# Environmental Assessment and Management Plan

Salt Valley Road Landfill – Cells 5 and 6 Development

**Prepared for Opalvale Pty Ltd**

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# Table of Contents

## Tables

## Figures



## Diagrams



## Appendices

# 1 Introduction

Opalvale Pty Ltd (Opalvale) currently operates the Salt Valley Road Class II Landfill, located approximately 80 kilometres (km) east of Perth and comprises part of Lot 11 Chitty Road on Deposited Plan 34937 (the Site). The Site's landfill operations have been split into two stages:

- Stage 1 – current operational landfill area, consisting of Cells 1-6:
  - Cells 1, 2, 3 and 4 are currently open and accepting waste; and
  - Cells 5 and 6 have yet to be constructed.
- Stage 2 – future landfill expansion area.

As Cells 1, 2, 3 and 4 are close to reaching their maximum operating height, the construction of Cells 5 and 6 is necessary to ensure that the landfill has sufficient capacity and to facilitate progress in accordance with the landfill's *Closure and Post-Closure Management Plan, Talis 2021* (the Closure Plan).

A Works Approval from the Department of Water and Environmental Regulation (DWER) is required to construct the new cells. Therefore, this Environmental Assessment and Management Plan (EAMP) has been prepared to support the Works Approval application for the development of Cells 5 and 6 by outlining the existing environmental attributes, detailed designs, proposed construction works, and environmental management measures to be implemented.

## 1.1 Objective

The objectives of this EAMP are to:

- Provide the design, construction and operational details of Cells 5 and 6;
- Outline the environmental aspects requiring management;
- Describe the proposed environmental management measures;
- Provide information to address the requirements of the DWER's *Application form annex: Category checklist (solid waste landfill sites)* (the DWER Checklist);
- Undertake a residual risk assessment in accordance with the DWER's *Guidance Statement: Risk Assessments* (2017); and
- Demonstrate that the proposed management measures adequately manage potential environmental risks.

## 1.2 Scope of Report

The scope of this EAMP includes:

- Section 1: Introduction;
- Section 2: Site Information;
- Section 3: Environmental Attributes;
- Section 4: Infrastructure Layout and Design;
- Section 5: Infrastructure Operational Aspects;
- Section 6: Environmental Aspects and Management;
- Section 7: Post Closure Management;
- Section 8: Residual Risk Assessment; and
- Section 9: Conclusion.

# 2 Site Information

The following sections provide details on the Site's location, zoning and surrounding land use, separation distances, licencing, and existing infrastructure.

## 2.1 Site Location

The Site is located at the Williamson's Clay Pit and is situated on the southeastern portion of Lot 11, occupying an area of approximately 48 hectares (ha). The Site boundary is shown in Licence L9089/2017/1 and depicted on Drawing W-101 (Appendix A). Access to the Site is via Salt Valley Road, with an internal road providing access to the landfill cells. The Site locality is provided in Figure 1 (Appendix B).

## 2.2 Licencing

The Site is classified as a Prescribed Premises under Schedule 1 – Prescribed Premises of Part V of the Environmental Protection Regulations 1987 and currently operates under DWER Licence L9089/2017/1 (the Site Licence). The Site is licenced as a Category 64, Class II putrescible landfill, which allows a maximum of 150,000 tonnes of waste disposal onsite per year. The categories covered under the Licence are listed in Table 2-1.

**Table 2-1: Prescribed Premise Categories**

| Category Number | Category Description | Assessed Design Capacity |
|---|---|---|
| 64 | Class II putrescible landfill site | 150,000 tonnes per annum |

## 2.3 Zoning and Surrounding Land Use

The Site is zoned as 'Special Use' and is surrounded by native vegetation and agricultural land. The Department of Agriculture and Water Resources (Catchment Scale Land Use 2018) defines agricultural land to the west and east of the Site as dryland and broad acre cropping, and grazing pastures. There are established irrigation areas (mainly for perennial horticultural purposes) located approximately 3-5 kilometres (km) north, east, and south of the Site.

Figure 2 (Appendix B) highlights the land use tenure around the Site.

## 2.4 Sensitive Receptors

The Environmental Protection Authority's (EPA's) *Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses (2005)* (Guidance Statement 3) contains the recommended separation distances between industrial activities, including waste management facilities, and sensitive land uses. Sensitive land uses are defined by the EPA as those that are sensitive to industrial emissions and include residential developments, schools, hospitals, shopping centres and other public areas and buildings. Table 2-1 provides the recommended minimum separation distances between sensitive land uses and the Prescribed Premises categories for which the Site is currently licenced.

**Table 2-2: Recommended Separation Distances between Industrial and Sensitive Land Uses**

| Category No. | Industry | Impacts | | | | | Recommended Minimum Separation Distance |
|---|---|---|---|---|---|---|---|
| | | Gaseous | Noise | Dust | Odour | Risk | |
| 64 | Class II or III putrescible landfill site | ✓ | ✓ | ✓ | ✓ | | 500m for subdivisions<br>150m for single residences<br>35m internal buffer from Site boundary |

Jimperding Brook is located approximately 780 metres (m) west and southwest from the Site. Jimperding Brook flows in a general northerly direction and ultimately ends in the Avon River Valley. The Avon River Valley is listed on the Directory of Important Wetlands in Australia (DIWA) and is situated approximately 12.5km northwest of the Site.

According to *Opalvale Salt Valley Road Class 2 landfill. Lot 11 Chitty Road, Toodyay. Works Approval Application Supporting Documentation* by IW Projects dated 21 December 2014 (Stage 1 Works Approval), the closest neighbouring residential property is a farmhouse located 400m to the southwest of the Site. A further two residential properties are located approximately 1,350m from the northeast boundary of the Site.

According to Table 2-2, the recommend minimum separation distance between a Class II landfill and offsite buildings or structures should be at least 500m. To address this, a letter from the owner of the residential property located 400m southwest of the Site has been obtained, providing written consent for the residential property to be ignored from consideration of any potential impacts of the landfill. Therefore, all Site current and future activities will maintain appropriate separation distances.

These separation distances are illustrated in Figure 3 (Appendix B).

## 2.5 Existing Site Infrastructure

The Site is owned and managed by Opalvale and has been in operation since 2018. The existing Site infrastructure includes:

- A weighbridge for secure Site access;
- A Site office;
- Putrescible Landfill Cells 1, 2, 3 and 4 surrounded by a 2m high chain-link fence; and
- Three leachate evaporation ponds.

Cells 1, 2, 3 and 4 are approaching the end of their lifespan and through this application for a Works Approval, Opalvale is seeking approval for the construction of Cells 5 and 6 to extend the lifespan of the Site.

## 2.6 Current Waste Types and Volumes

According to the Site Licence, the Site can accept the following waste types up to a combined total of 150,000 tonnes per annum (tpa):

- Clean Fill and Uncontaminated Fill;

- Inert Waste Type 1;
- Inert Waste Type 2;
- Special Waste Type 1;
- Special Waste Type 2;
- Putrescible Waste; and
- Contaminated solid waste.

The Site currently accepts waste six days a week, Monday to Saturday, receiving wastes from both the community and commercial operators, the largest of which is Resource Recovery Solutions. Approximately 90,000 to 100,000tpa of waste is accepted at the Site, and the approximate composition of the waste received is shown in Table 2-3.

**Table 2-3: Waste Composition**

| Waste Type | Percentage (%) |
|---|---|
| Food | 15 |
| Paper and cardboard | 15 |
| Garden and parks | 5 |
| Wood and wood waste | 25 |
| Textiles (e.g. carpets etc.) | 5 |
| Rubber and leather | 5 |
| Plastics | 20 |
| Other inert | 10 |

# 3 Environmental & Social Attributes

The following section outlines the key environmental and social attributes of the Site that are particularly relevant to the construction of Cells 5 and 6, including climate, topography, geology, hydrology, hydrogeology, flora and fauna, and heritage.

## 3.1 Climate

The Site is located within a temperate climactic zone that experiences distinctly dry and hot summers and cool wet winters. According to the Bureau of Meteorology (BOM), the closest weather station with long-term climate data is Northam (Station 010111), approximately 18.2km northeast of the Site. The prevailing wind data has been sourced from this weather station.

As there is limited quality controlled BOM data available for rainfall and evaporation, this data was sourced from SILO, a database of Australian climate data from 1889 to the present day that is hosted by the Queensland Department of Environment and Science (DES). It provides daily meteorological datasets for a range of climate variables in ready-to-use formats suitable for biophysical modelling, research, and climate applications. The datasets are constructed from observational data obtained from BOM, using mathematical interpolation techniques to infill gaps in time series and construct spatial grids. The spatial grid selected (Latitude: -31.65, Longitude: 116.45) is for Hoddy's Well, WA and encompasses the Site in its entirety.

Being in a temperate zone, rainfall is seasonal with higher rainfall generally in the months of May to September. Table 3-1 presents a summary of average rainfall and evaporation records, from 1973 to 2023. The average annual evaporation rate is approximately 1,930mm, which exceeds average annual rainfall by about 1,386mm.

**Table 3-1: Climate Statistic Summary in Millimetres from SILO (1973-2023)**

| Aspect | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Rainfall | 20 | 15 | 19 | 27 | 64 | 93 | 103 | 84 | 60 | 30 | 20 | 9 | 544 |
| Average Evaporation | 304 | 252 | 215 | 130 | 82 | 57 | 58 | 72 | 101 | 160 | 217 | 280 | 1,930 |

The wind direction generally ranges from east to south-easterly in the morning (9am), changing direction to westerly and south-westerly in the afternoon (3pm). Winds are typically moderate in the morning and moderate to strong in the afternoon. The wind rose for morning and afternoon winds can be seen in Diagram 3-1.

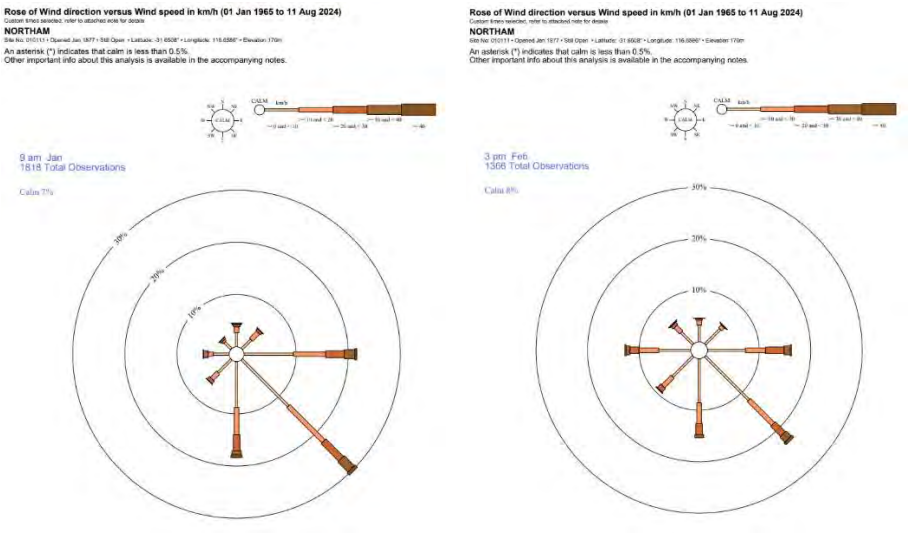


**Diagram 3-1: 9am (left) and 3pm (right) Wind Rose for Northam**

## 3.2 Topography

The Site is situated within a former clay pit, and the elevation ranges from approximately 270m Australian Height Datum (AHD) in the base of the pit to 300mAHD outside the Stage 1 footprint, in the eastern portion of the Site. Figure 4 (Appendix B) shows the general topography of the Site.

The existing topography within the Site development area ranges from 275mAHD to 295mAHD and is shown in Drawing W-101 (Appendix A).

## 3.3 Geology

Geoscience Australia (1:2.5 million scale) classifies surface geology profiles occurring across the Site as "*quartzite kyanite, sillimanite, muscovite/fuchsite, garnet, hornblende, clinopyroxene, epidote; psammitic and politic schists garnet, felsic gneiss and hornfels, quartz-mica-graphite schist, metaconglomerate, cordierite-bearing rock*". The Department of Mines, Industry Regulation and Safety (DMIRS) Geological Survey of Western Australia (GSWA) 1:500,000 map series describes the underlying bedrock geology as "*quartz – mica schist; includes sillimanite, andalusite, kyanite, graphite, and staurolite bearing varieties*".

Stass Environmental (Stass)[1] undertook a detailed hydrogeological investigation of the Site in 2015. It discusses the geology and underlying groundwater within the Site. The surface geology has been described as "*yellow gravelly loamy sand to depth of approximately 0.5m, underlain by sandy clay*". The Williamson's Pit is described as a "*void cut into deep micaceous clay*". The bedrock geology underlying this clay is described as "*inter-bedded schists, quartzites and metamorphosed volcanics*" that comprise the Jimperding Series.

