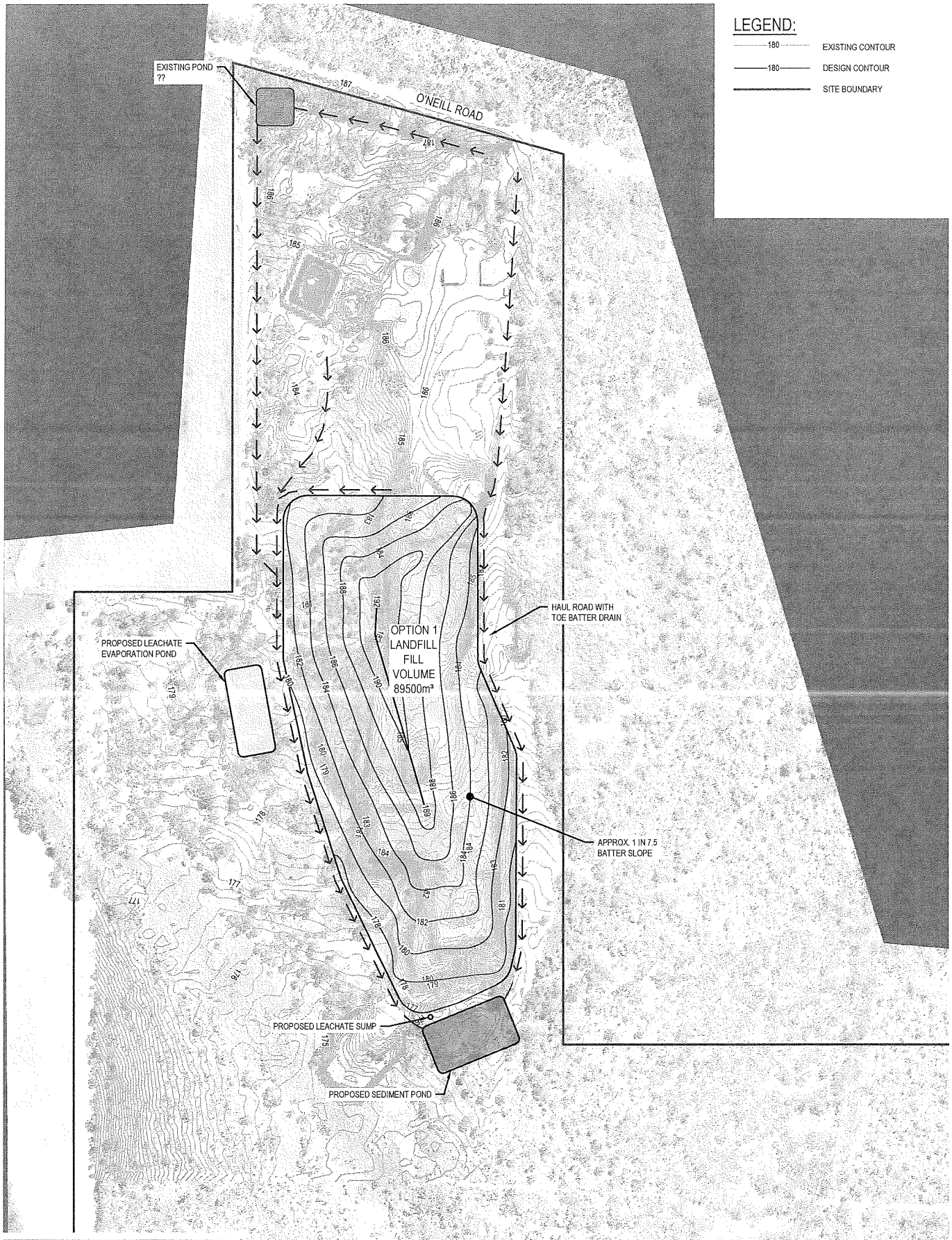

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0 20 40 60 80 100m

SCALE 1:2000 AT ORIGINAL SIZE

N

SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

FINAL LANDFORM OPTION 1

Job Number	12531104
