

## **Appendix G      Landfill Engineering Memo**

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# Memorandum

**Subject:** ARL Project - Landfill Engineering  
Memorandum

**Reference  
No:** 1101798

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## 1 Introduction

WM New Zealand (WMNZ) has engaged Tonkin & Taylor Ltd (T+T) to prepare technical memoranda for the proposed new solid waste management and disposal facility in the Wayby Valley, north of Auckland ('**ARL**' or '**Project**').

The Project will involve constructing, operating, closing and providing aftercare for a new 24 Mm<sup>3</sup> landfill facility and associated infrastructure at Wayby Valley, Wellsford. Ngāti Manuhiri are Project partners and will work with WMNZ on the proposed management and mitigation measures. Once landfilling ceases, the land will be returned to Ngāti Manuhiri as tāngata whenua.

The new landfill will be a Class 1 landfill, as defined in the Technical Guidelines for Disposal to Land (WasteMINZ Technical Guidelines)<sup>1</sup>, accepting municipal solid waste. This includes residential and commercial waste, construction and demolition waste, some industrial wastes that meet acceptance criteria, and contaminated soils. Following waste settlement, the landfill cap surface will have a maximum height of 205 m RL.

WMNZ landholdings in the Wayby Valley area comprise a total area of 1020 ha, with the landfill footprint being approximately 60 ha. The WMNZ landholdings have been divided into five general areas; the Eastern Block, the Western Block, the Southern Block, the Waiwhiu Tributary Block and the Waiteraire Tributary Block. The proposed works will involve the following:

- **Site access and operation:** Construction of site access roads, weighbridges, and a vehicle wheel wash.
- **Landfill development:** Major earthworks and the installation of environmental management systems, including a landfill lining system and collection networks for leachate, stormwater, and landfill gas (LFG).
- **Leachate and landfill gas management:** A dedicated leachate management system and a LFG treatment facility, including a LFG flare and a LFG waste-to-energy plant.
- **Support infrastructure:** Facilities for site staff, plant maintenance, and water supply.
- **Terrestrial, freshwater and wetland biodiversity measures:** This includes native revegetation, and a weed and animal pest management programme to offset or compensate for residual adverse effects on terrestrial, freshwater and wetland ecology.

This memorandum provides an outline of the initial findings set out in the Auckland Regional Landfill Engineering Report, May 2019, and incorporates changes to the design undertaken prior to and during the Environment Court hearings. This memorandum has been prepared for inclusion in an application for Ministerial referral of the Project under the Fast-track Approvals Act 2024 ('**FTAA**').

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<sup>1</sup> Technical Guidelines for Disposal to Land, WasteMINZ, September 2023, Revision 3.1.

Specifically, this memorandum responds to the requirements under section 3.4 of the Fast-track Approvals Referral Application Form and section 13(4)(h) of the FTAA. A full description of the draft proposal is included in the accompanying information attached to the application form for the referral.

## **2 Summary of findings**

The proposed landfill provides an airspace capacity of approximately 24 Mm<sup>3</sup>.

The preliminary design for the proposed landfill for ARL has been undertaken to meet or exceed the recommendations of the WasteMINZ Technical Guidelines for Disposal to Land, Revision 3.1, September 2023 (WasteMINZ Technical Guidelines) and in accordance with international good practice. Landfill design focusses on providing engineered solutions to avoid potential environmental effects that would otherwise result from the acceptance and disposal of waste. The key systems required are:

- A robust base containment system to avoid the discharge of leachate to the underlying groundwater
- Systems for the removal and disposal of leachate
- A suitable capping system to minimise leachate generation and landfill gas (LFG) escape
- Collection and disposal of LFG
- Control of stormwater to separate it from waste, minimise erosion and provide suitable treatment for sediment laden stormwater prior to discharge.

Robust solutions for these key engineering elements have been developed for ARL as described in the following sections.