An initial investigation was conducted by Martinick McNaulty in 1998 to assess the local geology and groundwater that is summarised in the Stass investigation. The in-situ soil material at the bottom of

[1] Groundwater Assessment, Stass, May 2015

Williamson's Pit found a "*4-8% clay, 26-33% silt content and 53 to 56% sand content*". The in-situ soil permeability tests were deemed suitable for construction of a compacted landfill basal liner.

Further limited (1 sample) soil characterisation testing undertaken in December 2020 as part of the Stability Risk Assessment completed by Talis (Appendix E) found the material is approximately 3% clay, 50% silt, 42% sand and 5% gravel. Emerson Class testing found the soil to be Class 5, non-dispersive, however under turbulent or concentrated fast flows, breakdown of the soil may occur causing soil particles to disperse. The geological data for the Site is illustrated within Figure 5 (Appendix B).

## 3.4 Hydrology

There are no natural surface water bodies within 500m of the Site, with the closest major hydrological feature being Jimperding Brook, located approximately 780m to the west-southwest. The Jimperding Brook ultimately joins the Avon River. Surface water flows to the northeast are captured by a small drainage line and diverted to Jimperding Brook.

The locations of the surface water bodies near the development are provided in Figure 6 (Appendix B).

## 3.5 Hydrogeology

Talis completed a review of groundwater levels at the Salt Valley Road Class II landfill (Appendix F) in accordance with the Site Licence for the purpose of assessing the separation distance to groundwater beneath the proposed Cell 5 and 6. Based on the results it is concluded the long-term maximum groundwater level beneath Cell 5 and 6 is approximately 271.9mAHD which is within the range of previous reported results.

The design level for the Cell 5 and 6 sump, which is the lowest part of the cell development area, is 273.9mAHD. Therefore, a groundwater separation distance of 2m is achieved, which satisfies the generally recommended minimum requirement for a Class II landfill[2].

## 3.6 Flora and Fauna

The Site was previously cleared for agriculture and extractive industry purposes, with native forests progressively cleared since the 1960s. The uncleared portion supports a forest primarily consisting of Jarrah, Marri, Wandoo, and Powderbark Wandoo trees, with native shrubs, herbs, and grasses in the understorey. These forests are well represented in surrounding areas and will not be significantly impacted by the proposed development. There is no native vegetation clearing required within the development footprint.

A desktop assessment was undertaken utilising the Department of Biodiversity, Conservation and Attractions (DBCA) database. There are not any threatened flora or fauna species recorded at the Site; however, there are three recordings of threatened fauna species approximately 1km north of the Site, as shown in Figure 7 (Appendix B). Given the nature, scale and distance of the proposed works, the likelihood of any impact to the threatened species is considered to be negligible.

The landfill will be developed in a former clay pit and upon being filled, will be rehabilitated back to native bushland and pasture, which will in time provide additional fauna habitat at the Site.

[2] State of Victoria's Environmental Protection Authority (EPA) Best Practice Environmental Management: Siting, Design, Operation and Rehabilitation of Landfills 2015 (BPEM Guidelines).

## 3.7 Heritage

### 3.7.1 Aboriginal Heritage

A search of the DPLH's Aboriginal Heritage Places dataset identified that the Site has no known Aboriginal Cultural Heritage within its boundaries. The Registered Site ACH-00015979: Avon River is located approximately 900 southwest of the Site.

As development of Cells 5 and 6 is occurring within a historically cleared clay pit, there are not anticipated to be any impacts to Aboriginal heritage aspects as part of the works.

### 3.7.2 European Heritage

There are no known European Heritage sites on or within 2km of the Site which could be impacted by the proposed development.

# 4 Infrastructure Layout and Design

Stage 1 of the landfill consists of six cells, with four already built and only Cells 5 and 6 still to be constructed. As the existing cells near maximum capacity, the construction of Cells 5 and 6 is critical in ensuring that the Site's development can occur in line with its Closure Plan and enable its long-term closure. The location of the proposed Cells 5 and 6 are shown in Drawing W-101 (Appendix A).

The following sections provide further details on the design and construction of the two proposed cells.

## 4.1 Site Infrastructure and Activities

There is currently no permanent infrastructure within the footprint of the proposed development area; however, access roads border the proposed cells to the north and south. To allow continued access during the operation of the proposed cells, there will be minor modifications to the internal road network at the Site, as shown in Drawing W-108 (Appendix A).

## 4.2 Cells 5 and 6 Design

As part of its commitment to undertake best practice waste management, the future cells will be developed in general accordance with the Victorian Environmental Protection Authority's (VIC EPA's) *Best Practice Environmental Management: Siting, Design, Operation and Rehabilitation of Landfills 2015* (BPEM Guidelines) and New South Wales Environmental Protection Authority's (NSW EPA's) *Environmental Guidelines Solid Waste Landfills* (NSW EPA Guidelines), collectively referred to as the Landfill Guidelines.

Designing landfill cells using the criteria within the Landfill Guidelines ensures that construction and operational risks are mitigated, and the environment is protected throughout the lifespan of the Site. Therefore, the proposed Cells 5 and 6 will consist of the following elements:

- Engineered Composite Lining System (in order of construction/installation):
  - 500mm engineered fill;
  - Geosynthetic clay liner (GCL);
  - 2mm double textured high-density polyethylene (HDPE) geomembrane;
  - Protection geotextile;
  - Leachate collection, extraction and management system incorporating:
    - 300mm thick aggregate leachate collection layer;
    - 225mm diameter perforated primary leachate collection pipes;
    - 160mm diameter perforated secondary leachate collection pipes;
    - Dual 355mm leachate extraction riser pipes and automatic submersible pump;
    - Leachate main for future connection to the existing leachate evaporation ponds; and
  - Separation geotextile.

Following development and operation of the cells, future environmental controls will comprise the following:

- Landfill gas management system incorporating gas wells and gas mains for future connection to methane destruction plant;
- Surface water management system consisting of open channel drains and sedimentation ponds;
- Engineered Landfill Capping System (in order of construction/installation):
  - 300mm sand gas collection layer/regulating layer;
  - 1.5mm thick double textured linear low-density polyethylene (LLDPE) geomembrane layer;
  - Geonet drainage layer;
  - 800mm thick layer of site won subsoils; and
  - 200mm thick layer of growing medium/mulch; and
  - Vegetation layer incorporating hydromulch/seeding to reduce erosion and advance revegetation.

Design of the landfill cells has also been undertaken to maintain consistency with previous landfill cell development at the Site, including compliance with the design criteria within existing Site Licence conditions.

### 4.2.1 Design Drawings

The detailed design drawings for Cells 5 and 6 are provided in Appendix A. The full list of design drawings is presented in Table 4-1.

**Table 4-1: Detailed Drawings**

| Drawing Reference | Description |
|---|---|
| W-101 | Existing Site Layout and Topography |
| W-102 | Top of Formation |
| W-103 | Top of Engineered Fill |
| W-104 | Cell 5 Leachate Management Layout |
| W-105 | Cell 6 Leachate Management Layout |
| W-106 | Maximum Recorded Groundwater Level in Cell 5 & 6 Footprint |
| W-107 | Maximum Recorded Groundwater Level 11 January 2023 |
| W-108 | Road Layout and Sections |
| W-109 | Surface Water Layout |
| W-110 | Gas Management System Layout |
| W-111 | Proposed Restoration Profile and Surface Water Management |
| W-201 | Hydrogeological Cross Section |
| W-202 | Long Sections |
| W-301 | Typical Details Sheet 1 of 4 |
| W-302 | Typical Details Sheet 2 of 4 |

| | |
|---|---|
| W-303 | Typical Details Sheet 3 of 4 |
| W-304 | Typical Details Sheet 4 of 4 |
| W-305 | Drain Sections |

## 4.3 Construction Quality Assurance and Technical Specification

To ensure the materials and construction of the landfill cells meet the design criteria, a Construction Quality Assurance (CQA) Plan and Technical Specification have been prepared for Cells 5 and 6, which are anticipated to be constructed in the 2024/25 financial year. The CQA Plan details the testing methods and quality assurance procedures to construct Cells 5 and 6. The Technical Specification details the earthworks, supply and installation of the composite lining system and leachate collection and extraction infrastructure. Copies of the Technical Specification and CQA Plan are provided in Appendix C and Appendix D, respectively.

## 4.4 Cell Construction

### 4.4.1 Earthworks

To prepare the area for construction, any incidental debris or deleterious material will first be removed. There is no native vegetation clearing required within the development footprint. Any existing topsoil/growth medium will be stripped from all areas within the earthworks to a minimum depth as specified in the construction drawings. After removal of topsoil, the cells will be excavated to the design formation levels and geometry.

### 4.4.2 Composite Lining System

To protect the surrounding environment and groundwater from contamination, a composite lining system will be constructed and installed. The key elements of the lining system are:

- 500mm thick engineered fill;
- GCL;
- 2mm double textured HDPE geomembrane;
- Protection geotextile; and
- Separation geotextile (following installation of leachate collection and extraction system; refer to Section 4.4.3).

The lining system has been developed in accordance with the Landfill Guidelines and the Site Licence, to achieve a permeability of less than $5x10^{-11}$m/s. The design of the composite system is shown in the detailed drawings in Appendix A.

A 500mm thick engineered fill layer will then be constructed using Site-won soil material to provide an additional low-permeability soil barrier layer in the unlikely event the overlying geosynthetic lining system is compromised. The engineered fill layer will be subject to conditioning, compaction and testing to ensure that it meets the design criteria. Field density tests will be performed to monitor the quality and uniformity of the soil placement and compaction. Tests will be carried out by a National Association of Testing Authorities (NATA) certified laboratory and all results will be checked by the CQA Consultant and Superintendent appointed by Opalvale. These tests include, but are not limited to, moisture content, Atterberg limits, grading, dry density and permeability. Further details regarding the earthworks are detailed in the Technical Specification (Appendix C).

Conformance testing of the geosynthetic lining materials (GCL, HDPE, protection geotextile and separation geotextile) will be undertaken prior to installation to ensure they meet the requirements outlined in the Technical Specification (Appendix C). Installation of the lining system will be undertaken by a qualified lining installer and supervised by a CQA consultant to ensure construction of the cell is in accordance with the CQA Plan and Technical Specification. Following completion of installation of the GCL, HDPE, protection geotextile and leachate collection layer, a leak detection survey will be undertaken (Section 4.4.4). Once the CQA consultant signs off on the survey, the final layer (separation geotextile) is installed. Further details regarding the installation of the lining system for Cells 5 and 6 is provided in the Technical Specification (Appendix C).

The lining system on the eastern boundary of Cell 5 will tie into the existing Cell 1 and Cell 6 will be tied into the existing Cell 3 as shown in Drawings W-103 and W-302 (Appendix A).

### 4.4.3 Leachate Collection and Extraction System

To protect the surrounding environment and groundwater from contamination, a leachate collection and extraction system will be constructed and installed. The key elements of this system are:

- 300mm thick highly permeable low calcareous aggregate leachate collection layer; and
- 225mm diameter perforated primary leachate collection pipes;
- 160mm diameter perforated secondary leachate collection pipes;
- Dual 355mm leachate extraction riser pipes and automatic submersible pump;
- Leachate main for future connection to the existing leachate evaporation ponds.

The leachate collection system incorporates an aggregate drainage layer, a network of primary and secondary leachate collection pipes, and leachate collection sump. The 300mm thick aggregate drainage layer consists of low calcareous aggregate with a hydraulic conductivity of >1 x $10^{-3}$m/s and will be installed across the full extent of the base and 4.5m vertically up the side batters. This fulfils the requirement of the Site Licence to install a leachate collection system that extends across the base and sides of each cell to intercept both vertical and lateral seepage occurring through the waste mass.

The pipe network consists of a 225mm Outer Diameter (OD) HDPE perforated primary pipe connected to 160mm OD HDPE perforated secondary pipes at maximum 25m spacings. In order to gain additional void space, the base of each cell has been designed with a series of 3% cross-fall slopes to 1% spines orientated perpendicular across the cell base, generating a corrugating pattern. The leachate will be directed towards the leachate collection sump located in the northeast and southeast corner of Cells 5 and 6, respectively.

The leachate sump contains a primary 355mm side riser pipe with a secondary one installed for contingency to assist in the removal of leachate from each cell.

The leachate collection system layout is shown in Drawings W-104 and W-105 (Appendix A) and described in detail within the Technical Specification (Appendix C). The construction details of the leachate collection and extraction system are shown in Drawings W-301, W-302, W-303 and W-304 (Appendix A).

