Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Licence

Part V Division 3 of the *Environmental Protection Act 1986*

Licence Number	L9443/2024/1
Applicant	Fernview Environmental Pty Ltd
ACN	617 674 469
File number	DER2024/000264
Premises	Fernview Landfill Lot 98 Wannamal Road South CULLALLA WA 6503 Legal description - Lot 98 on Plan 75926 Certificate of Title Volume 2847 Folio 974 As defined by the coordinates in Schedule 1 of the Licence
Date of report	19 November 2024
Decision	Licence granted

Grace Heydon

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Grace Heydon
MANAGER WASTE INDUSTRIES
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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1. Decision summary

This decision report documents the assessment of potential risks to the environment and to public health from emissions and discharges during the operation of the premises. As a result of this assessment, Licence L9443/2024/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this decision report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its regulatory framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary and overview of premises

On 4 June 2024, the applicant submitted an application for a licence to the department under section 57 of the *Environmental Protection Act 1986* (EP Act).

The application is to seek a licence relating to the operation of the first stage of the Class II landfill facility at the premises. The premises is located within the Shire of Gingin, approximately 16 km north of the Town of Gingin. The premises is zoned Special Use, with the surrounding land zoned as Parks and Recreation to the west (Boonanarring Nature Reserve) and Rural to the north, east and south. The Muchea fault line runs through the premises in a north-west to south-easterly direction, adjacent to the landfill area.

The original proposal for the landfill was referred under Part IV of the EP Act for assessment by the Environmental Protection Authority (EPA) (Referral Decision No. 1287). The landfill is subject to Ministerial Statements (MS) 796, 975, and 1073, which are discussed further in Section 2.4 of the Decision Report.

A total of 10 landfill cells have been proposed to be constructed throughout the life of the landfill, which will cover an area of approximately 28.7 ha. However, this application only covers the operation of Landfill Cell 1 and the infrastructure required to operate Landfill Cell 1, including a leachate collection system and a stormwater management system. Future Part V applications will be required for the construction and operation of subsequent landfill cells.

Approval for the construction of Landfill Cell 1, leachate pond, and associated infrastructure, of the Class II landfill facility was granted under DWER Works Approval W6083/2017/1. The Decision Report for W6083/2017/1 contains detailed background information which has been considered in the assessment of this licence application. A copy of the Decision Report for W6083/2017/1 is attached in Appendix 2.

Construction of site access roads, drainage infrastructure and excavation of Landfill Cell 1 began in early 2020. Construction works for Landfill Cell 1 and the leachate pond lining commenced in late 2021. Stage 1 works were completed on 27 January 2023 and included the construction of the following infrastructure:

- Site entrance and internal access roads;
- Administration Office;
- Water Supply and Firefighting Tanks;
- Refuelling Bay;
- Stormwater Drainage;
- Sediment Pond;

- Landfill Cell 1;
- Leachate Collection and Extraction System;
- Leachate Pond; and
- Site perimeter fencing.

On 2 May 2024, the works approval holder provided an Environmental Compliance Report (ECR) and a Construction Quality Assurance Validation Report (CQAVR) to demonstrate that the works were carried out in accordance with the works approval. Submission of the compliance documentation was delayed as Fernview Environmental Pty Ltd was engaged in an insolvency event involving its parent company around the time that construction works had been completed. The insolvency matters were resolved by January 2024, enabling the finalisation of the compliance documents for submission to the department. A number of departures to the works approval were identified during the assessment of the ECR and CQAVR which are discussed further in Section 2.3. Time-limited operations were not permitted under the works approval.

Waste meeting Class II acceptance criteria as per the *Landfill Waste Classification and Waste Definitions 1996 (as amended December 2009)* is proposed to be accepted for landfilling at the premises. These waste types are as follows:

- Clean fill
- Inert waste type 1
- Inert waste type 2 (excluding tyres due to the premises being located in the tyre exclusion zone as per Schedule 5 of the *Environmental Protection Regulations 1987* (EP Regulations)
- Putrescible waste
- Special waste type 2
- Contaminated solid waste meeting waste acceptance criteria specified for Class II landfills.

The majority of the waste received will be sourced from commercial customers in the Perth metropolitan area, having undergone sorting at a transfer station prior to arriving at the premises. The premises is not proposed to be open to the general public.

Waste will be placed into the cell using the area fill method which involves progressively filling the site in layers. Soft waste (containing no sharp items that could puncture the landfill liner) will be placed on the drainage layer of the cell and in an uncompacted 2 m deep layer to prevent damage to the liner. Subsequent waste lifts will be 2 m deep but placed in 500 mm compacted layers. One cell will be constructed at a time and filled to near finished surface prior to construction of the next cell. As each cell reaches finished levels then the final engineered landfill cap will be progressively placed. Waste materials shall be placed so that they do not exceed slopes of 1V:3H. At every 10 m in height of waste placement, the next waste lift will be set back 5 m, creating a bench, to assist with stability of the 1V:3H slopes in the landfill. For the finished landfill surface, external batters will be 1V:5H to ensure stability and prevent erosion.

The premises relates to the category and assessed design capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in licence L9443/2024/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020) are outlined in licence L9443/2024/1.

2.3 Compliance with Works Approval W6083/2017/1

The ECR and CQAVR submitted to DWER on 2 May 2024 noted departures from the works approval requirements which were reviewed and accepted by DWER in accordance with Condition 2 of W6083/2017/1. Condition 2 of the works approval allows for a departure to the requirements specified in Column 2 of Schedule 2 where the departure does not increase risks to public health, public amenity, or to the environment, and where all other conditions in the works approval are satisfied. Notification of compliance with the requirements of conditions 3, 4 and 5 of Works Approval W6083/2017/1 was provided to the works approval holder on 17 June 2024.

Table 1 below outlines the changes that were made to the original design and construction requirements specified in Schedule 2 of W6083/2017/1. These departures are not considered to change the overall risk profile of the landfill and are therefore, acceptable in accordance with Condition 2 of W6083/2017/1.

Table 1: Departures from Schedule 2 in Works Approval W6083/2017/1

Infrastructure/equipment listed in Schedule 2		**Departure**
1.	Landfill Cell 1	Landfill Cell 1 was constructed in the south-eastern position within the overall landfill footprint approved by MS 796, instead of being constructed in the southwestern portion as per the works approval. Schedule 2 in the ECR states that the location was changed at design stage to maximise landfill stability by constructing the first cell in the lowest point in the overall landfill footprint.
2.	Cell 1 - Subgrade	The 500 mm compacted fill required for the bottom layer of cell 1 was replaced by a GCL layer due to the unavailability of suitable clayey material. MS 796 requires the landfill cells and leachate storage ponds to include as a minimum a double-lined containment system consisting of a minimum 2.0 mm HDPE flexible membrane liner and a clay-based liner with a performance equivalent or greater than that of a compacted clay liner one meter thick and hydraulic conductivity less than $1x10^{-9}$ metres per second. The GCL layer appears to meet these requirements.
4.	Cell 1 – GeoNet (Secudrain)	The specification in the Works Approval referred to a specific product to be used (GeoNet Secudrain). The Contractor used an equivalent product (Interdrain) instead. The alternative product was determined, through CQA testing, as being equivalent to the specification requirements.
8.	Cell 1 – Leachate collection system pipework	Some of the HDPE leachate collection pipes had an internal diameter of 130 mm, whereas the Works Approval specified a minimum internal diameter of 150 mm. The design pipe diameter of 130 mm considered the anticipated leachate flow rate and maximum leachate extraction rate of 60 L/min and was considered appropriate. Leachate extraction pipes down to the leachate sumps are greater than 160 mm in internal diameter to provide sufficient access for maintenance.
9.	Cell 1 – Aggregate/ Leachate Drainage Layer	The leachate drainage layer aggregate was required to have a maximum particle size of greater than 20 mm but no greater than 37.5 mm. 8% of the aggregate in the leach drain layer is greater than 37.5 mm but less than 50 mm. This was accepted by the designer subject to it passing a liner strain test. A liner evaluation test was conducted using the site aggregate and a liner strain of less than 3% was achieved, demonstrating compliance with the design strain allowance. A 20 mm leachate aggregate was used during the completion of the aggregate layer due to no more 40 mm aggregate being available and the

		need to protect the geotextile from UV exposure. The 20 mm aggregate was used in a small section of the landfill containment cell north-east corner wall. The Victoria Landfill BEPM recommends drainage layer aggregate size to be less than 50 mm and greater than 20 mm. This 20 mm aggregate appears to be the minimum size acceptable and it is noted that it is only used on a small section of the cell.
11.	Cell 1 – Leachate collection system sump	The leachate sump was not constructed of concrete and situated on a concrete slab covering the entire base of the sump as required in the works approval. The ECR states that the design did not include a concrete sump. However, there is a concrete slab at the leachate sump access point.
14.	Leachate Pond	The final GCL layer was placed only on the base of the leachate pond and not on the side slopes as required in the works approval. The reasoning behind this was that on the side slopes it will not be typically confined by water pressure and may experience down-slope erosion over time. This could negatively impact the geocomposite leak detection layer at the base of the slope. The works approval also required the leachate pond to comprise a woven and non-woven geotextile layer. However, the ECR states that the Leachate Ponds do not have a geotextile layer on top of the HDPE surface and it was not in the original design. The Leachate Pond has a greater storage capacity (8,400 m^3) than the total storage capacity of 7,129.6 m^3 specified.
15.	Stormwater management system	The sedimentation pond has not been designed to maintain a minimum top of embankment freeboard of 500 mm as required. This is due to it being designed and constructed with an erosion protection outflow structure (not a total retention pond) to allow stormwater sediment to settle out of the water before it overflows into the environment. The ECR states that freeboard is not a relevant parameter.

Condition 6 of the works approval required the works approval holder to undertake quality assurance including visual inspection and materials testing for the GCL membrane, as specified in Schedule 2, in accordance with Table 2 in the works approval. Condition 7 of the works approval required the works approval holder to undertake quality assurance including visual inspection, materials testing and weld testing for the respective HDPE membranes, as specified in Table 2, in accordance with Table 3 of the works approval. The CQAVR submitted provided the details of compliance with these requirements. Some departures to the requirements were identified. However, these were certified by TerraFirma, a NATA Certified Geotechnical Inspection and Testing Authority, and the departures were determined to be acceptable by the department.

It was mentioned in the ECR that the leachate collection system separation geotextile installed for the landfill cell is expected to be significantly impacted by UV degradation due to the anticipated time delay between the completion of construction and commencement of waste placement. To rectify this, Fernview Environmental Pty Ltd has proposed to install a new layer of separation geotextile progressively, ahead of waste placement, to ensure that separation geotextile between the waste and the leachate aggregate layer will remain in good condition, free of UV damage. This proposal has been considered by the department as part of the licence application.

A Groundwater Quality and Flow Hydrogeological Report (Stass Environmental, 2024) was submitted with the ECR and CQAVR to satisfy the requirements of Conditions 4(g), 4(i), 9, 10, 11, 12 and 13 of W6083/2017/1. These conditions required groundwater monitoring to be undertaken at the site, with the CQAVR to include a groundwater monitoring well construction report and results of the groundwater monitoring undertaken. The Delegated Officer considers that compliance with these conditions has been achieved. The outcomes of the Groundwater Quality Flow Hydrogeological Assessment (GQFHA) are discussed further in Section 2.4 below.

2.4 Groundwater Quality and Flow Hydrogeological Assessment

Hydrogeological Setting

The Fernview Landfill is located between the Gingin Scarp (to the west) and the Barberton Plateau (to the east) on the southern section of the Dandaragan Plateau. The premises is situated over Upper Cretaceous sediments of the Coolyena Group, which are treated as a single unconfined and minor aquifer (Stass Environmental, 2024). Stass Environmental (2024) refers to this aquifer as the Poison Hill aquifer which consists of Poison Hill Greensand, Gingin Chalk and Molecap Greensand member units. This aquifer is also often referred to as the Mirrabooka aquifer. Underlying the Poison Hill aquifer is the Kardinya Shale, a thick sequence of shales with sandstone and silt, which confines the Leederville Formation aquifer below it.

It is inferred that groundwater flow within the Poison Hill aquifer is to the southwest. This is based on borehole data from recent investigations (Kay and Diamond, 2001). The evidence available from these investigations also suggests that in the region around the landfill, there is no direct connection between the Poison Hill aquifer and the Leederville aquifer. It also appears likely that the Poison Hill aquifer discharges into the Gingin Brook catchment (Stass Environmental, 2024).

Stass Environmental (2024) uses information from two sources to define local groundwater conditions at the premises. One being information from the drilling of deep bores (RG2A and RG2B) approximately 1 km south of the site, reported in Diamond (2000), for the investigation of groundwater in the Leederville formation and the unconfined Poison Hill aquifer at the same location. The other information source, being the more recent drilling undertaken by ATA Environmental (2006) as part of an assessment of the proposed landfill premises.

Figure 1 below is a summary log for borehole RG2A reproduced by Stass Environmental (2024) from the information in Diamond (2000) and describes the stratigraphic succession through to the Leederville Formation and Parmelia Formation.

<table>
<tr><th>Depth (m bgl)</th><th colspan="3">Stratigraphic units</th></tr>
<tr><td>0-6</td><td colspan="3">Quaternary (Surficial deposits)</td></tr>
<tr><td>6-25</td><td colspan="2">Poison Hill Greensand</td><td rowspan="4">Coolyena group</td></tr>
<tr><td>25-34</td><td colspan="2">Gingin Chalk</td></tr>
<tr><td>34-63</td><td colspan="2">Molecap Greensand</td></tr>
<tr><td>63-148
148-196</td><td>Kardinya Shale
Henley Sandstone</td><td>Osborne Formation</td></tr>
<tr><td>196-254</td><td>Pinjar Shale</td><td rowspan="3">Leederville Formation</td><td rowspan="3">Wamboro Group</td></tr>
<tr><td>254-450</td><td>Wanneroo Member</td></tr>
<tr><td>450-472</td><td>Marginiup Member</td></tr>
<tr><td>472-490</td><td colspan="3">Parmelia (Sandstone) Formation</td></tr>
</table>

Figure 1: Summary log for Bore RG2A (Stass Environmental, 2024)

From Figure 1, it can be seen that the Poison Hill aquifer is not in direct hydraulic connectivity with the Wanneroo Member which is the main groundwater yielding unit of the Leederville aquifer. Therefore, the Poison Hill aquifer is the main focus for assessing potential impacts from the landfill (Stass Environmental, 2024).

Detailed logs of six boreholes drilled for the recent investigations by ATA Environmental were used to

obtain detail on the shallow Quaternary and Upper Cretaceous sediments. These bore logs indicate mainly ferruginised medium to coarse sands with laterised horizons at depths between 2-5 mbgl, within the Surficial Deposits (Stass Environmental, 2024). The Poison Hill Greensand Upper Cretaceous sediments are weathered to the depth drilled in each borehole, making it unclear where the boundary is between the Surficial Deposits and the Poison Hill Greensand. This absence of a boundary infers that the Surficial Deposits and weathered Poison Hill Greensand form a single vadose zone for the unconfined Poison Hill aquifer located below the landfill site (Stass Environmental, 2024).

Depth and potential impacts to groundwater

Bore RG2B taps groundwater in the Poison Hill aquifer, with groundwater levels in the bore recorded at 18.26 m below casing (~143 m AHD) in November 2000 within the Poison Hill Greensand (Stass Environmental, 2024).

None of the bores drilled by ATA Environmental in February 2006 intercepted groundwater. However, bores MB1-4 and FLV4, drilled in September 2006, measured rest water levels (RWLs) on two occasions in September and December 2006 (shown in Figure 2).

Using data from bores MB2, MB3 and FLV4, Stass Environmental (2024) inferred that groundwater flow was in a west-southwest direction for the area to the south-east of the landfill in September 2006, with a shallow hydraulic gradient (0.0016). However, groundwater flow below the landfill may be more southerly, based on regional flow directions from Kay and Diamond (2001). This information suggests that groundwater beneath the premises generally flows towards the Gingin Brook where it is likely to discharge (Stass Environmental, 2024).

ATA bore	Elevation (m.AHD)	Groundwater RWL (m. AHD)		Drilled depth (m.AHD)
Bores drilled in February 2006				
BH2	-170*	-143.5**		-146
BH3	-185*	-143.7**		-156
BH6	-185*	-143.5**		-156
BH1	-195*	-		-167
BH5	-200*	-144**		-172
BH4	-220*	-		-193
Bores drilled in September 2006				
		8 Sept 2006	20 Dec 2006	
MB1 (GG1)	180.37	dry	dry	147.37
MB2 (GG2)	183.51	144.01	144.99	137.51
MB3 (GG3)	168.01	143.53	144.54	139.51
MB4 (GG4)	189.73	dry	dry	143.73
FLV4 (Prod Bore)	157.445	144.17	-	116.45

Figure 2: Approximate groundwater RWLs for bores drilled in the vicinity of the site (Stass Environmental, 2024)

Figure 2 shows that there is a depth of vadose zone of 25 m or greater beneath the premises. Stass Environmental (2024) determines that any subsurface contamination from a leak in the landfill liner, if sufficient to reach groundwater, which is at a significant depth below the premises, will likely flow towards the Gingin Brook. Given that the Gingin Brook is several kilometres from the proposed landfill, the contamination is expected to be diluted and dispersed prior to reaching the Gingin Brook.

Five production bores have been identified within the area surrounding the site. Three of these bores are located to the east and are proposed to be used as abstraction bores for landfill activities. The other two bores are located approximately 1 km south of the landfill. Given the distance of the two southern bores to the landfill, and the location of the other three bores up-hydraulic gradient of the landfill, Stass Environmental (2024) determines that all bores are unlikely to be impacted by contamination.

Groundwater monitoring 2022- 2024

There are seven groundwater monitoring wells currently installed on the premises. The co-ordinates and Australian Height Datum (AHD) level at the top of casing for each well is shown in Figure 3.

Bore ID	Easting	Northing	RL AHDm
GG1	403310	6546530	180.660
GG2	402820	6545834	183.455
GG3	402638	6545562	168.010
GG4	402127	6545628	189.680
GG5	402146	6545788	188.470
GG6	402411	6545560	171.755
GGN7	402818	6545561	164.930

Figure 3: Current groundwater well coordinates and AHD (re-surveyed in 2022)

GG1, GG2, GG3 and GGN7 (previously GG7) were re-drilled due to damage or insufficient depth. GG1, GG2 and GG3 were re-drilled in 2019, with GG7 being re-drilled in 2020 by Stass Environmental. Groundwater monitoring well construction logs for the current wells were provided to the Department in accordance with Condition 4(g) of W6083/2017/1. Monitoring has been undertaken quarterly at all seven wells since 2019 in accordance with Condition 9 of W6083/2017/1 and groundwater monitoring data from 2020 onwards has been provided to the Department as required by Condition 4(i) of W6083/2017/1. A gradual decline in water levels from 2020 until present was observed from the data. However, the direction of groundwater flow across the site has remained consistently towards the south-west with a gradient of 0.00145.

Conductivity of the upper layers of the unconfined aquifer appears to be low (1-5 m/d) based on the lithology of the sediments which were observed during drilling of the wells, being clayey sand to slightly silty sand (Stass Environmental, 2024).

Groundwater quality varies across the site, with a good groundwater quality profile to the west (wells GG4 and GG5) and east (wells GGN7 and GG2). Salinity ranges from 100 to 200 mg/L in these wells, with no heavy metals or other contaminants reported during the surveying period (Stass Environmental, 2024), apart from elevated levels of iron in GG5 in November 2022.

Wells GG6 and GG3 to the south and GG1 to the north appear to be affected by salinity and have minor concentrations of heavy metals. Some heavy metal concentrations are in excess of DWER Contaminated Site Guideline 2014 (Stass Environmental, 2024).

Overall, the study concluded the following:

1. Groundwater at the site is generally between 20 and 50 m below ground level.
2. The aquifer is unconfined.
3. Groundwater quality is good with no industrial contaminants, largely meeting Contaminated Sites *Guidelines (2014) Ecological and Drinking Water quality guidelines*.

4. Groundwater flows from northeast to southwest across the site.
5. Groundwater monitoring wells are well placed to monitor any potential impacts from the landfill.
6. Any potential subsurface contamination of leachate, if sufficient to reach groundwater, would flow generally in a west-southwest direction towards the Gingin Brook catchment. However, as the flow distance to Gingin Brook is 3.5 km, the dilution and dispersion of any contamination over this distance would be sufficient to preclude any impact on water in the Gingin Brook.

Key Finding: The Delegated Officer has reviewed the Groundwater Quality and Flow Hydrogeological Assessment (Stass Environmental, 2024) and has for the purposes of this licence assessment found:

1. Groundwater flow at the premises is in a south-westerly direction towards the Gingin Brook catchment.
2. The Poison Hill aquifer beneath the site is often referred to as the Perth - Mirrabooka aquifer and is unconfined.
3. The Perth-Mirrabooka aquifer is overlain in the area by the Perth-Surficial aquifer.
4. There is a thick layer (approximately 50 metres) of Kardinya Shale between the Mirrabooka aquifer and Leederville aquifer at the premises location, confining the Leederville aquifer.
5. The number and location of groundwater monitoring wells for the purpose of detecting leachate leaks into the Surficial/Mirrabooka aquifer is considered appropriate.
6. If leachate is detected in the monitoring wells in the future, then additional wells may be required further down gradient (towards the southwest) to characterise the contaminant plume.

2.5 Part IV of the EP Act

The landfill is subject to Ministerial Statements 796, 975 and 1073.This assessment has taken into consideration the ministerial conditions within Ministerial Statement 796, issued 11 June 2009 for the operation of the landfill. Ministerial Statement 1073, issued 26 February 2018, specifies requirements for environmental offsets and for feral animal control. Ministerial Statement 975, issued 2 July 2014, is administrative in matter and not related to the operation of the landfill.

The conditions of MS 796 related to operation of the landfill are as follows:

- Condition 4 – Compliance Reporting: This condition requires the preparation and maintenance of a compliance assessment plan, assessment of compliance with conditions of MS 796 in accordance with the compliance assessment plan, and submission of annual assessment reports.
- Condition 5 – Performance Review and Reporting: requires the proponent to submit Performance Review Reports at certain intervals after the start of implementation which address environmental risks, progress in achieving sound environmental performance and significant improvements gained in environmental management.

  Compliance audits and environmental reporting conditions will also be considered for the Part V licence.
- Condition 6 – Ground and Surface Water: This condition relates to the preservation of ground and surface water quality and requires groundwater monitoring to be conducted in accordance with the works approval or licensing provisions of Part V of the EP Act.
- Condition 8 – Landfill Decommissioning and Post-closure Management Plan: This condition

requires the submission of a final Landfill Decommissioning and Post-closure Management Plan at least two years prior to the anticipated date of closure of the landfill.

2.6 Planning Approval

The application for Planning Approval for the landfill was approved by the Mid-West/Wheatbelt Joint Development Assessment Panel on 20 January 2016 (reference DAP/15/00918). The conditions of the approval relevant to the operation of the landfill are as follows:

- The land use, development and dust management must be undertaken in accordance with the documentation submitted within the development application.
- The hours of operation must be between 7.00am to 5.00pm on weekdays and 7.00am to 4.00pm on weekends and public holidays.
- Only Class II waste is permitted to be accepted.
- The transport/handling/storage of fuels must comply with AS1940-2004.
- Decommissioning and post-closure management shall be in accordance with the plan provided within the development application and to the satisfaction of DWER and the Shire of Gingin.
- Annual waste inventory to be submitted annually to the Shire of Gingin.
- Revision of the fire management plan to the satisfaction of the Shire of Gingin's Chief Bushfire Control Officer.

2.7 Other Legislation

Environmental Protection and Biodiversity Conservation Act 1999 (Cth)

The project has been referred under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and in January 2016 was determined to be a controlled action. The reference number for the EPBC Act referral is 2015/7621. The action to develop the landfill was approved on 24 October 2019 and was subject to conditions. The conditions associated with the approval included weed and feral animal control requirements, and offsets for significant residual impacts.

Rights in Water and Irrigation Act 1914

Fernview Environmental Pty Ltd holds a groundwater licence (GWL) to take 149,750 kL of groundwater per annual period for industrial purposes from the Perth-Mirrabooka aquifer in the Gingin, Central Scarp Semi-confined, Perth – Mirrabooka aquifer. The GWL has a condition requiring the Licence Holder to submit an annual groundwater monitoring summary. A H2 hydrogeological assessment (Water Direct Pty Ltd, 2019) was prepared in support of the original groundwater licence application and indicated that impacts on the environment, other users and the aquifer system could be managed acceptably. Another GWL (GWL53186(5)) also exists for the premises, permitting the extraction of 129,150 kL per annual period for road construction, road maintenance purposes, and other stock and domestic purposes.

Landfill Levy Requirements

The operation of the landfill facility may be subject to the *Waste Avoidance and Resource Recovery Act 2007* (WARR) and the *Waste Avoidance and Recovery Levy Act 2007*, including subsidiary WARR legislation.

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020).

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

3.1 Source-pathways and receptors

Emissions and controls

The key emissions and associated actual or likely pathway during premises operation which have been considered in this decision report are detailed in Table 2 below. Table 2 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 2: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Noise	Waste acceptance and load tipping Machinery and vehicle use/movements Application of landfill cover	Air/windborne pathway	• Operating hours for waste acceptance will be Monday to Friday 7.00am to 5.00pm and Saturday 7.00am to 4.00pm. The premises will be open on some public holidays. However, there may be ongoing operations for application of cover material after the facility closes (up to 90 minutes). • All site roads will be progressively sealed. • All compactor drivers operating on the landfill will receive training regarding minimising potential noise impacts. • All mobile plant used on site will be regularly maintained including exhaust mufflers. • Speed limits will be enforced on all site roads. • The use of amplified telephone systems will be avoided. • All mobile plant used on site is to be fitted with either low frequency or concentrated sound reversing alarms. • Noise monitoring is to be conducted in accordance with licence conditions and the Minister's conditions. • A complaints register has been established to record and respond to noise complaints.
Dust			• All vehicles exiting the site will go through a wheel cleaning facility - a cattle grid arrangement to knock off any debris on the wheels and under body of vehicles before entering public roads. • The surface of the landfill will be sealed

Emission	Sources	Potential pathways	Proposed controls
			following cell completion with an engineered capping system to minimise potential dust emissions from the surface of the landfill. The landfill cap will be vegetated for erosion control. • All solid waste materials delivered to the facility will be contained in a covered vehicle, which will only be unloaded within the active cell and in the vicinity of the tipping face. • Unsealed roads, stockpiles of soil, exposed areas and tipping face will be watered down regularly. • A dedicated water tank and standpipe will be maintained for use on the site. Water for dust suppression will be obtained from existing licensed production bore FLV4 or other licensed groundwater resource. • The truck mounted water tank (min 14,000 L capacity) will be filled from the 150,000 L on site water tank, from a pump and standpipe at the stormwater dam or from bore FLV4 itself from which the onsite water tank is filled. • Permanent access roads will be progressively sealed (extending as far as possible to tipping face) and cleaned on a regular basis. • Vehicle movements will be restricted to designated roadways, with speeds restricted to less than 60 km/hr on access roads prior to weighbridge and 30 km/hr between the weighbridge and tipping face. • Disturbed areas not required during operation of the facility will be progressively stabilised with native vegetation/pasture. • Volumes of stockpiled soils will be kept to a minimum. • Emplaced waste will be regularly compacted. • Dust emissions will be monitored daily through visual inspections and results will be recorded and a log maintained onsite. • If dust monitoring is deemed necessary, PM_{10} dust emissions will be maintained below $\mu g/m^3$. • Nearby land users will be provided contacts that will record and address any valid dust complaints. A complaints register has been established. • The Site Manager will contact any complainants that have concerns related to dust. • A 150,000 L tank is available onsite for

Emission	Sources	Potential pathways	Proposed controls
			reticulation and dust supression
Odour	Putrescible waste acceptance and load tipping Decomposition of waste material	Air/windborne pathway	• The integrity of the engineered landfill lining and capping system will be maintained and not degraded by activities on site through adherence to operational management processes. • All waste delivered to site will be contained in a covered vehicle. • No prohibited waste will be accepted on site. • Odourous waste is to be covered immediately on receipt. • Only one tipping face will be active at any one time and the surface area of the active tipping face will be kept as small as possible. Daily inspections of the tipping face will be undertaken by the Site Manager. • Operational procedures will be adopted at the tipping face to prevent surface ponding of water which may emit odours. • Effective compaction of the waste will minimise odours. • Landfill Gas (LFG) and odour monitoring is to be conducted in accordance with licence conditions and the Minister's Conditions pursuant to Part IV of the Environmental Protection Act 1986. • Leachate pond is to be routinely checked for odour emissions. • Weather conditions will be monitored on site and cover materials placed for adverse weather conditions. • The active gas extraction system and utilisation plant (or enclosed flare) is to be operational as soon as possible to minimise the release of uncontrolled landfill gas emissions through passive venting. • Leachate infrastructure such as sumps and extraction risers are to be effectively sealed, only retaining any necessary access for monitoring and maintenance. • During the operation of the facility, operational procedures are to be implemented which will manage odour issues associated with: o Waste materials which have decomposed significantly prior to placement within the facility, o Old waste disturbed by digging,

Emission	Sources	Potential pathways	Proposed controls
			○ Malodorous waste, Agricultural and sewage treatment residues, ○ Operation and maintenance of leachate collection and treatment systems, and ○ Operation and maintenance of landfill gas collection and treatment systems. • Surface LFG monitoring will be conducted on a monthly basis – focusing on areas along the edge of the void and at regular intervals across the surface of the facility. • Odour monitoring is to be conducted in accordance with licence conditions and the Minister's Conditions pursuant to Part IV of the *Environmental Protection Act 1986.* • A complaints register has been established. The Site Manager will contact complainants, investigate complaints and address impacts. • The following contingency measures may possible be implemented: ○ Provision of improved drainage to minimise occurrence of standing water. ○ Spreading hydrated lime over newly filled or saturated waste. ○ Use of deodorises/odour suppressants. ○ Increasing cover thickness or using more impermeable intermediate cover material.
Windblown waste	Waste acceptance and load tipping Uncovered waste Vehicle use/movements	Air/windborne pathway	• The phasing arrangement of the landfill will minimise the potential for airborne emissions, along with screen planting and bunding on the perimeter of the facility. • A policy of good house-keeping will be endorsed at the site. • General public will not have access to the site, reducing the potential for open trailers. • All waste will be delivered to the facility in a covered vehicle which will only be unloaded within the active cell and in the vicinity of the tipping face. • A speed limit will be enforced at the site to limit litter from vehicles. • Only one tipping face will be active at a time and the surface area will be kept as small as

Emission	Sources	Potential pathways	Proposed controls
			possible. • Adequate mobile plant will be available for the placement, compaction and covering of waste. • An adequate supply of daily cover materials will be available on site. • Waste will be compacted on placement. • Daily meteorological monitoring will be undertaken. And the active tipping face will be kept damp by watering during dry and windy conditions. • Daily cover (soil) will be deposited over the waste at the end of each working day. • Portable litter screens will be used downwind of the tipping face to trap windblown litter. The screens will be inspected on a daily basis and trapped litter removed. • Temporary litter fences will be constructed around the active cell. • Site boundary fences will be used to control any litter which migrates outside of the working area. • Completed cells will be capped promptly once the design height has been reached. • The site manager will contact any complainants that have litter related concerns. • Waste vehicle operators will be required to inspect their vehicles prior to leaving the site to ensure all doors are securely closed and no waste debris is on the vehicles.
Pests, birds, vermin and weeds	Putrescible waste acceptance	Land and air	• Waste delivered to the site is to be contained in a covered vehicle to minimise odours which may attract vermin and birds and prevent the escape of environmental weeds. • Only one tipping face will be active at any one time and the surface area of the active tipping face will be kept as small as possible (less than 30 m). Daily inspections of the tipping face will be undertaken by the Site Manager. • No prohibited waste will be accepted on site. • Highly odourous waste will be covered completely on receipt. • Waste awaiting collection for some time is prone to fly infestations and acceptance of this waste will be limited. It will be buried promptly where accepted. • Daily cover will be deposited over the waste

Emission	Sources	Potential pathways	Proposed controls
			(either 150 mm of soil, biodegradable sheeting, or other alternative landfill cover system). • An intermediate less permeable (not sand) 300 mm layer will be placed over waste which is to be left for extended periods of time. • Effective compaction of the waste will minimise odours which may attract pests. • Odour monitoring is to be conducted in accordance with licence conditions and the Minister's Conditions pursuant to Part IV of the *Environmental Protection Act 1986.* • Leachate pond is to be routinely checked for odour emissions. • Bird scaring techniques will be employed onsite if necessary. • External fences have been constructed to capture windblown litter and regular patrols will be conducted to remove accumulation of litter. • Boundary fences will be inspected for damage on a monthly basis. • Weeds and pests will be monitored weekly. • If an increasing number of pests are identified on the premises, an exterminating firm will be contracted. • If weeds are increasing then a local weed control firm will be contracted. • Completed cells are to be capped within 18 months after they reach projected design height. • Waste generated on site (e.g. site offices) will be stored in vessels with lids to prevent vermin and bird ingress and emptied on a regular basis. • A complaints register is available for vermin/bird complaints. The Sire Manager will contact complainants to determine the nature of the nuisance and address identified impacts.
Contaminated or potentially contaminated stormwater	Rainfall and stormwater drainage contacting waste material	Infiltration through soil to groundwater causing	• Rainwater which comes into contact with the waste and/or leachate will be managed as leachate. • A surface water drainage system is in place to divert stormwater around the landfill footprint. • Surface water generated on site from hardstands, stockpiles and other areas outside the landfill footprint is directed to the sedimentation pond prior to discharge.
Sediment		Overland flow and runoff	

Emission	Sources	Potential pathways	Proposed controls
			• Progressive landfill capping will be undertaken within 18 months following cell completion. The cap is to be installed no steeper than 1V:5H. • Inspection of sedimentation ponds will occur weekly. • Inspection of stormwater diversion structures will occur weekly. • Surface water will be monitored to determine whether any contamination of surface waters (from leachate etc.) has occurred. Monitoring will be conducted at the surface water outfall. • Run-off from the site will be observed and site conditions logged on a weekly basis during and following rainfall. • Observations of vegetation deterioration due to surface water flow paths will be conducted monthly. • Surface water levels in the sedimentation pond will be observed and recorded monthly (referenced to surveyed datum level).
Leachate	Infiltration of water through landfilled waste	Infiltration through soil to groundwater	• A Leachate Management System is in place to manage leachate at the site. • Leachate visual alarms are located on the leachate risers in the landfill, with a red light that flashes when leachate has reached its highest acceptable level. • Leachate level must be maintained at 300 mm or less above the landfill base liner system. • A leachate pond freeboard of 1 m will be maintained (the high level alarm is set at a minimum 1 m freeboard). • Probes are located in the leachate pond to identify high levels of leachate. The leachate will be monitored for high levels to prevent an overflow occurring. • Leachate levels at the base of the landfill will be monitored on a weekly basis. • Leachate volumes extracted from the landfill are to be monitored and documented on a weekly basis. • Excessive leachate will be managed by recirculation through the landfill or tanking offsite by a licensed transporter in the event of an emergency. • Landfill Cell 1 has a leachate leak detection system to avoid negative impact to the surrounding environment.

Emission	Sources	Potential pathways	Proposed controls

			• The leachate collection system consists of:
			  ○ A 300 mm thick leachate drainage aggregate layer which is highly porous and provides a preferential pathway to the leachate extraction sump.
			  ○ Leachate collection pipework (perforated HDPE) laid in herringbone arrangement conveys leachate to the collection sumps. Leachate will collect in these sumps for recirculation or storage.
			  ○ Leachate sumps and extraction risers installed up the side slope of the cell. Leachate collection pipes turned up the perimeter bund and terminated with fitted caps at the crest of the bunds provide access for inspection and flushing of the leachate collection system. Leachate will be extracted from sumps by pumps and recirculated or stored in the leachate pond.
			• Maintenance of leachate collection lines will occur quarterly or as required.
			• Inspection of the leachate pond will occur daily.
			• To prevent damage to the liner on commencement of landfill operations, the first layer of waste will be a minimum 2 m layer of uncompacted soft waste (without sharp items which would puncture the liner). The waste will be placed as a full 2 m lift to avoid too much traffic on top of the waste. After this, waste will be compacted in layers of 500 mm.
			• Daily and intermediate cover material will be removed before the next waste placement to allow leachate to migrate down the collection system and prevent it from migrating horizontally and discharging through the side of the batters and outside of the landfill.
			• Routine groundwater monitoring will be conducted to provide ongoing baseline data an discern potential exceedances of assessment criteria.
			• Leachate composition will be monitored on a quarterly basis (sampled from leachate sumps, leachate pond and leachate detection layer extraction points) to identify the specific chemical characteristics of the leachate that will assist to identify any potential leakage into groundwater.
			• Leachate volumes extracted from the leachate detection layer are to be monitored and

Emission	Sources	Potential pathways	Proposed controls
			documented weekly.
Landfill gas	Decomposition of waste material	Subsurface lateral migration	• The applicant does not anticipate that sufficient quantities of landfill gas will be generated within the first two years of operation to justify the installation of an active landfill gas extraction system. • It is anticipated that within the first two years of operation, a specialist landfill gas company will be appointed to assess the actual and likely future gas generation potential and determine the best landfill gas management mechanism going forward.
Hydrocarbon spills	Fuel storage	Infiltration through soil to groundwater	• Any spills of fuel will be cleaned up immediately • All tanks will be clearly labelled and stored with appropriate placards • Spills will be contained as much as possible using the available materials on site (e.g. spill kits, sand). • All stormwater drains in the vicinity must be blocked/protected/sealed in the event of a spill. • Stormwater drains will be pumped out by licensed tankers if they are contaminated by spills. • The double-lined diesel tank has a dip tube which will signal if the inner wall has been breached.
Smoke and particulates	Waste fire Site plant/equipment fire	Air/windborne pathway	• Site security is to be maintained to prevent unauthorised access during and outside of operational hours. • Prohibited waste (e.g. reactive and hot waste) will be refused at the site entrance. • Waste is to be promptly emplaced, compacted and covered in well-defined cells to prevent ingress of air. • Active landfill gas management is to be endorsed and followed on site to prevent air ingress into the waste and the LFG extraction systems. • Fires will be extinguished as soon as possible and reported to DWER. • A Fire Management Plan has been developed in conjunction with the local fire authority. • A water supply capable of being delivered to any point on the landfill and to the satisfaction of the fire authority is to be maintained onsite. • In the event of a deep-seated fire within the
Fire embers		Air/windborne pathway	

Emission	Sources	Potential pathways	Proposed controls
			landfill, the use of leachate or water is to be minimised and alternative methods undertaken to eliminate the ingress of oxygen into the waste body. These may include chemical retardants and dedicated landfill fire suppression treatments. • No waste is to be burnt on site. • No fires are to be lit on site. • Smoking will only be allowed in designated areas of the site considered to be low fire risk. • All fuel or flammable solvents are to be kept in an appropriately ventilated secure store. • Landfill compactors and other machinery are to be fitted with an appropriate fire suppression system or extinguisher for equipment fires. • Vegetation around the boundary will not be allowed to overgrow. • Firebreaks will be maintained around the inside of the perimeter security fence. • Firefighting equipment will be maintained and inspected on a regular basis, in accordance with current legislation and Australian Standards. • A water cart is available on site for firefighting purposes. • Any spills of fuel or flammable liquid will be cleared up immediately. • All plant will be cleaned and maintained regularly to avoid the build-up of waste or other material. • Plant and equipment will be moved away from potential fire areas when not in use and out of hours. • Operators will check equipment throughout the shift to ensure that no fires or hazards are imminent • A 100,000 L capacity galvanised steel panel tank is available for firefighting purposes. • A quick response fire unit with 1,000 L of water, with an operational pump and 20 m of 19 mm diameter hose, capable of delivering water through an adjustable nozzle, will be located in close proximity to the site of any work. • Portable fire extinguishers will be provided in the office, workshop and on plant and equipment, including personnel vehicles. • The 14,000 L capacity water truck available for

Emission	Sources	Potential pathways	Proposed controls
			dust suppression can be coupled to the fire service tank for firefighting purposes. The water truck will also have 200 L foam injection systems with remote control cannon.
Fire wash-water		Overland flow and infiltration through soil to groundwater	• All fire wash-water will be treated as leachate and managed accordingly.

Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020), the Delegated Officer has excluded the applicant's employees, visitors, and contractors from its assessment. Protection of these parties often involves different exposure risks and prevention strategies, and is provided for under other state legislation.

Table 3 and Figure 4 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020)).

Table 3: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	Distance from prescribed activity
Nearest sensitive receptor (R1) – Residential farmhouse	Approximately 210 m south of the premises boundary and 1.3 km south of operational areas
Sensitive receptor (R2) – Residential farmhouse	Approximately 840 m south of the premises boundary and 1.9 km south of operational areas
Sensitive receptor (R3) – Residential farmhouse	Approximately 1.8 km northeast of the premises boundary and 2.5 km northeast of operational areas
Environmental receptors	**Distance from prescribed activity**
Surface water – Boonanarring Brook	Approximately 2.9 km west-southwest of the premises boundary and 3.5 km west-southwest of operational areas
Underlying groundwater – Perth – Surficial: Red Gully	The applicant states that groundwater depth ranges between approximately 20 – 70 mBGL across the premises and more than 15 m below the base of the landfill cell. Groundwater flow is westerly to south-westerly towards the Gingin Brook Catchment. The nearest downgradient registered abstraction bore for the aquifer is located approximately 6.1 km south-southwest of the premises boundary. Two abstraction bores are located approximately 1.2 km south of the landfill area for stock watering

	purposes.
DBCA Legislated Tenure – Boonanarring Nature Reserve	The Boonanarring Nature Reserve is located immediately adjacent to the west of the premises boundary. The purpose of the reserve is for the conservation of flora and fauna. A number of priority and threatened flora and fauna species have been recorded within the reserve.
Geomorphic Wetland – Unnamed conservation category sumpland	Approximately 1.3 km northeast of the premises boundary
Threatened Ecological Community (TEC) – Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	Occurrences of the TEC are located within the premises boundary to the east and south-east, and partly extend into operational areas. The TEC is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (C'Wth).
Threatened/Priority Flora Priority 4 Flora	Located within the 300 m west of the premises boundary in the adjacent Boonanarring Nature Reserve

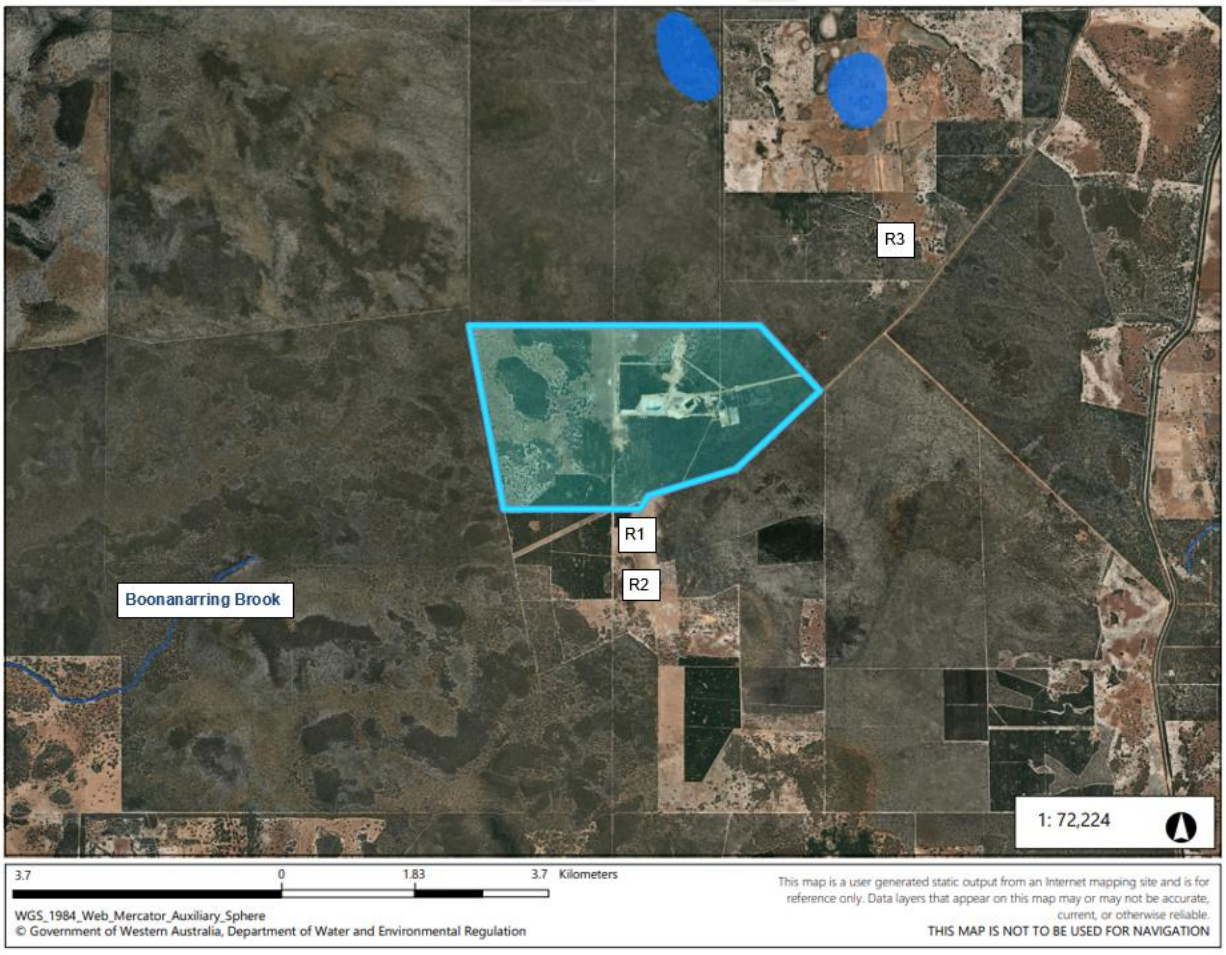


Figure 4: Distance to sensitive receptors

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section 3.1), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the licence as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 4.

