Government of Western Australia
Department of Water and Environmental Regulation

Amendment Report

Licence Number	L7344/1998/10
Licence Holder	Vancouver Waste Services Pty Ltd
ACN	135 344 357
File Number:	DER2016/002256-1
Premises	Vancouver Waste Processing & Disposal Site Mindijup Road PALMDALE WA 6238 Legal description – Part of Lot 3 on Diagram 61867 and Lot 102 on Plan 22860
Date of Report	12/08/2020
Decision	Amendment Granted

1. Definitions and interpretation

Definitions

In this Amendment Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
AHD	Australian Height Datum
Amendment Report	refers to this document
Application	refers to the documents and information submitted by the Licence Holder, as described in Section 2.1 and listed in Table 3 of this Amendment Report
Category/ Categories/ Cat.	categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CEO	means Chief Executive Officer. CEO for the purposes of notification means: Director General Department administering the *Environmental Protection Act 1986* Locked Bag 10 Joondalup DC WA 6919 or: info@dwer.wa.gov.au
City	City of Albany
Delegated Officer	an officer under section 20 of the EP Act
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation
EP Act	Environmental Protection Act 1986 (WA)
EP Regulations	Environmental Protection Regulations 1987 (WA)
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of and during this Review
Licence Holder	Vancouver Waste Services Pty Ltd

Term	Definition
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Amendment Report applies, as specified at the front of this Amendment Report.
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act, with changes that correspond to the assessment outlined in this Amendment Report.
Risk Event	as described in Guidance Statement: Risk Assessment

2. Amendment Description

This amendment has been informed by DWER's Regulatory Framework which is available at https://www.der.wa.gov.au/our-work/regulatory-framework.

2.1 Purpose and scope of assessment

A licence amendment application (Application) was submitted by Vancouver Waste Services Pty Ltd (the Licence Holder) to DWER on 2 May 2018. Further information was sought by DWER which resulted in re-submission of the application in August 2018. Further technical detail was then sought by DWER, which included a meeting between DWER and the Licence Holder, prior to validation of the application in January 2019.

The scope of the amendment is limited only to the addition of a new Category to the Existing Licence (L7344/1998/10). No changes to other aspects of the Existing Licence have been made.

The proposed Prescribed Premises category that the application is subject, as defined in Schedule 1 of the EP Regulations, is described in Table 2.

Table 2: Proposed prescribed premises category

Category	Description	Proposed throughput capacity	Description of proposed amendment
Category 64	Class II or III putrescible landfill site: premises (other than clean fill premises) on which waste of a type permitted for disposal for this category of prescribed premises, in accordance with the *Landfill Waste Classification and Waste Definitions 1996*, is accepted for burial.	50,000 tonnes per annum	New category

The application is specific to adding a new activity, being a Class III putrescible landfill site, which the Licence Holder proposes to construct in a staged manner. The application is limited to:

- construction and operation of the first cell (Cell 1);
- construction of the second cell (Cell 2); and
- construction of a leachate storage pond.

Construction and operation of subsequent 'cells' will require separate approvals.

Table 3 lists the documents submitted during the assessment process with full references provided in Appendix 1.

Table 3: Documents and information submitted for assessment

Document/information description	Author	Date received
Application form and supporting information, including: • Landgate certificates of title; • Soil test results (Trilab, 2017); • Odour assessment report (Envall, 2017); • Operational management plan; • Construction specification; • Construction Quality Assurance Plan; • CAD drawings.	Bowman & Associates Pty Ltd	2 May 2018 (B&A, 2018a)
Response to request for further information (1), including: • Updated application form and supporting information; • Boreholes 1-5 log sheets; • Most recent groundwater monitoring report; • Fire Management Plan	Bowman & Associates Pty Ltd	8 August 2018 (B&A, 2018b)
Response to request for further information (2) on stability modelling.	Bowman & Associates Pty Ltd	4 October 2018 (B&A, 2018c)
Response to request for further information (3), including: • Soil bore location map; • Construction Quality Assurance Plan (revised).	Bowman & Associates Pty Ltd	2 November 2018 (B&A, 2018d)
Response to request for further information (4) on pseudostatic modelling, including: • Seismic design parameters (CMW Geosciences, 2018).	Bowman & Associates Pty Ltd	6 December 2018 (B&A, 2018e)
Response to request for further information (6), including: • Fire Management Plan (October 2019)	Bowman & Associates Pty Ltd	15 October 2019 (B&A, 2019a)
Response to request for further information (7)	Bowman & Associates Pty Ltd	17 December 2019 (B&A, 2019b)
Response to request for further information (8) providing update on status of missing information.	Bowman & Associates Pty Ltd	17 January 2020 (B&A, 2020a)
Vancouver Waste Disposal Facility Quantitative Seepage Assessment	WML Consulting Engineers for Bowman & Associates Pty Ltd	21 February 2020 (WML, 2020)
Amended design drawings/maps dated 21 May 2020	Bowman & Associates Pty Ltd	25 May 2020 (B&A, 2020b)
Vancouver Waste Services Stability Analysis to support Licence Amendment for Class III Landfill at Lot 102 Mindijup Road	GHD	22 June 2020 (GHD, 2020)

2.2 Background

The Premises is a privately-owned waste processing and disposal site located on the South Coast sandplain, approximately 45 km north-east of Albany. It was first licensed under the EP Act in 1998 for the disposal of used tyres, with additional waste processing and disposal activities being added over the years, including a commercial composting operation, disposal of clean fill and asbestos, processing and storage of bulk green waste, char production (12 month trial) and asphalt manufacturing, in addition to mining and processing the on-site silica sand resource.

Activities on the Premises are conducted in conjunction with other businesses operated by the Licence Holder in the South Coast region, including a garden supplies centre and waste transfer station in the Milpara light industrial area, and a bulk earthmoving and sand supply business.

The Licence Holder is now proposing to develop a putrescible landfill at the site, which is intended as a future alternative waste disposal option for the City of Albany.

2.3 Exclusions to the Premises

The following matters are out of the scope of this assessment and have not been considered within the technical risk assessment detailed in this Amendment Report:

- office, administration area and carpark;
- laydown yards, maintenance areas and mechanical workshops, equipment storage areas, etc.;
- fuel storage and re-fuelling area(s); and
- existing prescribed activities being conducted on the Premises (to be reviewed independent of this assessment).

This Amendment Report is related to Category 64 activities only and the Amended Licence does not offer the defence to offence provisions in the EP Act (see s. 74, 74A and 74B) relating to emissions or environmental impacts arising from non-Prescribed Activities, including those referenced above.

2.4 Consolidation of Licence

As part of this amendment package DWER has consolidated the licence by incorporating changes made under the following Amendment Notices:

- Amendment Notice 1, granted 14 July 2016 – Amendment to include a new disposal cell location for inert waste; and
- Amendment Notice 2, granted 5 September 2017 – Addition of prescribed premises Category 12, screening of material for the extraction, washing and screening of silica sand.

The obligations of the Licence Holder have not changed in consolidating the licence. DWER has not undertaken any additional risk assessment of the Premises related to previous Amendment Notices.

In consolidating the licence, the CEO has:

- updated the format and appearance of the licence;
- deleted the redundant AACR form set out in schedule 1 of the previous licence and advise the Licence Holder to obtain the form from the Department's website;
- revised licence condition's numbers, and removed any redundant conditions and realigned condition numbers for numerical consistency; and

- corrected clerical mistakes and unintentional errors.

Previously issued Amendment Notices will remain on the DWER website for future reference and will act a record of DWER's decision making.

3. Overview of proposal

The overall proposal involves the following:

- construction and subsequent filling, capping and rehabilitation of 16 landfill cells within a larger footprint spanning 21.66 hectares (ha);
- overall footprint follows the contours of an existing cleared paddock area on the site, within an active silica sand mine;
- estimated total airspace volume of 3.5 million cubic metres; and
- estimated life span of around 26 years, with construction anticipated to occur in 2021 and operations to commence 2022.

Sixteen (16) individual cells are proposed as part of the overall design and each cell is expected to provide between 2 and 4 years of filling capacity (30+ years).

Whilst preliminary designs for the overall proposal were provided, this application relates only to the construction of Cell 1, Cell 2 and the leachate pond. Subsequent cells will require separate applications including detailed design drawings. DWER will assess future applications to ensure the designs are consistent with relevant landfill requirements at the time and any future landfill design improvements.

With this type of infrastructure, DWER recognises both the potential environmental impact, and the practical inability to easily rectify issues, once the containment infrastructure is in use. As such, on completion of construction, the Licence Holder must submit a licence amendment application under Division 3, Part V of the EP Act, with an Environmental Compliance Report prepared by an independent Professional Engineer who has verified the construction meets the approved design documents.

Once the Environmental Compliance Report is reviewed by DWER, the Licence will require amending to include the newly constructed cell(s), and filling of the cell with waste can commence (including operation of the leachate pond) upon granting of the amendment.

3.1 Concept design

The design of the proposed landfill is described in the application and illustrated by a set of computer-aided design drawings (see Schedule 1). The application indicates the design, construction, operation and ongoing maintenance is based on the principles of the EPA Victoria's *Best Practice Environmental Management for Landfills* (Landfill BPEM).

DWER utilises a risk-based regulatory framework and so currently does not require the use of specific standards such as the Landfill BPEM. DWER's regulatory framework is detailed in the *Guidance Statement: Regulatory Principles*.

Key elements of the design include:

- progressive sequencing of landfill cell construction and filling following sand mining activities;
- constructing the base and sidewalls with an appropriate liner system, including leachate collection;
- containment of wastes through lining and capping measures to prevent and reduce leachate from escaping the cells – combined with leachate collection;

- ensuring adequate batter and sidewalls to maintain the stability of the landfill cells as they are filled and subsequently capped and rehabilitated; and
- capturing stormwater runoff to minimise leachate generation.

DWER notes the proposed landfill is both an 'Area' method landfill and a 'Mound' method landfill, with the remaining void to be filled following mining of the *in situ* silica sand resource (i.e. an Area), which also rises above the pre-mining ground level (i.e. a Mound).

3.2 Site layout and associated ancillary infrastructure

Figure 1 illustrates the overall landfill design footprint and an indicative layout of the first 4 cells. In addition to the construction of the landfill cells and the necessary management systems required to manage the landfill as wastes decompose, associated and ancillary infrastructure are also needed and proposed:

- leachate storage pond;
- leachate collection sumps and transmission pipework;
- passive landfill gas (LFG) vents;
- groundwater monitoring bores;
- temporary stormwater dam(s);
- site access and internal haul road(s); and
- office, parking and weighbridge at the entrance to the facility.

3.2.1 Cells 1 & 2 construction and operation

It is proposed that Cell 1 will firstly be constructed and operated as a standalone cell, with Cell 2 to be constructed once Cell 1 is partially filled with waste.

The design of Cell 1 incorporates the eastern-most extent of the external sidewalls and an internal sidewall, with an airspace of 80,000 m^3 (Figure 16). The eastern internal sidewall of Cell 2 is shared with the western internal sidewall of Cell 1. The western internal sidewall of Cell 2 will be constructed as a new internal sidewall, with the northern and southern external sidewalls being further extensions from Cell 1 (Figure 17).The specifications for Cells 1 & 2 design and construction are described in the *Construction Specification* document (B&A, 2018b) and *Construction Drawings* (Schedule 1) and are summarised in the following sections.

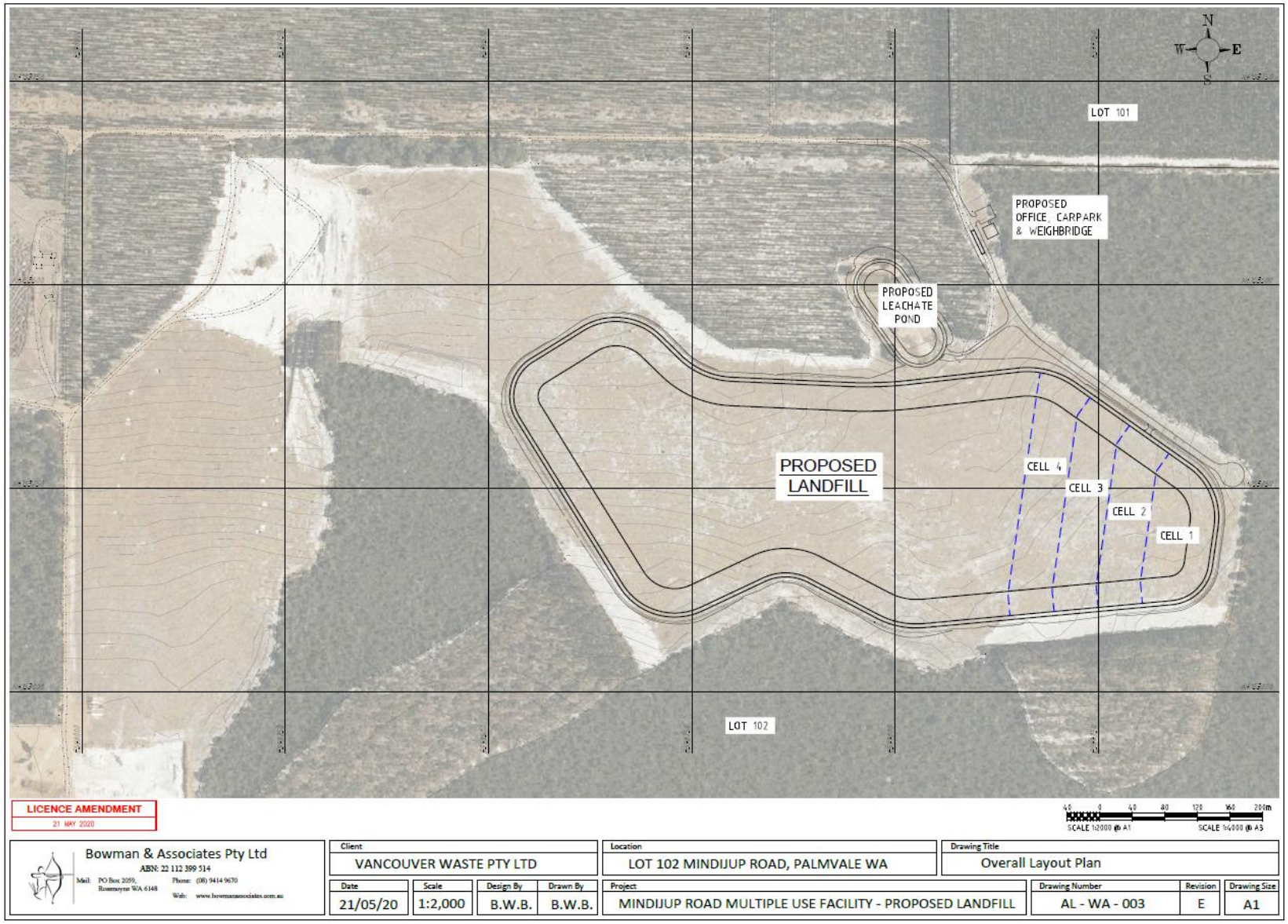


Figure 1: Overall layout plan

3.2.2 Base liner

The following liner configuration (from bottom to top) for the base of the cells is proposed:

- compacted, shaped and rolled subgrade consisting of *in situ* clay – compacted to a coefficient of permeability of less than 1 x 10^{-9} metres per second;
- geosynthetic clay liner (GCL) meeting a hydraulic conductivity of less than 1X10^{-9}m/s. It will consist of a layer of bentonite needle punched between two layers of geotextile and installed in direct contact with the compacted *in situ* clay. The GCL will extend up the side slopes and tie into adjacent cells and the landfill perimeter by an anchor trench;
- geomembrane liner – a high-density polyethylene (HDPE) geomembrane liner (2.0 mm thick) will be placed above the *in situ* clay with the textured side facing down;
- cushion geotextile – comprising a non-woven geotextile with a minimum specific mass of 500 g/m^2 and minimum puncture strength of 6,800 N;
- leachate collection/drainage layer (aggregate, pipes, leachate sump, etc.) consisting of:
  - leachate collection pipes: black perforated HDPE pipes;
  - leachate drainage aggregate: hard rock quarry product 20 – 50 mm particle size;
  - leachate sump: constructed as a depression within the landfill subgrade;
- separation geotextile – comprising a non-woven polyester or polypropylene geotextile.

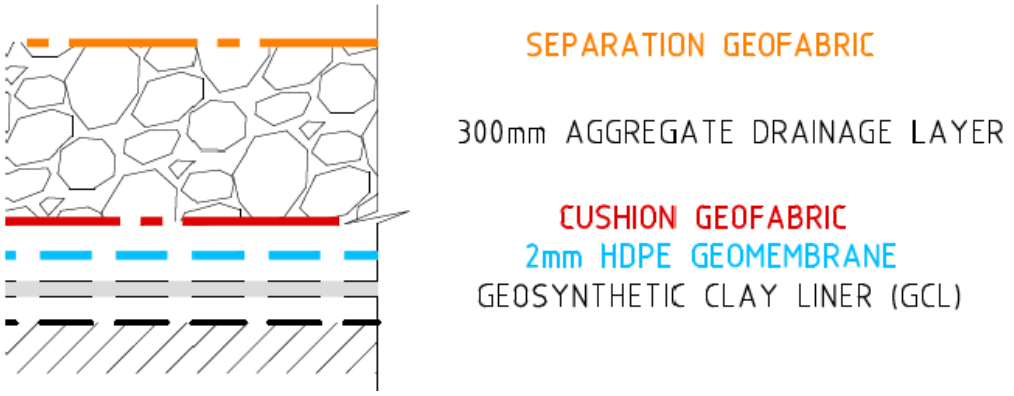


Figure 2: Proposed liner system

Figure 2 above and Figure 18 in Schedule 1 illustrates the proposed base liner configuration.

3.2.3 Sidewall batters and liner

The internal sidewall batters will be sloped at 1:3 gradients, and the external batters of the landfill at 1:5 gradient. The Licence Holder considers the *in situ* materials (mostly clayey sand) to be generally suitable as fill material for construction of the batters.

When constructing the batters, the fill material will be keyed back into the natural ground material by a minimum of 1.0 m.

The sidewalls will be lined using the same configuration as the base liner (Figure 2 and Figure 18). The geomembrane and cushion geotextile layers will be anchored at the crest of the batter slope, into anchor trenches constructed at least 1.5 m back from the landfill and excavated to a minimum depth of 0.75 m x 0.6 m (Figure 19), prior to construction of the leachate system. All liner components will be independently tested for conformance to required Technical Specifications and CQA prior to use.

Following a request for further information in relation to additional soil sampling or sensitivity testing (27 September 2018), the Licence Holder advised that interface shear testing will be performed for the interface of the sidewall subgrade and the compacted clay liner (in lieu of data being presented for more than one soil sample for verifying soil stability parameters). A subsoil drain (Megaflo) at the interface of the clay subgrade and the clay sidewall liner will also be included to provide a flow path for groundwater that may become trapped behind the compacted clay sidewall liner (see Section 3.3.4).

Stability assessments of the sidewall batters have also been undertaken (see Section 7.1.1) to validate that the liner design will remain stable over the operational life of the landfill to contain leachate.

Key findings:

The Delegated Officer notes the following in relation to the proposed landfill liner:

1. The site is located on sparse, rural land with minimal topsoil and approximately 6 – 8 m of fine silica sand, which is currently being mined. The *in situ* clay at the base of the pit is proposed to be compacted to form the base and subgrade of the landfill. Only two samples of the *in situ* clay beneath the site have been tested in an NATA accredited laboratory to demonstrate density and permeability. CQA testing of the landfill liner components will therefore be critical to ensure performance requirements of the landfill liner are met.
2. Revised design drawings dated 21 May 2020 and the revised stability assessment provided 22 June 2020 now propose the inclusion of a GCL layer in the landfill liner. This is consistent with similar landfill liner designs.

3.2.4 Landfill cap

The proposed capping system on the completed landfill will be 2.2 m thick and comprise a 2.0mm geomembrane liner, either HDPE or synthetic low density polyethylene (LDPE) and 0.6m of clay material overlaid with a growing medium (Figure 3). The maximum gradient of the landfill cap will be 5:1 and minimum gradient 2% to minimise ponding of water due to waste settlement.

Capping will occur progressively. On the completion of each cell the cap will be constructed and tied into the sideliner at the perimeter of the cells.