### 4.4.4 Leak Detection Survey

A leak detection survey will be undertaken on the geomembrane layer following installation of the leachate drainage layer and before the separation geotextile installation. A dipole survey will be conducted over the surface area of the completed leachate drainage stone and on the protection geotextile-covered side slopes in accordance with ASTM D7007 to identify any potential holes in the geomembrane. Any anomalies detected in the underlying geomembrane will be repaired by the

Contractor as directed by the CQA consultant. Further details regarding the leak detection survey are provided in the Technical Specification (Appendix C).

### 4.4.5 Surface Water Management System

A conceptual surface water management system has been developed as part of the Closure Plan for the long-term management of surface water following landfill closure. The conceptual stormwater designs developed as part of the Closure Plan are shown in Drawing W-109 (Appendix A).

As surface water runoff from the landfill will not be generated until closure, surface water bunds are included within the design of Cells 5 and 6 to ensure that clean surface water run-off does not drain into the landfill, generating excess leachate. These bunds will be a minimum 0.5m high and have been designed with a 2% fall away from the landfill cell to avoid any runoff entering the cell. A larger intercell bund has been installed to the west of Cells 5 and 6 to prevent any runoff entering the landfill cell along this boundary. The intercell bund protecting the western portion of the landfill is shown in Drawing W-103, while the bund detail for the northern and southern edges of the cell development area is shown in Drawing W-301 (Appendix A).

External to the landfill, surface water flows will follow existing drainage pathways to the northwest and southeast of the Site, and drainage channels adjacent to access roads have been lined with aggregate to minimise scouring.

### 4.4.6 Landfill Gas Management

As part of the Closure Plan, landfill gas generation was assessed to determine a conceptual design for the landfill gas management system for the Site. The following subsections summaries the landfill gas generation modelling and the conceptual design of the landfill gas management system.

#### 4.4.6.1 *Landfill Gas Generation Modelling*

The numerical modelling software GasSim was used to model landfill gas generation over the Site's operational and post-operational lifespan. GasSim estimates the quantity of LFG generated, including emissions, migration, dispersion, and possible impacts. It is the UK EA preferred method of assessment of the generation of LFG from landfill sites.

The GasSim model has been assessed in a stochastic fashion and throughout the modelling and the acceptable probability of an undesirable outcome occurring has been set at the 95$^{th}$ percentile, with a total of 201 simulations run to achieve this. The 95$^{th}$ percentile is commonly selected as a reasonable 'worst case', against which it is acceptable to make decisions considering the assumptions and limitations of the modelling process.

A summary of the major inputs to the GasSim model is presented in Table 4-2. A full description of the GasSim Modelling parameters can be found within the Closure Plan.

**Table 4-2: GasSim Landfill Input Data**

| **Landfill Details** | |
|---|---|
| Operating Period | Cell 1: March 2019 – April 2021<br>Cell 2: May 2021 – June 2023<br>Cell 3: July 2023 – May 2024 |

| | |
|---|---|
| | Cell 4: June 2024 – March 2025<br>Cell 5: April 2025 – April 2026<br>Cell 6: May 2026 – June 2028 |
| Average Rainfall (mm/yr) | 546.79 |
| **Landfill Geometry** | |
| Cell Dimensions (L x W (m)) | Cell 1: 140 x 120<br>Cell 2: 120 x 135<br>Cell 3: 110 x 95<br>Cell 4: 70 x 150<br>Cell 5: 140 x 140<br>Cell 6: 125 x 140 |
| Area ($m^2$) | Cell 1: 16,006<br>Cell 2: 15,018<br>Cell 3: 10,458<br>Cell 4: 8,943<br>Cell 5: 17,762<br>Cell 6: 17,525 |
| Capping Layers | 1.5mm LLDPE |
| Basal Liner | 2.0mm HDPE layer, 300mm compact subgrade layer |
| **Waste Details** | |
| Waste Tonnages | Ranging from 96,137-150,000 tonnes per annum during full years of operation |
| Waste Stream Breakdown | Modelled as a single custom waste stream with the given composition below. |
| Waste Stream Composition | 7.5% Other Paper<br>7.5% Other Card<br>5% Wood<br>5% Textiles<br>5% Garden Waste<br>15% Other Putrescible<br>35% Non-Degradable |
| Moisture Content of Waste | 30-60% |
| Leachate Recirculation | Cells 1-3: 20%<br>Cells 4-6: 40% |

The results of the gas modelling indicate that bulk gas production will peak in 2029 at a rate of approximately 890$m^3$/hr. This peak rate coincides with the final capping of Phase 1, as shown in Drawing W-111.

Based on the input data utilised, the anticipated landfill gas generation obtained from the model is shown in Diagram 4-1.

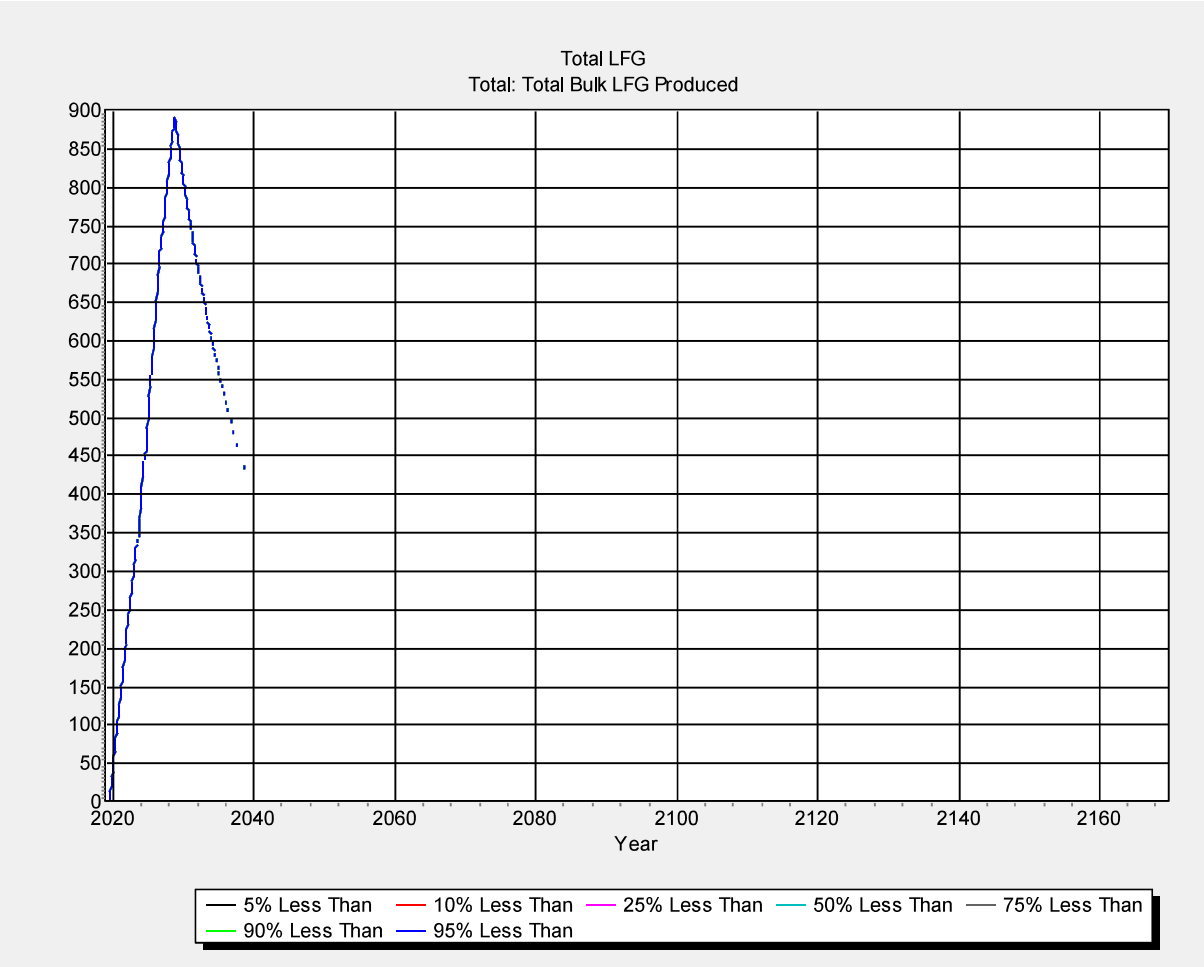


**Diagram 4-1: Total Bulk LFG Produced**

#### 4.4.6.2 *Conceptual Landfill Gas System Design*

The BPEM Guidelines provides direction on various landfill gas treatment technologies suitable for a range of gas generation rates, summarised in Table 4-3.

**Table 4-3: BPEM Guidelines Landfill Gas Treatment Technologies for a Range of Generation Rates**

| Landfill Gas Generation Rate ($m^3$/hr) | Potentially Suitable Landfill Gas Treatment Technologies | |
|---|---|---|
| >1000 | Combined heat and power<br>Substitute fuel<br>Power generation<br>Intermittent use and off-time flaring<br>High temperature flaring | Active System |
| **>250, <1000** | **Power generation**<br>**Intermittent use and off-time flaring**<br>**High temperature flaring**<br>**Low calorific flaring** | |

| Landfill Gas Generation Rate ($m^3$/hr) | Potentially Suitable Landfill Gas Treatment Technologies | |
|---|---|---|
| >100, <250 | Power generation<br>High temperature flaring<br>Low calorific flaring<br>Other oxidation technology and discharge (e.g. passive flares, biofilters, biocover) | Active/Passive System |
| <100 | Other oxidation technology and discharge (e.g. passive flares, biofilters, biocover) | Passive System |

Given the anticipated peak LFG production rate of 890$m^3$/hr following the final capping of Phase 1 indicates that an active system will be required.

A total of 21 vertical gas extraction wells will be installed in Stage 1 in a regular grid-like pattern at a spacing of 50m, the locations of which can be seen in Drawing W-110 (Appendix A). Gas extraction wells will not be installed within 5m of the edge of the landfill to reduce the risk of oxygen infiltration into the landfill, nor will they be installed on the temporary waste slope to the west of the Site. Wells should be drilled to 75% of the waste depth at a minimum depth of 10m to ensure optimal gas extraction without causing leachate ingress into the system.

Vertical gas wells are typically installed once the waste mass has reached its final height, and there is flexibility in their design depth at the time of installation. This enables the appropriate wells to be installed, ensuring that the right system is installed for the conditions of the Site at the time of installation. This may include the installation of sacrificial wells that are used to manage landfill gas before the waste mass has reached its final height.

Each landfill gas well will be connected to a 250mm diameter ring main header that extends north to south of the Site. Individual wells are connected in parallel to this ring main via a series of 110mm and 160mm diameter header HDPE pipes. The circular design enables gas to continually flow to the gas destruction system, even in the event of a blockage along the header or any of the pipes. The main header and lateral pipes are sloped against the flow of gas to facilitate the drainage of leachate and condensate, either back into the landfill or a number of naturally low ‘drop out’ points where leachate can then be pumped back into the landfill.

An active landfill gas system will be installed at the Site following the first stage of landfill capping. An active system of landfill gas extraction is not recommended until the first stage of capping occurs due to the potential for the system to promote air ingress into the waste mass, potentially sparking or fuelling subsurface fires.

Landfill gas monitoring will be undertaken in accordance with the Site Licence, and a proposed landfill gas monitoring suite has been provided in the Closure Plan.

### 4.4.7 Capping System and Restoration

To minimise long-term environmental and public health risks associated with the landfill, capping and restoration will occur progressively at the Site. A landfill capping system designed to comply with the

BPEM Guidelines is proposed for the Site. In accordance with BPEM Guidelines, the design of the final capping for the landfill shall:

- Ensuring that all waste materials are covered to mitigate long term environmental and health risks;
- A restoration profile which will incorporate a low permeability capping layer to restrict the infiltration of rainwater into the waste mass and stop the production of leachate;
- Final fill profile and slopes that are greater than 1V:20H and less than 1V:5H to:
    - Ensure the long term stability and integrity of the capping material and containment layer;
    - Promote the shedding of surface water from the landfill;
    - Provide an aesthetically acceptable landform; and
    - Minimise long term maintenance requirements.
- A system of surface water management to positively deal with any accumulation of the rainwater;
- A gas management regime to control the generation of landfill gases and reduce any significant risk of adversely impacting the surrounding environment;
- Revegetating of the landmass to blend in with the surrounding environment;
- Deliver a suitable post closure land use; and
- Phased closure of the landfill cells as the operational life of the landfill progresses.

The proposed capping system, from bottom to top, is as follows:

- 300mm sand gas collection layer/regulating layer;
- 1.5mm thick double textured LLDPE geomembrane layer;
- Geonet drainage layer;
- 1000mm of restoration layer, comprising:
    - 800mm thick layer of site won subsoils; and
    - 200mm thick layer of growing medium/mulch.
- Vegetation layer incorporating hydromulch/seeding to reduce erosion and advance revegetation.