Revision	A
Date	JULY 2020

Figure 03

166 Stirling Terrace Albany WA 6330 T 61 8 9840 5100 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

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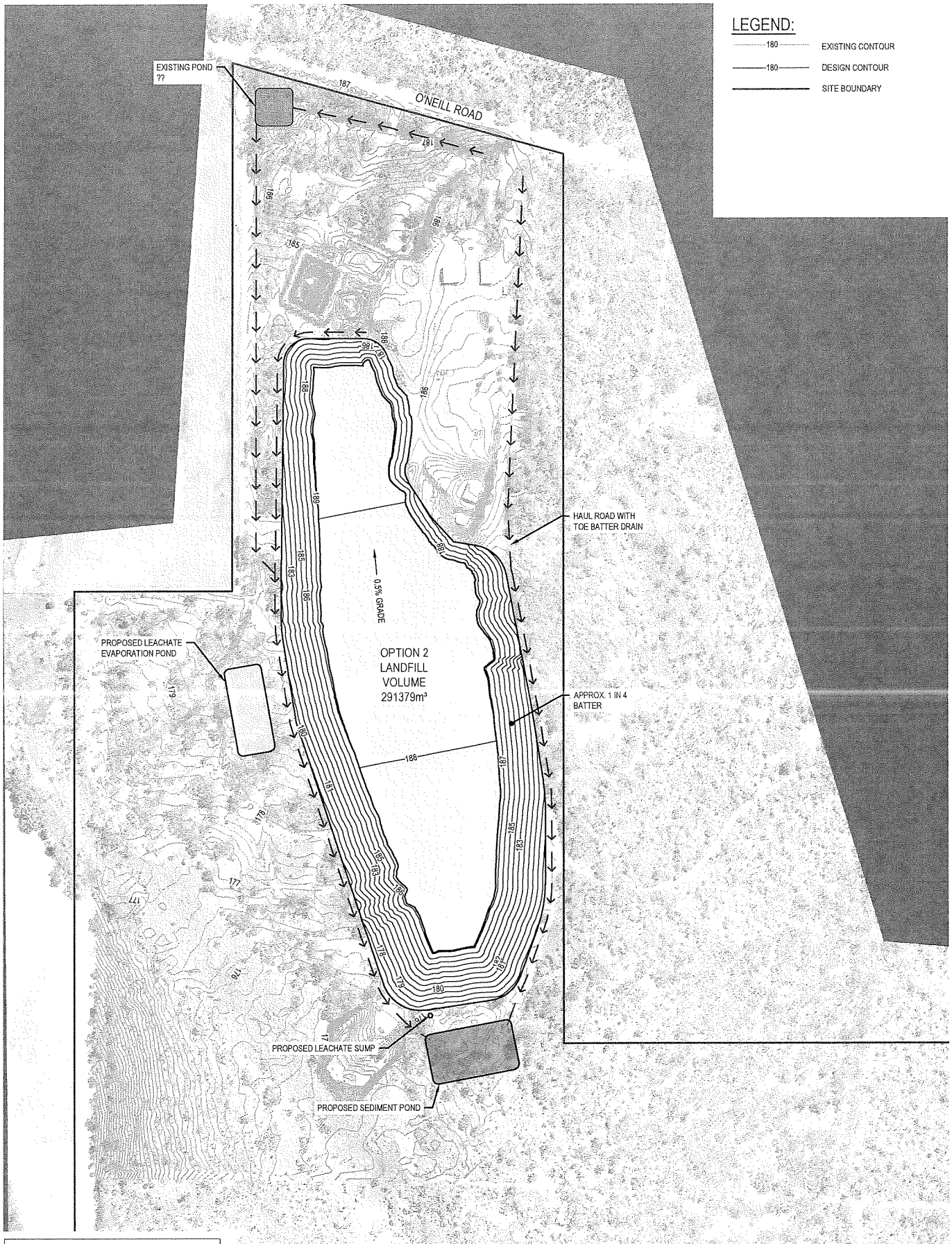

