Clutha District Council

TECHNICAL ASSESSMENT OF AIR QUALITY EFFECTS

MT COOEE LANDFILL EXPANSION

27 APRIL 2023

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TECHNICAL ASSESSMENT OF AIR QUALITY EFFECTS
MT COOEE LANDFILL

Clutha District Council

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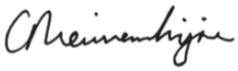
Reviewed by:	Cathy Nieuwenhuijsen Principal Consultant – Air Quality	27 April 2023	
Approved by:	Chris Fox Regional Project Director	27 April 2023	

TABLE OF CONTENTS

1 INTRODUCTION

Clutha District Council (CDC) operate the Mt Cooee Landfill (existing site) on Kaitangata Highway, on the outskirts of Balclutha. The site location is shown in Figure 5-1.

The landfill currently holds an air discharge consent (94510) that authorises the discharges of landfill gas (LFG) and dust to air until 1 October 2023. The landfill is currently nearing completion on the current fill area. WSP prepared a technical assessment of air quality effects report (*6-CO082.00-AQL-REP-001 Rev A*) to support a resource consent application under Section 124 of the Resource Management Act (RMA) to allow continued operation of this landfill. Where applicable, this report has been referred to as the *AEE for the existing site* in this document.

In addition to this, CDC is also seeking to submit an application for a resource consent to allow the expansion of the landfill to provide an additional fill volume of 320,000m^3 based on 35 years' demand (referred to as the *expansion site*). The application will also include the addition of an onsite waste transfer station and resource recovery centre.

WSP (NZ) Limited (WSP) has prepared this technical air quality assessment to support the resource consent application for the expansion site of the landfill.

2 SITE ACTIVITIES ON EXISTING LANDFILL

2.1 GENERAL

The Mt Cooee Landfill serves a population of approximately 17,550 and accepts around 8000 tonnes per annum of refuse from residential, commercial and some industrial customers primarily via CDC's kerbside collection service and rural waste transfer stations. The landfill is also open to the general public.

The existing facilities on the landfill include a staff building, a vehicle weigh bridge, staff and visitors' carpark area, a temporary storage building for hazardous waste, areas for rubber tyres, green waste, scrap metal, an ash pit, a liquid waste disposal area, leachate and stormwater ponds, an animal carcasses area (closed) and a tip face for general municipal waste.

The landfill is proposed to continue as per current operating hours, from Monday to Friday between 8.00 am and 4.30 pm and on Saturday and Sunday between 10.00 am and 4.30 pm.

2.2 WASTE TYPES

The landfill accepts around 8,000 tonnes of refuse per annum. The common waste types accepted on the landfill include:

- Municipal solid waste (MSW) of a domestic / household nature or from businesses and farms;
- Construction and demolition waste;
- Green waste such as lawn clippings, hedge clippings, leaves, tree trimmings, and garden weeds;
- Rubber tyres;
- Scrap metal;
- Household recycling
- Glass; and
- Septage and grease trap waste and occasionally other liquid organic wastes generated from food processing or nearby industries.

Hazardous wastes are generally not accepted at the Mt Cooee landfill. However, domestic, business and farm waste does, by nature, contain small quantities of hazardous wastes or special wastes. Hazardous and special wastes would normally constitute less than 2 % of the overall waste stream accepted at the landfill. Special wastes that require special measures in handling and disposal but are not necessarily hazardous (e.g., farm waste including animal carcasses[1]) are not

[1] WSP understands that this type of waste has not been received in the past year.

routinely accepted at the landfill but can be accepted with a Special Waste Permit approved under a licensing procedure through CDC.

The site currently does not accept large quantities of cleanfill material, contaminated soils, bulk loads of recycling material or any solid, liquid or gaseous hazardous waste that can be ignitable, explosive, corrosive, reactive, toxic, infectious or radioactive. Exceptions to this include treated timber, wood painted with lead-based paint, household batteries, electronic equipment and smoke detectors which are currently accepted within the general waste stream at the Mt Cooee site.

2.3 WASTE RECEIVING AND HANDLING

Waste receiving and handling varies depending on the type of waste. Under current operations for general waste (or refuse), all incoming vehicles (public cars as well as bulk load trucks) drive onto the tip face of the landfill and unload. For other waste types, including green waste, tyres and scrap metal; the incoming deliveries are directed to the dedicated areas of the site on top of capped landfill sections. There is a dedicated area for animal carcasses on site as they are classified as special waste; however, this area is currently closed, and in the last year the site has not received any such waste. Other special waste that requires isolated handling is septage or liquid waste, which is disposed by excavating pits into old landfill areas. Each pit is covered with old refuse or soil after each liquid disposal. Ash is disposed of in an isolated area to ensure hot ash doesn't lead to refuse ignition.

2.4 STORMWATER AND LEACHATE COLLECTION SYSTEM

Stormwater management on site aims to achieve a separation of water streams from clear/undisturbed areas on site and potentially contaminated areas on site. Stormwater flows from undisturbed areas are diverted away around the north side of the landfill and discharged directly to the Clutha River/ Mata-Au. There are two stormwater ponds on site that collect runoff from general areas within the site, with the exception of runoff from the active face of the landfill. A sediment-settlement time is allowed within the ponds before discharging into the Clutha River/Mata-Au. Run-off from the active face of the landfill is captured by leachate collection system. Regular water quality testing is undertaken to confirm level of contamination at several locations along the stormwater management network.

Liquid that leaches from the waste during its degradation process are called leachate. This is a combination of water and biosolids or toxic chemicals generated from the landfill waste. At the existing site, leachate produced at the active and closed landfill faces is captured by a leachate control system. This comprises of a drainage system to collect the leachate from the site and pump it to the council sewage treatment plant for further treatment. The site also has a 770 m^3 pond to provide emergency storage of leachate overflow. This pond is lined with a 600 mm layer of clay. From communication with site operators, WSP understands that this pond has not been used in the last ten years. Groundwater monitoring is undertaken around the site regularly to detect any leachate contamination.

2.5 LANDFILL COVER / CAPPED AREAS

The existing landfill at Mt Cooee site has been operating since the late 1990s and has several areas on the site that have been filled and capped. As the currently operating cells reach fill capacity, these will also be capped. The current requirements for capping the cells at the existing landfill include 200 mm of final cover over refuse, followed by 500 mm of compacted silt and 150 to 200 mm of topsoil.

Deposited refuse (solid and liquid) within the landfill actively goes through the waste biodegradation process for several years after being disposed. This results in a generation of landfill gas (LFG) that can have odour effects. Any produced LFG from the existing areas of the site is currently discharged through any capping to ambient air.

3 SITE ACTIVITIES ON PROPOSED EXPANSION SITE

3.1 GENERAL

The current landfill cells are near to their capacity and the existing consent (Ref: 94510) for discharges to air from the site is due to expire in October 2023. CDC propose to expand the landfill capacity and establish a more modern Class 1 landfill on the Mt Cooee site. For the proposed expansion site, the total landfill volume over a proposed life span of 35 years is estimated to be 320,000 m^3.

The proposed expansion site design has followed the current best practice for landfill design in New Zealand as provided by the Waste Management Institute of New Zealand (WasteMINZ), published in 2022. This has included site selection, design and operational parameters for a Class 1 Landfill as proposed for this site. A Class 1 landfill is defined based on types of acceptable wastes, requirement for a liner, and leachate collection system and requirement of landfill gas management (including requirements for flaring of all captured landfill gas).

The expansion of operation at the Mt Cooee site is expected to receive up to 9,000 tonnes of waste per annum. The waste types within these volumes are expected to be similar to the existing operation. CDC also propose the additional development of waste transfer station facilities and a resource recovery centre (RRC) at the Mt Cooee site.

The site layout of the proposed expansion of landfill at Mt Cooee site is shown in Figure 3-1 and details of the site are provided in the following sections.

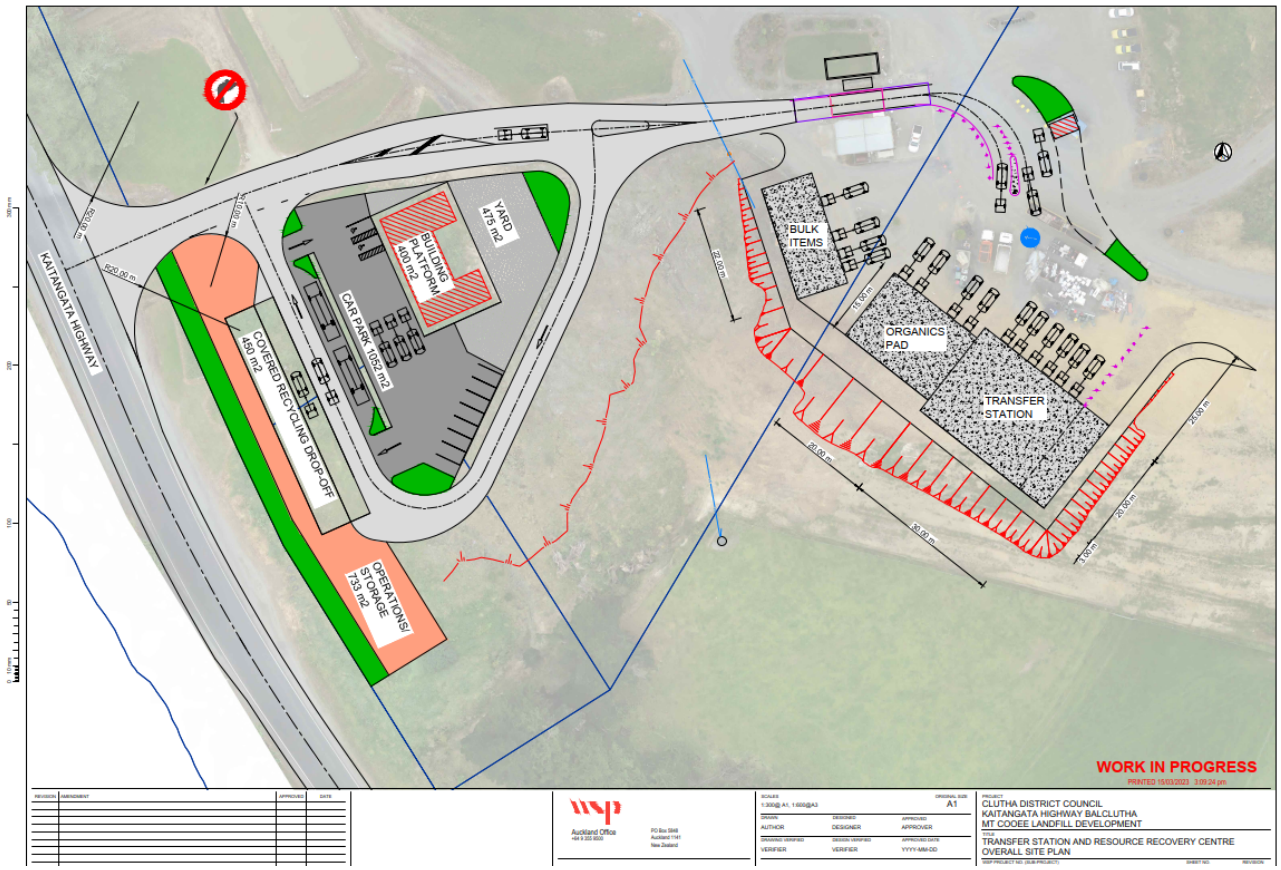


Figure 3-1: Mt Cooee Landfill – Site Layout for the proposed expansion (concept design).