Licence L9443/2024/1 that accompanies this decision report authorises emissions associated with the operation of the premises.

The conditions in the issued licence, as outlined in Table 4 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

Table 4: Risk assessment of potential emissions and discharges from the premises during operation

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of licence	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Waste acceptance and load tipping Machinery and vehicle use/movements Application of landfill cover	Noise	Air/windborne pathway causing impacts to health and amenity	Nearest sensitive receptor (1.9 km south of operational areas)	Refer to Section 3.1	C = Minor L = Rare **Low Risk**	Y	Conditions 19, 20	N/A The premises is subject to the *Environmental Protection (Noise) Regulations 1997.*
	Dust			Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	Conditions 1, 4, 8, 9, 10, 11	N/A
Putrescible waste acceptance and load tipping Decomposition of waste material	Odour			Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	N	Conditions 2,3,4,5 **Conditions 16, 17, 18**	The Delegated Officer considers the controls proposed by the applicant to be appropriate to assist in controlling odour emissions. Although, odour impacts have been determined to be unlikely due to the distance to the nearest human receptors, there are uncertainties associated with assessing proposed odour generating facilities. Therefore, the Delegated Officer has determined that an Odour Management Plan is required to mitigate residual risk. The requirement for an Odour Management Plan has been included as a regulatory control on the licence.
Waste acceptance and load tipping Uncovered waste Vehicle use/movements	Windblown waste	Air/windborne pathway causing impacts to terrestrial ecosystems	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region TEC (east of operational areas within the premises) Boonanarring Nature Reserve (immediately adjacent to the west)	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	N	Conditions 1, 4, 5 **Conditions 14**	The applicant has specified that mobile litter screens will be used around the working face of the landfill. The Delegated Officer has specified that litter will be collected weekly as a regulatory control as a frequency has not been provided by the applicant.
Putrescible waste acceptance	Pests, birds, vermin and weeds	Disease and weed vectors causing impacts to terrestrial ecosystems		Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	N	Conditions 1, 4, 5 **Condition 21**	The Delegated Officer considers that boundary fences should be inspected for damage weekly instead of monthly as proposed by the applicant. As windblown litter checks are required weekly then the Delegated Officer considers it reasonable for the condition of fencing to be checked at the same time.
Rainfall and stormwater drainage contacting waste material	Contaminated or potentially contaminated stormwater	Infiltration through soil to groundwater causing impacts to groundwater quality and downgradient receptors	Underlying groundwater (>15 m below the base of the landfill cell) Boonanarring Brook (3.5 km west of operational areas) Downgradient beneficial users of groundwater (6.1 km south-southwest of the premises)	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	Y	Conditions 1, 4, 29	N/A
	Sediment	Overland flow and runoff causing impacts to terrestrial and aquatic ecosystems	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region TEC (east of operational areas within the premises) Boonanarring Nature Reserve (immediately adjacent to the west) Boonanarring Brook (3.5 km west of operational areas)	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	Y	Conditions 1, 4, 29	N/A
Infiltration of water through landfilled waste	Leachate	Infiltration through soil to groundwater causing impacts to groundwater quality and downgradient receptors	Underlying groundwater (>15 m below the base of the landfill cell) Downgradient beneficial users of groundwater (6.1 km south-southwest of the premises)	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	N	Conditions 2, 3, 30, and 31 **Condition 1, 32, 33, 34**	The Delegated Officer considers it necessary to stipulate management actions in the event that problems are identified with the leachate management system. Due to concerns raised by the Department of Fire and Emergency Services (DFES) regarding leachate being used for firefighting, the Delegated Officer has included a condition which only permits leachate to be used for recirculation back onto the landfill to assist with waste decomposition.

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of licence	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Decomposition of waste material	Landfill gas	Subsurface lateral migration causing impacts to health and amenity, and impacts to terrestrial ecosystems, from methane	Nearest sensitive receptor (1.9 km south of operational areas) Sensitive receptor (2.5 km northeast of operational areas) Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region TEC (east of operational areas within the premises) Boonanarring Nature Reserve (immediately adjacent to the west)	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	N	**<u>Condition 22</u>**	There is currently no gas management infrastructure in place, which increases the risk of landfill gas emissions. The Delegated Officer considers it appropriate to require the Licence Holder to investigate landfill gas emissions and prepare a Landfill Gas Management Plan, including plans and specifications for an appropriate landfill gas extraction and management system.
Fuel storage	Hydrocarbon spills	Infiltration through soil to groundwater causing impacts to groundwater quality and downgradient receptors	Underlying groundwater (>15 m below the base of the landfill cell) Downgradient beneficial users of groundwater (6.1 km south-southwest of the premises)	Refer to Section 3.1	C = Minor L = Unlikely **Medium Risk**	N	Condition 12 **<u>Condition 13</u>**	The Delegated Officer has determined the applicant's controls to be suitable for managing spills. However, the Delegated Officer considers it appropriate to require the Licence Holder to store all material used for the recovery, removal and disposal of environmentally hazardous materials in an impermeable container prior to disposal to a suitably licensed premises. This has been included as an additional regulatory control on the licence.
Waste fire	Smoke and particulates	Air/windborne pathways causing impacts to health and amenity	Nearest sensitive receptor (1.9 km south of operational areas) Sensitive receptor (2.5 km northeast of operational areas)	Refer to Section 3.1	C = Major L = Unlikely **Medium Risk**	N	Conditions 1, 2 **<u>Conditions 6, 7</u>**	The Delegated Officer considers the controls proposed by the applicant to be appropriate to assist in reducing a risk of a fire on the premises. However, the Delegated Officer considers it appropriate to specify a timeframe to report any fire incidents on the premises and conditions for the disposal of firefighting wash-water and fire impacted waste.
	Fire embers	Air / windborne pathway causing bushfire and impact to terrestrial ecosystems	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region TEC (east of operational areas within the premises) Boonanarring Nature Reserve (immediately adjacent to the west)	Refer to Section 3.1	C = Major L = Unlikely **Medium Risk**	N		
	Fire wash-water	Overland flow and infiltration through soil to groundwater causing impacts to terrestrial and aquatic ecosystems.	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region TEC (east of operational areas within the premises) Boonanarring Nature Reserve (immediately adjacent to the west) Boonanarring Brook (3.5 km west of operational areas) Underlying groundwater (>15 m below the base of the landfill cell) Downgradient beneficial users of groundwater (6.1 km south-southwest of the premises)	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	N	**<u>Conditions 6, 7</u>**	

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk Assessments* (DWER 2020).

Note 2: Proposed applicant controls are depicted by standard text. **<u>Bold and underline text</u>** depicts additional regulatory controls imposed by department.

4. Consultation

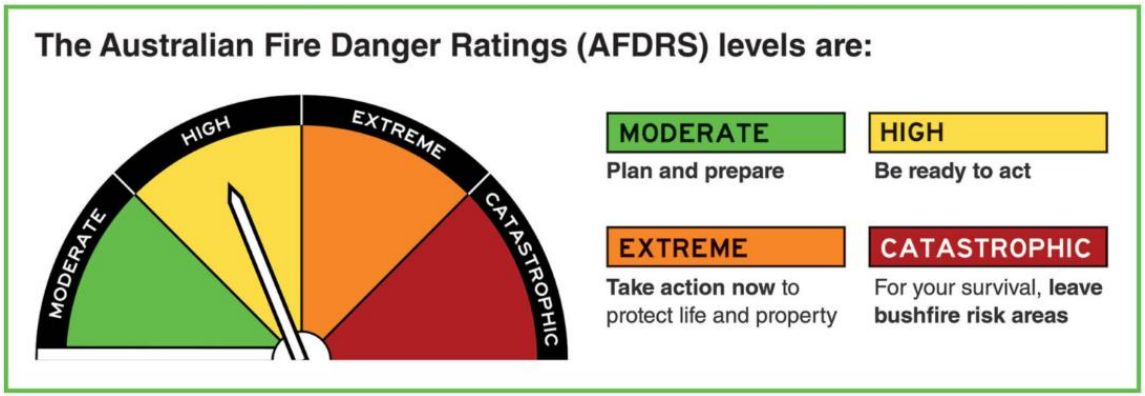
Table 5 provides a summary of the consultation undertaken by the department.

Table 5: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on 5 August 2024	None received	N/A
Local Government Authority advised of proposal on 5 August 2024	The Shire of Gingin responded on 8 August 2024, providing the following comments: 1. Condition 7 of the development approval issued by the Mid-West/Wheatbelt Joint Development Assessment Panel on 20 January 2016 for the Development on the Land states as follows: 7. *Arrangements are to be made to the satisfaction of the local government for the upgrading and/or construction of Wannamal Road West, Wannamal Road South and the unconstructed road shown on plan FERN-DA-02, plus the Wannamal Road West and Brand Highway intersection to achieve Restricted Access Vehicle Network classification by Main Roads WA.* 2. In order for the current owner of the Land to undertake the Development, it is necessary for the relevant roads to be upgraded. This has not occurred and the road upgrades are extensive. 3. The Applicant should not misconstrue a works licence as consent to commence landfill operations onsite, as development approval conditions remain outstanding and must be fulfilled prior to operation. It is requested that this be emphasised to the applicant via a condition or advice note.	Noted. The advice from the Shire of Gingin regarding fulfillment of development approval conditions has been emphasised in the conclusion of this decision report.

Department of Biodiversity, Conservation and Attractions (DBCA) advised of proposal on 5 August 2024	DBCA replied on 21 August 2024. A summary of DBCA's comments is provided below.	
	<u>DBCA Managed Lands</u> • The premises abuts the DBCA managed Boonarring Nature Reserve to the west and the DBCA managed State of Western Australia freehold to the South. • The DBCA managed freehold land was only acquired by DBCA in 2012/2013 and therefore would not have been considered in the advice provided on the original approval process. • As a condition of EPBC 2015/7621 and Condition 10 of MS 1073, portions of native vegetation surrounding the landfill facility were proposed to be ceded to DBCA. If these lands are ceded, it is important that their status as a conservation area is recognised and the direct and indirect impacts of the landfill site are appropriately managed. • Indirect impacts to DBCA-managed lands during operation of the landfill include potential increases in fire risk and feral animal populations and windblown litter.	Noted. Feral animals are managed through MS 1073. Fire risk and windblown litter have been considered in the risk assessment. Please refer to Table 4 of this Decision Report.
	<u>Bushfire mitigation</u> • DBCA requests the project provides adequate bushfire mitigation measures to prevent the occurrence of fires originating from the facility and spreading to DBCA-managed lands. • DBCA defers to the Shire of Gingin in reviewing the bushfire mitigation measures proposed and determining their adequacy.	A Bushfire Management Plan is required to the satisfaction of the Shire of Gingin's Chief Bushfire Control Officer as a condition of development approval DAP/15/00918. Controls have been included in the licence to prevent and reduce the impacts of fires on the premises. Please refer to Section 3.2, Table 4, of this decision report for further details.
	<u>Feral animal control</u> • There may be an increase in feral animal numbers as a result of operation of the facility. If not managed, this may impact the adjacent conservation areas. • The 'Feral and Pest Animal Management Plan for the Fernview Class II Waste Management Facility' (FPAMP) was prepared and submitted to DWER following consultation with DBCA to address Condition 11 of MS 1073 which required the preparation of a Feral animal Management Plan.	Noted. Condition 11 relates to minimising the number of feral animals within and attracted to the proposal area rather than to

	• The FPAMP did not consider the additional DBCA managed lands which should also be monitored for feral animals, with control measures applied direct on those lands. • The wording of the FPAMP and Condition 11 of MS 1073 do not stipulate the period of implementation of the plan. • DBCA would be interested in receiving reports outlining the results of the feral animal monitoring and animal control activities undertaken. DBCA can also provide the necessary Conservation and Land Management Act 1984 approvals to authorise monitoring and control measures to be undertaken on DBCA-managed lands as part of the FPAMP implementation.	the adjacent areas, regardless of the titleholder of those areas.
	<u>Windblown litter</u> • DBCA requests that the licence also include a requirement to remove any litter within the Boonanarring Nature reserve and areas of the DBCA managed freehold, that may be attributed to the landfill operations.	The licence includes a condition for the licence holder to ensure that windblown waste is contained within the boundary of the premises and that windblown waste is returned to the tipping area on at least a weekly basis. The Delegated Officer considers that this licence condition will ensure that the Boonanarring Nature reserve and areas of the DBCA managed freehold will not be impacted by litter.
Department of Fire and Emergency Services (DFES) advised of proposal on 17 September 2024, with a reminder sent 3 October 2024. North Coastal District Office contacted on 8 October 2024.	DFES responded on 9 October 2024 requesting more time to provide comment on the Fire Management Plan for the premises so that it could be referred to operational staff from the region and the HAZMAT Branch. A further 21 days were provided to DFES. DFES HAZMAT Branch provided the following comments (in blue) on sections of the Fire Management Plan V2 for the premises on 8 November 2024: 1. 8.1.2 internal Incident Command Structure. DFES 000 is to be immediately notified of fire or Hazmat incidents beyond the capacity of the facility. 2. 9 Fire Mitigation Measures Notification of an uncontrolled event of fire by telephoning 000,	DFES HAZMAT comments have been provided to the applicant to address in their Fire Management Plan. A condition has been included in the licence to prevent the use of leachate for any other purpose other than recirculation onto the landfill to assist in waste decomposition. A condition has also been placed on the licence requiring the Quick

	3. 9.2.4 Plant, equipment and machinery will not be operated within Zone 4 during 'Very High' fire danger days. FDR levels have changed, there is no longer 'Very High'  4. 9.3.1 Leachate or a water-based fire retardant will be added to the water in the water truck, hot spots excavated and the landfill mass saturated with leachate or fire retardant. Any fire in or around the lined leachate dam will be controlled using the water based fire retardant described above. Where will the leachate be obtained from, if from organic waste it is likely to contain organic compounds, dissolved organic matter, heavy metals, and inorganic macro components which may not be safe for firefighting. What fire retardant will be used, how will it be applied. 5. 9.4.4.3 Quick Response Fire Unit Is this vehicle mounted or a trailer unit, preference for vehicle mounted. 6. 9.5.6 Checklist **Please review and update the following:** **Emergency calls** to 000 **132 500** is the number to call when you need the assistance of the State Emergency	Response Fire Unit to be vehicle mounted.

	Service (SES) in non-life-threatening emergency situations, during floods and storms or other similar events. **Fire Weather Hotline** number is not a connected number – Emergency WA is the State's official website for community warnings and other emergency information for bushfires, storms, floods and others. **Medical Centre** number is not correct – call 000 **Shire of Gingin** contact number is not correct – update to correct number **Gingin Volunteer Bush Fire Brigade** number is not correct – call 000 for assistance **Shire SMS Service** number is the General Inquiries line. 7. 9.6.1 Department Responsible for each Zone. DFES/VBFB are not responsible for internal management of the facility. The above comments were the only ones provided due to DFES workloads and operation commitments.	
Applicant was provided with draft documents on 11 October 2024	The applicant provided comments on the draft documents on 14 October 2024 and 24 October 2024. Refer to Appendix 1	Refer to Appendix 1

5. Conclusion

Based on the assessment in this decision report, the delegated officer has determined that a licence will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

The delegated officer notes that it is the Licence Holder's responsibility to ensure that they have fulfilled the relevant requirements of the development approval granted by the Mid-West/Wheatbelt Joint Development Assessment Panel on 20 January 2016 (reference DAP/15/00918) prior to commencing operations at the premises.

References

1. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
3. DWER 2019, *Guideline: Odour emissions*, Perth, Western Australia.
4. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
5. Kay, T. and Diamond, R. 2001 A hydrogeological assessment of the Victoria Plains, Red Gully, Gingin Townsite and Eclipse Hill Subareas of the Gingin Groundwater Area
6. Stass Environmental (2024), *Proposed Fernview Landfill, Groundwater Quality and Flow Hydrogeological Assessment Cullalla, WA*, Kalamunda, Western Australia.
7. Water Direct Pty Ltd (2019), *H2 Hydrogeological Assessment, Lot 98 on Plan 75926, Lot 98 Wannamal Road South Cullalla*, East Perth, Western Australia

Appendix 1: Summary of applicant's comments on risk assessment and draft conditions

Condition	Summary of applicant's comment	Department's response
Condition 1 Table 1: Infrastructure and equipment requirements Leachate collection, extraction and reticulation system Condition c)	Add "or recirculation on the landfill surface" to the end of this condition. This enables the facility operator to recirculate leachate from the leachate sump directly onto the landfill surface (to increase leachate evaporation = good leachate management), as opposed to having to pump the leachate to the leachate pond and then pump the leachate from the leachate pond onto the landfill surface. Simply a more efficient pumping procedure.	The Delegated Officer has amended the condition to allow for leachate to be recirculated back onto the landfill surface as requested.
Condition 1 Table 1: Infrastructure and equipment requirements Wheel cleaning facility	A 3 m long wheel cleaning rumble strip will be installed at the exit to the site to clean lose dirt off the exiting vehicles before they get onto the sealed public road. A marked-up site plan has been provided indicating the location of the wheel cleaning device.	Site plan showing wheel cleaning facility has been added to Schedule 1 of the licence.
Condition 7(c)	Add "and either put it in the landfill (solid waste) or put it into the leachate pond (liquid waste)" at the end of the condition. This provides the most efficient means of managing fire residues, via internal disposal methods, as opposed to off-site disposal.	Licence conditions (c), (d) and (e) have been amended to allow solid fire impacted waste to be disposed of into Landfill Cell 1 and for firefighting wash-water to be disposed of into the onsite leachate pond.
Condition 7(d)	If Condition 7(c) is changed to enable liquid waste to be disposed of into the leachate pond, then there is no need for a licenced carrier to move the liquid waste, which would be required for off-site disposal. The preference is that this condition be deleted.	
Condition 7(e)	The burnt waste would only be Class II waste, as that is all that is allowed to be accepted on site; hence, the burnt waste would simply be disposed of to landfill and not removed from site. The preference is that this condition be deleted.	

Condition	Summary of applicant's comment	Department's response
Condition 11	This condition mentions a wheel wash, whereas condition 1 lists a wheel cleaning facility.	Condition wording has been changed to "wheel cleaning facility" instead of "wheel wash" for consistency.
Condition 15	There would be six mesh litter screens, each 5 m long and 4 m high.	Number of litter screens and their dimensions has been included in Condition 15 of the licence.
Condition 18	Suggest 31 December 2025, as odour emissions will be highly dependent on the type of waste being landfill. With a new business, the waste stream is currently unknown. Suggest to allow 12 months of operation for the waste stream to be determined.	The Delegated Officer has determined that an Odour Management Plan should be in place sooner than 31 December 2025 to mitigate odour emissions from the premises. The Delegated Officer considers 30 June 2025 is sufficient time to develop and submit an Odour Management Plan to DWER. The Odour Management Plan should take into consideration the type of wastes permitted to be accepted at the premises in accordance with the acceptance table in condition 2 of the licence.
Condition 26(b)	Suggest 2 months apart, as 3 months apart provides no flexibility in monitoring date, which will result in the monitoring progressively extending beyond the annual cycle if monitoring is not done exactly on the day of the end of the 3 month period. This is consistent with Condition 26(a), where the monthly monitoring has to occur at least 15 days apart, not one month apart, providing some leeway from the absolute period.	The Delegated Officer has resolved to amend the condition to allow quarterly monitoring to be undertaken 2 months apart.
Condition 30 Table 9: Leachate Management System monitoring requirements Depth of leachate (m AHD) Leachate Pond	Suggest that the Leachate Pond should be monitored by the depth of freeboard in the pond and not the depth of leachate in the pond, as the depth of freeboard is the relevant dimension. If the depth of leachate is provided, then, to assess the overflow likelihood (lack of freeboard), the overall pond depth is needed and the liquid depth subtracted from the overall pond depth. Also, the pond floor is sloping, hence, the pond depth changes based on where the leachate depth is taken, where as the pond perimeter bund is at the same level all the way around the pond; hence, it is irrelevant where the freeboard depth is measured, the correct value will always be recorded.	The Delegated Officer has resolved to amend the condition as requested.

Condition	Summary of applicant's comment	Department's response
Condition 30 Table 9: Leachate Management System monitoring requirements Depth of leachate (m AHD) Landfill Cell 1 riser and sumps (10 monitoring points within the landfill)	Suggest the Location be changed to "Landfill Cell riser and sump". The reference in the Landfill Management Plan to 10 monitoring points within the landfill is relative to when there are 10 individual cells (and sumps) in the landfill. With the Licence being for only one landfill cell (Cell 1), it is suggested to remove the "s (10 monitoring points within the landfill)"; hence, there is only reference to the first landfill cell. Having 10 monitoring points may cause confusion for operations staff and compliance inspectors who do not know the reference to the future expansion of up to 10 landfill cells.	The reference to 10 monitoring points within the landfill has been deleted as requested.
Condition 30 Table 9: Leachate Management System monitoring requirements Volume of leachate (m3)	If the above Condition 1 change is accepted, then add an additional line to this item in the table. Location "Recirculated from landfill sump"	Additional line added to Table 9 as requested to monitor the volume of leachate recirculated directly onto the landfill.
Condition 31 Table 10 Leachate operational levels	General comment: To always maintaining a 300 mm leachate level in the landfill sump "instantaneously" is an impossible condition for any landfill. With this landfill having a leak detection system, there could be some flexibility allowable with the max. leachate depth in the landfill primary leachate sump, as the secondary sump will collect any leachate leakage through the primary liner. Maintaining the secondary leachate sump at a low level (300 mm) is achievable and will protect the environment. Suggest landfill primary sump be allowed max. 1 m leachate level. This can always be reduced in future if it is found the secondary sump is accumulating too much leachate (due to the increased leachate pressure head on the primary liner). If the above is not acceptable, then it is suggested that the Cell 1 sump "Averaging Period" be "Monthly". This will allow the facility operator to balance the leachate through periods of excess generation (storm events etc.), while maintaining a reasonable level of leachate within the landfill, and ensuring that the leachate level is always at required levels at least monthly; hence, no long-term accumulation of leachate within the landfill cell. If this is still not acceptable, then as a minimum, the "Averaging Period" should be "Instantaneously or within 24 hours of a storm event". Even this will be extremely unlikely for any landfill to comply with.	The Delegated Officer has considered the applicant's comments and has resolved to change the averaging period for maintaining a 300 mm leachate level in the landfill sump to monthly.

Condition	Summary of applicant's comment	Department's response
Condition 32 Table 11: Management actions Base of Landfill Cell 1 liner	The event causing the increase in depth of leachate in the sump may be due to a sump pump failure. Need an option to use a liquid waste truck or temporary pumping system to transfer leachate from Cell 1 sump to leachate pond or recirculate onto landfill.	The Delegated Officer does not consider it suitable to specify an option for a temporary pumping system as it is not something that should be done on a regular basis. An assessment of the temporary pumping system would need to be undertaken and no information on the type of infrastructure, spill controls, etc. has been provided. The Delegated Officer considers the management controls specified currently to be appropriate in the event of a failure or blockage in the leachate management system.
Condition 33 Table 11: Leachate quality monitoring Monitoring location Landfill Cell 1 riser and Landfill Cell 1 Leachate detection layer	The visual appearance of the leachate will only be able to be assessed where it is being discharged into the leachate pond or onto the landfill surface, as the landfill sumps are sealed systems, with no visible access to the leachate. Suggest that this condition only apply to the Leachate Pond. It is not necessary to do visual monitoring of the leachate being discharged onto the landfill surface, as it is the same leachate that will be pumped out of the landfill to either the leachate pond or the landfill surface; hence, the same visual observation.	The Delegated Officer has resolved to amend condition 33 as requested.
Condition 34 Table 11: Leachate head monitoring requirements Leachate head recovery period ….	Recovery time will be a function of the depth of the leachate at the start of pumping and what material has to drain to release the leachate, for the leachate level to return to rest. Aggregate drainage rate is rapid, while waste drainage rate is slow and highly variable on the waste type. There will be a different recovery times for different leachate depths, also assuming that the cessation of pumping to emptying the sump (same cut-off point for all pumping). If the maximum depth of leachate is 300 mm, then the leachate will only be in the aggregate layer and hence, will drain rapidly and recover almost immediately (max a few minutes). However, as described above, a 300 mm leachate depth is an extremely unlikely scenario. The value of the single data recording is unknown and hence, not sure that it is worth including this condition. To get meaningful information, the recovery period should be tested at varying leachate depths, say 300 mm, 1 m and 1.5 m (and be pumped to sump empty condition), but only when the base of the landfill is filled with waste to above the maximum leachate	The Delegated Officer has determined that condition 34 is not required and the condition has been deleted.

Condition	Summary of applicant's comment	Department's response
	measurement level. A further complication is that if the landfill is perpetually generating leachate, the leachate level will never stabilise.	
Condition 34 Table 11: Leachate head monitoring requirements Leachate head within the leachate sump	Table 9 requires weekly monitoring of leachate depth in the sumps. This is the same thing as leachate head. Suggest that this condition be deleted. With the relevance of the leachate recovery time being questioned (refer comment immediately above), this whole condition and table could be deleted.	
Condition 43 Table 15: Environmental reporting requirements Condition 27, 28	Waste is measured in tonnage. "Volume" should be "Tonnage".	"Volume" has been changed to "Tonnage" as requested.
Condition 43 Table 15: Environmental reporting requirements Condition 30-34	Table 9, which is the main leachate monitoring table refers to "depth" and not "head". And Table 11 may be deleted (if the above recommendation is accepted). Maybe change references from "head" to "depth".	The Delegated Officer has amended the condition to reflect the removal of the leachate head monitoring requirements table.

Appendix 2: Decision Report for W6083/2017/1

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6083/2017/1
Applicant	Fernview Environmental Pty Ltd
ACN	617 674 469
File Number	DER2017/001450
Premises	Fernview Landfill Wannamal Road South CULLALLA WA 6503 Legal description - Lot 98 on Plan 75926 Certificate of Title Volume 2847 Folio 974
Date of Report	13/02/2019
Status of Report	Final

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1. Definitions of terms and acronyms

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

Table 6: Definitions

Term	Definition
AACR	Annual Audit Compliance Report
ACN	Australian Company Number
AHD	Australian Height Datum
ANZECC	Australian Water Quality Guidelines for Fresh and Marine Waters, ANZECC (November 1992, and its updates)
Applicant	Fernview Environmental Pty Ltd
AS 1940:2017	Australian Standard AS 1940:2017 The Storage and Handling of Flammable and Combustible Liquids
AS 2436-1981	Australian Standard AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
AS 4678 – 2002	Australian Standard AS 4678 – 2002 Earth Retaining Structures
AS/NZS 1170.4:2007	Australian New Zealand Standard AS/NZS 1170.4:2007 Structural design actions – Part 4:Earthquake actions in Australia
AS/NZS 5667	Australian New Zealand Standard AS/NZS 5667.1:1998 Water quality – Sampling
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CS Act	*Contaminated Sites Act 2003* (WA)
Decision Report	refers to this document.
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 As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental*

Term	Definition
	Protection Act 1986 along with other legislation.
EN 13719-12 2002	Also referred to as the LFE-2 Cylinder Testing Geomembranes and their Protective Materials: A methodology for testing protector geotextiles for their performance in site specific conditions.
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
GCL	Geosynthetic Clay Liner
km	Kilometres
LWCWD	*Landfill Waste Classification and Waste Definitions 1996 (as amended December 2009)*
m	metres
m^3	cubic metres
mbgl	metres below ground level
mBGS	metres below ground surface
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
PM	Particulate Matter
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Issued Works Approval	the Works Approval issued under Part V, Division 3 of the EP Act following the finalisation of this assessment.
Risk Event	As described in *Guidance Statement: Risk Assessment*
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)

2. Purpose and scope of assessment

On 2 August 2017, the Department of Water and Environmental Regulation (DWER) received an application for a works approval (Application) from Fernview Environmental Pty Ltd (the Applicant) for the construction of the Class II (Category 64) Putrescible Landfill at Lot 98 on Plan 75926, Wannamal Road South, Cullalla (the Premises).

The Applicant has previously held Works Approval W5031/2011/1 for the Premises which expired in June 2017. This assessment has been undertaken in accordance with DWER's revised risk-based approach as set out in DWER's *Guidance Statement: Regulatory Principles (*July 2015).

This assessment has also taken into consideration the Part IV assessment and approval under Ministerial Statement 796 issued 11 June 2009 and Ministerial Statement 1073 issued 26 February 2018.

This Decision Report presents an assessment of potential environmental and public health risks from emissions and discharges from the construction and operation of the Premises. As a result of this assessment, a Works Approval has been granted (Issued Works Approval) (Attachment 1).

2.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

The guidance statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Land Use Planning (February 2017)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Risk Assessments (February 2017)*
- *Guidance Statement: Environmental Siting (November 2016)*

2.2 Information received

The Application was received on 2 August 2017 from the Applicant to construct a Prescribed Premises Category 64 landfill. The Delegated Officer considered that the information provided as part of the Application was sufficient to validate and commence with the risk assessment. Further information was subsequently requested by DWER and provided on 17 April 2018, 19 November 2018, 6 December 2018 and 15 January 2019 by the Applicant.

Table 7 lists the Prescribed Premises Categories that have been applied for.

Table 7: Prescribed Premises Categories applied for

Classification of Premises	**Description**	***Approved Premises production or design capacity or throughput***
Category 64	Class II or III putrescible landfill site: premises on which waste (as determined by reference to the waste type set out in the document entitled "Landfill Waste Classification and Waste Definitions 1996" published by the Chief Executive Officer and as amended from time to time) is accepted for burial.	150,000 tonnes/annual period

Table 8 lists the documents submitted during the assessment process.

Table 8: Documents and information submitted during the assessment process

Document/information description	Date received
Application Form	2 August 2017
Application for Works Approval Ministerial Statements No 796 & No 975 - Attachments	
Letter - Aurora Environmental to the Department of Environment (Canberra)	
Decommissioning and Post Closure Management Plan	
Landgate Deposited Plan 75926 (sheets 1 to 3)	
Emergency Response Plan	
Application for amendment of Ministerial Statements No 796 and No 975	
Letter - Fernview Environmental to DWER - Fee waiver request	
ASIC company extract	
Record of Certificate of Title	
Premises boundary and regional location map	
Premises siting map	
Veolia Environmental Services – Works Approval - Fernview Landfill – Part 1 to 3 – December 2010 (Application documents for original works approval application in 2011)	
Aurigen Group Limited – Development Application	
Aurigen Group Limited – Development Application (duplicate of one figure within above document)	
Fire Management Plan	
Landfill Management Plan	
Local Water Management Plan	
Letter - Development Assessment Panels to Aurigen Group Limited – approval of Development Application	
Letter – Office of the Environmental Protection Authority to Aurigen Group Limited – Notice of change of nominated proponent – Ministerial Statements 796 and 975	
Copy of amendment to Works Approval W5031 issued on 19 May 2017	
Landfill Batter Stability Assessment, October 2010	
Revised Stability Assessment V2, April 2018	17 April 2018
Revised Stability Assessment V3, October 2018	19 November 2018
Revised Detailed Design Drawings	
ATC Williams Memorandum – DWER Clarification #1 request for Fernview Landfill dated 4 December 2018	6 December 2018
Revised Locality Plan (Drawing 001-011_RevB)	
Letter – Re: Application for a works approval under the Environmental Protection Act 1986 – Draft Instrument and Decision Report	15 January 2019
Fernview Environmental Memorandum – DER2017/001450 Draft Works Approval and Decision Report dated 15 January 2019	
ATC Williams Memorandum – Draft Works Approval W6083/2017/1 and Decision Report dated 15 January 2019	
Revised drawings 118061-05-001-012-A (Catchment Layout Plan) 118061-05-001-013-A (Rehabilitation Landfill Cap Option) and 118061-05-001-002-C (Site Plan)	

2.3 Stakeholder consultation

The Application was advertised in The West Australian newspaper and on the DWER website on 28 August 2017.

The Application was also referred to the following direct interest stakeholders:

- Shire of Gingin
- Department of Biodiversity, Conservation and Attractions (DBCA)
- Department of the Environment and Energy (DoEE)
- Seven adjacent surrounding landowners (including the Water Corporation)

Responses were received from the Shire of Gingin, DBCA, DoEE and Water Corporation and are summarised in the sections below.

2.3.1 Shire of Gingin

The Shire of Gingin provided information relating to the provisions of the Shire of Gingin's Local Planning Scheme No. 9 (LPS 9) – Special Use Schedule, SU5 – Portion of Lot 7778 situated north of the Boonanarring Road Reserve and Wannamal Road south reserve (east of the intersection with Boonanarring Road) AMD 14 GG 08/04/2016.

Provisions relevant to DWER's assessment include:

- *"Development of the Waste Management Facility is to be generally in accordance with the Shire of Gingin TPS 8 Amendment No 104 Scheme Amendment Report September 2009, the Design and Hydrology Assessment Report December 2008 and the Statement of Conditions No. 796 issued by the Minister for the Environment; or in such other manner as may be approved by local government and the Minister for Environment*.
- *Except as otherwise approved by local government, the Development Application will be required to address the Fernview Regional Waste Management Facility – Design and Hydrology Assessment Report prepared by IW Projects Pty Ltd, Final, December 2008 and, as a minimum, shall also address the following:*

    (a) Provide a Stability and Settlement Assessment carried out by a competent stability expert to the satisfaction of the Chief Executive Officer at the Shire of Gingin.

    (b) Confirm that the detailed landfill design includes adequate localised stormwater diversion particularly around the perimeter of the landfill and the leachate evaporation ponds.

    (c) Confirm that the final detailed design for the leachate collection system adequately addresses acceptability of the liner slopes, leachate sump configuration, extraction system, consistency with landfill staging and the need, or otherwise for separate leachate sumps for each landfill stage.

    (d) Include a detailed design of the proposed Geosynthetic Clay Liner (GCL) and consider the impact of constructing the GCL Layer on the 200mm sand layer and geomembrane liner below and the constructed methodology of the geomembrane liner to consider the stability and constructability issues when placing the geomembrane.

    (e) Groundwater extraction bores will be required immediately downstream of the landfill leachate sumps and sediment pond.

    (f) Include provision for groundwater rest levels to be measured regularly and the groundwater contours to be updated and flow directions repositioned.

(g) Groundwater monitoring to be supplied to the Shire on a bi-annual basis.

(h) Require that any future Development Application for the re-mining and re-processing of inert waste shall consider the overall impacts on the landfill operation, liner and leachate collection, detection systems and the environment including:

(i) The long term stability of the waste mass;

(ii) Potential for damage to the liner and leachate collection systems from mining and refilling with new waste;

(iii) Adequacy of the existing leachate collection system to collect leachate from new waste;

(iv) The composition of the mined and reprocessed material; and

(v) The need, or otherwise, for any liner system to the inert spoil dump to prevent contamination of the local groundwater.

(i) All development that includes uses incompatible with sensitive land uses will be located such that the 500m buffer is fully accommodated within the boundaries of the Portion of Lot 7778 zoned 'Special Use'".

2.3.2 Department of Biodiversity, Conservation and Attractions

The DBCA noted that the proposal is subject to existing approval under Part IV of the EP Act and that DBCA provided substantial input to the 2008-09 environmental assessment and approval of the facility. On that basis and noting DWER's capacity to apply appropriate regulatory measures for environmental management of the facility under Part V of the EP Act, DBCA did not propose to review or provide specific comments on the Application documentation.

2.3.3 Department of the Environment and Energy

The DoEE provided that the project has been referred to the DoEE under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and in January 2016, was determined to be a controlled action (EPBC Number 2015/7621).

The DoEE advised that the Department is assessing the potential impacts on the project on Carnaby's black cockatoo and will be assessing direct impacts such as habitat clearance as well as indirect impacts (if any) such as groundwater contamination by leachate.

The DoEE advised that they are unable to review and provide detailed comment on the Applicant's supporting information, however given that the works approval application is expected to be substantially the same as previously submitted, the Department would not seek to provide comment if the potential impacts were likely to be of the same nature and scale.

2.3.4 Water Corporation

Water Corporation has advised that Reserves 22602 and 24559 will not be used for water supply infrastructure in the future and therefore Water Corporation has no significant comments regarding the Application. Nonetheless, Water Corporation will expect appropriate controls are put in place to mitigate contamination affecting Water Corporation's sites.

3. Assessment of operator

When assessing and making a decision on whether to grant a works approval or licence, the CEO or his Delegate can have regard to the fitness and competency of the proposed applicant.

The Delegated Officer has identified that Fernview shares Directors with Aurigen Group Ltd (Aurigen) and therefore, the compliance history of Aurigen is relevant to consider in the assessment. Aurigen is also affiliated with the following companies:

- Auricom Pty Ltd;
- Cityscore Pty Ltd (All Earth Group);
- Starworks Pty Ltd; and
- Matera 3 Pty Ltd.

An internal review of Fernview and the above companies has been undertaken, based on records held by DWER.

Administration August 2017

DWER was advised early September that Aurigen Group Ltd had entered into external administration on the 24th August 2017.

Previous operating history

The Applicant has experience in recycling of construction and demolition (C&D) waste and commercial and industrial waste, which includes, but is not limited to, sorting, crushing and screening of wastes. Below is a summary of the licensing history for the affiliated companies:

- Cityscore Pty Ltd (Cityscore) operates the Aurigen Group Limited facility on Lots 280 and 281 on Plan 3327 Kelvin Road in Maddington pursuant to Licence L7845/20003/5 granted under Part V of the EP Act for Prescribed Premises Categories 13 (crushing of building material), 61A (solid waste facility) and 62 (solid waste depot). The Licence was transferred from All Earth Group to Cityscore Pty Ltd on 23 June 2016. On 9 August 2018, Licence L7845/2003/5 was further transferred from Citscore to Starworks Enterprises Pty Ltd.
- Aurigen Group Limited (Aurigen) applied for a concurrent works approval (application number W6025/2017/1) and licence (application number L9026/2017/1) under Part V of the EP Act for Prescribed Premises Categories 47 (scrap metal recovery), 61A and 62 at Lot 2 on Diagram 51806 Jackson Street in Bassendean on 5 January 2016. The application was a result of previous site visits by DWER that identified unregulated activities occurring on site and directed the Applicant to apply for a works approval/licence.

  The Town of Bassendean advised on 18 May 2017 that development approval for the proposed development is required however; a development application has yet to be lodged. It is the Applicant's intention that the proposed use and associated buildings be considered by the Joint Development Assessment Panel.

  Intention to grant a works approval, subject to conditions, for the proposed facility was provided to Aurigen Group Limited on 8 August 2017. The granting of the works approval is subject to planning approval.

  The Town of Bassendean advised on 15 September 2017 that the development application from Aurigen Group Limited was never accepted and has not been considered by the Joint Development Assessment Panel.

- Matera 3 Pty Ltd (Matera) operates the Matera waste Recycling Facility on Part of Lot 313 on Plan 243063 Abercrombie Road in Postans pursuant to Licence L8632/2012/1 granted under Part V of the EP Act for Prescribed Premises Categories 13 and 62.

  On 7 March 2018, Aurigen confirmed that the site has been closed since 2016 and no works has occurred onsite since 2016 except for various remediation works until August 2017 and advised of its intent to let the Licence cease to have effect. On 3 May 2018, Licence L8632/2012/1 ceased to have effect due to non-payment of fees.

3.1 DWER compliance history check

A search of DWER's Industry Licensing System (ILS) and Incidents and Complaints Management System (ICMS) has been undertaken using links to other previously licensed Prescribed Premises who share Directors or links to Directors or the CEO of Fernview.

Based on DWER records, three dust complaints were received in relation to the Cityscore premises between November 2015 and September 2016 however these were not substantiated by DWER Officers.

Two other complaints were received in relation to the Cityscore premises in regards to asbestos waste and storage of green waste which may discharge to the environment during rain events. DWER enquiries confirmed that the asbestos was disposed of to an appropriate facility and there was no evidence of green waste accepted onto the site.

Further to the above, a site inspection of the Cityscore premises by DWER officers on 17 October 2017 identified lead contaminated crucibles had been accepted at the Premises, contrary to licence conditions. An Environmental Field Report was issued on 3 November 2017 and an Environmental Protection Notice (Reference No: CEO 2953/17) was served on 8 December 2017 requiring the removal of the contaminated crucibles from the site and the preparation of a remediation and validation report. The Premises has also been reported as a potentially contaminated site under the *Contaminated Sites Act 2003*.

In March 2016, DWER received a complaint from the Town of Bassendean in regards to waste recycling activities being undertaken by Auricom Pty Ltd at Jackson Street in Bassendean. A site inspection by DWER Officers confirmed that activities causing the premises to be prescribed were occurring onsite. In January 2017, Aurigen submitted an application for a works approval and licence for the premises and the application was accepted in April 2017. DWER is currently awaiting confirmation of planning approval prior to issuing a works approval for the premises.

Three complaints in regards to dust from the former Matera premises were received by DWER between December 2015 and August 2016. Non-compliance with licence conditions were identified by DWER Officers during site inspections and an Environmental Field Report was issued to address these matters.

The majority of the complaints received were not substantiated and the non-compliances identified appear to have been rectified by the Licence Holders.

Following the attendance of a DWER Officer at the former Matera premises for a fire in March 2018, it was identified that remedial actions appear not to have been undertake to remove the remaining waste onsite. The Applicant has confirmed that the residual material has not yet been fully removed from the site.

Key findings:

1. Fernview Environmental has not previously constructed or operated a landfill facility.
2. Affiliated companies have previously been investigated for non-compliance.

4. Regulatory context

Table 4 summarises approvals relevant to the assessment.

Table 9: Relevant approvals and tenure

Legislation	Number	Subsidiary	Approval
Rights in Water and Irrigation Act 1914	CAW200646 issued 11 December 2017	Fernview Environmental Pty Ltd	Approval to construct four groundwater production wells.
Part IV of the EP Act (WA)	Statement Number 796 issued 11 June 2009	Veolia Environmental Services (Australia) Pty Ltd	Approval of the Fernview Landfill proposal - to construct and operate a landfill accepting Class II-type waste. Six cells are to be constructed with a total operational lifetime of not more than 30 years. A landfill gas collection system and utilisation plant facility will also be constructed.
	Statement Number 975 issued 2 July 2014	Veolia Environmental Services(Australia) Pty Ltd	Removal of the previous limit of authorisation and inclusion of new condition requiring that the implementation of the proposal begins prior to the 12 June 2017.
	Statement Number 1073 issued 26 February 2018	Fernview Environmental Pty Ltd	Deletion of all conditions of Statement Number 975 and inclusion of new conditions requiring that the implementation of the proposal begins prior to 13 June 2022. New conditions were also added relating to environmental offsets for the Carnaby's black cockatoo habitat and development and submission of a Feral Animal Management Plan.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	Reference Number EPBC 2015/7621	Fernview Environmental Pty Ltd	On the 16 June 2017, the designated proponent was changed from Aurigen Group Pty Ltd to Fernview Environmental Pty Ltd. The proposal is still under assessment under the EPBC Act. The assessment process has been suspended by the Department of Environment and Energy pending provision of the Works Approval.
Part V of the EP Act (WA)	W5031/2011/1	Fernview Environmental Pty Ltd	Works Approval for the construction of Stage 1 of the Fernview Landfill. The Works Approval expired on 11 June 2017.

4.1 Approvals: Part V of the EP Act

4.1.1 Background

Veolia Environmental Services (Australia) Pty Ltd (Veolia) was originally granted Works Approval W5031/2011/1 in October 2012 for the construction of a Class II putrescible landfill within the Premises, with an annual capacity of 150,000 tonnes.

In May 2017 the Works Approval was transferred from Veolia to the Applicant following their purchase of the Premises.

On 13 April 2017 the Applicant applied to amend the Works Approval to extend the expiry date, however the amendment was not issued prior to the expiry of the Works Approval on 11 June 2017. The Applicant has therefore applied for a new Works Approval for the Premises.

4.1.2 Key and recent works approvals

Table 10 summarises the works approval and licence history for the Premises.

Table 10: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
W5031/2011/1	27 September 2012	Works approval granted to Veolia Environmental Services (Australia) Pty Ltd to construct Cell 1 and associated stormwater and leachate infrastructure of the Fernview Landfill.
W5031/2011/1	18 June 2015	Amendment to works approval - to extend the expiry date from 30 September 2015 to 11 June 2017 to align with Ministerial Statement No. 975.
W5031/2011/1	15 September 2016	Amendment to works approval – to change the premises address from Lot 7778 on Plan 209805 to Lot 98 on Plan 75926 as per a change by Landgate due to a subdivision.
W5031/2011/1	19 May 2017	Amendment to works approval – transfer of Works Approval Holder from Veolia Environmental Services (Australia) Pty Ltd to Fernview Environmental Pty Ltd.