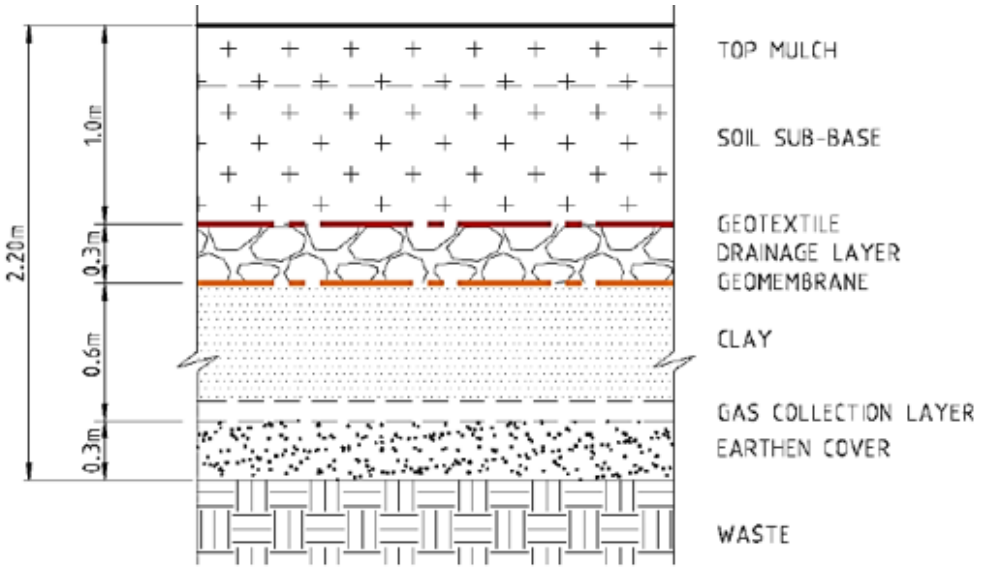


Figure 3. Landfill cap design

3.3 Proposed design containment measures

The application proposes the following containment measures associated with construction of the landfill:

- landfill liner with appropriate barrier system (described above);
- leachate collection and management system; and
- LFG venting system.

3.3.1 Leachate collection system

The landfill liner system will consist of a leachate collection system containing a drainage aggregate layer placed above the liner in each cell, and leachate collection pipes with a sump constructed within the subgrade at the lowest point of the floor in each cell. Leachate will collect in each sump and be transferred to the leachate pond via gravity flow (Figure 20).

The application includes a basic water balance model for Cells 1 & 2, using average rainfall and evaporation data from the Albany airport (approx. 32 km south-west of the Premises). Three scenarios were considered – Cell 1 only (uncapped), Cells 1 & 2 uncapped, and Cell 1 with 30% capped and Cell 2 uncapped as detailed in Section 7.1.2.

3.3.2 Leachate pond

The application proposes a single leachate pond 140 m x 60 m x 3 m depth, giving a design storage capacity of 15,597 m^3 (without freeboard capacity) (Figure 21).

The design operating depth for leachate storage will be 2.5m providing a 0.5m freeboard for wave action. Based on Cell 1 operation and partial capping of Cell 1 while Cell 2 is being landfilled, the expected maximum depth of leachate in the leachate pond will be 0.7m.

The leachate pond will be lined using the same configuration as the base liner, with the exception of the cushion geotextile, leachate collection and separation geotextile layers. All batters (external and internal) will be constructed with a 1:3 gradient.

3.3.3 Landfill gas management

As the proposed geomembrane is designed to inhibit the transfer of LFG up through the cap material, the management of LFG is required to ensure that LFG does not build up over time and exit the landfill in an uncontrolled manner.

The Licence Holder has calculated the volume of LFG to be generated during the life of Cells 1 & 2 to be in the order of 57 m^3/hr, which is less than the minimum generation rate required for LFG flaring or collection systems. The application therefore proposes to install LFG vents in the landfill cap to allow passive venting of gases.

Figure 4 illustrates a typical schematic of a passive landfill gas vent. The slotted portion of the vent will penetrate through the clay layer and into the landfilled waste. The passive LFG vents will be positioned on a grid with spacing of 60 m between each vent.

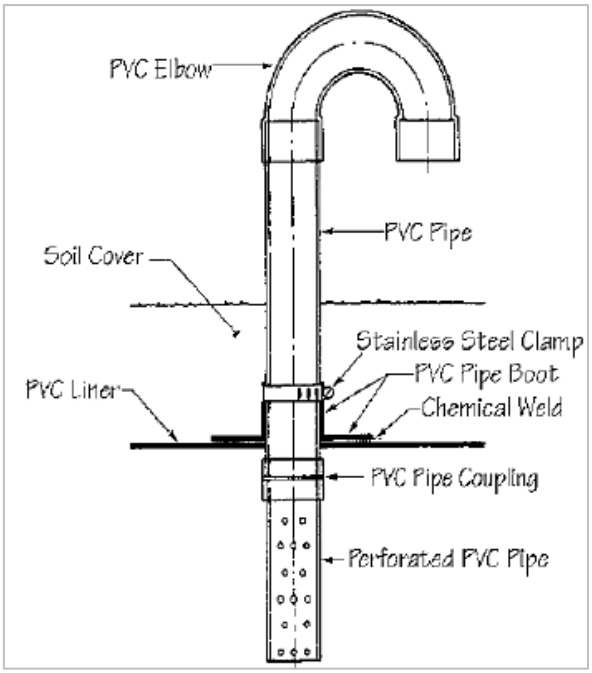


Figure 4: Schematic of typical passive LFG vent

Key findings:

The Delegated Officer notes the following in relation to landfill gas:

1. Management of landfill gas is important to minimise odour emissions and to prevent the uncontrolled release of landfill gas.
2. The landfill gas management/collection system should be progressively installed during the operational period of the landfill. Conditions will be included in the operational licence to require progressive installation of the landfill gas management/collection system during operation.
3. Limited quantities of landfill gas are expected to be generated during operation of Cell 1 and 2. Controls may be imposed on the operational licence to require gas generation rates to be assessed annually to determine whether the active control of landfill gas is feasible and/or required to mitigate risk associated with uncontrolled releases.

3.3.4 Stormwater management

Due to the sandy nature of the surface soils on the Premises, the Licence Holder has not proposed to construct an engineered stormwater management system. A temporary stormwater dam will be constructed in the clay base next to the landfill, measuring 400 m^2 in area, to collect stormwater from the excavated areas outside of Cells 1 & 2.

The Licence Holder has proposed the use of Geofabrics Megaflo 300 geocomposite panel drainage as a subsoil drain located at the interface of the clay subgrade and the compacted clay side slope liner. The drain will flow in both direction and on top of the clay subgrade. The subsoil drain is designed to provide a flow path for groundwater which may become trapped behind the compacted clay side slope liner. During construction of the landfill cells the Megaflo will daylight at the end of each cell and any water collected will feed into a temporary stormwater sump constructed nearby. The temporary stormwater sump will be backfilled when the next landfill cell is constructed.

The Megaflo product has a horizontal flow rate of 46 Litres/minute and a compressive strength in excess of 200 kPa in horizontal mode and in excess of 300 KPa in the vertical mode. It is intended that the Megflo will be laid on the diagonal subgrade prior to engineered fill being

placed.

Once the Cell 1 liner has been completed and landfilling has commenced, the stormwater from the completed liner area will be managed as leachate and pumped to the leachate pond for storage, consumption and evaporation.

Key findings:

The Delegated Officer has reviewed the Licence Holder's stormwater management controls notes the following:

1. The Licence Holder has included the Megaflo product to provide drainage for stormwater infiltration.
2. A minimum freeboard should be maintained in the leachate pond and conditioned for in the operational licence to prevent overtopping (e.g. by wave action) and to provide capacity of unseen events.
3. The landfill gas management/collection system should be progressively installed during the operational period of the landfill.
4. Limited quantities of landfill gas are expected to be generated during operation of Cell 1 and 2.
5. Controls may be imposed on the operational licence to require gas generation rates to be assessed annually to determine whether the active control of landfill gas is feasible.

3.4 General construction specifications

3.4.1 Construction materials

The Licence Holder considers the *In situ* materials available on the Premises to be suitable for construction of embankment fill, pavement material and daily cover. Soil testing has been conducted on two occasions, from which two predominant soil types beneath the proposed landfill site are inferred, being silica sand to a depth of 3 – 5 mbgl, overlying sandy clay material to depth. The silica sand resource will be mined to the top of the sandy clay layer.

From the samples collected, the sandy clay has 97 – 100% passing the 2.36 mm sieve and 26 – 68% passing the 0.075 mm sieve. The sample with 26% passing the 0.075 mm sieve was tested for permeability which provided a result of 4.5×10^{-10} m/s, in addition to a shear angle of 32.5° and a cohesive strength of 8.7 kPa.

3.4.2 Construction Quality Assurance

The *Construction Quality Assurance Plan* (B&A, 2018) documents the plan for the proposed construction of Cells 1 & 2 and the leachate pond, and outlines the test methods, frequency of testing and quality assurance procedures for the following materials to be used in the proposed works:

- subgrade;
- HDPE geomembrane liner (supply and installation);
- cushion geotextile;
- leachate collection system; and
- separation geotextile.

The CQAP specifies that a suitably qualified Superintendent will be appointed to provide project management and quality assessment of the works, including ensuring that field and laboratory testing is in accordance with the CQAP and inspection of the works at hold points

identified within the CQAP. A CQA Engineer will be onsite full time during placement of the HDPE liners, and regular site visits during construction of the leachate drainage system.

A CQA Validation Report will be prepared by the Superintendent or CQA Engineer following completion of the construction works. The report will include the results of surveys, inspections, material conformance tests, as-constructed drawings, monitoring records, soil testing and justification for any deviations from the approved design, and be submitted to DWER.

Key findings:

The Delegated Officer has reviewed the Licence Holder's CQAP and associated Construction Specification and notes the following:

1. A revised CQAP and Construction Specification including the proposed GCL layer in the landfill liner has not been provided to DWER, as such it is not clear what CQA testing will be undertaken for this layer.
2. Correct CQA procedures and testing must be conducted during installation of the liner and leachate collection system to ensure required performance of the liner system is met. Conditions will be included in the Licence to require CQA testing and validation to ensure set material specifications are met.
3. The Licence Holder will be required to prepare and submit a CQA Validation Report to demonstrate that construction complies with the requirements of the Licence. It will be required that the CQA report include the results for the surveys, inspections, as constructed drawings, monitoring reports, testing and any corrective action taken and that all work will comply with relevant Australian Standards.

3.5 Proposed operational management

3.5.1 Waste acceptance

The landfill will initially be operated as a private landfill and as such will be closed to commercial users and the general public. In the future, the landfill may accept waste from these sources. Initially, all wastes to be disposed at the Premises will be sourced from the Licence Holder's waste transfer station in the Milpara Industrial Area, where all waste sorting, separation and resource recovery will occur, prior to transfer and disposal at the landfill.

The following pre-sorted waste streams will be disposed at the Premises:

- clean fill;
- solid inert waste Type 1;
- uncontaminated fill;
- neutralised acid sulfate soil;
- solid inert waste Type 2
- putrescible waste;
- special wastes (asbestos and biomedical wastes); and
- contaminated solid waste meeting the waste acceptance criteria for Class III landfills.

Likely waste sources will include:

- municipal solid waste, including wastes received from the public and from kerbside collection;
- commercial and industrial waste;

- construction and demolition waste; and
- waste from private waste companies and industries.

The Licence Holder has nominated an annual throughput of 50,000 tonnes.

Key findings:

The Delegated Officer notes the following:

1. The proposed landfill design for construction of Cells 1 & 2 incorporates a composite liner system, comprising compacted subgrade, GCL, HDPE geomembrane, and a leachate collection system, which is suitable for receiving solid waste types meeting the waste acceptance criteria for Class II and III landfills.

3.5.2 Waste placement and cover

A designated tipping face will be established during landfill operation. The size of the active tipping area will be kept as small as possible and will be no larger than 30 m in length to minimise amenity impacts such as odour and to better control litter and pests.

The cell will be filled in horizontal layers both initially and once the initial temporary bunds have been covered. Daily cover will be continually placed over the waste during the filling of each cell with only the active tipping area exposed.

The waste will be further compacted once daily filling is completed, and a subsequent daily cover of at least 230 mm of sand or soil will be placed over the last active tipping area at the end of filling each day. The material to be used for the daily cover will be primarily sourced from the on-site sand resource.

When landfilling is complete within a cell, the waste will have an intermediate cover layer placed over it. The intermediate cover layer will consist of at least 300 mm of compacted clay or clay-rich soil. Inspection of the cover layers will be undertaken, and any damage or cracks will be rectified.

Each completed cell will be required to be capped. The cap has the following purposes:

- minimises infiltration of water to the waste, which therefore minimises leachate generation;
- reduces uncontrolled emissions of LFG and odour;
- minimises wind and water erosion; and
- allows for settlement of waste during degradation.

Disposal activities are proposed to occur 6:00 am to 5:00 pm Monday to Saturday, excluding public holidays in Western Australia.

Plant typically expected to be used in the landfilling operations includes: compactor, bulldozer, front end loader, excavator and a water cart.

3.5.3 Leachate collection and management

Leachate will be collected through the leachate pipe system embedded in the liner system and will be directed to the leachate sumps constructed at the lowest point in each cell for transfer via gravity flow to the leachate pond.

The level of leachate head kept on the base liner in each cell will be maintained at less than 300 mm over the liner in the vicinity of the leachate sump. The Licence Holder is proposing monitoring of the leachate level within the leachate sump of each cell on a monthly basis, or more regularly if required, particularly after storm events.

The primary leachate disposal method is mass reduction by evaporation. Leachate may also be recirculated over the active landfill cell to manage the level of leachate within the storage pond and assist the decomposition of waste. Other leachate management options, such as use in the on-site composting operation, may be proposed at a later stage by the Licence Holder if necessary and subject to appropriate approvals.

Key findings:

1. Leachate collection, evaporation and recirculation is proposed to manage the volumes of leachate generated and stored on the Premises. These methods require ongoing operational monitoring and inspection to ensure infrastructure is maintained and operated in a manner that prevents unacceptable discharges to leachate to the environment.
2. Leachate seepage to groundwater from landfilling operations may arise if defects occur during placement and/or over time in the operation of the landfill cell or leachate management system, including leachate storage ponds. Conditions will therefore be included in the amended licence requiring correct CQA procedures and testing to be undertaken during installation of the leachate collection system and associated infrastructure.
3. Maintenance of leachate within the landfill will assist in prolonging the performance of the liner.

3.6 Infrastructure

The proposed infrastructure, as it relates to the Category 64 activity, is detailed in Table 4 and with reference to the updated Site Plan (Schedule 1).

Table 4: Vancouver Waste putrescible landfill infrastructure

Infrastructure	
Prescribed Activity Category 64	
Construction of the first two cells and leachate pond for a new putrescible landfill	
1	Cell 1 – composite lining system, leachate collection system, 80,000 m^3 capacity
2	Cell 2 – composite lining system, leachate collection system 150,000 m^3 capacity
3	Leachate pond – 160 x 60 x 3 m – 15,597 kL operational capacity (without freeboard capacity)
Other activities	
1	Office, weighbridge, carpark
2	Entrance/access road, including landfill access point

4. Other approvals

The Licence Holder has provided the following information relating to other approvals as outlined in Table 5.

Table 5: Relevant approvals

Legislation	Number	Approval
Planning and Development Act 2005 (WA)	P2180245	Development approval issued by the City of Albany to construct a waste disposal facility on 25 August 2018

4.1.1 Part IV of the EP Act

The proposal to construct and operate a putrescible landfill on the Premises has not been assessed by or referred to the Environmental Protection Authority.

4.1.2 Clearing of native vegetation

Clearing of native vegetation in Western Australia requires a clearing permit, unless exemptions apply. Clearing is not proposed as part of this application but may be required as part of future developments at the site.

5. Licensing history

The Premises was first licensed in 1998 as an inert landfill (Category 63) for the disposal of used tyres.

In 2011, the Licence Holder constructed a composting facility on the Premises to facilitate the processing of green waste from the Licence Holder's waste transfer station in Albany (Category 67A). The facility is licensed for the storage and composting of up to 12,000 tonnes per annum (tpa) of green waste, agricultural bedding straw and forestry residues.

In 2012, a works approval was obtained for the disposal of asbestos on the Premises in commercial quantities (Category 63). In the same year, an amendment was issued to authorise the composting of biosolids from the Albany wastewater treatment plant on a trial basis (Category 67A). The trial never eventuated and this provision was later removed from the licence in 2014.

In 2014, approval was obtained for the campaign grinding of green waste, and storage and disposal of construction and demolition wastes from the Licence Holder's earthmoving business (Category 62). In the same year, an amendment was issued to authorise a one-off green waste burn, and a one year char production trial using green waste (Category 37). The Delegated Officer notes the Licence Holder has not made further representations to DWER to continue the char production operation beyond 31 July 2016, and therefore any reference to Category 37 should be removed from the Existing Licence during the next licence review.

In 2016, an amendment was issued to reduce the production limit for the composting facility to 5,000 tpa, in addition to removing the provisions for the burning of green waste. In the same year, an amendment notice was issued to authorise a new cell for the disposal of used tyres.

In 2017, an amendment notice was issued to authorise the washing and screening of silica sand on the Premises (Category 12). The Delegated Officer notes this activity requires reassessment under Category 5 (processing or beneficiation of metallic or non-metallic ore), consistent with the adjacent TT Sand mining operation.

The works approval and licence amendment history for the premises is summarised in Table 6.

Table 6: Works approval and licence amendment history

Instrument	Issued	Details
L7344/5	03/11/2003	Licence renewed (1 year).
L7344/6	17/05/2004	Licence renewed (1 year).
L7344/7	12/01/2005	Licence renewed (5 years).
L7344/1998/7	07/04/2008	Administrative Licence amendment to ensure licence dates run for a year period.
L7344/1998/8	24/12/2009	Licence renewed (1 year).
W4797/2010/1	06/01/2011	Works approval for construction of a composting facility.
L7344/1998/9	13/01/2011	Licence renewed (1 year).
L7344/1998/9	07/07/2011	Licence amendment to authorise operation of composting facility constructed under W4797.
L7344/1998/10	22/12/2011	Licence renewed (5 years).
W5082/2011/1	12/01/2012	Works approval for asbestos disposal pit.
L7344/2011/10	15/03/2012	Licence amendment for composting biosolids (trial only).
W5573/2013/1	01/05/2014	Works approval for grinding of green waste and storage and disposal of C&D wastes.
L7344/2011/10	30/10/2014	Licence amendment, including conversion to new format and authorise grinding of green waste and storage/disposal of C&D wastes.
L7344/2011/10	29/10/2015	Licence amendment for a one-off green waste burn, and a one year char production trial.
L7344/2011/10	18/01/2016	Licence amendment for reducing composting limit and green waste burning provisions removed.
L7344/2011/10	14/07/2016	Amendment Notice 1 – new cell for inert waste disposal.
L7344/2011/10	05/09/2017	Amendment Notice 2 – inclusion of category 12 for screening of silica sand
L7344/2011/10	2019	Amendment 3 – amalgamation of previous Amendment Notices and construction of a lined putrescible landfill (this Amendment).

6. Environmental siting

6.1 Siting context

The Premises is located in the Great Southern region, approximately 45 km north-east of Albany.

It is located on the sandplain between the Stirling Range and the Albany coast. The surrounding area is predominantly agricultural, forestry and remnant vegetation. Immediately south of the premises is an active silica sand mining operation (AustSand).

6.2 Residential and sensitive premises

The site and surrounding areas are zoned as 'Priority Agriculture' in the *City of Albany Local Planning Scheme Map 42*.

Farm residences make up most of the identified sensitive receptors in the vicinity of the Premises. TT Sand's mining operation abuts the southern boundary of the site and is considered a receptor in accordance with DWER's *Guidance Statement: Risk Assessment*. The nearest residential receptor is located approximately 1.5 km south-east of the proposed landfill, and 3 others within 2.5 km.

Table 7 below lists the relevant sensitive land uses in the vicinity of the Prescribed Premises which may be receptors relevant to the proposed amendment.

Table 7: Receptors and distance from proposed landfill

Residential and sensitive premises	Distance from Prescribed Activity
TT Sand – silica sand mine (Licence L6798/1993/11)	Approx. 0.6 km south of the proposed landfill
494 Mindijup Rd, Palmdale (Lot 6)	Approx. 1.5 km south-east of the proposed landfill
713 Mindijup Rd, Palmdale (Lot 5)	Approx. 1.7 km west of the proposed landfill
1483 Palmdale Rd, Palmdale (Lot 251)	Approx. 1.9 km east of the proposed landfill

6.3 Environmental receptors

Table 8 below lists the relevant environmental receptors in the vicinity of the Prescribed Premises which may be receptors relevant to the proposed amendment.