3.2 LANDFILL CELL DEVELOPMENTS

To keep the footprint of the active face of the landfill to a minimum, the landfill will be developed in stages where the borrow area within smaller sub cells would be progressively mined out for landfill cover to create the base surface.

Figure 3-2 shows the landfill cells as proposed with three base cells and two additional cells built on top. The construction of these cells is proposed to commence 3 to 5 years prior to its use. In accordance with the WasteMINZ guideline for a Class 1 landfill, a geomembrane (1.5 mm HDPE geomembrane and engineered clay liner) or a composite (1.5 mm HDPE geomembrane, geosynthetic clay liner and engineering clay liner) lining system will be employed for all landfill cells.

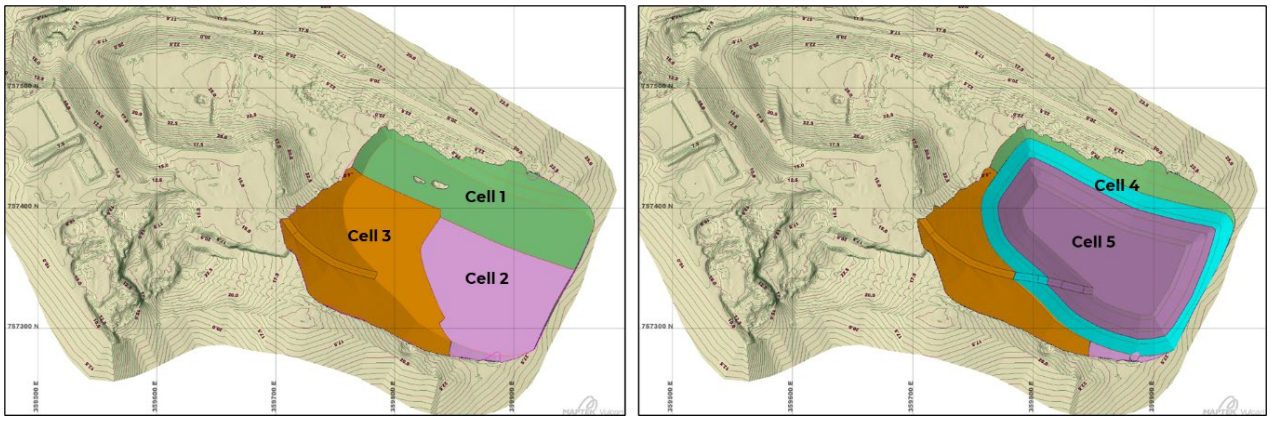


Figure 3-2: Cell stages (concept design).

Based on a design specified total fill volume of 11,000 m^3 per year (a combination of compacted refuse of 9,000 tonnes per annum and additional cover material), the indicative life of each cell, as a minimum, is estimated and provided in Table 3-1. The life of each cell can vary anywhere between 5 to 8 years.

Table 3-1: Cell Capacity (indicative based on concept design).

Cell	Cell capacity (m^3)	Life in years
1	59,200	5
2	62,200	6
3	79,400	7
4	69,200	6
5	50,400	5
Total	**320,400**	**29**

3.3 WASTE TYPES AND HANDLING OF WASTE

As stated in Section 2.3, at the existing cell on the Mt Cooee site, all drop-offs are directly at the tip-face of the landfill. However, this is not considered practical and cost-effective for the site and poses health and safety risks to public due to proximity to the refuse and operational machinery. There is also the potential for re-use or recovery of some of the waste brought onto the site.

Therefore, in addition to the expansion of landfill cells, CDC propose a covered waste transfer station is built on site, just after the weigh bridge. CDC have also proposed a covered materials recovery and recycling collection area (Resource Recovery Centre, RRC) to be developed immediately next to the site entrance adjacent to Kaitangata Highway.

The development of these two facilities will lead to the site being able to receive additional waste types and also segregation of waste under the classifications of landfilling, recycling, or re-use/recovery.

Any customers bringing in recycling would be directed to the RRC and would not need to go over the weigh bridge. The waste received within RRC could include glass, cardboard, scrap metals, plastics and goods for re-use, batteries, and electronic waste. These will be collected in specific collection bins within the RRC.

All other public drop offs of refuse will be received via the weigh bridge and into the waste transfer station, including waste paint and motor oil which will be disposed of in the Hazardous Materials area. Similar to current operation, kerbside collection trucks will go over the weighbridge and onto the active cell for tipping over the load.

The waste received within transfer station could include general waste (public drop-offs), green waste, tyres, gas cylinders, special waste (by permit), screened soil, timber, plasterboard, bitumen & asphalt, concrete (clean), bricks, tiles, re-useable building materials, food waste, hazardous waste, commercial organics and sweeper waste. The waste will be accepted in separate dedicated areas within the transfer station, including a dedicated area for organics. Contaminated soils and special wastes (such as liquid sludge) that meet the waste acceptance criteria as defined for Class 1 landfills by WasteMINZ (2022), including biosolids, will also be accepted.

General waste, special waste, contaminated materials and sweeper wastes will all be hauled to the active cell of the landfill multiple times a day. Divertible materials such as food waste and commercial organics, timber, building materials, concrete, bricks, tiles will be recovered where possible for re-use and taken off site. Any hazardous material will be appropriately segregated in an enclosed shipping container and processed off site.

An area is also set aside for stockpiling of green waste on the existing landfill. Green waste from the organics pad at the transfer station will be brought onto this area of the existing site. The green waste will either be taken off site for composting, or there may be shredding of green waste on a regular basis to make mulch for use as daily cover. No burning of waste or composting activities are proposed on site.

Special waste that requires isolated handling is septage, sludge or liquid waste. Subject to meeting the waste acceptance criteria, it is assumed that the landfill will accept spadable sludge (18-20 % solids). If liquid wastes are accepted, these will be dewatered onsite, with geobags to be used with the dewatered product landfilled. The liquid drainage from this process will be directed through the leachate collection system.

Animal carcasses and biowaste are also considered special waste and management procedures to ensure this and other odorous special waste is covered after disposal will be developed. Should any changes to the on-site processing of this waste be proposed, a further odour assessment will be completed.

3.4 STORMWATER AND LEACHATE COLLECTION

As per current operational procedures, it is proposed that the stormwater from undisturbed areas of the site will be discharged to the Clutha River/ Mata-Au without treatment. Stormwater from the access roads, open earthworks, borrow areas and landfill's intermediate cover will be directed to stormwater ponds and to a newly constructed manhole for further use for irrigation on site. Any stormwater from the active fill areas will be treated as leachate and connected to the leachate system.

The existing leachate collection system will be extended to the new cells and will be placed on top of the liners within the cells. The leachate stream will be carried to the existing pumpstation by gravity for further treatment at the municipal treatment plant.

The existing emergency leachate collection pond will be replaced with an overflow collection chamber and water from here will also be pumped to the municipal treatment plant.

3.5 LANDFILL COVER

The landfill cover system consists of daily, intermediate and final cover. In all cases, the recommendations from WasteMINZ 2022 will be employed on site.

Daily cover is applied at the end of each day and will consist of clay, topsoil or similar cleanfill material. The site may also shred the received green waste into mulch and use it as cover in combination with other materials.

Intermediate cover will be used to close off a cell once it reaches capacity. It is likely that this will consist of a compacted soil layer, along with green waste mulch.

The final capping for all cells will follow the below specifications as a minimum:

- 300mm of Compacted Soil ($K<10^{-7}$m/s)
- Geosynthetic Clay Liners
- 200mm Drainage layer
- 300mm Soil (Growth layer)
- 150mm Topsoil (Grassed)

At the end of its life, a final closure cover will be constructed, including construction of final stormwater, leachate and LFG control structures. Biosolids and shredded green waste may be used as part of the upper soil layers. These can provide nutrients for grass growth. Following closure and installation of final cap, the site will be progressively revegetated for the intended final use for recreational activities (walking, biking). Final capping and rehabilitation will be designed to ensure the final surface provides enough control for discharges of leachate and LFG.

3.6 LFG COLLECTION AND TREATMENT

As stated in Section 2.5, the old refuse (solid and liquid) under the capped/filled landfill areas actively goes through waste biodegradation process and results in a generation of LFG. Although there are no controls at the existing site and LFG is discharged directly to air, this is not considered to be best practice as direct discharges of LFG include methane which is a greenhouse gas, has health and safety risks due to being flammable and has the potential for air quality and odour effects.

The recently published NZ Emissions Reduction Plan (May 2022) requires that LFG from operating landfills is captured via a collection system and treated by flaring or energy generation. Therefore, CDC propose to capture the LFG from the expansion site using a gas collection system comprising of gas wells and trenches and network of gas conveyance pipes installed as new cells get built. The system is expected to capture LFG at a methane concentration that is typically in the range of 45 to 60 % (WasteMINZ 2022), which is considered to be conservative based on current landfill gas testing at the site indicating 34 % methane. CDC propose to investigate design options for flaring of the collected gas within five years of commencement of filling in the first cell on the expansion site. An indicative location of the flare is proposed to be on the existing site, away from the general use areas to avoid any health and safety risks.

4 NATURE OF DISCHARGES

4.1 ODOUR

The main discharge from the site is expected to be odour that may become noticeable offsite at locations that are downwind of the landfill, especially during calm to light wind conditions that lead to poor dispersive conditions.

Odour expected from general refuse, particularly decomposing organic waste have a rotten fruit/vegetable or dead/decaying animal like character and liquid septage waste that has an ammonia like character.

Odour associated with LFG that is not captured through the LFG collection system and instead vented naturally to air through the cover, is expected to be of hydrogen sulphide or rotten egg like character.

The location and scale of expected odour sources are discussed further below.