Other engineering aspects comprise all components required for the ongoing operation of the landfill, including: site access; on-site roading to connect the various parts of the site; provision of site facilities for management, operation, plant and maintenance; stockpiling of soils required for construction and operation of the landfill including bulk excavation soils, topsoil and clay liner soils. These aspects are also described below.

Overall, the preliminary design of ARL provides suitable safeguards to control potential effects on the environment.

## **3 Assessment methodology**

The preliminary landfill engineering design has been informed by a comprehensive review of available site information and includes:

- Collection of all relevant existing data related to the site including topographical, geological and climatic data.
- Selection of a suitable footprint and landfill profile to provide the target airspace within site topographical, geotechnical and environmental constraints.
- Assessment of overall requirements for the operation of the landfill over its expected life and the preliminary design of key elements of the landfill. These elements include leachate management, stormwater management, landfill gas management, availability of liner and cover soils including requirements for stockpiling, site access, access between parts of the site and provision of facilities required for landfill operation.
- Assessment of site climatic and hydrological data for the preliminary design of leachate management systems and stormwater systems.

- Review of work undertaken by other specialists for integration of those findings into the engineering design where applicable.
- Assessment of the proposed designs against the recommendations set out in the WasteMINZ Technical Guidelines and international good practice for landfill design.

## **4 Engineering design and performance**

### **4.1 Site suitability**

The Wayby Valley site is well suited for the development of a landfill of the size proposed for ARL as it includes:

- Direct access to the site from State Highway 1 (SH1), avoiding waste trucks travelling on minor roads.
- Suitable topography for forming a valley landfill, with suitable side slopes for low permeability liner construction.
- Geology and hydrogeology that is suitable for landfill development in combination with appropriate design elements (refer to other specialist reports).
- Suitable soils located at the site for construction of the low-permeability soil components of the landfill lining system.
- An elevated site that is well above any potential flood plain and will not be affected by the long-term effects of sea level rise. In particular, the landfill footprint is well above the flood plain of the nearby Te Awa o Hōteao.
- Good separation distances from neighbours and sensitive receivers.

### **4.2 Base containment (lining system) and basegrade formation**

The landfill lining system is one of the key components of a landfill, providing separation between the landfilled waste and the surrounding environment and providing containment for any leachate produced. The lining system for ARL will be a Type 1 lining system as described in the WasteMINZ Technical Guidelines. The details of the lining system are described in the Lining System Memorandum forming part of this application.

The lining system is constructed on a basegrade formed by earthworks within the Landfill Valley. Significant earthworks will be undertaken to modify the shape of the valley. The main reasons for these earthworks are:

- To provide a landform suitable for landfill operation and for development in a staged manner.
- To provide a surface suitable for construction of a composite lining system (comprising a low permeability compacted soil layer and geosynthetic components) which requires the formation of uniform and planar surfaces with few deviations in angle or plane. Ideally the slopes will be in the order of 1 vertical to 3 horizontal (1V:3H) to facilitate clay liner construction and for deployment of geosynthetic components. This will be confirmed when the project is progressed.
- To provide a source of soils for the ongoing operation of the landfill (for daily, intermediate and final capping systems and ongoing construction works). The quantity of soils required is typically about 20% of the landfill airspace volume (in this case amounting to approximately 5 Mm<sup>3</sup> of soil). Surplus soils from construction works are stockpiled for later use for landfill operation and construction of future stages.
- To provide for ongoing stormwater control during the operation and development of the landfill.

Benches are proposed on the side slopes to facilitate construction, for leachate and stormwater control and to provide for staging of the landfill development.

The basegrade provides a surplus cut over fill. Surplus excavated material at any time will be stockpiled for later use for landfill operation. All stripped topsoil will be stockpiled separately.

Detailed design of the landfill may result in changes to the landfill basegrade, which may result in minor changes to the location of the perimeter of the landfill. It is essential to retain some flexibility in the landfill footprint definition to allow for actual conditions encountered on site following more detailed site investigations and/or during construction.