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0 20 40 60 80 100m
SCALE 1:2000 AT ORIGINAL SIZE

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SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

FINAL LANDFORM OPTION 2

Job Number 12531104
Revision A
Date JULY 2020

Figure 04

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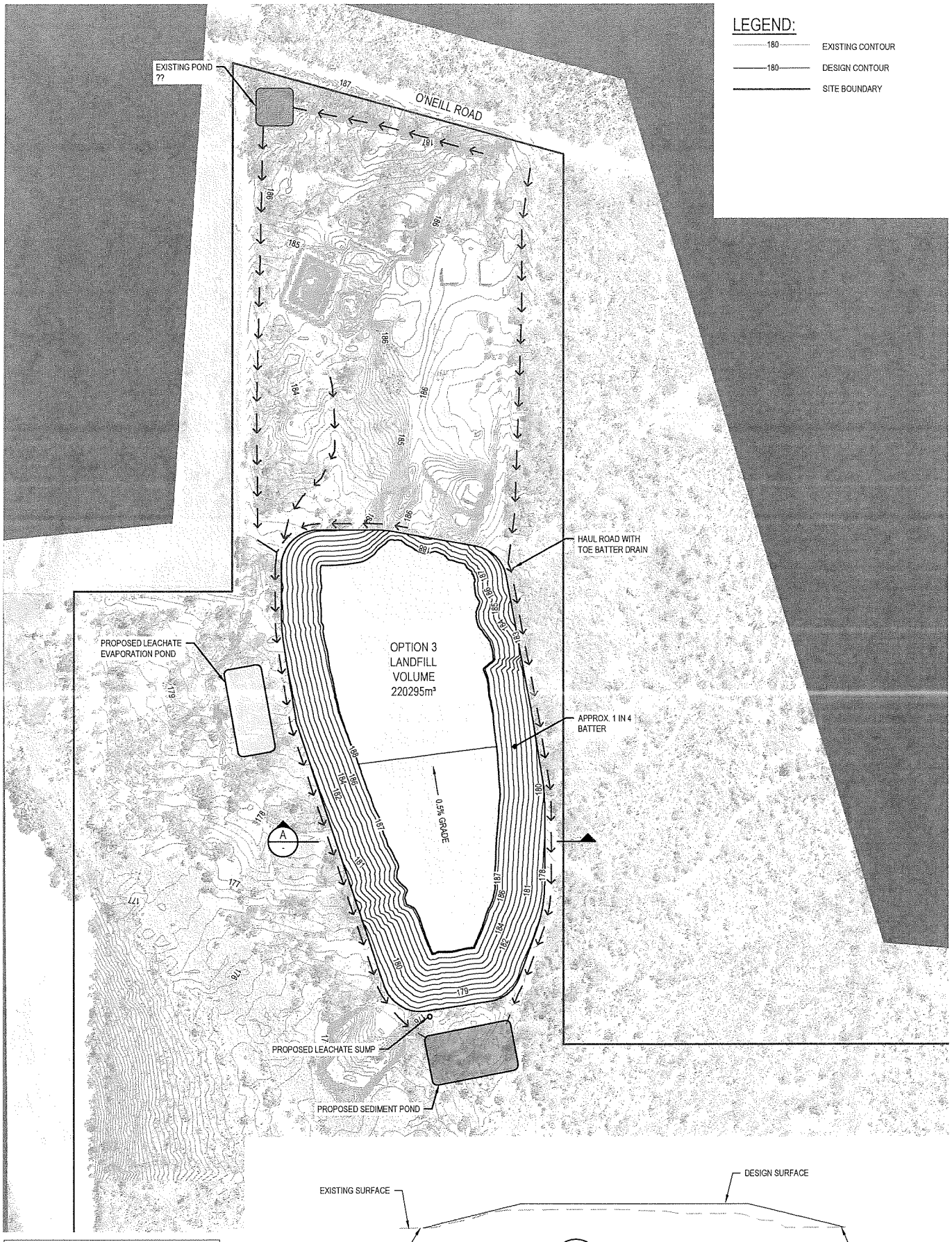