Onsite transfer station, and active face of the landfill:

Any general or organic waste received in the transfer station will be undercover and transferred to active face of the landfill multiple times a day. Based on there being a relatively low volume at this location a low intensity general rubbish type odour is likely to occur only within a few tens of metres of the transfer station. The odour character is similar to what would be at the active face of the landfill, that is described below.

The active face of the landfill receives waste from kerbside collection trucks as well as from the onsite transfer station regularly and is expected to have continuous low-moderate odour intensity and have a waste/decomposing waste like character associated with it.

The proposal is to keep the active area to a minimum and spreading and compacting the waste regularly. The active face is also covered with soil or mulch at the end of each day. If these areas are kept open for long (multi-day) durations, there is a potential for odours to be observed offsite.

Liquid waste dewatering location, leachate collection chamber, and pump station sump:

The odours associated with septage, and liquid waste dewatering may be unpleasant and experienced off site depending on volumes and the decomposition level of the waste. The drainage from dewatering process also will contributed to the leachate on site.

Leachate is collected in the leachate collection system and pumped through the pump station to the sewage treatment plant. The pump sump has the potential to be an odour source depending on the storage capacity and duration.

The leachate collection chamber for emergency use can also become odorous if the leachate is not pumped out quickly after use and becomes anaerobic.

LFG:

LFG primarily comprises methane and carbon dioxide and with trace levels of odorous compounds such as hydrogen sulphide (H_2S) and other reduced sulphur compounds. Due to a low odour threshold, reduced sulphide compounds can result in odour effects. The proposal is to capture as much LFG as practicable from all new cells and flare it.

The landfill design comprises of an LFG capture system to collect the LFG from all the new cells progressively as they are built. The maximum level of gas extraction efficiency achievable from landfills as stated in *Chapter 6 of The International Best Practices Guide for Landfill Gas Energy Projects (US EPA, 2012)* is in the range from 75 % in wet climates to 80 % in dry climates. According to the latest New Zealand greenhouse gas inventory[2], on average, the lifetime efficiency of LFG capture at open landfills as 68 % in New Zealand. However, given the smaller load at the Mt Cooee site of around 9,000 tonnes per annum, there may be periods when the capture efficiency is as low as 50 % owing to the possible coverage of wells to area and the economic implications of setting it up. Additionally, LFG collection and flaring may be feasible only after five to six years of landfill operation depending on the waste streams coming into the landfill.

Based on this, there is potential odour discharges due to LFG and mitigation and monitoring will be required.

LFG not captured will be managed similar to the current management practice on existing site, through capping that follows WasteMINZ guidelines, passive venting through the active fill area and intermediate capping. There is also minor potential for LFG release via the leachate collection system. LFG management and monitoring is discussed further in Section 8.

Other odour sources:

The general waste from kerbside collection is delivered using closed/covered trucks, therefore the potential for odour from the trucks is low except when the truck is opened and discharged to the active face of the landfill. The general public bringing in residential household and green waste, or small volumes of commercial waste, is expected to be brought in small quantities. Therefore, the potential for these transporting activities to result in significant odour emissions is also low.

Bulk loads of organic waste (or animal carcasses) are infrequent and are only received on site in agreed circumstances and are managed to minimise potential for significant odour emissions. Other waste types received on site such as ash pit, tyres and special wastes have a very minor potential to result in any odour that would be observable off site.

4.2 LANDFILL GAS (LFG) FLARE

LFG generated on site will be captured as much as practical and flared. There is a potential for discharges to air from combustion of the LFG through flaring. In order to estimate the volumes of expected LFG generation on site a USEPA emissions estimation tool – LandGEM[3] was used, based on an annual waste to landfill of 9000 tonnes/annum being assumed. Following on from the typical methane concentration within LFG as stated in Section 3.6, an average of 50 % by volume of total LFG was assumed to be comprised of methane. This is also a default value within the LandGEM model.

[2] New Zealand's Greenhouse Gas Inventory 1990–2019, at p. 377. Retrieved from https://environment.govt.nz/assets/Publications/New-Zealands-Greenhouse-Gas-Inventory-1990-2019-Volume-1- Chapters-1-15.pdf#page=401 (accessed 15 March 2023).

[3] Landfill Gas Emissions Model (LandGEM), Version 3.03, 2020 (XLS) (xlsm) (2.6 M)
Landfill Gas Emissions Model (LandGEM) Version 3.02 User's Guide, EPA-600/R-05/047 (PDF)(56 pp, 1.3 M, May 2005)

LandGEM user guide recommends use of inventory model parameters that are based on the emission factors in EPA's Compilation of Air Pollutant Emission Factors (AP-42) for use within air permit assessment works. Therefore, inventory default model parameters were assumed for the Mt Cooee site and are stated below:

- Methane Generation Rate: 0.04 k/yr
- Potential Methane Generation capacity, L^0 (m^3/Mg): 100

For the purposes of this calculation 100 % LFG capture has been assumed to provide conservative estimates for discharges to air from flaring of landfill gas. Figure 4-1 provides a trend in the average methane emissions as estimated for the Mt Cooee expansion site.

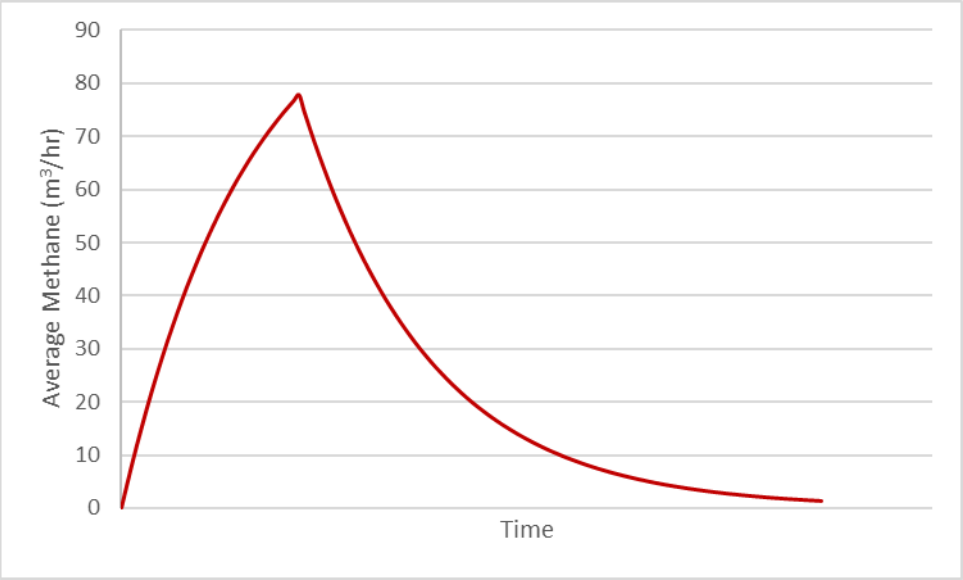


Figure 4-1: Trend in average methane emission rates associated with total LFG generation per year

Based on a calorific value for methane of 56 megajoules/kg and density of 0.67 kg/m^3, the calculated maximum energy generation potential of the LFG is 800 kW. This is a relatively small flare. Therefore, the discharges to air from combustion of LFG in a flare at the proposed site are expected to result in negligible ground level concentrations of air contaminants beyond the boundary, and therefore have not been further considered as part of this assessment.

Note that this assessment for flaring related discharges to air are based on 100% LFG recovery. However, as stated in Section 4.1 above, it is expected that up to 50 % LFG is not captured by the collection system and therefore will discharge to air as fugitive emissions from the landfill surface.

4.3 DUST

There is the potential for dust discharges from a range of activities on hot and dry days. These include:

- Construction of the onsite transfer station and recycling centre and earthworks associated with the development of new subcells,

  Any discharges of dust associated with road upgrades and earthworks associated with the landfill expansion fall under *Rule 16.3.14.1 of the Air Plan* as a permitted activity, providing any discharge of smoke, odour, particulate matter or gas is not noxious, dangerous, offensive or objectionable at or beyond the boundary of the property.

Based on the assumption that standard dust mitigation measures will be employed on site during earthworks, the dust effects associated with earthworks are considered to result in negligible offsite effects are unlikely to result in noxious, dangerous, offensive or objectionable discharges and therefore have not further assessed.

- Wind erosion from exposed surfaces and stockpiles of fill materials.

  The nature of material that is stockpiled on site as part of the daily cover material available is generally damp and in a stable pile that are not prone to wind erosion.

- Vehicle movements

  The site roads are unsealed gravel roads. Currently, the number of trucks coming into site each day are between 2 to 6 and the number of cars/trailer units can be up to 40. The proposal for the expansion site is to limit all vehicle movements to the transfer station only on sealed surfaces, except for kerbside collection trucks. Therefore, compared to current operation, a considerable reduction in vehicle movements on site is expected from this proposal. There are expected to be truck movements on site between the transfer station and active cell of the landfill a few times each day. The landfill enforces a speed limit of less than 20 km/hr on site. Other heavy machinery on site includes front end loader or excavator and compactor.

Overall, these activities are considered to have a very minor potential of dust and likely to be contained within site boundary provided standard dust mitigation measures are employed.

5 ENVIRONMENTAL SETTING

5.1 SITE LOCATION AND LAND USE

The Mt Cooee Landfill is located approximately 1.2 km southeast of Balclutha's town centre. The site is bounded by the Main South Railway Line to the north and north-east, the Balclutha to Kaitangata Highway to the west and south-west, and a rural residential property to the southeast. The Balclutha Golf Course is located across the railway line to the north and the Clutha River / Mata-Au is located to the west across the Kaitangata Highway. The immediate land use to the east and south of the site is primarily farmland. There is a motocross track to the west of the site across the Clutha River/ Mata-Au.

There are 78 residential dwellings within 500 m of the landfill site boundary. The closest residence (125 Kaitangata Highway) is located approximately 90 m to the site's south-eastern boundary and approximately 170 m to the proposed active areas of the site at the closest point. There are six residential dwellings located on Arthur Terrace, around 400 m to the northwest of the proposed transfer station.

Figure 5-1 shows the site location and surrounding environment.