Soils for the compacted soil component of the lining system will be obtained, as far as possible, from the landfill footprint or within other planned earthworks. All suitable lining soils found within earthworks areas and not immediately used will be stockpiled within a clay borrow area for later use. Should there be a shortfall of lining soils from earthworks at any time, a source of suitable soils has been identified within the Western Block.

### **4.3 Sub-liner drainage**

Uplift pressures from the build-up of groundwater seepages beneath the landfill lining system has the potential to damage the liner before it is buttressed by the weight of waste above it. To prevent this happening subsoil drains will be installed beneath the lining system to drain away groundwater seepages. Drains will be installed only as required to control groundwater pressures and their location will be determined following detailed site investigations or in response to the presence of seepages exposed during construction.

Subsoil drains beneath the lining system can intercept potential leakage through the lining system should this occur. Therefore, the outlet(s) from the subsoil drainage system will be continuously monitored for electrical conductivity to identify the possible presence of leachate. In the unlikely event leachate is detected then additional monitoring and investigation will be undertaken in accordance with a Landfill Monitoring and Contingency Plan to confirm the presence and source of the leachate and possible remediation options.

### **4.4 Leachate generation**

Leachate is produced when rain falling on the surface of the landfill percolates through the waste and collects contaminants from the waste it passes through. The lining system is designed to contain and collect this leachate and prevent it from entering the surrounding environment.

The quantity of leachate produced can be determined using numerical models or it can be determined empirically from experience at similar sites – which is often more accurate. In the case of ARL, the quantity of leachate has been assessed based on historical data from WMNZ's Redvale and Whitford Landfills. Based on this data, and taking a worst-case scenario, leachate generation at ARL may be as high as 15 % of rainfall, but it is likely to be much less than this (typically would expect about 5 % long term). On this basis, average daily leachate generation for the early phases of the landfill operations is calculated to be in the order of 95 m<sup>3</sup>/day and at full development would be in the order of 476 m<sup>3</sup>/day (average daily) and 564 m<sup>3</sup>/day (average day of peak month).

Leachate quantities can be controlled by:

- Keeping the working face to the minimum practicable size to minimise the area where waste is directly exposed to rainfall.
- Controlling stormwater around the working face to prevent stormwater runoff entering the waste. All stormwater that comes into contact with waste will be treated as leachate.

- Covering areas with intermediate and final cover as soon as is practicable to shed stormwater to the site drainage system.
- Implementing and maintaining a leachate management system.

Leachate percolating out of the bottom of the waste is collected in a gravel drainage layer placed on top of the low permeability lining system. Collected leachate drains to the toe of the landfill from where it is pumped out of the landfill.

In the early stages of landfill operation when leachate quantities will be relatively small, leachate will be pumped to covered holding tanks located near the site office area from where the leachate will be loaded into tankers for removal off site to an authorised disposal location. The tanks will be designed with safeguards, such as bunding around the tanks, to prevent accidental release of leachate.

Once sufficient LFG is being generated at the landfill, perhaps after 1 to 2 years, the leachate will be pumped to larger covered holding tanks located at the renewable energy centre for disposal using a leachate evaporator which is fuelled with LFG.

#### 4.5 Leachate leakage through the lining system

The landfill lining system is designed to fully contain the leachate (i.e. no leaks), and strict quality control and quality assurance is provided during liner manufacture and installation to avoid any defects in the liner that may result in leakage. However, it is international best practice to assume a certain number of defects in the HDPE geomembrane component of the lining system for assessing potential leakage and effects on the receiving environment.

Potential leakage from the landfill was modelled using Visual Hydrologic Evaluation Landfill Performance (HELP). Calculations were based on a 50-year climatic model and assuming “good” quality installation (rather than “excellent”) with two manufacturing defects per ha and 4 installation defects per ha. In addition, we undertook a sensitivity analysis by modelling various alternative scenarios likely to yield much greater leakage volumes. These included “poor” installation, a constant 300 mm head of leachate over the floor liner (rather than a variable head calculated by HELP) and a constant 1000 mm head over the floor liner. Leakage calculated for the peak year of the 50 years modelled is shown in Table 4.1.