The proposed restoration profile is presented in Drawing W-111 (Appendix A). Three phases of capping have been proposed to ensure the landfill can be progressively rehabilitated, minimising environmental impacts.

#### 4.4.7.1 *As-Built Drawings*

During cell construction, an approved qualified surveyor will survey each layer of the composite liner system. This data will be used to prepare 'as-built' drawings which will be endorsed by the surveyor. The as-built drawings will include but are not limited to:

- Formation excavation levels;
- Top of engineered fill layer levels;
- Construction details including levels and slope angles for the basal liner system;
- Location of leachate collection and extraction pipework including connections of primary pipework to secondary pipework;

- Top of leachate drainage aggregate collection layer levels including mounding of material over pipework (top of bank and bottom of bank each side of mound);
- Location and inverts of leachate extraction pipework and sumps;
- Locations and identification marks of each geosynthetic panel, including anchor trenches;
- Locations of damaged areas and penetrations; and
- Locations of patch repairs.

## 4.5 Staging of Construction

Once Cells 1, 2, 3 and 4 reach capacity, landfill operations will begin in Cells 5 and 6. According to the Closure Plan, the proposed cells are anticipated to provide approximately 3.2 years of life, as outlined in Table 4-4.

**Table 4-4: Landfill Cell Capacity**

| Landfill Cell | Available Airspace ($m^3$) * | Life Expectancy (yrs) * |
|---|---|---|
| Cell 5 | 240,283 | 1.0 |
| Cell 6 | 503,833 | 2.2 |
| **Total** | **744,116** | **3.2** |

*Based on 2021 Closure Plan modelling

## 4.6 Project Timeline

The current estimated timeframe for each stage is shown in Table 4-5.

**Table 4-5: Project Timeline**

| Infrastructure | Project Stage | Timeframe |
|---|---|---|
| Cells 5 and 6 | Start of earthworks construction | Summer 2024/2025 |
| | End of earthworks construction | Summer 2024/2025 |
| | Start of lining system construction | Summer 2025 |
| | End of lining system construction | Summer/Autumn 2025 |
| | Waste acceptance | Autumn/Winter 2025 |
| | Cells at capacity | Winter 2028 |

# 5 Infrastructure Operational Aspects

The following sections outline the key operational aspects of the proposed landfill cells and their corresponding environmental control systems.

## 5.1 Class II Landfill

### 5.1.1 Waste Acceptance & Disposal

Cells 5 and 6 are classified as Class II landfill cells and will be licenced to accept the following waste types only, in accordance with the DWER's *Landfill Classification and Waste Definitions 1996 (as amended 2018)* and as per the Site Licence:

- Clean Fill and Uncontaminated Fill;
- Inert Waste Type 1;
- Inert Waste Type 2;
- Special Waste Type 1;
- Special Waste Type 2;
- Putrescible Waste; and
- Contaminated solid waste.

Upon entering at the weighbridge, customers are required to provide information about the source and type of waste material being delivered. Since vehicles are either covered (transfer trailers and bin vehicles) or sealed (compactor vehicles), visually inspecting the waste material at the weighbridge is not practical or possible. However, an elevated camera is mounted on the weighbridge gatehouse to allow the weighbridge operator to monitor the contents of incoming vehicles where possible.

The incoming load is weighed over the weighbridge, and at minimum, the following information is recorded:

- Customer name;
- Waste type, including identification of asbestos;
- Waste load weight (either by deducting the vehicle's stored tare weight from the gross weight or reweighing of empty vehicle on exiting the Site);
- Date and time of entry; and
- Vehicle registration.

If there is a likelihood that the incoming load may contain non-acceptable waste, the load inspected as best as possible before discharge at the active tipping face. If not possible, the load is tipped under supervision on the side of the active landfill area to allow adequate inspection while unloading. If the load is deemed unacceptable, it is placed back into the delivery vehicle and removed from the Site. If deemed acceptable, it is pushed up into the landfill and compacted.

When a waste load is discharged at the active landfill tipping area, landfill operations personnel inspect it for conformance with the Site's waste acceptance criteria. Acceptable waste is incorporated into the landfill, while unacceptable waste is rejected, reloaded into the customer's vehicle, and removed from the Site.

Since the active tipping area is permanently manned, all loads are inspected upon arrival. Thus, if unacceptable waste is identified, there is a reasonable likelihood that the customer will still be on-site and able to remove the non-conforming waste. If the customer has departed the site and is subsequently unidentifiable, the Site operator separates the waste, quarantines it to one side, and

makes necessary arrangements to remove the waste from the Site to the appropriate disposal location.

#### 5.1.1.1 *Asbestos Management*

The Site accepts asbestos-containing material, and controlling such materials is crucial within the facility's management framework. Asbestos material is accepted only if appropriately wrapped and sealed in plastic. Upon delivery, it is promptly taken to the landfill where it is buried within a specially designated area, with proper coordination and documentation.

### 5.1.2 Operational Hours

The current operational hours for the Site will not change during the operation of the new cells. Therefore, the hours for landfill operations are:

- Monday to Saturday 6:00am to 6:00pm; and
- The Site is closed on Sundays and Public Holidays.

## 5.2 Leachate Management System

The leachate collection and extraction system for Cells 5 and 6 will remove leachate from within the landfill cells and facilitate the transfer of leachate to the Site's existing centralised evaporation pond system for treatment via evaporation. Further discussion on the operation of Cells 5 and 6 leachate management system is provided in the following sub-sections.

### 5.2.1 Leachate Collection System

The leachate collection layer uses a combination of aggregate and collection pipes to provide an effective long-term solution for the collection and extraction of leachate from the base of each landfill cell. The sloped floor provides additional contingency to ensure that all leachate generated within each cell is directed towards the leachate sump for extraction.

### 5.2.2 Leachate Extraction System

Once each landfill cell is constructed, a submersible pneumatic pump, installed inside the primary 355mm leachate extraction riser pipe of each cell, will extract leachate automatically when sufficient head is present over the pump's inlet. The pumps, which use the direct air displacement method, are fitted with a built-in level sensor which triggers the controller to feed air from an air compressor into the submerged pump chamber to displace the leachate. This direct air displacement method enables the system to self-regulate, operating at the very low flow rates (0-1L/s) as is typical in landfill applications, extracting small quantities of leachate as soon as enough is present at the sump. As there is a set of 355mm side risers for each landfill cell, there is contingency built into the design to allow for an additional high-flow pump to be placed into the cell if required. However, this is unlikely to occur since the Site is not within a cyclonic region.

The hydraulic head of leachate over the landfill liner surface will be managed during the landfill operation in general accordance with the Landfill Guidelines requirements through extraction of leachate from the sump. Leachate levels on the landfill base will be maintained as low as reasonably practicable in compliance with the Site Licence.

The leachate will then be transferred via a solid HDPE pipe rising main to the Site's centralised landfill leachate evaporation pond system located to the north of the landfill.

### 5.2.3 Leachate Evaporation Pond System

The Site has three landfill leachate evaporation pond system, consisting of one 1,322m$^3$ pond and two 5,024m$^3$ ponds providing a combined operational capacity of approximately 11,370m$^3$. Since its construction, the pond system has effectively managed all existing leachate generated at the Site from landfill operations.

To prevent leachate stored in the evaporation ponds from percolating into the groundwater system, the ponds are lined in general accordance with Landfill Guidelines as follows:

- 2mm thick HDPE geomembrane;
- GCL; and
- 250mm thick compacted subgrade layer.

A 0.5m freeboard is maintained for all ponds as per the Landfill Guidelines and Site Licence.

### 5.2.4 Water Balance Assessment

A water balance assessment was undertaken to assess the adequacy of the existing leachate evaporation pond capacity and to determine if additional leachate evaporation ponds are required to manage leachate at the Site in accordance with the DWER Checklist following development of Cells 5 and 6. The assessment was undertaken in general accordance with BPEM Guidelines, and uses a Microsoft Excel algorithm to evaluate the system, utilising a simplified input and output system based on the following:

- Inputs:
  - Leachate generation
  - Monthly rainfall on the evaporation ponds
- Outputs:
  - Evaporative losses from the leachate evaporation ponds
  - Leachate recirculated onto the landfill

To determine if the leachate management system for the Site can manage leachate generation in consecutive wet years, a five-year timeframe for the Site was considered, commencing in October 2024 and concluding in September 2028.

A memorandum discussing the details of the water balance assessment is provided in Appendix G. Section 3 of the memorandum describes the use of the HELP model, and Section 4 explains the parametrisation of the water balance model and the assumptions made in relation to the water balance modelling.

#### 5.2.4.1 *Assessment Results*

Assuming the current state of the Site, which has no leachate in any of the three ponds, as the starting point, Diagram 5-1 shows the existing ponds have adequate operational capacity to manage the leachate generated during consecutive, wet, 90$^{th}$ percentile years. Only at the start of the third year is leachate recirculation required to maintain leachate levels below operational thresholds. An additional leachate pond is required only at the start of the fifth year of operation in the modelled scenario.

The maximum 'worst case' leachate generation at the Site will occur when the largest open waste catchment occurs, immediately following the opening of Cells 5 and 6 prior to the construction to Phase 1 of capping. The assessment, graphically presented in Diagram 5-1, shows that the Site's leachate management system is capable of handling the leachate generated in the unlikely chance that these conditions are experienced at the Site in the short window of time between Cells 5 and 6 becoming operation, and Phase 1 of capping occurring.

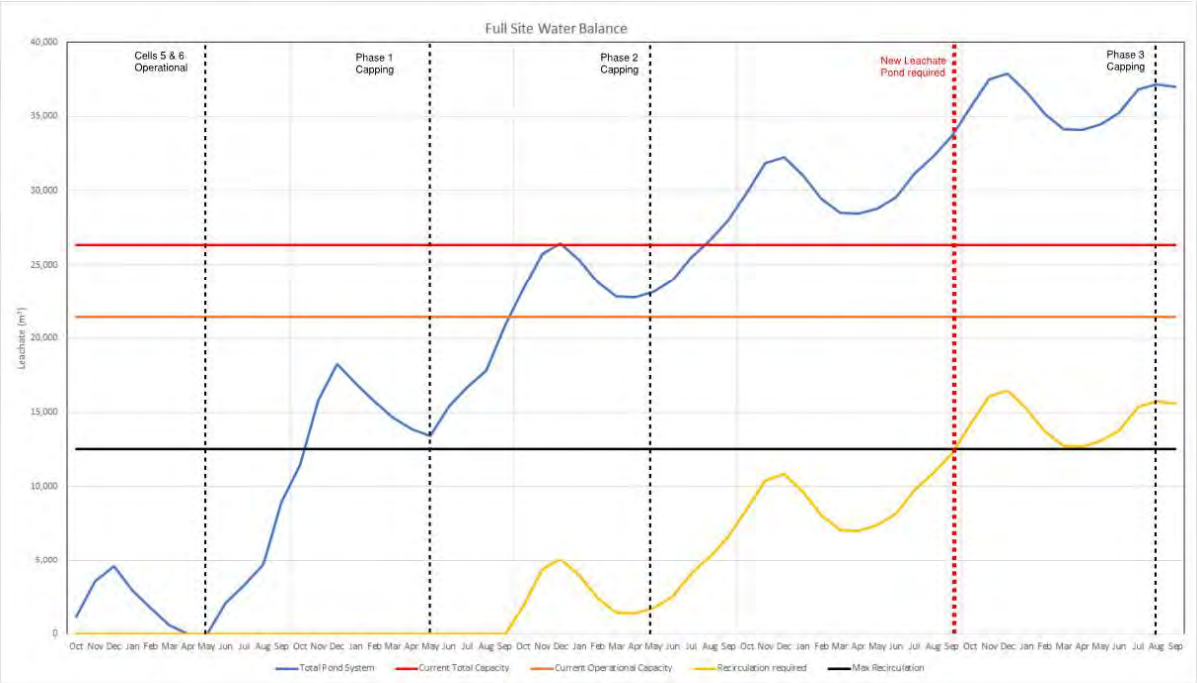


**Diagram 5-1: Summary of Site Water Balance Assessment**

Since opening, the Site has only had to use one of its three leachate ponds, and currently has no leachate in any of its three leachate ponds, nor a leachate level within any leachate sump which allows leachate extraction. This indicates that there is likely an additional level of leachate storage within the waste mass which has not been captured by the modelling parameters. This adds conservatism to the water balance model, with onsite conditions likely to result in a lowered leachate generation rate, pushing out the dates for which an additional pond may be required if consecutive wet years are experienced.

The Site water balance will continue to be monitored and updated as future cells are developed, to determine the Site's future pond requirements, if any.

## 5.3 Landfill Gas Management

Landfill gas will be managed by a specialist landfill gas contractor. This contractor will be responsible for progressively installing landfill gas infrastructure as the waste mass develops, including installing a flare or other destructive mechanism(s) for treating the extracted gas.