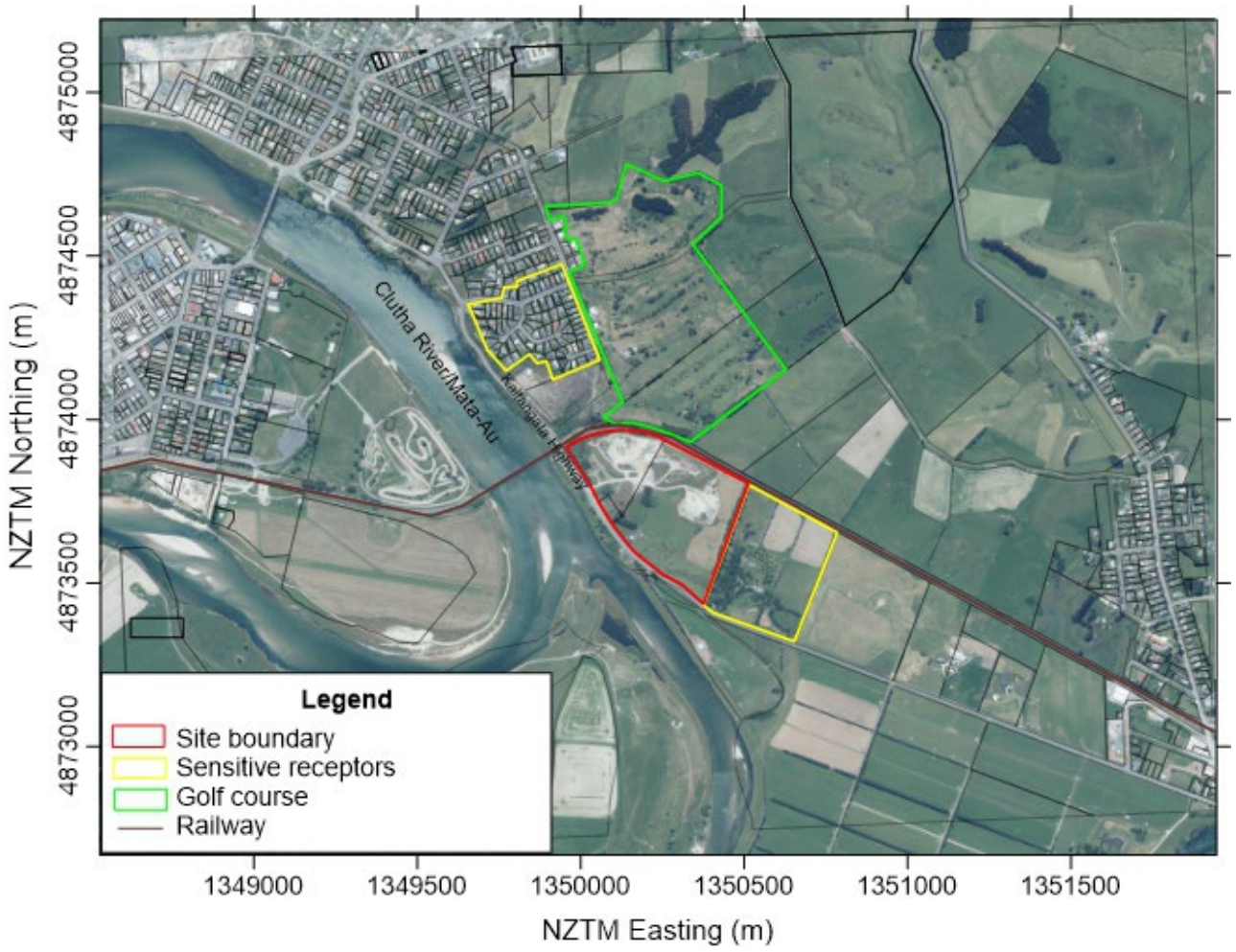


Figure 5-1: Site location and surrounding environment.

5.2 TERRAIN AND METEOROLOGY

The landfill occupies a shallow valley sloping towards the Clutha River / Mata-Au immediately to the south and west of the site and the township of Balclutha to the west of the site. The township of Balclutha lies on a generally flat land, with gently rolling hills to the north and to the southwest. The coast is approximately 13 km to the south and southeast of the site.

The local topography of the site influences the wind regime in the immediate vicinity. It is expected that during the night or early morning, low wind speed katabatic (air moving from high to low grounds, also known as drainage flows) flows of cooler air will tend to occur from the elevated areas north of the site, drifting in a south or south-easterly direction. These conditions direct airflow from the landfill across the Kaitangata Highway to the low land along Clutha River / Mata-Au and towards the coast.

The nearest weather station to the site is *Balclutha Telford EWS*, 5 km to the south of the landfill in the township of Finegand, where the terrain is also generally flat. Five years of hourly wind data from January 2016 to December 2021 was extracted from the NIWA Climate Database for this weather station.

This weather station is relatively close to the site and is expected to be broadly representative of wind patterns experienced at the site. A wind rose depicting the wind patterns in the region are presented in Figure 5-2. A seasonal wind rose and a wind rose varying with time of day are presented in Figure 5-3 and Figure 5-4.

The prevailing wind in the region is from the west to west-northwest (approximately 27 % of the total time) blowing generally down the Clutha Valley. Strong winds are mainly from the west and southwest and are more prevalent during the day, and during summer and spring seasons. Autumn and winter months, along with morning and evening hours tend to have more light winds blowing from northwest and southwest.

Calm conditions are rare all year around (around 2.3 % of the year) and winds from the southeast and northeast quarters are less frequent overall. During the night and in early mornings (between midnight to 8 am), the wind patterns are similar to those from the full dataset, except that there is a tendency for lower wind speeds at night and in the morning, when the north-westerly low wind speed flows are developed.

Drainage flow conditions occurring during early morning or night-time conditions are likely to result in minimal dispersion of any potential odours from the site and carry them towards low ground to the south or southeast of the site.

With regards to seasons, spring and summer typically have a much higher proportion of strong winds that would lead to relatively more active dispersion and dilution of any potential odour generated from the site compared to autumn and winter that are more characteristic of light wind conditions.

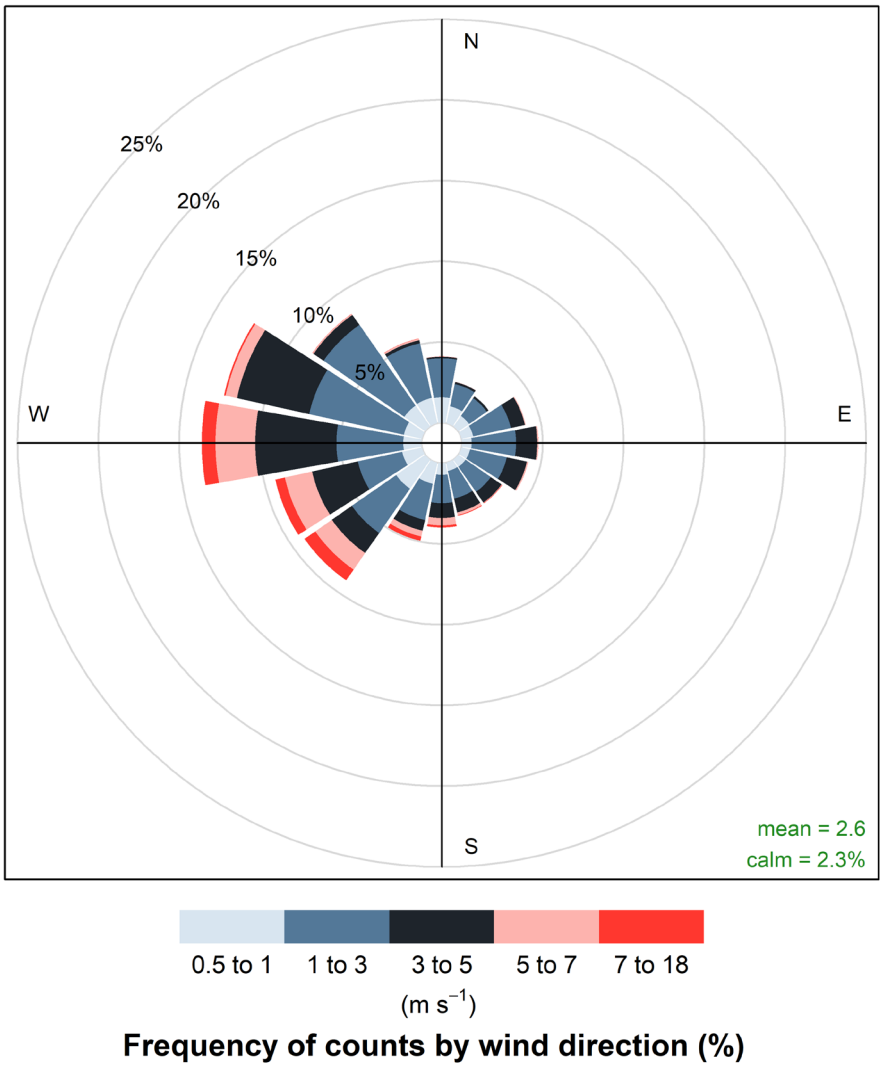


Figure 5-2: Wind rose based on hourly wind data from Balclutha Telford EWS for the period 2016 to 2021.

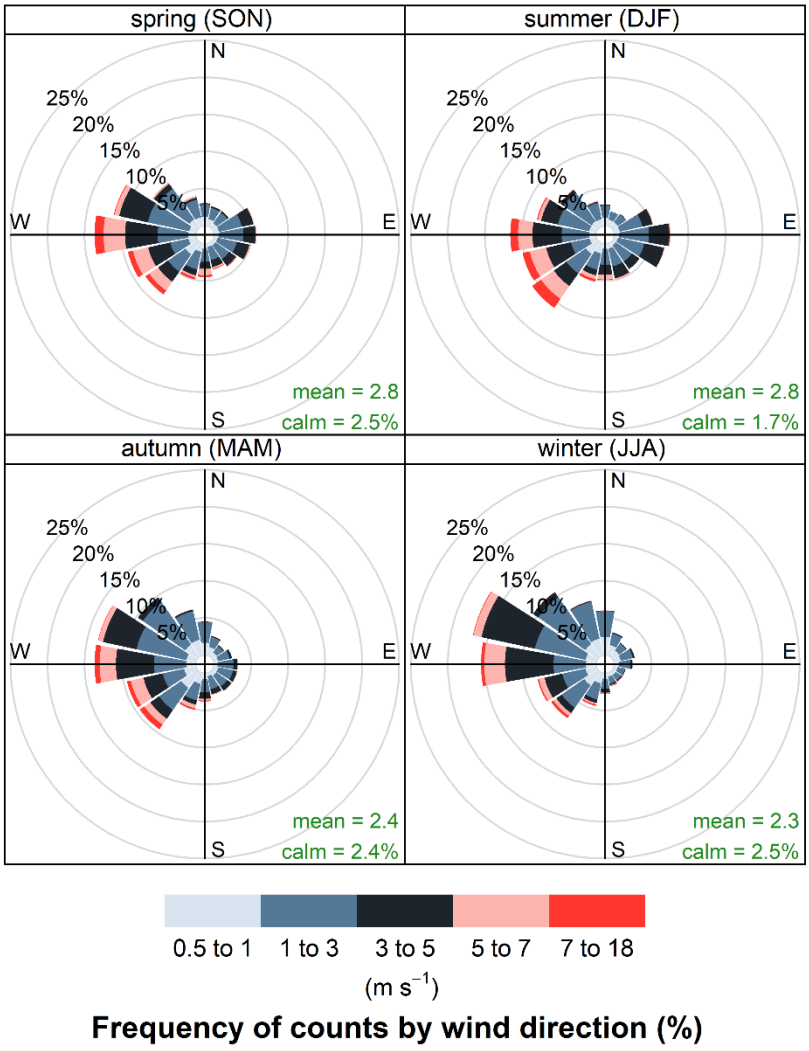


Figure 5-3: Seasonal wind rose.