Table 8: Environmental receptors and distance from activity boundary

Environmental receptors	Distance from Prescribed Premises
Public drinking water source areas	The Premises is not located within a public drinking water source area or catchment area. There are no drinking water source or catchment areas within 2km of the Premises
Major watercourses/waterbodies	The Kalgan River is approximately 150m from western boundary of the Premises
Groundwater	According to the Licence Holder, the regional groundwater table is at least 12mbgl but varies significantly. Monitoring of standing water level in 2017 and 2018 indicated depths to groundwater between 16 and 31mbgl. The Fire Management Plan provided with the application

	states that groundwater flows steadily from south to the north. The groundwater salinity is mapped at 1,000 – 3,000 mg/L classified as some beneficial use – suitable for livestock. No bores are located within 1km of the Premises (based on available GIS dataset – WIN groundwater sites).
Department of Biodiversity Conservation and Attractions managed lands and waters	Nature Reserve located approximately 1.8km from the eastern boundary of the premises
Threatened Ecological Communities and Priority Ecological Communities	None within 2km of the Premises
Threated/Priority Flora	None within 2km of the Premises
Threatened/Priority Fauna	None within 2km of the Premises

6.4 Environmental setting

6.4.1 Physiography

Regionally, the area between the Stirling Range and Albany is sandplain overlying a shallow basin of sedimentary strata. It slopes downwards from about 200 m AHD at the footslopes of the Stirling Range in the north to about 50 m AHD in the south behind the coastal dune system and bedrock headlands. Locally, wetlands lie to the east of the Premises, between the sandplain and the coastal fringe where hills of limestone, dune sand, and bedrock reach from sea level to elevations of up to 100 m or more.

The plains of the Albany coast are drained by several short south-flowing rivers, such as the Kalgan, Hay and Denmark Rivers. Locally, the Kalgan River is the predominant surface water feature, which empties into Oyster Harbour at the coast. Numerous other creeks drain the sandplain to the south of the Premises, including Napier Creek, which borders the King River catchment to the west.

6.4.2 Climate

The climate in the Albany region is considered to be mild Mediterranean with a distinctly dry and warm summer and a winter which experiences seasonal rainfall, as per the Köppen classification system used by the Bureau of Meteorology. The nearest weather station, Windrush (BOM site no. 009848), approximately 3.3 km south-east of the premises, indicates an average annual rainfall of 665 mm (Table 9). The wettest six months (May to October) receive 68 percent of the annual rainfall, on average; July is the wettest month, recording 13 percent of the annual rainfall, on average.

Table 9: Average rainfall for Windrush 1959 – 2019 (BOM, 2019).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ave rainfall (mm)	22.9	24.2	34.1	52.1	73.3	76.4	86.9	81.1	75.1	61.5	46.5	29.8	665.5

Average pan evaporation at the premises is estimated to be 1,500 mm per annum; monthly evaporation would on average exceed the rainfall for most of the year except May to September.

6.4.3 Topography

The site generally slopes down from the south-east to the north-west, towards the Kalgan River. The highest point sits at approximately 135 m Australian Height Datum (AHD) along the southern boundary and lowest at 110 m AHD at the north-western corner of the proposed landfill (Figure 5).

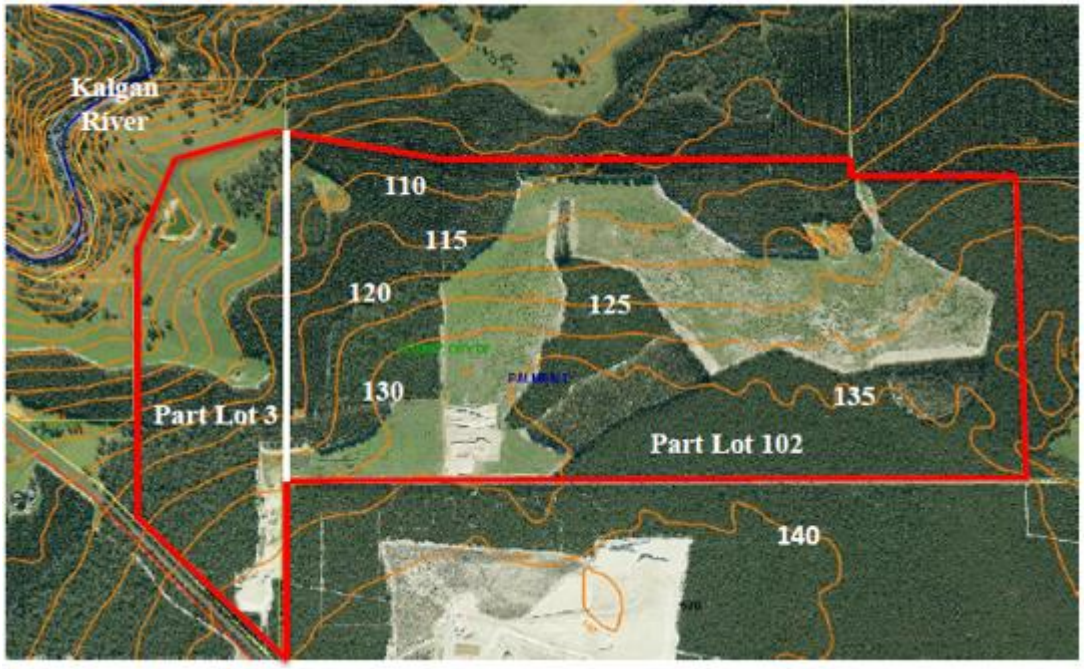


Figure 5: Topography of the area

6.4.4 Geology

Quaternary sediments

The Department of Mines, Industry Regulation and Safety (DMIRS) geological online database (DMIRS, 2019) has classified the site as:

“Czs: Sand or gravel plains, quartz sand sheets commonly with ferruginous pisoliths or pebbles, minor clay, local calcrete, laterite, silt, clay, alluvium, colluvium and aeolian sand”.

These deposits are derived from the reworking of the underlying Pallinup Siltstone formation.

Drill logs from five holes drilled to between 9 and 17.5 m below ground level across the site in 2011 identified a relatively consistent sequence of interbedded sands and clays underlying a thick sequence of pale sand.

Cainozoic geology

The underlying Cainozoic era geology is described as the ‘Plantagenet Group’, which consists of the Werillup formation and the Pallinup Siltstone formation.

The Pallinup Siltstone formation was deposited in a shallow-marine environment during a major marine transgression in the late Eocene period. The unit comprises very fine sandstone, multi-coloured siltstone and clay, and minor lignite layers near the base.

The Werillup formation underlies the Pallinup Siltstone formation and consists of a discontinuous basal gravel, coarse sands, lignite (‘black shale’), and clay, and locally near the top includes the Narnarup Limestone Member.

Proterozoic geology

The bedrock is anticipated to comprise highly deformed granitoid gneiss and granitoid rocks of

the Albany-Fraser Orogen and unconformably underlies the Plantagenet Group. These rocks are poorly exposed due to the extensive superficial cover and deep weathering.

Structural geology

No major linear structures have been identified within the confines of the site, while no information has been sourced on the dip and strike of the sedimentary lithologies.

The site straddles two large linear features, approximately 8.4 km to the north and 3.7 km to the south. Both have been described as exposed major fault or shear zones (DMIRS, 2019).

6.4.5 Hydrogeology

Surficial sediments

The surficial sediments consist mainly of limestone (equivalent to the Tamala Limestone), sand, silt, and clay, with a small proportion of gravel and gypsum, and are generally less than 10 m thick within inland depressions. They lie unconformably on all other units, though mainly Tertiary sediments, and are recharged by rainfall, river flow and occasional flooding, and from upward groundwater leakage from underlying aquifers. Groundwater flow is generally localised, discharging into surface water drainages or lakes.

Plantagenet Group

Sedimentary strata of the Plantagenet Group (Werillup formation and Pallinup Siltstone) comprise the main aquifer systems in the area. The Werillup formation is generally between 40 and 87 m thick, with the Pallinup Siltstone up to 50 m thick. The Werillup formation rests unconformably on bedrock and is extensively overlain by Pallinup Siltstone – the Pallinup Siltstone also has a wider distribution and overlies bedrock in places (Figure 6). Both units are recharged by rainfall, leakage from overlying surficial sediments and leakage from bedrock. Groundwater movement is generally to the east or south-east. The regional hydrogeology of the Mount Barker – Albany 1:250,000 sheet area has been described by Smith (1997).

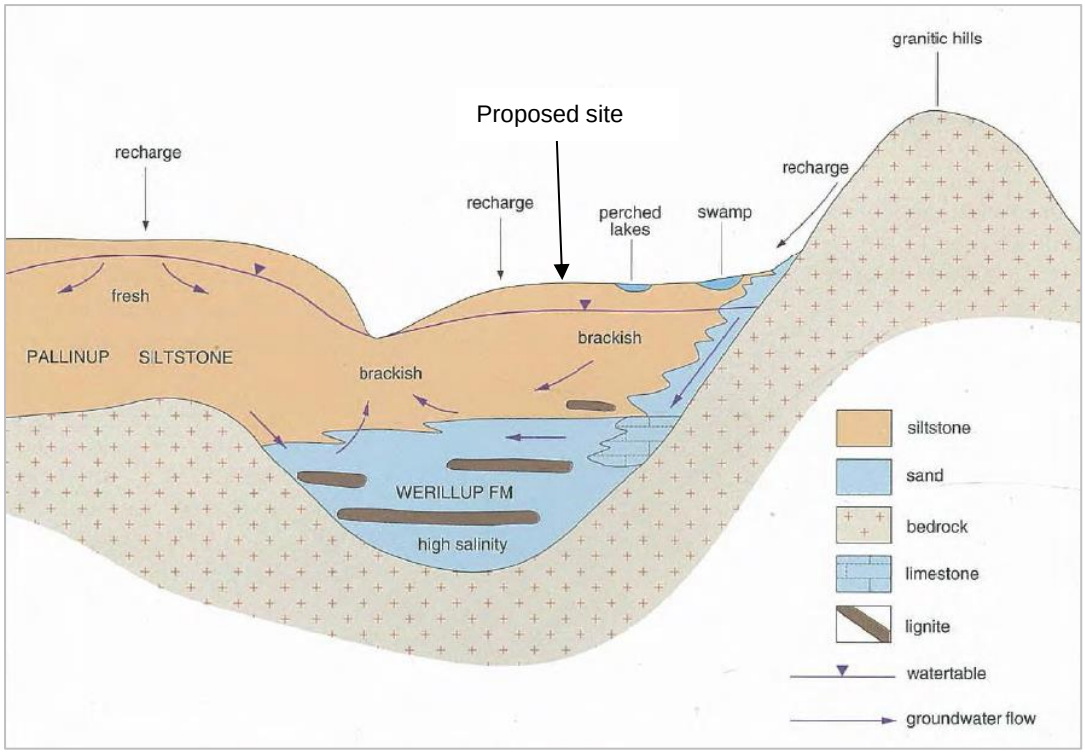


Figure 6: Schematic of groundwater flow in the Plantagenet Group (Smith, 1997).

Groundwater quality

Regionally, groundwater is generally of stock quality (less than 8,000 mg/L) to hypersaline (up to about 100,000 mg/L), with groundwater salinity increasing sharply with depth.

Groundwater samples were collected from three of the five monitoring bores at the Premises in February 2018 and were analysed for basic physical parameters (pH, electrical conductivity), nutrients and some metals. The monitoring was conducted to provide baseline data prior to construction of the landfill.

The results indicate the quality of groundwater beneath the proposed landfill site is slightly acidic (pH 5.6 – 6.6), low in suspended solids and of generally good quality (EC 470 – 1,400 µS/cm).

The proposed groundwater monitoring network for monitoring during construction and operation of the Premises is depicted in Figure 7. Three additional groundwater monitoring bores are proposed. One new bore, MW19 will be placed down gradient (groundwater) from the leachate pond. A second bore, MW18, will be placed down gradient of Cell 1. The third new bore, MW17 will be placed up gradient to provide ongoing background levels of groundwater analytes.

The Licence Holder has proposed that during the first twelve months, leachate will be sampled and tested quarterly. Groundwater monitoring bores would be sampled and tested on a quarterly basis as well. After the first 12 months of operation, it is proposed that sampling and testing of leachate would remain on a quarterly basis and groundwater sampling and testing would be bi-annually.

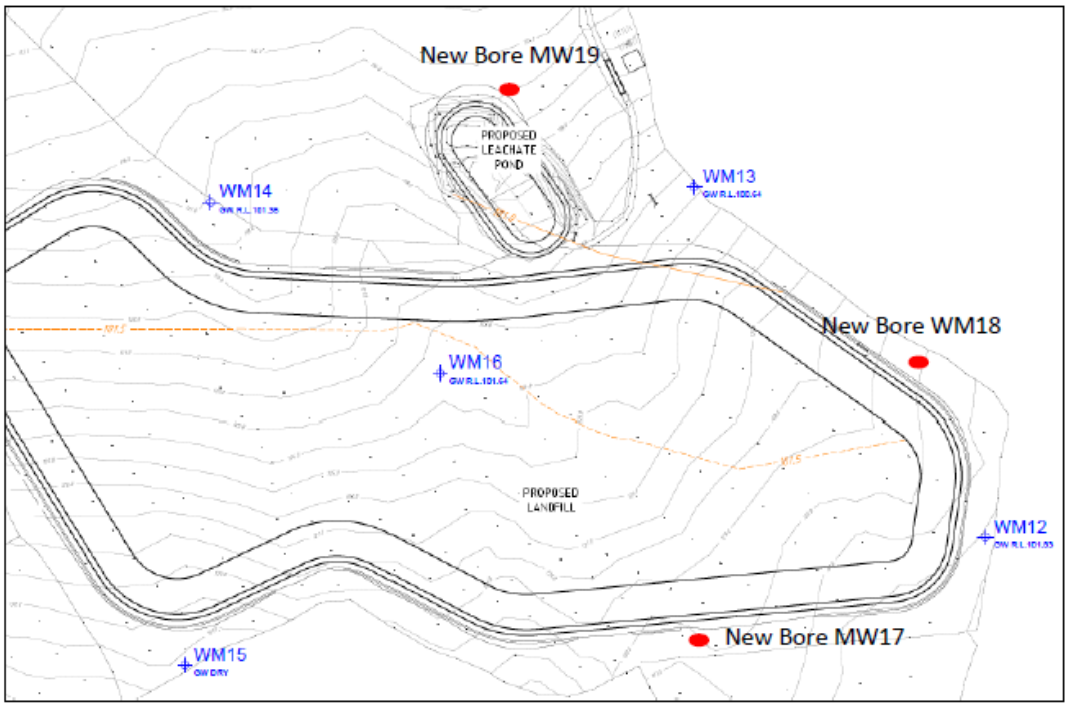


Figure 7: Groundwater monitoring bore network

Key findings:

The Delegated Officer has reviewed the information provided in relation to groundwater quality and monitoring and has found:

1. The pre-development monitoring is considered insufficient to provide a good understanding of the pre-development site conditions given the limited number of samples. However, it is understood that this monitoring has just commenced, so it

should continue until there is at least 12 months of to provide a baseline of groundwater quality prior to landfill operations commencing.

2. The monitoring frequency should be increased to monthly for groundwater level, and quarterly for groundwater quality to ensure that monitoring results account for potential seasonal variations.
3. The new bores MW18 & MW19 are not located in the best position to detect any groundwater contamination, as information provided in the reports suggests that the groundwater was flowing directly north. At least two additional bores, one located approximately immediately north of the landfill in-between the leachate pond and one located down gradient of the leachate pond, would be required to detect any leakage from the landfill site and the leachate pond.

7. Modelling data

7.1.1 Stability assessment

Stability of a landfill is important to ensure the landfill will maintain integrity over the entire lifecycle of the landfill. Instability of the landfill has the potential to result in liner system failure resulting in leachate emissions to land and groundwater.

A slope stability analysis should demonstrate that there are adequate safety factors for all relevant potential failure mechanisms, both at the proposed final landform and at interim stages during construction.

Bowman and Associates provided stability modelling as part of the application using SLOPE/W modelling software to assess the stability of the final external landfill batter slope and the interim internal landfill batter slope. DWER requested further information and reassessment due to:

- Uncertainties relating to the relationship between the site-specific soil conditions and variability of soil conditions and the presented stability model.
- The slopes assessed for failure primarily focused on failure between the liner and cushion and assessment of subbase and clay liner stability appears not to have been assessed in detail. Also external waste slopes and the stability of down-slope *in situ* and constructed batters do not appear to have been assessed under operational and closure loading scenarios.
- The presence of permeable sand may also present a risk to the performance of a liner system under periodic wetting and draining conditions over the lifespan of the landfill, it was unclear how the drained conditions presented in the stability model will be maintained during wet period, through stormwater control or similar.
- Stability modelling under pseudo-static conditions had not been presented.

In response to the request for further information, SLOPE-W stability modelling was re-run using varying friction angles with revised modelling provided to DWER in October 2018. The Licence Holder also engaged CMW Geosciences to determine parameters for seismic modelling.

Stability analysis peer review – August 2019

Golder Associates were commissioned by DWER to undertake a peer review of the landfill stability assessment/s submitted as part of the application. A report detailing the findings of the review was provided to DWER on 19 August 2019.

Further information was requested by DWER as a result of the independent review with particular reference to the following:

- Several analyses have been provided in response to DWER's requests for further information however the analyses do not seem to be consistent with each other.
- The modelled geometry is not consistent with the cross sections provided in the application. The stability model of the subgrade batter slope does not show a clear geological layering and several assessments have adopted different stratigraphic profiles that might have different assigned properties for the same material. It is not clear which Factory of Safety is applicable to the batter slope stability.
- The presence of leachate is not shown on the stability model.
- Only circular failure planes were analysed for the subgrade and waste materials. The modelling to date has only assessed failures within the waste and subgrade materials. No basal liner system interface failure surface has been analysed.

GHD – Stability Analysis – June 2020

Following the request for further information, a revised stability analysis was provided from GHD. The stability assessment was undertaken using the limit equilibrium method in SLOPE/W software using the Morgenstern-Price vertical slices method. Results from the stability analysis are summarised in Table 10.

Sensitivity analysis were applied to load cases 5 and 6 as follows:

- Internal friction angle of the liner checked between 6 and 10 degrees given this is critical to the liner stability (Figure 8)
- Waste friction angle checked between 18 and 34 degrees given the uncertain nature of the waste material (Figure 9)

The results of the sensitivity analyses show at lower bound friction angles with the leachate set at 1.0m above liner level the factor of safety is still greater than 1.0.