The landfill gas contractor will also be responsible for monitoring fugitive emissions from the landfill in accordance with the Site Licence and the proposed monitoring levels within the Site Closure Plan. If elevated emissions are recorded, they will determine and implement remedial solutions to improve landfill gas capture.

It is not anticipated that the landfill gas system will be installed until the first phase of capping, when the waste mass has reached its maximum height and the capping system acts to minimise air intrusion into the landfill, minimising the risk of subsurface fires at the Site.

## 5.4 Surface Water Management

Once the capping system has been installed, more significant surface water run-off flows at the Site will require the development of a more formalised surface water management system, including expansion of the informal drainage lines and sedimentation ponds at the Site.

Run-off will drain to the northwest and southeast of the Site via trapezoidal swales. Drainage infrastructure will be inspected under a regular program of Site maintenance and monitoring, with any erosion, sedimentation or contamination issues addressed and rectified. Any environmental monitoring will be undertaken in accordance with the Site Licence.

Surface water captured within the existing quarry footprint will be allowed to pool in this area, with slopes immediately adjacent to the landfill sloped to ensure this water does not enter the landfill cell. Pumps will be used to empty this void on an as-needs basis, with the water either being stored within empty ponds for use in dust suppression and Site operation or discharged into the environment via existing drainage lines. Drawing W-109 (Appendix A) highlights the proposed layout of the surface water management, and Drawing W-305 (Appendix A) shows typical drain sections.

## 5.5 Time Limited Operations

Time Limited Operations (TLO) of 180 days is requested for Cells 5 and 6 under the Works Approval, with operations occurring in accordance with the Site Licence. In line with other applications, the TLO period is requested to commence 30 days following submission of the Critical Containment Infrastructure Report for the works.

# 6 Environmental Aspects and Management

The potential for the expansion of Class II landfill operations to impact on a number of key environmental and social aspects is well recognised with the development of Cells 5 and 6. The potential impacts associated with each key aspect are discussed in the following subsections, namely:

- Surface water;
- Leachate
- Groundwater;
- Air emissions, including:
  - Landfill Gas;
  - Odour;
  - Dust;
  - Noise; and
  - Asbestos;
- Geotechnical Stability;
- Vermin and Feral Animals;
- Weeds;
- Litter;
- Fire;
- Traffic; and
- Security.

## 6.1 Surface Water

As stated within Section 5.4, stormwater will be diverted from active landfill cells and leachate ponds via bunding which is a minimum 0.5m high and will promote drainage away from the landfill cell. Existing drainage lines at the Site will be used to direct incidental surface water generation towards the northwest and southeast, where existing informal surface water ponds are present. Where adjacent to roads and operational areas, these drainage lines have been lined with aggregate to slow water movement and minimise scouring and erosion.

Surface water within the existing quarry will naturally collect away from the landfill cell and will be managed via pumps into other ponds. Regular inspections of the bunds, drains, and sedimentation ponds will be conducted to ensure that these systems are operating efficiently. Any identified issues, such as blockages or damage, will be addressed immediately to prevent stormwater from entering the landfill or leachate ponds. Discharges to the environment are expected to be minimal and only occur under heavy rainfall conditions when streams are already flowing.

The landfill's design incorporates a sloped waste profile, directing uncontaminated surface water away from the active landfill area, while ensuring exposed waste surfaces slope into the landfill to minimise run-off. Intermediate cover materials will be regularly inspected to minimise erosion risks and potential surface water contamination. Water collected in the external water storage dam will be monitored for turbidity, and if water quality exceeds set limits, it will not be discharged, instead being used for dust suppression or other similar activities at the Site.

Surface water will be managed in accordance with any requirements of the Site Licence, with long-term surface water management systems developed in accordance with the conceptual designs presented in the Site's Closure Plan.

In accordance with the Site Licence, any surface water that interacts with the landfill cells will be classified as leachate and would be collected via the leachate collection system prior to evaporation in the Site's centralised leachate pond system. Regular inspections and maintenance of the leachate collection system will be undertaken to maintain serviceability and landfilling practices will be undertaken in accordance with the Site Licence to prevent any surface water from perching within the waste mass.

## 6.2 Leachate

Environmental issues associated with leachate include the potential contamination of groundwater, leachate accumulation increasing the risk of structural liner failure, inadequate or malfunctioning pumps preventing timely removal of leachate, and surface water contamination from the overtopping of the landfill cell or leachate ponds.

As outlined in Section 4.4.3, leachate will be collected in the leachate collection system designed for each landfill cell. Leachate will be pumped from the sumps by automatic pneumatic pumps with the ability to manually activate the system if required. Leachate extraction points are checked on a daily basis to ensure pumps are operating effectively and the leachate head within the landfill cell is kept to a minimum. The leachate will be transferred from the sumps via pipework to the existing evaporation leachate ponds shown in Drawing W-101 (Appendix A). The water balance performance of the leachate pond system has been assessed and determined to comply with the DWER Checklist in combination with leachate recirculation.

Any malfunctions in the extraction system, such as pump failures or blockages, could lead to an elevated leachate head, increasing the risk of groundwater contamination or liner system failure. Therefore, preventive maintenance and quick response measures will be incorporated into Site operations.

Additional leachate management measures will include regular inspections of the pumps and pipework to ensure there are no blockages or malfunctions, which could impact the efficiency of leachate removal. These inspections will include checks for sediment buildup, corrosion, or damage to pipes and risers, and verification of the pneumatic pump functionality.

The Site's leachate management system and leachate levels and quality are currently monitored in accordance with Table 11 and Table 12 of the Site Licence. Monitoring includes leachate level measurements, regular testing for chemical composition, and assessing potential environmental impacts. The same monitoring procedures will to be implemented at the Site following the development of Cells 5 and 6, which is anticipated to be sufficient to ensure the leachate management system continues to operate effectively.

## 6.3 Groundwater

As outlined in Section 4.4.2, a composite lining system designed using the criteria within the Landfill Guidelines will be installed within each landfill cell. One of the key purposes of the lining system is to protect the surrounding environment and groundwater from impacts caused by leachate. A minimum 2m groundwater separation has also been considered in the design of the cells in alignment with the Landfill Guidelines.

Groundwater monitoring is undertaken in accordance with the Site Licence to ensure that in the event the integrity of the lining system is comprised and leachate seeps from the landfill cell, contamination can be detected early. Throughout the lifespan of the Site, groundwater will continue to be monitored at all bore locations in the network.

There are three temporary monitoring bores within the Cells 5 and 6 development footprint will be decommissioned as part of the development works. All other existing monitoring bores will continue to be monitored as per the Site Licence requirements to highlight any potential impacts to groundwater from these landfill cells.

## 6.4 Air Emissions

### 6.4.1 Landfill Gas

During operation of the cells, the decomposition of the organic content within the waste stream will result in the generation of landfill gas which contains methane, carbon dioxide and other volatile organic compounds. These gases contribute to the effects of climate change, produce an odour, reduce amenity, impact human health and present explosive risks.

To ensure these impacts are mitigated, several management measures are proposed, including:

- An extensive network of landfill gas extraction wells and pipework will be installed across the Site following the progressive closure of the landfill cells;
- Through an active vacuum system, landfill gas will be removed from the landfill cells and transferred to a flare for combustion;
- Management of the wellfield in accordance with the landfill gas management plan;
- Monitoring of landfill gas in accordance with the Site Licence and landfill gas management plan; and
- When required, undertaking contingency actions in accordance with the Site's Landfill Gas Management Plan.

Landfill gas will be monitored in accordance with any relevant conditions within the Site Licence.

### 6.4.2 Odour

Odours are generated during the operation of each cell from a range of sources including the acceptance/transport of putrescible waste, leachate evaporation ponds, leachate recirculation, and exposed waste prior to the application of cover material. To mitigate odours, there are a range of management measures currently employed which include:

- Installation of a landfill gas management system post-closure;
- Consideration of meteorological conditions during material handling and leachate recirculation;
- Regular maintenance and monitoring of the leachate treatment system;
- Rejection of excessively odorous waste streams;
- Covering of waste during transport;
- Management of tip face size in accordance with the Site Licence;
- Daily cover and compaction of waste as per the Site Licence;
- Immediate burial of highly odorous wastes on acceptance at the weighbridge; and
- Odour complaint system and follow-up investigations/actions.

The Site will continue to operate in accordance with the Site Licence which contains measures to limit emissions within acceptable limits.

### 6.4.3 Dust

Dust will be generated during the construction and operation phase of each landfill cell as a result of clearing, earthworks and handling of materials. Excessive dust generation can impact local air quality causing respiratory impacts and reduced vision. To manage dust generation, a range of measures are currently implemented including:

- Vehicles to comply with a maximum speed limit of 40km/hr;
- Road surfacing to minimise dust generation;
- Wetting down access roads;
- Wetting of the active tip face in accordance with the Site Licence;
- Restricted activities during certain weather conditions (strong winds);
- Application of dust suppressant chemicals;
- Use of a water cart as necessary;
- Covering of waste during transport; and
- Appropriate handling and unloading of waste to minimise dust generation.

These measures will continue to be implemented during the construction and operation of Cells 5 and 6.

### 6.4.4 Noise

Noise will be generated during the construction and operational phases of each landfill cell as a result of vehicle and machinery activities. Noise can impact the amenity of surrounding property users and have health consequences for onsite staff. To reduce noise impacts, a range of management measures are currently implemented. The facility operating hours are limited to 6:00 AM to 6:00 PM, Monday to Saturday, to reduce disturbance to surrounding areas. All mobile machinery is fitted with low frequency reversing alarms to reduce noise emissions. Regular maintenance ensures that the equipment continues to operate efficiently, and PPE is required for onsite personnel to protect their hearing when working near machinery. Additionally, any noise complaints will trigger further investigation and corrective actions, which may include third-party noise monitoring and equipment adjustments as necessary.

### 6.4.5 Asbestos

Asbestos is a hazardous fibrous substance which can occur within waste materials, particularly construction and demolition wastes such as building rubble. Asbestos poses a potential risk if fibres become airborne and are breathed into the lungs. Serious health impacts may occur, often as a result of significant exposure to asbestos, including mesothelioma, lung cancer and asbestosis. The Site accepts asbestos and asbestos containing materials for burial in a dedicated asbestos disposal area as per the Site Licence conditions.

All personnel are trained in the appropriate inspection, handling and disposal of asbestos materials and must ensure that appropriate PPE is worn.

All asbestos materials received must be appropriately wrapped and sealed in plastic. If any substandard asbestos materials are identified, they will be securely wrapped onsite before being buried in the dedicated disposal area. Asbestos is not to be disposed of within two metres of the final landfill surface. The landfill operators ensure that asbestos is placed, covered as soon as practicable

or by the end of the working day after unloading, and that all disposal activities are recorded in the asbestos disposal register.

An Asbestos Management Plan has been implemented at the Site, which includes detailed procedures for inspection, handling, and disposal of asbestos materials. These procedures ensure that all personnel involved in handling asbestos wear appropriate PPE and follow safety protocols to prevent asbestos fibres from becoming airborne.

## 6.5 Geotechnical Stability

The geotechnical stability of the landfill is a key factor that may impact on the integrity of the landfill environmental controls. Loss of integrity to the landfill liner can result in contamination of groundwater and soils. An assessment of the soil characteristics is critical to understanding the stability risks and to define appropriate engineering requirements.

The stability risk assessment is intended to provide sufficient confidence that stability is assured, and the integrity of the new Class II landfill cells will be maintained through construction, operation, closure and the post-closure lifecycle. The assessment includes risk screening to determine the geotechnical analysis required with respect to the natural geology, waste stream, and proposed engineering works for the basal, side slope, waste mass and capping systems. The assessment will also consider monitoring and risk management systems to be implemented across the lifecycle of the landfill cells.

A conservative approach to all proposed slopes was adopted. All basal and side slopes comply with the Landfill Guidelines, and Site specific engineering controls for the subgrade were developed with consideration of the local groundwater and geology. In addition, the proposed landfill closure profile consists of 1V:5H pre-settlement grades on the side slopes in accordance with the Landfill Guidelines, with mid-slope benches to facilitate vehicular access and surface water drainage.

The following Stability Risk Assessments (SRAs) have previously been completed for the Site:

- The Capping Stability Risk Assessment (Capping SRA), Talis, (March 2021), presented the risks associated with the Stage 1 filling and capping design to support the Closure and Post-closure Management Plan (Closure Plan), Talis, (February 2021). The Closure Plan was submitted to the DWER to meet Specified Actions (SA2 and SA4) listed within the Site Licence.
- The Cell 3 and 4 Cell Development Stability Risk Assessment (Cell Development SRA), Talis, (July 2021), presented the stability of the basal, side slopes and temporary waste slopes for combined Cell 3 and 4, specifically. The Cell 3 and 4 SRA was submitted to the DWER in support of the approvals for the development of Cell 3 and 4.