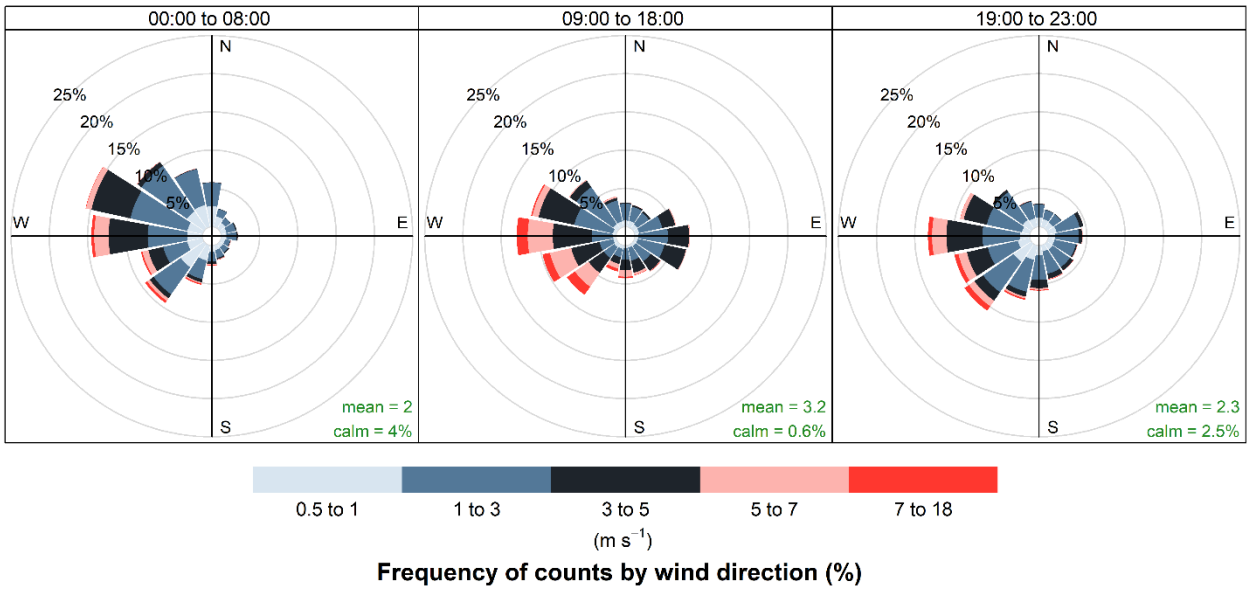


Figure 5-4: Wind rose for different times of day.

6 ASSESSMENT METHODOLOGY

6.1 GENERAL

Based on a review of nature of discharges, it was concluded that dust nuisance effects during construction of new site facilities and earthworks associated with the development of new cells fall under a permitted activity rule in the regional plan and can be controlled by following standard dust mitigation measures.

Based on the review of expected landfill gas and methane generation, the potential for any appreciable air quality effects associated with flaring of LFG is also likely to be very minor.

Odour associated with activities within the transfer station, active landfill areas, landfill gas and leachate collection system was identified as the primary pollutant of concern from a review of current and proposed site activities at Mt Cooee Site.

Therefore, the assessment tools and methodology has focused on odour effects from here on.

6.2 ASSESSMENT TOOLS

The Ministry for the Environment 'Good Practice Guide for Assessing and Managing Odour in New Zealand' provides guidance on the management of odour emissions from an industrial facilities and methods for assessing the likelihood that these emissions are likely to be objectionable or offensive to an ordinary person (MfE, 2016). It also states that whether an odour has an offensive or objectionable effect requires "an overall judgement that considers the frequency, intensity, duration, offensiveness/character, and location of the odour event". These are referred to as the "FIDOL" factors. Table 5 of the MfE (2016) guide describes a range of assessment techniques that indirectly account for FIDOL factors. It assigns a different priority to each technique, depending on whether the activity under consideration is an existing operation, an expanding operation, or a new operation. The priorities assigned by MfE (2016) to different odour assessment tools for an expanding operation are listed in Table A2.2 in Appendix 2 of MfE (2016). The tools include the use of information from following:

- Community consultation,
- Complaint records
- Industry/council experience
- Meteorology and terrain assessment, and
- Review of emission control systems/odour management plan.

The MfE (2016) assigns high to moderate priority to these tools, while a moderate to low priority is assigned to odour dispersion modelling assessment for modification to an existing activity. To establish the odour effects from the site, the assessment has been undertaken in a manner consistent with these recommendations by MfE (2016). The information collected using the tools, with consideration of FIDOL factors has allowed for an assessment of the extent of adverse impact on exposed people and whether or not this is likely to lead to an objectionable and/or offensive odour effect to be determined.

WSP staff visited the existing site and reviewed all site activities to identify potentially odour generating activities and their locations on the site. Trained WSP odour assessors also made odour observations downwind of the existing site, undertook a community survey and review of complaint records to determine the existing level of effects from this site. The methods used for undertaking downwind odour assessment are presented in Section 6.3. The questionnaire used during the community survey is provided with the AEE for the existing site. Complaint records (provided by Otago Regional Council) were also reviewed for this assessment.

Currently practiced and proposed future mitigation measures to reduce the potential for offsite odour effects were reviewed during the site visit and through a review of the recently prepared draft landfill management plan (WSP 2021) for the site. Experience at other sites of a similar nature, scale, and location, including consideration of appropriate separation distance were also used to consider any further required mitigation and what can be considered good practice odour management for landfills. Further details on the review of separation distance are provided in Section 6.4.

6.3 ODOUR DOWNWIND OBSERVATIONS

The odour downwind assessment method employed by WSP was in accordance with the approach recommended by the MfE guide. This approach utilises aspects of Verband Deutscher Ingenieure (VDI) standards[4] for ambient odour assessment. Undertaking fields surveys of ambient odour is an accepted method used to generate information on ambient odour levels over time at locations surrounding the site.

The VDI standard 3940 Part 2 (VDI 3940)[4] was utilised for recording odour intensity in the field (every 10 seconds) as per Table 6-1. This follows the intensity scale specified by VDI standard 3882 Part 1 (VDI 3882)[5] and also as recommended by MfE (2016).

Table 6-1: Odour intensity scale.

Intensity Description	Intensity Scale
Extremely strong	6
Very strong	5
Strong	4
Distinct	3
Weak	2
Very weak	1
No odour	0

4 VDI "Measurement of odour impact by field inspections - Measurement of the impact frequency of recognisable odours Plume measurement." 3940 (Part 2), February 2006.

5 VDI "Olfactometry - Determination of Odour Intensity" 3882 (Part 1) October 1992.

On 21 and 22 September 2022, WSP's trained odour assessors[6] undertook downwind odour assessment at nearby receptor locations while being downwind of the landfill site. Another set of downwind odour assessments were also undertaken on 16 November 2022. The downwind odour assessment recorded the character and intensity (as per Table 6-1) of ambient odour observed at every 10 seconds around the site for a ten-minute period. Assessments were undertaken at ten locations (by two assessors) on three separate days. Results are discussed in Section 7.1.4 of the report.

6.4 SEPARATION DISTANCE GUIDELINES

There is no New Zealand National or Otago regional guidance on separation distance for landfills or waste transfer facilities. While there are some regions in New Zealand with separation distance publications, in WSP's experience the Australian criteria provide an appropriate upper limit distance for determining the extent of potential offsite odour effects for large landfills with good practice management.

A review of separation distance guidance for landfills and waste transfer facilities was based on the following three Australian guidelines:

Victoria Environment Protection Authority (Vic EPA): *Best practice environmental management - Siting, design, operation and rehabilitation of landfills. August 2015 (Vic EPA 2015)*:

The Vic EPA published separation distance is 500 m measured between the edge of the landfill to buildings or structures for municipal solid waste landfills (a Type 2 landfill defined by Vic EPA). This distance also applies to residential dwellings to avoid LFG migration and adverse odour and dust effects. Vic EPA also advises that lesser buffer distances may be applied subject to a risk assessment that considers design and operational measures. No guidance on the size of landfill considered is provided.

Southern Australia EPA (SA EPA): *Evaluation distances for effective air quality and noise management (2019 version), March 2019 (SA EPA 2019)*:

The SA EPA buffer distance is 500 m from the landfills for sensitive uses (subdivisions) and 150 m for single residences. This criterion takes into account the fact that the LFG can cause odour effects and dust can be an issue due to vehicle movements, dusty waste and soil stockpiles. No guidance on the size of landfill considered is provided.

Western Australia EPA (WA EPA): *Separation distances between industrial and sensitive land use, June 2005 (WA EPA 2005)*:

The WA EPA buffer distance is 500 m for putrescible landfill sites when considering sensitive subdivisions. Putrescible wastes contain waste stream likely to become putrid, including municipal wastes. The guideline also notes a separation distance of 200 m from a waste depot, that is equivalent to the onsite waste transfer station in this proposal. No guidance on the size of landfill considered is provided.

The appropriateness of the above separation distances for landfills has been considered in this assessment, given that the adverse effects can be influenced by scale, and site-specific topography and meteorological conditions.

[6] A Kachhara and T Verhulst

7 ASSESSMENT OF EFFECTS

7.1 COMPARISON TO EXISTING SITE OPERATIONS

7.1.1 GENERAL

Comparison to existing site and using assessment of existing effects is valuable to some level for assessing the potential for odour effects from the expansion site. This is because there are similarities in waste types and some of the existing odour sources on site will continue operating for the expansion site.