**Table 4.1 Worst case leachate generation results**

| Scenario                                                                                                                | Leachate leakage (m <sup>3</sup> /yr) |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 1 Base case: HELP model – HDPE over clay (Type 1 liner): good installation                                              | 3.01                                  |
| 2 HELP model – HDPE over clay (Type 1 liner): poor installation                                                         | 16.7                                  |
| 3 300 mm leachate on floor (using the Giroud equation) and HELP modelled Type 1 liner on side slopes: poor installation | 14.8                                  |
| 4 1000 mm leachate on floor (Giroud) and HELP modelled Type 1 liner on side slopes: poor installation                   | 107.7                                 |

#### **4.6 Final landform and final cap system**

The fill profile for the landfill has been established to provide approximately 24 Mm<sup>3</sup> of landfill airspace following expected settlement of the waste. The current proposed final fill profile is expected to have slopes generally no steeper than 1V:4H (typically 1V:5H) and the upper portion of the fill is expected to have slopes no shallower than 1V:20H to promote stormwater runoff while allowing for some settlement.

The landfill will be covered with a final capping system. The purpose of this is to minimise the ingress of water to the landfill to minimise leachate generation and to control emissions of LFG through the landfill surface. It also provides a physical separation between placed waste and any future land use.

#### **4.7 Landfill gas management**

LFG is generated from anaerobic decomposition of the organic components of the waste and comprises methane (50 to 60%), carbon dioxide (40 to 50%) and trace compounds. The harmful products in LFG are destroyed by combustion. At ARL, a flare(s) will be installed to treat the LFG by burning it at a controlled temperature and retention time to destroy the methane and trace gases present. When sufficient LFG is being produced it will be used to fuel generators to produce electricity and to fuel a leachate evaporator for leachate disposal. The flare will be retained to destroy any surplus LFG not used by the generators or evaporator or as a backup should the generators or evaporator not be functioning at any time. The combustion facilities at ARL are predicted to meet the requirements of the National Environmental Standards for Air Quality. A comprehensive LFG collection system will be installed within the waste mass to collect LFG and convey it to the combustion facilities. These will comprise a combination of horizontal collection pipes and vertical wells. The system will be progressively extended as the landfill develops.

#### **4.8 Landfill staging**

The landfill will be constructed and operated in a series of stages over its operating life. It is anticipated that each stage will typically be developed to have an operating life of 2 to 3 years, but this will likely vary depending on the specific design for each stage. It is anticipated that the first stage will comprise the construction of the toe bund and the floor liner up to the first 20 m height bench at the western extent of the footprint (Stage 1). Stage 2 is expected to be a vertical extension of Stage 1 up to the second 20 m bench on the south side of the footprint. Stage 3 is expected to complete construction of the floor lining system up to the first 20 m bench. Subsequent stages will build vertically above these stages, generally working from east to west to allow for stormwater drainage towards the west.

#### **4.9 Stormwater management**

Overall stormwater management in relation to stormwater quality is described in the Operational Stormwater and Water Quality Memorandum. This section addresses stormwater management only around the landfill footprint.

Stormwater control around the operating landfill is provided to separate clean stormwater from waste so that no water that has come into contact with waste will be discharged to the stormwater system, and to safely convey all stormwater falling on the landfill footprint to the stormwater treatment ponds below the toe of the landfill. The main drainage system comprises drains installed on the landfill benches which drain westward toward the toe of the landfill. These bench drains will be progressively filled over as the landfill develops, but the final perimeter drain will remain in operation. During operation, intermediate capped areas will drain towards the bench drains. Contour drains will be formed in the final landfill cap to convey water to the perimeter drains. All permanent drains will be designed for a 1 % annual exceedance probability (AEP) rainfall event and

temporary drains designed for a 10 % AEP event. In all cases the design will consider the safe conveyance of water should the design rainfall event be exceeded.