During the Cells 5 and 6 design process, Talis reviewed the geometry of the proposed cells to check if the temporary waste slopes that were assessed in the Capping SRA had changed. The Capping SRA modelled a 1V:3H, temporary waste slope filled from 280m at the interface of Cells 5 and 6 and future Stage 2 to a pre-settlement elevation of up to 312m, creating a 32m high temporary waste slope. The Capping SRA was based on the Cells 5 and 6 geometry presented in IW Projects Drawings submitted with the Stage 1 Works Approval.

Following redesign of Cells 5 and 6 by Talis, the geometry was checked to determine if it created temporary slope heights greater than 32m. The intercell bund between future Stage 2 and Cells 5 and 6 is slightly lower at 278m, creating a slope height of 34m. To assess acceptability, the Capping SRA results for the 32m high slope, summarised in Table 6-1 for ease of reference, were revisited.

**Table 6-1: Waste Mass Analysis Results from the Capping SRA**

| Scenario | Method | Factor of Safety | Comments |
|---|---|---|---|
| Temporary Capping Slope<br>No Seismic Loading | Drained<br>Circular | 1.735 | 1V:3.0H temporary waste slope. $R_u$ value of 0.0 applied to waste.<br>Acceptable (FoS > 1.3) |
| Temporary Capping Slope<br>No Seismic Loading | Drained<br>Non-Circular | 1.581 | 1V:3.0H temporary waste slope. $R_u$ value of 0.1 applied to waste.<br>Acceptable (FoS > 1.3) |
| Temporary Capping Slope<br>with Seismic Loading (OBE - 1:475) | Drained<br>Circular | 1.421 | 1V:3.0H temporary waste slope. $R_u$ value of 0.0 applied to waste.<br>Acceptable (FoS > 1.1) |
| Temporary Capping Slope<br>with Seismic Loading (OBE - 1:475) | Drained<br>Non-Circular | 1.299 | 1V:3.0H temporary waste slope. $R_u$ value of 0.1 applied to waste.<br>Acceptable (FoS > 1.1) |
| Temporary Capping Slope<br>with Seismic Loading (SEE/MCE - 1:1000 AEP) | Drained<br>Circular | 1.157 | 1V:3.0H temporary waste slope. $R_u$ value of 0.0 applied to waste.<br>Acceptable (FoS > 1.0) |
| Temporary Capping Slope<br>with Seismic Loading (SEE/MCE - 1:1000 AEP) | Drained<br>Non-Circular | 1.062 | 1V:3.0H temporary waste slope. $R_u$ value of 0.1 applied to waste.<br>Acceptable (FoS > 1.0) |

The Capping SRA found the lowest calculated factor of safety for the 32m high temporary capped waste slopes to be greater than 1.3, 1.1 and 1.0 for the static, OBE and SEE/MCE AEP scenarios, and are therefore considered acceptable.

While the FoS under static conditions are comfortably above the minimum required, the FoS under seismic conditions are closer to the limits of acceptability.

To assess the impact of the 2m higher slope on the FoS, mass block analysis was undertaken. The analysis found that the FoS reduces by 1.5%, from 1.062 to 1.042 for the lowest FoS presented in Table 6-1, which is still considered to be acceptable.

It should also be acknowledged that the temporary status for the slope will last just a few years until such time that it is buttressed with the first lift of waste from Stage 2. It should also be noted that it is highly unlikely that the Stage 1 landfill will be filled to full height (312m) on the western edge until

sometime after waste lifts have been placed in the Stage 2 landfill, buttressing the slope. Since the modelled scenario is unlikely to occur in either a short-term or permanent condition, the inclusion of the 1:1000 AEP is perhaps regarded as unnecessary, because of the unlikelihood that such a severe seismic event would occur in such a short time frame. However, it is still included for comparison.

Given the very minor change to the slope height, and particularly the likelihood and/or duration in which the slope may be in this condition, repeating the SRA modelling is not warranted and the Capping SRA remains valid for the development of Cells 5 and 6.

Both the Capping SRA and the Cell Development SRA are provided in full in Appendix E.

## 6.6 Vermin and Feral Animals

Due to the types of waste accepted, water sources and surrounding bushland, feral animals and vermin such as cats, foxes, rabbits, mice and rats have the potential to be attracted to the Site. Management of feral animals and vermin is currently undertaken through:

- Regular pushing up and compaction of the waste;
- Application of adequate cover material;
- Progressive closure of completed landfill areas; and
- Monthly inspections by operational staff to identify any vermin presence on or around the landfill;
- Use of a 2m high chain link fence with a 400mm wire mesh skirt around the landfill cell disposal area;
- Electrification of the landfill area fence using two hotwire lines to prevent entry by feral animals;
- Placement of motion sensor infrared cameras to monitor the landfill area and detect feral animal activity; and
- Vermin control such as baiting and trapping, when required.

## 6.7 Weeds

Weed species have been recorded in cleared or disturbed areas within the Site. A range of management measures is currently implemented at the Site to ensure that weed populations do not spread and compromise the integrity of the native rehabilitation program on capped landfill cells. Management measures include the following:

- No greenwaste processing onsite;
- Application of adequate cover material;
- Regular Site inspections; and
- Weed eradication as required – small areas are controlled by landfill operations staff; larger areas are controlled by a professional weed control company or with the assistance of a local farmer.

With the Site being located within a rural area, and a large, predominantly agricultural property that is well away from public roads, there are currently very few weeds observed at the Site.

## 6.8 Litter

Litter requires ongoing management due to its potential impact on amenity and fauna. The primary sources of litter at the Site include wind-blown litter from waste delivery vehicles, and from the active tipping area during placement and compaction of waste.

To control litter emissions, the following mitigation measures are implemented at the Site:

- Waste delivery vehicles are adequately covered or tarped when on public roads, in compliance with road regulations;
- Utilisation of 2m high temporary or mobile litter panels around the active landfill tipping area to catch litter during tipping and compaction operations;
- Regular removal of litter from the litter screens and fences as soon as possible, but at least every two days;
- Collecting litter blown beyond the active landfill as soon as possible, but at least on a weekly basis;
- Collecting any litter blown beyond the property boundary on a weekly basis at a minimum.

Daily inspections of the active landfill tipping area and weekly inspections of the greater landfill site ensure that litter is collected and removed. Litter collection is also conducted along Salt Valley Road near the site entrance, within the first kilometre of the Site.

## 6.9 Fire

There are a variety of fuel sources for fires at the Site, including waste in the active landfill areas and machinery. Fires can cause harm both to the surrounding environment, and to the health and safety of staff onsite. Therefore, to manage the risk of landfill fires, the following measures are implemented at the Site:

- All waste is accepted in accordance with DWER waste acceptance criteria and Site Licence conditions;
- Waste is properly compacted and covered;
- Litter is regularly cleared from around the litter fences;
- Avoid piling up significant amounts of flammable material in one spot;
- Flammable materials such as plastics and tyres are evenly distributed throughout the waste mass to reduce the chance of large uncontrolled fires;
- The Site is kept secure and locked outside of operating hours to deter vandals; and
- Maintaining appropriate firefighting equipment onsite:
    - Use of a water cart at the Site, which is kept fully filled at all times to respond immediately to a fire;
    - Sufficient cover material stored nearby the active tipping area for quick waste covering during a fire;
    - At least 50kL of water is stored onsite in a storage dam; and
    - Adequate training is provided to Site operating staff.

## 6.10 Traffic

The proposed operations will result in continued traffic movements to and from the Site and on the surrounding road network. Onsite traffic movements have the potential to generate noise, dust and create an occupational health and safety risk to staff.

To minimise any potential impacts of traffic movements at the Site, the following management measures are implemented:

- Signage providing directions, traffic control measures and safety instructions will be established and maintained at appropriate locations around the Site;
- Vehicles are restricted to a maximum speed limit of 40km/hour, unless otherwise signed;
- Employees and contractors wear high visibility and reflective clothing when working in areas where vehicle movement occurs;
- All vehicles are maintained in good working condition and drivers instructed to use conservative driving techniques; and
- All employees and contractors are inducted with the Site Occupational Health and Safety (OHS) and traffic management procedures.

Through the continued implementation of these management measures, all potential impacts associated with traffic movements on and surrounding the Site as part of the development of Cells 5 and 6 will be controlled to appropriate standards.

## 6.11 Security

A breach of security may result in injury to persons or damage to infrastructure. To minimise potential security issues, the following management measures are implemented:

- Appropriate signage is installed at the Site entrance;
- Signage clearly indicating after-hours contact details of the Site supervisor;
- Lighting is installed in relevant areas of the Site, including at the main Site access road and key buildings;
- Where possible, all valuable assets, including fuel, are kept securely under lock and key;
- A 2m high perimeter fence is installed around the Site and is monitored and maintained on a regular basis; and
- All access gates and buildings are locked securely outside of operational hours.

## 6.12 Environmental Management Summary

A summary of the environmental management measures is provided in Table 6-2.

**Table 6-2: Summary of Environmental Management Measures**

| Aspects | Management Measures |
|---|---|
| Surface Water | • Surface water management system:<br>o 0.5m minimum bund around the landfill to prevent surface water inundation; |

| Aspects | Management Measures |
|---|---|
| | ○ Informal drainage around the landfill to divert surface water away from the active cells; and<br>○ Sedimentation ponds.<br>• Regular monitoring, maintenance and reporting in accordance with the Site Licence. |
| Leachate | • Leachate collection system within each landfill cell, designed using the criteria within the Landfill Guidelines, including:<br>○ A 300mm aggregate drainage layer;<br>○ Primary and secondary pipe network (225mm and 160mm OD HDPE);<br>○ A 1-3% base slope; and<br>○ Collection sump.<br>• Leachate extraction system, including:<br>○ Primary and secondary 355mm OD side risers;<br>○ Submersible pumps; and<br>○ Solid HDPE pipe rising main to the Site's centralised leachate pond system.<br>• Landfill leachate evaporation pond system, consisting of three ponds with a combined operational capacity of approximately 11,370m$^3$. These ponds are lined with a composite, geosynthetic lining system;<br>• Limited leachate recirculation to manage large levels during consecutive wet years;<br>• Regular inspections of pumps and pipework to ensure efficiency of leachate removal; and<br>• Ongoing monitoring in accordance with the Site Licence. |
| Groundwater | • Composite lining system designed using the criteria within the Landfill Guidelines;<br>• Minimum separation distance of 2m from known groundwater table levels; and<br>• Ongoing monitoring in accordance with the Site Licence. |
| Landfill Gas | • Progressive installation of a destructive landfill gas management system, as part of phased closure activities; and<br>• Monitoring in accordance with the Site Licence and the Site's Landfill Gas Management Plan. |
| Odour | • Installation of a landfill gas management system post-closure;<br>• Consideration of meteorological conditions during material handling and leachate recirculation;<br>• Regular maintenance and monitoring of the leachate treatment system;<br>• Rejection of excessively odorous waste streams;<br>• Covering of waste during transport;<br>• Management of tip face size in accordance with the Site Licence;<br>• Daily cover and compaction of waste as per the Site Licence;<br>• Immediate burial of highly odorous wastes on acceptance at the weighbridge; and<br>• Odour complaint system and follow-up investigations/actions. |

| Aspects | Management Measures |
|---|---|
| Dust | • Vehicles to comply with maximum speed limits of 40km/hr;<br>• Road surfacing to minimise dust generation;<br>• Wetting down access roads;<br>• Wetting of the active tip face in accordance with the Site Licence;<br>• Restricted activities during certain weather conditions (strong winds);<br>• Application of dust suppressant chemicals;<br>• Use of a water cart as necessary;<br>• Covering of waste during transport; and<br>• Appropriate handling and unloading of waste to minimise dust generation. |
| Noise | • Restricted operating hours;<br>• Regular maintenance of mobile machinery and equipment;<br>• Use of low frequency reversing alarms instead of broadband alarms to reduce noise emissions; and<br>• Use of appropriate PPE. |
| Asbestos | • All asbestos and asbestos containing materials accepted at the Site are buried as soon as practicable or by the end of the working in a dedicated asbestos disposal area as per the Site Licence;<br>• All personnel are trained in the appropriate inspection, handling and disposal of asbestos materials;<br>• Asbestos must be double-wrapped in heavy-duty plastic (0.2 mm thick) or otherwise contained;<br>• Asbestos is not to be disposed of within two metres of the final landfill surface; and<br>• Use of appropriate PPE. |
| Geotechnical Stability | • All basal and side slopes comply with the Landfill Guidelines;<br>• The proposed landfill closure profile consists of a 1V:20H profile on the crown and 1V:5H on the side slopes;<br>• Site specific engineering controls for the subgrade were developed with consideration of the local groundwater and geology; and<br>• Assessment of the landfill design through a Stability Risk Assessment which determined that all required factors of safety were met, and the design is deemed acceptable. |
| Vermin and Feral Animals | • Regular pushing up and compaction of the waste;<br>• Application of adequate cover material;<br>• Progressive closure of completed landfill areas; and<br>• Monthly inspections by operational staff to identify any vermin presence on or around the landfill;<br>• Use of a 2m high chain link fence with a 400mm wire mesh skirt around the landfill cell disposal area;<br>• Electrification of the landfill area fence using two hotwire lines to prevent entry by feral animals;<br>• Placement of motion sensor infrared cameras to monitor the landfill area and detect feral animal activity; and |