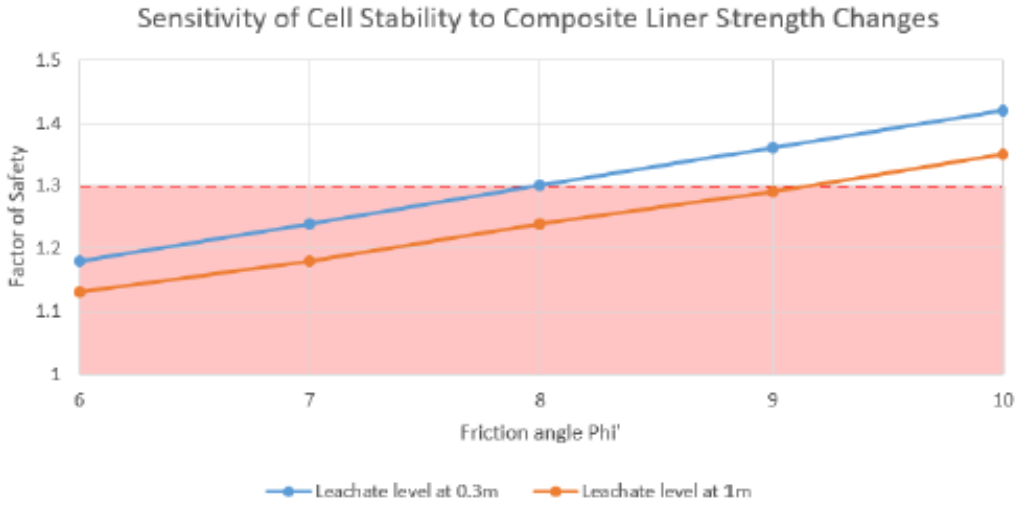


Figure 8: Sensitivity of cell stability to composite liner interface strength changes

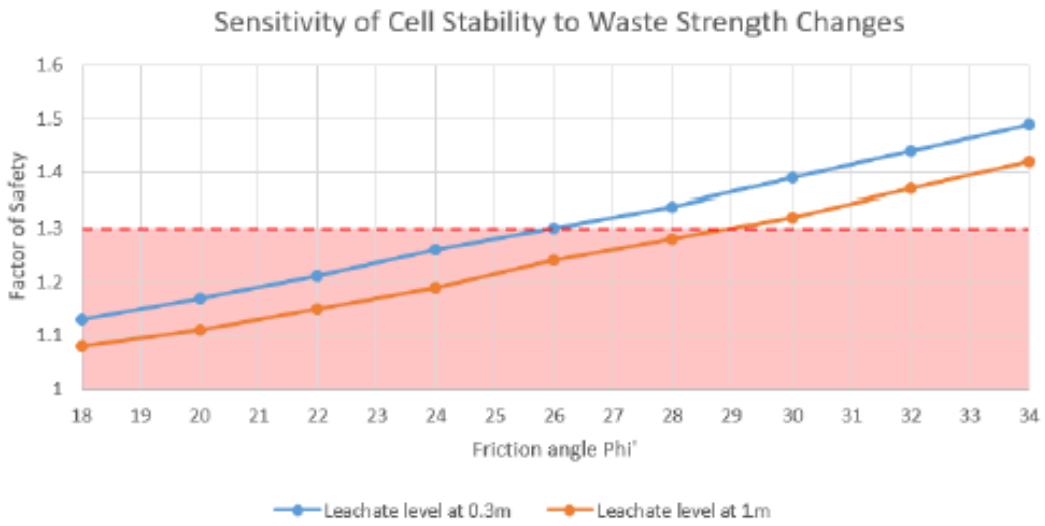


Figure 9: Sensitivity of cell stability to waste strength changes

The stability assessment found:

- The stability of steady state scenarios meets or exceeds required criteria;
- The stability of embankment and waste construction scenarios met or exceed the required criteria, except where the leachate level increases to 1.0m above the liner for the construction of the initial cells due to a leachate system failure. This could result in instability of the advancing waste face during initial placement should there be a failure in the leachate system causing the leachate level to rise. This risk can be mitigated through active management of the facility and by ensuring any issues with the leachate management systems are rectified as soon as possible;
- The stability of post seismic scenarios meets or exceeds required criteria.
- The sensitivity analyses indicated that the factors of safety remained above 1.0 with lower bound friction angle parameters even with increased pore water pressures due to increased leachate levels.

Key findings:

The Delegated Officer has reviewed the revised stability report and notes the following:

1. The Delegated Officer considers the type of modelling and factor of safety utilised to be acceptable and generally agrees with the conclusions of the report.
2. The modelling indicates that stability issues may arise where leachate is not appropriately managed within the landfill, in particular where the leachate head exceeds 1m. Therefore the Delegated Officer considers that active management of leachate in the landfill will be important to ensure stability of the landfill. Timely capping of the landfill will also be important to reduce leachate levels following completion of waste filling.
3. Conditions will be included in the operational Licence to limit the height of the leachate head and to require regular monitoring of the leachate levels in the landfill cell.
4. Conditions will also be included in the operational licence requiring submission of a final capping plan at least 12 months prior to completion of filling of the cell.

Table 10: GHD stability analysis results

Load case	Scenario	Section geometry	Slip surface shape	Phase of facility development	Waste details	Leachate level	Impact of failure	Required FoS	Achieved FoS	Acceptable (Y/N)
1	Downstream stability	Maximum external embankment height	Circular	Normal (steady state)	Before filling	Before filling - no leachate	Waste loss outside of footprint	1.5	2.5	Yes
2	Upstream stability	Maximum external embankment height	non-circular	Normal (steady state)	Before filling	Before filling - no leachate	Liner failure	1.5	2.3	Yes
3	Downstream stability	Maximum external embankment height	non-circular	During embankment construction	Before filling	Before filling - no leachate	Waste loss outside of footprint	1.5	3.6	Yes
4	Upstream stability	Maximum external embankment height	non-circular	During embankment construction	Before filling	Before filling - no leachate	Liner failure	1.3	2.9	Yes
5	Internal waste on liner stability	Temporary Cell 1 adjacent to bund	non-circular	During waste placement	Filled to embankment crest	Normal - 0.3 m	Internal containment failure	1.3	1.3	Yes
6	Internal waste on liner stability	Temporary Cell 1 adjacent to bund	non-circular	During waste placement	Filled to embankment crest	Leachate system failure - 1 m	Internal containment failure	1.3	1.2	No
7	External waste on liner stability	Maximum external embankment height	non-circular	Normal (steady state)	Filled to maximum height	Normal - 0.3 m	Waste loss outside of footprint	1.5	1.7	Yes
8	External waste on liner stability	Maximum external embankment height	non-circular	Normal (steady state)	Filled to maximum height	Leachate system failure - 1 m	Waste loss outside of footprint	1.5	1.7	Yes
9	External waste on liner stability with increased pore water pressure	Maximum external embankment height	non-circular	During waste placement	Filled to maximum height	Pore pressure increased defined by ratio	Waste loss outside of footprint	1.5	1.5	Yes
10	Downstream stability	Maximum external embankment height	Circular	Post earthquake	Before filling	Before filling - no leachate	Waste loss outside of footprint	1.1	2.8	Yes
11	Upstream stability	Maximum external embankment height	Circular	Post earthquake	Before filling	Before filling - no leachate	Liner failure	1.1	2.2	Yes
12	Internal waste on liner stability	Temporary Cell 1 adjacent to bund	non-circular	Post earthquake	Filled to embankment crest	Normal - 0.3 m	Internal containment failure	1.1	1.1	Yes
13	Internal waste on liner stability	Temporary Cell 1 adjacent to bund	non-circular	Post earthquake	Filled to embankment crest	Leachate system failure - 1 m	Internal containment failure	1.1	1.1	Yes
14	External waste on liner stability	Maximum external embankment height	non-circular	Post earthquake	Filled to maximum height	Normal - 0.3 m	Waste loss outside of footprint	1.1	1.5	Yes
15	External waste on liner stability	Maximum external embankment height	non-circular	Post earthquake	Filled to maximum height	Leachate system failure - 1 m	Waste loss outside of footprint	1.1	1.5	Yes

7.1.2 Water balance model

A water balance model for Cells 1 and 2 was provided as part of the revised amendment application in August 2018.

The modelling has assumed a minimum of 215kL per week will be removed from the leachate pond through:

- Aeration of leachate within the leachate pond;
- Trickling of leachate over the black HDPE exposed liner in the leachate pond during summer;
- Returning leachate to the active areas of the landfill in summer for evaporation; and
- Consumption of leachate in the greenwaste composting facility as part of the feedstock (pending future trials and approvals).

The leachate modelling was carried out for Cell 1 and for Cell 1 and Cell 2 combined. Three models were carried out:

1. Cell 1 only and not capped;
2. Cell 1 and Cell 2 both cells not capped; and
3. Cell 1 with 30% capped and Cell 2 not capped.

When the landfill cells are not capped the waste in each cell was assumed to be fully saturated resulting in all captured rainfall being collected and transferred to the leachate pond.

In all scenarios, the modelling included the consumption of 215kL per week of leachate.

Figure 10, Figure 11 and Figure 12 provide the expected volume of leachate in the leachate pond which has a capacity of 15,597 kL, for each month over a 24 month period.

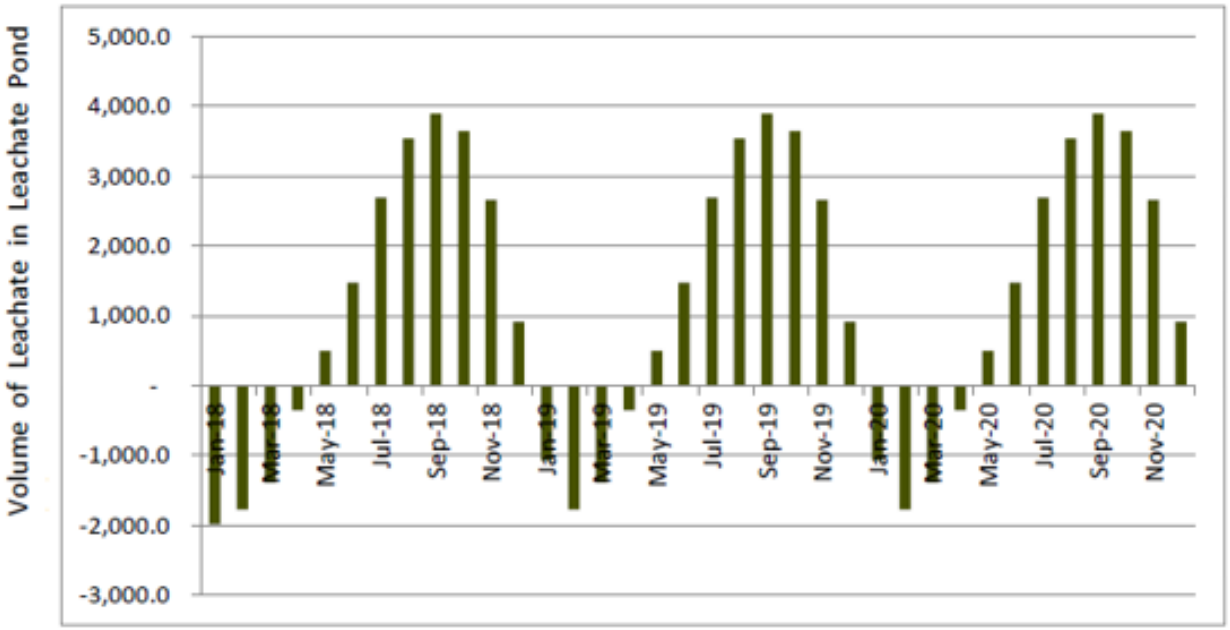


Figure 10: Volume of leachate in Leachate Pond - Cell 1 only

The modelling indicates there would be an accumulation of leachate in the leachate pond where the completed portion of Cell 1 is not capped while landfilling Cell 2.

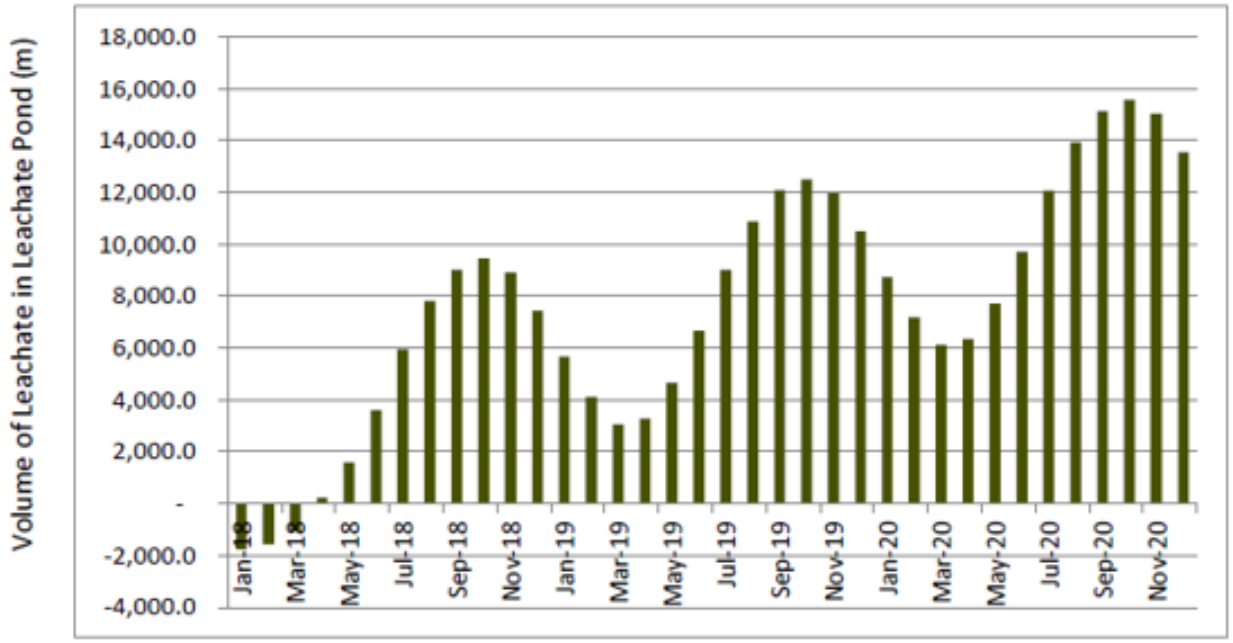


Figure 11: Volume of leachate in leachate pond - Cell 1 and Cell 2 both cells not capped

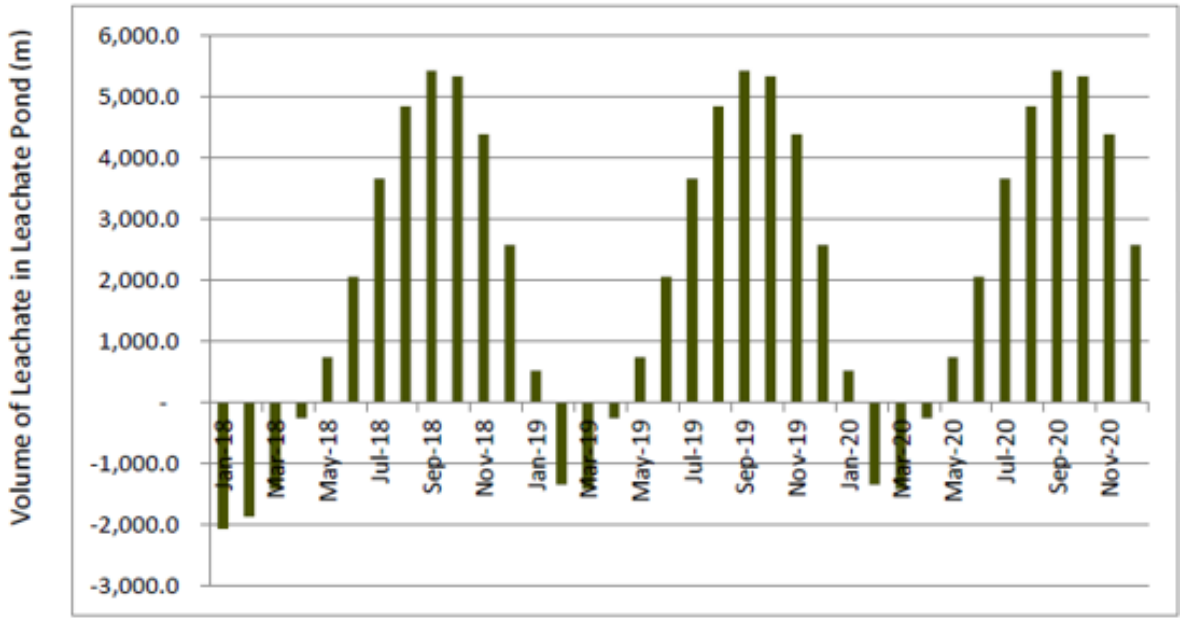


Figure 12: Volume of leachate in leachate pond - Cell 1 30% capped and Cell 2 operational

Once landfilling of Cell 2 begins, to maintain appropriate levels of leachate in the leachate pond, either capping of the completed portion of Cell 1 will be required or additional consumption or evaporation of leachate at the site will be required.

In addition to the above, the Licence Holder advised in information provided November 2018:

"Groundwater modelling has been carried out using a 72hour storm event at 63.2% Annual Exceedance Probability (AEP) giving 59.7 mm of rainfall. The quantity of water to be managed over the 72 hour period equates to 4,238 kL. The length of flow was conservatively estimated as 250m. As the gradient of the subsoil drain is not yet known the worst case of 1.0m fall was used giving a pressure head of 1 Bar. Based on 250m of pipe we have a flow rate of 353.7 L/min providing a clearance time of 12 minutes".

Further information was provided by the Licence Holder in October 2019 which advised that raw data for the determination was taken from the BOM Albany website for IFD Design rainfall depth. The Licence Holder advised that this data was summarised and applied to the landfill site deriving the information presented in Table 11**Error! Reference source not found.** below:

Table 11: Leachate pond capacity

72 hours storm								
AEP	63.20%	63%	50%	20%	10%	5%	2%	1%
Rainfall	mm	59.7	67	93.6	115	140	177	210
Surface capture area	m2	31277	31277	31277	31277	31277	31277	31277
Surface capture	kL	1,867	2,096	2,928	3,597	4,379	5,536	6,568
Freeboard capacity	kL	3,814	3,814	3,814	3,814	3,814	3,814	3,814

At 5% AERP the leachate pond would be overtopped if the leachate pond was filled to capacity.

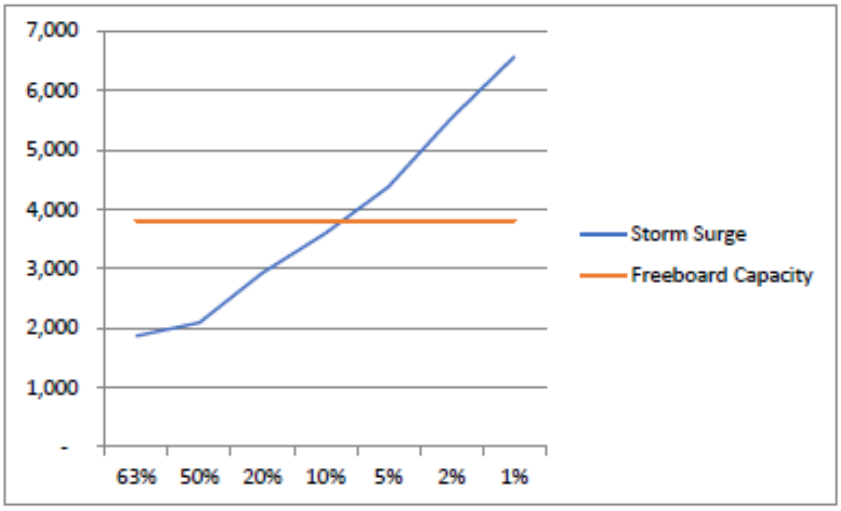


Figure 13: Leachate pond capacity

To manage a 72 hour storm with an AEP of less than 5% the leachate pond would be required to be below the freeboard level. The Licence Holder states that this will be achieved by the following:

- Aeration of leachate within the leachate pond to increase the rate of evaporation;
- Trickling of leachate over the black HDPE exposed liner in the leachate pond during summer;
- Returning leachate to the active tipping face to add moisture to the waste; or
- Construction of an additional leachate pond.

DWER review

The model indicates a storage capacity of at least 4,000 kL and 16,000 kL would be required for the first two scenarios, respectively, assuming a worst case scenario (i.e. 72-hour storm event at 63.2% Annual Exceedance Probability giving 59.7 mm) and at least 215 kL per week of leachate being consumed through evaporation or other means.

In view of the above, the model indicates that once landfilling of Cell 2 commences, capping of

the completed portion of Cell 1 will be required (or additional consumption or evaporation of leachate) to ensure leachate volumes do not exceed the design capacity of the leachate pond under worst case conditions.

Table 11 and Figure 13 indicate that at around a 10% AEP storm surge the leachate pond freeboard would overtop. Given the proximity to the Kalgan River, the Delegated Officer considers that the leachate pond should have capacity to cater for a 5% AEP storm surge. Further information was requested from the Licence Holder in relation to potential redesign of the leachate pond to meet a 5% AEP. The Licence Holder advised that they had re-run for 10% AEP and adjusted the freeboard in the leachate pond to 1.0m freeboard. The overall design of the leachate pond remains unchanged.