4.1.3 Clearing

The Application states that 42.5ha of vegetation is proposed to be cleared using mobile plant and chains between November 2017 and January 2018. Subject to issue of the Works Approval and Department of Environment and Energy approval, the Applicant proposes to commence clearing between May 2019 and August 2019.

Clearing associated with the Stage 1 proposal has been assessed under Part IV of the EP Act and is subject to regulatory conditions under Ministerial Statements 796 and 975. Therefore, further assessment of the clearing component under Part V is not required.

Approvals: Part IV of the EP Act

Background

The original proposal was referred (Referral decision No. 1287) to the Environmental Protection Authority (EPA) for assessment under Part IV of the EP Act and is subject to two Ministerial Statements as outlined below.

Ministerial Statement 796

The original proposal related to the construction and operation of a "bioreactor" landfill accepting biological liquid wastes and sludge in addition to Class II type waste at the Premises. This proposal was amended to a landfill accepting Class II type waste, including a landfill gas collection and utilisation plant.

The EPA report and recommendations (Bulletin No. 1287, May 2008) detail the assessment of the below key environmental factors relevant to the proposal:

- Ground and surface water quality; and
- Flora and vegetation.

The EPA assessment concluded the following:

Ground and surface water quality –

- *"the proposed liner and capping design, which exceeds the specifications for a Class II landfill, would minimise impacts on groundwater if constructed in accordance with the Draft Best Practice Environmental Management on Siting, Design, Operation and Rehabilitation of Landfill (Department of Environment, 2005).*
- *potential risk to ground and surface water would be minimised through the satisfactory implementation of the Leachate Monitoring and Management Plan, which addresses leachate management and contingency measures".*

Flora and vegetation –

- *"that the landfill has been sited to minimise impacts on 'Excellent' condition vegetation.*
- *the proposal can be managed to meet the EPA's environmental objectives, provided there is satisfactory implementation by the proponent of their commitments and the recommended conditions".*

The EPA report and recommendations stated that issues such as details of leachate management, groundwater monitoring, litter and pest management, dust, odour and post closure can be managed under the approval process of Part V of the EP Act.

Following the EPA report and recommendations, the Ministerial Statement No. 796 (MS 796) was published on 11 June 2009. MS 796 specifies conditions relating to compliance reporting, liner specifications, ground and surface water conditions, flora and vegetation and landfill decommissioning and post closure management plan conditions.

Proposal Implementation

Condition 1-3 requires that the Applicant refer any changes to the type of waste intended for acceptance to the EPA.

Compliance reporting, performance review and reporting

Conditions 4-1 through 4-6 relate to compliance reporting, requiring the development and submission of a compliance assessment plan identifying:

1. frequency of compliance reporting;
2. approach and timing of compliance assessments;
3. retention of compliance assessments;
4. reporting of potential non-compliances and corrective actions taken;
5. table of contents of compliance reports; and
6. public availability of compliance reports.

These conditions also require the Applicant to advise DWER of any potential non-compliance as soon as practicable and require the submission of an annual compliance assessment report addressing the previous twelve month period (or as agreed by DWER).

In addition to the above compliance reporting, conditions 5-1 and 5-2 require the Applicant to submit to the EPA and make publicly available, a Performance Review Report at the conclusion of the first, second, fourth, sixth, eighth and tenth years after the start of implementation and then at such intervals as the EPA may regard as reasonable. This report is to address:

1. The major environmental risks and impacts; the performance objectives; standards and criteria related to these; the success of risk reduction/impact mitigation measures and results of monitoring related to management of the major risks and impacts;
2. The level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable; and
3. Significant improvements gained in environmental management which could be applied to this and other similar projects.

Ground and surface water

Of these conditions, section 6 of the statement relates to the specified infrastructure requirements in relation to groundwater and surface water management.

Condition 6-1 specifies:

> *"The proponent shall construct the landfill cells and leachate storage ponds to include as a minimum, a double-lined containment system consisting of a minimum 2.0 millimetre high-density polyethylene flexible membrane liner and a clay based liner with a performance equivalent of greater than that of a compacted clay liner one metre thick and a hydraulic conductivity less than 1 x 10-9 metres per second. The lining system shall also incorporate a leakage detection and recovery system beneath the double liner consisting of a permeable layer underlain by a further 2.0 mm thick high-density polyethylene flexible membrane."*

Condition 6-3 specifies that the proponent shall monitor the quality of groundwater on and in proximity to the proposal area, which shall be done in accordance with the works approval and licensing provisions of Part V of the EP Act.

Landfill decommissioning and post-closure management plan

Conditions 8-1 and 8-2 require the preparation and submission of a Landfill Decommissioning and Post-closure Management Plan designed to ensure that the Premises is left in an environmentally acceptable condition. The plan will need to address the following:

1. Progressive rehabilitation to pre-development condition or better through re-vegetation of capped landfill cells with selected local native species;
2. Choice of capping materials which are consistent with Best Practice Guidelines which shall include a low permeability layer, followed by a sub-soil layer and a final layer of soil suitable for vegetation establishment;
3. Ongoing operational practice to ensure that the final landfill surface will be constructed to a predetermined crossfall to enhance surface water runoff while safeguarding against erosion and to ensure that final contours of the site will blend into the surrounding environment;
4. Monitoring and management of ground and surface water; and
5. Response, mitigation and contingency measures to be implemented if ground and surface water quality is affected to an unacceptable level.

The draft plan is required to be prepared prior to the commencement of construction and a final plan submitted at least two years prior to the anticipated date of closure.

Financial assurance

Conditions 9-1 through 9-6 of the ministerial statement relate to payment of a financial assurance of an initial amount of AU$3.5 million is to be provided to the CEO prior to the commencement of construction.

Condition 9-2 requires that prior to the commencement of landfilling, the Applicant must prepare and submit to the CEO an assessment of the risk covered by the financial assurance.

The amount of the financial assurance will be reviewed and replaced as necessary every three years in accordance with condition 9-2 of the statement and may be discharged by the CEO in accordance with the conditions of the ministerial statement if required.

Key findings:

1. Condition 6.1 of MS796 stipulates landfill liner requirements, which is a matter that can be regulated through the Part V licensing process. While this may cause perceived regulatory duplication, it is noted that the condition itself will not limit more stringent controls on a works approval, should the assessment of the works approval application identify environmental risks that warrant such controls.
2. The Applicant will be required to verify construction of works as part of the Works Approval to ensure that compliance with the Ministerial requirement can be verified by DWER.

Ministerial Statement 975

Ministerial Statement 975 was published on 2 July 2014 and was granted to delete condition 3 of Ministerial Statement No 796, which referred to the time limit of the authorisation and to extend this date by replacing the condition with a new subset of conditions. The revised conditions were as follows:

> *"3-1 The proponent shall not commence implementation of the proposal after the 11 June 2017, and any commencement, prior to this date, must be substantial.*
>
> *3-2 Any commencement of implementation of the proposal, on or before 11 June 2017, must be demonstrated as substantial by providing the Chief Executive Officer with written evidence, on or before 11 June 2017."*

These conditions limited the extent of any future approvals granted under Part V of the EP Act.

A site visit by DWER Officers on 30 March 2017 confirmed construction works had not commenced.

Ministerial Statement 1073

Ministerial Statement 1073 was published on 26 February 2018 following a section 46 request on 10 August 2017 to amend the time limit condition of Ministerial Statements 796 and 975 due to delays in obtaining other approvals including those required under the EPBC Act.

An assessment was undertaken under Part IV of the EP Act and a Report and Recommendations of the EPA provided to the Minister (EPA R&R No: 1612). As part of this assessment, further consideration was given to the potential impacts of clearing of native vegetation with particular regard to the impacts on the Carnaby's cockatoo (*Calyptorhynchus latirostris*).

The following conclusions have been made by the EPA as a result of the assessment:

- "*the impacts to the key environmental factors of Inland Waters Environmental Quality*

and Flora and Vegetation are considered manageable, based on the requirements of the existing implementation conditions of Ministerial Statement 796;

- *there has been a change in the relevant environmental factors since the proposal was originally assessed by the EPA (Report No. 1287, May 2008), and Terrestrial Fauna is now also considered a key environmental factor;*
- *it is appropriate to require an offset to counterbalance the loss of 42.5ha of Carnaby's cockatoo foraging habitat;*
- *it is appropriate to require the proponent to prepare a Feral Animal Environmental Management Plan; and*
- *it is appropriate to extend the authorised timeframe for substantial commencement of the proposal for another five (5) years."*

As a result of this assessment, Ministerial Statement 1073 was issued with a revised time limit of authorisation condition replacing Condition 3 of Ministerial Statement 796 as follows:

> *"3-1 The proponent shall not commence implementation of the proposal after 13 June 2022, and any commencement prior to this date must be substantial.*
>
> *3-2 Any commencement of implementation of the proposal on or before 13 June 2022, must be demonstrated as substantial by providing the CEO with written evidence, on or before 13 June 2022"*

Additional conditions relating to environmental offsets for the Carnaby's black cockatoo and preparation and submission of a Feral Animal Environmental Management Plan were also added to Ministerial Statement 796 as part of this statement.

Occupancy

Fernview Environmental Pty Ltd is listed as the registered proprietor on the Certificate of Title for Lot 98 on Deposited Plan 75926.

Contaminated Sites Act 2003

Lot 98 on Deposited Plan 75926 is not listed as a suspected or known contaminated site on DWER's contaminated sites database.

Development approval relevant to Application

On 17 August 2010 the former Works Approval Holder was granted approval under the Shire of Gingin's *Town Planning Scheme No. 8* to change the land use zoning from 'Rural' to 'Special Use' to allow the construction and operation of the class II landfill.

The Mid-West/Wheatbelt Joint Development Assessment Panel resolved to approve the application for Planning Approval for the proposal (reference DAP/15/00918) on 20 January 2016. The notice of determination provided to the Applicant specifies 11 conditions to which the approval is subject. Conditions relevant to this assessment are summarised below:

- The land use, development and dust management must be undertaken in accordance with the documentation submitted within the development application.
- The hours of operation must be between 7am – 5pm on weekdays and 7am – 4pm on weekend days and public holidays.
- Only Class II waste (as per the LWCWD) is permitted to be accepted.
- A stability and settlement assessment report must be completed and approved prior to the commencement of works.
- The transport/handling/storage of fuels must comply with AS1940-2004.

- Decommissioning and post closure management shall be in accordance with the plan provided within the development application and to the satisfaction of DWER and the Shire of Gingin.
- Several outstanding issues and actions must be addressed to the satisfaction of the Shire of Gingin, relating to:
    - the review of the local water management plan;
    - how the GCL will achieve adequate levels of hydration;
    - assessment of the likelihood of the GCL clogging the GeoNet liner;
    - development of a mechanism to prevent aggregate entering the leachate sumps;
    - protection of the sump liner around the perimeter of the concrete slab;
    - moving the concrete slab and leachate extraction riser well away from the leak detection sumps;
    - adequate sealing of all penetrations through the leak detection liner system.
- Annual waste inventory to be submitted annually to the Shire of Gingin.
- Revision of the fire management plan to the satisfaction of the Shire of Gingin's Chief Bushfire Control Officer.

The Applicant has advised that all outstanding issues have been addressed directly with the Shire. Additionally copies of the updated stability assessment reports have also been provided to the Shire with respect to the stabilising buttress design (in November 2018).

Note: Australian Standard AS1940-2004 has since been superseded by AS1940:2017

Other Legislation

4.1.4 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

As per section 2.3.2, the Department of Environment and Energy (DoEE) have advised that the project has been referred under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and in January 2016 was determined to be a controlled action.

The DoEE have advised that they are assessing the potential impacts of the project on Carnaby's black cockatoo (*Calyptorhynchus latirostris*) and will be assessing direct impacts such as habitat clearance as well as indirect impacts (if any) such as groundwater contamination by leachate. DoEE have advised that they would not seek to provide comment if the potential impacts were likely to be of the same nature and scale.

The reference number for the EPBC Act referral for the proposal is 2015/7621. The assessment is currently on hold pending the Works Approval decision

4.1.5 Rights in Water and Irrigation Act 1914

Advice from DWER's Regulatory Services (Water) Branch indicates that the Premises currently holds a groundwater licence for 129,150kL per annual period. However, they indicated that the Licence Holder would need to amend their Licence to include dust suppression should they propose to use the existing licence for the operation of the proposed landfill.

A Licence was granted under the *Rights in Water Irrigation Act* on 11 December 2018 for the construction of 3 non-artesian wells in the Mirrabooka aquifer.

4.1.6 Landfill Levy Requirements

The operation of the facility may be subject to the *Waste Avoidance and Resource Recovery Act 2007* (WARR) and *Waste Avoidance and Resource Recovery Levy Act 2007*, including subsidiary WARR legislation, if waste generated from the Perth metropolitan area is taken to the Fernview landfill for disposal.

5. Overview of Premises

5.1 Premises location and boundary

The proposed Fernview Landfill is located on Lot 98 on Plan 75926 in Certificate of Title Volume 2847, Folio 974 (the Premises). Lot 98 is situated on Wannamal Road South and is the result of a recent subdivision from the property known as 'Fernview Farm' (formerly Lot 7778).

The landfill will be located in the eastern part of Lot 98 resulting in a minimum 500m buffer being achieved within the Lot.

5.2 Premises operations

The Applicant proposes to construct and operate a valley landfill incorporating engineered liner and capping systems and leachate and gas management systems. The area of the landfill (all cells) will cover approximately 28.7ha, with a depth of 25 to 48m (approximately 117-172m AHD), resulting in total landfill airspace of approximately 6.7Mm^3.

Operations will occur over an area of approximately 164ha, comprising of 28.7ha landfill area to the southwestern corner of the site, a spoil dump/future inert cell to the northern land boundary and a weighbridge, office and workshop and leachate ponds adjacent to the southern boundary.

The landfill facility will be constructed in stages (consisting of a total of 10 landfill cells) throughout the life of the landfill, which is expected to be less than 30 years.

At the time of closure, final waste contours for the cells/stages will be achieved and a landfill cap installed. The topography of the landfill cap will blend into the surrounding landscape with a gradient of no steeper than 1V:5H to reflect surrounding landforms with a maximum landform height of 224m AHD. The Application states that the surface of the cap will be vegetated with selected local native species. The Applicant intends to rehabilitate and return the site to grazing with native planting following landfill closure.

The initial construction works (Stage 1) will include the establishment of the infrastructure needed for the operation of Cell 1. This will include bulk earthworks and the installation of the liner system for Cell 1, leachate collection system and stormwater management system.

According to the Application, earthworks are required for preparing the Premises for construction of the Landfill and will include the following:

- Removal of existing vegetation and stripping of topsoil;
- Preparatory earthworks to achieve the formation levels, including the selective excavation of the existing landform. Excavated in-situ materials will be stockpiled. The basal formation will be engineered to fall to the south at a minimum gradient of

2%;

- The base of the cells to be sloped with at least a 1% longitudinal gradient and 3% transverse gradient;
- Formation of inter-cell and perimeter bunds;
- Creation of batters in natural ground at the landfill perimeter to be a maximum of 3:1 slope;
- Earthworks formations to be occupied by the engineered containment system will be cleared of uneven, soft or loose material and be prepared by re-grading and compacting as necessary to produce a stable formation; and
- 500mm thick compacted select subgrade over the entire earthworks footprint, which will form a firm platform for the composite liner system or approved equivalent. The surface will be smooth and firm, without irregularities including bumps, hollows or shrinkage cracks and free of unsuitable materials.

The Application states that the permanent internal access roads will be sealed as part of the initial construction and development of Stage 1 of the landfill. Roads on and near the tipping face will be constructed of locally sourced laterite gravel, compacted to an appropriate specification and crowned to allow for storm water runoff and to prevent ponding.

Future operation of the landfill will occur simultaneously with the construction of additional cells and the capping and revegetation of cells which have reached their finished levels.

The works involved in subsequent stages will require separate approval.

The landfill proposes to accept waste meeting the Class II acceptance criteria as per the *Landfill Waste Classification and Waste Definitions 1996 (as amended December 2009)*.

The waste types proposed to be accepted are as follows:

- Clean fill
- Inert waste type 1
- Inert waste type 2
- Putrescible waste
- Special waste type 2 dition
- Contaminated solid waste meeting waste acceptance criteria specified for class II landfills

The Premises will not be open to the general public. The majority of the waste received at the Premises will be sourced from the Perth metropolitan area and will have undergone sorting at a transfer station before transportation to the Premises.

The Delegated Officer has reviewed the proposed waste types to be accepted at the Premises and has found that the Premises is located in the tyre exclusion zone as per Schedule 5 of the *Environmental Protection Regulations 1987* (EP Regulations), as such, tyres (classified under inert waste type 2) must not be accepted at the Premises.

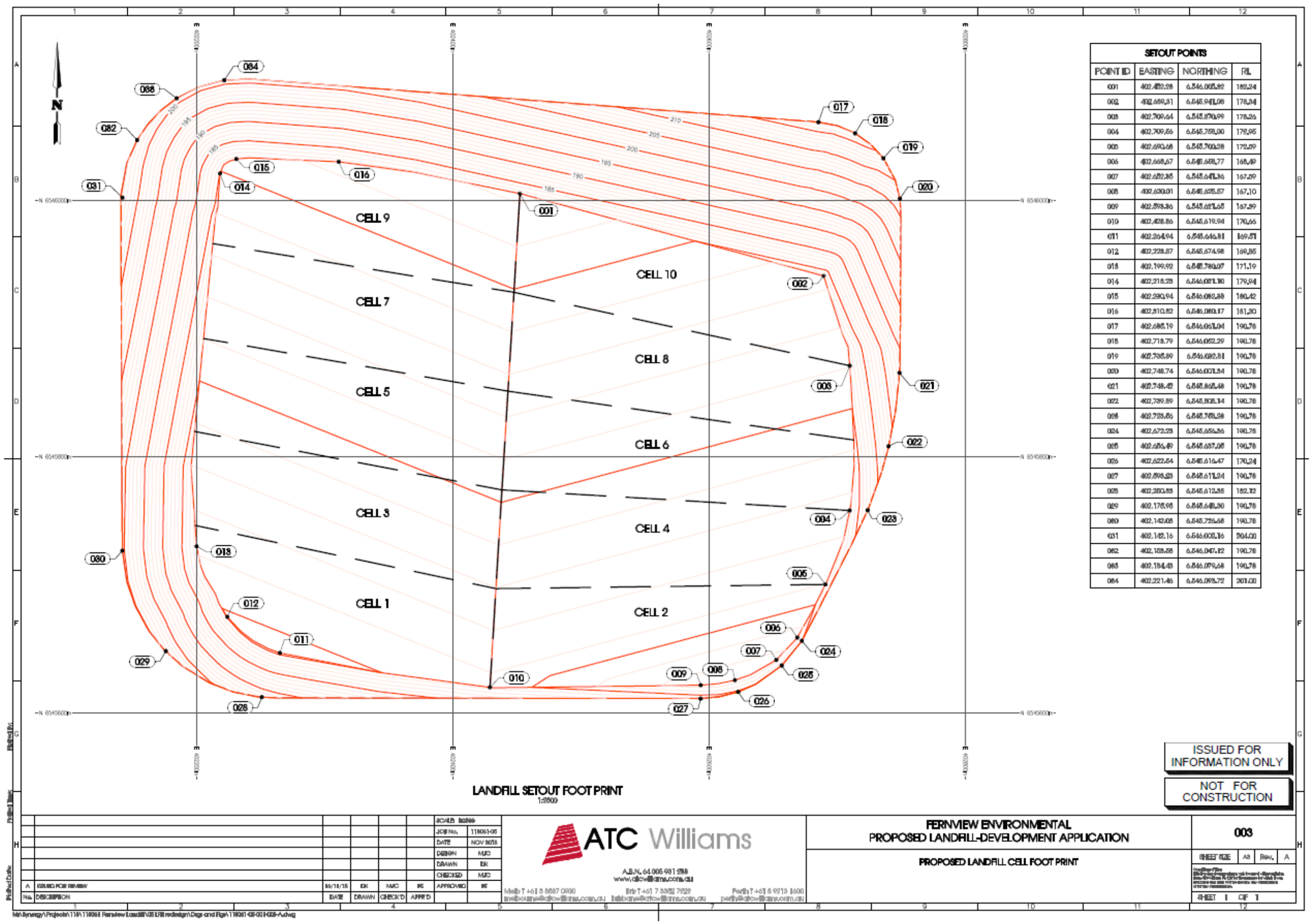
5.3 Premises Infrastructure

5.3.1 Infrastructure overview

The Premises infrastructure which is proposed to be constructed within Stage 1 of the works, and as related to Category 64 activities, is detailed in Table 11 and with reference to the site plans below (Figures 1-6).

Table 11: Fernview Landfill Category 64 infrastructure for Stage 1 works

	Infrastructure	**Plan Reference**
	Prescribed Activity Category 64	
1.	Landfill cell 1	Figure 5. Proposed landfill cell foot print
2.	Leachate collection system for Cell 1: • Leachate pond • Leak detection system	Figure 6. Leachate collection layout plan Figure 7. Leachate pond layout plan and details
3.	Stormwater management system: • Bunds and surface water diversion drains • Sedimentation pond	Figure 8. Stormwater & leachate layout plan Figure 9. Sedimentation dam layout plan and details
4.	Weighbridge	Figure 10. Site plan
5.	1.8m high mesh security fence and lockable access gates	Figure 10. Site plan
	Associated activities	
6.	Perimeter groundwater monitoring bores	Figure 10: Site Plan Bore Locations: GG1, GG2, GG3, GG4, GG5, GG6 and GG7
7.	Groundwater abstraction bores	Figure 10: Site Plan FLV4
8.	Fuel storage tank	Figure 10. Site plan
9.	100kL firefighting water storage tank	Figure 10. Site plan
10.	Contractors Storage Yard	Figure 10. Site plan
11.	Internal access roads	Figure 10: Site Plan



SETOUT POINTS			
POINT ID	EASTING	NORTHING	RL
001	402,482.28	6,546,065.82	182.24
002	402,689.31	6,545,941.06	178.34
003	402,709.64	6,545,870.99	178.26
004	402,709.56	6,545,758.00	179.95
005	402,690.68	6,545,760.28	172.59
006	402,668.67	6,545,668.77	168.49
007	402,652.85	6,545,647.34	167.59
008	402,630.01	6,545,625.57	167.10
009	402,598.36	6,545,621.65	167.39
010	402,428.86	6,545,619.94	170.66
011	402,264.94	6,545,646.81	169.71
012	402,228.87	6,545,674.98	169.85
013	402,199.92	6,545,780.07	171.19
014	402,218.28	6,546,021.30	179.94
015	402,230.94	6,546,082.39	180.42
016	402,310.82	6,546,080.17	181.30
017	402,685.19	6,546,051.04	190.78
018	402,718.79	6,546,052.29	190.78
019	402,736.89	6,546,052.81	190.78
020	402,748.74	6,546,001.84	190.78
021	402,748.42	6,545,865.48	190.78
022	402,739.89	6,545,808.14	190.78
023	402,728.86	6,545,768.38	190.78
024	402,672.28	6,545,656.36	190.78
025	402,654.49	6,545,637.08	190.78
026	402,622.64	6,545,616.47	170.24
027	402,598.28	6,545,611.24	190.78
028	402,280.88	6,545,612.38	182.12
029	402,176.98	6,545,648.30	190.78
030	402,142.08	6,545,726.68	190.78
031	402,142.16	6,546,002.16	204.00
032	402,168.68	6,546,047.82	190.78
033	402,184.43	6,546,079.68	190.78
034	402,221.46	6,546,093.72	201.00

Figure 5. Proposed landfill cell foot print

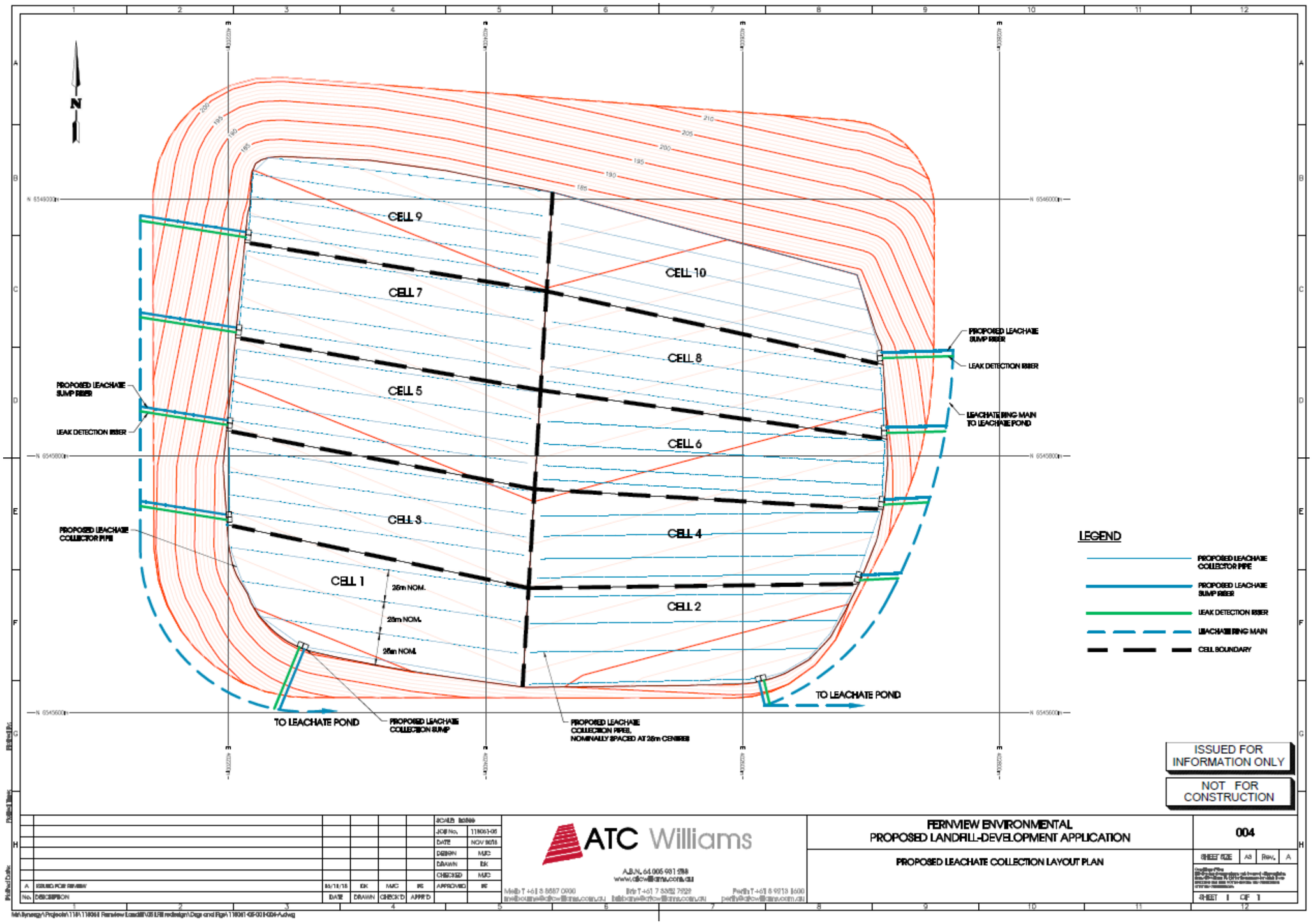


Figure 6. Leachate collection layout plan

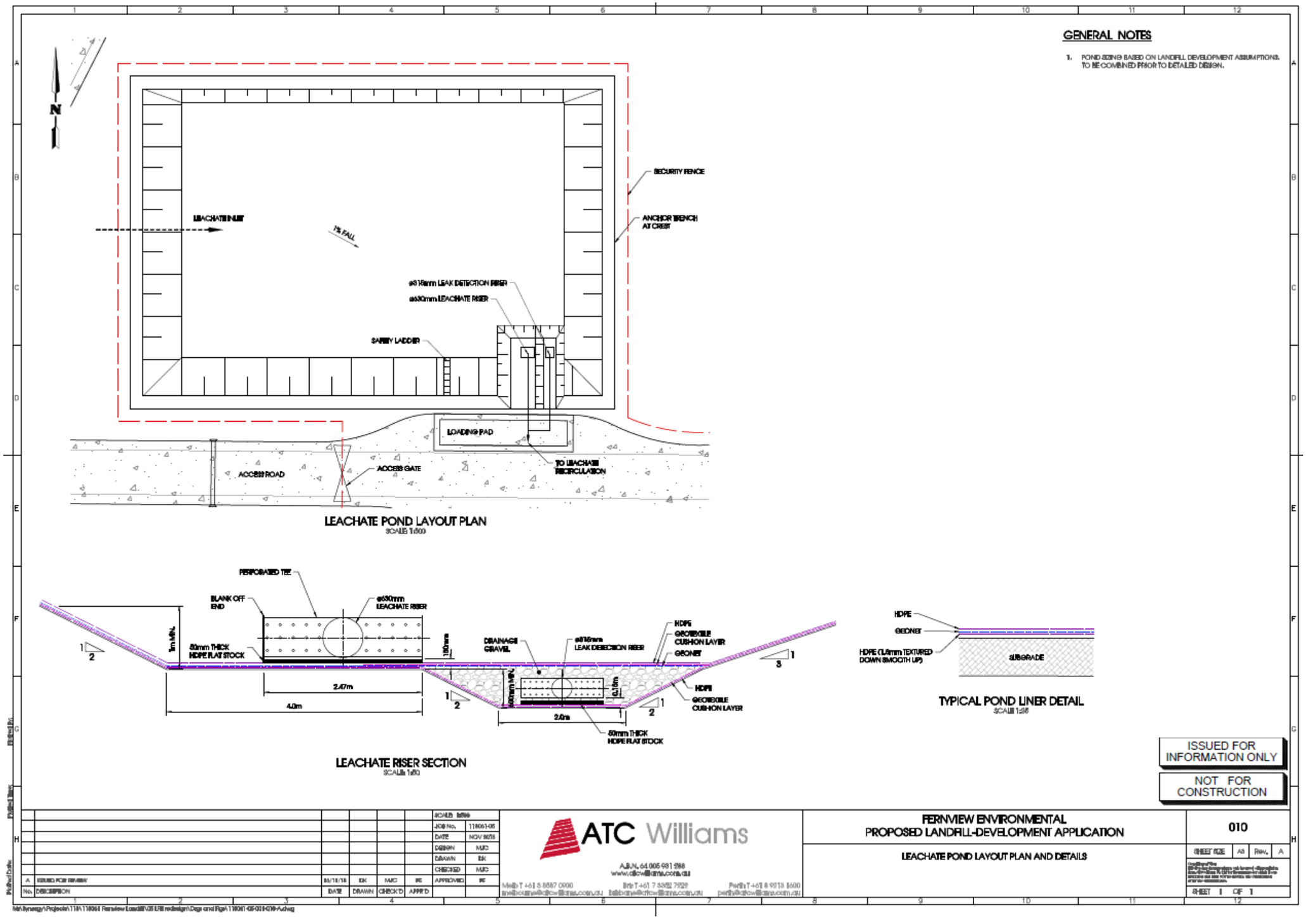


Figure 7. Leachate pond layout plan and details

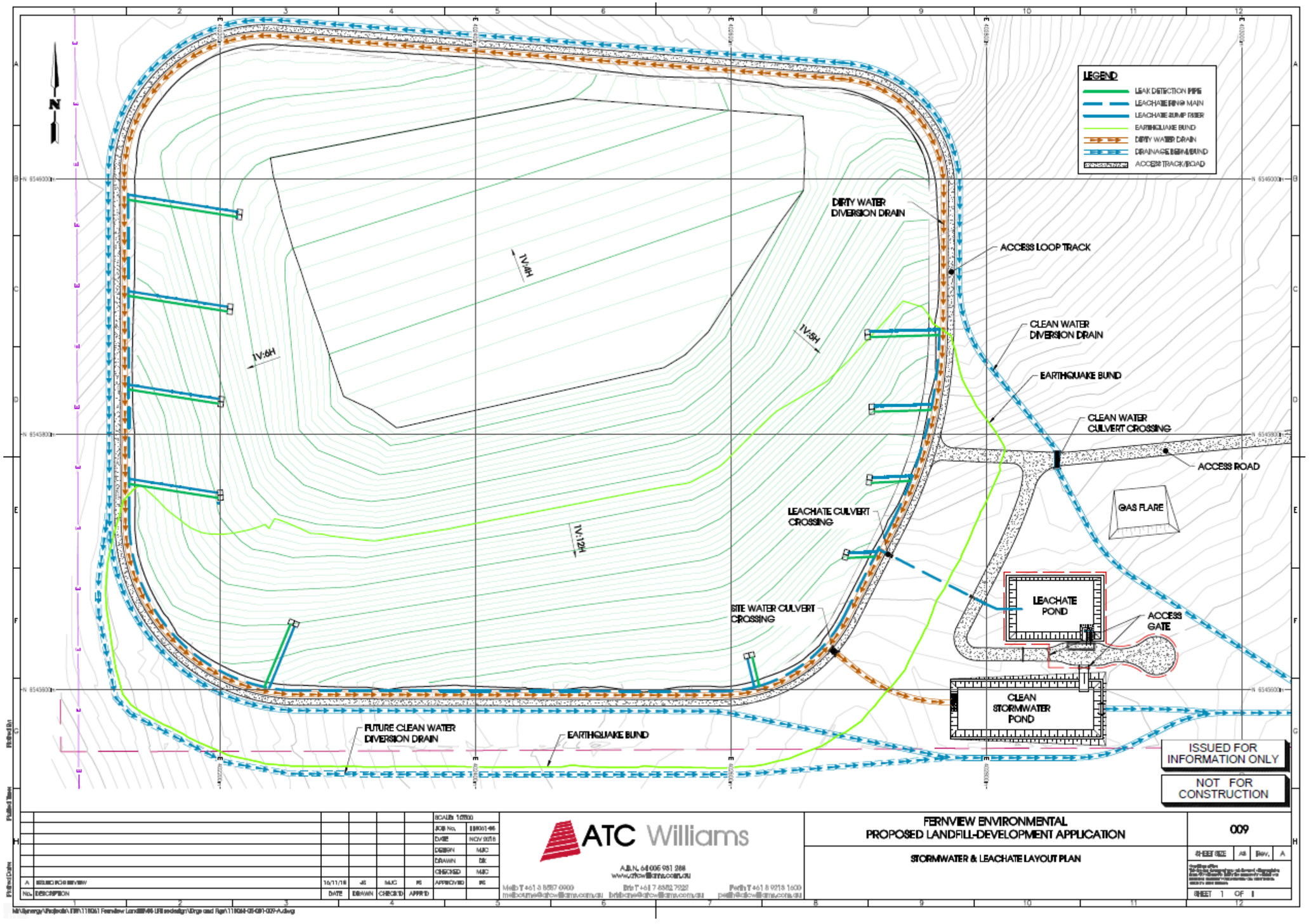


Figure 8. Stormwater & leachate layout plan

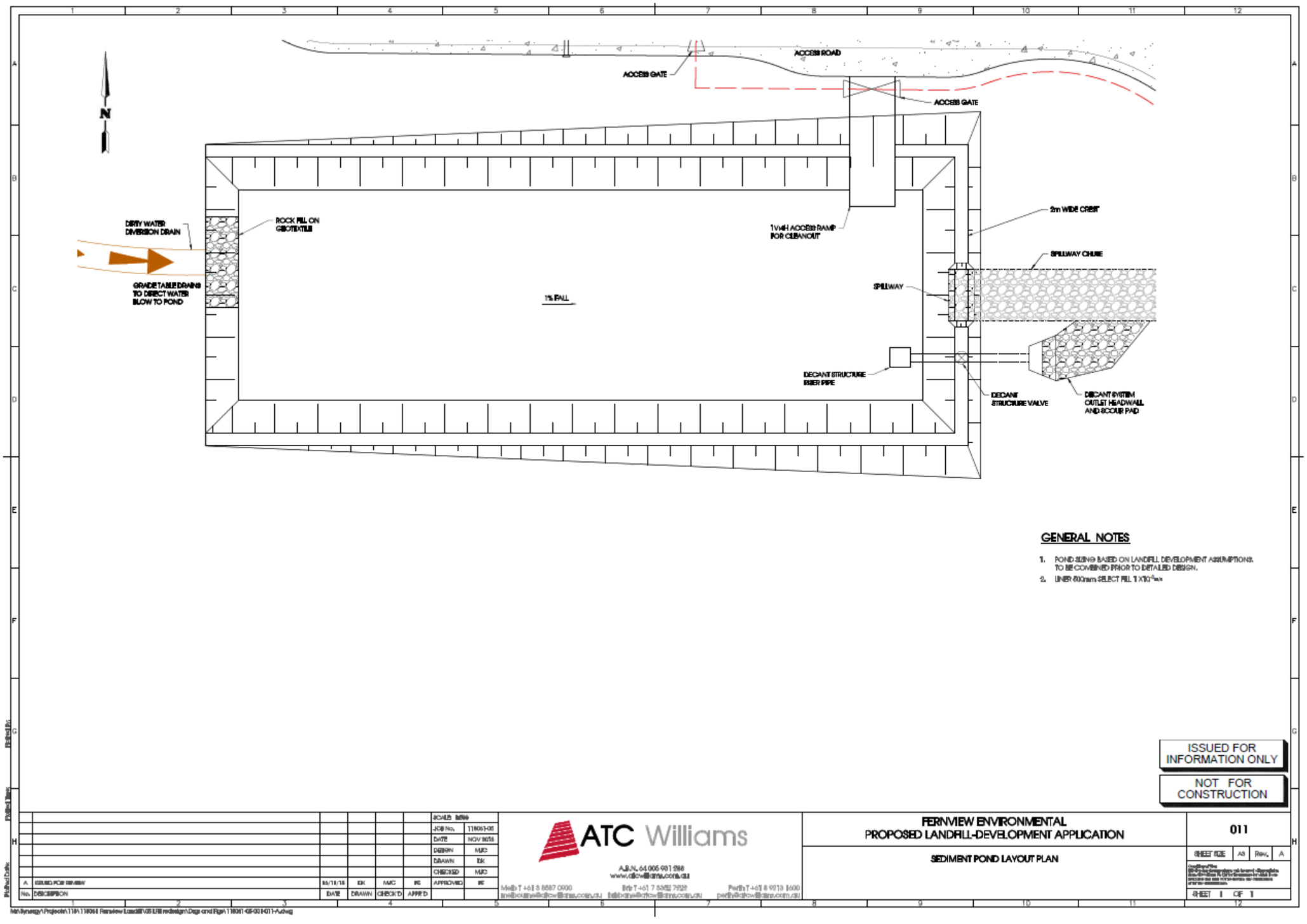


Figure 9. Sedimentation dam layout plan and details

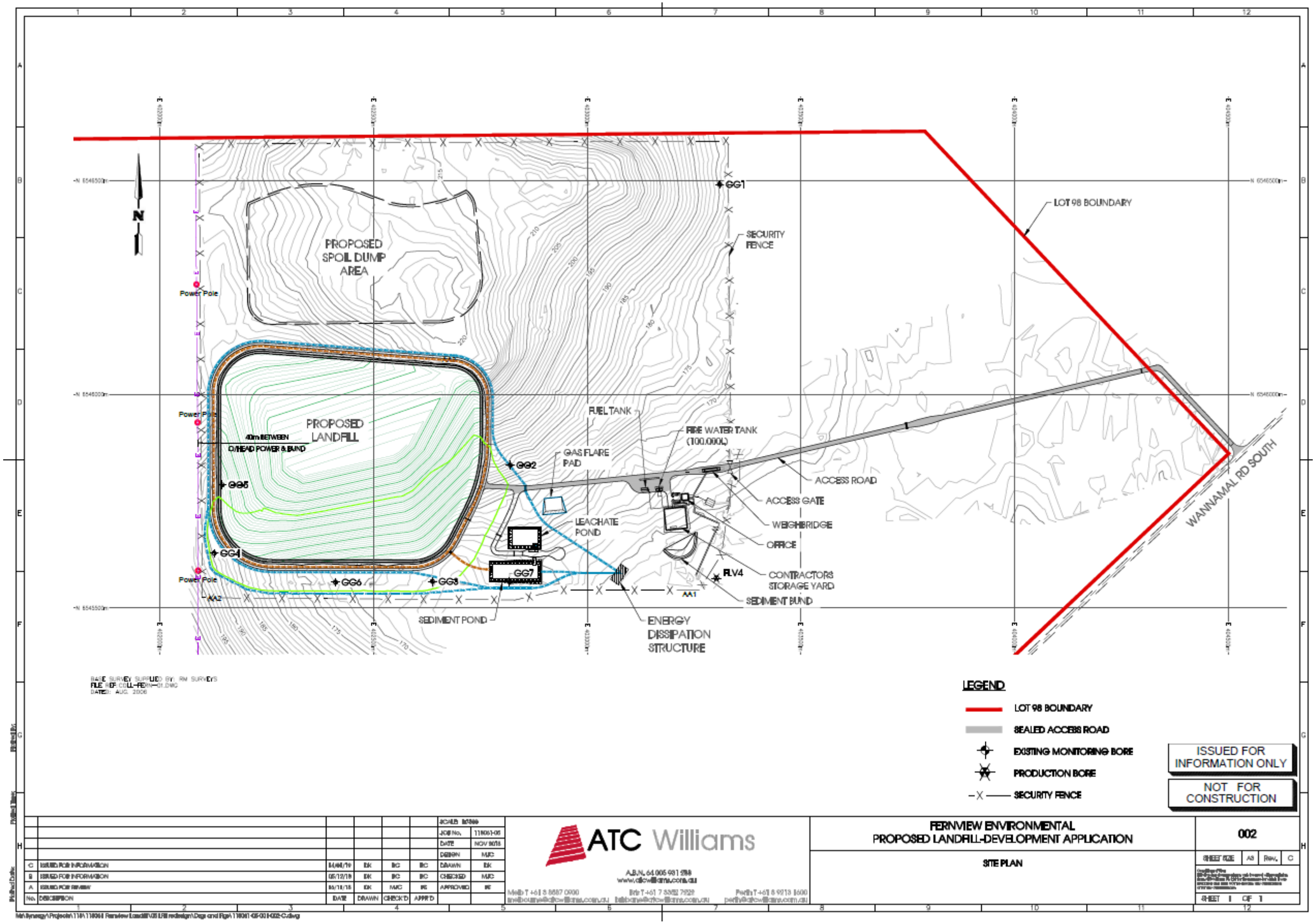


Figure 10. Site plan

6. Environmental Setting

6.1 Siting context

The Premises is located in Cullalla approximately 16km north of the Gingin township within the Shire of Gingin (Figure 12). The Premises are located on Lot 98 Wannamal Road South, a privately owned property of 684ha. The area proposed for the landfill itself covers approximately 29ha.

There is no residential development within the Lot, or the immediate surrounding area. The Premises is zoned Special Use. The surrounding land is zoned Parks and Recreation to the west and Rural to the north, east and south.

The Muchea fault line is immediately adjacent to the proposed landfill, running through Lot 98 in a north-west to south-easterly direction (Figure 9).

6.2 Residential and sensitive premises

The distances to residential and sensitive receptors are detailed in Table 12.