| Aspects | Management Measures |
|---|---|
| | • Vermin control such as baiting and trapping. |
| Weeds | • No greenwaste processing on Site;<br>• Application of adequate cover material;<br>• Regular Site inspections; and<br>• Weed eradication as required – small areas are controlled by landfill operations staff; larger areas are controlled by a professional weed control company or with the assistance of a local farmer. |
| Litter | • Waste delivery vehicles must be adequately covered or tarped when on public roads, in compliance with road regulations;<br>• Utilisation of 2m high temporary or mobile litter panels around the active landfill tipping area to catch litter during tipping and compaction operations;<br>• Regular removal of litter from the litter screens and fences as soon as possible, but at least every two days;<br>• Collecting litter blown beyond the active landfill as soon as possible, but at least on a weekly basis;<br>• Collecting any litter blown beyond the property boundary on a weekly basis as a minimum. |
| Fire | • All waste is accepted in accordance with DWER waste acceptance criteria and Site Licence conditions;<br>• Waste is properly compacted and covered;<br>• Litter is regularly cleared from around the litter fences;<br>• Avoid piling up significant amounts of flammable material in one spot;<br>• Flammable materials such as plastics and tyres are evenly distributed throughout the waste mass to reduce the chance of large uncontrolled fires;<br>• The Site is kept secure and locked outside of operating hours to deter vandals; and<br>• Maintaining appropriate firefighting equipment onsite:<br>o Use of a water cart at the Site, which is kept fully filled at all times to respond immediately to a fire;<br>o Sufficient cover material stored nearby the active tipping area for quick waste covering during a fire;<br>o At least 50kL of water is stored onsite in a storage dam; and<br>o Adequate training is provided to Site operating staff. |
| Traffic | • Signage providing directions, traffic control measures and safety instructions are established and maintained at appropriate locations around the Site;<br>• Vehicles are restricted to a maximum speed limit of 40km/hour, unless otherwise signed;<br>• Employees and contractors wear high visibility and reflective clothing when working in areas where vehicle movement occurs;<br>• All vehicles are maintained in good working condition and drivers instructed to use conservative driving techniques; and<br>• All employees and contractors are inducted with the Site Occupational Health and Safety (OHS) and traffic management procedures. |
| Security | • Appropriate signage is installed at the Site entrance; |

| Aspects | Management Measures |
|---|---|
| | • Signage clearly indicating after-hours contact details of the Site supervisor;<br>• Lighting is installed in relevant areas of the Site, including at the main Site access road and key buildings;<br>• Where possible, all valuable assets, including fuel, are kept securely under lock and key;<br>• A 2m high perimeter fence is installed around the Site and is monitored and maintained on a regular basis; and<br>• All access gates and buildings are locked securely outside of operational hours. |

# 7 Post Closure Management

The Landfill Guidelines state that the typical period for aftercare for a putrescible landfill is approximately 30 years. The Closure Plan for the Site considered the following aspects in planning for the aftercare period:

- Maintenance of landfill cap, in particular to:
  - Prevent/control erosion
  - Restore depressions, seal and monitor cracks in the cap caused by settlement
  - Restore/maintain vegetation
- Maintenance and operation of leachate collection and treatment systems
- Maintenance and operation of landfill gas extraction systems
- Environmental monitoring of:
  - Groundwater
  - Surface water
  - Landfill gas
  - Leachate
  - Settlement.

The environmental management measures that will be employed, and associated monitoring works, are described in the following sections.

## 7.1 Landfill Gas

During the use of an active system, the wells within the waste mass will be monitored monthly as part of the well tuning process to ensure air is not being drawn into the landfill. Once the regular monitoring indicates that a passive system is viable, the system will be installed and monitored monthly for two years to confirm that the gas has stabilised, after which the wells will be monitored biannually for 28 years.

## 7.2 Landfill Leachate

### 7.2.1 Leachate Head

Leachate levels are currently being monitored according to the Site Licence. Post-closure leachate levels in the engineered cells will be measured on a quarterly basis to ensure that the extraction system is maintaining leachate levels in line with the Site Licence. Prior to monitoring leachate head, the pumps should be switched off for several days to allow leachate levels to stabilise. As further cells come into use, these will also be monitored, with the intention to establish a production rate for leachate as discussed in Section 7.2.2.

### 7.2.2 Leachate Generation Rates

The quantity of leachate extracted from each of the cells should be monitored via an inline water meter. In the absence of an inline meter, quantities can be estimated based on pumping flow rates and pump operating durations. Volumetric leachate generation data can be used to check water balances for the Site, to potentially identify potential loss of containment at the landfill or additional evaporation capacity.

### 7.2.3 Leachate Composition

Leachate collected in the landfill cells will be sampled directly from the leachate risers and a further sample obtained from the leachate evaporation ponds to characterise composition and strength. Annual monitoring of leachate composition following the closure of the Site is considered sufficient from a risk management perspective.

## 7.3 Surface Water

To ensure that the surface water management system is functioning effectively, samples should be taken at the discharge points to the surface water ponds twice annually and tested for evidence of leachate. Based on the climate and precipitation patterns the sampling rounds should be carried out during the winter, ideally at the start and end or after a significant rain event. The current Site Licence monitoring, requiring two sampling events between the months of May and September separated by at least 30 days, is a good reflection of this monitoring interval. Where the results indicate the presence of contaminants, the source of the contamination should be identified, and action taken to remedy any failures in the system. This may require sampling of the individual channels of the surface water management system to assist in the identification of the source. A physical inspection of the surface water management system during sampling rounds should also be carried out to ensure that it is operating effectively.

After the first five years following the rehabilitation of the landfill, monitoring can be carried out at a reduced frequency of once a year and following a heavy rainfall event. After this time, further monitoring may not be required if results indicate that the surface water management system is effective.

## 7.4 Groundwater

A network of groundwater monitoring bores is currently installed at the Site, with extensive studies having been undertaken to understand the underlying groundwater at the Site.

Groundwater is currently monitored quarterly in accordance with the Site Licence. Following rehabilitation, groundwater will be monitored at the same frequency for the first five years, reducing to annually for the remaining 25 years, unless groundwater chemistry indicates impacts from the landfill in which case more frequent monitoring may be required.

## 7.5 Topography

Following rehabilitation, inspections of the integrity of the capping system should be conducted twice annually and following severe weather events. It would be beneficial for the proposed topsoil/compost layer to remain in place, at least until the surface vegetation has established and it may be necessary to reinstate displaced restoration soils.

It is expected that, following the waste reprofiling works and installation of the capping system, a minimal amount of settlement will occur, as the waste has been compacted during placement. In general, most of the settlement occurs in landfills in the first two years following rehabilitation.

It is therefore proposed that annual surveys be undertaken to monitor the settlement rate for the first two years. Following this, surveys will be conducted every two years (up to 15 years post-rehabilitation), unless the settlement rate observed indicates that more frequent surveys are required. By this time, it is anticipated that settlement will be very minor so surveys should be undertaken every five years, or until the topography of the cell has stabilised.

## 7.6 Vegetation

Vegetation growth should be visually monitored following the revegetation of the Site. Any plants that die off or fail to take should be replaced to ensure the integrity of the cap. Monitoring for weeds should also be undertaken, with weed control measures implemented quarterly.

## 7.7 Monitoring Program

The proposed post-closure management and monitoring program is presented in Table 7-1.

**Table 7-1: Post-Closure Management & Monitoring Program**

| Aspect | Monitoring Method | Frequency | Duration |
|---|---|---|---|
| Topography | Topographic survey | Biannually* | First 2 years following closure |
| | | Every 2 years | Following 13 years |
| | | Every 5 years | Following 15 years |
| Landfill Gas | Landfill Gas Wells | Monthly | Whilst an active system is still operational |
| | | Monthly | For the first two years following the installation of a passive system |
| | | Biannually | For the third through to the 30th year following the installation of the passive system |
| | Surface Emissions | Annually | Ongoing for 30 years post-closure |
| | Accumulation | Annually | Ongoing for 30 years post-closure |
| | Flare Emissions | Continuous | During operation of the active system |
| Landfill Leachate | Leachate riser and evaporation pond sampling. | Biannually | First 5 years following closure |
| | | Annually | Following 25 years |
| Groundwater | Borehole sampling. | Quarterly | During operation |
| | | Annually | Following 25 years |
| Surface water | Sampling at surface water evaporation pond | Biannually | First 5 years following closure |
| Vegetation | Visual Inspection | Quarterly | During operation and the post-closure period |

** Following extreme weather events, it is recommended to undertake an inspection on of the restoration soils and monitor the formation of any rills or gullies*

As the Site is still operational and will be closed off in phases, Opalvale will consider its current monitoring commitments as specified within the Site Licence as well as the post-closure monitoring requirements detailed in Table 7-1.

# 8 Residual Risk Assessment

The objective of the Residual Risk Assessment is to ensure the potential risks associated with the proposed activities are understood and managed appropriately to ensure that there is no unacceptable residual risk. Each of the potential risks was assessed as per the *DWER Guidance Statement: Risk Assessments - Part V, Division 3, Environmental Protection Act 1986* (February 2017) (DWER's Guidance Statement). The sources of hazards, pathways and receptors of hazards identified are outlined in the following subsections.

## 8.1 Sources of Hazards

For the purpose of this assessment, a source is defined as a primary risk with the potential to cause significant contamination or harm to the environment. With regards to the environment and public health, sources and its potential hazards which may arise from the various future activities have been identified and are shown in Table 8-1.

**Table 8-1: List of Potential Hazards**

| Source | Description of Hazards |
|---|---|
| Surface Water | Excessive surface water that is not properly managed can lead to flooding onsite.<br>Surface water that comes into contact with general mixed or putrescible waste can generate leachate. |
| Leachate | Risk to surface and groundwater from the seepage of leachate from the landfill. |
| Groundwater | Risk to groundwater from the seepage of leachate from the landfill in the event the integrity of the lining system is compromised. |
| Landfill Gas | Generation of landfill gas and uncontrolled release to the atmosphere contributing to greenhouse gas emissions.<br>Vertical or horizontal movement of gases through soil to buildings onsite or nearby houses presenting an explosion risk. |
| Odour | Odours generated from putrescible waste can cause impacts to amenity. |
| Dust | Dust generated during construction works can result in reduced visual amenity and cause respiratory issues. |
| Noise | Noise emissions can cause impacts to amenity. |
| Asbestos | Asbestos is a known carcinogen that can cause mesothelioma, lung cancer and asbestosis. Asbestos fibres inhaled deep into the lungs can result in the development of mesothelial cells which may result in cancer. |
| Litter | Litter can result in impacts to amenity on and immediately surrounding the Site. |
| Traffic | Traffic can cause occupational health and safety issues in addition to contributing to dust, litter and noise generation |

| Source | Description of Hazards |
|---|---|
| Vermin and Feral Animals | Exposed waste can attract vermin which may cause nuisance and present health risks. |
| Weeds | Introduction and spread of weeds can comprise revegetation. |
| Fire | Potential for fires from waste materials and equipment. |
| Security | Unauthorised personnel may access the Site resulting in a security breach of the Site facilities, plant and equipment. |

## 8.2 Pathways for Hazards

For the purpose of this assessment, a pathway for a hazard is defined as the route by which potential contamination or harm can migrate. The key migration pathways at a landfill generally include the following:

- Air through which lightweight materials, such as dust, litter, odour and landfill gas, can travel;
- Surface along which the sources of contamination or harm can travel or be present at (e.g., surface water runoff, litter, persons walking or working over the surface); and
- Sub-surface whereby the underlying soils, bedrock, aquifers and infrastructure permit gas and leachate migration towards the receptors as follows:
  - Lateral and vertical migration of leachate within or towards the groundwater; and
  - Lateral and vertical migration of landfill gas either in the gas phase or dissolved in groundwater via subsoil, bedrock, aquifers and manmade underground services such as pipelines, drainage systems and manholes.

For the purpose of this assessment, a receptor is defined as the location where the impact of the contamination or harm is registered. The possible receptors of the contamination or harm cause by the identified hazards are summarised in Table 8-2.