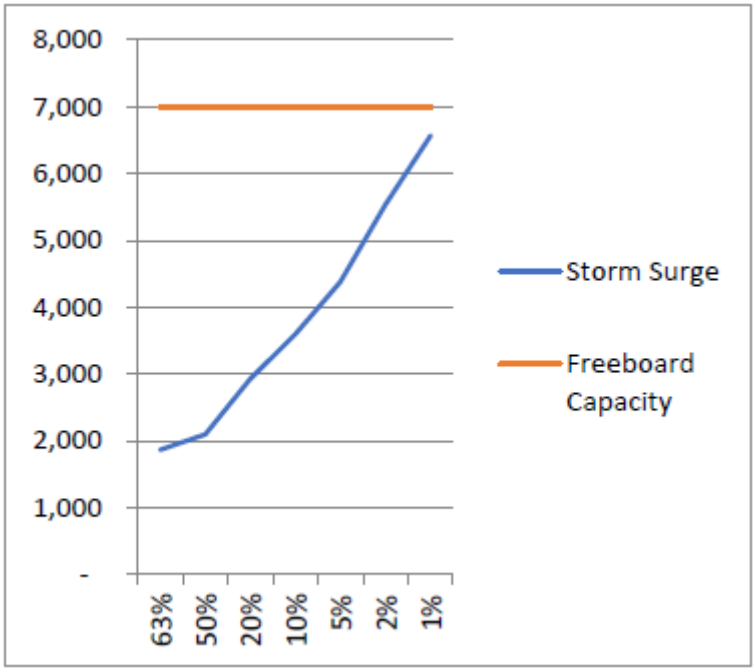


Figure 14. Leachate pond capacity with 1.0 metre freeboard

-

Key findings:

1. Modelling of the leachate storage capacity indicates that with a freeboard of 300mm the pond has potential to overtop in the event of a storm event. The Licence Holder has indicated that maintenance of a 1 metre freeboard would allow capacity to cater for a 5% AEP storm event. Conditions will be included in the operational licence requiring maintenance of a 1m freeboard for the leachate pond.
2. Conditions will also be included in the operational licence to require submission of a capping plan at least 12 months prior to completion of waste filling in the cell.

7.1.3 Quantitative Seepage Assessment

Inputs

The Licence Holder's Seepage report provides that best available technology will be used to control seepage to an amount not exceeding 10L/ha/day. In order to assess the potential seepage through the liner, numerical modelling was undertaken utilising the Hydrologic Evaluation of Landfill Performance (HELP 3.95D) computer program.

The landfill development area covers an area of 21.66ha. For the uncapped operational phase, the seepage has been modelled with zero (0%) potential runoff and will be modelled

over an area of 21.66ha. For the capped and restored landfill, the seepage has been modelled over an area of 21.66ha and with the potential for 100% runoff. Given the geology of the site and the selected site parameters, a runoff curve number of 80 was used to represent high potential runoff. The lowest runoff curve number of 0.1 was used for the operational uncapped phase to represent little to no runoff. Table 12 denotes the maximum potential area for the active generation of leachate during each phase.

Table 12: Landfill information

Parameter	Operational Phase Uncapped	Restored Phase Capped
Landfill Area	21.66ha	21.66ha
Percent Area where runoff is possible	0%	100%
Runoff Curve number	0.1	80

Results

HELP modelling was undertaken by WML Consultants to assess the potential seepage through the liner. A copy of the Seepage Report was provided to DWER in February 2020. The modelled seepage rates for the uncapped operational phase of the landfill with no capping and incident rainfall directly flowing on the waste with Excellent, Good and Poor geomembrane installation quality are summarised in Table 13. The modelled seepage rates for the capped and restored landfill with Excellent, Good and Poor geomembrane installation quality are summarised in Table 14 below.

Table 13: Summary of seepage rates for the uncapped operational phase

Month	Seepage rate as a function of Geomembrane installation/Placement Quality (mm/m2/year)					
	Seepage through layer 4 (Geomembrane)			Seepage through layer 6 (Subgrade)		
	Excellent	Good	Poor	Excellent	Good	Poor
Jan	0.0000	0.0001	0.0025	0.0000	0.0001	0.0025
Feb	0.0000	0.0001	0.0019	0.0000	0.0001	0.0019
Mar	0.0000	0.0001	0.0020	0.0000	0.0001	0.0020
Apr	0.0001	0.0002	0.0043	0.0001	0.0002	0.0043
May	0.0001	0.0004	0.0076	0.0001	0.0004	0.0076
Jun	0.0001	0.0004	0.0074	0.0001	0.0004	0.0074
Jul	0.0002	0.0006	0.0118	0.0002	0.0006	0.0118
Aug	0.0002	0.0007	0.0133	0.0002	0.0007	0.0133
Sep	0.0002	0.0006	0.0112	0.0002	0.0006	0.0112
Oct	0.0002	0.0005	0.0100	0.0002	0.0005	0.0100
Nov	0.0001	0.0005	0.0092	0.0001	0.0005	0.0092
Dec	0.0001	0.0003	0.0049	0.0001	0.0003	0.0049
Average Annual	0.00134	0.00449	0.08618	0.00134	0.00449	0.08618

Note: HELP model results do not output individual annual monthly percolation data greater than 4 decimal places. The minimum default average annual percolation rate through a layer is 0.00006 mm/m2/year

Table 14: Summary of seepage rates for the capped restored phase

Month	Seepage rate as a function of Geomembrane installation/Placement Quality (mm/m2/year)					
	Seepage through layer 7 (Geomembrane)			Seepage through layer 9 (Subgrade)		
	Excellent	Good	Poor	Excellent	Good	Poor
Jan	0.0000	0.0000	0.0037	0.0000	0.0000	0.0037
Feb	0.0000	0.0000	0.0028	0.0000	0.0000	0.0028
Mar	0.0000	0.0000	0.0028	0.0000	0.0000	0.0028
Apr	0.0000	0.0000	0.0024	0.0000	0.0000	0.0024
May	0.0000	0.0000	0.0022	0.0000	0.0000	0.0022
Jun	0.0000	0.0000	0.0020	0.0000	0.0000	0.0020
Jul	0.0000	0.0000	0.0018	0.0000	0.0000	0.0018
Aug	0.0000	0.0000	0.0019	0.0000	0.0000	0.0019
Sep	0.0000	0.0000	0.0027	0.0000	0.0000	0.0027
Oct	0.0000	0.0000	0.0039	0.0000	0.0000	0.0039
Nov	0.0000	0.0000	0.0043	0.0000	0.0000	0.0043
Dec	0.0000	0.0000	0.0044	0.0000	0.0000	0.0044
Average Annual	0.00006	0.00038	0.03487	0.00006	0.00038	0.03487

Note: HELP model results do not output individual annual monthly percolation data greater than 4 decimal places. The minimum default average annual percolation rate through a layer is 0.00006 mm/m2/year

The results indicate that there is an increased seepage through the liner the greater the number of defects that are present and the reduction of quality of the liner installation. Table 15 presents the summary of the liner performance (seepage rates) with respect to liner configuration and the 7 years of climatic input data.

Table 15: Summary of liner performance for capped and uncapped phases

Landfill phase	Maximum seepage as a function of Geomembrane Installation / Placement Quality		
	Excellent	Good	Poor
Uncapped, operational ($mm/m^2/year$)	0.00134	0.00449	0.08618
Uncapped, operational (L/ha/day)	0.03681	0.1230	2.3611
Capped, restored ($mm/m^2/year$)	0.00006	0.00038	0.03487
Capped, restored (L/ha/day)	0.00164	0.01041	0.95534

Note: 1mm/m2/day = 10,000L/ha/day.
The seepage rate through layer 4 represents the maximum seepage for the uncapped operational phase and the seepage rate through Layer 7 represents the maximum seepage for the capped restored phase.

The performance of the proposed liner configuration design for the Vancouver Waste Disposal Facility meets the 10/L/hect/day seepage rate set by the Licence Holder . The highest simulated seepage rate recorded was 2.36L/ha/day which is less than the maximum allowable seepage of 10L/ha/day during the uncapped operational phase with poor installation quality.

The seepage report notes that limited geotechnical information specifically lab testing/permeability data is available for the subgrade material of the site and default HELP model geotechnical parameters have been used for the simulations. Due to the lack of information for the subgrade material, a fine sandy loam has been assumed as the subgrade with a separation of 7m to groundwater. Assessment of the impacts of the seepage rate to groundwater will require further geotechnical investigation and analysis to provide site specific geotechnical parameters. A quantitative environmental risk assessment using LandSim cannot be undertaken until more detailed geotechnical investigation coupled with soils lab testing is

available for soils below 107m to 95 m AHD.

Key findings:

The Delegated Officer has reviewed the Quantitative Seepage Assessment and notes the following:

1. Assessment of impacts to groundwater has not been undertaken using quantitative modelling. A more limited HELP assessment has been undertaken.
2. The results of the HELP assessment indicate that the performance of the liner is appropriate assuming the quality of the liner construction is high and the cell is capped in a timely manner. It is noted that conservative values have been utilised in the assessment for the run-off curve number and in the absence of sufficient site-specific information for the subgrade material and so the actual performance of the liner may be better than modelled.
3. Given the location to the Kalgan River, CQA testing and correct installation of the liner will be important to ensure a high level of liner performance is met to mitigate potential environmental impacts.
4. Capped phases relates only to the fully capped phase and does not consider progressive rehabilitation. Timely capping of the cell following completion of waste filling will also be important to reduce the generation of leachate.

7.1.4 Odour assessment

Results

The Licence Holder engaged ENVALL to undertake an odour impact assessment of the proposed landfill in addition to the existing potentially odour-producing operations at the Premises.

The U.S. Environmental Protection Agency's (US EPA's) CALPUFF model was used for the dispersion modelling of odours from the proposed landfill.

The EPA's criterion for acceptable odour impacts is 2.5 ou, 1-hour average at 99.5 percentile of one year's data.

The 2.5 ou contour shows the extent from the source within which the EPA's criterion is exceeded. Areas outside the 2.5 ou contour have odour levels less than the criterion.

Similarly, the 99.9 percentile is the 9th highest ranked concentration. Areas outside the 8 ou contour have odour levels less than the criterion.

The extent of the predicted odour concentrations against the criteria is shown in Figure 15.

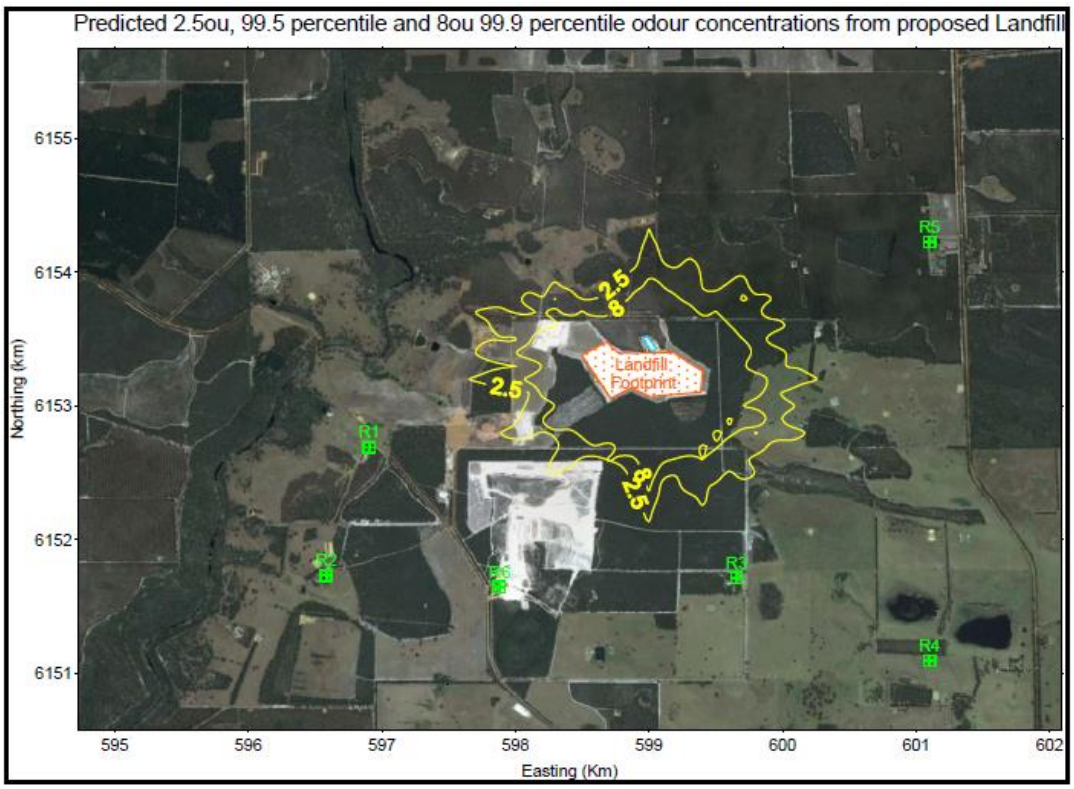


Figure 15. Predicted odour concentrations (ou) from proposed landfill

Notes:
Landfill footprint shown in orange outline
Leachate pond shown in blue outline
Residences shown in green squares

Table 16: Predicted odours at residences compared to criteria

Residence ID	C99.9, 8 ou		C99.5, 2.5 ou	
	Predicted concentration (ou)	Percent of criterion (%)	Predicted concentration (ou)	Percent of criterion (%)
R1	0.9	11	0.4	16
R2	0.5	6	0.2	10
R3	1.6	20	1.1	44
R4	0.5	6	0.3	11
R5	0.5	6	0.3	11
R6	1.0	12	0.4	18

In relation to C99.5, 2.5ou criterion, the maximum predicted odour concentration relative to criteria is at residence R3 at 44% of the criterion. The next highest prediction is at residence R6 at 18% of the same criterion.

In relation to the C99.9, 8ou criterion, the maximum predicted odour concentration relative to criteria is also at residence R3 at 20% of the criterion. The next highest prediction is at residence R6 at 12% of the same criterion.

On this basis, the Licence Holder concluded that the odour impact predicted for the proposed landfill meets the relevant odour criteria with a good margin of safety.

Key findings:

1. Since receipt of this Application, DWER has released the *Guideline: Odour emissions* which requires applicants to undertake a screening analysis to assess whether further detailed analysis of odour emissions and impacts is required. For a category 64 putrescible landfill the screening distance is 1,000 metres. The closest residential

receptor to the proposed landfill is 1.5km.

8. Risk assessment

Table 17 and Table 18 below describe the Risk Events associated with the amendment consistent with the *Guidance Statement: Risk Assessments*. Both tables identify whether the emissions present a material risk to public health or the environment, requiring regulatory controls.

Table 17: Risk assessment for proposed amendments during construction

Risk Event				Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (Refer to conditions of the Amendment below)
Source/ Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
Site preparation	Noise and dust associated with construction activities	4 rural dwellings located between 1.5 km and 1.9 km from proposed landfill site TT Sand mine located approx. 600 m south of proposed landfill site	Air / wind dispersion, causing amenity impacts/ health impacts	Minimal off-site impacts, not detectable on a wider scale **Minor**	May occur in exceptional circumstances only **Rare**	**Low** Acceptable, not subject to controls	Some additional noise and dust is expected during construction works, however the levels are not expected to be significantly different from current noise and dust levels from existing operations at the Premises. Based on the separation to off-site receptors (at least 1.5 km), the Delegated Officer does not reasonably foresee off-site receptors being impacted by noise and dust during construction works.	None specified.
Construction of Cells 1 & 2 and leachate pond	Contaminated stormwater	Soil, groundwater Kalgan River	Runoff from construction area, causing increased load of sediment to stormwater / contamination of soil / surface water / groundwater	Low level, local scale **Moderate**	Probably not occurring in most circumstances **Unlikely**	**Medium** Acceptable, subject to Licence Holder controls and regulatory controls conditioned	Stormwater is not expected to be an issue except during storm events. Stormwater channels will be constructed or current channels will be utilised during the Works and water directed to infiltration drains, to divert and capture uncontaminated stormwater. These should be constructed to convey the 5% AEP event (at a minimum).	Infrastructure construction requirements: - upstream surface water cutoff drains; - erosion and sedimentation controls. Refer to Conditions in the Revised Licence: - 1.4.1

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)

Table 18: Risk assessment for proposed amendments during operation

Risk Event				Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (Refer to conditions of the Amendment below)
Source/ Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
Waste acceptance, handling, deposition and covering	Odour	4 rural dwellings located between 1.5 km and 1.9 km from proposed landfill site TT Sand mine located approx. 600 m south of proposed landfill site	Air / wind dispersion, causing amenity impacts/ health impacts	Minimal off-site impacts, not detectable on a wider scale **Minor**	Probably not occurring in most circumstances **Unlikely**	**Medium** Acceptable, subject to Licence Holder controls conditioned	Odour modelling (Envall, 2018) indicates the landfill can be operated in a manner that does not cause unacceptable impacts to off-site receptors, providing the proposed management practices are adhered to. These include: daily covering of waste; restricting the active tipping area; and use of intermediate cover material, etc. In accordance with DWER's Guidance Statement: Risk Assessments (DER, 2017a), as the proposed controls lower the risk of odour causing off-site impacts, they will be imposed on the Licence.	Specified actions (indicative only): - daily cover and interim cover; - covering of vehicle loads arriving at and leaving the Premises; - complaints management. *Note: the above controls will not be imposed on the Licence as part of this Amendment – a subsequent amendment will be required to authorise the commencement of landfilling operations following construction and CQA validation of the works under this amendment.*
	Noise associated with machinery operation			Minimal off-site impacts, not detectable on a wider scale **Minor**	May occur in exceptional circumstances only **Rare**	**Low** Acceptable, not subject to controls	Some additional noise is expected during landfill operations, however the levels are not expected to be significantly different from current noise levels from existing operations at the Premises. Based on the separation to off-site receptors (at least 1.5 km), the Delegated Officer does not reasonably foresee off-site receptors being impacted by noise in most circumstances.	None specified. The Licence Holder will be required to meet the requirements of the Noise Regulations
	Dust associated with waste acceptance, handling, deposition and covering					**Low** Acceptable, not subject to controls	Additional dust is expected to be generated during the proposed landfill operations, however this is not expected to be significantly different from current dust levels from existing operations at the Premises. Based on the separation to off-site receptors (at least 1.5 km), the Delegated Officer does not reasonably foresee off-site receptors being impacted by dust in most circumstances.	None specified.