Table 12: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Residential Premises	1.9 km south (Fernview Farm) 2.3 km northeast (Lot 5294 on Plan 207122, Wannamal Road, Cullalla)

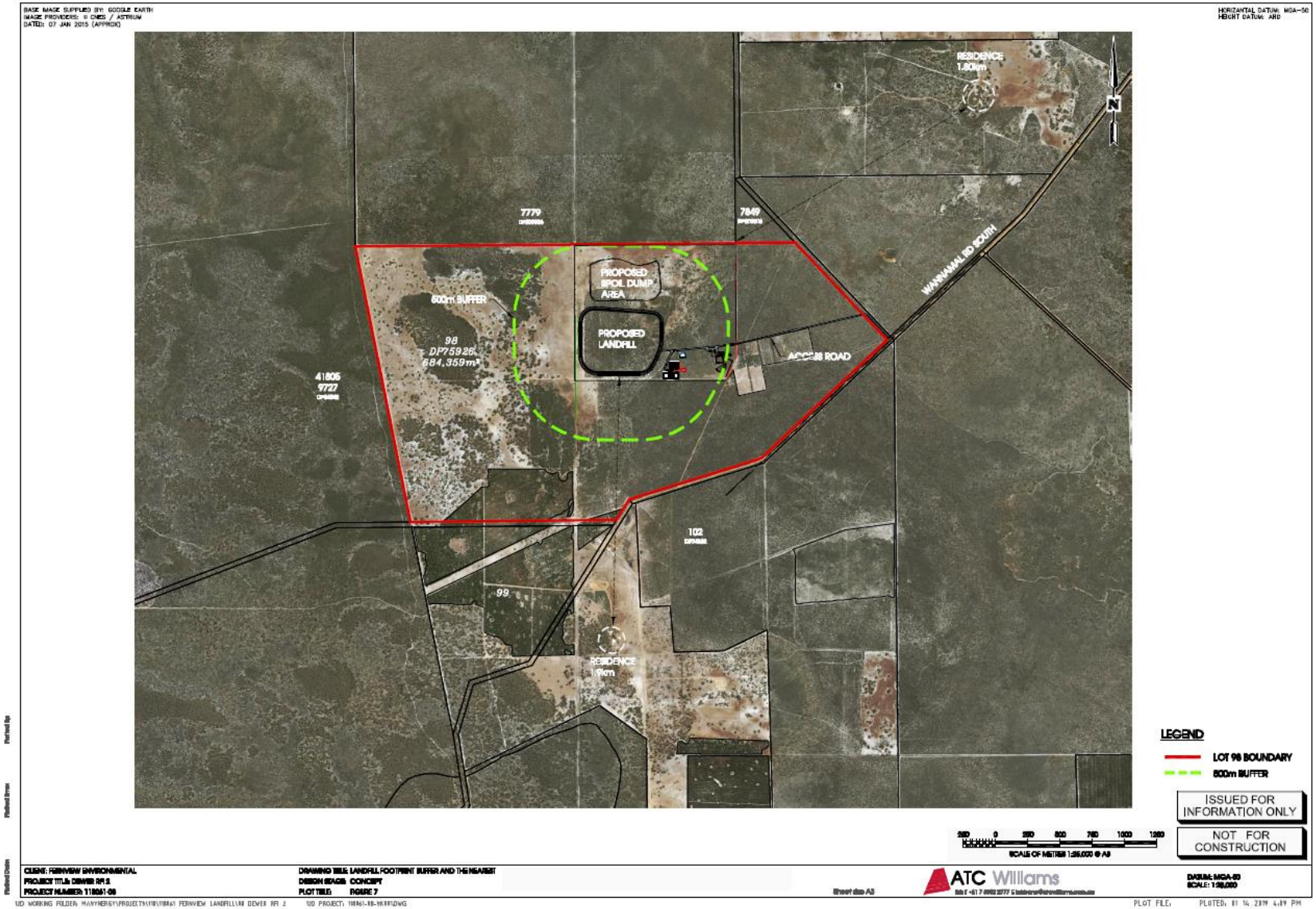


Figure 11. Landfill footprint, buffer and the nearest residences

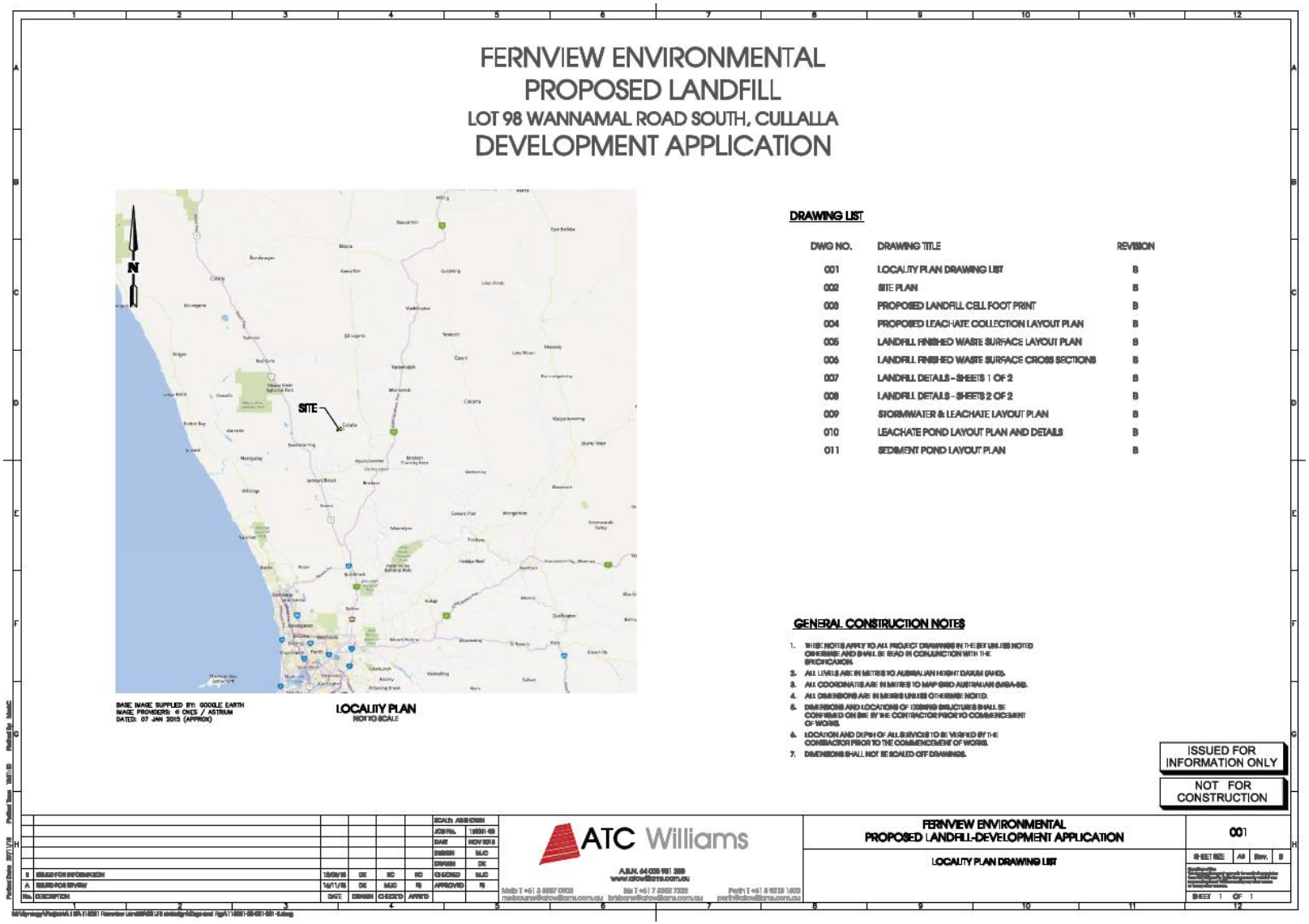


Figure 12. Locality plan

6.3 Groundwater and surface water

The distances to groundwater and water sources are shown in Table 13.

Table 13: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Public drinking water source areas	None within 5 km of the Premises boundary.	N/A
Major watercourses/ waterbodies	There are no major water courses/water bodies within the Premises boundary. Boonanarring Brook which extends into the Boonanarring Nature Reserve is located approximately 3km west of the Premises boundary. The Brook flows in a south-westerly direction. A Boonanarring Brook tributary is located approximately 700m southwest of the Premises boundary and 2.4km from the landfill activity boundary. Red Gully Creek is approximately 15km to the northwest and the Moore River 25km directly to the north. Lake Beermullah and White Lake are approximately 15km to the east, with Wannamal Lake lying approximately 15km to the northeast.	See Table 14
Groundwater	Groundwater at the site is located within the unconfined Poison Hill aquifer, comprised of Poison Hill Greensand, Gingin Chalk and Molecap Greensand stratigraphic units Depth to groundwater is approximately 20m – 70mBGS (143m AHD). Variation is driven by the undulating topography of the Premises. Groundwater appears to be shallowest beneath the lower, southern end of the proposed site (bore BH2 and MB3) where the depth of the unsaturated zone is approximately 26m and 24.5mBGS respectively. Two ground water extraction bores are located approximately 1.2km to the south of the proposed landfill. The Application states that the main groundwater flow direction across the Premises is westerly to west-south-westerly, towards the Gingin Brook catchment.	Seven groundwater monitoring bores have been established on the landfill site (GG1-7), as depicted in Figure 10. Analysis of groundwater samples collected from the monitoring bores shows groundwater quality to be generally very good, with pH varying from 5.8 to 6.2, low total dissolved solids (up to 440mg/L) being sodium-chloride dominated. There are generally low concentrations of nutrients. The highest total nitrogen measurement was 3mg/L, mainly consisting of nitrate and organic-N. Ammonium-N is present in low concentrations. Trace metal ions are all within freshwater criteria, and all trace organic contaminants (hydrocarbons – benzene, toluene, ethylbenzene, xylene/polycyclic aromatic hydrocarbons, pesticides and polychlorinated biphenyls have not been detected. Water has potential non-potable uses such as livestock watering and garden/agricultural use. Ground and surface water quality was considered a key environmental factor relevant to the Part IV assessment of the proposal.

6.4 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 14. Table 14 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting.*

Table 14: Environmental values

Specified ecosystems	Distance from the Premises
Ramsar Sites in Western Australia	None within 5km of the Premises boundary.
Important wetlands – Western Australia	None within 5km of the Premises boundary. Wannamal Lake System is located approximately 6.5km northeast of the Premises boundary.
Geomorphic Wetlands	Conservation: Unnamed wetland (Sumpland) is located 1.3km to the northeast of the Premises boundary. Unnamed wetland (Dampland) is located 2.3km to the north of the Premises boundary. Boonanarring Brook (Palusplain) is located approximately 3km west southwest of the Premises boundary. Unnamed wetland (Sumpland) is located approximately 3.6km south of the Premises boundary. Multiple Use: Unnamed wetland (Palusplain) is located approximately 1.6km to the northeast of the Premises boundary. Unnamed wetland (Dampland) is located approximately 1.7km to the north of the Premises boundary. Unnamed wetland (Dampland) is located approximately 4.2km to the southeast of the Premises boundary. Resource Enhancement: A series of unnamed wetlands (Sumpland) are located approximately 1.5km to the northeast of the Premises boundary.
Department of Biodiversity, Conservation and Attractions Managed Lands and Waters	Boonanarring Nature Reserve (R 41805) for the purpose of Conservation of Flora and Fauna is located immediately adjacent to the west boundary of the Premises. The distance from the landfill activity boundary to the Boonanarring Nature Reserve is approximately 1.5km. Vegetation in the Boonanarring Nature Reserve is part of the pre-clearing Cullalla Complex in the Swan Coastal Plain. This vegetation consists predominately of a mixture of Low Open Forest of Banksia species and Open Woodlands. Crown Freehold – Department Interest land is located immediately adjacent to part of the southeast Premises boundary.
Bush Forever: Regional open space or proposed regional open space	None within 5km of the Premises boundary.
Western Swamp Tortoise Habitat	None within 5km of the Premises boundary.
Regional Parks	None within 5km of the Premises boundary.

Specified ecosystems	Distance from the Premises
Waterways Conservation Areas	None within 5km of the Premises boundary.
Threatened Ecological Communities and Priority Ecological Communities	Threatened Ecological Communities Approximately 238ha of the eastern portion of the Premises comprises of a Threatened Ecological Communities (TEC) Buffer. There are 8 overlapping TECs of Banksia Woodland within the Premises boundary. Part of the proposed landfill activities will intercept with the TEC Buffer. Priority Ecological Communities Swan Coastal Plain Banksia – Banksia menziesii woodlands (Priority 3) is located approximately 1.5km to the north, 1.8km to the east and 4.8km to the west of the Premises boundary. The recommended buffer distance is 500m.
Biological component	**Distance from the Premises**
Threatened/Priority Flora	Located within the adjacent Boonanarring Nature Reserve is a Priority 4 Flora (Rare, Near Threatened and other species in need of monitoring). The Priority 4 Flora is located approximately 300m west of the Premises boundary and 2km from the landfill activity boundary.
Threatened/Priority Fauna	None within 5km of the Premises boundary.

6.4.1 Acid Sulfate Soils

The Premises is not located in or near an area identified as being at risk of acid sulfate soils

Topography

The site is located on the southern part of the Dandaragan Plateau, elevated away from the Swan Coastal Plain and the Gingin town site. The Dandaragan Plateau is gently undulating and covered in sand and laterite at a height of approximately 140m AHD to 260m AHD (Moncrieff, 1989). There is little runoff from the Plateau due to the permeable surface cover (Moncrief, 1989). The Gingin Scarp lies to the west of the site and the Muchea and Darling Faults to the east.

The Application states that the proposed area is undulating with a rounded hill present along the centre of the northern boundary. The remainder of the area generally decreases in elevation from the western and northern boundaries with a low point in the southeast. Elevation ranges from approximately 220m AHD along the northern and western boundaries. The Application proposed that the landfill site will be cut into a hill where the topography shields it from view from most aspects in the surrounding landscape. The surrounding area is sparsely to very heavily vegetated with remnant bush and regrowth.

The proposed landfill does not fall within any flood plains. The direction of stormwater flow for the site varies in accordance with the surface contours and site catchment areas as shown in Figure 14 below.

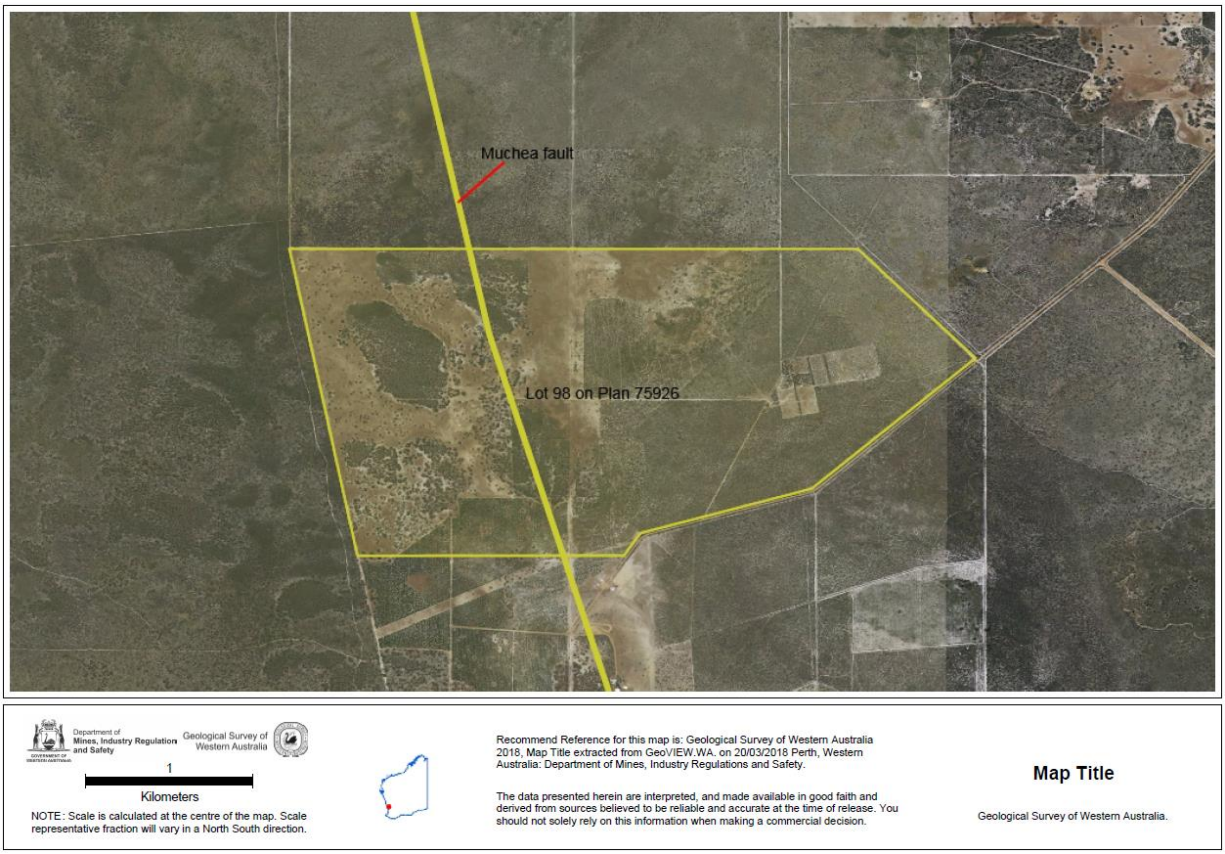


Figure 13. Muchea fault location

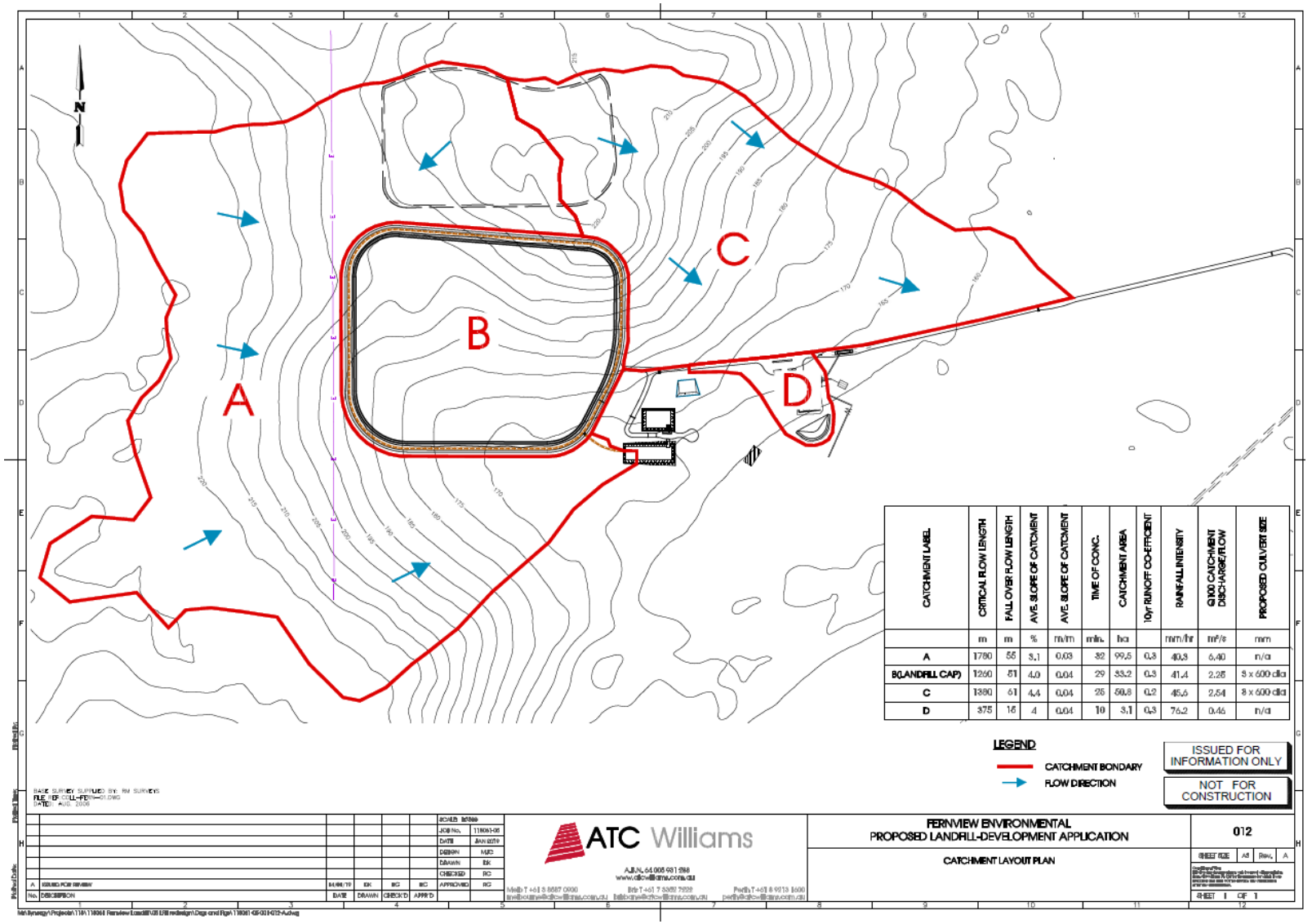


Figure 14. Catchment area and stormwater flow direction

Geology and soils

The Application states that the Premises is situated in the southern part of the Dandaragan Plateau, between the Gingin Scarp to the west and the Muchea Fault to the east. The geology of the southern part of the Plateau is dominated by the Upper Cretaceous Coolyena Group, a series of marine derived sediments deposited within the Dandaragan Trough, part of the Perth Basin. In the vicinity of the Premises the Coolyena Group includes the Osbourne Formation, the Group basal sequence of marine sandstone, shale and interbedded shale-and sandstone units, which is unconformably overlain by the Molecap Greensand, Gingin Chalk and Poison Hill Greensand sequence. Basement rocks underlying the Coolyena Group extend below 190mBGS and include the Leederville Formation and Parmelia Formation which extends below 490mBGS.

Locally, recent sediments which overly the Coolyena Group form a thin layer of medium to coarse sands, mostly ferruginised, with laterised horizons from 2 to 5mBGS. The surficial sediments grade into the Poison Hill Greensand which is comprised of pale yellow, unconsolidated weathered clay, glauconitic sandstone and shale. Drilling undertaken ~1 km south of the Premises described the Poison Hill sediments as cream to light grey, fine to medium grained, subangular, poorly sorted clayey sand, with cream to white clay (Diamond, 2000). More recent drilling on the disturbance footprint of the Premises described the Upper Cretaceous sediments as medium to coarse sand, mostly ferruginised (cream to red brown). The Poison Hill Greensand is weathered to a depth of 29m, and boundaries between the surficial sediments, Greensand unit and underlying sediments were not well defined (Crisalis, 2007).

Subsidence allowing deposition in the southern parts of the Dandaragan Trough is thought to have been controlled by the Muchea fault. In the vicinity of the site, the subsidence resulted in a significant thickness of Osbourne Formation sediment deposition. The Kardinya Shale unit extends approximately 80m below the base of the Coolyena group sediments in the vicinity of the Premises.

Drilling approximately 1km south of the site, as part of an investigation by Diamond (2000) showed the stratigraphic succession through to the Leederville Formation and underlying Parmelia Formation. A summary log for bore RG2A is provided in Figure 15, as reproduced from Diamond (2000).

Table 1: Summary Log for Bore RG2A

DEPTH (mbgl)*	STRATIGRAPHIC UNITS		
0-6	Quaternary (Surficial Deposits)		
6-25	Poison Hill Greensand		Coolyena Group
25-34	Gingin Chalk		
34-63	Molecap Greensand		
63-148	Kardinya Shale	Osborne Formation	
148-196	Henley Sandstone		
196-254	Pinjar Shale	Leederville Formation	Warnboro Group
254-450	Wanneroo Member		
450-472	Marginiup Member		
472-490	Parmelia (Sandstone) Formation		

*mbgl = metres below ground level

Figure 15. Summary log for bore RG2A

6.4.2 Hydrogeology

In the vicinity of the Premises, the Dandaragan Plateau forms part of the Perth Basin aquifer system. In the southern region of the Perth Basin, unconfined, perched water tables within and above the Osbourne formation are complex and often mask true aquifer properties, and depth to groundwater. The deeper basement aquifers are the Leederville Formation and Parmelia aquifer which together form a multi-layered, significant aquifer within the Perth Basin.

Locally, the Kardinya Shale unit of the Osbourne formation forms an extensive (~80 m thickness) aquaclude, confining the Leederville-Parmelia aquifer from the surface. Regional faults (Muchea) are not inferred to provide hydraulic connection from surface aquifers to deep aquifers in the vicinity of the Premises. The standing water levels measured in shallow and deep groundwater monitoring wells located ~ 1 km south of the Premises indicates that the surficial and basement aquifers are not in hydraulic connection (Diamond, 2000).

At the Premises, the Poison Hill aquifer is a shallow, unconfined groundwater aquifer within the Coolyena group. Because of the undulating topography, depth to groundwater varies from 13 to 56mBGS (Crisalis, 2007). In the vicinity of the proposed landfill, depth to groundwater is generally greater than 20mBGS. The application states that groundwater flow if to the west-south-west towards Gingin Brook.

Climate

The region has a Mediterranean climate with mild wet winters and hot dry summers. These seasons extend into the autumn and spring months which are transitional periods between the main seasons. The climate of the region is strongly influenced by high pressure systems and in the warmer months by the development of easterly winds.

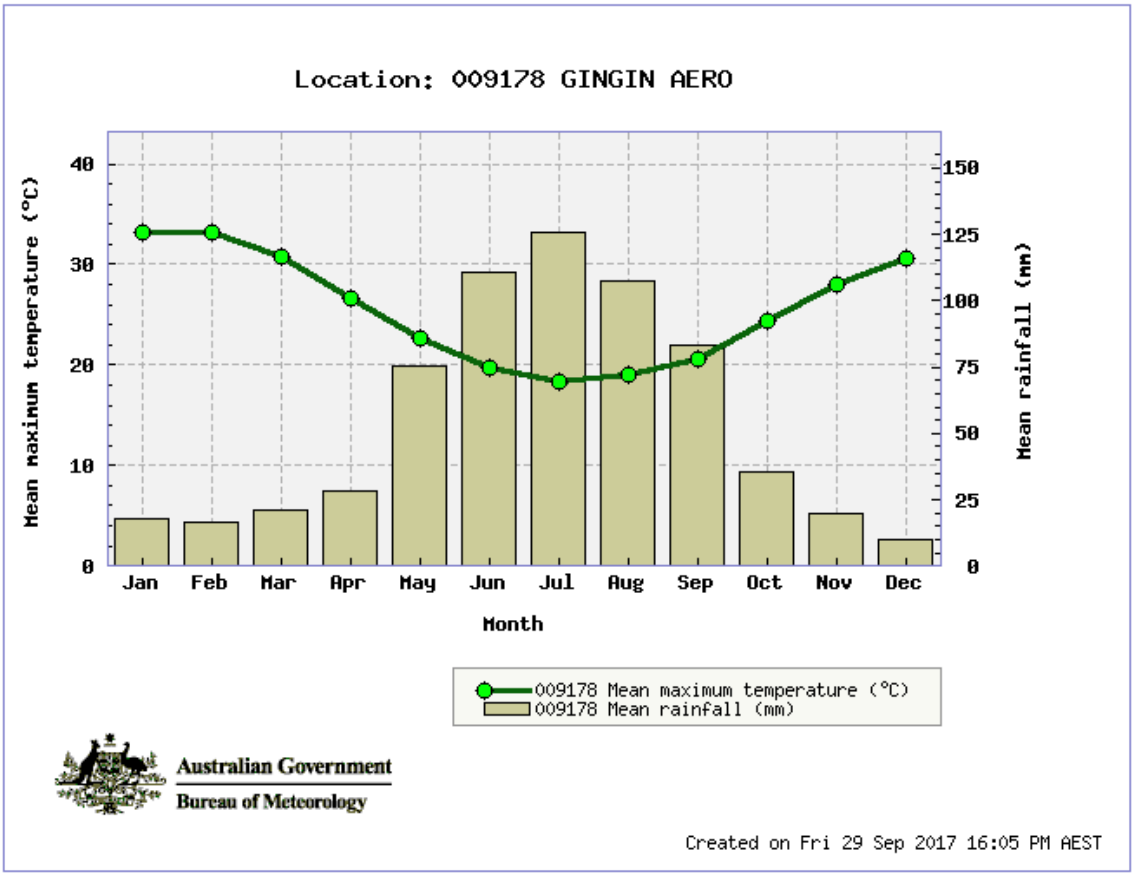
Meteorological data has been collected from the Bureau of Meteorology site “Gingin Aero” (site number 009178), located approximately 32km southwest of the Premises.

6.4.3 Rainfall and evaporation

Rainfall data dating from 1996 to 2017 indicates an average annual rainfall of 657.4mm, of which the majority falls within the months from May to September. Summer months can often exhibit extended dry periods (Figure 16).

The regional evaporation rate is estimated to be approximately 2,000mm per year, exceeding the average annual rainfall by more than 1,000mm. Evaporation generally exceeds rainfall year round except for the months of June, July and August (Figure 17).

Seasonal temperature variations range from mean daily maximum and minimum temperatures of 33.2 °C and 14.3 °C respectively in summer to a mean of daily maximum and minimum temperatures of 19.7 °C and 6.3 °C respectively in winter.



Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean maximum temperature (°C) for years 1996 to 2017	33.2	33.2	30.7	26.7	22.7	19.7	18.3	19.1	20.6	24.4	28.0	30.6	25.6	21
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**	**Years**
Mean rainfall (mm) for years 1996 to 2017	17.7	16.3	21.2	28.4	75.6	110.5	125.8	107.3	83.2	35.6	19.6	9.7	657.4	21

12.3 = Not quality controlled

Figure 16. Mean maximum temperature vs. mean maximum rainfall for Gingin Airport

Table 1. Monthly and annual Class A pan evaporation rates for various centres in the agricultural areas/ in mm

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Ajana	397	367	324	217	160	99	99	127	150	246	304	384	2874
Albany	220	171	150	91	63	47	49	67	84	106	150	199	1397
Armadale	297	257	224	123	87	59	60	69	106	154	203	259	1898
Berkshire Valley	381	343	304	183	117	74	73	96	127	200	276	373	2547
Brookton	336	276	233	137	86	51	53	64	101	153	220	294	2004
Corrigin	381	301	260	153	91	54	54	73	110	177	243	339	2237
Cranbrook	267	230	184	110	67	44	47	61	89	119	176	257	1651
Dandaragan	353	293	283	166	113	77	74	97	119	187	264	350	2376
Donnybrook	221	187	150	84	63	47	50	63	73	109	149	203	1399
Esperance	266	211	193	133	93	64	79	90	114	151	191	254	1840
Geraldton	361	337	313	207	151	103	89	113	140	216	280	366	2676
Gingin	330	296	259	149	96	66	63	91	114	173	239	321	2197
Goodlands	439	391	337	214	133	81	86	109	144	239	311	413	2897
Holt Rock	380	284	247	160	97	67	79	89	121	191	253	331	2300

Figure 17. Annual evaporation rates for Gingin

(Sourced from Luke, G J, Burke, K L, and O'Brien, T M. (1987), *Evaporation data for Western Australia.* Department of Agriculture and Food, Western Australia. Report 65)

Wind direction and strength

Winds are predominantly from the east in the mornings and from the southwest towards receptors located 2.3km to the northeast of the Premises in the afternoon.

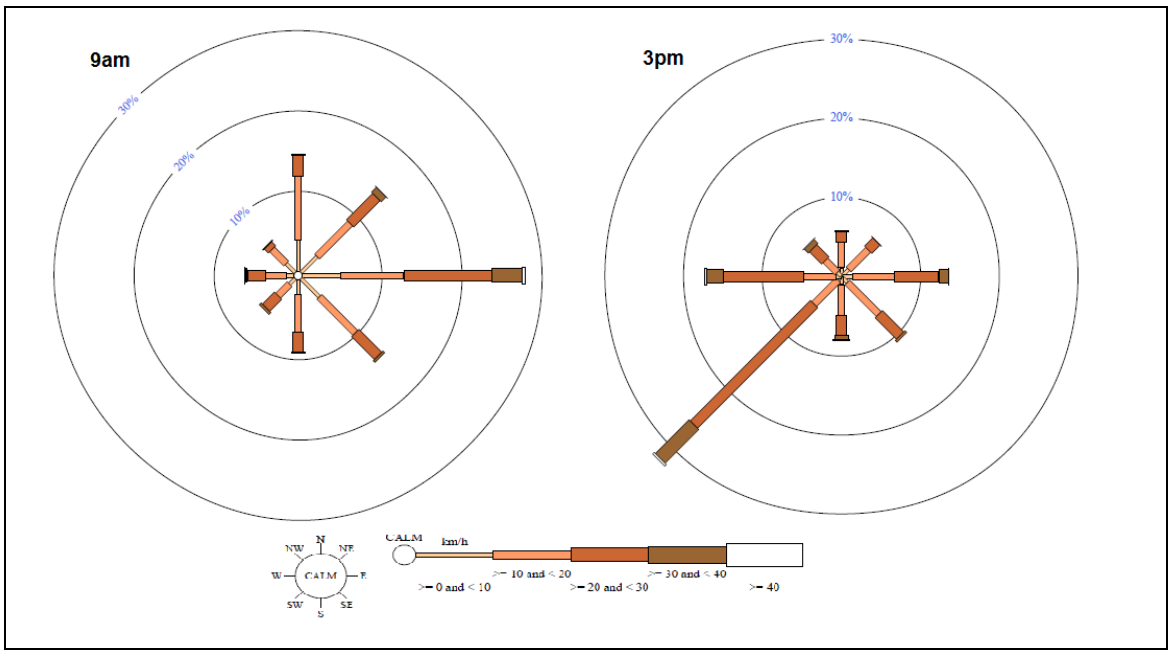


Figure 18. 9am and 3pm wind roses for Gingin Aero

It is important to note that these wind roses show historical wind speed and wind direction data for the Gingin Aero weather station and should not be used to predict future data.

7. Landfill Engineering Design

7.1 Landfill lifespan and staging

The Application states that the proposed landfill will be a staged development over ten cells with construction activities occurring at intervals throughout the life of the landfill. It is proposed that this will allow the progressive use of the landfill areas so that construction, operation, capping and leachate recirculation can occur simultaneously.

The initial construction works at the Fernview Landfill will include (Stage 1):

- establishing infrastructure (access roads etc.);
- bulk earthworks, leachate storage ponds; and
- the construction of landfill cell 1.

The Application states that subsequent stages will be constructed as required with the exact timing of future stages being dependent on the volumes of waste received at the Premises and the requirement to prepare the next cell in time for ongoing receival of waste. The Premises will comprise a total of ten cells (stages) however this assessment relates only to Cell 1 (Stage 1).

Following a revised stability assessment (see Section 0) and additional information provided to DWER on the 16 November 2018 and 6 December 2018 (see Section 0), some changes have been made to the landfill design including relocation of the overall landfill footprint to allow for the potential construction of a toe buttress in the future (post Cell 1). This shift is approximately 20m to the north and 10m to the east and setbacks from the western power line and sensitive environmental areas have been maintained.

7.2 Landfill liner

7.2.1 Landfill liner design

According to the Application, the liner will maintain a minimum 15m vertical clearance to the water table and will be installed upon the formation created by the earthworks. The liner will be constructed using a double lining system incorporating a leak detection layer and the following engineering components and layering:

i. A 500mm compacted select fill subgrade will be created during the earthworks stage with a minimum 2% gradient to the perimeter of the landfill. The select fill will have a permeability of no more than $1x10^{-8}$m/s.

ii. A 2.0 mm thick smooth (smooth/textured on the side slopes) high-density polyethylene (HDPE) geomembrane will be installed over the compacted select subgrade. The Application states that the geomembrane will meet the landfill best practice physical and mechanical requirements. The geomembrane will extend up the side slopes and tie into adjacent cells and the landfill perimeter by an anchor trench.

iii. A GeoNet (Secudrain) layer will be placed to form a continuous protective layer across the geomembrane and to assist in detecting leaks from the lining above.

iv. GCL will be installed directly over the GeoNet on the base and the sidewalls. The GCL will have a hydraulic permeability of less than $1x10^{-9}$m/s. The GCL will extend up the side slopes and tie into adjacent cells and the landfill perimeter by an anchor trench.

v. A 2.00mm thick, smooth/textured HDPE layer will be installed directly above the GCL. The HDPE will extend up the side slopes and tie into the landfill perimeter by an anchor trench and adjacent cells by overlap and weld.

vi. A protective cushion of non-woven geotextile will be installed directly above the 2.0mm HDPE lining as soon as practicable. The proposed non-woven geotextile protection layer will be graded at 650g/m^2. The geotextile will extend up the side slopes and tie into adjacent cells. The protective geotextile will be placed to form a continuous layer across the geomembrane to prevent the intrusion of the overlying leachate drainage media onto the geomembrane (HDPE layer).

vii. A 300mm deep layer of aggregate will act to collect and divert leachate to the leachate collection system and towards the sump located in each cell. The aggregate layer will be mounded over the leachate collection pipe to maintain a 300mm depth across the landfill cell. The hydraulic conductivity of the drainage layer will be greater than 1x10^{-3}m/s. The aggregate shall consist of clean, virgin aggregate (blue metal), free of organic matter, lumps of clay, or other deleterious material and be free of fine-grained material. The maximum particle size of the cell floor drainage material shall be no greater than 37.5mm.

viii. A final geotextile layer will be placed over the aggregate layer before any waste is placed in the landfill cell. The separation geotextile is installed to provide separation of the waste and the aggregate drainage layer.

ix. Once the landfill lining system is in place, a layer of waste will be emplaced to commence filling of the first cell.

All of the above features will be constructed in accordance with the construction specification. A compliance report will be submitted at the end of the construction phase to ensure that all standards are met in the construction of the landfill lining system.

Components (ii) and (iii) of the liner system comprise a leakage detection system and will be installed between the GCL and the 500mm compacted base. They will be regularly monitored to ensure no movement of leachate between the landfill and the base (see Section 7.2.7).

Protection geotextile specification revisions

Following a further information request by DWER, additional information regarding the specifications of the geotextile cushion material was provided by the Applicant on 6 December 2018. The Applicant advised that a performance-based standard approach for assessing the adequacy of the protection (cushion) layer for the HDPE liner element in a new landfill cell will be adopted in the design of Cell 1 with the current proposed specifications as follows:

"The protection geotextile shall be a non-woven needle punched continuous filament polyester, polyethylene or polypropylene fabric that complies with the properties below:

Table 15: Material properties for protection geotextile

Property	Test Method	Value (MARV)
Wide Strip Tensile Strength	AS 3706.2 / ASTM D 4595	≥ 52 kN/m
Trapezoidal Tear	AS 3706.3	≥ 1200 N
CBR Burst Strength	AS 3706.4	≥ 9000 N
CBR Puncture Strength	AS 3706.5	≥ 4000 N
Grab Tensile Strength	AS 3706.2	≥ 4000 N

MARV = Minimum Average Roll Value representing a confidence level of 97.5% of test results meet the required value

The geotextile shall be UV stabilised to retain at least 50% of the trapezoidal tear strength when tested for 500 hours exposure in accordance with ASTM D 4355 (2002), where the geotextile is exposed to sun during construction for less than 2 weeks. Where the protection geotextile is proposed to be exposed to the weather longer than two weeks, the geotextile supplied shall be suitable for long term exposed conditions and subject in writing by the Superintendent".

"Notwithstanding the minimum requirements specified in Table [10] above, the Contractor

shall perform a geotextile liner protection evaluation (pressure plate test) using ASTM D5514-06 and laboratory approved by the Superintendent. The Contractor shall provide the results of the liner protection evaluation to the Superintendent prior to its procurement of protection geotextile".

"The liner protection evaluation shall be performed with the test parameter and materials specified in the table below.

Table 16: Test parameters and materials for liner protection evaluation

Test Parameter / Materials	Requirement
Test pressure (basal)	640kPa
Test pressure (side wall)	320kPa
Test duration	24 hours
Geomembrane material	Geomembrane conforming with the requirements of the Specification
Gravel material	Leachate drainage layer material conforming to the requirements of the Specification. The Contractor may consider testing varied drainage aggregate sources.
Geotextile material	Protection geotextile conforming with the requirements of the Specification or as necessary to pass the test. Note that multiple layers of Protection geotextile are not preferred – the Contractor shall include a Basal Sand Layer should a single Protection geotextile layer prove inadequate.
Basal sand protection layer (if required)	Should a single Protection geotextile layer prove insufficient to meet the performance requirements, a 200mm Basal Sand layer conforming with the requirements of the Specification shall be included.

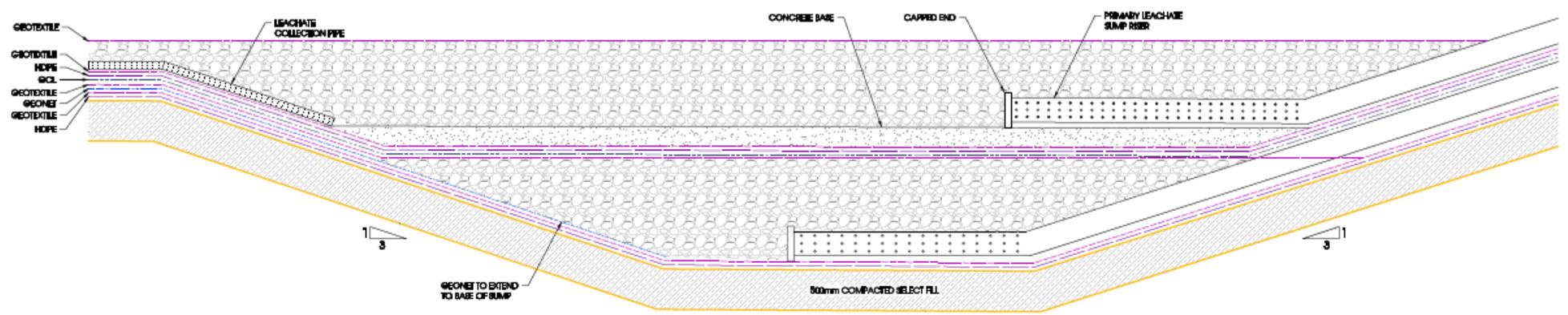
The maximum strain recorded in the liner protection evaluation shall be:

- *Basal layer 3%*
- *Side wall 4%*

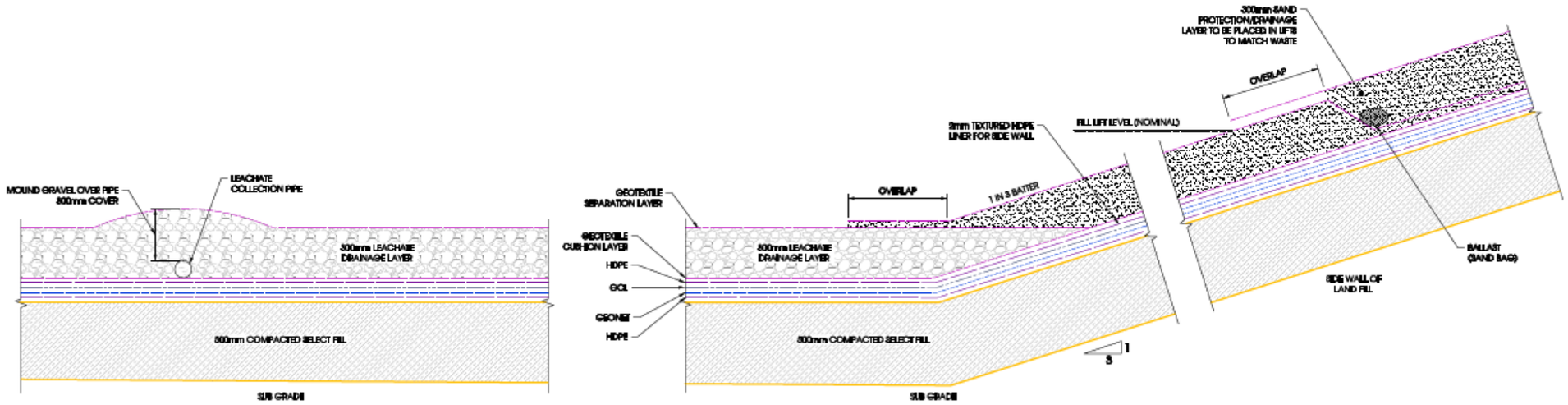
These strains allowing the potential for use of textured geomembranes to improve basal stability, and the potential operation of a bioreactor with associated elevated basal temperatures. The Contractor shall provide protection geotextile or protection geotextile + sand layer to achieve the specified maximum strain criteria, notwithstanding the minimum requirements specified above. The Contractor shall note that it is considered unlikely that a Protection Geotextile alone will meet the strain criteria for the Basal layer".

Key Findings:

1. The Applicant proposes to use a dual liner with an underlying leachate detection/capture system in receiving wastes that meet the acceptance criteria for Class II landfills.
2. The proposed landfill configuration has been stipulated in MS 796 with some minimum specification requirements (see Section 0).
3. There has been some variation to the configuration approved by the Shire of Gingin Local Planning Scheme No 9 – Special Use Schedule (see Section 2.3.1) in that the permeable layer above the leachate detection system now proposes to use a synthetic drainage layer ('secudrain') instead of 200mm of sand. The design provided has not considered how any leakage will be captured; the drawing (Figure 20) shows a pipe will be connected to this layer but no further detail is provided on the design.
4. This alternative geosynthetic leakage detection layer could compromise GCL performance because, for GCLs to operate effectively, they need to be make full contact on the underlying material to ensure and maintain hydration without scope of bentonite being eroded into the underlying layer should there be a leak in the liner. This concern can be mitigated through the use of a coated GCL, with the coating facing downward towards the secudrain.
5. There is uncertainty as to whether the 650g/m^2 geotextile is a strong enough cushion layer, to withstand deformity and protrusions without compromising the liners. The Landfill Engineering, Naue Geosynthetics product guide suggest that in their experience, 3,000g/m^2 is an appropriate for non-woven protection layers with up to 50m of waste confining stress imposed on the layer.
6. Figure 19 and Figure 20 indicate that 300mm of sand will be placed in the lifts as a protection/drainage layer. The Delegated Officer considers that sand is generally not an appropriate drainage medium and that the sand would need to be a very coarse/clean sand to meet permeability of less than $1x10^{-3}$m/s. Sand of this nature is also likely to be unstable on a 1:3 slope. The risk of sand clogging increases forces applied to side batters which may result in slumping.
7. The Applicant has provided limited specifications of liner materials and the demonstration of acceptability for selection which will result in regulatory controls being imposed on the Works Approval Holder to ensure the lining achieves the required outcome without compromise. Where risk justifies; specific testing and demonstration of suitability of materials will need to be provided prior to construction.