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SCALE 1:1000 AT ORIGINAL SIZE

0 20 40 60 80 100m
SCALE 1:2000 AT ORIGINAL SIZE

N

SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

FINAL LANDFORM OPTION 3

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Figure 05

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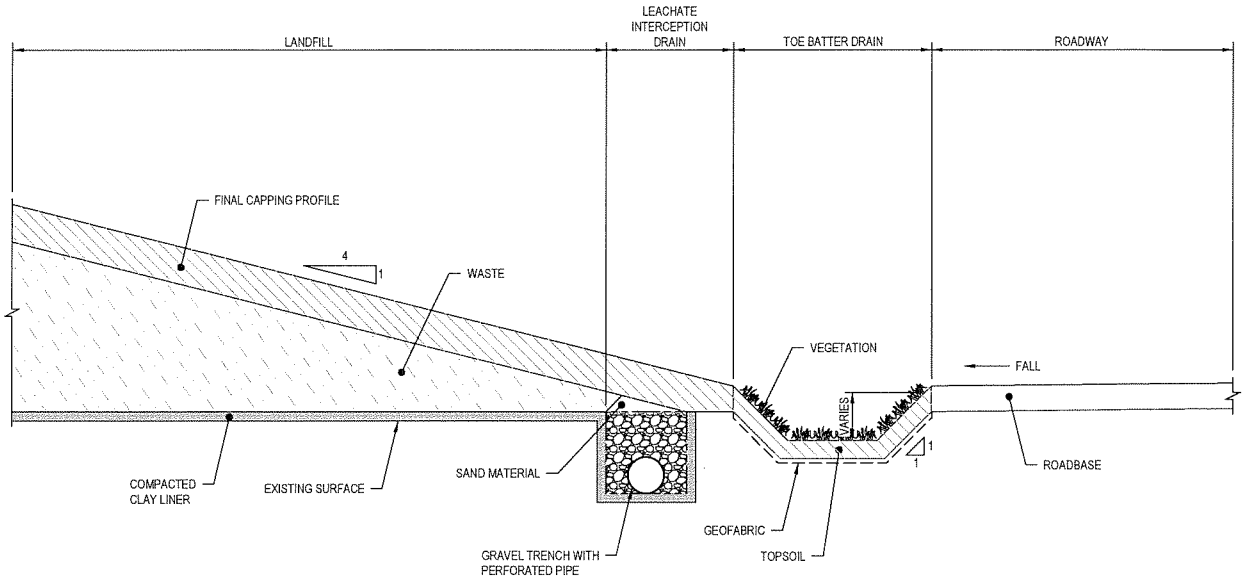

TYPICAL SECTION
HAUL ROAD WITH TOE BATTER DRAIN AND LEACHATE COLLECTION DRAIN OPTION 1

SCALE 1:20

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SCALE 1:20 AT ORIGINAL SIZE

SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

TYPICAL SECTION - DRAIN OPTION 1

Job Number	12531104
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Figure 06