Risk Event				Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (Refer to conditions of the Amendment below)
Source/ Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
	Contaminated stormwater runoff	Soil, groundwater Kalgan River	Overland flow of contaminated stormwater, causing contamination of soil / surface water / groundwater	Mid-level on-site impacts Low-level off-site impacts **Moderate**	Probably not occurring in most circumstances **Unlikely**	**Medium** Acceptable, subject to regulatory controls conditioned	Stormwater is not expected to be an issue except during storm events. A subsoil drain (Megaflo) has been included in the landfill design to divert infiltrated uncontaminated stormwater away from the landfill. Stormwater entering the landfill cell will be pumped to the leachate storage pond and managed in the same manner as leachate.	Infrastructure construction requirements: - Megaflo Existing Licence condition 1.2.3 will apply during operations.
	Windblown waste / litter	4 rural dwellings located between 1.5 km and 1.9 km from proposed landfill site TT Sand mine located approx. 600 m south of proposed landfill site Transient receptors at site boundary	Air / wind dispersion, causing amenity impacts / nuisance Attraction of pests and vermin	Low-level on-site impacts Minimal off-site impacts, not detectable on a wider scale **Minor**	May occur in exceptional circumstances only **Rare**	**Low** Acceptable, not subject to controls	There is a risk of lightweight rubbish being dispersed into the surrounding environment by wind and rain if not properly secured during transit, deposition or by covering. This may cause visual pollution, in addition to litter infiltrating surface water systems creating a toxic environment or being ingested by native fauna. The Licence Holder has proposed controls to manage litter including: daily covering of putrescible wastes, returning waste to tipping area on at least a weekly basis, minimising the face of the active tipping area, compaction of waste as soon as possible and installation of, and use of temporary fencing around the perimeter of the active landfill cell, which will also serve as a litter screen. Based on the separation to off-site receptors (at least 1.5 km), the use of a litter screen and the vegetative buffer surrounding the proposed landfill, the Delegated Officer does not reasonably foresee significant impacts from windblown waste in most circumstances. The Licence Holder's controls will be conditioned in the Licence to ensure the risk of windblown waste impacts remain low.	Specified actions (indicative only): - daily cover and interim cover; - covering of vehicle loads arriving at and leaving the Premises; - use of litter screens; - complaints management. *Note: the above controls will not be imposed on the Licence as part of this Amendment – a subsequent amendment will be required to authorise the commencement of landfilling operations following construction and CQA validation of the works under this amendment.*
	Landfill fire	4 rural dwellings located between 1.5 km and 1.9 km from proposed landfill site TT Sand mine located approx. 600 m south of proposed landfill site Transient receptors at site boundary Remnant vegetation and fauna habitat Soil, groundwater	Air / wind dispersion, causing amenity impacts/ health impacts from noxious fumes Contamination of soil and groundwater from discharge of fire water	Low-level or occasional adverse health effects Mid-level on-site impacts **Moderate**	Could occur at some time **Possible**	**Moderate** Acceptable, subject to regulatory controls conditioned	There is an inherent risk of underground fires at the landfill, due to the nature of the waste being buried. Such fires are most likely to be caused by spontaneous ignition (from increased bacterial activity leading to internal hotspots that may combust upon contact with methane) and will be difficult to detect. They will also be problematic and take significant resources to extinguish. Smoke containing hazardous chemicals can be particularly dangerous, as it can be inhaled by members of the community relatively far from the incident. The immediate environment around the landfill can also become significantly contaminated in the fire-fighting process. Preventing and preparing for landfill fires is therefore the best defence against the risk of impacts. The Licence Holder has prepared a Fire Management Plan, which includes site security, maintenance of firebreaks, daily covering and access to a water truck and other equipment for fire-fighting onsite.	Specified actions (indicative only): - prohibiting all forms of deliberate burning on the landfill site; - thoroughly inspecting and controlling incoming waste - compacting buried waste to prevent hotspots from occurring; - firebreaks constructed around the landfill. *Note: the above controls will not be imposed on the Licence as part of this Amendment – a subsequent amendment will be required to authorise the commencement of landfilling operations following construction and CQA validation of the works under this amendment.*

Risk Event				Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (Refer to conditions of the Amendment below)
Source/ Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
Decomposition of deposited wastes	Leachate to groundwater	Beneficial users of groundwater Soil, groundwater Remnant vegetation	Seepage of leachate through landfill liner to groundwater Discharge of contaminated groundwater to surface water Groundwater contamination	Low-level on a local scale with specific consequence criteria at risk of not being met **Moderate**	Could occur at some time **Possible**	**Medium** Acceptable, subject to Licence Holder controls and regulatory controls conditioned	Groundwater in the vicinity of the proposed landfill is approximately 16-31 metres below the base of the cells and of good quality (EC 500 – 1,000 µS/cm), therefore a high level of protection is required. The landfill has been designed with a liner and leachate collection system to a standard where seepage is no more than 10 L/ha/day. The Licence Holder has submitted a CQA plan containing material / construction specifications, testing methods and frequency, corrective action and documentation procedures. The Delegated Officer has reviewed this plan and considers it to be deficient in the following areas: - details on materials, performance and re-working of the subgrade; - no materials testing (geotextiles and geomembrane) being proposed following delivery on-site; - no post-manufacture QA at the place of production. The Delegated Officer considers it critical that a high level of CQA is conducted to demonstrate that design requirements have been met, such that the maximum seepage rates will not be exceeded. Controls will therefore be placed on the Licence to specify the level of CQA required and to address the identified deficiencies. If it can be demonstrated the 'as constructed' cells meet design specification, the Delegated Officer considers the landfill should provide a high level of protection to the environment.	Infrastructure construction requirements: - landfill liner minimum standards - construction compliance reporting on base liner; - CQA requirements specified for GCL, HDPE and cushion geotextile; - CQA reporting upon completion of construction; - Sensors or monitoring wells will be required to enable leachate head monitoring over the landfill cell; and - Additional ambient groundwater monitoring bores. Capping plan requirements: - Submission of a capping plan no later than 12 months before completion of waste disposal in Cell 1 - Capping plan requirements Monitoring requirements: - Leachate head monitoring (after the pump has been turned off for a period of time) - Ambient groundwater monitoring <u>Refer to Conditions in the Revised Licence:</u> - 1.5.1 – 1.5.5 - 1.6.1 – 1.6.7 - 1.7.1 – 1.7.2 - 3.4.1 *Note: leachate head monitoring will not be imposed on the Licence as part of this Amendment – a subsequent amendment will be required to authorise the commencement of landfilling operations following construction and CQA validation of the works under this amendment.*
			Liner failure resulting in loss of leachate containment to groundwater Groundwater contamination	Catastrophic onsite impacts and potential high level or above offsite impacts on a local scale **Severe**	Will probably not occur in most circumstances **Unlikely**	**High** Acceptable subject to multiple regulatory controls	Stability modelling indicates potential stability issues where the leachate head on the liner exceeds 1m, as such, ongoing monitoring and management of leachate within the landfill is important. The Delegated Officer therefore considers it appropriate that controls are included in the Licence in relation to regular monitoring of the height of leachate on the landfill liner. In order to provide assurance over the effectiveness of the liner and leachate collection system, and to enable early detection and proactive management of any leachate contamination in groundwater, the Delegated Officer considers it appropriate that monitoring of groundwater is conducted, using the standard suite of parameters likely to be present in landfill leachate. To minimise the potential for leachate generation, the Delegated Officer considers it appropriate that capping is undertaken as soon as possible following completion of filling the cell. As such, the Delegated Officer considers it appropriate to include a requirement to submit a capping plan at least 12 months prior to the completion of filling the cell to allow sufficient time to assess and amend the operational licence to authorise capping works.	

Risk Event				Consequence rating	Likelihood rating	Risk	Reasoning	Regulatory controls (Refer to conditions of the Amendment below)
Source/ Activities	**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
	Landfill gas	4 rural dwellings located between 1.5 km and 1.9 km from proposed landfill site TT Sand mine located approx. 600 m south of proposed landfill site Transient receptors at site boundary	Lateral migration through landfill cap or embankments, or passive venting to air, causing amenity impacts / health impacts (explosion and asphyxiation)	Low-level off-site impacts at local scale **Moderate**	Probably not occurring in most circumstances **Unlikely**	**Medium** Acceptable, subject to regulatory controls conditioned	Due to the type of wastes to be deposited, landfill gas will be produced that will require management due to its potentially hazardous nature. Landfill gas can cause human health and environmental impacts due to the methane and CO_2. Limited quantities of landfill gas are expected to be generated during the operation of Cell 1 of the landfill, however the Delegated Officer considers it appropriate to assess the gas generation rates on an annual basis to confirm this. Odour emissions from landfill gas will be of the most concern during landfill operation however landfill gas impacts including the risk of explosion and/or asphyxiation remain potential risks post closure.	Infrastructure controls relating to the progressive installation of landfill gas management/collection infrastructure during the operational period of the landfill. Monitoring controls to assess the gas generation rates on an annual basis. *Note: the above controls will not be imposed on the Licence as part of this Amendment – a subsequent amendment will be required to authorise the commencement of landfilling operations following construction and CQA validation of the works under this amendment.*
Leachate storage	Odour	4 rural dwellings located between 1.5 km and 1.9 km from proposed landfill site TT Sand mine located approx. 600 m south of proposed landfill site	Air / wind dispersion, causing amenity impacts/ health impacts	Minimal off-site impacts, not detectable on a wider scale **Minor**	May occur in exceptional circumstances only **Rare**	**Low** Acceptable, not subject to controls	Odour modelling (Envall, 2018) indicates the leachate pond will not be a significant source of odour. The Delegated Officer therefore does not reasonably foresee off-site receptors being impacted by odour from the leachate pond under most circumstances.	None specified.
	Leachate discharge to land	Soil, groundwater Kalgan River Remnant vegetation	Overtopping of leachate pond and subsequent infiltration to shallow groundwater or flow into surface water bodies, causing contamination of groundwater or surface water Overland flow to cause degradation of remnant vegetation	Low level off-site impacts Mid-level on-site impacts, with specific consequence criteria at risk of not being met **Moderate**	Could occur at some time **Possible**	**Medium** Acceptable, subject to Licence Holder controls and regulatory controls conditioned	The water balance provided with the application indicates that there is a risk of the pond overtopping at some time during a storm event. As such, active management of leachate volumes within the leachate pond will be required once landfilling in Cell 2 commences, to ensure volumes do not exceed the design capacity under worst case conditions. The Licence Holder has proposed to manage this by minimising the volumes of leachate being generated (by capping cells upon completion) in addition to other measures, such as recirculation back over the waste, additional consumption (composting – pending future assessment/trials) or evaporation. Management of leachate is especially important given the proximity of the landfill to the Kalgan River.	Capping plan requirements: - Submission of a capping plan no later than 12 months before completion of waste disposal in Cell 1 - Capping plan requirements Operation of infrastructure requirements (indicative only): - maintenance of 1m freeboard; - monitoring of leachate levels on the landfill liner and within the collection sumps; - groundwater monitoring *Note: the above controls will not be imposed on the Licence as part of this Amendment – a subsequent amendment will be required to authorise the commencement of landfilling operations following construction and CQA validation of the works under this amendment.*
	Leachate seepage to groundwater	Beneficial users of groundwater Soil, groundwater Remnant vegetation	Seepage of leachate through landfill liner to shallow groundwater Discharge of contaminated groundwater to surface water Groundwater contamination	Low-level on a local scale with specific consequence criteria at risk of not being met **Moderate**	Could occur at some time **Possible**	**Medium** Acceptable, subject to Licence Holder controls and regulatory controls conditioned	Groundwater in the vicinity of the proposed landfill is about 16-31 m below the base of the cells and of good quality (EC 500 – 1,000 µS/cm), therefore a high level of protection is required for all waste containment infrastructure. The leachate pond has been designed with a lining system consistent with the landfill cells, i.e. compacted clay subgrade underlying a HDPE liner. The Delegated Officer therefore considers the same level of CQA should apply to the leachate pond as the landfill cells to ensure the amount of seepage is controlled and a high level of protection is provided to the environment. This also includes monitoring of groundwater down gradient of the leachate pond.	Infrastructure construction requirements: - pond liner must be constructed in accordance with minimum Landfill BPEM requirements; - construction compliance reporting on base liner and subgrade; - CQA requirements specified for HDPE; - CQA reporting upon completion of construction <u>Refer to Conditions in the Revised Licence:</u> - 1.5.1 – 1.5.5 - 1.6.1, 1.6.2, 1.6.3 and 1.6.5 - 1.6.7 - 3.4.1

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)

9. Consultation

The application was referred to several direct interest public authorities, natural resource management (NRM) groups and nearby landowners. A summary of responses is provided in Table 19.

Table 19: Direct interest stakeholder submissions and DWER consideration

Submitter	Comment
City of Albany	The City issued an approval on 25 August 2018 for a waste disposal facility on the site. The matter was referred to DWER through the development application process on which comments were received on 4 July 2018. A building licence is required to be obtained from Council prior to commencing any construction works on the site.
DFES	A formal response was not received within specified consultation period.
DBCA	It is considered the proposal and any potential environmental impacts will be appropriately addressed through the existing planning framework.
Traditional landowner groups	No responses received within specified consultation period.
NRM groups	No responses received within specified consultation period.
Nearby landowners	No responses received within specified consultation period.

The Licence Holder was provided with the draft Amendment Report on 22 July 2020. The Licence Holder responded on 7 August 2020 with no comments.

10. Decision

Based on the assessment in this Amendment Report, the Delegated Officer has determined that a licence amendment will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

The Delegated Officer has taken into consideration the information submitted with the application, in addition to further research by DWER to address information gaps in the application and external review of critical design details of the proposed infrastructure, and has determined from the risk assessment in Table 17 and Table 18 the proposal to construct and operate a putrescible landfill at the Premises does not pose an unacceptable risk of impacts to public health or the environment, subject to a number of regulatory controls.

Due to the small number of soil samples tested to demonstrate the suitability of the *in situ* soils on the Premises, which are proposed to be used to construct the facility, the Delegated Officer considers that CQA of all aspects of the development will be critical in demonstrating the design requirements have been met, and to ensure the constructed landfill will remain a stable, non-polluting structure both during and after its operational life.

On the basis of the above, the Delegated Officer has determined to grant an amendment to the Licence to authorise construction of the first 2 landfill cells and leachate pond on the Premises. Regulatory controls determined to be appropriate for the Risk Events set out in Table 17 and Table 18 are detailed below. Conditions in the Revised Licence have been

amended to give effect to the determined regulatory controls.

10.1 Summary of amendments

Table 20 provides a summary of the proposed amendments and will act as record of implemented changes. All proposed changes have been incorporated into the Revised Licence as part of the amendment process.

Table 20: Licence amendments

Condition No.	Proposed amendments and grounds
Definitions	Multiple new definitions added to reference relevant standards used in the amendment, define new terms in the licence and update terminology to reflect current licensing approach.
1.4.1	Added to require construction of surface water and erosion / sedimentation controls, prior to construction works commencing. The requirements generally reference the design and specifications outlined in the application and with reference to the relevant CAD drawings, and have been determined as being required to mitigate potential risks identified in this Amendment Report.
1.5.1, 1.5.2 & 1.5.3	Added to specify the design and construction requirements for Cells 1 & 2 and the Leachate Pond. The requirements generally replicate the design and specifications outlined in the application and with reference to the relevant CAD drawings. Condition 1.5.1 also requires installation of at least two additional groundwater monitoring bores in accordance with set standards. This is to ensure groundwater monitoring can adequately identify any potential impacts from the landfill. Condition 1.5.2 allows for minor departures from the specified design requirements in certain circumstances and where they can be justified. Condition 1.5.3 requires the reporting of departures with the Construction Quality Assurance Validation Report.
1.5.4 & 1.5.5	Because of the importance of the base liner and subgrade in the overall liner performance, construction of these components must be accompanied by full-time testing and inspection of all earthworks by a geotechnical engineer independent of the liner constructor. Condition 1.5.4 requires submission of a Construction Quality Assurance Report following construction of these components for each cell and the leachate pond. Condition 1.5.5 specifies the report must be prepared by the independent geotechnical engineer conducting the testing, and must provide details of all testing undertaken, including certification that the works comply with the requirements of the specifications and drawings, in order to demonstrate the works have been appropriately constructed, prior to installation of the geomembrane and geotextile layers.
1.6.1, 1.6.2, 1.6.3& 1.6.4	Added to specify the CQA requirements for GCL, HDPE membrane, geotextile cushion and separation geotextile layers, respectively. The requirements generally replicate the specifications outlined in the application. The relevant testing standards have been referenced, which specify the individual testing requirements, frequency and minimum values for all relevant properties.
1.6.5	Added to require all laboratory testing to be conducted by a NATA accredited geosynthetics laboratory, in order to provide confidence in the reliability of the test results to government, industry, professional and community stakeholders.

Condition No.	Proposed amendments and grounds
1.6.6 & 1.6.7	Added to require submission of a Construction Quality Assurance Validation Report following completion of construction of each cell and the leachate pond. Condition 1.5.6 specifies the report must be prepared by a Professional Engineer, and must provide details of all CQA testing undertaken, including certification that the works comply with the requirements of the specifications and drawings, in order to demonstrate the works have been appropriately constructed, prior to operations commencing.
1.7.1 & 1.7.2	The application includes limited information on the design and specifications of the capping layer following the completion of cells. Capping is considered important to limit the generation of leachate as determined in the stability assessment in Section 7.1.1, the water balance detailed in Section 7.1.2 and in the quantitative seepage assessment in Section 7.1.3.
2.2.1	Added to clarify that no specified emissions have been authorised by this amendment, and that general emissions arising from the construction works, such as noise and dust, must not be unreasonable or result in pollution or the like.
3.1.1	Amended to require sampling of groundwater in accordance with the relevant Australian Standards, to ensure the samples are representative of groundwater in the aquifer and will remain representative until analytical determination or measurements are made.
3.1.2	Added to specify the time period(s) in which groundwater monitoring is to be conducted.
3.1.3 & 3.1.4	Added to require all monitoring equipment used to comply with monitoring requirements of the Licence be calibrated in accordance with the manufacturer's specifications. Condition 3.1.4 requires the CEO be notified where calibration requirements cannot be reasonably met.
3.4.1	New condition specifying requirements for groundwater monitoring at the premises. More frequent monitoring will be required for the first two years to determine a baseline, after which time monitoring frequency may be reduced.