TYPICAL LEACHATE SUMP DETAIL
NOT TO SCALE



TYPICAL BASE AND SIDE LINER DETAIL
NOT TO SCALE

ISSUED FOR INFORMATION ONLY

NOT FOR CONSTRUCTION

						SCALES AS SHOWN	
						JOB No.	118061-05
						DATE	NOV 2018
						DESIGN	MJC
						DRAWN	BK
						CHECKED	MJC
A	ISSUED FOR REVIEW	16/11/18	BK	MJC	IR	APPROVED	IR
No.	DESCRIPTION	DATE	DRAWN	CHECK'D	APPR'D		

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FERNVIEW ENVIRONMENTAL
PROPOSED LANDFILL DEVELOPMENT APPLICATION

LANDFILL DETAILS - SHEETS 1 OF 2

007

SHEET SIZE A3 REV. A

SHEET 1 OF 1

Figure 19. Landfill liner details drawing 1

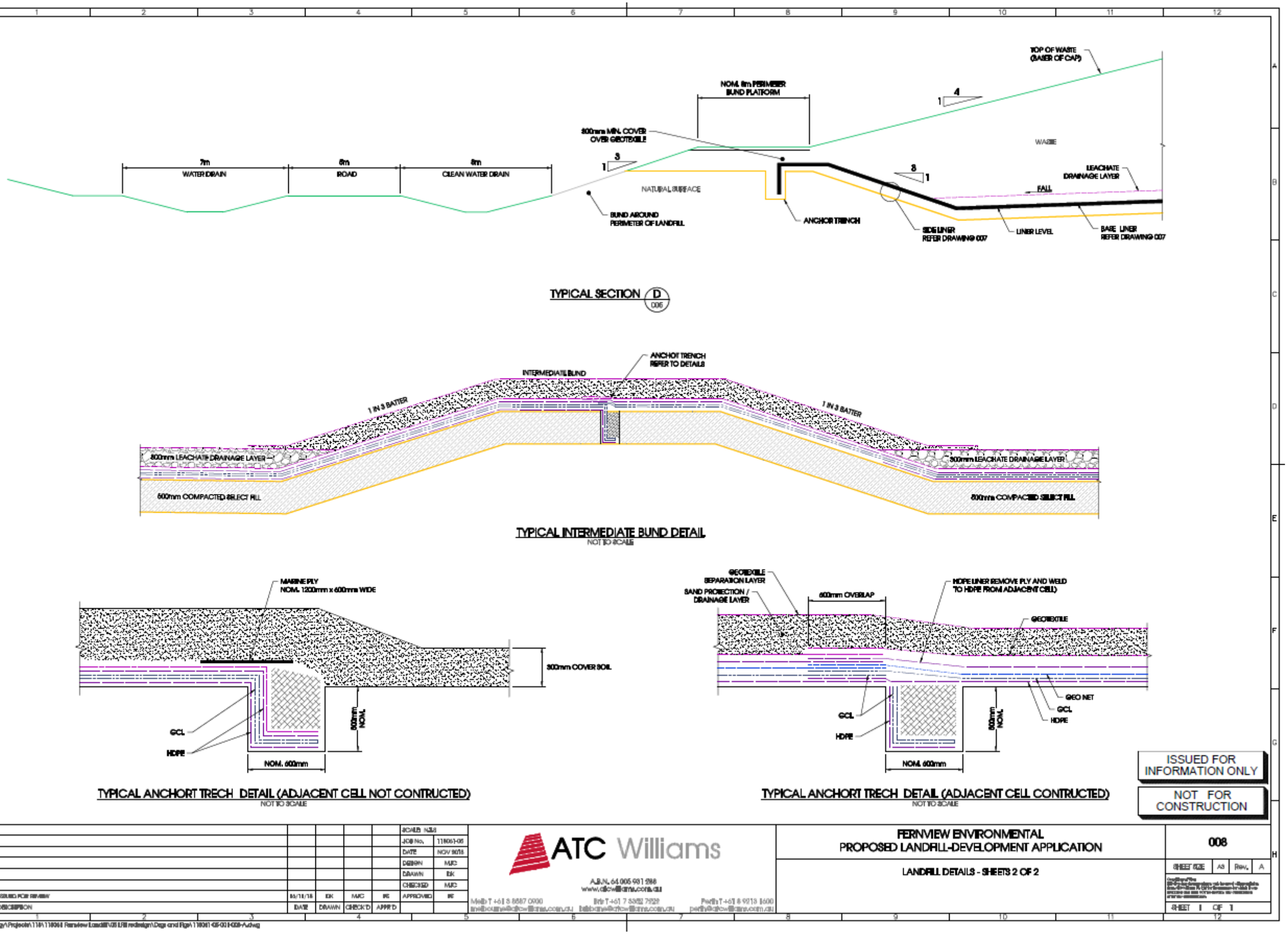


Figure 20. Landfill liner details drawing 2

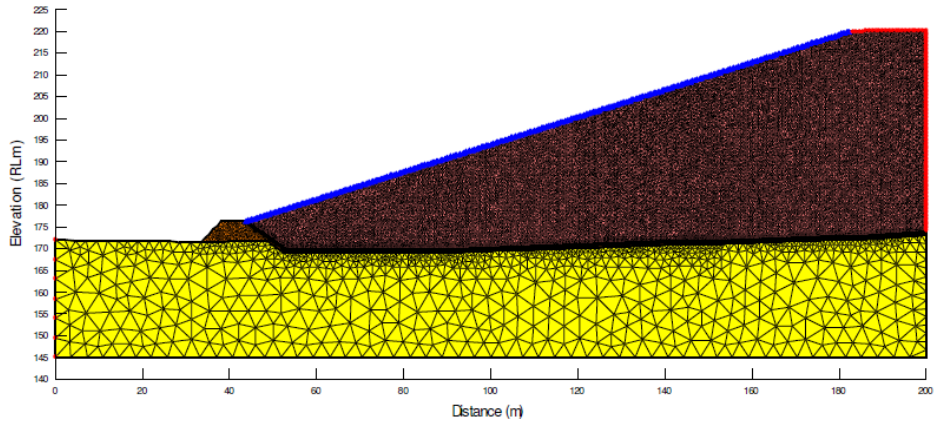
7.2.2 Assessed Landfill liner performance

Seepage Modelling

The original Works Approval Application provided a document titled “Assessment of Bio-Reactor Landfill Integrity” by Allan Watson Associates, July 2007 which included a seepage analysis of the leakage rate for the proposed landfill liner. It is noted that there are slight variations in the proposed landfill liner compared to the above assessment, specifically, an additional HDPE liner above the sub-base before the GCL layer is proposed by the Applicant as part of this Application. No additional modelling has been provided as part of this Application despite this change.

The seepage analysis comprised computer-based numerical seepage modelling using the SEEP/W finite element package formulated on the basis of Darcy’s Law for both saturated and unsaturated flow. The model configurations analysed are shown diagrammatically in Figure 21 below.

Plate 2 – Seepage Model Configuration



Details of the model liner configuration setup (not to scale) is shown below:

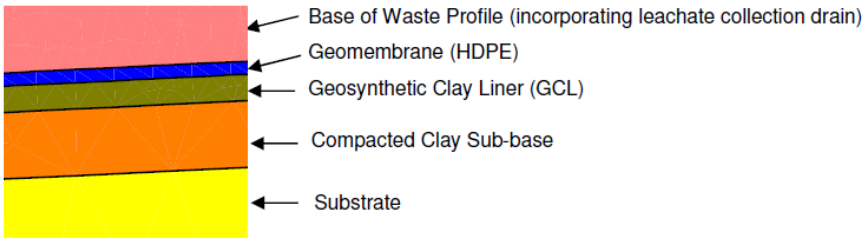


Figure 21. Seepage model configuration

Table 1 – Model Parameters Adopted for Base-Case Analysis

Component	Dimension Thickness	Permeability (k_{sat})	Comment
Waste profile	0m to 48m	10^{-4} m/s	Inferred value derived from Tchobanoglous *et al* (1993).
Drainage Layer	300mm	10^{-4}m/s	Lower bound for drainage aggregate (Typical range 10^{-2} to 10^{-4}m/s)
Geomembrane (HDPE) liner	1.5mm	10^{-14} m/s	Giroud *et al* (1988) indicates equivalent permeability for HDPE geomembrane of 10^{-15}m/s. Permeability of 10^{-14}m/s has been conservatively adopted.
Geosynthetic Clay Liner (GCL)	5mm	3×10^{-11} m/s	Refer **Section 1.1** and **Appendix A**.
Sub-base	500mm	2×10^{-8} m/s	Consistent with conventional practice
Foundation/Subgrade	n/a	1.8×10^{-5} m/s	Considered typical of sand material making up the subgrade beneath the bio-reactor landfill footprint.

Figure 22. Model parameters adopted for base-case analysis

Steady state leakage rates through the liner were predicted using the seepage model and base-case parameters outlined in Figure 22. A leachate head of 300mm above the liner was adopted. Based on these conditions, a leakage rate for the base of the liner configuration of 0.025L/day per unit width along the model section, was been calculated with a total estimated leakage rate of the base of the liner was 1.5L/day. Averaged over the total proposed footprint of the landfill, an equivalent leakage rate of 0.05L/ha/day was calculated.

Sensitivity analysis was also undertaken to assess the impact on leakage rates from variations in key model conditions, including those identified in Figure 23 below.

Condition	Purpose/Response	Variation in Model Parameters	
• Leachate level (head)	Reflects the extremes in leachate management practices, with leachate level increasing as these practices deteriorate.	Increase as follows:	
		Leachate Level (Head)	**Equivalent Elevation**
		0.3m (Base-Case)	RL 170.3m
		0.9m	RL170.9m
		2.0m	RL 172.0m
		6.0m (Top of Clay Bund)	RL 176.4m
• Equivalent permeability for (HDPE) geomembrane	Reflects loss of integrity of the geomembrane liner, being quantified in terms of increase in permeability.	Increase as follows:	
		Base-Case	10^{-14}m/s
		Minor geomembrane flows	10^{-11}m/s
		Severe geomembrane damage	10^{-9} m/s

Figure 23. Key model condition variations

Results of the sensitivity modelling are shown in Figure 24 below.

Table 2 – Summary Results of Sensitivity Seepage Modelling (expressed in equivalent L/ha/day)*

Leachate Level (Head)	Variation in Geomembrane Permeability		
	Base-Case (10^{-14}m/s)	Minor Flows (10^{-11}m/s)	Severe Damage (10^{-9}m/s)
0.3m	0.05	8.7	9.6
0.9m	0.16	27	-
2m	0.36	67	-
6m	1.3	600	750

*Analysed as leakage from the base of the liner configuration.

Figure 24. Summary results of sensitivity seepage modelling

The modelling indicated that *"under benchmark operating conditions (i.e. by maintaining a leachate level of 0.3m depth), leakage rates of less than 10L/ha/day are achieved for the range of geomembrane permeability"*.

DWER's Environmental Sciences Branch reviewed this document and additional information provided by the Applicant during an assessment of the original works approval application and noted the following:

- The potential heterogeneity of aquifer sediments near the landfill site and the potential scale-dependence of hydraulic conductivity values in this area have not been acknowledged by the Applicant.
- The significant degree of uncertainty with the approach used to determine the hydraulic conductivity value assumed in the model of the unconfined aquifer has not been considered in a model sensitivity analysis.
- There is also a high degree of uncertainty associated with the longitudinal and horizontal dispersivity values assumed in the model. It was recommended that the Applicant carry out a sensitivity analysis on the effect on model output of varying longitudinal dispersivity over a range of approximately 10 to 100m.

Key Findings:

1. Based on the proposed design of the leachate extraction system of the landfill, it is likely that leachate heads would be higher with the potential to be exacerbated with the recirculation of leachate through the waste. It is not clear if this has been factored into the seepage modelling.
2. The Application does not consider how the contaminant plume may impact on the overall quality status of the aquifer, especially when the leakage will be cumulative for some contaminants (i.e. those that will not naturally degrade) and does not consider whether there are any groundwater dependent ecosystems that may be impacted.
3. The EPA considered ground and surface water quality to be a key environmental factor relevant to the assessment of the proposal and imposed ministerial conditions to mitigate the risk to waters (see Section 0).

Surface water management

Contaminated surface water generated during the operation of the landfill from rainfall falling within active cells of the landfill will be controlled in the same manner as leachate via the leachate collection system, landfill lining system and the cell perimeter bunding. The surface water management system will be separate to the leachate management system.

The Application states that given the sandy, porous nature of soils on-site, there is low potential for surface water flows to be generated. Drainage structures will be sized to meet landfill best practice design requirements.

Uncontaminated stormwater runoff (not contaminated by the active landfill and/or uncapped cells or leachate storage ponds) will be prevented from entering the active cells with the construction of surface water/stormwater diversion drains at the perimeter of the cells. Uncontaminated runoff from rainfall falling on capped areas of the landfill will also flow into surface water diversion drains. The Application states that the surface water/stormwater diversion drains will be designed for a peak flow rate for the catchment by landfill best practice, suggesting that the design of the drains has not yet been finalised.

The drains will direct the stormwater to unlined retention/sedimentation ponds for evaporation, infiltration and re-use on site (e.g. dust control or irrigation of revegetated areas outside the landfill area). The retention/sedimentation pond will be located down gradient to facilitate the passive collection of any surface waters from the Premises. The ponds will be designed to trap sediment and act as a detention basin during peak storm flows. The pond will be maintained to prevent excess silting.

The Application states that surface water contained within the sedimentation/retention ponds will be monitored on a quarterly basis. Parameters monitored will include:

- total dissolved solids
- total suspended solids
- turbidity
- pH
- electrical conductivity
- nutrients (nitrogen and phosphorous)
- ammoniacal nitrogen and
- total petroleum hydrocarbons.

This monitoring regime may be reduced following a 12 month period.

The Application states that:

> *"Where monitoring indicates elevated nutrients or other contaminants in the sedimentation pond, a contingency plan will be implemented and the general approach to this contingency plan will be as follows:*
>
> - *identification of the type of contamination;*
> - *assessment of the potential environmental impact;*
> - *isolation and rectification of the source of the contamination and redirection of the flow to leachate storage ponds if possible until rectified;*
> - *assessment and implementation of appropriate treatment for contamination;*
> - *further monitoring of the source of contamination;*
> - *undertake measures to rectify the source of contamination.*
>
> *All monitoring results will be recorded and reported to DWER annually. Where an anomalous result is identified, the sample will immediately be directed for analysis in a NATA registered laboratory and investigations implemented to identify potential causes for the anomaly".*

Additional information provided to DWER on the 16 November 2018 and 6 December 2018 resulted in revisions to the sediment pond design (see Figure 9). The revised sediment pond (clean stormwater pond) incorporates a decant structure (with valve) to allow the pond to be empty by gravity, while still enabling containment if desired (by shutting the valve). A spillway has also been incorporated for high-flow situations.

7.2.3 Stormwater pond sizing

On 15 January 2019, the Applicant provided that stormwater management for the Fernview Landfill is based on:

- Shaping of the final landform to allow for positive surface water drainage;
- Encouraging sheet flow when possible rather than concentrated flow-paths to manage surface erosion
- Maintaining separation of 'Dirty' Site water (water which has been in contact with operational site surfaces), and 'Clean' water, which originates from external catchments but may traverse the site
- Conservative consideration that up to 4 landfill cells (assumed to be interim capped) may contribute the catchment area of 'Dirty' water
- Control and containment of rainfall runoff from site affected areas, for a minimum 1-in-20-year (5% Annual Exceedance Probability, AEP) rainfall event as recommended in Section 6.5.1 of the VIC Landfill BPEM.
- The structure should also be able to avoid catastrophic damage in a 1-in-100-year storm event.
- The Australian Rainfall and Runoff data (data.arr-software.org) sourced for the site provides storm losses as follows:
    - Storm Initial Loss: 48.0mm
    - Storm Continuing Loss: 4.4mm/hr

The Applicant states that Based on the Intensity/Frequency/Duration (IFD) information sourced from the Bureau of Meteorology (BOM) with the appropriate storm losses applied, it is calculated that the catchment does not generate rainfall runoff. However the storm losses do necessarily apply to the modified landfill area. As such, the International Erosion Control Association (IECA) approach was adopted for the sediment basin design.

Sediment basin design:

The site's sediment basin was designed in accordance with IECA Guideline for sizing Type D basins. Figure 25 shows the key input data and assumptions, and outcomes of the design process.

Element	Factor
Basin Design (IECA)	
Dirty Water Catchment Area (after clean water diversions in place) This is based on assuming up to 4 interim capped landfill cells being able to report to the sediment basin at any one point in time.	12.15ha
Diverted Catchment Area	104.5ha
Rainfall Intensity (1yr, 120hr)	0.60mm/hr
Y% Value Selection	85% - Consideration that site runoff may be of poor quality.
Calculated Rainfall value (Y85%, 5-day)	26.6mm
Volumetric Runoff Coefficient	1.0 - conservative value for operational construction or landfill sites.
Calculated Volume of Settling Zone	3,232m³
Allowance for sediment storage	50% additional volume, or 1,616m³
Total Volume of Basin to Spillway Invert	4,850m³ (rounded)
Basin Internal Batter Slopes	3(H):1(V)
Basin Depth from Spillway (FSL)	1.2m
Basin Dimension - Length at FSL	114m
Basin Dimension - Width at FSL	40m
Freeboard depth	0.5m vertically from spillway invert to crest
Decant outlet system	Yes, with control valve
Spillway	**Factor**
Simplified Spillway Peak Discharge (2% AEP) (Rational Method)	1.9 cumecs
C10 runoff coefficient	0.74
Time of concentration	25 minutes
Rainfall Intensity	65.28 mm/hr
Spillway width (along embankment crest)	8m
Critical Flow Depth (2% AEP)	200mm

Figure 25. Sediment basin design details

Key Findings:

1. The Delegated Officer considers that drainage structures and surface water/stormwater diversion drains should be graded so as not to cause erosion.
2. The Delegated Officer considers that ponds should be sized to accommodate a 1 in 20 year storm event and should also take into consideration emergency performance in the event of a 1 in 100 year storm event.
3. There is potential for the infiltration of water through the sedimentation dams to act as a conduit for any leakage from either the leachate pond immediately upstream from the retention pond and the landfill itself.
4. Taking into consideration the average rainfall and evaporation rates for the area as well as the unlined nature of the sedimentation pond, the Delegated Officer considers it unlikely that sufficient water will be available for monitoring in the pond on a quarterly basis as detailed in the Application.

Leachate collection and management

7.2.4 Leachate collection system

The leachate collection system at the Premises will enable the collection of landfill leachate for recirculation and will also control the leachate head on the liner system.

The Applicant has provided that Leachate will flow by gravity through the 300mm leachate collection aggregate layer (which includes) leachate collection pipes to the cell leachate sump (see Figure 6 and Figure 20). There is a pump in the side-riser sump which extracts the leachate and directs it to the leachate storage pond.

The leachate collection piping will be flexible HDPE pipes or similar with an internal diameter of at least 150mm. The Applicant has advised that the leachate collection piping will be strong enough to maintain performance under the maximum loads likely to be imposed in service, complying with the requirements of AS 2566.1-1998. The piping will be perforated such that the size, frequency and layout of the perforations are sufficient to facilitate leachate inflow and extraction without clogging, prevent entry of drainage gravel and maintain adequate pipe strength.

Leachate collection piping will be placed on the floor at intervals of not more than 25m (running the length of the cell and will be laid at gradients of at least 1% longitudinally into the sump and 3% in the transverse direction. The piping will be joined using techniques and materials recommended by the pipe manufacturer.

The Application states that the leachate collection system will contain all landfill leachate at the facility even after closure of the landfill.

Following a revised stability assessment (see Section 0) and additional information provided to DWER on the 16 November 2018 and 6 December 2018 (see Section 0), some changes have been made to the landfill design including relocation of the overall landfill footprint to allow for the potential construction of a toe buttress in the future (post Cell 1). This shift is approximately 20m to the north and 10m to the east and setbacks from the western power line and sensitive environmental areas have been maintained.

Revised drawings received by DWER on 16 November 2018 identified a number of changes to the proposed leachate collection system. Justification and details of these changes were sought by DWER and additional clarification provided on 6 December 2018 as follows:

> *"The previous design incorporated a valley in the middle of the landfill (North-South) direction with landfill cells located on each side of the valley. This design layout drains leachate to the middle of landfill, including leachate collected in the leak detection layer. The centre of the landfill is also the deepest part of the landfill, where vertical leachate risers are subjected to significant amount of drag down forces from waste settlement from skin friction of the risers. This occurrence requires significant design consideration for the riser footing located on the base of the leachate sump.*
>
> *The updated design proposes a ridge in the middle of the landfill (north-south direction) with leachate draining to the edges of the landfill. There are multiple advantages to this design, summarised below:*
>
> - *Enables use of side risers, rising up along the sidewall that will minimise the drag down from waste settlement as the sumps are generally not* [as] *deep compared to the previous design.*
> - *The shallower sumps also allow for easier inspection of the sump riser, undertake maintenance works (e.g. servicing and/or replacement of the leachate pumps, use of cameras for inspection of the risers, etc.)*
> - *The shallower sump also reduces the amount of stress on the risers, concrete base*

and associated infrastructure (e.g. less pumping head requirements).

- *The edge sumps mean the leak detection sumps are also now on the edge of the landfill. This location of the leak detection sump means:*
    - *Each and every cell will have its own leak detection sump and sump riser, allowing easy access and inspection and to carry out maintenance works.*
    - *The entire leak detection system is within the composite liner system and there are no protrusions through the liners. Protrusions through any liner system are typically weak points as they are prone to breakages and leaks.*

  ATCW considers the revised design to have significant advantages over the previous design that would allow for better management of the leachate collection system, leak detection system and lesser stress on lining system in the landfill cell sumps".

The revised design is detailed in Figure 6.

Key Findings:

1. The Delegated Officer considers that the liner should be sloped into the leachate collection pipes which in turn should be sloped to the leachate collection pipes. These slopes should be a minimum three per cent to the pipes and one per cent to the sump.
2. Artificial drainage composite must be padded to prevent fines from entering the drainage layer and must be capable of resisting degradation from chemical attack, temperature and oxidation over the entire life of the landfill including sheer strength and interface friction with adjacent layers.
3. Correct CQA procedures and testing must be undertaken during installation of the leachate collection system and associated infrastructure.

7.2.5 Leachate recirculation

The leachate recirculation method will be used to re-hydrate the landfill cells and assist the decomposition of waste. Leachate will be continuously pumped out of the landfill cell via the collection system and back onto the landfill.

The Application provides that the leachate recirculation system for the proposed landfill will consist of the following elements:

- In areas of significant waste depth, slotted dispersion pipes may be installed in vertical bore holes 1m wide, backfilled with rubble;
- In areas close to the perimeter of the landfill, over bunds, slopes and shallow waste areas, horizontal leach drains will be constructed by excavating trenches within previously completed landfill lifts and burying horizontal slotted dispersion pipes in drainage aggregate and backfilling the trench with waste; and
- The leachate recirculation system will be connected to the rising main from the leachate storage ponds via portable pipework.

Leachate that drains into the sumps within each cell will be extracted through an automated system using a submersible pump placed down the sump. Leachate will then be recirculated into the landfill through a series of perforated pipes buried during landfilling or temporarily conveyed to the leachate ponds.

The Application states that leachate levels within the landfill will be controlled by regular monitoring of the leachate head on the landfill liner. The addition of leachate to the landfill will be carefully controlled, avoiding complete saturation of the waste, which can potentially impact on the stability of cells and also inhibit decomposition of wastes.

When leachate levels are high, the excess will be transferred to a leachate pond where it will be stored for recirculation, allowed to evaporate or be removed for treatment off-site by a licensed waste water treatment contractor.

The Application states that the recirculation system will be designed to ensure sufficient capacity to store and treat all leachate generated over two consecutive wet years.

In further information received 15 January 2019, the Applicant advised that leachate recirculation is unlikely to commence on the site until at least the commencement of Cell 3 due to insufficient waste mass being present. The sizing of the leachate pond has been based on the assumption that no recirculation of leachate will occur during the development of Cell 1 and 2.

Extraction of leachate from the landfill sumps to the leachate pond is a continuous process, driven by automatic pumps. This is the primary means by which the head on the liner is managed.

The activation of leachate recirculation is not automatic and is a conscious decision. Recirculation is likely to be an intermittent and ancillary landfill management tool, used to manage peak leachate flows, improve landfill gas recovery and for seasonal flow-balancing.

The physical infrastructure may include:

- Vertical slotted pipes
- Horizontal leach drains.

Key Findings:

1. Management of the leachate recirculation is not clearly defined in the Application. It is unclear at what leachate depth/head the switch from recirculation to leachate ponds will be made to ensure that a maximum leachate head of 300mm will be maintained.
2. Further information relating to leachate recirculation will need to be provided for assessment at the licensing stage to confirm the appropriateness of leachate recirculation.

7.2.6 Leachate level monitoring

The Application states that leachate levels within the landfill will be controlled by regular monitoring of the leachate head on the landfill liner. Typically, the maximum head of leachate on the liner will be limited to 300mm; however the level of leachate at the sump will be higher to protect the pump. To maintain a level of 300mm or less above the liner system, leachate will be pumped from the leachate collection wells for recirculation into the landfill mass and/or storage in the leachate ponds for potential treatment and evaporation.

The Applicant has advised that the operation of the leachate extraction pump is the primary control for the level of leachate in the cell. There will be a visual (flashing light) and telemetry (SMS) alarm to alert the operator should the pump in any of the sumps cease working for any reason.

Landfill leachate will be sampled from the leachate storage ponds on a quarterly basis. The baseline of the monitored parameters will include but not be limited to; visual appearance (colour, turbidity, free phase hydrocarbons, foaming), pH, electrical conductivity, heavy metals, nutrients (nitrogen and phosphorus), ammoniacal nitrogen, chemical oxygen demand and total petroleum hydrocarbons.

The monitoring of leachate volumes will determine the effectiveness of the capping and leachate management system and will continue for the period the landfill generates leachate.

Key Findings:

1. Increased leachate head increases the rate of leakage through the liner; as such the Delegated Officer considers it appropriate that conditions be included in an operational licence to ensure the leachate head remains within acceptable levels (i.e ≤ 300mm).
2. Monitoring of the leachate head on the landfill liner should be automated and continuous.

7.2.7 Leachate leakage detection system

The landfill liner comprises (bottom upwards) (see Figure 20):

- 500mm select fill
- HDPE
- Geonet
- GCL
- HDPE
- Geotextile cushion layer
- Leachate drainage aggregate/pipework
- Geotextile separation layer
- Waste

The initial proposal intended that the system would include a 200mm sand layer between the HDPE and GCL. This has been replaced with a permeable GeoNet sandwich due to difficulties in maintaining the stability of the sand layer during construction. The GeoNet sandwich will achieve the same purpose of the sand layer whilst maintaining structural stability.

The Applicant provides that the Geonet acts as a leakage detection layer, transmitting leachate to a leakage detection sump and pump. The media in this sump is leachate drainage aggregate. The activation of a cell's leakage detection pump will be the primary means of leakage control/minimisation of head on the secondary liner, although other strategies, such as not recirculating in that cell, could also be implemented. The Applicant notes that liner repair will not generally be feasible.

In the event of any leakage, the leachate will pass through the GeoNet and travel down into a separate collection sump at the down gradient end of the cell form where it will be pumped to collection and evaporation ponds.

The presence of leachate in the detection sump will signify a breach in the particular cell and necessary remedial measures will be implemented. In the event of deviation from normal function, leachate visual alarms located on the leachate risers will flash a red light indicating that leachate has reached its high level. Excessive leachate will be managed by recirculation through the landfill or tankering off-site by a licensed transporter in the event of an emergency.

7.2.8 Leachate storage pond

The Application proposes to incorporate a leachate storage pond into the leachate collection and recirculation system, located on the east of the south side of the proposed landfill area.

Leachate is proposed to be pumped from the base of the landfill through wells to the pond. The leachate pond will provide storage, if required, prior to recirculation into the landfill. The Application states that this offers the opportunity to buffer the pH of the leachate and also provide some additional treatment (e.g. aeration for leachate produced during the acetogenic phase), subsequently also controlling the leachate head on the liner system, however it has not been defined when this may be required or if progressed.

The Application states that the leachate storage pond will have the same lining system as the landfill which will include the following (see Figure 7):

- Earthworks formations to be occupied by the leachate ponds will be cleared of uneven, soft, or loose material and be prepared by re-grading and compacting as necessary to produce a stable formation;
- A 500mm compacted select subgrade will be created during the earthworks stage. The select fill will have a permeability of no more than $1x10^{-8}$m/s
- A 1.5mm thick, smooth HDPE geomembrane will be installed over the compacted select subgrade. The geomembrane will meet the physical and mechanical requirements of landfill best practice. The geomembrane will extend up the side slopes and tie into an anchor trench;
- A GeoNet layer will be placed to form a continuous protective layer across the geomembrane and to assist in detecting leaks from the above lining;
- A GCL will be installed directly over the GeoNet on the base and the sidewalls. The GCL will have a hydraulic permeability of less than $1x10^{-9}$m/s. The GCL will extend up the side slopes and tie into an anchor trench; and
- A 2.0mm thick smooth HDPE layer will be installed directly above the GCL. The HDPE will extend up the side slopes and tie into an anchor trench.

A loading pad will be constructed adjacent to the leachate storage pond consisting of a hardstand area bunded to capture potential spillage and return to the leachate pond. The Application states that this will provide the opportunity for off-site tankering of leachate in the event that the leachate storage pond approaches full capacity.

The Application states that the pond will be designed in accordance with landfill best practice maintaining a freeboard of at least 1m. It is also stated that the pond will be designed to ensure the system can store the volume of leachate expected to be generated over two consecutive (90^{th} percentile) years of rainfall, whilst also maintaining a freeboard of at least 1m. The Application notes that the pond will store the rainfall generated within the footprint of the ponds for a critical (1-in-100 year) storm event.

The Application states that probes are located in the leachate pond to identify high levels to prevent overflow and that accumulated sediment will be periodically removed from the evaporation ponds and disposed of in a secure landfill or other form of secure disposal facility.

Leachate volume will increase and decrease from the surface of the leachate pond via evaporation and incident rainfall respectively. If necessary, leachate will be tankered off-site for disposal at licensed disposal premises.

Revised drawings received by DWER on 16 November 2018 identified a number of changes to the proposed leachate pond. Justification and details of these changes were sought by DWER and additional clarification provided on 6 December 2018 as follows:

"The revised leachate pond geometry will enhance evaporation by being shallower than the previous design (by being rectangular). Note that our design review identified that using an updated water balance technique (e.g. as per latest NSW Landfill guidelines) as well as consideration of progressing capping/cell development, it may be possible to reduce the leachate pond volume somewhat from the previous 7,129m^3.

However, FE is not proposing any change to the previous leachate pond storage volume.

The revised leachate pond concept design also incorporates side-risers for leachate extraction and leak detection, as well as a slightly modified leak detection sump that is easier to construct".

The revised design of the leachate pond is detailed in Figure 7.

Key Findings:

1. The Applicant has not provided a hydrogeological assessment of the potential for impacts of leachate from the leachate pond on local groundwater quality.
2. The storage ponds should be lined to the same standard as the landfill to prevent seepage into groundwater.
3. A minimum freeboard should be maintained and conditioned for in an operational licence to prevent overtopping (e.g. by wave action) and to provide capacity for unforeseen events.

7.2.9 Leachate pond storage capacity

Waste will be exposed to rainfall at the tipping face and when it is awaiting covering or capping. The Application proposes that approximately half of the rainfall on the Premises will produce leachate when the tipping face is exposed. The leachate produced from direct rainfall under a closed/capped area of the landfill is proposed to decline significantly over a five year period when leachate is not being recirculated.

The Application includes calculated values for the worst case scenario in which leachate can be produced from a 1 in 100-year storm event for 24 hours. The calculations have been based on the Basha Equation for an area of 4ha with no evaporation occurring. Table 17 below (Table 3.1 in the Application) provides the Applicant's leachate storage calculations.

The original Works Approval application submitted for the proposed landfill (included as an attachment to the Application) used the Hydrological Evaluation of Landfill Performance (HELP) Model to calculate the production of leachate over an entire year. The resulting leachate was calculated to be 3.9ML/year (3,900m^3/year) for the intermediate cover and 8.5 ML/year (8.500m^3/year) for the daily cover. In comparing the quantities, the Applicant determined that the leachate pond should be constructed based on the worst case scenario for a 24 hour storm event with the capacity to contain 7,129m^3 of leachate.

The Application states that the dam size for leachate storage is modelled from these calculations and will include a 1m freeboard above that of the 7,129.6m^3 storage capacity. The pond will also be required to store the rainfall generated within the footprint of the pond for a critical storm event. As such, a pond size of approximately 10,000m^3 was determined by the Applicant, inclusive of a 1m freeboard above the greatest capacity.

Table 17: Leachate storage calculations

Tc (hrs)	L (mm/hr)	Qi (m^3/s)	r	Vi (m^3)	Vs (m^3)
1.0	46.2	0.5133	1.0000	2464.0000	2464.0000
2.0	28.9	0.3211	1.0000	3082.6667	3082.6667
3.0	21.9	0.2433	1.0000	3504.0000	3504.0000
6.0	17.9	0.1989	1.0000	5728.0000	5728.0000
12.0	8.4	0.0929	1.0000	5350.4000	5350.4000
24.0	5.6	0.0619	1.0000	7129.6000	7129.6000
		max Vs (m^3) = 7129.6000			

Revised leachate storage pond capacity

On 15 January 2019, the Applicant provided an updated water balance analysis, undertaken as per Section 2.3 of the VIC Landfill BPEM, to estimate the size of the required leachate pond.

Simulations were undertaken using the Hydrologic Evaluation of Landfill Performance (HELP). The first six years of the landfill operation were modelled assuming that zero leachate recirculation was undertaken during this period.

Modelling was undertaken based on the following assumptions:

- No up-catchment stormwater runoff reporting to the site
- No contribution from groundwater inflow
- No recirculation of leachate
- Storage of leachate within the landfill mass
- Waste filling occurred in cumulative 12m phases
- All profiles were consisting of bare ground
- The evaporative depth zone is 381mm
- Drainage quantities were collected in the gravel layer installed above the waste
- The general slope of the landfill floor is 3%
- No leachate leakage through the liner.

The leachate percolation output from HELP assumes drainage at the base of the landfill liner. To this end, interaction of landfill leachate and underlying sequences was not considered in the model.

For the basis of the HELP model, the Premises was characterised to have 6 years of varying stages as described in Table 18 below.

Table 18: Model staging description

Year	Average Cell Area	Details		Rainfall Percentile
		Cell 1	Cell 2	
1	18,100m²	Operational - 12.3m waste depth	N/A	50th
2		Operational - 24.7m waste depth		50th
3		Operational - 37m waste depth		50th
4		Interim Cap	Operational - 12.3m waste depth	90th
5		Interim Cap	Operational - 24.7m waste depth	90th
6		Final Cap	Operational - 37m waste depth	50th

The analysis against a median (50th) percentile) and a wet/peak period (90th percentile) allows a conservative approach. A level of conservatism has been placed on year 4 and 5, as it is anticipated that leachate generation will also be at its peak during these two stages.

The HELP model generated a series of results which allowed for the calculation, in relation to precipitation, of the percentage of leachate generated from a year of rainfall, leachate generated over the Stage 1 and Stage 2 landfill areas. These calculations can be found in Table 19 and Table 20 below.

Table 19 shows the precipitation, runoff and evaporation volumes per hectare per year.

Table 19: HELP model results

Stage/Year	Precipitation (mm)	Runoff (m^3/ha)	Evaporation (m^3/ha)	Est. Leachate Generation (L/ha/year)
1	599mm	370	3,005	770
2	599mm	370	3,006	674
3	599mm	370	3,006	570
4	667mm	3,155	5,329	1,489
5	667mm	3,155	5,328	1,213
6	599mm	2,569	576	570

Table 20: Estimated leachate generation quantities

Stage/Year	Est. Leachate Generation (m^3/year)		Est. Total Leachate Generation (m^3/year)
	Cell 1	Cell 2	
1	1,395	-	1,395
2	1,220	-	1,220
3	1,032	-	1,032
4	944	1,752	2,696
5	944	1,252	2,196
6	0.0001	1,032	1,032

The Applicant noted that operational practices strongly influence the amount of leachate generated in a landfill and that the rate and total quantity of leachate reporting to the landfill base is also sensitive to the initial moisture condition of the waste.

A water balance analysis was undertaken to estimate the leachate pond size to manage (via

evaporation) the leachate estimated to be generated within the landfill.

Simulations were undertaken using the GoldSim model, run for a duration of 7 years.

GoldSim model inputs and assumptions were adopted based on recommendations in the Landfill VIC BPEM and NSW EPA (2016).

Water balance model results indicate a maximum water storage elevation of 1.2m, indicating the required freeboard allowance of 0.5m would be maintained.

Storage levels, assessed on a yearly basis are summarised as follows.

- For years 1 to 3, on average 1,000m^3 could accumulate in the storage. During wet sequences, up to 1,950m^3 could accumulate
- For year 4, a maximum storage volume of 2,500m^3 was modelled
- For year 5, some residual volume (500m^3 for average rainfall conditions) remains during the dry season.
- At the end of the 6th year, model results indicate no accumulated volume remains. For above average rainfall, during the dry season, some 200m^3 could remain in the storage caused by rainfall during the dry season.

The modelled storage volume and water surface elevation are depicted in Figure 26 and Figure 27 respectively.

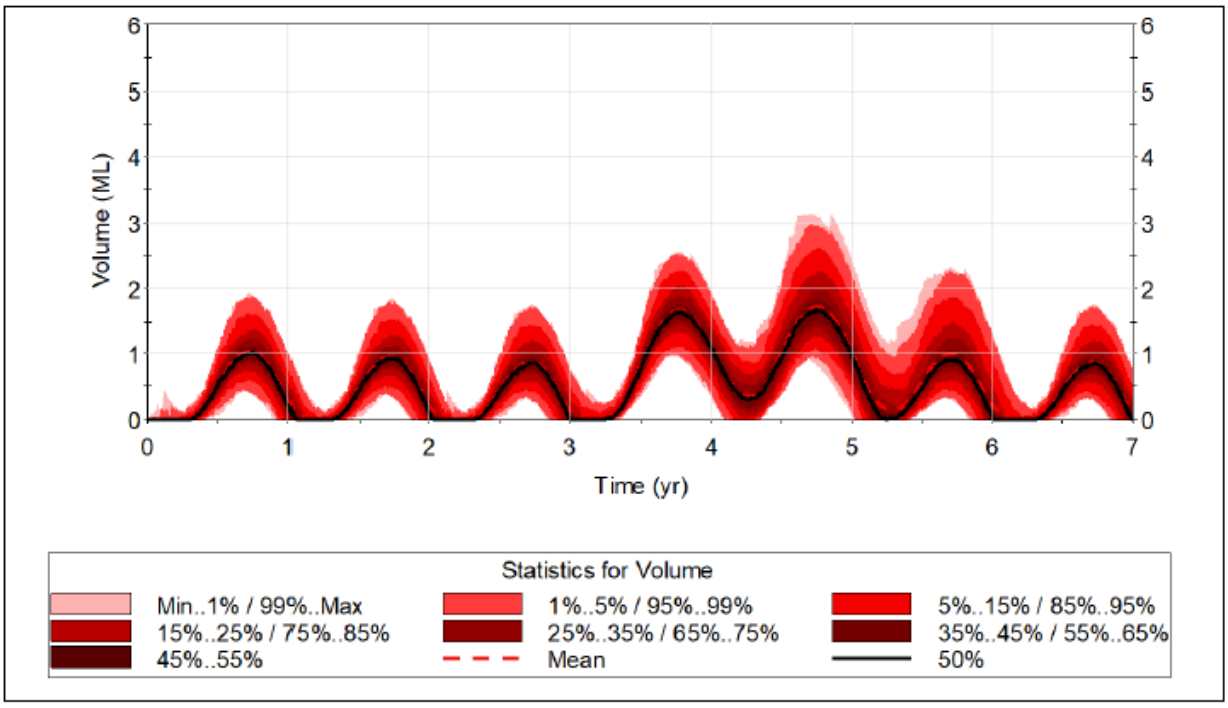


Figure 26: Modelled storage volume (Plate 5)

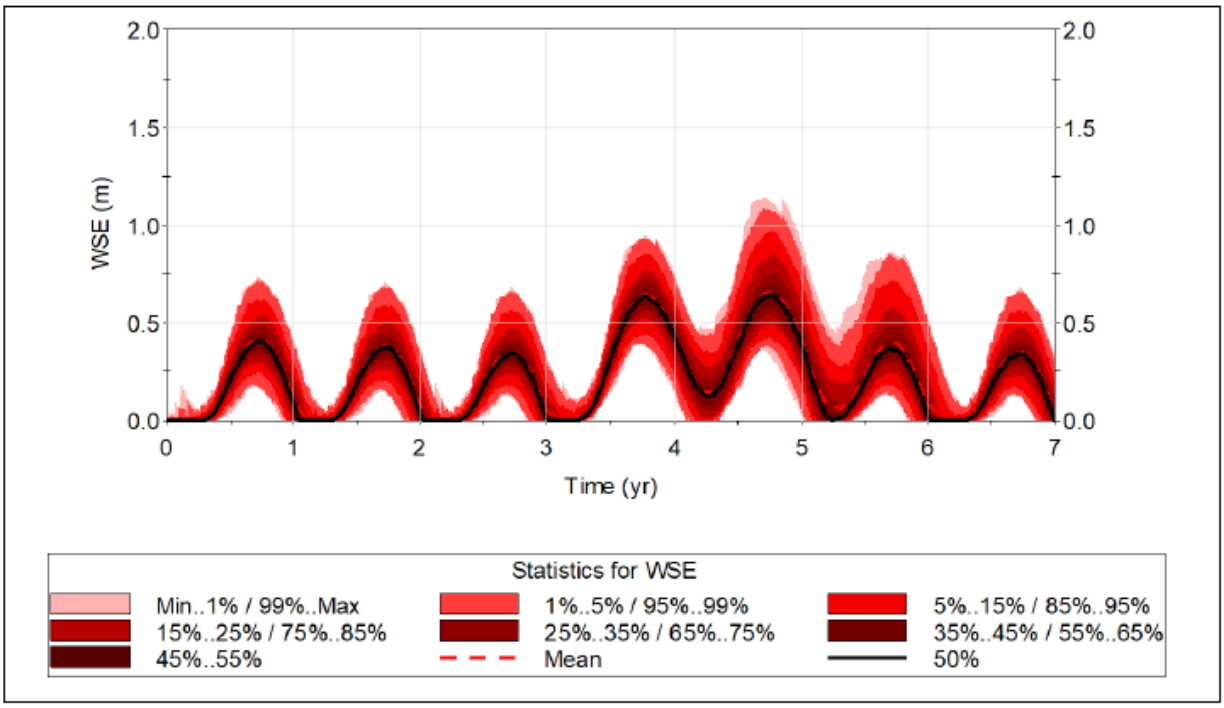


Figure 27: Modelled storage elevation (Plate 6)

The Applicant provided that this process identified that a lesser leachate pond volume (of approximately 6,100m^3) may be sufficient (even assuming no recirculation). However, to be conservative and minimise change, the original large volume of 7,129m^3 was maintained.

The leachate pond design also still allows for tanker removal offsite as a last resort.

7.3 Landfill stability assessment

7.3.1 Stability assessment

The Application states that the internal batter of the landfill would be 1 in 3 from platform to natural surface and the angle of repose for the sand material in situ is typically 1V:5H.

A landfill stability assessment has been undertaken by Allan Watson and Associates – Waste and Water Management Consultants utilising SLOPE/W Software to determine the factors of safety in the landfill design slopes having regard for both "circular" failures (within the waste mass itself) and "planar" failures (between the waste mass and the liner/containment system) (AWA Stability Assessment).

The assessment considered the following two key scenarios:

i. Final landform profile (External Batter)

ii. Internal/developing landform profile (Internal Batter), focusing on the contribution of the landfill liner/leak detection system on internal batter stability.

The assessment provided that:

> "*A general review of the proposed development configuration for the Fernview Landfill indicated that a combination between gross batter failure and failure of water management system would likely exist as a critical scenario. Failure of Landform Foundation is a less likely contribution to a critical stability condition given the integrity of the landfill base"*.

The principal conclusions from the landfill batter stability analysis completed in relation to the Fernview Landfill are as follows:

- *"The external landform configuration based on 5(H) to 1(V) batter slopes, is generally*

stable for the conditions adopted. A key influence on stability is friction angle for the waste material, although under lower bound conditions, the batter remains geotechnically stable.

- *Internal (interim) batters would need to be benched to maintain stable conditions. In general, such conditions would reflect appropriate landfill operating practice.*
- *As a final point, implementation of appropriate measures for leachate management are assumed as a basic operating requirements, recognising that elevated leachate levels contribute to reduction of batter stability as well as (most importantly) the potential for release of leachate to the environment".*

7.3.2 Stability assessment peer review

Golder Associates were commissioned by DWER to undertake a peer review of the landfill stability assessment undertaken by Allan Watson and Associates (AWA). A report detailing the findings of the review was provided to the DWER on 23 February 2018.