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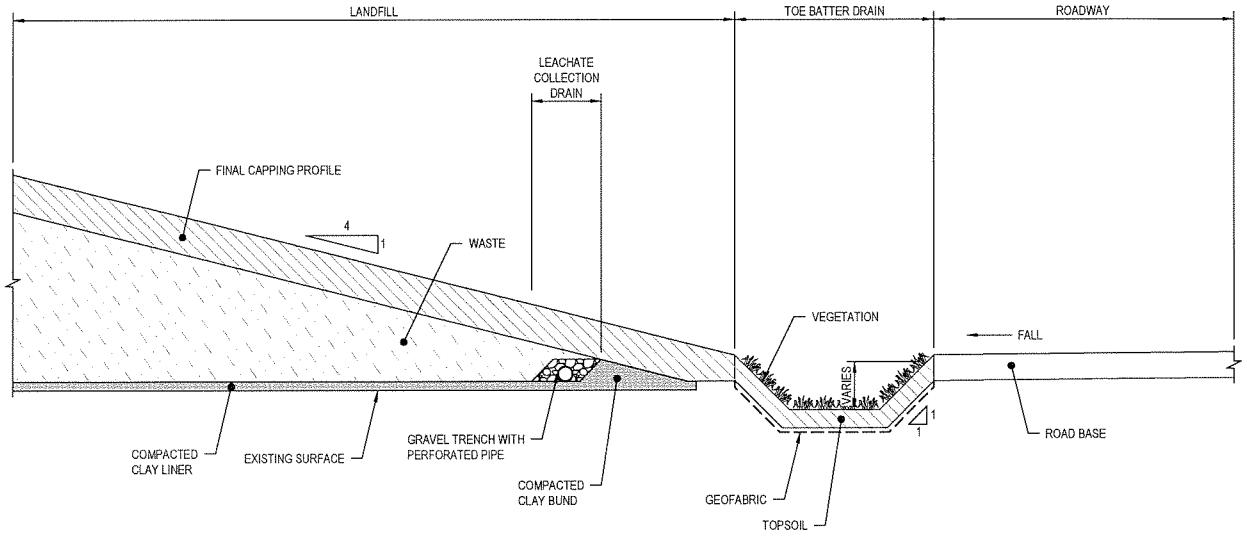

TYPICAL SECTION
HAUL ROAD WITH TOE BATTER DRAIN AND LEACHATE COLLECTION DRAIN OPTION 2

SCALE 1:20

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SCALE 1:20 AT ORIGINAL SIZE

SHIRE OF PLANTAGENET
O'NEILL ROAD LANDFILL

TYPICAL SECTION - DRAIN OPTION 2

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Figure 07

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Appendix B – Waste composition data

Appendix B
Waste Composition Data

Category 61: Liquid waste facility							
Liquid Waste Type	**03/15 - 02/16**	**03/16 - 02/17**	**03/17 - 02/18**	**03/18 - 02/19**	**03/19 - 02/2020**	**Total (litres)**	**Total (%)**
Septage wastes	255,800	344,050	204,850	254,650	126,210	1,185,560	68%
Waste from grease traps	73,740	128,810	96,340	187,710	60,735	547,335	32%
TOTAL	329,540	472,860	301,190	442,360	186,945	1,732,895	100%

Category 64: Class II or III putrescible landfill							
Waste Type	**03/15 - 02/16**	**03/16 - 02/17**	**03/17 - 02/18**	**03/18 - 02/19**	**03/19 - 02/2020**	**Total (tonnes)**	**Total (%)**
Putrescible waste (other than green waste)	3,104	2,743	3,145	2,985	2,804	14,781	59%
Inert waste type 1	1,220	202	481	-	-	1,903	8%
Speacial waste type 1 (asbestos)	19	141	32	6	5	203	1%
Clean fill (used as cover)	1,938	1,872	1,560	1,560	1,040	7,970	32%
Green waste (used as cover)	489	-	-	-	-	489	2%
Cardboard bales (used as cell walls)	-	-	-	-	69	69	0%
TOTAL	**6,751**	**4,817**	**5,186**	**4,545**	**3,913**	**25,213**	**100%**

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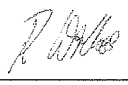
https://projectsportal.ghd.com/sites/pp18_01/oneilroadlandfillclo/ProjectDocs/12531104-REP-0_Landfill Closure Design Basis.docx
Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	N Ambrey	R Wilkes		J Foley		17/07/2020