Ruth Dowd
SENIOR MANAGER WASTE INDUSTRIES
INDUSTRY REGULATION

An officer delegated by the CEO under section 20 of the EP Act

Schedule 1: Maps and drawings

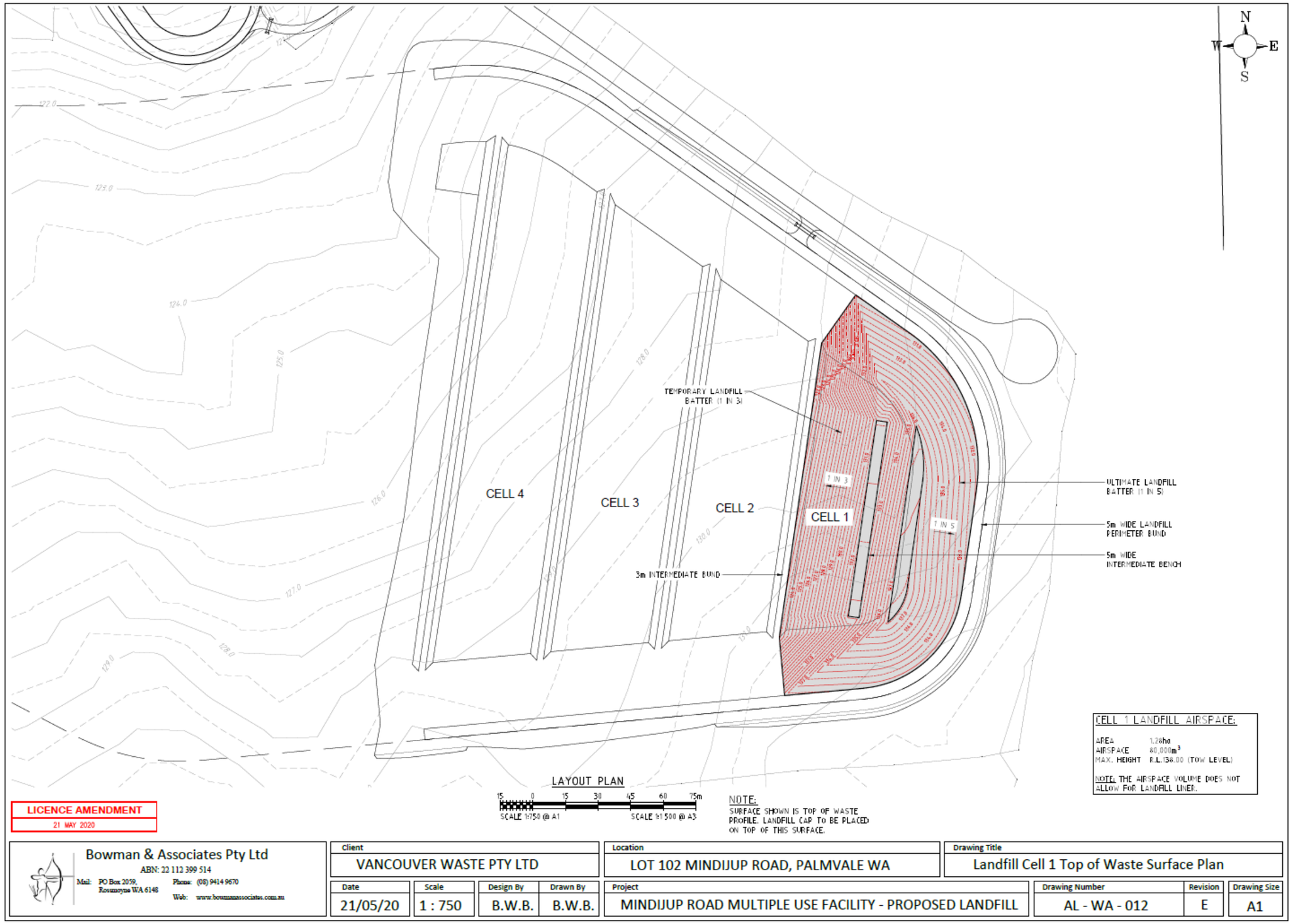


Figure 16: Cell 1 – top of waste surface plan

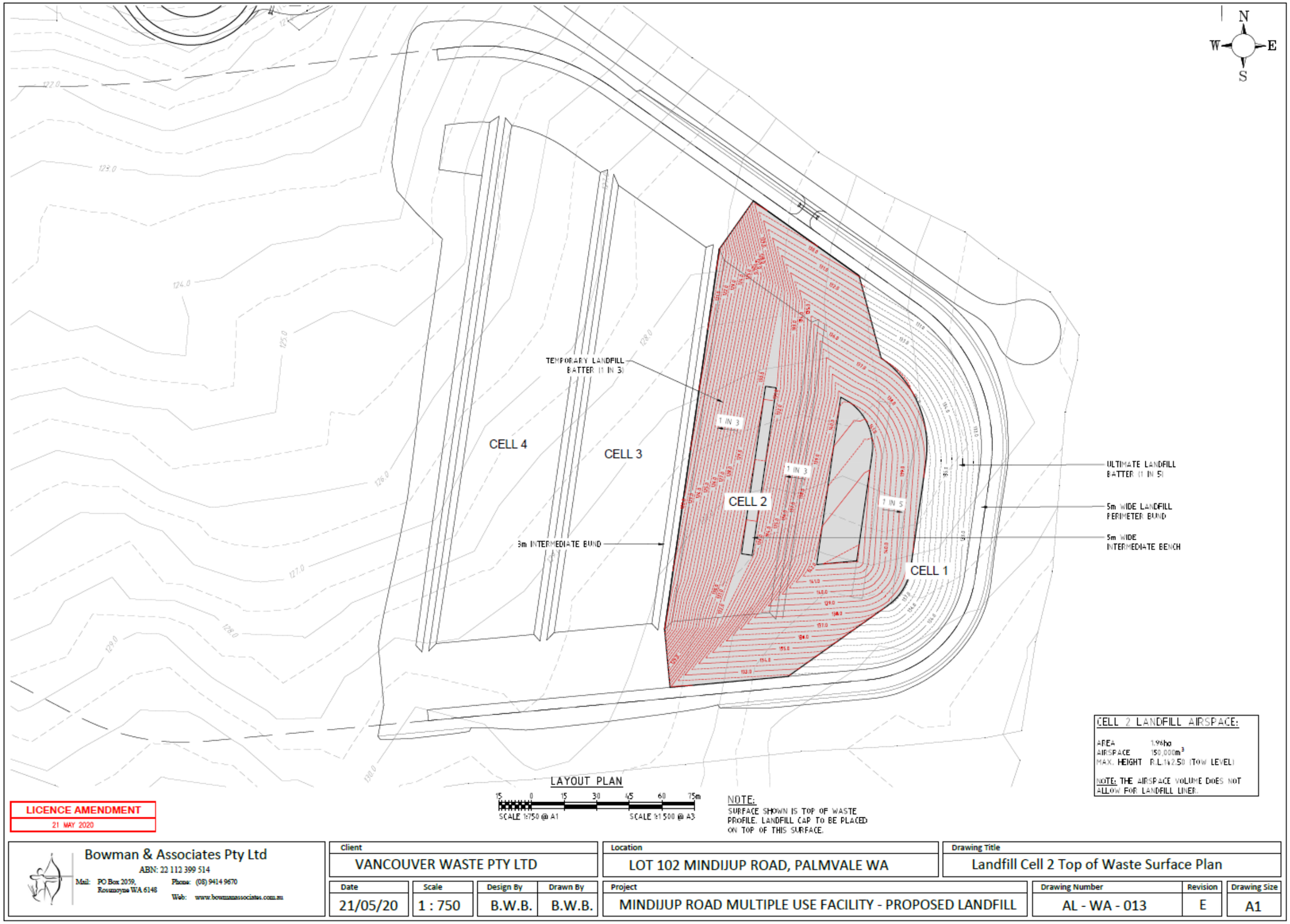


Figure 17: Cell 2 – top of waste surface plan

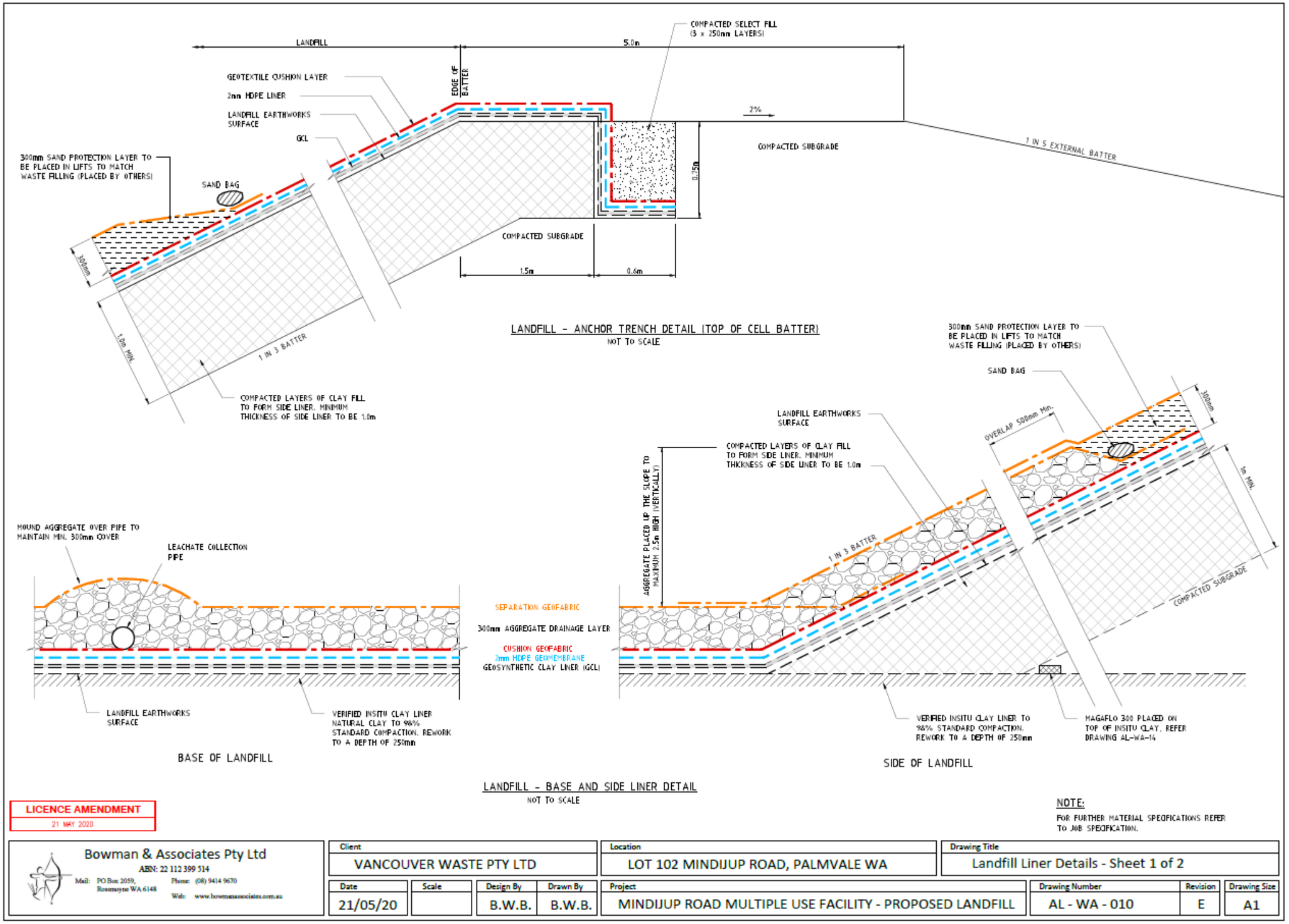
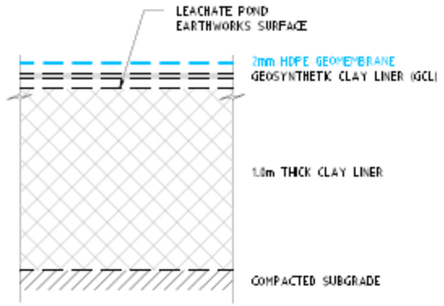
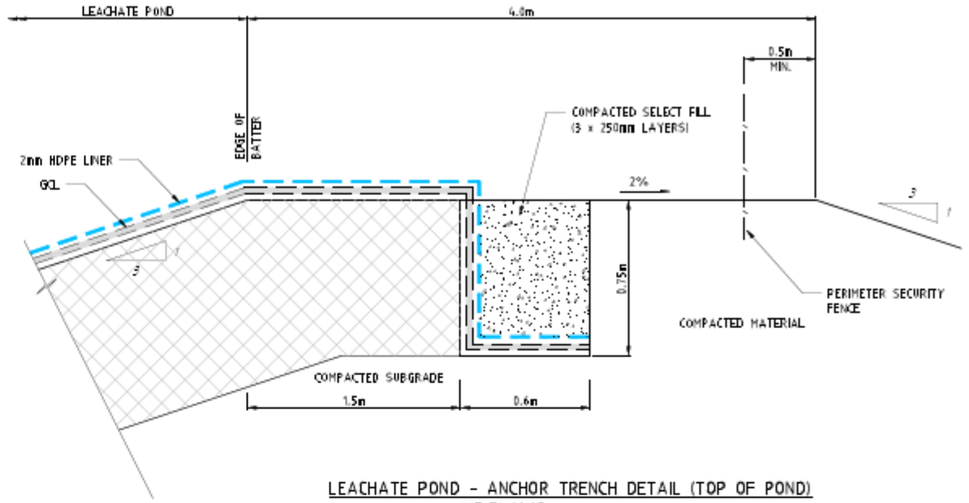


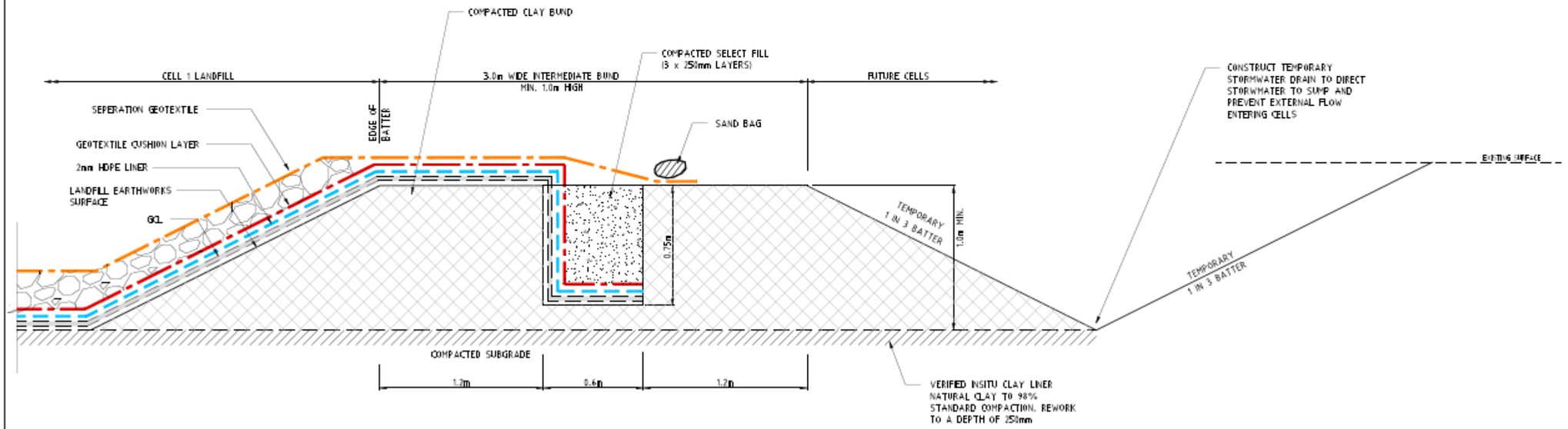
Figure 18: Landfill Liner details



LEACHATE POND
BASE AND SIDE LINER DETAIL
NOT TO SCALE



LEACHATE POND – ANCHOR TRENCH DETAIL (TOP OF POND)
NOT TO SCALE



LANDFILL – ANCHOR TRENCH DETAIL (INTERMEDIATE BUND)
NOT TO SCALE

LICENCE AMENDMENT
21 MAY 2020

Bowman & Associates Pty Ltd
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Phone: (08) 9414 9670
Web: www.bowmanassociates.com.au

Client	Location	Drawing Title
VANCOUVER WASTE PTY LTD	LOT 102 MINDIJUP ROAD, PALMVALE WA	Landfill Liner Details - Sheet 2 of 2

Date	Scale	Design By	Drawn By	Project	Drawing Number	Revision	Drawing Size
21/05/20		B.W.B.	B.W.B.	MINDIJUP ROAD MULTIPLE USE FACILITY - PROPOSED LANDFILL	AL - WA - 011	E	A1

Figure 19: Anchor trench details

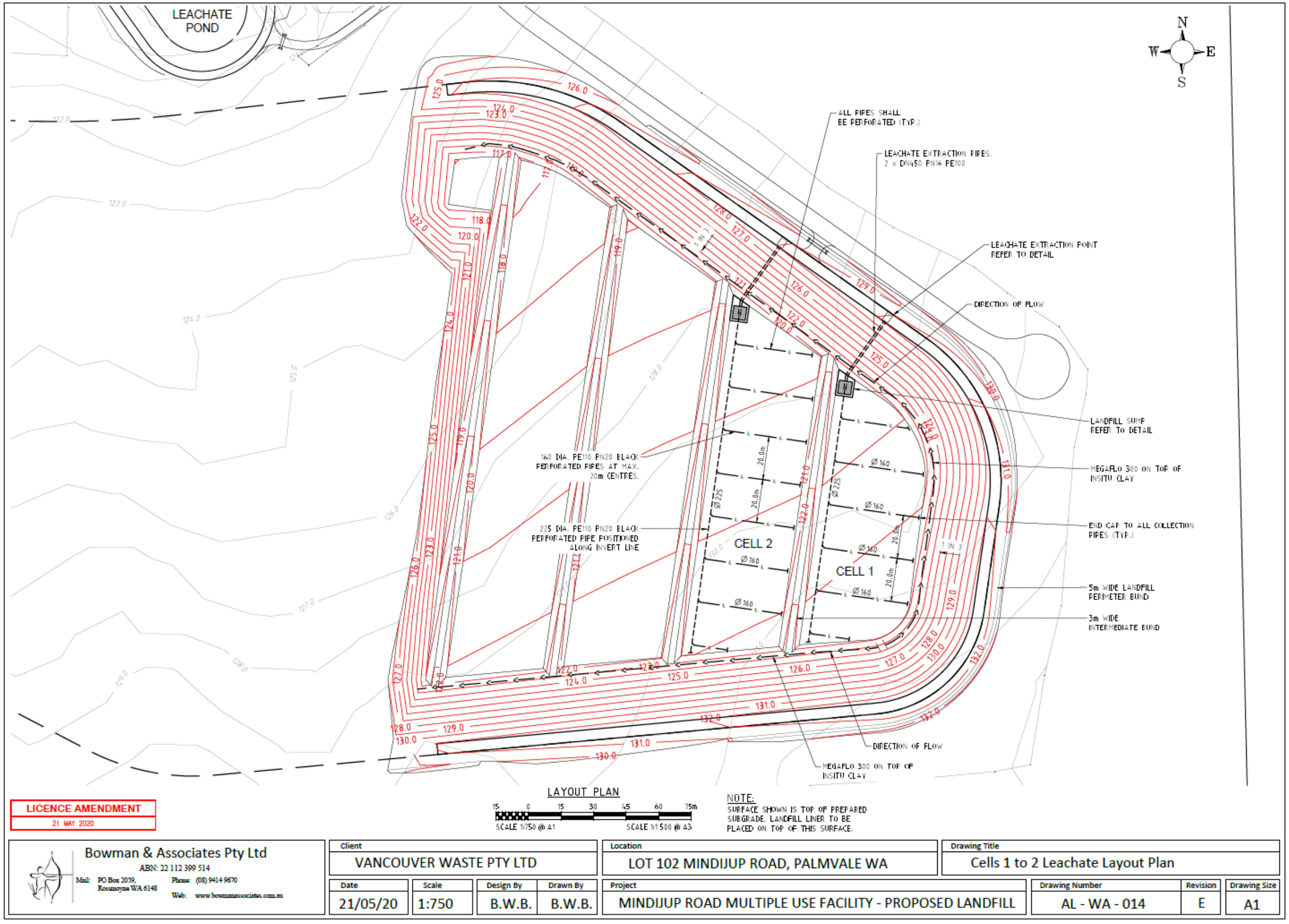
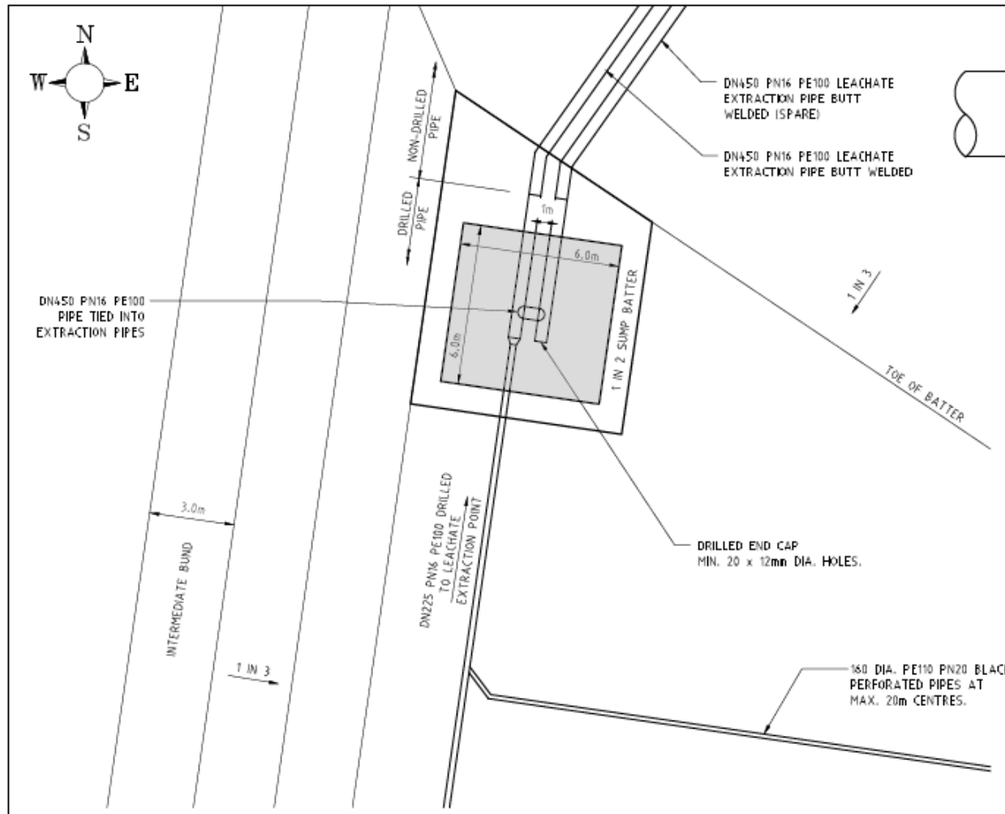


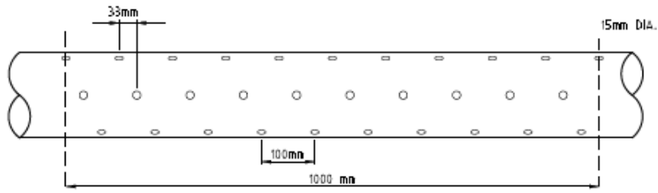
Figure 20: Leachate collection - Layout Plan

L7344/1998/10

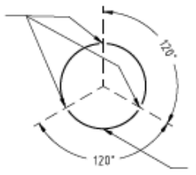


TYPICAL LEACHATE SUMP PLAN

SCALE 1 : 100 (A1)



PLAN

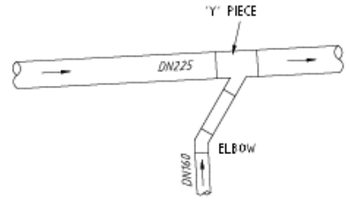


SECTION

TYPICAL PERFORATION PATTERN FOR LEACHATE COLLECTION PIPES. HOLES ARE SPACED 120 DEG. APART IN SECTION, AND AT 33mm CENTRES LONGITUDINALLY, TO CREATE A SPIRAL PATTERN OF 30 HOLES PER METRE LENGTH OF PIPE ACROSS BODY OF FLOOR.