Key findings and recommendations from this review are as follows:

Input data:

- *"AWA has assumed that the geomembrane-soil interface will be the critical surface (i.e. lowest friction coefficient) within the liner configuration. No justification is provided for this assumption. A critical interface at the base of a liner system is concerning as no containment will be provided in the event of a failure. AWA adopted a friction angle of 15° for the critical interface based on a literature review. In our experience, it is optimistic to assume that all layers within the liner system will have an interface friction angle of at least 15°. Therefore, we recommend that a sensitivity analysis be carried out to assess the effect of lower interface friction angles on the stability of the landfill. Prior to construction, it is recommended that a suite of interface shear tests be carried out on the propped liner materials to check the assumptions regarding interface friction angles."*

Modelling:

- *"SLOPE/W is a widely used tool for the geotechnical assessment of slopes and is considered appropriate for use in this situation.*
- *The geometry of the model presented in AWA (2010) appears to be consistent with the current design presented in BA (2015a)* [Landfill Management Plan]. *The north-south section line used to model the landfill incorporates the maximum waste height and is considered appropriate for the analysis.*
- *The factor of safety of 1.5 used by AWA is considered appropriate for static (i.e. long term) loading conditions.*
- *The modelling by AWA has only considered static (i.e. long term) loading conditions. Consideration should be given to assessing pseudo-static (earthquake) scenarios in accordance with relevant Australian standards as part of the overall stability analysis.*
- *The modelling by AWA has only assessed failures within the waste material and along the liner interface. Consideration should also be given to assessing the stability of the natural cut slopes and capping layer under static and pseudo-static conditions. It is acknowledged that slopes of 3H:1V are likely to be stable, however this needs to be confirmed.*
- *The presence of leachate is not shown on the stability model or discussed in the accompanying report. AWA should confirm the assumptions made in the stability model regarding head of leachate assumed during operation, particularly noting that leachate will be recirculated during operations.*

- *As recirculation of leachate is planned to be performed throughout the life of the facility, consideration should be given to modelling a scenario that accounts for a build-up of pore water pressure in the waste and lining system due to failure of the leachate system.*
- *AWA have concluded that failure of the landfill foundation is less likely to cause a critical stability condition given the integrity of the landfill base. No details are provided by AWA on how they came to this conclusion, so we are unable to assess how appropriate it is. We note that there is no mention of a geotechnical investigation being conducted at the site in any of the information provided to us. If not already conducted, we recommend that a geotechnical investigation be conducted at the site to assess foundation conditions and provide data so that material parameters can be estimated for the natural ground.*
- *It is noted that the gridpoint with the lowest factor of safety on Plate 2a within AWA (2010) is located on the edge of the grid. AWA should confirm for all modelling that the grid assumed captures the critical failure surface".*

Recommendations:

Golder Associates recommended that the following be undertaken in order to adequately assess the stability of the Fernview Landfill:

- *"Complete a geotechnical investigation to assess the foundation conditions for the proposed landfill. Based on the expected soil conditions, this could comprise drilling several boreholes and standard penetration testing within the landfill footprint.*
- *Complete a suite of interface shear tests on the proposed liner materials, to estimate a set of parameters for the specific liner interfaces.*
- *Update the stability analysis to incorporate the following:*
    - *An assessment of foundation stability based on the results of the geotechnical investigation.*
    - *Revised interface friction angles for the liner components based on the results of the interface shear tests.*
    - *Assessment of pseudo-static (earthquake) loading conditions and assess landfill stability under this load case.*
    - *Analysis of the stability of the natural cut slopes and capping layer.*
    - *Confirm design assumptions regarding the leachate level for the stability analysis and model a scenario that accounts for a build-up of pore water pressure in the lining system due to failure of the leachate system".*

Stability Monitoring:

Golder Associates found that whilst the information provided to date was incomplete, it was considered unlikely that the landfill will have stability issues and in this case, considered that no ongoing stability monitoring would be required.

However, if a revised stability assessment indicated the potential for stability issues, then ongoing monitoring may be required.

Regardless, Golder Associates recommended that regular visual inspections of the embankments and cut slopes are carried out by a suitably competent person to identify any actual or potential issues that could impact the stability of the landfill.

Key Findings:

1. The landfill stability assessment has not considered a number of conditions and

aspects including pseudo-static conditions and an analysis of natural cut slopes and capping layers.

2. Ongoing inspections and monitoring of the stability of the landfill may be included as regulatory controls in an operational Licence for the Premises.

7.3.3 Revised stability assessment – April 2018

The Applicant provided DWER with a revised stability assessment on 17 April 2018 from ATC Williams addressing the recommendations made during the peer review of the AWA Stability Assessment.

As part of the revised assessment, additional slope stability modelling was undertaken to model different scenarios including:

1. A sensitivity analysis of the assumed interface friction parameters between the landfill elements;
2. Additional modelling incorporating earthquake accelerations (pseudo-static);
3. Additional modelling of the proposed natural cut slopes and final capping layers incorporation static and pseudo-static conditions; and
4. Additional modelling incorporating an elevated leachate phreatic surface within the landfill to model the condition where the leachate collection and extraction system fails.

Slope stability modelling and assessment of the proposed landfill sections was undertaken using the computer program SLOPE/W. The mathematical model adopted in the analysis was Morgenstern-Price. Table 21 identifies each model and the conditions which were adopted for each model in the revised assessment.

Table 21. Models analysed

Model	Analysis Reference	Description
1	A.1.A	Completed landfill with cap installed Critical interface of geosynthetic lining system (cap, side wall and base) of 15° Fully saturated leachate collection system
2	A.1.B	Completed landfill with cap installed Critical interface of geosynthetic lining system (cap, side wall and base) of 15° Leachate phreatic surface to crest of southern cell embankment
3	A.1.C	Completed landfill with cap installed Critical interface of geosynthetic lining system (cap, side wall and base) of 10° Fully saturated leachate collection system
4	A.1.D	Completed landfill with cap installed Critical interface of geosynthetic lining system (cap, side wall and base) of 10° Leachate phreatic surface to crest of southern cell embankment
5	A.2.A	Completed landfill with cap installed Critical interface of geosynthetic lining system (cap, side wall and base) of 15° Fully saturated leachate collection system horizontal seismic acceleration of 0.05g
5	A.2.B	Completed landfill with cap installed Critical interface of geosynthetic lining system (cap, side wall and base) of 15° Fully saturated leachate collection system horizontal seismic acceleration of 0.05g stabilising earthen buttress concept design on southern edge of landfill
6	B.1.A	Maximum height excavated surface of landfill void Natural soils only No perched groundwater
7	B.2.A	Maximum height excavated surface of landfill void Natural soils only No perched groundwater horizontal seismic acceleration of 0.05g
8	C.1.A	Maximum height excavated surface of landfill void Proposed lining system installed to full height No perched groundwater or leachate

The results for the modelling for each case are presented in Table 22 below.

Table 22: Modelling results

Model	Analysis Reference	FoS	Acceptable	Comment
1	A.1.A	1.63	Yes	A small rotational failure near the toe of the cap due to slight steepening of the cap as it intersects the side wall embankment
2	A.1.B	1.46	No	Larger rotational failure at a similar location to A.1.A due to the significantly elevated leachate phreatic surface. Whilst not likely to induce failure, emphasises the need to control leachate levels when considering stability (not considering seepage from the landfill)
3	A.1.C	1.63	Yes	A small rotational failure the same as A.1.A indicating that reducing the critical interface from 15° to 10° does not significantly impact this type of failure.
4	A.1.D	1.48	No	Larger rotational failure due to the significantly elevated leachate phreatic surface and reduced the critical interface from 15° to 10°. As with A.1.B, whilst not likely to induce failure, emphasises the need to control leachate levels when considering stability (not considering seepage from the landfill)
5	A.2.A	0.87	No	Applying an earthquake acceleration of 0.05g to A.1.A results in a significantly lower factor of safety. This failure mode indicates a large rotational and translation failure will occur impacting most of the landfill.
5	A.2.B	1.11	Yes	To stabilise A.2.A and increase the FoS, a concept design toe buttress was modelled with site won sand. This buttress is of significant size to achieve an appropriate FoS for this case, approximately 125m wide and 20m high. This will need to be further assessed and designed in the detailed design stage.
6	B.1.A	1.59	Yes	Shallow rotational failures of the cut sand surface are indicated in the model. Additional consideration of this case is needed as it is likely that the exposed sands will loosen and spall and easily erode due to rainfall or wind.
7	B.2.A	1.38	Yes	Shallow rotational failures of the cut sand surface are indicated in the model as with B.1.A with the FoS reduced due to the earthquake loading
8	C.1.A	1.21	No	Shallow rotational and translational failures of the sand drainage and protection layer overlying the geosynthetics indicated. Additional consideration of veneer stability and sliding of the materials is required and discussed further in **Section 6.11.**

The modelling indicated that further consideration of the landfill design and staging is required as part of the detailed design including:

- Detailed assessment of the construction materials (soil materials and geosynthetics) and their shear strengths and interface shear strengths;
- Further and detailed assessment of the earthquake loading condition and detailed modelling and design of a stabilising soil buttress along the toe of the cap, including the extents requiring stabilisation; and
- Further consideration and detailed design of the cap and side wall lining, drainage and protection system to ensure stability of the layers overlying the lining system.

Pseudo-static modelling indicated significant stability issues for larger scale rotational and translation failures impacting the majority of the final landform with a Factor of Safety (FoS) of 0.87.However, the inclusion of a concept design buttress increased the FoS to greater than 1.1 for pseudo-static modelling. The report notes however that this is a significant structure and needs to be appropriately designed during the detailed design phase or alternatives be

considered such as reducing the slope angle of the final landform.

Stability modelling of the natural cut batters indicates a FoS greater than 1.5 (Model B.1.A) under steady state conditions and greater than 1.3 under pseudo-static earthquake loading (Model B.2.A), however this modelling does not account for loss or erosion of the exposed cohesionless soils due to loosening, rainfall or wind.

The report notes that surficial erosion and slumping of the sand resulting from loosening or exposure to wind or surface water runoff can be expected. The impact of this erosion or slumping is not expected dramatically impact on the stability of the overall slope, however over time may reduce the factor of safety of the slope if not controlled. The report recommends that the amount of exposed cut sand surfaces should be minimised and the excavation of the landfill void undertaken in a staged manner to limit the amount of exposed cut faces.

The modelling of the final capped surface (including the proposed geosynthetic capping system indicates a suitable FoS of greater than 1.5 for the steady state condition (Model A.1.A and A.1.C) for interface friction of 15°) reducing to greater than 1.4 for the steady state condition (Model A.1.B and A.1.D for interface friction of 10°). The report recommends that further design and assessment of the capping system is undertaken as part of the detailed design including:

- Design, specification and interface friction testing of the materials for the capping system;
- Additional stability assessment (slope and veneer) or the final capping system and overlying soils; and
- Detailed assessment and design of the stabilising toe buttress, including geometry, extents and material specifications.

Veneer stability assessment:

A veneer stability assessment was also undertaken to consider the sand drainage and protection layer proposed to overlay the geosynthetic composite lining system.

This assessment indicated that constructing the side wall lining system to a maximum vertical lift height of 2m (or 6m parallel to the side wall batter) including overlying sand drainage protection layer, is marginally unstable (FoS of 1.04) and will likely result in the sand veneer failing and slumping. This FoS is likely to be significantly impacted (to below 1.0) by any rainfall saturation or rainfall or wind erosion of the sand layer.

Modelling found that reducing the lift height to 1m vertically (or 3m parallel to the side wall batter) was found to increase the FoS to 1.36. Including a seismic load to this case reduced the FoS to 1.14 which is considered suitable for the short-term event only.

The veneer stability assessment indicates that further detailed assessment of the side wall design is required during the detailed design stage to ensure appropriate construction lifts are adopted or the design is altered to improve stability of this veneer. Alternative options for increasing the FoS against veneer failure and subsequent lift height could be considered during the detailed design phase, such as decreasing the batter of the sand protection drainage layer, including geosynthetic reinforcement or using a material with higher shear strength.

The report notes that in relation to the drainage of the material, due to the free draining nature of the site-won sands proposed to be used, it is unlikely that this layer will become fully saturated when unsupported by the waste. If this layer becomes saturated when confined by the waste, the waste placed against this layer will provide confinement and support, reducing the potential for the sand layer to slump.

Key recommendations:

Key recommendations of the Revised Stability Assessment included:

- *"Appropriate selection of geosynthetics during the detailed design stage for the landfill, specifically, but not limited to the following items;*
    - *Geomembrane liners for the base, side walls and cap – texturing of the geomembrane liner, single or double sided texture;*
    - *Leak detection GeoNet – the GeoNet is able to withstand the waste loading (about 50m deep waste) without affecting its ability to drain leachate, the GeoNet does not damage the geomembrane liner and GCL adjacent to it;*
    - *GCL – appropriate design and selection of a GCL that is suitable to be left unconfined in the short to medium-term and is not susceptible to downslope bentonite erosion, including consideration of the GCL carrier geotextile when placed over a GeoNet drainage layer to protect the bentonite in the GCL;*
    - *Cushion geotextile – appropriate design and selection of the cushion geotextile to protect the geomembrane liners under the design surcharge loads so that the strain on the geomembrane liner does not exceed the allowable strain limits;*
    - *General consideration of geosynthetic materials when used in a bio-reactor landfill where average temperatures are higher than conventional 'dry tomb' landfills.*
- *Laboratory direct shear testing works under the expected design conditions to confirm and assess the interface friction between the liners using site specific materials for the entire lining system be undertaken to validate the assumptions used in this assessment. Where there is variation to the interface friction values adopted in the modelling presented in the report, the modelling shall be reviewed and reassessed.*
- *Further assessment of the site soils including additional boreholes, insitu and laboratory testing to confirm the shear strength values adopted in the modelling presented in this report.*
- *Consideration be given to the stability of the long side walls and potential need of benches to minimise the potential of slope failure as well as erosion protection of these slopes before the placement of the lining system;*
- *Detailed assessment and design of the stabilising toe buttress, including geometry extents and material specifications.*
- *Consideration for an alternate leak detection sump and leachate sump design and location".*

Key Findings:

1. Pseudo-static modelling indicates potential stability issues with a Factor of Safety (FoS) well below 1.0. The inclusion of a stabilising soil buttress along the toe of the cap increased the FoS to greater than 1.1 for pseudo-static conditions.
2. The veneer stability assessment indicated potential stability issues with the potential for failure and slumping of the sand drainage protection layer. In the absence of further detailed assessment from the Applicant, the unsupported sand protection layer will be limited to a maximum vertical height of 1m (or 3m parallel to the side wall batter).
3. The amount of exposed cut sand surfaces should be minimised and the excavation of the landfill void undertaken in a staged manner to limit the amount of exposed cut faces.

7.3.4 Revised stability assessment – November 2018

Further to the findings of the April 2018 stability assessment, further detail was requested from the Applicant in relation to the detailed design of the proposed stabilising toe buttress, including plans/drawings, location on the Premises, geometry, extent and material specification as well as details of how the construction of this will interact with the landfill cells. DWER requested that this information should be supported by a stability assessment demonstrating how this information has been modelled to demonstrate the buttress can achieve a satisfactory factor of safety.

A revised stability assessment was provided to DWER on 19 November 2019 which assessed the slope stability of the Fernview Landfill after the landfill footprint was re-located a small distance to accommodate the need for a stabilising toe buttress. The proposed landfill design was analysed for the following cases:

- Long Term Static Stability - The structures capacity to support the weight of the contained material as well as its self-weight. Drained parameters were adopted for the modelling works.
- Seismic Loading (Pseudo-Static Analysis) – A 1 in 500-year event ground acceleration was applied to the model. This corresponds to a horizontal seismic peak ground acceleration of 0.05g and vertical seismic acceleration of 0.00g, in accordance with AS1170.4 and AS4678-2002 *Earth Retaining Structures* (AS4678).

Three profiles through the landfill were selected for the stability assessment works.

- Section A, starts from the south-west corner through the centre of the landfill (highest point of the landfill), to the north-west corner, that includes the deepest cut profile into the natural surface to form the landfill void.
- Section B, was modelled on a typical north-south section of the landfill, located along the centreline of the landfill.
- Section C, starts from the south-east corner to the north-west corner of the landfill and represents the longest landfill slope across the landform.

The results of the stability modelling are summarised in Table 23 below.

Table 23: Summary of Stability Analysis

Section	Stability Case	Factor of Safety	Acceptable	Figure No.
A	Long Term Static, No Buttress	1.84	Yes	1
	Pseudo-Static Seismic, No Buttress	1.17	Yes	2
	Pseudo-Static Seismic, with Buttress	1.26	Yes	3
B	Long Term Static, No Buttress	1.37	No	4
	Pseudo-Static Seismic, No Buttress	0.91	No	5
	Long Term Static, with Buttress	1.76	Yes	6
	Pseudo-Static Seismic, with Buttress	1.12	Yes	7
C	Long Term Static, No Buttress	1.63	Yes	8
	Pseudo-Static Seismic, No Buttress	0.99	No	9
	Pseudo-Static Seismic, with Buttress	1.20	Yes	10

The stability analysis found that the modelling indicated section B was the most critical of the three sections assessed, with both the Long Term Static and pseudo-static conditions not meeting the minimum required FoS without a toe buttress.

Using the toe buttress design from the previous ATCW study as a starting point, the current works indicated a marginally smaller toe buttress was required to provide the required ballast to stabilise the waste mass at the new landfill footprint location. The minimum buttress size required for section B was approximately 29m high, about 55m wide at the base and 60m wide at the crest for the sections assessed. The buttress extends up to approximately RL 203m.

The Applicant has confirmed that the buttress crest is wider than the base because the crest has a grade on it to allow stormwater runoff. The Applicant notes that the base width would be very highly dependent on the grade of the existing surface (e.g. if it grades/falls away from the landfill, then the base width would be greater than the current layout and vice versa).

The buttress design for section A indicated a lower buttress height, of approximately 11m high, was required due to the higher existing ground elevation at that location. The buttress maintained similar base width of about 53m but wider crest of about 73m. The existing surface grades towards the landfill (e.g. falls towards the landfill), hence the 'narrower' base than the buttress crest.

The buttress design for section C was generally consistent with the design for section B, with a slightly shallower grade of 5H:1V compared to the 4.5H:1V for section C.

The reports stated that based on the stability assessment works undertaken, it appears that the buttress will not be required until at least after the filling of Cells 3 and 4, possibly longer. However, ATCW recommends that a detailed stability assessment be undertaken in the future to assess when the buttress is required and subsequent staging of the construction of the buttress. This detailed assessment would preferably be undertaken before Cell 4 is filled, but this timing can be reviewed later in the future.

The stability analysis assumed the buttress would be constructed using materials excavated to form the void of the landfill. If different materials are proposed for the construction of the buttress, additional stability analysis should be undertaken to review the stability of the waste mass.

ATCW noted that there are future considerations that will need to be considered prior to the construction of the buttress. These considerations include, but are not limited to the following items:

- Accessibility of construction vehicles along the crest of the buttress;
- The design of the landfill cap and its interface with the buttress design;
- Stormwater management on the buttress and the need to shed stormwater away from the buttress and not let it soak and/or infiltrate into the buttress and saturate it. Further stormwater management consideration includes an assessment for a need for subsoil drainage system to drain infiltrated stormwater so that it is allowed to drain away from the buttress and not saturate it.
- Selection of appropriate vegetation for the buttress to minimise erosion of the buttress materials and stormwater
- Development of an inspection and management plan, as part of the landfill's Rehabilitation Plan, to manage waste settlement and remedial works required to repair the buttress at these locations.

Key Findings:

1. The stability analysis states that “it appears that the buttress will not be required until at least after the filling of Cells 3 and 4, possibly longer”, it is not clear the justification for this statement.
2. The analysis indicates that the assessment has also assessed elevated leachate levels within the waste mass, however the assessment of this and discussion is not clear in the document.

Additional information clarification - 6 December 2018

Further clarification on the November 2018 stability analysis was requested by DWER based on the key findings above. A summary is provided below:

Figure 28 (Plate 1) indicates the three sections that were used for the stability assessment. The report notes that as Cell 1 is located in the south east corner of the landfill, the relevant section is section A. As waste will be laid back in Cell 1, the consultant considers section B is not applicable for Cell 1.

The further information clarifies that the assessment undertaken for section A considers the following conditions;

- The landfill is complete, i.e. the site is at the end of landfill operations.
- Elevated leachate levels, indicated by the blue dashed line (refer Figure 29 (Plate 2)), to the side wall crest of Cell 1. The consultant notes that this is a very conservative scenario as it is not common to allow leachate to build up to this level in a landfill. Furthermore, this ignores the impact that progressive capping will have on reducing leachate levels.
- Municipal Solid Waste (MSW) waste profile in a bioreactor (the actual waste profile may be dryer than typical MSW and include a greater proportion of inert waste)
- Pseudo-static conditions (earthquake conditions)

The assessment indicated the Factor of Safety (FoS) for this scenario is 1.25.

It is highlighted that the assessment indicated the potential failure mode only occurs when there is sufficient waste mass in the landfill and only occurs beyond the crest of the landfill waste.

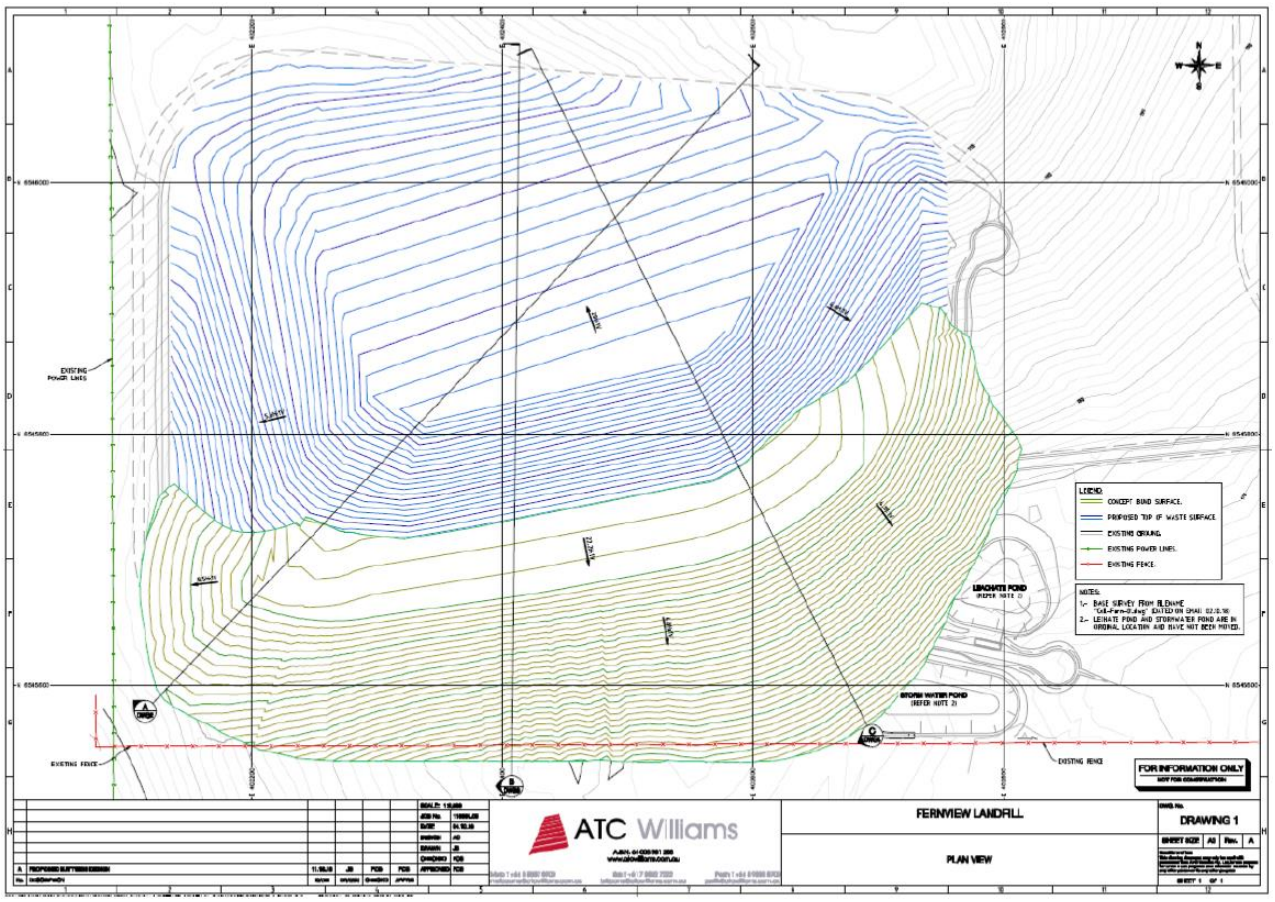


Figure 28: Stability sections

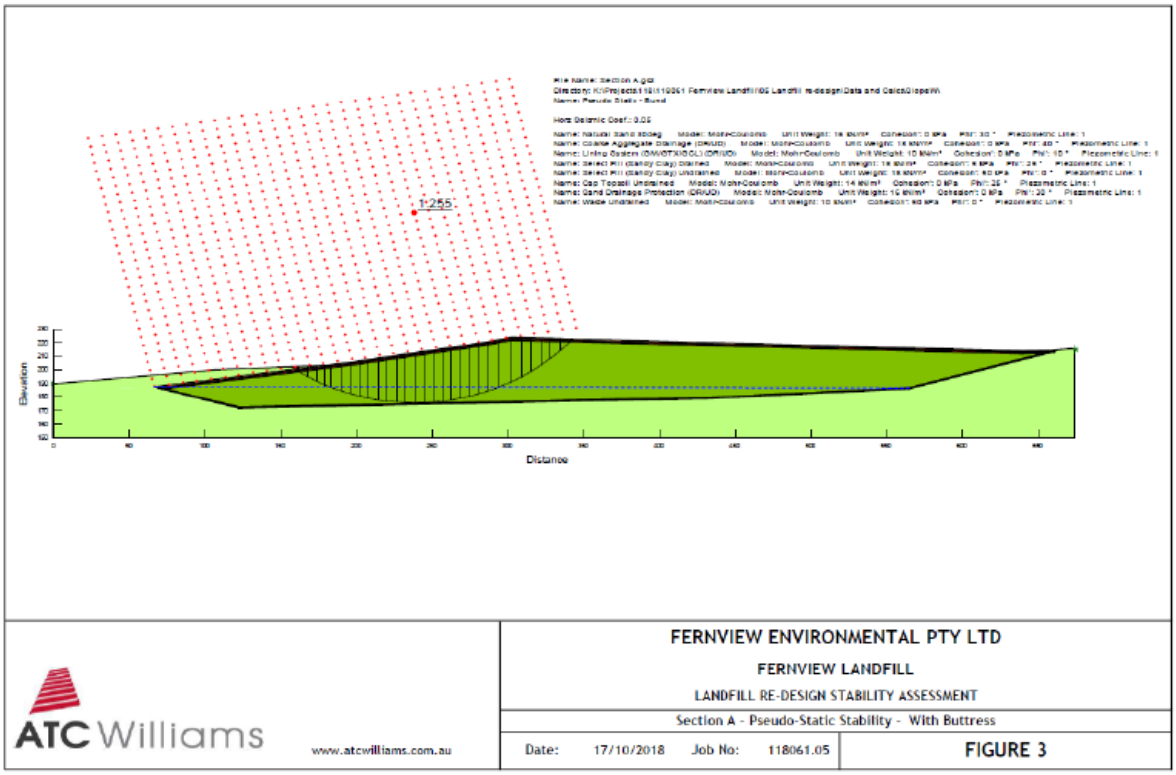


Plate 2: Section A - Pseudo-Static with buttress, FoS 1.25

Figure 29. Plate 2

In relation to Cell 1 and 2 filling, due to geometry, the waste mass in the landfill will not be sufficient to justify the need of the buttress as shown in Figure 30 (Plate 3) below. Figure 30 indicates the approximate extent of Cell 1 compared to waste levels once all the adjoining cells are constructed.

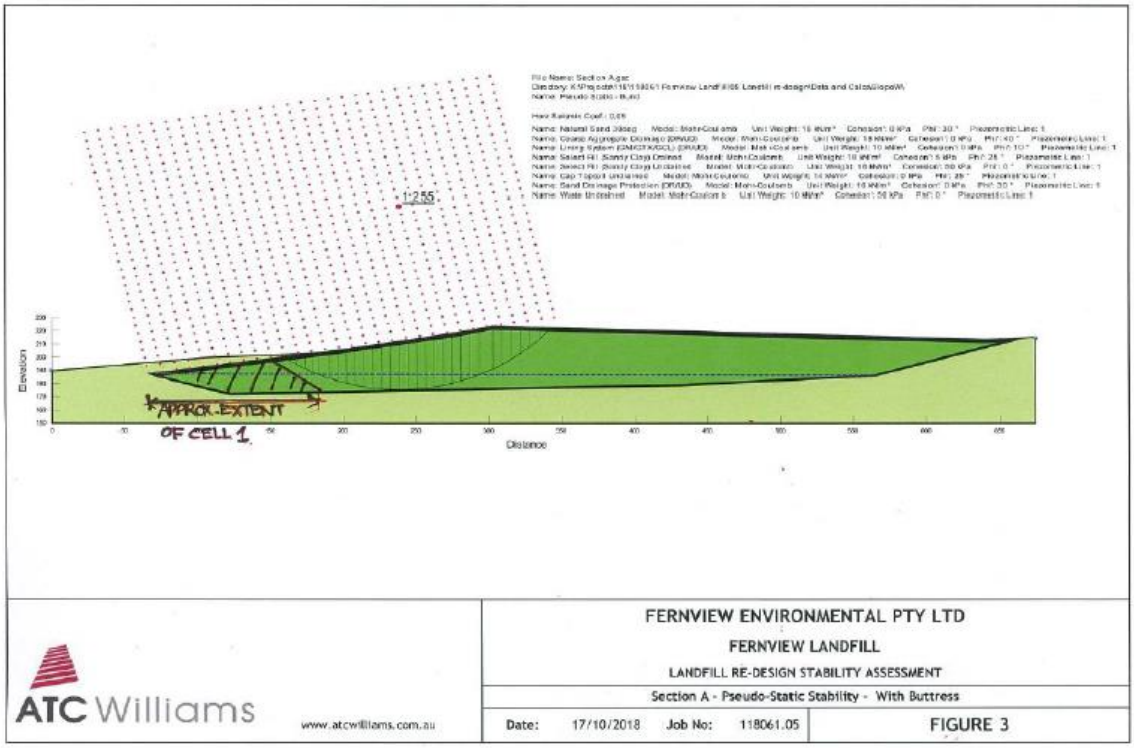


Plate 3: Section A - Approximate Extent of Cell 1 Waste (Cell 2 similar as adjacent)

Figure 30. Plate 3

The report states that based on the stability assessment previously undertaken and clarification provided in the memo, a buttress is not required for the stability of Cell 1 or Cell 1 in combination with Cell 2.

As per the stability assessment, once the actual operation of the landfill is underway (i.e post Cell 1, and likely not until after the filling of Cell 3 and 5). The consultant recommended that the timing and the need for the buttress is reassessed with an updated stability assessment, using actual site data (particularly leachate levels/waste types).

Key Findings:

1. It is unlikely that the stabilising buttress will be required until after the completion of Cell 1.
2. The Applicant will be required to undertake an updated stability assessment using actual site data prior to the construction of future cells.

Landfill cover requirements

The Application states that daily cover will be used at the end of every working day to cover the deposited waste. The cover material will typically be sand, soil or biodegradable sheeting. The Landfill Management Plan states that this material will either be from an approved on-site location or sourced from off-site. The plan states that soils should be applied to a minimum cover thickness of 230mm and if sand is used, the cover will be at least 300mm.

The daily cover may be scraped back before additional waste is placed on top and if this occurs, the daily cover will then be stored for reuse.

An intermediate cap or thickened daily cover material will be placed over waste which will be left for extended periods of time. Before placement of wastes over these areas, the intermediate

cap will be removed, and the surface ripped to prevent stratification within the waste body.

The Application states that an adequate supply of daily cover materials will be available on-site and the Landfill Management Plan states that at least two weeks cover material must be available at the waste facility under all weather conditions with two days of cover material available at the tipping area at all times. The exact quantities of cover material required have not been provided by the Applicant.

Landfill capping and rehabilitation

The Applicant intends that the Premises is rehabilitated and returned to grazing, together with native planting following the landfill closure. A Landfill Decommissioning and Post Closure Management Plan (LDPCMP) has been provided as Appendix 5 of the Application, setting out the proposed process by which operational landfill areas will be progressively shut down and managed beyond the active life of the landfill. The Applicant envisages that the Premises will require management for an extended period following closure, typically 15-25 years.

The Application states that landfill capping and rehabilitation will be progressive during the operation of the landfill and will be undertaken as soon as practically possible following cell completion to reduce infiltration.

Wastes will be placed according to the cells staging plan with each cell representing a stage. The filling will progress from south to north across the Premises (stages 1 through 10) where only one cell will be active at any time. As finished levels are reached in each cell, the final cap will be progressively placed.

The landfill capping will tie into the perimeter bunding and the adjacent cell/stage once completed to provide a seal.

The Applicant proposes to construct a final capping design consisting of the following (bottom upwards):

- Waste;
- Landfill gas strip drains;
- Interim cover/regulating layer (0.3m min);
- GCL (replaces 600m low permeability fill from original Application)
- Textured LLDPE
- Drainage geonet (replaces 300mm drainage layer from original Application)
- Reinforcement geogrid (if requied for slope stability)
- 0.8m cover soil;
- 0.2m topsoil; and
- Select vegetation

as depicted in Figure 31 below.

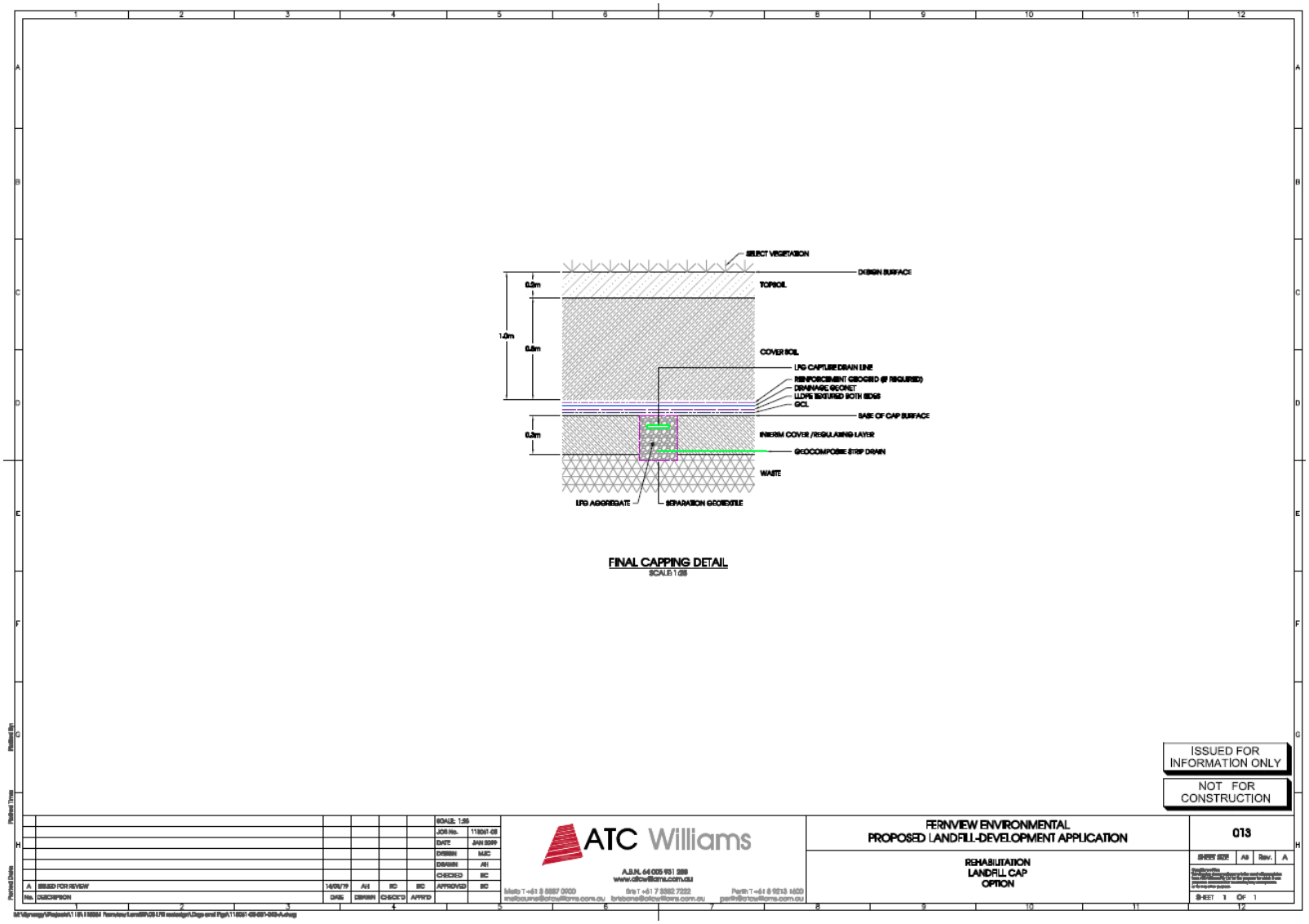


Figure 31. Final capping detail

Landfill gas strip drains in the cap will be connected to feeder liners which will convey landfill gas to vertical active LFG wells installed prior to capping. This system will ultimately convert to a passive system when gas volumes/quality are no longer sufficient to support combustion. The Application states that the topography of the landfill cap will blend into the surrounding landscape, with a gradient of no steeper than 1V:5H (20%) to reflect surrounding landforms. Figure 32 and Figure 33 depict the finished waste surface layout plan and finished waste surface cross sections.

The surface of the cap will be vegetated with selected local native species based on the data obtained from baseline vegetation surveys as soon as possible following the placement of topsoils to provide erosion control.

Vegetation on the final cap will be initially selected to promote rapid root growth and stabilise the newly formed slopes. Once the slopes have been stabilised by the initial vegetation growth, native plants species will be grown to allow the landfill capped surface to blend in to the surrounding landscape.

The site will be cleared of all non-essential manmade improvements and all open areas revegetated with native species. As part of the annual weed inspection, the quality and quantity of species used for revegetation will be assessed. Should it be determined that the revegetation is not developing sufficiently, more revegetation will be carried out in these particular areas.

Key Findings:

1. Condition 8-1 of Ministerial Statement 796 requires the Applicant to submit a draft LDPCMP under Part IV of the EP Act prior to commencement of construction.
2. Detailed specifications of the materials proposed to be used in the capping design is largely absent from the LDPCMP.
3. Further assessment of the LDPCMP will be undertaken through Part IV of the EP Act and any deficiencies with the LDPCMP will be highlighted through this process.

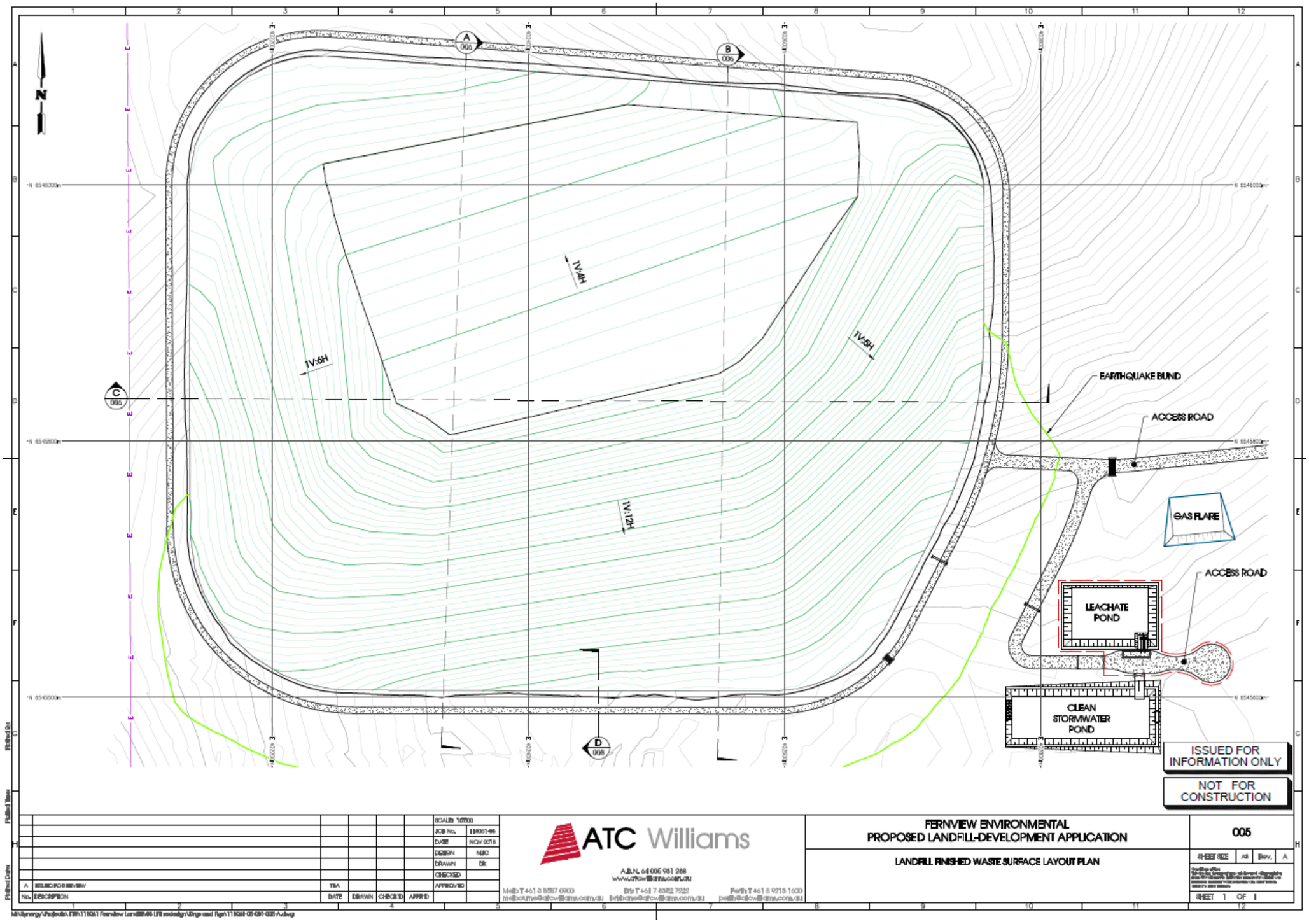


Figure 32. Landfill finished waste surface layout plan

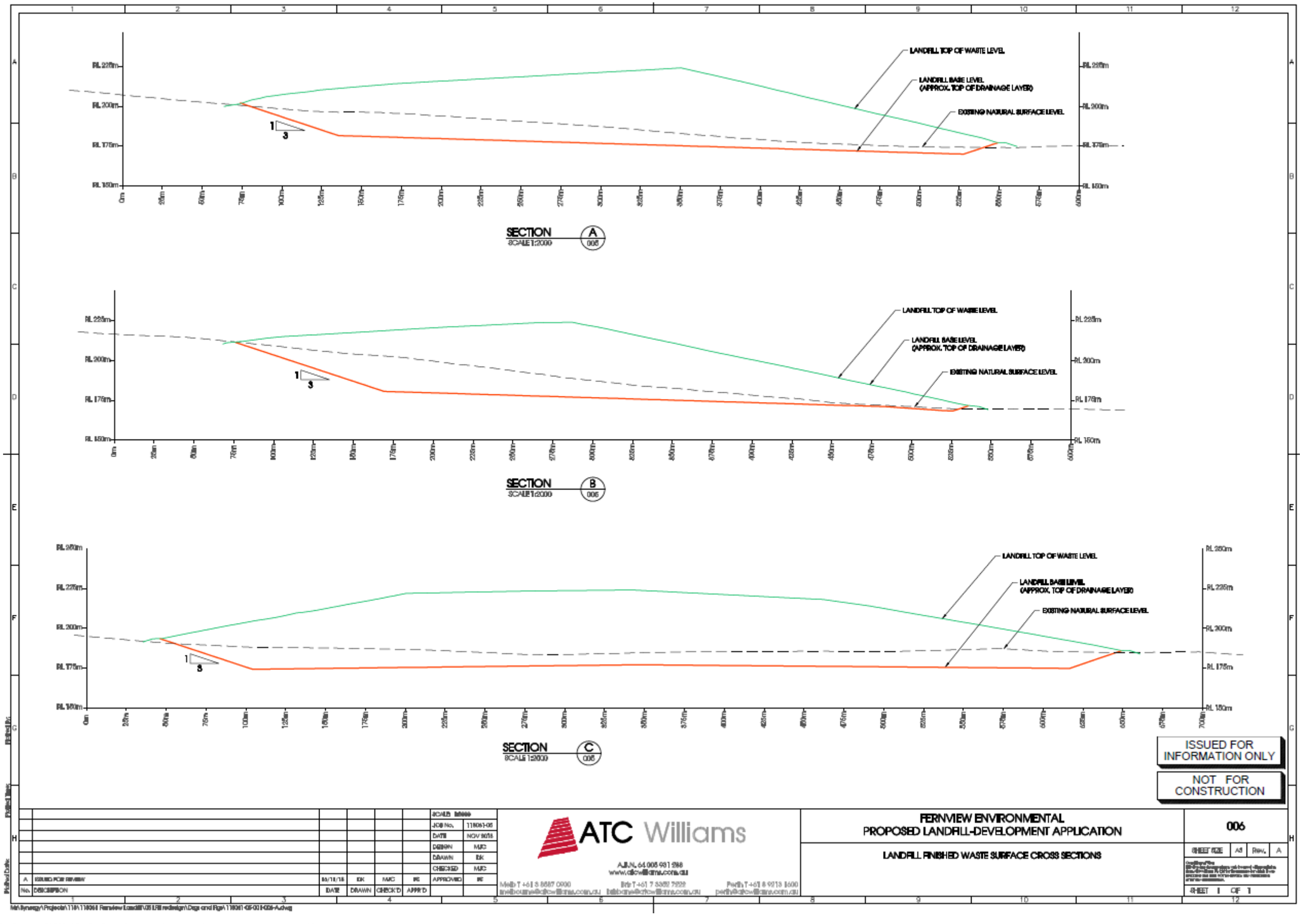


Figure 33. Landfill finished waste surface cross sections

Key Findings:

1. The proposed capping gradient of 1V:5H (20%) is sufficient to assist in shedding of water.
2. Shallow-rooted vegetation should be selected for the final capping and the topmost layer of the capping must be of sufficient depth to ensure that roots do not penetrate the cap.