Operation of the early stages of landfill development requires specific consideration of stormwater management. Construction of Stage 1 will effectively dam the landfill valley. In order to manage stormwater from the valley upstream of Stage 1 and 2 the following is proposed:

- A stormwater attenuation pond will be constructed on the footprint of Stage 3.
- Normal flows from the stormwater attenuation pond will discharge through a pipe laid beneath Stage 1 of the landfill
- Any overflow from the stormwater attenuation pond will discharge to the surface drain on the bench above and to the north of Stage 1 and 2.
- The stormwater attenuation pond and the pipe beneath Stage 1 of the landfill will be decommissioned for the construction of Stage 3.

#### **4.10 Site access**

Access to the site will be from the existing SH1. It is anticipated that the design will include the provision for a weighbridge, wheelwash and other infrastructure as required. Due to the topography and features on the site, bridges may be required which will be confirmed and appropriately designed.

#### **4.11 Site roading**

Roads will be required on site for the operation of the landfill. These include, but are not limited to:

- A road around the perimeter of the landfill footprint for site vehicles to access areas of the landfill. This will typically be a gravel road and will be progressively constructed as the landfill expands.
- Stage access road from the main access road to connect with the first bench within the landfill footprint. This road will be progressively constructed over the landfill surface as landfilling progresses.
- Access for carting surplus excavated soils to the stockpile, carting soils from the stockpile to the landfill to meet operational requirements and for carting clay to/from the clay borrow area.
- Access road to the stormwater ponds.
- General site roading consisting of various minor service roads, access roads and other roading. Wherever possible, existing forestry roads which are generally located on ridgelines will be retained.
- Access via Wilson Road.

#### **4.12 Ancillary buildings and facilities**

Ancillary buildings and services include, but are not limited to:

- A site office for staff responsible for the operation of the landfill, including parking adjacent to the site office.
- A workshop for plant and general maintenance. A hardstand area will be provided for outside of the workshop. Additional small buildings will also be provided in this general area to house small plant, equipment, etc.
- Weighbridge kiosk.

#### **4.13 Water supply**

Potable water will be required on site which is proposed to be sourced from a groundwater bore to be installed near the landfill facilities area, with water pumped from the bore to a tank located at a suitable elevation near the bore.

It is proposed to use any remaining yield from the bore noted above as a source for non-potable water. Any remaining non-potable water requirement would be sourced from the main stormwater treatment ponds downstream from the toe of the landfill.

#### **4.14 Stockpiles**

Surplus excavated material will be stockpiled with the stockpile anticipating to hold approximately 2.7 Mm<sup>3</sup> of soil. Much of the capacity of the stockpile will be required for the initial stages of construction. Soil will be removed as required for landfill operation and additional soil added as further construction proceeds.

The stockpile area will be formed by first stripping any topsoil and/or clay soils suitable for liner construction and with the installation of subsoil drains where required. Stormwater runoff from the stockpile will be treated in a sediment pond prior to discharge. The stockpile and associated stormwater treatment pond will be carefully designed and located to avoid wider impacts on the surrounding area.

### **5 Conclusions**

The proposed design for ARL is technically robust and is consistent with or exceeds the recommendations set out in the WasteMINZ Technical Guidelines.

The engineering designs for the landfill basegrade, final landform and associated containment and collection systems (leachate and LFG) are considered to be appropriate and will provide for the safe, long-term containment of waste while minimising environmental effects. The preliminary design of stormwater systems around the landfill provides for ongoing safe operation of the landfill over its lifetime to minimise potential adverse effects from stormwater discharges.

## 6 Applicability

This technical memorandum has been prepared for the exclusive use of our client WMNZ, with respect to the particular brief given to us, and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that WMNZ will submit this technical memorandum to the Environmental Protection Authority in support of a referral application under the Fast-track Approvals Act 2024 for the works described herein, and that the Environmental Protection Authority will rely on this technical memorandum for the purpose of assessing that application.

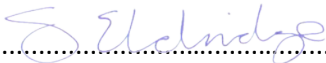
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