Following the detailed assessment of effects undertaken as part of the AEE for the existing Mt Cooee site, the following are considered relevant for the assessment of effects for the expansion site:

- Onsite observations of active landfill areas, capped landfill areas, leachate and stormwater ponds, green waste area and general maintenance of the site.
- Community feedback and complaints review – to gauge the level of odour and dust nuisance in the surrounding environment caused by the operation.
- Downwind odour assessments – to assess the level of odour associated with the active landfill area in particular.
- Landfill gas discharges from capped areas on existing site

These have been summarised in the below sections with further details available in the AEE for the existing site.

There are also differences between the existing and newly proposed landfill design, including several design enhancements that reduce the potential for odour generation compared to the existing site. For example, the addition of onsite transfer station as part of the landfill expansion would mean that the movement at the active face of the landfill is significantly reduced. The waste tipping and compaction is likely to occur after delivery of refuse from kerbside trucks and when the waste from the transfer area is moved to the active cell, which is expected to occur a few times per day depending on the volume of incoming public drop-offs. The addition of transfer station and RRC on site will also reduce the amount of waste that goes to the active cell. It is understood that CDC aim to improve the waste recovery at this site and expect a reduction of 20 to 40 % that goes to landfill.

The addition of landfill gas capture and destruction system will lessen the quantity of LFG venting through the landfill capping on the new cells. This will result in a reduced odour potential. The capping material used for daily, intermediate and final cover follows the current industry standard recommended by WasteMINZ (2022) guidelines and provides a better method of containing any odour compared to the existing system. Therefore, the site will overall achieve lower level of odour generation provided the best practicable option is employed on site for mitigation and management of odours.

7.1.2 ONSITE OBSERVATIONS

Very weak to weak intensity odour was observed at most areas around the landfill and the odour character was mainly rotten fruit or food waste. No odours were observed close to the leachate pond, pump station or covered off areas, including areas where animal carcasses were previously landfilled. No odour was noticeable beyond 150 m from the tip face of the existing landfill at the Mt Cooee site.

The observations made during site visits confirm good management practice being employed on site with respect to the odour emissions and the relatively small size of the existing operation. The proposed expansion has similar waste types to the current operation and is also likely to be a more enhanced landfill design as stated in Section 7.1.1 and therefore, based on just the site observations, it is likely to result in similar or lower level of odour emissions; provided appropriate mitigation as in Section 8 are applied on site.

7.1.3 COMPLAINT RECORDS AND COMMUNITY FEEDBACK

Based on the information provided by Otago Regional Council, WSP understands that there have been no odour or dust complaints associated with the landfill during the last five years (2017 to 2022). WSP staff surveyed the nearest residents during their site visit to assist in understanding whether odour or dust from the landfill was noticeable or of concern for these neighbouring locations. The locations of these dwellings are shown on Figure 7-1. In general, the community feedback was positive about the landfill operation, as well as regarding the expansion of the landfill. There were no reports of odour or dust concerns during the survey. Based on the review of complaints records and community consultation, the existing level of odour and dust effect in the receiving environment arising due to the current landfill operation is very low.

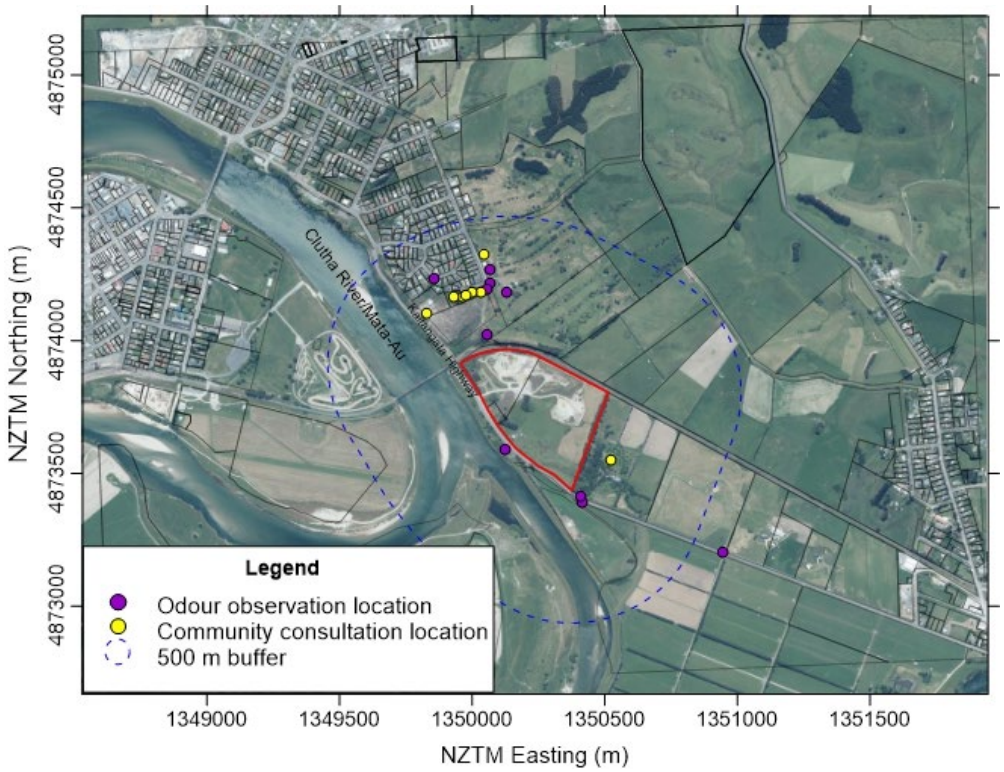


Figure 7-1: A separation distance of 500 m and locations of WSP's odour observation and community survey.

7.1.4 DOWNWIND ODOUR OBSERVATIONS

WSP odour specialists[6] undertook downwind odour observations during the site visit on 21 and 22 September. Another set of downwind odour observations was also undertaken on 16 November 2022. In total, 20 odour surveys were undertaken at ten locations that were identified to be downwind of the site. These locations are shown in Figure 7-1.

The results are described in detail in the assessment for existing Mt Cooee site. In summary the odour observations downwind of the site indicate there is a low frequency of observing very weak to weak intensity odours downwind of the landfill. The character of the odours observed was associated with those observed at the active face of the landfill.

Therefore, there is some potential for noticeable odour effects originating from the existing site. These odours are mainly associated with tipping of the waste at the landfill cell and compaction of waste every few hours as the disturbance of waste can result in release of odour from the waste.

The addition of onsite transfer station as part of the landfill expansion would mean that the vehicle movement and volume of material is reduced and therefore the waste disturbance at the active face of the landfill is reduced. Therefore, the general disturbance of waste will occur infrequently and thereby reduce the potential for odour discharge provided mitigation measures as in Section 8 are employed on site.

7.1.5 LANDFILL GAS MONITORING

Landfill gas monitoring is undertaken on the existing site on a quarterly basis inside the manholes at the active face of the landfill and the pump station sump. The monitoring includes detection of methane and H_2S concentrations. Although the other reduced sulphide compounds of the LFG are likely to be more odorous, H_2S is most practical to measure routinely and provides a good indication of the state of the LFG on site and thereby its potential to result in offsite odours. The latest quarterly monitoring report, provided in Appendix A, was reviewed for methane and H_2S results. Methane results were compared against Table 6.4 of Vic EPA that provide a concentration threshold that could be used as a trigger for further mitigation. The applicable limit for the measurement technique at Mt Cooee would be 10,000 ppm[7].

The results show very low concentrations of both methane (50 to 80 ppm) and H_2S (0 to 1 ppm) at both these locations compared to the Vic EPA threshold guideline values. As mentioned before, these measurements are undertaken within a manhole, below ground level to assess the LFG at source. Given the low concentrations at source, it is expected that the LFG concentrations in ambient air from the existing site will be negligible provided good mitigation measures as in Section 8 are routinely practiced. It is likely that the gas release from capped areas on existing landfill are low considering the waste is old and has released most LFG already.

Monitoring of new boreholes within the proposed cell location has shown no indication that landfill gas from the existing cell is migrating through the underlying geology and being emitted to air outside of the current cell. Results of gas monitoring completed on both existing monitoring points within the landfill and on new boreholes around the proposed cell are presented in the Appendix A along with a location plan of all monitoring points.

[7] Measurement at subsurface levels on and adjacent to the landfill site.

7.2 REVIEW OF SEPARATION DISTANCE GUIDELINES

A review of Australian separation distance guidelines indicates when there are sensitive receptors within 500 m of a solid waste landfill and within 200 m of a waste transfer station, a detailed investigation to confirm the level of adverse odour effects in the surrounding environment is appropriate.

These guidelines are based on larger landfills. In WSP's experience and based on a review of published assessment of odour effects for several other landfills, it is considered that a distance of 500 m is more applicable for landfills with waste receivables greater than 30,000 tonnes per year therefore a separation distance of 500 m is likely to be conservative for the site, given its smaller scale (receiving around 9,000 tonnes waste per year). For the waste transfer station, a smaller buffer of 100 m is considered more appropriate for this site, given the low volumes and short timeframes of waste storage within these areas on site. Therefore, any odours from the waste transfer station are expected to be of a very weak intensity and only infrequently observed beyond the site boundary.

As mentioned in Section 5.1, there are around 78 residential dwellings within this distance from the Mt Cooee Landfill. Figure 7-1 shows a map with a separation distance of 500 m. The existing effects assessment shows a less than minor potential for odour effects at the locations within this buffer from the site boundary provided good mitigation practices are in place. To assess the potential for odour effects or change in risk of odour potential, a review of local meteorological and terrain effects was undertaken for nearby receptors under relevant wind directions. Results are presented in the following section.

7.3 LOCAL METEOROLOGICAL AND TERRAIN EFFECTS

Meteorological data obtained from Balclutha Telford EWS was examined in Section 5.2 and shows the predominant wind patterns and their distribution through the daytime and through different seasons. The assessment identifies prevailing westerlies and west-north westerlies which persist through the year. Wind speeds less than 0.5 m/s occur for approximately 2.3 % of the time and are expected to result in downslope drainage flows from the site to the south to south-southeast towards the coast. These low wind speed conditions minimise the dispersion of odour and thereby can result in elevated odour levels at locations downwind from the site at distances beyond 250 m even. The winds are also expected to be of light to moderate wind speeds in the region thus readily dispersing the odour on most days.

The key wind directions that result in one or more of the sensitive receptors being downwind of the site are north-westerlies (1 house adjacent to the landfill), southeasterlies (multiple houses to the north-northeast of site) and south-southwesterlies (golf course).

The minimum distance of these locations to proposed active cells and frequency of wind directions for which these are likely downwind of any of the proposed active cells at the expansion site are summarized in Table 7-1. To assess the change in odour risk for these receptors, a comparison of these potential future separation distances to those separation distances using the location of the active face on the existing site.