**Table 8-2: Receptors**

| Receptor | Description of the Receptor |
|---|---|
| Air Quality | • Local air quality. |
| Site Users | • Persons authorised to traverse across the Site including:<br>o Operational staff;<br>o Contractors carrying out maintenance or monitoring; and<br>o Visitors/Customers. |
| Site Infrastructure | • Buildings onsite and associated infrastructure. |
| Surrounding Land Users | • People who work or live beyond the boundary of the facility. |
| Surface Water | • Surrounding natural surface water bodies. |
| Groundwater | • Groundwater that exists beneath the landfill either as a local perched system or as a regional aquifer from which a water supply may be extracted for industrial or potable purposes. |

| | |
|---|---|
| Vegetation and Flora | • Vegetation and flora in surrounding areas. |
| Fauna | • Fauna species whose habitat is within or surrounding the facility. |

## 8.3 Risk Rating Matrix

To assess the various risks, the potential hazards identified in Table 8-1 were classified according to the DWER's Guidance Statement shown in Table 8-3.

**Table 8-3: Risk Rating Matrix**

| | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | Slight | Minor | Moderate | Major | Severe |
| Probability | 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 |

## 8.4 Risk Profile

Risk management measures refer to the key management strategies that will be adopted onsite to ensure that all hazards and potential risks identified are controlled to an appropriate level, and that strategies are in place to react to any potential incidents or accidents. In most cases these risk management measures decrease the probability and/or consequence of identified hazards and therefore lower the risk rating. The current risk rating and revised probability and consequence for each identified hazard following the implementation of management measures for the proposed works are shown in Table 8-4.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ion a | Surface | Sedimentation from uncontrolled stormwater impacting flora and vegetation | Possible | Minor | Medium | • Surface water management system:<br>o 0.5m minimum bund around the landfill to prevent surface water inundation;<br>o Informal drainage around the landfill to divert surface water away from the active cells; and<br>o Sedimentation ponds.<br>• Regular monitoring, maintenance and reporting in accordance with the Site Licence. | Unlikely | Slig |
| water | Surface | Water that encounters waste generating leachate that can cause contamination to groundwater | Almost certain | Major | Extreme | | Almost certain | Slig |
| water | Surface | Uncontrolled stormwater that encounters waste generating leachate and contaminating surrounding surface water | Possible | Major | High | | Unlikely | Slig |
| water | Subsurface | Contamination of groundwater resulting from seepage from the landfill | Possible | Major | High | • Composite lining system designed using the criteria within the Landfill Guidelines;<br>• Leachate collection system within each landfill cell, designed using the criteria within the Landfill Guidelines;<br>• Regular inspections of pumps and pipework to ensure efficiency of leachate removal; | Unlikely | Min |
| water | Surface | Overtopping of containment infrastructure can contaminate surface waters | Unlikely | Major | Medium | • Minimum separation distance of 2m from known groundwater table levels; and<br>• Ongoing monitoring in accordance with the Site Licence. | Rare | Min |
| ucture | Subsurface | Vertical or horizontal movement of gases through soil to buildings onsite or nearby houses presenting an explosion risk | Possible | Severe | Extreme | • Progressive installation of a destructive landfill gas management system, as part of phased closure activities; and<br>• Monitoring in accordance with the Site Licence and the Site's Landfill Gas Management Plan. | Rare | Ma |
| ding ers | Subsurface | | Possible | Severe | Extreme | | Rare | Ma |
| rs | Air | Odours generated from the acceptance and degradation of waste in the landfill impacting amenity onsite | Almost certain | Minor | High | • Installation of a landfill gas management system post-closure;<br>• Consideration of meteorological conditions during material handling and leachate recirculation; | Possible | Slig |
| ding ers | Air | Odours generated from the acceptance and degradation of waste in the landfill impacting nearby receptors | Possible | Minor | Medium | • Regular maintenance and monitoring of the leachate treatment system;<br>• Rejection of excessively odorous waste streams;<br>• Covering of waste during transport;<br>• Management of tip face size in accordance with the Site Licence;<br>• Daily cover and compaction of waste as per the Site Licence;<br>• Immediate burial of highly odorous wastes on acceptance at the weighbridge; and<br>• Odour complaint system and follow-up investigations/actions. | Unlikely | Slig |
| rs | Air | Visibility may be impaired, and inhalation of dust may occur during construction activities and handling of waste | Possible | Minor | Medium | • Vehicles to comply with maximum speed limits of 40km/hr;<br>• Road surfacing to minimise dust generation;<br>• Wetting down access roads;<br>• Wetting of the active tip face in accordance with Site Licence;<br>• Restricted activities during certain weather conditions (strong winds);<br>• Application of dust suppressant chemicals; | Possible | Slig |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| rs | Air | Noise impacts from activities onsite impacting Site users | Likely | Slight | Medium | • Restricted operating hours;<br>• Regular maintenance of mobile machinery and equipment; | Unlikely | Sli |
| ding ers | Air | Noise impacts from activities onsite impacting nearby receptors | Possible | Slight | Low | • Use of low frequency reversing alarms instead of broadband alarms to reduce noise emissions; and<br>• Use of appropriate PPE. | Unlikely | Sli |
| rs | Air | Inhalation of asbestos fibres from asbestos | Possible | Major | High | • All asbestos and asbestos containing materials accepted at the Site are buried as soon as practicable or at the end of the working day in a dedicated asbestos disposal area as per Site Licence;<br>• All personnel are trained in the appropriate inspection, handling and disposal of asbestos materials;<br>• Asbestos must be double wrapped in heavy-duty plastic (0.2 mm thick) or otherwise contained;<br>• Asbestos is not to be disposed of within two metres of the final landfill surface; and<br>• Use of appropriate PPE. | Unlikely | Mod |
| ucture | Surface | Partial collapse of batter can lead to damage to the landfill lining system and its environmental engineering controls | Possible | Major | High | • All basal and side slopes comply with the Landfill Guidelines;<br>• The proposed landfill closure profile consists of a 1V:20H profile on the crown and 1V:5H on the side slope;<br>• Site specific engineering controls for the subgrade were developed with consideration of the local groundwater and geology; and<br>• Assessment of the landfill design through a Stability Risk Assessment which determined that all required factors of safety were met, and the design is deemed acceptable. | Rare | Mi |
| rs | Surface | Instability of landfill waste profile can lead to health and safety concerns | Possible | Major | High | | Rare | Mi |
| ding ers | Air and surface | Litter impacting amenity of nearby receptors | Unlikely | Slight | Low | | Rare | Sli |
| rs | Surface | Putrescible waste can attract vermin and feral animals presenting health risks, reduced amenity and nuisance | Possible | Minor | Medium | • Regular pushing up and compaction of the waste;<br>• Application of adequate cover material;<br>• Progressive closure of completed landfill areas; and<br>• Monthly inspections by operational staff to identify any vermin presence on or around the landfill;<br>• Use of a 2m high chain link fence with a 400mm wire mesh skirt around the landfill cell disposal area;<br>• Electrification of the landfill area fence using two hotwire lines to prevent entry by feral animals;<br>• Placement of motion sensor infrared cameras to monitor the landfill area and detect feral animal activity; and<br>• Vermin control such as baiting and trapping. | Possible | Sli |
| ion a | Air and Surface | Introduction of weeds impacting surrounding native vegetation or revegetation onsite | Possible | Minor | Medium | • No greenwaste processing onsite;<br>• Application of adequate cover material;<br>• Regular Site inspections; and<br>• Weed eradication as required – small areas are controlled by landfill operations staff; larger areas are controlled by a professional weed control company or with the assistance of a local farmer. | Unlikely | Sli |

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| rs | Surface | Risk of fires onsite from equipment or landfill creating risk to personnel and infrastructure | Unlikely | Severe | High | All waste is accepted in accordance with DWER waste acceptance criteria and Site Licence conditions;<br>• Waste is properly compacted and covered;<br>• Litter is regularly cleared from around the litter fences;<br>• Flammable materials, such as plastics and tyres, are evenly distributed throughout the waste mass to reduce the chance of large uncontrolled fires;<br>• Avoid piling up significant amounts of flammable material in one spot;<br>• The Site is kept secure and locked outside of operating hours to deter vandals; and<br>• Maintaining appropriate firefighting equipment onsite:<br>o Use of a water cart at the Site, which is kept fully filled at all times to respond immediately to a fire;<br>o At least 50 kL of water is stored onsite in a storage dam;<br>o Sufficient cover material stored nearby the active tipping area for quick waste covering during a fire; and<br>o Adequate training is provided to Site operating staff. | Rare | Mi |
| ucture | Surface | | Unlikely | Major | Medium | | Rare | Mi |
| rs | Surface | Litter can impact amenity of Site and surrounding land users | Almost Certain | Slight | Medium | • Waste delivery vehicles must be adequately covered or tarped when on public roads, in compliance with road regulations;<br>• Utilisation of 2m high temporary or mobile litter panels around the active landfill tipping area to catch litter during tipping and compaction operations;<br>• Regular removal of litter from the litter screens and fences as soon as possible, but at least every two days;<br>• Collecting litter blown beyond the active landfill as soon as possible, but at least on a weekly basis;<br>• Collecting any litter blown beyond the property boundary on a weekly basis as a minimum. | Possible | Sli |
| ding ers | Air | | Possible | Slight | Low | | Rare | Sli |
| | Surface | Fauna can consume litter leading to injury or death | Possible | Moderate | Medium | | Unlikely | Mi |
| rs | Air and Surface | | | | | • Signage providing directions, traffic control measures and safety instructions are established and maintained at appropriate locations around the Site;<br>• Vehicles are restricted to a maximum speed limit of 40km/hour, unless otherwise signed;<br>• Employees and contractors wear high visibility and reflective clothing when working in areas where vehicle movement occurs;<br>• All vehicles are maintained in good working condition and drivers instructed to use conservative driving techniques; and<br>• All employees and contractors are inducted with the Site OHS and traffic management procedures. | | |

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| ucture | Surface | Unauthorised personnel may access the site resulting in a security breach of the Site facilities, plant and equipment | Unlikely | Minor | Medium | • Appropriate signage is installed at the Site entrance;<br>• Signage clearly indicating after-hours contact details of the Site supervisor;<br>• Lighting is installed in relevant areas of the Site, including at the main Site access road and key buildings;<br>• Where possible, all valuable assets, including fuel, are kept securely under lock and key;<br>• A 2m high perimeter fence is installed around the Site and is monitored and maintained on a regular basis; and<br>• All access gates and buildings are locked securely outside of operational hours. | Unlikely | Sli |

## 8.5 Assessment Conclusion

The Residual Risk Assessment identified the current sources of hazards as well as possible sources of hazards arising from the proposed works. The risk rating prior to the implementation of management measures ranged from 'Low' to 'Extreme'. The revised risk ratings were all downgraded to 'Low' to 'Medium' once management measures were applied. Given the proposed management measures, Opalvale will ensure any potential health, environment, and amenity impacts are avoided or minimised.

# 9 Conclusion

The construction of Cells 5 and 6 is required to ensure that there is sufficient capacity at the Site for disposal of Class II waste and to allow development of the final landform required for closure of the Site in accordance with the Closure Plan. The landfill cells have been designed using the criteria within the Landfill Guidelines and will be constructed in accordance with these guidelines to minimise the risk of potential environmental impacts.

To further reduce potential environmental impacts associated with the operation of the landfill cells, Opalvale will continue to implement its existing environmental management procedures. As determined through the Residual Risk Assessment in Section 8, the residual risk rating was determined to be 'low' to 'medium' following the implementation of these management measures. Therefore, Opalvale believes that the construction and operation of Cells 5 and 6 can be adequately managed in accordance with the existing Site Licence.

# APPENDIX A
## Drawings

Drawing W-101: Existing Site Layout and Topography
Drawing W-102: Top of Formation
Drawing W-103: Top of Engineered Fill
Drawing W-104: Cell 5 Leachate Management Layout
Drawing W-105: Cell 6 Leachate Management Layout
Drawing W-106: Maximum Recorded Groundwater Level in Cell 5 & 6 Footprint
Drawing W-107: Maximum Recorded Groundwater Level 11 January 2023
Drawing W-108: Road Layout and Sections
Drawing W-109: Surface Water Layout
Drawing W-110: Gas Management System Layout
Drawing W-111: Proposed Restoration Profile and Surface Water Management
Drawing W-201: Hydrogeological Cross Sections
Drawing W-202: Long Sections
Drawing W-301: Typical Details Sheet 1 of 4
Drawing W-302: Typical Details Sheet 2 of 4
Drawing W-303: Typical Details Sheet 3 of 4
Drawing W-304: Typical Details Sheet 4 of 4
Drawing W-305: Drain Sections

# APPENDIX B
## Figures

# APPENDIX C
## Technical Specification

# APPENDIX D
## CQA Plan

# APPENDIX E
## Stability Risk Assessments

# APPENDIX F

## Groundwater Technical Memorandum

# APPENDIX G
## Water Balance Memorandum

**Assets | Engineering | Environment | Noise | Spatial | Waste**

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