Landfill gas management

The Application states that landfill gas will be collected as required over the life time of the landfill and that the collection system will ensure that the majority of landfill gas produced by the decomposition of the waste within the landfill does not escape to the atmosphere.

Vertical and/or horizontal gas extraction wells are proposed to be progressively installed as waste is placed in the landfill with the spacing of the wells will be determined following an operational assessment for the Site. The gas wells and connecting joints will be designed to withstand anticipated settlement rates.

Condensate traps, gas well heads and associated gas pipework will be connected to gas extraction wells once the cell has been completed and the landfill cap has been installed to allow the capture and conveyance of gas to either a flare or an energy recovery landfill depending on the quality and quantity of the extracted landfill gas. The system is proposed to operate by inducing a slight vacuum within the extraction wells and associated piping that will promote gas flow from the waste mass to the gas extraction wells.

The Application notes that, typically landfill gas volumes are not sufficiently high enough or consistent enough to warrant on-site power generation for some years following commencement of filling operations. The Applicant has advised that it will conduct an assessment of the landfill to estimate the future rates of gas production over the lifetime of the landfill to allow for subsequent sizing and design of the plant and that this will be presented in a report to DWER for approval before construction.

An energy recovery Landfill will be used once a consistent quality and quantity of landfill gas are generated from the landfill. Generated electricity will supply power to the south-west interconnected grid. The Application states that until gas generation is consistent enough to enable installation of the first power unit, gas extracted from the Landfill will be burnt in the flare to atmosphere. It is anticipated that up to three generators will be required at full gas production. The landfill gas management system will be designed and operated through operational and monitoring procedures to prevent the escape of landfill gas beyond the containment system.

The Application states that the design for the gas control systems will consider:

- Performance standards which aim to achieve landfill gas control at the Landfill (e.g. whether temporary or permanent systems);
- The design life of the elements of the gas control system;
- Selection of materials and products;
- Compatibility of the installed elements of the control system in terms of the phased development of the Site;
- Operational and maintenance requirements; and
- Health and safety issues.

Ongoing monitoring and maintenance

The Application states that ongoing site monitoring and maintenance will be carried out to determine the effectiveness of the capping and gas extraction systems with the ongoing post closure period continuing until the site is deemed to be benign.

A twice yearly site inspection (February to March and August to September) will be carried out for a minimum of 15 years following closure of the landfill to monitor and report on evidence of any leachate pop-outs, topsoil erosion and any areas showing poor vegetative regrowth.

The Application states that the August – September inspection period of the landfill cap follows the dominant rainfall months of the year allowing any problems associated with rainfall to be identified and maintenance work scheduled for the following drier months.

Maintenance work to the landfill cap following closure may consist of, but is not limited to, mobilising earthmoving equipment to complete the following:

- Reinstatement of eroded areas of the cap to prevent landfill gas venting and infiltration of storm water into the landfill; and
- Maintenance of stormwater drainage over the landfill cap to minimise the probability for cascading flow down landfill batters.

The Application states that in time, once the site has been adequately revegetated and erosion is no longer occurring, the sediment ponds and other surface water features will be allowed to gradually fill up with sediment and return back to a more natural self-sustaining state.

Ambient groundwater monitoring programme

The Application states that details of the ambient groundwater water monitoring programme will be set in consultation with DWER. Standing water levels of the monitoring wells will be taken to validate groundwater flow direction. Analysis of the following parameters every six months is currently proposed, with the intention of reducing the analysis period as potential environmental harm reduces:

- pH
- Chemical oxygen demand
- Lead
- Mercury
- Chromium
- Total petroleum hydrocarbons
- Nickel
- Electrical conductivity
- Ammonia-nitrogen
- Iron
- Nitrogen oxide
- Sulphate
- Total phosphorus
- Cadmium
- Arsenic
- Chloride
- Manganese
- Copper
- Total nitrogen
- Zinc

Waste settlement monitoring

A landfill is subject to long-term settlement as waste decomposes and consolidates which can have significant impacts on the final surface profile, the landfill cap and potential after uses for the site.

The Application states that aerial surveys will be used to assess waste settlement. Initially these surveys will take place annually; however as the settlement rate decreases the surveys will be undertaken every two years.

Key Findings:

1. The landfill aftercare program must include inspections of the cap, checking for differential settlement and indicators that the integrity of the low-permeability cap has been compromised.
2. The leachate collection and treatment system will need to be inspected and maintained for as long as the landfill is actively generating leachate. This will include inspection and cleaning of leachate collection pipes, maintenance of leachate treatment plants and inspection after periods of heavy rain to ensure that the system is not overloaded.
3. The landfill gas-extraction system will need to be maintained for the life of landfill's gas generation. This will include maintaining the plant, such as generation plant or flares used to combust the gas.
4. Ambient groundwater monitoring bores will need to be maintained to assess potential impacts to groundwater

8. Landfill Management

8.1.1 Waste Acceptance

Only Class II waste will be accepted at the Premises, being principally municipal solid waste, commercial and industrial waste and biodegradable organics (meet Class II contaminant thresholds). No hazardous or noxious or toxic chemicals will be accepted.

Waste proposed to be accepted at the Premises will primarily be sourced from the Perth Metropolitan Area, transported to the Premises by road train on a daily basis.

Waste will undergo a pre-sort at transfer stations prior to delivery to ensure that only waste acceptable for disposal at the Premises are transported for deposition.

The Premises will not be open to the general public and the Premises will be fenced to prevent unauthorised entry.

Wastes originating from sources other than transfer stations will only access the Premises after pre-booking and gaining approval from the Applicant.

All waste delivery vehicles will pass over a weighbridge on entry and exit of the Premises. Waste loads which do not comply with the Class II acceptance criteria will be rejected from the Premises. Entry to the operational area will only be gained using automatic recognition and security access provided for vehicles that regularly access the Premises or following approval from the Site Supervisor.

Waste loads will undergo visual inspection at the tipping face prior to unloading.

8.1.2 Waste storage, processing and burial

Filling will progress from south to north across the cells (Stages 1 through 10), where only one cell will be active at any time. During the placement of waste materials, the working face will be kept as narrow as possible.

Delivery vehicles will reverse up to the tipping face and gravity discharge the waste into the trench. Waste will be deposited in 500mm deep layers and compacted progressively in layers, by 3 to 5 passes of the compaction equipment, to achieve a compacted vertical lift height of 2m.

8.1.3 Daily cover

The daily cover will be used at the end of every working day to cover the deposited waste. The Applicant has advised that daily cover material will be a combination of site or imported soils and/or multiple robust tarpaulin covers that can be readily deployed and recovered using

hydraulic-powered equipment fitted to compactors (Tarpomatic or similar). A slurry based alternative daily cover (OCS Environmental ConCover or similar) may also be utilised. The daily cover may be scraped back or ripped prior to further waste being placed above the previously deposited waste to prevent stratification within the waste body.

An intermediate cap or thickened daily cover material will be placed over waste which will not be covered with additional wastes for an extended period of time. This cap will be removed and the waste surface ripped prior to the placement of additional wastes on top, to prevent stratification within the waste body.

8.1.4 Hours of operation

The Premises will not be open to the general public. The Premises will accept waste from delivery vehicles between the following hours:

- Monday to Friday: 7am to 5pm
- Saturday: 7am to 4pm

The operation of the Premises (i.e. waste compaction and cover) may extend past these hours by approximately 90 minutes.

8.1.5 Record Keeping

Records of delivered loads will be kept, including the name of the customer, truck identification and the origin of the waste material.

A record will be kept for each truck entering the Premises and will include the following information:

- Customer;
- Truck identification;
- Driver's name;
- Incoming truck weight;
- Date and time of arrival;
- Origin of materials;
- Type of material delivered and the origin of truck contents;
- Outgoing truck weight; and
- Date and time of trucks exiting the site.

All information will be entered into a computer where records can be regularly backed up and archived. Records will be kept for the life of the landfill.

9. Risk assessment

9.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 24 and Table 25.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 24 and Table 25 below. While not an emission, vermin and fire has been considered within the risk assessment as an environmental aspect or potential hazard event relating to the proposal.

Table 24. Identification of emissions, pathway and receptors during construction

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction of landfill cell	Vehicle movements on unsealed access roads	Dust	Residential Premises located 1.9km south and 2.3km northeast (see Table 7)	Air/ wind dispersion	Amenity impacts	Yes	See Section 9.4
		Noise		Air	Amenity impacts	No	The Delegated Officer considers it unlikely that there is a pathway for noise given the distance of 1.9km between the Premises boundary and the nearest residential receptors. Noise emissions can be managed under the *Environmental Protection (Noise) Regulations* 1987.
	Earthworks	Dust	Residential Premises located 1.9km south and 2.3km northeast (see Table 7)	Air/ wind dispersion	Amenity impacts	Yes	See Section 9.4
		Noise		Air	Amenity impacts	No	The Delegated Officer considers it unlikely that there is a pathway for noise given the distance of 1.9km between the Premises boundary and the nearest residential receptors. Noise emissions can be managed under the *Environmental Protection (Noise) Regulations* 1987.
Fuel storage	Fuel for construction contained within an above ground self bunded fuel tank	Hydrocarbon spills	Groundwater 20-70mbgl (see Table 8) Conservation category sumpland 1.3km northeast of Premises Boundary and other surface water bodies as identified in Table 14	Land and waters	Contamination of soil and groundwater	No	The Delegated Officer considers that the storage of fuel is effectively regulated under the general provisions of the EP Act and the Unauthorised Discharge Regulations and does not require specific management under the Works Approval or Licence.

Table 25: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions/ environmental aspect**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Landfilling operations	Unsealed surfaces and movement of waste and materials during landfilling operations	Dust	Residential Premises located 1.9km south and 2.3km northeast (see Table 7)	Air/ wind dispersion	Health and amenity impacts	Yes	See Section 9.4
	Vehicle movements and operation of the landfill	Noise	Residential Premises located 1.9km south and 2.3km northeast (see Table 7)	Air	Health and amenity impacts	Yes	See Section 0
	Landfilling of putrescible wastes	Odour	Residential Premises located 1.9km south and 2.3km northeast (see Table 7)	Air / wind dispersion	Amenity impacts	Yes	See Section 0

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions/ environmental aspect	Potential receptors	Potential pathway	Potential adverse impacts		
	Surface water drainage contacting waste	Potentially contaminated stormwater	Groundwater 20-70mbgl (143m AHD) (see Table 8) Conservation category sumpland 1.3km northeast of Premises boundary and other surface water bodies as identified in Table 14	Land to waters	Contamination of surface waters	Yes	See Section 0
	Wastes landfilled during operations	Leachate	Groundwater 20-70mbgl (see Table 8) Conservation category sumpland 1.3km northeast of Premises Boundary and other surface water bodies as identified in Table 14	Seepage through soil and transport through groundwater	Contamination of groundwater Indirect contamination of surface waters at the point of groundwater expression	Yes	See Section 0
			Priority 4 flora located approximately 300m west of Premises (see Table 9)	Seepage through soil and transport through groundwater	Potential impacts to vegetation	No	The Delegated Officer does not consider that a direct pathway exists given the depth to groundwater and the distance of the flora to the proposed landfill.
	Landfill gas generated through the decomposition of waste within the landfill.	Landfill gas	Residential Premises located 1.9km south and 2.3km northeast and the surrounding environment (see Table 7)	Lateral migration through soil, or Passive venting to air	Health impacts from explosion risk from potential high methane concentration Health and amenity impacts from odour	Yes	See Section 0
	Asbestos waste	Asbestos fibres	Residential Premises located 1.9km south and 2.3km northeast and the surrounding environment (see Table 7) Workers onsite	Air/ wind dispersion	Health impacts	No	The Applicant has advised that asbestos waste is not proposed to be accepted at the Premises.
	Waste materials	Windblown waste/ litter	Residential Premises located 1.9km south and 2.3km northeast and the surrounding environment. (see Table 7)	Air/ wind dispersion	Amenity and nuisance impacts Attraction of pests and vermin	Yes	See Section 0
	Waste providing a breeding habitat for rats, flies, cockroaches and mosquitoes as disease vectors	Vermin and pathogens	Residential Premises located 1.9km south and 2.3km northeast and the surrounding environment (see Table 7).	Air and land via insects, birds and rodents.	Amenity impacts and pest associated diseases.	Yes	See Section 0
	Upset conditions	Smoke / fire	Residential Premises located 1.9km south and 2.3km northeast and the surrounding environment (see Table 7).	Air / wind dispersion	Amenity impacts	Yes	See Section 0
			Groundwater 20-70mbgl (see Table 8)	Direct discharge to land Infiltration to groundwater	Landfill liner damage resulting in increased leachate loss leading to contamination of groundwater	Yes	See Section 0
	Hydrocarbon/ Chemical storage	Hydrocarbon spills	Groundwater 20-70mbgl (see Table 8)	Direct discharge onto land Infiltration to groundwater	Contamination of groundwater	No	The Delegated Officer considers that the storage of fuel is effectively regulated under the general provisions of the EP Act and the Unauthorised Discharge Regulations and does not require specific management under the Licence.

9.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 26 below.

Table 26: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with below.

Table 27: Risk criteria table

Likelihood		Consequence		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		The following criteria has been used to determine the consequences of a Risk Event occurring:		
			Environment	Public health* and amenity (such as air and water quality, noise, and odour)
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **onsite impacts**: catastrophic • **offsite impacts local scale**: high level or above • **offsite impacts wider scale**: mid-level or above • Mid to long-term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **onsite impacts**: high level • **offsite impacts local scale**: mid-level • **offsite impacts wider scale**: low level • Short-term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid-level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **onsite impacts**: mid-level • **offsite impacts local scale**: low level • **offsite impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid-level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **onsite impacts**: low level • **offsite impacts local scale**: minimal • **offsite impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **onsite impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite**"** means within the Prescribed Premises boundary.

9.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 28 below:

Table 28: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

9.4 Risk Assessment – Dust

9.4.1 Description of dust emissions

Construction

Construction activities may generate dust emissions which may cause adverse health and amenity impacts outside the Premises.

Operation

Vehicle movements on unsealed roads, handling of waste and fill material may generate dust emissions which may cause adverse health and amenity impacts outside of the Premises.

9.4.2 Identification and general characterisation of emission

Construction

The frequency and time of exposure of receptors to dust may vary depending on the activities carried out at the Premises and weather conditions.

The potential sources of dust during construction include:

- vehicle movements on unsealed access roads;
- earthworks;
- machinery movements; and
- stockpiling of excavated material.

Operation

The potential sources of dust during operation include:

- vehicle movements through the landfill;
- stockpiling and general handling of waste including waste loading/unloading;
- filling/burial of waste;
- placement of cover material; and
- exposed areas of soil and clean fill during normal operations.

The Application states that the landfill will be open for waste acceptance at the following times:

- Monday to Friday: 07:00hrs to 17:00hrs
- Saturday: 07:00hrs to 16:00hrs.

The landfill will generally be open on public holidays except for Good Friday and Christmas Day.

Due to the nature of operations, waste compaction and cover operations may extend beyond the opening hours for waste acceptance by approximately 90 minutes.

9.4.3 Description of potential adverse impact from the emission

Construction and operation

Dust emissions have the potential to impact public health when inhaled; affecting both the respiratory and cardiovascular systems. Amenity may also be impacted by visible dust plumes and the deposition of material on a variety of surfaces such as vehicles, dwellings and clothing.

The receptors most affected by dust emissions from the Premises would be residents located approximately 1.9km south (Fernview Farm) and 2.3km northeast of the Premises.

9.4.4 Criteria for assessment

Impacts can be assessed against the general provisions of the EP Act, specifically whether fugitive dust unreasonably interferes with the health, welfare, convenience, or comfort of any person.

9.4.5 Applicant controls

This assessment has reviewed the controls set out in Table 29 below.

Table 29: Applicant's proposed controls for dust

Control	Description
Revegetation/ stabilisation of excavated material stockpiles	• Materials excavated as part of the earthworks activities will be stockpiled within a specific location. • The stockpiles will be immediately re-vegetated or stabilised to provide erosion control and minimise potential dust migration.
Rehabilitation and limited accessibility	• Those areas of the site disturbed during the construction phase will no longer be accessed during operation and will be rehabilitated with native vegetation. • Site operational procedures will prevent unauthorised access to rehabilitated areas to enhance the establishment of vegetation.
Engineered landfill capping system	• The surface of the landfill will be sealed with an engineered landfill capping system to minimise potential dust emissions from

Control	Description
	the surface of the landfill. • The landfill cap will be vegetated to provide erosion control. • The landfill will be completed in accordance with the staging plan. Following the completion of landfilling a cell, the surface will be capped and re-vegetated as soon as possible to minimise potential dust emissions.
Vehicle management	• All trucks entering and leaving the Premises will be covered to prevent windblown emissions; • All solid waste materials delivered to the Landfill will be contained in a covered vehicle, which will only be unloaded within the active cell and in the vicinity of the tipping face. • All vehicles leaving the Premises will pass over a cattle grid arrangement which will serve to knock off any materials on the wheels and under body of the vehicle before entering public roads. • Vehicle movements, except movements within the landfill cells, will be restricted to designated roadways. • Vehicle speeds will be restricted to less than 60km/hr on access roads before the weighbridge and 30km/hr between the weighbridge and the landfill tipping face.
Sealed internal access roads	• The permanent internal access roads will be sealed with asphalt as part of the initial construction and development of stage 1 of the landfill. The extent of sealed access roads is shown in Figure 10. • The seal will extend as far as possible to the tipping face. • Roads will be maintained using a grader, mechanical road sweeper/cleaner and water truck as required on a regular basis.
Water tank and stand pipe	• Unsealed roads, stockpiles of soil and exposed areas and if necessary the tipping face, will be regularly watered down, especially during dry and windy conditions to minimise dust generation. • A dedicated water tank and stand pipe will be maintained for use on the Premises. • Water for dust suppression will be obtained from an existing licensed production bore FLV4 or other licensed groundwater resource if required.
Dust monitoring	• Dust emissions will be monitored daily through visual inspections of disturbed and open areas. The results of these inspections will be recorded in a log maintained on-site. • Ambient dust monitoring using instrumentation will not be conducted unless dust is determined to be an issue at the site boundary, which will be determined by daily visual assessments. Where dust monitoring is deemed necessary, PM_{10} dust emissions beyond the boundary of the Premises will be maintained below 50µg/m^3.

Control	Description
Complaints management	• Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid dust complaints. • A complaints register will be established to record any complaints received, date, nature and resolution action undertaken. • The Site Manager will contact any complainants that have concerns related to dust and determine the nature of the nuisances. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the Site Manager will take steps to ensure that any identified impacts are addressed.

9.4.6 Key findings

The Delegated Officer has reviewed the information regarding dust emissions and has found:

1. With the controls proposed by the Applicant, it is unlikely that dust generated during construction activities will travel 1.9km to the nearest residential receptors.
2. With the controls proposed by the Applicant, it is unlikely that dust generated during operation of the landfill will travel 1.9km to the nearest residential receptors.

9.4.7 Consequence

Construction

If dust emissions occur during construction, then the Delegated Officer has determined that the impact of dust emissions on amenity will be minimal on a local scale. Therefore, the Delegated Officer considers the consequence of dust impacts during construction to be **slight**.

Operation

If dust emissions occur during operation, then the Delegated Officer has determined that the impact of dust emissions on amenity will be minimal on a local scale. Therefore, the Delegated Officer considers the consequence of dust impacts during operation to be **slight**.

9.4.8 Likelihood of Risk Event

Construction

The Delegated Officer has determined that dust emissions impacting amenity during construction will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of dust emissions impacting amenity to be **unlikely**.

Operation

The Delegated Officer has determined that the likelihood of dust emissions impacting amenity during operation will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of dust emissions impacting amenity to be **unlikely**.

9.4.9 Overall rating of dust emissions

Construction

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of dust emissions impacting amenity during construction is **low**.

Operation

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of dust emissions impacting amenity during operation is **low**.

9.4.10 Acceptability of Risk Event

Construction

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable, and will not be subject to regulatory controls.

Operation

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable, and will not be subject to regulatory controls.

Risk Assessment – Noise (Operation)

9.4.11 Description of Noise emissions

Waste handling and landfilling activities within the Premises may generate noise emissions which may result in health and amenity impacts for people near the Premises.

9.4.12 Identification and general characterisation of emission

Potential sources of noise within the Premises include vehicle movements such as trucks delivering waste, compactors and dozers as well as noise from pumps associated with the leachate management systems.

The Application states that the Premises will be open for waste acceptance at the following times:

- Monday to Friday: 07:00 hrs to 17:00 hrs
- Saturday: 07:00 hrs to 16:00hrs

The landfill will also generally be open on public holidays except for Good Friday and Christmas Day.

Due to the nature of operations, waste compaction and cover may extend beyond the opening hours for waste acceptance by approximately 90 minutes.

9.4.13 Description of potential adverse impact from the emission

Noise emissions have the potential to reduce public wellbeing, amenity and comfort.

The receptors most affected by noise emissions from the Premises would be residents located approximately 1.9km south (Fernview Farm) and 2.3km northeast of the Premises.

9.4.14 Criteria for assessment

The current applicable criteria for noise emission levels are detailed in the *Environmental Protection (Noise) Regulations 1997*.

9.4.15 Applicant controls

This assessment has reviewed the controls set out in Table 30 below.

Table 30: Applicant's proposed controls for noise emissions

Site infrastructure	Description
Controls for noise during operation	
Hours of operation	• Particularly noisy activities will be scheduled in consideration of the EP Noise Regulations criteria to minimise public disturbance. The majority of activities will be undertaken within normal working hours (07:00 to 19:00 hours Monday to Saturday).
Infrastructure and equipment	• All mobile plant equipment used on the site will be compliant with the Vehicle Standard (Australian Design Rule 80 – Emission Control for Heavy Vehicles) 2005. • All mobile plant used on-site will be regularly maintained including exhaust mufflers. • The use of amplified telephone systems will be avoided.
Speed Limits	• Speed limits will be enforced on all access roads.
Complaints management	• Establishment of a complaints register to record the details of any complaints received, date, nature and resolution of the undertaken action. • The Site Manager will contact any complainants that have concerns related to noise levels and determine the nature of the noise nuisance. If the nuisance is of an ongoing nature, the Site Manager will take steps to ensure that any identified noise source is addressed within 48 hours. If the source is not clear, the Site Manager may initiate additional monitoring or other evaluation involving a noise specialist. The Site Manager or Noise Specialist will then ensure that appropriate measures are implemented to remove the nuisance if it is caused by the construction or operation of the Premises. • In the event of repeated complaints, the complaint will be investigated to assess the need for completion of a detailed noise assessment that will be undertaken by a qualified sub-consultant using approved methods. A report will be prepared to address potential noise exceedances and will include practical and feasible mitigation measures that may be adopted
Noise monitoring	The Application states that noise monitoring will be conducted as per conditions of an operational licence for the landfill, however no further information has been provided as to what this entails.

9.4.16 Key findings

The Delegated Officer has reviewed the information regarding noise emissions and has found:

1. Given the distance to nearest sensitive receptors and restriction of operational hours, the Premises is likely to comply with the Noise Regulations.

9.4.17 Consequence

If noise emissions occur during operation, then the Delegated Officer has determined that the impact of noise emissions will be minimal offsite on a local scale. Therefore, the Delegated Officer considers the consequence of noise emissions during operation to be **minor**.

9.4.18 Likelihood of Risk Event

The Delegated Officer has determined that the likelihood of noise impacts occurring during operation may only occur in exceptional circumstances. Therefore, the Delegated Officer considers the likelihood to be **rare**.

9.4.19 Overall rating of noise emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of noise emissions impacting receptors during operation is **low**.

9.4.20 Acceptability of Risk Event

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable, and will not be subject to regulatory controls.

9.4.21 Regulatory controls for noise emissions

Regulatory controls are not required. Noise emissions from the Premises will be subject to the *Environmental Protection (Noise) Regulations 1997*.

Risk Assessment – Odour (Operation)

9.4.22 Description of odour emissions

Putrescible landfills have the potential to cause odour emissions through the deposition of odorous loads, inadequate covering and decomposition of putrescible waste over time causing amenity impacts outside the Premises.

Potential sources of odour emissions during the operation of the landfill include:

- the acceptance, movement and disposal of putrescible wastes;
- un-capped or exposed operation areas of the landfill including the active tipping face; and
- leachate, which also includes leachate collection systems (e.g. leachate storage ponds) and treatment infrastructure (e.g. recirculation).

Odour emissions associated with landfill gas have been assessed separately in Section 0.

9.4.23 Identification and general characterisation of emission

Factors that influence the emission rate from landfill surfaces include the type and thickness of cover material and the degree of compaction. Factors that affect air dispersion include:

- odour emission rates;
- topography; and
- meteorological conditions including wind speed and direction.

9.4.24 Description of potential adverse impact from the emission

Individual responses to odour emissions may vary depending on age, health status, sensitivity and odour exposure patterns. Perceived odour intensity may increase or decrease on exposure. Community response to an odour can include annoyance, potentially leading to stress and loss of amenity. Exposure to repeated odour events can create a nuisance effect.

9.4.25 Criteria for assessment

There are no set threshold or concentration criteria for odour assessment. Under section 49(5) of the EP Act, it is an offence to emit or cause to be emitted, an unreasonable emission from any premises.

An unreasonable emission is defined in the EP Act (section 49(1)) as an emission or transmission of noise, odour or electromagnetic radiation which unreasonably interferes with the health, welfare, convenience, comfort or amenity of any person.

Regardless of material used as cover, sufficient material should be available at the tipping face for at least two weeks of operations.

9.4.26 Applicant controls

This assessment has reviewed the controls set out in Table 31.

Table 31: Applicant's proposed controls for odour

Aspect	Description
Controls for odour during operation	
Odorous wastes	• All odorous wastes will be covered immediately upon receipt. • Only one active tipping face will be exposed during active operations and the surface area will be kept as small as possible. • Daily cover (soil) or biodegradeable sheeting will be deposited over waste at the end of every working day. No waste surface will be left uncovered for extended periods of time (e.g. more than 12 hours)
Leachate collection system	• Leachate collection wells and associated pipework will be adequately sealed to prevent potential odour emissions. • The landfill leachate management system will be designed to complement the liner and capping system such that they do not adversely impact on the integrity of the landfill liner of capping system. • The leachate ponds will be routinely checked for odour emissions.
Complaints management	• Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid odour complaints. • A complaints register will be established to record and complaints received, date, nature and resolution action undertaken.

Aspect	Description
	• The site manager will contact any complainants that have concerns related to odours and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the site manager will take steps to ensure that any identified impacts are addressed.

9.4.27 Key findings

The Delegated Officer has reviewed the information regarding odour emissions and has found: that given the distance to nearest sensitive receptors and the implementation of proposed Applicant controls, specifically, the immediate covering of odorous wastes, it is unlikely that odour will impact on nearby sensitive receptors.

9.4.28 Consequence

If odour emissions occur, then the Delegated Officer has determined that the impact of odour emissions will be low level on a local scale. Therefore, the Delegated Officer considers the consequence of odour emissions to be **moderate**.

9.4.29 Likelihood of Risk Event

The Delegated Officer has determined that the likelihood of odour emissions impacting sensitive receptors will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **unlikely**.

9.4.30 Overall rating of odour emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of odour emissions is **medium**.

9.4.31 Acceptability of Risk Event

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable, and will be subject to regulatory controls to maintain the acceptability.

9.4.32 Regulatory controls for odour emissions

The following controls would be required to be implemented in an operational licence to manage the potential impacts from odour emissions:

- Operational controls including minimum amounts of cover material required, timeframes for when waste is to be covered and restrictions on the size of the active tipping area; and
- Limits on waste acceptance/waste processing.

These controls generally replicate the Applicant's proposed controls which the Delegated Officer considers necessary for the management of potential odour emissions.

Risk Assessment – Fugitive Landfill Gas

9.4.33 Description of landfill gas

Landfill gas in the form of methane and carbon dioxide generated from the degradation of putrescible and biodegradable waste migrating laterally from the landfill cap and proposed lined landfill cells causing health impacts from inhalation, ecotoxicity, fire / explosion, asphyxiation and odour.

Landfill gas can be passively vented to the atmosphere through the surface of the landfill where a low permeability cap or cover material has not been applied. It can also migrate through the subsurface and through features such as pipelines and service ducts in the gas and leachate collection systems.

Landfill gas may migrate from the landfill through the cap and sidewalls by diffusion, convection or water transport.

9.4.34 Identification and general characterisation of emission

Limited Landfill gas may be generated for the first 3-12 months after a landfill is commissioned and waste placement commences but will increase proportionate to the amount of waste decomposing under anaerobic conditions.

Post capping, the landfill presents a risk due to the on-going presence and production of landfill gas. Landfill gas comprises a mixture of methane, carbon dioxide and small quantities of trace elements. Methane and carbon dioxide are greenhouse gases.

Landfill gas is produced in an anaerobic environment within the landfill and production and composition will vary according to the dominant microbial degradation. It is a by-product of the waste decomposition process, and its composition varies greatly depending on factors such as:

- Waste composition;
- Age of the emplaced waste;
- The depth of waste;
- Density of waste;
- The moisture content and distribution;
- pH and nutrient availability;
- landfill temperature;
- the presence of chemical inhibitors;
- the design of the landfill cell; and
- the hydraulic characteristics of the site.

Landfill gas is primarily comprised of 45-60% methane, 40-60% carbon dioxide and three groups of trace components. The trace compounds are Oxygen, Sulphur and Hydrocarbons. The sulphur compound is the primary cause of odours, while the hydrocarbons are considered the most hazardous due to their persistence.

The Application states that Landfill gas generation is expected to peak approximately 10 years after closure of the landfill and that beyond this time, gas generation quantities are expected to gradually reduce as the waste stabilised.

9.4.35 Description of potential adverse impact from the emission

If not appropriately managed, landfill gas can be emitted from a landfill site by a number of pathways including:

- The landfill site's surface, including compromised capping;
- Subsurface geology;
- Subsurface services (man-made);
- The landfill gas management system; and
- Leachate migration.

Landfill gas can cause health, safety, amenity and environmental impacts due to the methane and carbon dioxide content. Under certain conditions, trace components of hydrogen sulphide may also pose a risk.

Potential impacts associated with the release of landfill gas include toxicity from inhalation, ecotoxicity, fire and explosion if gas collects in high enough concentrations, asphyxiation and odour.

Once the capping system is in place, there is the potential for landfill gas to be trapped beneath the capping layer. If allowed to build up, pockets of pressurised gas may explode, presenting a safety risk to personnel on site and damaging the integrity of the capping system. The likelihood of landfill gas build-up increases with the completion of each phase of rehabilitation.

The closest sensitive receptors to the Premises are residential premises located 1.9km south and 2.3km north-east of the Premises.

9.4.36 Criteria for assessment

Amenity impacts can be assessed against the general provisions of the EP Act, specifically whether odour unreasonably interferes with the health, welfare, convenience, or comfort of any person.

9.4.37 Applicant controls

This assessment has reviewed the proposed controls set out in Table 32 below.

Table 32: Applicant's proposed controls for landfill gas

Site infrastructure	Description / Operation details
Stage 1 controls for landfill gas	
Waste inputs	Control of waste inputs into the landfill, focusing on biodegradable wastes to encourage decomposition within the landfill.
Landfill cell design	The landfill cells are designed to encourage the early establishment of methanogenic conditions and help maintain them (promotion of anaerobic conditions)
Engineered lining system	The sides and base of the landfill will be lined with an engineered lining system; to prevent uncontrolled movement of landfill gas into the surrounding strata.
Leachate infrastructure	Leachate infrastructure such as sumps, wells and side wall risers will be effectively sealed, only retaining any necessary access for monitoring and maintenance.
Landfill Gas extraction/ collection system	The gas extraction wells will be either horizontal or vertical or a combination of both. Construction of the extraction wells will occur progressively during the operation of the landfill as waste is deposited. The Application states that spacing of the wells will be determined following an operational assessment for the site and that the gas wells and connecting joints

Site infrastructure	Description / Operation details
	will be designed to withstand anticipated settlement rates.
Adverse weather and cover materials	Weather conditions will be monitored on-site. Cover materials placed for adverse weather conditions will avoid any opening and be able to reasonably withstand the anticipated conditions without significant damage and exposure of the underlying waste material.
Complaints management	• Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid landfill gas complaints (most likely to be received regarding odour). • A complaints register will be established to record any complaints received, date, nature and resolution action undertaken. • The site manager will contact any complainants that have concerns related to landfill gas (odour) and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the site manager will take steps to ensure that any identified impacts are addressed.
Future controls for landfill gas	
Engineered capping system	The Application states that the surface of the landfill will be sealed with an engineered cap to minimise landfill gas emissions to the atmosphere and control the ingress of air. The cap will allow the controlled recovery and management of landfill gas and odour and will be designed by the best practice for a Class III landfill.
Landfill gas extraction/ collection system	In landfilled areas that have been completed and reached final profile, vertical gas wells will be drilled into the waste. Condensate traps, gas well heads and associated gas pipework to allow the capture of landfill gas will be connected to the gas extraction wells once the cell has been completed and the landfill cap has been installed. The Application states that the collection system will ensure that the majority of landfill gas produced by the decomposition of waste within the landfill does not escape to the atmosphere. The system will operate by inducing a slight vacuum within the extraction wells and associated piping that will promote gas flow from the waste mass to the gas extraction wells. Condensate wells will be installed to allow for the capture and temporary storage of the condensate, which will be collected and used in the leachate recirculation system Captured gas will be conveyed to the flare or the gas utilisation plant according to the quality and quantity of the extracted landfill gas.
Portable flare and gas utilisation plant	A portable flare and gas utilisation plant will be constructed at later stages of the overall landfill development. The flare will be used to burn recovered gas that has low methane content. The flare will remain in place throughout the life of the landfill to burn excess landfill gas that cannot be utilised to generate power. The gas utilisation plant will be used to generate power when there is a consistent quality and quantity of landfill gas being generated by the waste mass. Generated electricity will supply power to the southwest interconnected grid. The Application states that the system of combustion will be designed and operated to meet emission limits for flares and stationary gas engines. The Application states that landfill gas management of the landfill is expected to

Site infrastructure	Description / Operation details
	continue for a minimum term of 15 years post-closure and as long as the gas is produced from landfilling activities and will operate continually from the date of commissioning throughout the contract term, subject to normal stoppages for maintenance.
Landfill gas monitoring	The Application states that monitoring of landfill gas quality and quantity produced from the facility will be undertaken. Surface landfill gas monitoring will also be conducted on an annual basis focusing on areas along the edge of the void and at regular intervals across the surface of the landfill. The Application also states that testing for hydrogen sulphide will also be undertaken if landfill gas odours are of concern.
Vegetation monitoring	The Application states that vegetation around the vicinity of the landfill will be monitored on a monthly basis, where particular attention will be given to any areas that indicate decline in health. The Applicant has advised that photographic monitoring of vegetation based on the Photopoint Monitoring methodology is to be undertaken in accordance with the ”Information Notes for the Land for Wildlife Scheme in Western Australia” issued by the Department of Conservation and Land Management in the Wildlife Notes No 9. July 2001.

9.4.38 Key findings

The Delegated Officer has reviewed the information regarding landfill gas impacts and has found:

1. Landfill gas utilisation is not proposed for several years following the commencement of filling operations.
2. The landfill gas management/collection system should be progressively installed during the operational period of the landfill.
3. The Applicant will be required to submit a gas management plan for assessment with the licence application for the landfill.
4. Controls may be imposed on the licence to require gas generation rates to be assessed annually to determine whether the active control of landfill gas is feasible.
5. Limited quantities of landfill gas are expected to be generated during the operation of the Cell 1 landfill.
6. Odour emissions 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.

9.4.39 Consequence

If landfill gas impacts occur during the operation of Cell 1, then the Delegated Officer has determined that the impact of landfill gas will be limited to low level odour impacts on a local scale. Therefore, the Delegated Officer considers the consequence of landfill gas emissions to be **moderate**.

9.4.40 Likelihood of Risk Event

The Delegated Officer has determined that landfill gas impacts occurring during the operation of Cell 1 could occur at some time in the future in the absence of gas management infrastructure. Therefore, the Delegated Officer considers the likelihood of landfill gas impacts to be **possible**.

9.4.41 Overall rating of landfill gas emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of landfill gas impacts during the operation of Cell 1 is **medium**.

9.4.42 Acceptability of landfill gas emissions

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk of landfill gas emissions during the operation of Cell 1 is acceptable and will be subject to regulatory controls to maintain the acceptability.

9.4.43 Regulatory controls for landfill gas emissions

The Delegated Officer has determined that no specific conditions in relation to landfill gas emissions are required for this Works Approval.

Conditions requiring the progressive installation of the landfill gas management system and annual monitoring of gas generation rates would be included on an operational licence for the Premises.

Future controls for an operational licence would also include requirements for progressive capping of the landfill; vegetation monitoring and landfill gas monitoring as well as the installation and management of the portable flare and the gas utilisation plant.

These controls generally replicate the Applicant's proposed controls which the Delegated Officer considers necessary in managing potential impacts.

Risk Assessment – Potentially Contaminated Stormwater

9.4.44 Description of contaminated stormwater

Rainfall may come into contact with waste, causing run-off and overland flow of contaminated stormwater to neighbouring properties and surface water.

Rainfall and surface water entering the landfill will be considered as leachate and has been assessed separately in Section 0.

9.4.45 Identification and general characterisation of emission

Putrescible, inert, special type waste and contaminated wastes are proposed to be accepted for disposal at the Premises. Stormwater may become contaminated if it comes into contact with waste material at the Premises.

9.4.46 Description of potential adverse impact from the emission

Direct (overland flow) of stormwater contaminated with waste or leachate from landfill infrastructure may cause off-site impacts on neighbouring properties and ecosystems including potential contamination of surrounding land, surface water drainage and groundwater systems.

Contaminated stormwater may enter surface waters in the area causing aquatic organism death or bioaccumulation of contaminants in the surrounding ecosystems. A tributary of the Boonanarring Brook is located approximately 700m south-west and a conservation category sumpland is located 1.3km to the north-east of the Premises boundary.

9.4.47 Criteria for assessment

Relevant land and groundwater criteria include the ANZECC Guidelines for Fresh and Marine Quality, and the Assessment of Site Contamination National Environmental Protection Measure 1999 (as amended in 2013)(NEPM) for soils and groundwater.

The Delegated Officer considers that storage ponds and other drainage measures should be designed to contain and control rainfall run-off for a 1-in-20-year storm event for a putrescible landfill. Storm events up to 1-in-100 year recurrence intervals should also be considered to ensure that they do not result in any catastrophic failures such as flooding of the landfill or failure of dams or leachate storage ponds.

9.4.48 Applicant controls

This assessment has reviewed the controls set out in Table 33 below.

Table 33: Applicant's proposed controls for contaminated stormwater

Aspect	Description
Controls for stormwater	
Diversion drains	Uncontaminated stormwater (not contaminated by the active landfill and/or uncapped cells or leachate storage ponds) will be intercepted by surface water diversion drains. The drains will direct the stormwater to unlined retention ponds for evaporation, infiltration and re-use on site. The stormwater drains will be excavated to follow the natural fall of the land and will utilise a combination of sand bags, check dams and riprap armour to prevent erosion by flowing the rate of the water. The Application states that due to the dry conditions at the Premises, it is expected that stormwater in drains will dissipate before reaching the sedimentation dam. Uncontaminated runoff from rainfall falling on capped areas of the landfill will also flow these drains.
Stormwater retention pond/ Sedimentation pond	The stormwater retention pond/sedimentation pond will be located down gradient of the landfill to passively collect any surface waters from the site. The pond will be unlined to allow sedimentation and infiltration into the ground. The Application states that the dam will be managed to prevent excess silting. The sedimentation ponds will be designed to trap sediment and act as a detention basin during peak storm flows and will be designed for a peak flow rate for the catchment. Water within the sedimentation dam may be disposed of by: • infiltration into the ground; • evaporation from the pond surface;

Aspect	Description
	• used for dust control onsite, and/or • used for irrigation of re-vegetated areas outside the landfill area.
Landfill capping	Capping of the landfill cells will be progressive and the cap will be installed no steeper than 1V:5H. On the completion of each cell, the cap will be installed as soon as possible to minimise leachate generation and tied into the basal liner at the perimeter. Where applicable, the cap edges will be left exposed and easily accessible for future incorporation into the adjacent cells. The Application states that planting will be undertaken to protect the cap against erosion.
Management controls	
Sedimentation pond monitoring	Surface waters contained with the sedimentation dam are proposed to be monitored on a quarterly basis for the following parameters (including but not limited to): • total dissolved solids; • total suspended solids; • turbidity • pH • electrical conductivity • nutrients (nitrogen and phosphorous) • ammoniacal nitrogen; and • total petroleum hydrocarbons. The Application states that the monitoring frequency may be reduced following a 12 month monitoring period if approved by DWER. The Application states that where monitoring indicates elevated nutrients or other contaminants in the sedimentation dam, a contingency plan will be implemented with the following general approach: • Identification of the type of contamination; • Assessment of the potential environmental impact; • Isolation and rectification of the source of contamination; • Redirection of the flow to leachate storage ponds if possible until rectified; • Assessment and implementation of appropriate treatment for the contamination; • Further monitoring of the source of contamination; and • Undertake measures to rectify source of contamination. All monitoring results will be recorded and reported to DWER annually and a copy provided to the Shire. Where an anomalous result is identified, the sample will be immediately directed for analysis in a NATA registered laboratory and investigations implemented to identify potential causes of the anomaly.

Aspect	Description
Firewater management	All firewater will be treated as leachate and managed accordingly (see Section 0). If any firewater has entered any first flush system, then all waters must be removed by a licensed contractor or otherwise as soon as practical, to prevent the release of firewater into the environment.

9.4.49 Stormwater Pond Capacity

The Application states that it is expected that low volumes of stormwater will be generated on-site due to the high permeability and depth of sand present (see Section 7.2.3). Notwithstanding this, the Premises will be designed such that surface water is directed around and away from the active portion of the landfill.

The Application also states that the surface water drainage system will be designed to cope with predicted storm events in accordance with the document titled *Siting, design, operation and rehabilitation of landfills (Environment Protection Authority Victoria, August 2015)* (VIC Landfill BPEM).

9.4.50 Key findings

The Delegated Officer has reviewed the information regarding contaminated stormwater impacts and has found:

1. Evaporation generally exceeds rainfall throughout the year; however stormwater still requires management.
2. The Delegated Officer considers that the design of the stormwater pond should include consideration of the average recurrence interval (ARI), gradients and flow rates to prevent erosion.
3. The Application states that the surface water drainage system will be designed to cope with predicted storm events in accordance with the VIC Landfill BPEM but has not provided further details for the sizing of the stormwater pond.
4. Given the nature of the soils, it is unlikely that larger rainfall runoff events captured in the stormwater pond will infiltrate rapidly.

9.4.51 Consequence

If contaminated stormwater emissions occur, then the Delegated Officer has determined that the impact of contaminated stormwater on surrounding land, surface water and groundwater will be low level on a local scale. Therefore, the Delegated Officer considers the consequence of contaminated stormwater impacts to be **moderate**.

9.4.52 Likelihood of Risk Event

The Delegated Officer has determined that contaminated stormwater impacting surrounding land, surface water and groundwater will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **unlikely**.

9.4.53 Overall rating of contaminated stormwater

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of contaminated stormwater impacts is **medium**.

9.4.54 Acceptability of Risk Event

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable, and will be subject to regulatory controls to maintain the acceptability.

9.4.55 Regulatory controls for contaminated stormwater risk

Controls relating to the construction of surface water diversion drains and the stormwater retention pond/sedimentation pond will be included in the Works Approval. This is consistent with the Applicant's proposed controls.