Table 7-1: Percentage of time in a year, sensitive receptors are downwind of the active cells of the landfill.

Wind Direction when Sensitive Locations Downwind of the Site	Closed Landfill Cell on:	Minimum Distance to Landfill Cell (M)	Percentage of Time Downwind of Landfill (%)	
			All Wind Speeds	Wind Speeds Between 0.5 and 1 M/S
Northwest (on Kaitangata Highway)	Existing site	500	26	5
	Expansion Site	170	26	5
Southeast	Existing site	250	10	1
	Expansion Site	400	6	1
South to southwest (golf course)	Existing site	50	20	4
	Expansion Site	100	20	4

The nearest residential dwelling to the site boundary, located on Kaitangata Highway is currently 500 m to the southeast of the current active face of the landfill. As the active face moves to the expansion site, the distance could be as low as 170 m between the dwelling and the active face of the landfill[8]. It is downwind of the site during predominant westerly and north-westerly winds. This dwelling is likely to be the most sensitive to the potential odour effects due to the landfill expansion.

The overall frequency that this receptor is expected to be downwind of the site is expected to be the same as for the current operation. In light wind (less than 1 m/s) and thereby poor dispersive conditions, the dwelling could be downwind of the site for around 5% of the year (see Figure 5-2). This dwelling is likely to miss being impacted by any site odours during drainage flows as it is typically to the southeast of the site.

Residences to the northwest of the site (shown in Figure 5-1) are expected to be downwind of the existing site in light south-easterly wind conditions for up to 1% of the year (10% overall). The frequency of being downwind of the active fill areas is lower for the expansion site. The distance to the active face has also increased compared to the current operation and this is expected to result in a lower potential for odour exposure.

The golf course is likely to be downwind of the site during light south to south-westerly wind conditions for 4% of the year. The golf course also operates only during the day, whereas the light wind conditions are more likely to occur during night-time or early mornings. Therefore, the visitors of the golf course are not expected to be downwind of the site very frequently. Similar to the residential dwellings to the northwest of the site, the golf course is not expected to be downwind in cool air drainage flows. Overall, the landfill expansion is expected to result in a lower potential for odour exposure for the golf course users.

[8] This assessment considers effects within 20 m from the façade of the existing dwelling and assumes no further dwellings can be built at 125 Kaitangata Highway.

7.4 SUMMARY OF ASSESSMENT OF EFFECTS

All the proposed waste types and areas on the Mt Cooee landfill expansion site were assessed for the potential to result in adverse odour effects in the receiving environment around the Mt Cooee site. The assessment was based on a review of proposed site activities as well as current and further recommended management/monitoring practices, the receiving environment, meteorology and terrain effects, industry experience, field odour observations and review of community feedback for existing level of effects.

The proposed landfill expansion has enhanced design elements compared to existing landfill, including:

- a covered onsite refuse transfer station,
- resource recovery centre,
- addition of base liner,
- Leachate and landfill gas collection system that are in line with the industry best practice for a Class 1 Landfill,
- Best practice landfill capping/ cover
- Landfill aftercare and maintenance program

These enhanced design elements effectively mitigate the potential risk of odour generation from the expansion site, which as a result is expected to be a similar risk or lower risk than the existing site. The assessment of odour effects due to the existing site operation concluded that there was a less than minor risk of offsite odour effects.

Except for the nearest dwelling to the southeast of the site, the expansion of the landfill will move landfill operations further from sensitive receptors. The dwelling to the southeast is approximately 170 m of the nearest potential odour sources on the expansion site and downwind during low wind speed (low dispersion) conditions up to 5% of the time. This location is considered to the be the most sensitive to current and proposed landfill activities.

As set out in Section 8, the design and management improvements are expected to reduce the potential for odour emissions and therefore the potential for offsite effects compared to the existing landfilling activity. The key mitigation measures are around capping and landfill gas capture and destruction through flaring. If these are employed on site as described in Section 3 and 4 and per the recommendations in Section 8, the improved mitigation measures are expected to result in a similar or lower level of offsite effect at all but the most sensitive receptor. At the most sensitive receptor, a slightly higher level of odour exposure is expected from the proposed expansion.

8 MITIGATION, MONITORING AND MANAGEMENT

8.1 MANAGEMENT PRACTICES

The main potential sources of odour at the expansion site include:

Waste received at the transfer station

Kerbside truck drop-offs at the active landfill cell

Open and active landfill cells

Location where dewatering of liquid waste occurs

LFG generated from waste degradation

Special waste (contaminated soils, biosolids animal carcasses etc)

At the existing site, management of the active face and other waste disposal areas, capping of the filled material and leachate management are the primary odour mitigation methods. These standard mitigation measures will also be applicable to the proposed expansion site. Key procedures for these are as follows:

The refuse is spread to achieve around 0.5 m of thickness and compacted several times a day. At the end of the day, it is covered with a layer of topsoil or clay in combination with mulch. As the active face is a potential odour source area, keeping the open fill area to a minimum and covered daily is a primary mitigation measure to preventing occurrences of offsite odour effects.

Green waste deliveries will be managed to reduce potential anaerobic conditions, which will minimise the odour potential. For example, where large volumes of lawn trimmings are delivered, they will be turn/blended with other waste materials.

Any delivery of highly odorous waste including special waste is only accepted by prior arrangement to allow the site to ensure that the material can be covered immediately with sufficient cover or refuse.

When the active cell is completely filled, the process followed for intermediate and final capping of the landfill includes specifications as per the WasteMINZ (2022) guideline for Class 1 landfills and described in Section 3.5 of this report. It is recommended that capping of a finished cell is undertaken within 6 months of final refuse placement. Any capping materials that have potential for odour discharges (e.g., biosolids, manure etc,) need to meet Waste Acceptance Criteria (WAC) set by WasteMINZ (2022) for Class 1 landfills and should be evaluated prior to application to ensure that odour potential is minimised. Evaluation and application procedures should be documented in site management plan.

Any leachate collected from the active fill area, dewatering location and other areas on site is pumped off site routinely for further treatment at the Balclutha's sewage treatment plant. Procedures around leachate management from different areas on the site should be accounted for in the site's management plan. The pump station operation, volumes and level of leachate in the ponds are inspected every day. After a period of heavy rain, the leachate levels are checked and pumped out of site as necessary to avoid accumulation on site. The pump station sump is not

expected to be a significant source of offsite odour. However, if post operation it is identified as an odour source, then an extraction and treatment of odour through a biofilter could be considered.

Dewatering location should be chosen so it is close to the leachate collection system to ensure that the drainage from the dewatering process is transferred quickly to the system. It should also be flushed regularly to ensure dewatering leachate cannot go decompose within the leachate collection system.

The capping of landfill cells is designed so that, once the landfill is closed, the land could be repurposed for grazing or recreational activities. WasteMINZ (2022) guideline for final cover for Class 1 landfill as specified in Section 3.5 of this report should be followed. Monitoring of LFG should continue during and after closure works to confirm the level of performance of the control systems in place. WasteMINZ (2022) has stated a typical aftercare period for Class 1 Landfills to be 30 to 50 years. This is considered reasonable at this stage, but if the monitoring shows a considerable reduction in contaminant concentrations, this period may be reduced.

8.2 LFG FLARE

For the flare, the following is recommended:

1. The LFG collection and destruction system must be designed, constructed and operated to minimise the potential oxygen ingress into the landfill waste and maximise the rate of extraction of LFG.
2. All collected LFG should be flared to minimise direct discharge of LFG to air.
3. The flare should be located at least 100 m from any nearby sensitive receptor location and no visible emissions are apparent from the flare.
4. The following parameters must be continuously monitored at the inlet to the flare:
    a. Gas flow rate (m^3/hr)
    b. Suction Pressure (mb)
    c. Methane (%v/v)
    d. Carbon dioxide (%v/v)
    e. Oxygen (%v/v)

    And any other parameters required to determine the destruction efficiency.
5. In the event of an ignition failure of the flare due to system failure or if methane concentration within the LFG is insufficient for the gas to successfully flare, LFG can discharge from the flare and result in odour effects beyond site boundary. As a control for this, it is recommended that the flare system is equipped with failsafe control measures that efficiently terminate LFG supply once system failure is detected. Ignition failure or flare failure alarm should provide a signal to the site management to alert the need for prompt action to avoid release of LFG. Procedures and responses will be documented in the site's management plan.

8.3 LANDFILL GAS MONITORING

There is potential for LFG discharge to ambient air from capped areas of the existing site. Therefore, it is recommended to continue LFG monitoring at the boreholes and capped surface inspections on existing site.

For the proposed expansion site, the addition of LFG collection and destruction by flaring is likely to keep the LFG discharges to air at a minimum. However, as previously mentioned there is still potential for LFG passive venting through the landfill covers on the expansion site. It is therefore recommended that LFG monitoring is undertaken at various locations around the site.

8.4 GENERAL MONITORING METHODS

The site has several monitoring methods in place to proactively manage any potential for odour discharge from the site. These include:

- Daily site inspections, including inspections of active fill area (extent and size of the active face), leachate drains, ponds, special waste areas and general inspection
- Daily checks for odour at the Kaitangata Road gate and at the kiosk
- If odour is noticeable at any locations around site, scout around the fill itself to see if there is any obvious source/cause
- Use the weather forecasts and known wind flows to time any potentially odour releasing operations.
- Preparedness to apply additional cover on the active fill area in the form of stockpile on the tip face.
- Maintain surface drainage away from the active tip face.
- Do not allow leachate to pool on the fill surface. If necessary, excavate pits to break through any sealing layers that are preventing drainage.

WSP recommends that these monitoring and management methods are maintained for the proposed expansion site to keep odour discharge potential to a minimum.

9 CONCLUSION

CDC operate Mt Cooee landfill in the outskirts of Balclutha. Discharges to air from the landfill are currently authorised by consent that is due to expire in October 2023 and CDC wish to apply for a consent for an expansion of the operation of the current landfill with design modifications to align with current industry best practice for Class 1 landfills (WasteMINZ 2022). WSP has undertaken a technical assessment of air quality effects for the landfill based on a concept design to support the resource consent application.

The main discharges to air from the proposed landfill expansion are odour and to a much lesser extent, dust and combustion products from the proposed LFG flare. These latter two are considered to result in negligible offsite effects, subject to the proposed good practice mitigation being implemented.

This assessment has focused on potential for odour effects and has followed the MfE (2016) guideline to assess the effects from the proposed landfill expansion. It has included a review of current and proposed site activities, assessing the existing level of odour effects associated with the current operation, a review of local meteorology and terrain effects, and recommended design specifications including mitigation and management of landfill to limit odour emissions. Should any changes to the on-site processing of waste (e.g., composting) be proposed as part of the expansion, a further odour assessment will be required.