LEACHATE PIPE PERFORATIONS DETAIL

NOT TO SCALE



PIPE CONNECTION DETAIL

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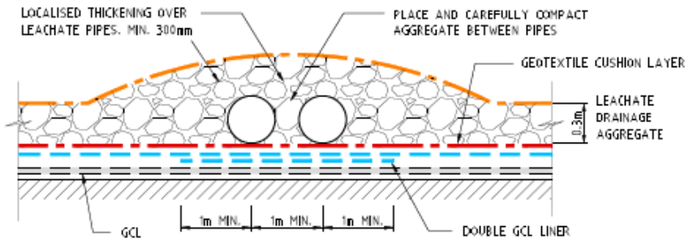
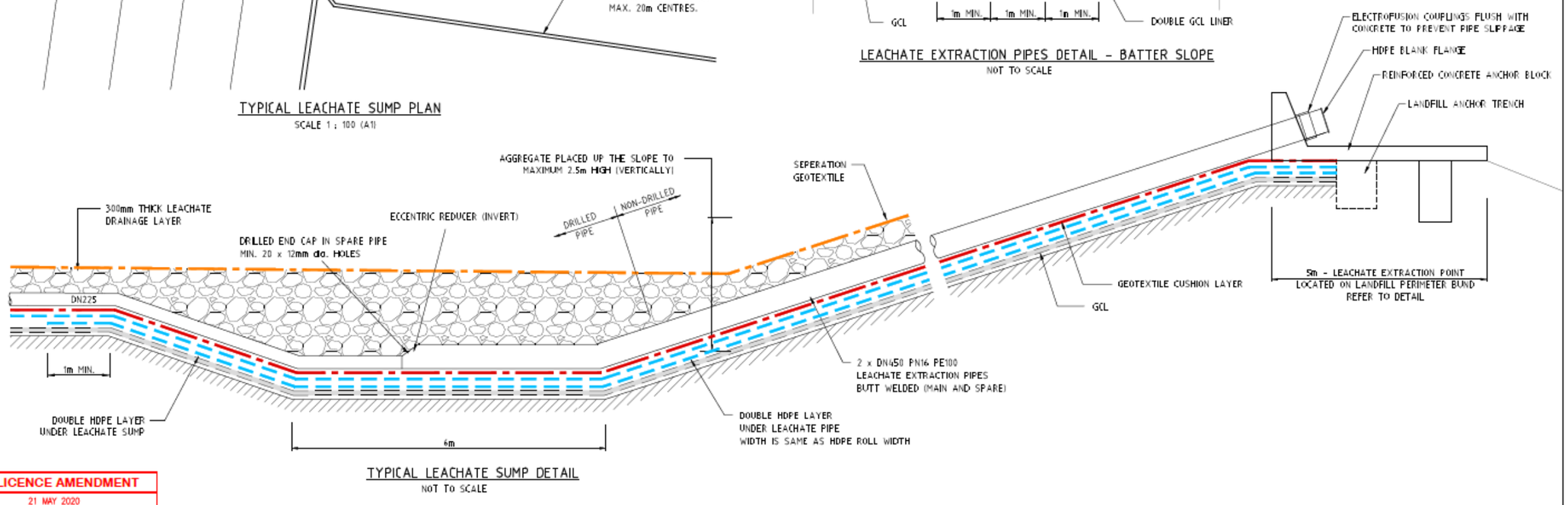


LEACHATE EXTRACTION PIPES DETAIL - BATTER SLOPE

NOT TO SCALE



TYPICAL LEACHATE SUMP DETAIL

NOT TO SCALE

LICENCE AMENDMENT

21 MAY 2020

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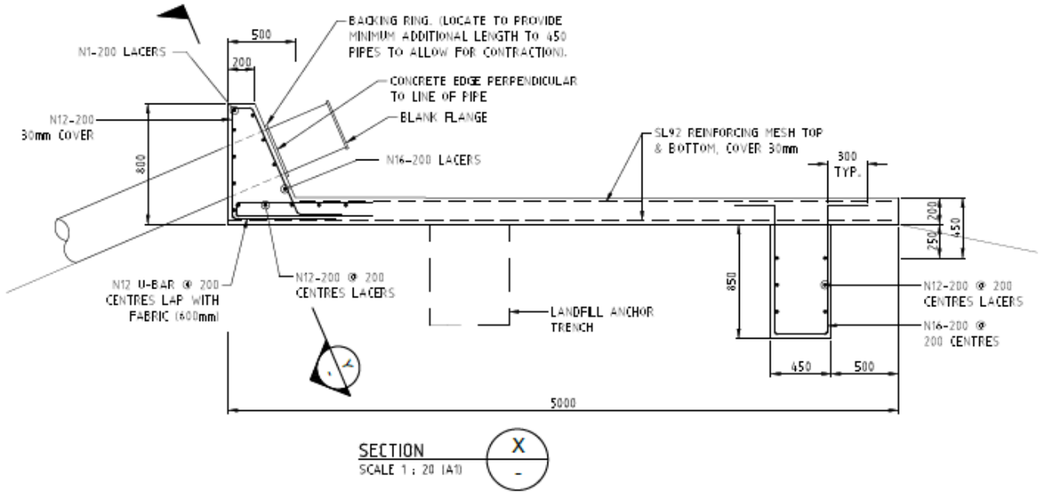
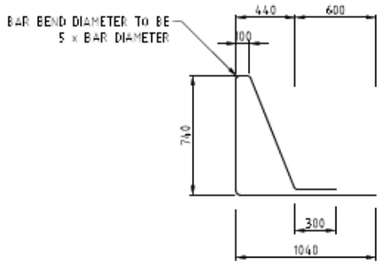
Client	Location	Drawing Title
VANCOUVER WASTE PTY LTD	LOT 102 MINDIJUP ROAD, PALMVALE WA	Leachate Details - Sheet 1 of 2

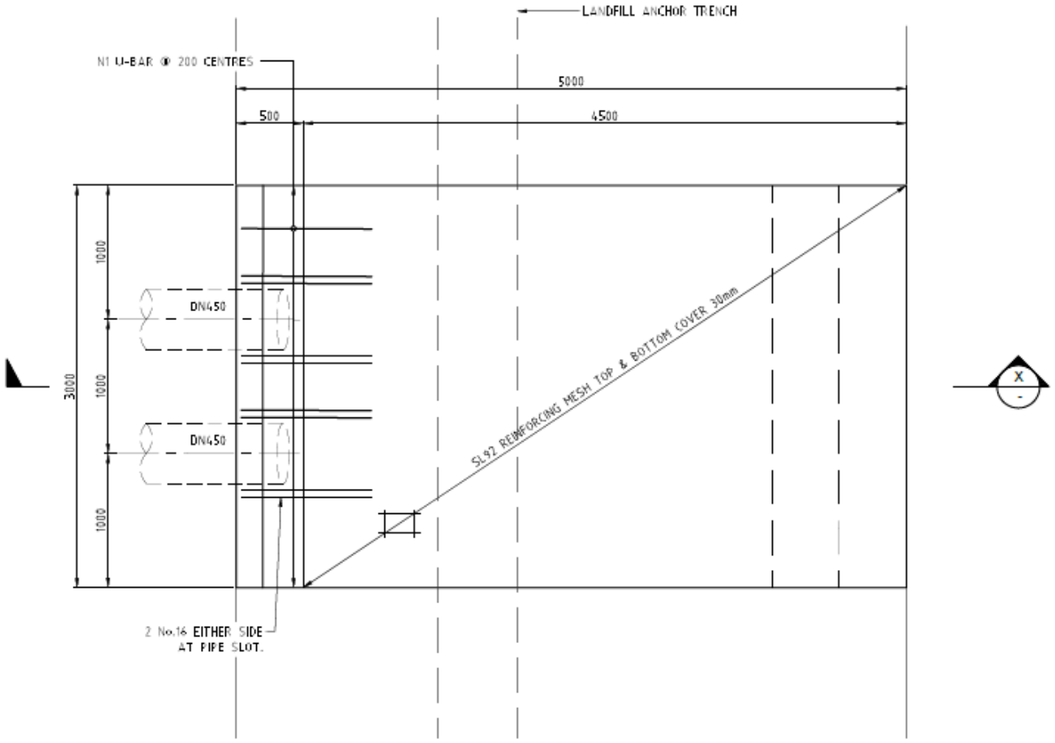
Date	Scale	Design By	Drawn By	Project	Drawing Number	Revision	Drawing Size
21/05/20		B.W.B.	B.W.B.	MINDIJUP ROAD MULTIPLE USE FACILITY - PROPOSED LANDFILL	AL - WA - 015	E	A1

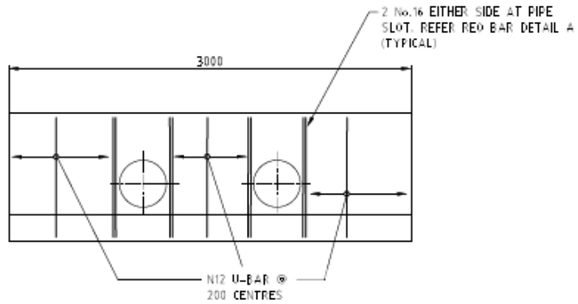


SECTION X
SCALE 1 : 20 (A1)



REO BAR DETAIL A
SCALE 1 : 20 (A1)





SECTION Y
SCALE 1 : 20 (A1)

LEACHATE EXTRACTION POINT LAYOUT
REINFORCED CONCRETE SLAB ON TOP OF LANDFILL BUND
SCALE 1 : 20 (A1)

GENERAL NOTES:

GENERAL:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT DRAWINGS AND SPECIFICATIONS.
2. WORKMANSHIP AND MATERIALS ARE TO BE IN ACCORDANCE WITH THE LATEST REVISION OF AUSTRALIAN STANDARDS AND STATUTORY AUTHORITY REGULATIONS.
3. PROVIDE ALL TEMPORARY SUPPORTS REQUIRED FOR SAFE CONSTRUCTION.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

GROUND AND SLAB FORMATION:
5. FOUNDATIONS SHALL BE INSPECTED AND APPROVED BY THE SUPERINTENDENT PRIOR TO CONSTRUCTION.
6. ALL CONCRETE SLABS ON GROUND TO BE CONSTRUCTED ON 200mm THICK CRUSHED LIMESTONE BASE FORMED TO WITHIN 15mm OF DESIGNATED FALLS AND LEVELS AND COMPACTED TO 95% MAX. DRY DENSITY.
7. CONCRETE SLABS TO BE UNDERLAIN BY 200um POLY-ETHYLENE SHEETING LAPPED WITH 200mm AND SEALED WITH APPROVED ADHESIVE TAPE AT ALL JOINTS.

CONCRETE AND FORMWORK:
8. FORMWORK SHALL BE IN COMPLIANCE WITH AS3610 WITH EXPOSED FACES OF CONCRETE HAVING A SURFACE FINISH MINIMUM QUALITY EQUIVALENT TO CLASS 3.
9. ALL CONCRETE WORK SHALL BE IN COMPLIANCE WITH AS3600.
10. CONCRETE MIX TO BE N32 GRADE, WITH 32MPa MINIMUM 28d COMPRESSIVE STRENGTH, 20mm MAX. AGGREGATE SIZE.
11. ALL CONCRETE POURS SHALL BE VIBRATED.
12. CONCRETE SHALL BE CURED BY KEEPING EXPOSED SURFACES CONTINUOUSLY WETTED FOR 7 DAYS AFTER POURING.
13. CONCRETE SURFACE SHALL BE BROOM FINISHED.

REINFORCING STEEL:
14. ALL REINFORCEMENT SHALL COMPLY WITH THE REQUIREMENTS OF AS4671.
15. MESH AND BAR REINFORCEMENT SHALL BE D500 GRADE.
16. BOTTOM MESH SHEETS SHALL BE SUPPORTED ON APPROVED PLASTIC STOOLS AT 1m C/C IN BOTH DIRECTIONS AND NOT HOOKED UP DURING CONCRETE POUR.
17. COVER TO SLAB REINFORCEMENT TO BE 30mm MINIMUM ALL ROUND.
18. ALL MESH OVERLAPS SHALL COVER AT LEAST 2 x TRANSVERSE BARS.
19. REINFORCEMENT SHALL NOT BE RE-BENT OR WELDED WITHOUT APPROVAL OF THE SUPERINTENDENT.

LICENCE AMENDMENT
21 MAY 2020

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Client	Location	Drawing Title
VANCOUVER WASTE PTY LTD	LOT 102 MINDIJUP ROAD, PALMVALE WA	Leachate Details - Sheet 2 of 2

Date	Scale	Design By	Drawn By	Project	Drawing Number	Revision	Drawing Size
21/05/20		B.W.B.	B.W.B.	MINDIJUP ROAD MULTIPLE USE FACILITY - PROPOSED LANDFILL	AL - WA - 016	E	A1

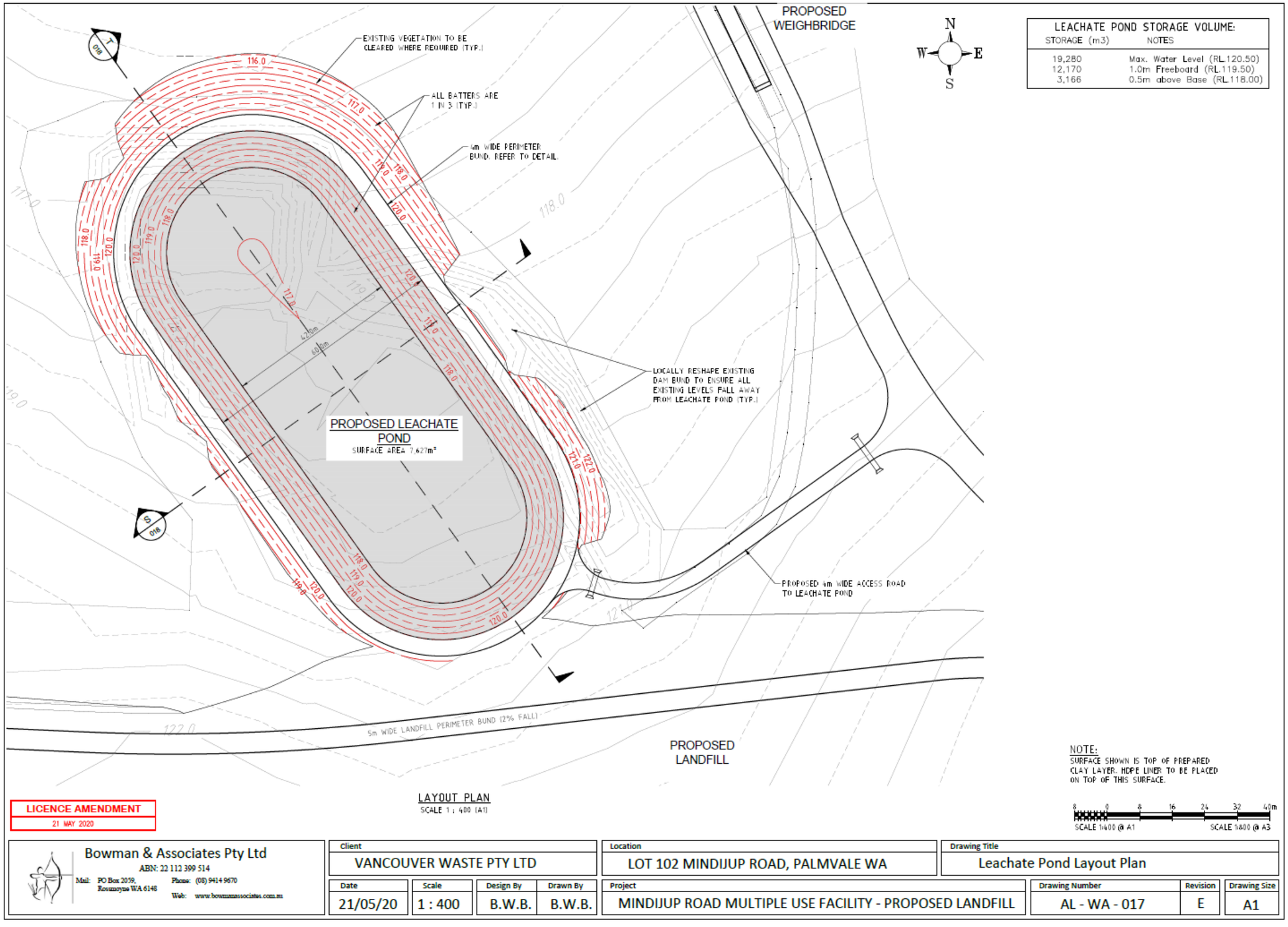

Figure 21: Leachate pond layout plan

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Bowman & Associates, April 2018. Vancouver Waste Disposal Facility – Application Licence Amendment. Prepared by Bowman & Associates Pty Ltd for Vancouver Waste Services Pty Ltd. Received 2 May 2018	B&A, 2018a	DWER records (A1666116)
2.	Bowman & Associates, August 2018. Vancouver Waste Disposal Facility – Updated Application Licence Amendment. Prepared by Bowman & Associates Pty Ltd for Vancouver Waste Services Pty Ltd. Received 8 August 2018	B&A, 2018b	DWER records (A1710191)
3.	DWER Application Form and associated attachments. Received 8 August 2018		
4.	Bowman & Associates Pty Ltd, August 2018. Reference L7344/1998/10, DER2016/002256 Application for Licence Amendment – Request for Further Information. Received 8 August 2018.		
5.	Bowman & Associates Pty Ltd, October 2018. Reference L7344/1998/10, DER2016/002256. Application for Licence Amendment – Request for Further Information. Received 4 October 2018.	B&A, 2018c	DWER records (A1726257)
6.	Bowman & Associates, November 2018. Reference L7344/1998/10, DER2016/002256 Application for Licence Amendment – Request for Further Information. Received 2 November 2018	B&A, 2018d	DWER records (A1772893)
7.	Bowman & Associates, November 2018. CAD Drawings - Vancouver Waste Pty Ltd – Mindijup Road Landfill, Lot 102 Mindijup Road, Palmvale WA Works Approval. Received 2 November 2018		DWER records (A1772898)
8.	Bowman & Associates, December 2018. Reference L7344/1998/10, DER2016/002256 Application for Licence Amendment – Request for Further Information. Received 6 December 2018.	B&A, 2018e	DWER records (A1745983 and A1772918)
9.	Department of Water and Environmental Regulation. 23 May 2019. Memorandum: Surface and groundwater advice request – Vancouver Waste Services – Proposed Class III Landfill – Lot 102 Mindijup Rd, Palmdale	-	DWER records (A1849735)
10.	Golder Associates Pty Ltd, August 2019. Mindijup Road Class III Landfill Facility – Cell 1, Cell 2, & Leachate Pond – Review of	Golder Associates,	DWER records (A1831958)

	Stability Assessment and Design Basis submitted to: Department of Water and Environmental Regulation	2019	
11.	Bowman & Associates, 11 October 2019. Reference L7344/1998/10 Application for Licence Amendment – Request for Further Information. Received 15 October 2019.	B&A, 2019a	DWER records (DWERDT211967 and A1831947)
12.	Bowman & Associates, 11 October 2019. Vancouver Waste Services Pty Ltd – Lot 3 and Lot 102 Mindijup Road, Palmdale – Fire Management Plan. Received 15 October 2019.		
13.	Bowman & Associates, 4 December 2019. Reference L7344/1998/10 Application for Licence Amendment – Request for Further Information in Letter dated December 2, 2019. Received 17 December 2019.	B&A, 2019b	DWER records (A1852687)
14.	Bowman & Associates, 15 January 2020. Reference L7344/1998/10 Application for Licence Amendment – Request for Further Information Email dated January 10, 2020. Received 17 January 2020.	B&A, 2020a	DWER records (DWERDT245548)
15.	WML Consulting Engineers, 19 February 2020. Vancouver Waste Disposal Facility Quantitative Seepage Assessment. Received 21 February 2020.	WML, 2020	DWER records (A1900401)
16.	Bowman & Associates, 21 May 2020. Vancouver Waste Pty Ltd – Mindijup Road Landfill Lot 102 Mindijup Road, Palmvale WA Licence Amendment – Amended drawings. Received 25 May 2020.	B&A, 2020b	DWER records (A1897693)
17.	GHD. 22 June 2020. Vancouver Waste Services Stability Analysis to support Licence Amendment for Class III Landfill at Lot 102 Mindijup Road. Received 22 June 2020.	GHD, 2020	DWER records (A1906013)
18.	Licence L744/1998/10 Vancouver Waste Processing & Disposal Site	L7344/1998/10	accessed at: www.dwer.wa.gov.au
19.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	DER 2015a	
20.	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	DER 2015b	
21.	DER, November 2016. *Guidance Statement: Environmental Siting.* Department of Environment Regulation, Perth.	DER 2016b	
22.	DER, February 2017. *Guidance Statement: Risk Assessments*.	DER 2017	

	Department of Environment Regulation, Perth.		
23.	DWER, June 2019. *Guideline: Decision Making*. Department of Water and Environmental Regulation, Perth.	DWER 2019	