Controls on an operational licence would include maintenance of the above infrastructure including the maintenance of existing groundwater monitoring bores and the regular monitoring of ambient groundwater. Future controls would also include progressive capping to limit rainfall ingress into the landfill.

These controls generally replicate the Applicant's proposed controls and are considered relevant by the Delegated Officer in managing potential risks associated with contaminated stormwater.

The Delegated Officer considers that the establishment of an ambient groundwater monitoring program is important to detect potential contamination; this is detailed further in the regulatory controls for landfill leachate (Section 9.4.66).

Risk Assessment – Leachates (operation)

9.4.56 Description of landfill leachate

Waste deposited at the Premises has the potential to generate leachate. Leachate may result in contamination of soil, surface water and/or groundwater and nearby connected surface water systems.

9.4.57 Identification and general characterisation of emission

Leachate is formed from the infiltration of water (e.g. from rainfall) into the landfill and also from the moisture content of the waste itself.

Landfill leachate from a putrescible landfill mainly consists of dissolved organic matter and inorganic compounds such as sulphates, chlorides and ammonium salts. Leachate may also contain some heavy metals including lead, nickel, copper, hydrocarbons and synthetic organic compounds.

The sources of leachate at the Premises include:

- Landfill cells
- Leachate collection and leakage detection system
- Leachate pond

The Application states that the landfill liner will maintain a minimum 15 metre clearance to the groundwater however groundwater may be impacted by leachate from seepage through the lining system

A fire in the landfill could also result in landfill liner failure resulting in increased leachate loss. The risk of a fire at the landfill has been assessed separately in Section 0.

9.4.58 Description of potential adverse impact from the emission

Leachate from landfilled waste may cause contamination of the groundwater from nutrients, metals and toxicants. This may result in reduction of the quality of extracted groundwater for human uses and impacts to the survival or growth capacity of stygofauna in the aquifers beneath the site.

Where groundwater is a pathway to surface waters, contaminated groundwater may cause indirect impacts to surface waters at the surface expression of the groundwater, such as the geomorphic wetlands to the east of the Premises. This may result in eutrophication and the excessive growth of algae impacting the survival of aquatic biota through attenuated light and dissolved oxygen reduction in lakes, rivers and wetlands.

There is also potential for leachate to contaminate surrounding land impacting priority flora located within the adjacent Boonanarring Nature Reserve.

9.4.59 Criteria for assessment

The Delegated Officer considers that groundwater in the area is potentially suitable for non-potable uses such as livestock watering and garden/agricultural use. It is not known whether groundwater is abstracted for domestic potable purposes. Impacts to groundwater can be assessed against the Australian Drinking Water Guidelines (NHMRC/ARMCANZ, 2011) as well as the Non-Potable Use Guidelines (DoH, 2014). Given that groundwater is likely to be utilised for non-potable purposes, it is considered that the Non-Potable use guidelines are the most appropriate criteria for assessing impacts to groundwater.

9.4.60 Applicant controls

This assessment has reviewed the controls set out in Table 34 below. Controls for the management of fires at the Premises have been identified in Section 9.4.92.

Table 34. Applicant's proposed controls for leachate

Site infrastructure	Description/Operation details
Infrastructure controls for leachate	
Landfill liner	As detailed in Section 7.2
Leachate visual alarms	Leachate visual alarms are located on the leachate risers in the landfill to indicate when leachate has reached its highest acceptable level. This will trigger management actions including increasing leachate pumping rates from the base of the landfill or using secondary (backup) vertical riser to remove leachate from the base of the cell as well as checking the efficiency of the leachate removal system, addressing any failures (i.e. replacing the pump).
Leachate storage pond	As detailed in Section 7.2.8
Leachate recirculation	As detailed in Section 7.2.5
Landfill capping	As detailed in Section 0. The cap will be used to reduce the amount of water ingress into the landfill during winter periods when rainfall frequency is much higher.
Management controls for leachate	

Site infrastructure	Description/Operation details
Waste acceptance	Waste inputs to the proposed landfill will be controlled to eliminate waste materials containing hazardous chemical wastes, significant concentrations of heavy metals, pesticides, asbestos and other contaminants which pose a risk to human health.
Leachate monitoring	The Application states that the following parameters will be analysed on a quarterly basis during landfill operation but may be reduced to half yearly or annually in consultation with DWER once the landfill has ceased operation: pH, Alkalinity, Conductivity, Total Suspended Solids (TSS), Total Organic Carbon (TOC), Nitrite, Chemical Oxygen Demand (COD), Total Phosphorus (TP), Biological Oxygen Demand (BOD5), Sodium, Chloride, Calcium, Sulphate, Iron, Total Nitrogen (TN), Cadmium, Zinc, Chromium, Manganese, Copper, Total Phenol(s), Nickel, Potassium, Magnesium, Total Petroleum Hydrocarbons (TPH), Lead, Ammoniacal-N, Arsenic, Nitrate and Mercury.
Ambient Groundwater monitoring (baseline)	The Application states that a groundwater monitoring program will be established during construction and operation of the landfill to determine potential changes in groundwater quality as a result of landfill operations. Three groundwater monitoring bores have been installed to obtain baseline water quality data during the design phase. Baseline groundwater monitoring is proposed to be undertaken every four months until submission of a construction compliance document for standing water levels and the other parameters specified in the previous Works Approval for the Premises. Monitoring will commence no more than one month after the start of construction works and will be undertaken in accordance with AS/NZS 5667.1 *AS/NZS 5667.1 – Water quality – Sampling*.
Ambient Groundwater monitoring (operation)	The Applicant has advised that seven monitoring bores in total have been installed around the landfill and leachate storage ponds. Bores have been installed on the inferred up hydraulic gradient side to monitor background groundwater quality and on the inferred down hydraulic side of potential contaminant sources to monitor for contamination. Groundwater monitoring is proposed to be undertaken every three months during operation from six water bores (GG1, GG2, GG3, GG4, GG5, GG6 and GG7). Ongoing groundwater monitoring parameters are proposed to include: • pH • Electrical conductivity • Heavy metals • Nutrients (nitrogen and phosphorous) • Ammoniacal nitrogen • Total dissolved solids (TDS) • Total petroleum hydrocarbons. Results will be compared to background concentrations and ANZECC guidelines and has proposed the groundwater assessment criteria detailed in Figure 34 below. The Application states that where groundwater monitoring indicates elevated nutrients or other contaminants in the groundwater and/or sedimentation pond, this will be reported to the Shire immediately and a contingency plan implemented. Where an anomalous result is identified, the sample will be immediately directed for analysis in a NATA registered laboratory and investigations implemented to identify

Site infrastructure	Description/Operation details
	potential cause for the anomaly.

Table 3.1 Groundwater Assessment Criteria

Chemical Parameter	ANZECC & ARMCANZ 2000/ADWG 6 2004 GUIDELINES	Maximum Background Concentrations	Assessment Level (Maximum Baseline + 50%)
Electrical Conductivity		0.95mS/cm	1.425mS/cm
Ammoniacal Nitrogen		0.3mg/L	0.45mg/L
Arsenic		0.003mg/L	0.0045mg/L
Cadmium		<0.0001mg/L	0.0015mg/L
Chemical Oxygen Demand	<40mg/L		60.0mg/L
Chloride		270.0mg/L	4.5mg/L
Chromium		0.001mg/L	0.0015mg/L
Copper		0.002mg/L	0.003mg/L
Iron		0.4mg/L	0.6mg/L
Lead		0.001mg/L	0.0015mg/L
Manganese	0.5mg/L		0.75mg/L
Mercury		<0.0001mg/L	0.00015mg/L
Nickel		0.001mg/L	0.0015mg/L
Nitrite/Nitrate (NOx)		1.6mg/L	2.4mg/L
pH		5.8-6.2	5.8-8.5
Sulphate		26.0mg/L	39.0mg/L
Total Nitrogen		3.2mg/L	4.8mg/L
Total Petroleum Hydrocarbons		<0.01mg/L	0.012mg/L
Total Phosphorous		0.03mg/L	0.04mg/L
Zinc		0.080mg/L	0.12mg/L

Figure 34. Applicant's proposed groundwater assessment criteria

9.4.61 Key findings

The Delegated Officer has reviewed the information regarding leachate impacts and has found:

1. Condition 6-2 of Ministerial Statement 796 requires that at all times landfill and waste mining activities preserve the quality of ground and surface water consistent with ANZECC requirements, taking into consideration natural background water quality, so that existing and potential uses, including ecosystem maintenance, are protected.
2. Condition 6-3 of Ministerial Statement 796 requires monitoring of groundwater quality on and in proximity to the Premises to be done in accordance with works approval and licensing provisions of Part V of the EP Act.
3. The maximum background concentrations identified in Figure 34 are based on limited baseline groundwater monitoring. It is considered appropriate that additional baseline monitoring be undertaken as a requirement of the works approval to provide a representation of seasonal variations in groundwater.
4. The proposed landfill is located in a sensitive groundwater environment and modelling has shown that the leachate leakage rate through the liner increases significantly as the leachate head increases. Conditions will be included in an operational licence to ensure that the landfill is operated and monitored to ensure leachate heads remain within the modelled parameters.

9.4.62 Consequence

If landfill leachate impacts occur, then the Delegated Officer has determined that the impact of landfill leachate impacts will be low level on a local scale. Therefore, the Delegated Officer considers the consequence of landfill leachate impacts to be **moderate**.

9.4.63 Likelihood of Risk Event

The Delegated Officer has determined that landfill leachate impacts could occur at some time; therefore, the Delegated Officer considers the likelihood of landfill leachate impacts to be **possible**.

9.4.64 Overall rating of landfill leachate

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of landfill leachate impacts is **medium**.

9.4.65 Acceptability of Risk Event

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is tolerable, subject to regulatory controls.

9.4.66 Regulatory controls for landfill leachate

The Applicant will be required to implement the following controls to manage the potential impacts from leachate emissions:

- Infrastructure controls including construction, testing and maintenance of liners for the cells, leachate pond and stormwater retention pond;
- Infrastructure controls for the construction and maintenance of the leachate collection and leakage detection system;
- Operational controls including maintaining a 1m freeboard on the leachate ponds

- Limits on waste acceptance/waste processing/waste storage.

Specific requirements for the liner and leachate systems have been identified in Sections 7.2 and 0. CQA testing will be required to ensure that the identified standards have been met. The Applicant has provided minimal CQA testing requirements as part of the Application, as such CQA testing requirements have been derived by the Delegated Officer. A summary of CQA testing requirements and the derivative is included in Appendix 2.

Consistent with the Application, the Applicant will be required to maintain a minimum 10m separation (allowing for natural groundwater fluctuations) between the highest known groundwater level and the lowest elevation of the landfill liner at any point (the assessed design indicates a 15m separation distance will be achieved however, DWER considers a 10m separation distance appropriate to allow for natural fluctuations of the local water-table).

The Applicant will also be required to prepare and submit a CQA report to demonstrate that construction complies with the requirements of the Works Approval. 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.

The Applicant will be required to undertake quarterly groundwater monitoring from seven bores installed at the Premises for the following parameters:

- Standing water level
- pH
- Electrical conductivity
- Redox potential
- Chemical Oxygen Demand
- Temperature
- Ammonia-nitrogen
- Nitrate – nitrogen
- Total nitrogen
- Total phosphorus
- Calcium
- Magnesium
- Sodium
- Potassium
- Sulphate
- Chloride
- Bicarbonate
- Iron
- Manganese
- Cadmium
- Chromium
- Copper
- Nickel
- Lead
- Zinc
- Arsenic
- Mercury
- Total petroleum hydrocarbons

The Delegated Officer considers that the suite of parameters identified are useful in establishing background levels for contaminants commonly found in landfill leachates.

Risk Assessment – Windblown waste (Operation)

9.4.67 Description of windblown waste

Litter from landfilling of municipal waste may be spread over a wide area by wind movement, impacting public amenity and potentially altering local ecosystems.

Sources of litter at the Premises include:

- vehicles transporting waste into the Landfill;
- the active tipping face; and
- exposed surfaces of the landfill.

9.4.68 Identification and general characterisation of emission

Litter from landfilling municipal waste, especially light items such as paper, plastic film and plastic bags can be spread over a wide area by wind movement. The rate of litter borne from landfilling activities will be dependent on the waste type, ambient weather and efficiency of litter prevention activities onsite.

9.4.69 Description of potential adverse impact from the emission

Litter can result in potential nuisance impacts including degradation to the aesthetic value of local properties as well as potential alteration to local ecosystems through threat of litter from the landfill site.

9.4.70 Criteria for assessment

There are no specific criteria for the assessment of windblown waste impacts, general provisions of the EP Act apply.

9.4.71 Applicant controls

This assessment has reviewed the controls set out in Table 35 below.

Table 35: Applicant's proposed controls for windblown waste/litter

Aspect	Description
Landscaping	Screen planting and bunding on the perimeter of the landfill.
Accessibility	• The site will be maintained in a secure manner using fences, gates and entry point so that only authorised vehicles and persons can enter the site. • The general public will have no direct access to the site, reducing the potential for open trailers, etc.
Trucks/Vehicles	• All trucks entering and leaving the Premises will be covered to prevent windblown emissions. • All waste materials delivered to the landfill will be in a covered vehicle which will only be unloaded within the active cell and in the vicinity of the tripping face. • A speed limit will be enforced at the site, to limit the potential for materials loss (litter) from vehicles. • waste vehicle operators will be required to inspect their vehicles before leaving the site to ensure all doors are securely closed, and no waste debris is on the vehicle.
Fencing and screens	• Temporary litter fences will be constructed on top of the perimeter bund surrounding the active cell. • Portable litter screens will be used downwind of the tipping face to trap windblown litter. The screens will be inspected on a daily basis or more frequently if required and the trapped litter will be removed. Staff will be trained in the appropriate placement of the screens to trap as much litter close to the tipping areas as possible. • Site boundary fences will be used to control any litter which migrates outside of the working area.
Litter inspections	• Dedicated staff will be employed to collect windblown litter from litter fences and from around the site. • Regular inspections of the fences and collection of litter around the site boundary and beyond, specifically targeting ditches and access/haul roads.
Meteorological monitoring	• Daily meteorological monitoring will be undertaken as part of the daily and weekly operations.

Aspect	Description
	• During dry and windy conditions, the active tipping face will be kept damp by watering. • During very strong winds operations may be suspended for a short period.
Active tipping face management	• Only one tipping face will be active for solid waste at any one time, where the surface area of the active tipping face will be kept as small as possible. The Site manager will undertake daily inspections of the tipping face. • Appropriate mobile plant will be available on-site for the placement, compaction, and covering of waste. • An adequate supply of daily cover materials will be available on-site. • The waste will be compacted following placement. • Phasing arrangement of the landfill.
Daily cover	Daily cover (soil) or biodegradable sheeting will be deposited over the waste at the end of every working day. No waste surfaces will be left uncovered for extended periods of time (e.g. more than 12 hours).
Capping	Completed cells will be capped promptly once design height has been reached.
Complaints management	• Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid litter complaints. • A complaints register will be established to record and complaints received, date, nature and resolution action undertaken • The Site Manager will contact any complainants that have concerns related to litter and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the Manager will take steps to ensure that any identified impacts are addressed.

9.4.72 Key Findings

The Delegated Officer has reviewed the information regarding windblown waste and has found:

1. The use of litter screens, regular covering of waste and reducing the area of the active tipping face are appropriate controls to reduce the amount of windblown waste form the Premises.
2. Litter screens should be capable of withstanding wind loads when loaded with litter and should be at least four metres high.
3. A regular litter program should be implemented to remove litter from fences and surrounding areas.

9.4.73 Consequence

If windblown waste/litter emissions occur, then the Delegated Officer has determined that the impact of windblown waste impacting sensitive receptors will be low level on a local scale. Therefore, the Delegated Officer considers the consequence of windblown waste impacts on sensitive receptors to be **moderate**.

9.4.74 Likelihood of Risk Event

The Delegated Officer has determined that windblown waste impacting sensitive receptors will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of windblown waste impacting amenity to be **unlikely**.

9.4.75 Overall rating of windblown waste

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of windblown waste impacting sensitive receptors is **medium**.

9.4.76 Acceptability of Risk Event

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable, and will be subject to regulatory controls to maintain the acceptability/ is tolerable.

9.4.77 Regulatory controls for windblown waste

The Applicant will be required to install fencing around the perimeter of the Premises as part of the Works Approval.

Regulatory controls to be included in an operational licence to manage the risk of windblown waste will include:

- Infrastructure controls including the requirement to maintain litter screens; and
- Operational controls including the collection of windblown waste from fences, litter screens and access roads and the regular covering of waste.

These controls are generally consistent with those proposed by the Applicant.

Risk Assessment – Vermin/Pests (operation)

9.4.78 Description of Vermin/Pathogens

Municipal waste at the Premises may provide a breeding habitat for rats, flies, cockroaches and mosquitos as disease vectors. If uncontrolled, these vermin can be a nuisance and affect public health and surrounding ecosystems.

9.4.79 Identification and general characterisation of emission

Landfills may become habitat for pests and animals that may act as disease vectors.

Typical vermin that can be found on landfill sites include rats, mice, flies, mosquitoes, feral cats, foxes, birds and cockroaches which are attracted by food wastes and still waters at landfills. These pests and animals could arise from existing vermin living in and around the landfill site and vermin being transported to the Premises within waste material.

If uncontrolled, these pests can affect public health and surrounding ecosystems.

9.4.80 Description of potential adverse impact from the emission

Uncontrolled dispersion of litter by wind and weather from landfills can lead to an increase in rodent populations, injury and death of domestic and wild animals and reduction in the visual amenity and welfare of people.

Sensitive receptors may be exposed to airborne (mosquitos and flies) or land borne (rodents and insects) disease vectors.

9.4.81 Criteria for assessment

There are no specific criteria for the assessment of vermin/pathogen impacts, general provisions of the EP Act apply.

The main mechanisms for the control of disease vectors are the use of cover material to cover waste daily and eliminating any waterbodies that are not required for fire, sediment and leachate control. Other measures such as scare devices and traps may also be used to reduce or control infestations.

The Delegated Officer considers it appropriate that waste is covered at least daily to reduce potential food and shelter for vermin/pests at the Premises.

9.4.82 Applicant controls

This assessment has reviewed the controls set out in Table 36 below. In addition to the controls in Table 36, Condition 11 of Ministerial Statement 1073 requires that the Applicant prepare and submit a Feral Animal Management Plan to the EPA (see Section 0).

Table 36: Applicant's proposed controls for vermin/pests

Aspect	Description
Waste delivery	Wastes delivered to the Premises will be contained in a covered vehicle to minimise potential odours which may attract vermin and birds.
Tipping face	• Only one tipping face will be active for solid waste at any time. • The surface area of the active tipping face will be kept as small as possible. • Daily inspections of the tipping face will be undertaken by the Site Manager.
Waste cover/burial	• Highly odorous waste will be covered immediately upon receipt. • Daily cover (soil) or biodegradable sheeting will be deposited over the waste at the end of every working day. • Mobile plant will be available onsite for the placement, compaction and covering of waste as well as an adequate supply of daily cover materials.
Fencing	External fences will be constructed with regular patrols to remove accumulated litter.
Capping	Completed cells will be capped immediately after they reach the projected design height.
Bird scaring	Bird scaring techniques will be employed on-site if deemed necessary. Where undertaken, a log of techniques employed will be maintained on-site to assess the effectiveness of the methods employed. Neighbouring land users will be notified of bird scaring programmes.

Aspect	Description
Onsite waste generation	Wastes generated on-site will be stored in vessels with lids to prevent vermin and bird ingress and will be emptied on a regular basis.
Complaints management	• Nearby land users will be advised of appropriate contacts that will record and subsequently address any valid vermin or bird complaints. • A complaints register will be established to record any complaints received, date, nature and resolution action undertaken. • The Site Manager will contact any complainants that have concerns related to vermin and determine the nature of the nuisance. If the nuisance is of an ongoing nature as deemed from the receipt of repeated valid complaints, the Site Manager will take steps to ensure that any identified impacts are addressed.

9.4.83 Consequence

If vermin/pest impacts occur, then the Delegated Officer has determined that the impact will be low level on a local scale. Therefore, the Delegated Officer considers the consequence of vermin/pests be **moderate**.

9.4.84 Likelihood of Risk Event

Given the Applicant's proposed controls, in particular, limiting the size of the active tipping face and covering of waste at least daily, the Delegated Officer has determined that the impacts to health and amenity from vermin/pest impacts will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of impacts from pests/vermin to be **unlikely**.

9.4.85 Overall rating of vermin/pests

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of vermin/pests is **medium**.

9.4.86 Acceptability of Risk Event

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the risk event is acceptable and will be subject to regulatory controls to maintain the acceptability.

9.4.87 Regulatory controls for vermin/pests

The Applicant will be required to implement the following controls to manage the potential impacts from vermin/pests:

- Infrastructure controls including fencing to prevent feral animals such as pigs and foxes from entering the facility; and
- Operational controls in an operational licence include regularly covering waste with cover material and maintaining appropriate quantities of cover material onsite.

These controls generally replicate the Applicant's proposed controls and are considered appropriate by the Delegated Officer to manage the risk of vermin/pests.

Risk Assessment – Fire/Smoke emissions (upset conditions)

9.4.88 Description of fire/smoke emissions

In the event of a fire at the Premises (upset conditions), smoke may travel through the air and land causing vegetation, livestock, public health and amenity impacts near the Premises.

Fire within the waste body may impact the liner if near the base or side lining which could give rise to leachate emissions. The risk of leachate emissions has been assessed separately in Section 0.

9.4.89 Identification and general characterisation of emission

Smoke and fire emissions are not anticipated during normal operations at the Premises. Waste materials accepted and disposed of at the Premises provide a fuel source if ignited. There is also the potential for spontaneous combustion of deposited wastes where wastes are exposed to oxygen (i.e. left uncovered) for extended periods of time.

9.4.90 Description of potential adverse impact from the emission

Smoke from fire causes an amenity impact as it decreases the local air quality and may prevent the enjoyment of outdoor spaces. Smoke also causes health impacts due to the inhalation of Particulate Matter and other substances such as volatile organic compounds, dioxins and polycyclic aromatic hydrocarbons which can penetrate deep into the lungs and cause irritation of the eyes, nose and throat.

Subterranean landfill fires may burn for many days, months and potentially years before they are detected and in some cases, the surface of the landfill may collapse as a result of the fire creating a subsurface cavity. In addition, fire has the potential to damage the landfill liner or capping which has the potential to result in the release of leachate through a perforated liner.

Fire may also spread beyond the confines of the Premises and impact priority flora and fauna in the area triggering a grass or bushfire.

9.4.91 Criteria for assessment

There are no specific criteria for smoke emissions. The general provisions of the EP Act make it an offence to cause or allow unreasonable emissions that unreasonably interfere with the health, welfare, convenience, comfort or amenity of any person.

9.4.92 Applicant controls

This assessment has reviewed the controls set out in Table 37 below.

Table 37: Applicant's proposed controls for smoke/fire

Site infrastructure	Description	Operation details	Reference to plan
Infrastructure controls for smoke/fire			
Fencing	The Premises will have a minimum 1.8m high security fence around the landfill area to prevent unauthorised entry. Site access gates will be provided at the site entrance which will be secured with suitable locks.	The gates will be locked outside of operating hours. Only authorised Applicant personnel and the Fire Brigade will hold keys.	Figure 10. Site plan
Water tank(s)/ Reticulation	Dedicated 100,000L capacity galvanised steel panel tank (Fire	Available for fire-fighting services.	Figure 10. Site plan

Site infrastructure	Description	Operation details	Reference to plan
	service tank).		
	150,000L tank allocated for water reticulation and dust suppression. The tank will have a 20mm diameter pipe and an adapter to convert into a 50mm diameter coupling suitable to connect the local government authority's firefighting fleet.	Water for water reticulation and dust suppression. The pipe adapter to convert the tank into a 50mm adapter will be available at all times.	
Fire retardants	Stored in 20L drums near the water tanks for mixing before application.	For the fighting of landfill (waste fires).	N/A
Water truck	14,000L capacity and can be coupled to the 100,000L fire service tank using a fitting compatible with the Department of Fire and Emergency Services (DFES)/Volunteer Bush Fire Brigades (VBFB) and the LGA firefighting fleet for easy filling of the tank. 50mm diameter heavy duty hose will be used for coupling the water truck to the fire service tank and 20mm diameter heavy duty hose will be used for hand fighting. The water truck will be fitted with a pump for pressurised release of water for firefighting.	Available for dust suppression and firefighting	N/A
Quick response fire unit	One quick response fire unit, comprising a minimum of 1,000L of water, with an operational pump and 20m of 19mm diameter hose (minimum)	Capable of delivering water through an adjustable nozzle. To be located near the site of any work.	N/A
Fire Extinguishers	Portable fire extinguishers will be provided in the office, workshop and also on the plant and equipment, including personnel vehicles.	None specified.	N/A

Management controls for smoke/fire	
Aspect	**Details**
General	• no burning of waste materials will be permitted onsite. • operators will check the area they are working in throughout the day, to ensure any potential fire situation is recognised quickly, allowing prompt action to extinguish it; • waste will be covered with suitable cover material to ensure that the risk of fire within the waste mass is minimised; • flammable goods are not permitted in the landfill; and • smoking will not be permitted in landfill areas.
Management during days declared as Total Fire Ban under *Bush Fires Act 1954 Section 22C* and ban on harvesting and the movement of vehicles in paddocks by the Shire of Gingin	The operation of the Premises during days declared as Total Fire Ban under *Bush Fires Act 1954 Section 22C* and ban on harvesting and the movement of vehicles in paddocks by the Shire of Gingin will be undertaken with strict adherence to the following: • Only work which cannot reasonably be postponed to time with safer weather conditions will be undertaken. • Weather conditions are to be continuously assessed and warnings observed. • All firebreaks are to be maintained in accordance with the Shire of Gingin's firebreak order. • One person is to undertake the role of "fire spotter" for the duration of the Total Fire Ban or ban on harvesting and the movement of vehicles in paddocks period. • One quick response fire unit, comprising a minimum of 1,000L of water, with an operational pump and 20m of 19mm diameter hose (minimum) capable of delivering water through an adjustable nozzle, to be located near the site of any work. • One water truck of at least 14,000L fitted with 200L foam injection systems with remote control cannon available at all times at the waste facility. • The 100,000L water tank dedicated for firefighting purposes is maintained full of water at all times and regularly checked to ensure that it is full. • All vehicles and stationary motors are to be inspected before leaving any formed road to ensure that the exhaust systems are in a sound condition. • All vehicles and stationary motors are to be refuelled on clear ground and in an appropriate method to avoid the release of static electricity. • The entrance road and access to the work areas are to be regularly checked to ensure that no windblown vegetation can come into contact with exhaust or catalytic convertors fitted to any vehicle. • The vehicles and plant are to be sited/parked in areas free from vegetation and combustible material; and • At least two personnel are to remain at the work site for at least thirty minutes after the works have been completed to ensure the work site remains safe and the Premises is to be thoroughly inspected for any potential fire activity before their departure.

Recordkeeping	All fire events will be tabulated and will contain at least the following information: • Time and date of fire; • Weather conditions prevailing during the event of fire (temperature, wind speed and direction, rainfall etc.) • Any variations from the documented precautionary measures; • Firefighting measures and strategy adopted; • Suitability and success of firefighting measures; and • Time taken to arrest the fire.
Key contacts	Emergency contact numbers will be available, along with a fire zone map, from within a weatherproof emergency information cylinder located at the main gate. Emergency contact numbers will also be displayed at both the main gate to the facility and the office.

9.4.93 Key findings

The Delegated Officer has reviewed the information regarding smoke/fire emissions and has found:

1. Water tanks should have fittings to allow DFES appliances to connect into, as per "DFES BEB Guideline No: GL-08 – Hard Suction Connections" and should have British Instantaneous Couplings (BIC) and associated fittings to allow DFES appliances to fill tanks during operations.
2. Once started, landfill fires are difficult to extinguish, so the primary objective is to prevent a fire from starting.
3. The Applicant is also required to adhere to the requirements of the *Bush Fires Act 1954* which includes the maintenance of fire breaks

9.4.94 Consequence

Smoke emissions

If fire/smoke emissions occur, then the Delegated Officer has determined that the impact of fire/smoke emissions on health and amenity will be mid-level on a local scale. Therefore, the Delegated Officer considers the consequence of smoke emissions to be **major**.

Fire emissions

If fire emissions occur from the Premises, the Delegated Officer has determined that the impact of fire emissions to surrounding priority flora and other vegetation will be mid-level on a local scale. Therefore the Delegated Officer considers the consequence of fire emissions to surrounding vegetation to be **major**.

Damage to liner integrity

If an unauthorised fire occurs within the landfill, then the Delegated Officer has determined that the impact of fire emissions on the integrity of the landfill liner and subsequently groundwater will be mid-level on a local scale. Therefore, the Delegated Officer considers the consequence of fire impacts on the landfill liner to be **major**.

9.4.95 Likelihood of Risk Event

Smoke emissions

The Delegated Officer has determined that a fire occurring resulting in smoke emissions would probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **unlikely**.

Fire emissions

The Delegated Officer has determined that the likelihood of fire spreading to surrounding vegetation including priority flora would probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **unlikely**.

Damage to liner integrity

The Delegated Officer has determined that the likelihood of a fire occurring resulting in damage to the landfill liner and potential contamination of groundwater would probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **unlikely**.

9.4.96 Overall rating of smoke/fire emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 26) and determined that the overall rating for the risk of smoke/fire emissions and damage to liner integrity is **medium**.

9.4.97 Acceptability of smoke/fire emissions

As per DWER's acceptability and treatment of risk events (detailed in Table 28) the Delegated Officer has determined that the Risk Event is acceptable, and will be subject to regulatory controls to maintain the acceptability.

9.4.98 Regulatory controls for fire risk

The Applicant will be required to implement the following controls to manage the potential impacts of fires:

- Infrastructure controls including maintaining water tanks/trucks in working order and with appropriate fittings
- Having sufficient cover material available onsite
- Operational controls including no burning of waste onsite, maintaining a minimum 50kL of waste onsite at any time and controls to collect windblown waste

These controls generally replicate the Applicants proposed controls and the requirements of DFES.

10.Determined Regulatory Controls

A summary of the risk assessment and the acceptability or unacceptability of the Risk Events set out above, with the appropriate treatment, control and regulatory controls are set out in Table 38 below.

Table 38: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)	Regulatory Controls (Works Approval/ Licence Condition(s))
	Emission	**Source**	**Pathway/ Receptor (Impact)**				
1.	Fugitive dust (construction)	Vehicle movements and construction activities	Air/wind to sensitive receptor causing amenity impacts from dust observation and deposition or health impacts from inhalation of dust particles.	Management controls	Slight consequence Unlikely likelihood **Low risk**	Acceptable subject to the *Environmental Protection (Unauthorised Discharge) Regulations 2004*.	Not required
2.	Fugitive dust (operation)	Vehicle movements and handling of waste and fill materials	Air/wind to sensitive receptor causing amenity impacts from dust observation and deposition or health impacts from inhalation of dust particles.	Infrastructure and management controls	Slight consequence Unlikely likelihood **Low risk**	Acceptable subject to the *Environmental Protection (Unauthorised Discharge) Regulations 2004*.	Not required
3.	Noise (construction)	Vehicles and onsite machinery	Air/wind dispersion to sensitive receptor causing amenity impacts.	Infrastructure controls	Minor consequence Rare likelihood **Low risk**	Acceptable subject to the *Environmental Protection (Noise) Regulations 1998*.	Not required
4.	Noise (operation)	Vehicles and onsite machinery	Air/wind dispersion to sensitive receptor causing amenity impacts.	Infrastructure and management controls	Minor consequence Rare likelihood **Low risk**	Acceptable subject to the *Environmental Protection (Noise) Regulations 1998*.	Not required

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)	Regulatory Controls (Works Approval/ Licence Condition(s))
	Emission	**Source**	**Pathway/ Receptor (Impact)**				
5.	Odour (operation)	Waste materials	Air/wind to sensitive receptor causing amenity impacts.	Infrastructure and management controls	Moderate consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes - Licence conditions
6.	Landfill gas (operation)	Waste materials landfilled	Lateral migration through soil or passive venting to air causing health impacts and an explosion risk from potential high methane concentration.	Infrastructure and management controls	Major consequence Possible likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes – infrastructure requirements in Works Approval and Licence conditions
7.	Contaminated stormwater (operation)	Waste materials and stormwater	Soil to surface water causing contamination of surface water.	Infrastructure controls	Moderate consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes – infrastructure requirements in Works Approval
8.	Landfill leachate (operation)	Waste materials landfilled and rain/stormwater	Soil to groundwater causing contamination of groundwater.	Infrastructure and management controls	Moderate consequence Possible likelihood **Medium risk**	Acceptable subject to regulatory controls.	Yes – infrastructure requirements in Works Approval
9.	Windblown waste (operation)	Waste materials	Air/wind dispersion to sensitive receptors causing amenity impacts from waste observation and deposition.	Infrastructure and management controls	Minor consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes – infrastructure requirements in Works Approval and Licence conditions

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)	Regulatory Controls (Works Approval/ Licence Condition(s))
	Emission	**Source**	**Pathway/ Receptor (Impact)**				
10.	Vermin/Pests (operation)	Waste materials	Pests and Vermin attracted to waste materials causing health and amenity impacts.	Infrastructure and management controls	Moderate consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes - Infrastructure requirements in Works Approval and Licence conditions.
11.	Smoke/Fire (operation)	Landfilled materials during operation of the landfill facility	Damage to liner	Infrastructure and management controls	Moderate consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes – Infrastructure requirements in Works Approval and Licence conditions
			Spread of fire from waste to surrounding vegetation causing damage to priority flora.	Infrastructure and management controls	Moderate consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes – Licence conditions
		Smoke from fire (upset conditions)	Spread of smoke from fire via air moving with direction of wind to sensitive receptor causing health an amenity impacts from smoke.	Infrastructure and management controls	Moderate consequence Unlikely likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned.	Yes – Licence conditions

11.Determination of Regulatory Controls

11.1 Works Approval Conditions

The conditions in the issued Works Approval in Attachment 1 have been determined in accordance with the *Guidance Statement: Setting Conditions*.

Table 39 provides a summary of the conditions to be applied to this works approval.

Table 39: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and Equipment 1, 2, 3, 4, and 5	These conditions are valid, risk-based and contain appropriate controls.
Construction Quality Assurance Testing 6, 7, and 8	These conditions are valid, risk-based and contain appropriate controls.
Monitoring 9, 10, 11, 12, and 13	These conditions are valid, risk-based and contain appropriate controls.
Emissions 14	This condition is valid, risk-based and consistent with the EP Act.
Record-keeping 15 and 16	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

DWER notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, DWER may initiate amendments to the Works Approval under the EP Act.

Upon the completion of construction, the Applicant will be required to apply for a licence to operate the Premises.

11.2 Licence Conditions

In consideration of the above assessment regulatory controls may be included in the Licence relating to:

- Throughput restrictions;
- Waste type acceptance restrictions;
- Waste management and covering requirements;
- Maintenance of site security;
- Wind–blown waste management;
- Unauthorised fire management;
- Monitoring of inputs and outputs;
- Leachate management;
- Groundwater monitoring; and
- Landfill gas monitoring.

12.Applicant's comments

The Applicant was provided with the draft Decision Report and draft issued Works Approval on 21 December 2018; the applicant was requested to provide comment on the draft assessment and works approval and was also requested to provide additional information in response to gaps or queries raised in the draft documentation.

The Applicant provided additional information as requested by DWER on 15 January 2019. The Decision Report and Works Approval was revised to incorporate this information.

Requirements for monitoring bores were removed as the Applicant confirmed these are already installed onsite. Requirements for UV resistance CQA for the cushion geotextile layer was also removed from the Works Approval as the Applicant advised that this material is covered quickly onsite and is tested by the manufacturer prior to delivery to the Premises.

The Applicant advised that no further comments were to be provided on the documents and opted to waive the remaining comment period.

13.Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (summarised in Appendix 1).

Based on this assessment, it has been determined that the Issued Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

A/MANAGER WASTE INDUSTRIES
REGULATORY SERVICES
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Application for Works Approval – Fernview Landfill	Application	DWER records (A1498245)
2.	Allan Watson Associates. *RE: Fernview Landfill Development Landfill Batter Stability Assessment*. October 2010	Stability Assessment	DWER records (A1555008)
3.	Allan Watson Associates. *Veolia Environmental Services Fernview Farm Bio-Reactor Landfill Proposal – Assessment of Bio-Reactor Landfill Liner Integrity*. July 2007	Landfill Liner Integrity Assessment	DWER records (A1498267)
4.	Bowman & Associates "*RE: Proposed Landfill – Summary of Clarification Sought by DEC Relating to Works Approval Application for Fernview Landfill*". 28 November 2011	Bowman & Associates, 2011	DWER records (A455159)
5.	Works Approval W5031/2011/1 – Fernview Landfill	W5031/2011/1	DWER records (A551246)
6.	Amended Works Approval W5031/2011/1 – Fernview Landfill	Amended W5031/2011/1	DWER records (A1436830)
7.	Golder Associates. *Peer Review of Stability Assessment Fernview Class II Landfill, Cullalla, WA*. 23 February 2018.	Golder Associates Stability Assessment Review	DWER records (A1623850)
8.	ATC Williams. *Fernview Landfill Stability Review and Assessment*. April 2018	April 2018 Revised Stability Assessment	DWER records (A1655625)
9.	ATC Williams. *Fernview Landfill Stability Analysis*. October 2018	October 2018 Revised Stability Assessment	DWER records (A1740327)
10.	Crisalis International Pty Ltd. *Hydrogeology of a Proposed Bioreactor Landfill site, Fernview Farm, Cullalla, Northeast of Gingin: Report* for ATA Environmental, April 2006. January 2007	Crisalis, 2007	DWER records (A1498265)
11.	EP Bulletin 1287	Bulletin 1287	accessed at www.epa.wa.gov.au/
12.	Ministerial Statement 796	MS 796	
13.	EPA Report 1510	Report 1510	
14.	Ministerial Statement 975	MS 975	
15.	EPA Report and Recommendations 1612	EPA R&R No: 1612	

	Document title	In text ref	Availability
16.	Ministerial Statement 1073	MS 1073	
17.	DWER 26D Licence CAW200646 for the construction of 3 non-artesian wells.	26D Licence	DWER records (DWERDT31345)
18.	Department of the Environment. *Works Approval for the Gingin Regional Landfill Project: Response to invitation to comment.* 14 September 2017	DoE, 2017	DWER records (A1522504)
19.	Water Corporation. *RE: Request for comments – Stakeholder notification – W6083/2017/1 – Referral of a Works Approval*. 22 September 2017	Water Corporation, 2017	DWER records (A1530224)
20.	Shire of Gingin. *Referral of a Works Approval Under the Environmental Protection Act 1986 – Extension to Consultation Period – Request for Comment*. 22 September 2017	Shire of Gingin, 2017	DWER records (A1531428)
21.	ATC Williams Memorandum – DWER Clarification #1 request for Fernview Landfill dated 4 December 2018	ATC Williams, December 2018	DWER records (A1745745)
22.	Revised Locality Plan (Fernview Landfill Drawings_001-011_RevB)	Revised Locality Plan	DWER records (A1745746)
23.	Letter from Fernview Environmental dated 15 January 2019– Re: Application for a works approval under the Environmental Protection Act 1986 – Draft Instrument and Decision Report	Additional information received 15 January 2019	DWER records (A1756938)
24.	Fernview Environmental Memorandum – DER2017/001450 Draft Works Approval and Decision Report dated 15 January 2019		DWER records (A1756944)
25.	ATC Williams Memorandum – Draft Works Approval W6083/2017/1 and Decision Report dated 15 January 2019		DWER records (A1756942)
26.	Revised drawings 118061-05-001-012-A (Catchment Layout Plan) 118061-05-001-013-A (Rehabilitation Landfill Cap Option) and 118061-05-001-002-C (Site Plan)		DWER records (A1756941, A1756945 and A1756946)
27.	Environment Protection Authority Victoria. *Siting, design, operation and rehabilitation of landfills*. August 2015	VIC Landfill BPEM	accessed at www.epa.vic.gov.au
28.	Geosynthetic Institute. *GRI – GCL3 Test Methods, Required Properties, and testing Frequencies of Geosynthetic Clay Liners (GCLs)*. Revised 28	GRI – GCL3	accessed at http://www.geosyntheti

	Document title	In text ref	Availability
	March 2016.		c-institute.org/specifications.htm
29.	Geosynthetic Institute. *GRI – GM13 Standard Specification for "Test Methods, Test Properties and testing Frequencies for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes"*. Revised January 2016.	GRI – GM13	
30.	Geosynthetic Institute. *GRI Guide GM10 Standard Guide for "The Stress Crack Resistance of HDPE Geomembrane Sheet"*. Revised July 2015.	GRI – GM10	
31.	Geosynthetic Institute. GRI Standard GM19a Standard Specification for Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers. Revised July 2017.	GRI – GM19a	
32.	Geosynthetic Institute. GRI Standard GM19b Standard Specification for Seam Strength and Related Properties of Thermally Bonded Reinforced Polyolefin Geomembranes/Barriers. October 2017.	GRI – GM19b	
33.	Geosynthetic Institute. GRI Test Method GT12(A) – ASTM Version Standard Specification for "Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials". Revised March 2016	GRI - GT12(a)	

Appendix 2: CQA testing requirements

Requirement	Comment
Geosynthetic Clay Liner CQA	
Mass per unit area of bentonite content	Minimum value and frequency derived from the Geosynthetic Research Institute document GRI – GCL3. Frequency derived from the VIC Landfill BPEM.
Montmorillonite content	Minimum value derived from the Geosynthetic Reserch Institute document GRI – GCL3. Frequency derived from the VIC Landfill BPEM and is consistent with other landfill approvals.
Mass of GCL	Minimum value and frequency derived from the Geosynthetic Research Institute document GRI – GCL3.
Moisture content (bentonite)	Minimum value and frequency derived from the Geosynthetic Research Institute document GRI – GCL3.
Tensile strength	Minimum value and frequency derived from the Geosynthetic Research Institute document GRI – GCL3.
Swell index (free swell of clay/bentonite)	Frequency and minimum value derived from the Geosynthetic Research Institute document GRI-GCL3.
Peel strength	Minimum value and frequency derived from the Geosynthetic Research Institute document GRI – GCL3.
Permeability	Frequency derived from the Geosynthetic Research Institute document GRI – GCL3. The minimum permeability value is consistent with Ministerial Statement 796 and that proposed by the Applicant.
Index flux	Minimum value and frequency derived from the Geosynthetic Research Institute document GRI – GCL3.
Visual Inspection - Colour, thickness, needle punching, presence of needles or broken needles, and sewing density or other faults in the material	Consistent with requirements of the VIC landfill BPEM.
HDPE CQA	
Thickness	The thickness minimum value is consistent with Ministerial Statement 796 and that proposed by the Applicant. The frequency and minimum value are consistent with the Geosynthetic Research Institute document GRI – GM13.
Density	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.

Requirement	Comment
Tensile properties: Yield strength Break strength Yield elongation Break elongation	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.
Puncture resistance	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.
Tear resistance	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.
Carbon black content	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.
Stress crack resistance	Minimum value derived from the Geosynthetic Research Institute document GRI – GM13. Frequency derived from the VIC Landfill BPEM.
Oxidative induction time (OIT): Standard OIT or High Pressure OIT	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.
Oven ageing and oxidative induction time: Standard OIT - % retained after 90 days High Pressure OIT - % retained after 90 days	Frequency and minimum values derived from the Geosynthetic Research Institute document GRI – GM13.
Welding equipment	Requirements derived from the VIC Landfill BPEM.
Weld conditions	
Destructive weld testing - Onsite, hand tensiometer in peel and shear	Frequency and minimum values have been derived from the Geosynthetic Research Institute document GRI – GM19A.
Non-destructive weld testing - Air pressure test	Requirements derived from the VIC Landfill BPEM.
Non-destructive weld testing - Vacuum box test	
Visual Inspection - Tears, punctures, abrasions, cracks, indentations and thin spots	
Non-Woven Cushion Geotextile CQA	

Requirement	Comment
Mass per unit area	Mass per unit area has been determined by comparison to approvals for similar landfill facilities. Frequency has been derived from the VIC Landfill BPEM.
Wide strip tensile strength	Minimum value consistent with that provided by the Applicant. Frequency has been derived from the VIC Landfill BPEM.
Trapezoidal tear shear strength	Minimum value consistent with that provided by the Applicant. Frequency has been derived from the VIC Landfill BPEM.
Burst strength (CBR)	Minimum value consistent with that provided by the Applicant. Frequency has been derived from the VIC Landfill BPEM.
Puncture strength (CBR)	Minimum value consistent with that provided by the Applicant. Frequency has been derived from the VIC Landfill BPEM.
Grab tensile strength	Minimum value consistent with that provided by the Applicant. Frequency has been derived from the VIC Landfill BPEM.
UV Resistance	Requirements consistent with those proposed by the Applicant.
Visual inspection – Colour, thickness, tears, holes, punctures, needle-punching, presence of needles and other faults in the material.	Requirements derived from the VIC Landfill BPEM