Subject to site management being maintained, particularly with regard to the regular capping (daily, intermediate and final), landfill gas capture and destruction, recovery of waste (and thereby reducing overall fill to landfill), and the good practice monitoring being continued, the expansion of the Mt Cooee Landfill is expected to have less than minor potential for causing adverse odour effects at all but one offsite location. Additionally, the expansion of the landfill, with associated design improvements is expected to result in a lower potential for offsite odour effects compared to the current landfill operation. For the nearest sensitive receptor location, similar or elevated odour effects compared to the current landfill operation are expected, due to the smaller separation distance to the active landfill face.

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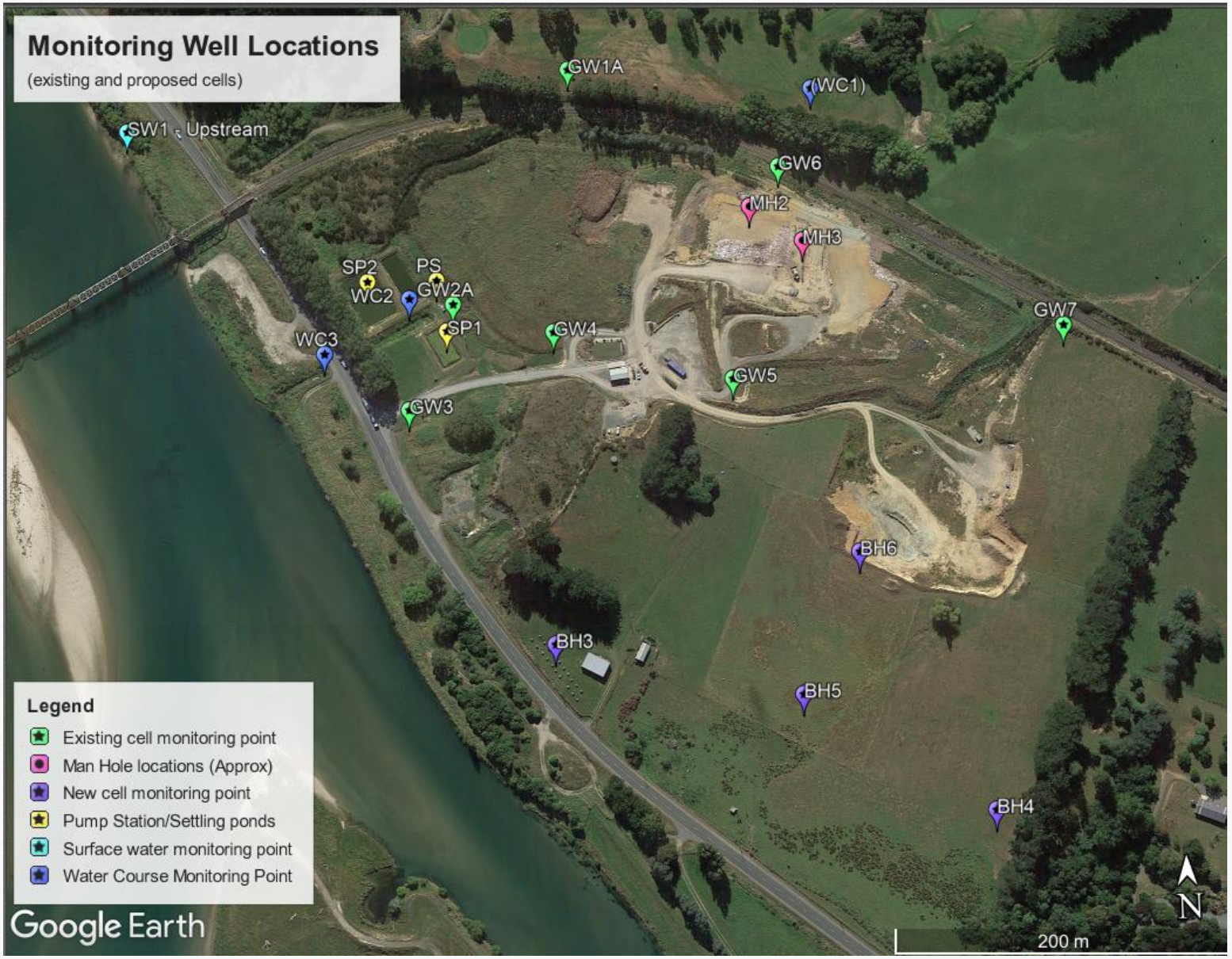
APPENDIX A

LANDFILL GAS MONITORING LOCATION PLAN AND RESULTS


Monitoring Well Locations
(existing and proposed cells)
GW1A
WC1)
SW1 - Upstream
GW6
MH2
MH3
SP2
PS
WC2
GW2A
SP1
GW4
GW7
WC3
GW5
GW3
BH6
BH3
BH5
BH4
Legend
Existing cell monitoring point
Man Hole locations (Approx)
New cell monitoring point
Pump Station/Settling ponds
Surface water monitoring point
Water Course Monitoring Point
Google Earth
N
200 m

Mt Cooee Landfill
Landfill gas analysis GA5000
24-25 January 2023

Well	Well number CDC	Date	Time	Depth to water (mbTOC)	Depth to bottom well (mbTOC)	CH_4 %	CO_2 %	O_2 %	CO ppm	H_2S ppm	Bal %
BH01	E1350037 N4873816	24/01/2023	10.32 - 10.34	3.21	11.80	0.1	0.1	20 - 19.9	0.0	0	79.9
BH02 / GW1	E1350241 N4873977	25/01/2023	13.58 - 14.00	2.97	4.48	0.0	12.3 - 13.4	9.7 - 7.4	0.0	1	78.7 - 79.1
BH03	E1350133 N4873639	25/01/2023	13.29 - 13.31	2.85	3.00	0.0	0.8 - 0.1	19.6	0	1	79.7 - 80.2
BH04	E1350395 N4873539	25/01/2023	13.14 - 13.16	4.33	5.07	0.0	0.1 - 0.4	19.9 - 19.5	0	1	80.0 - 80.1
BH05	E1350277 N4873605	25/01/2023	13.24 - 13.26	1.66	1.66	0.0	0.0	19.6 - 19.5	0	1	80.4 - 80.5
BH06	E1350313 N4873695	25/01/2023	13.20 - 13.22	3.11	3.11	0.0	0.2 - 0.1	19.6 - 19.7	0	1	80.3 - 80.2
GW2A	-	24/01/2023	11.33 - 11.35	1.82	6.3	0.0	0.1	21.1 - 21.0	0	0	78.8 - 78.9
GW3	-	24/01/2023	12.21 - 12.23	3.43	6	0.0	0.0	21.2	0	0	78.8
GW4	-	24/01/2023	16.29 - 16.31	5.66	8	27.5 - 29.5	12.5 - 12.7	11.9 - 11.6	0	6 - 7	48.5 - 46.0
GW5	-	24/01/2023	15.40 - 15.42	5.88	11	0.0	0.0 - 0.1	21.1	0	0	78.8
GW6	-	24/01/2023	14.02 - 14.05	4.97	11	0.1 - 0.0	0.1 - 0.0	20.7	0	0	79.2 - 79.3
GW7	-	24/01/2023	13.09 - 13.11	3.50	5.95	0.0	0.0	20.0 - 19.8	0	1	80.0 - 80.2
MH2	-	25/01/2023	13.42 - 13.44	-	-	19.3 - 13.5	14.1 - 9.9	13.4 - 15.3	0	3	54.0 - 60.8

Note: MH3 has recently been moved approximately 30m north-west of the previous location. As the top of the manhole was approximately 2m above ground level, gas analysis was not carried out due to H&S considerations. Sign of MH3 has been placed at MH2!

Mt Cooee Landfill
Landfill gas analysis GA5000
9 March 2023

Well	Well number CDC	Date	Time	Depth to water (mbTOC)	Depth to bottom well (mbTOC)	CH_4 %	CO_2 %	O_2 %	CO ppm	H_2S ppm	Bal %
Background		9/03/2023	9.3			0	0.1	21.0	0	0	78.9
BH01	E1350037 N4873816	9/03/2023	9.31-9.35	3.21	11.80	0	0.1	21.0-20.9	0.0	0	79.0
BH02 / GW1A	E1350241 N4873977	9/03/2023	11.31-11.35	2.97	4.48	0.0	0.1-17.0	21.2-5.0	0.0	0-1	78.7-78.0
BH03	E1350133 N4873639	9/03/2023	11.03-11.07	2.85	3.00	0.0	0.7-0.2	20.6-20.9	0	0	78.6-78.9
BH04	E1350395 N4873539	9/03/2023	10.44-10.48	4.33	5.07	0.0	2.3-0.1	20.0-21.1	0	0	78.0-78.8
BH05	E1350277 N4873605	9/03/2023	10.56-11.00	1.66	1.66	0.0	0.0	20.9-20.8	0	1-0	79.1
BH06	E1350313 N4873695	9/03/2023	10.50-10.54	3.11	3.11	0.0	0.1	21	0	0	78.9
GW2A	-	9/03/2023	11.20-11.24	1.82	6.3	0.0	0.1	21.0-20.9	0	0	78.9-79.0
GW3	-	9/03/2023	9.42-9.46	3.43	6	0.0	0.1	20.9	0	0	79.0-79.1
GW4	-	9/03/2023	9.47-9.51	5.66	8	34.4-31.3	15.8-14.1	14.0-10.3	6-8	0-1	42.5-40.0
GW5	-	9/03/2023	10.22-10.26	5.88	11	0.0	0.1	21.3-21.4	0	0	78.6
GW6	-	9/03/2023	10.28-10.32	4.97	11	0	0.1	21.3	0	0	78.6
GW7	-	9/03/2023	10.38-10.42	3.50	5.95	0.0	0.1	21.1	0	0	78.8
PS		9/03/2023	9.37-9.41			0.0	0.1	20.9-20.8	0	0-1	79
MH2		9/03/2023	9.53-9.57			18.4-17.7	14.3-13.8	14.7-14.2	2	1	52.7-55.3
MH3		9/03/2023	10.05-10.09			11.8-11.1	8.1-7.6	17.9-17.1	0	1-0	62.6-64.4
TMH	-	9/03/2023	10.31-10.35	-	-	0	0.2	21.1	0	0	78.6-78.7

Note: MH3 has recently been moved approximately 30m north-west of the previous location. Sign of MH3 has been placed at MH2!