BEFORE A HEARINGS PANEL APPOINTED BY THE OTAGO REGIONAL COUNCIL

IN THE MATTER OF	the Resource Management Act 1991 ("the Act" or "the RMA")
AND	
IN THE MATTER OF	An application RM23.185 by Dunedin City Council for the continued operation and closure of the Green Island Landfill, Dunedin

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STATEMENT OF EVIDENCE OFMR JAMES COLIN ELLIOTT ON BEHALF OF OTAGO REGIONAL COUNCIL

21 February 2025

INTRODUCTION

1 My name is Mr James Colin Elliott.

2 I am a Technical Director at SLR Consulting, where I have worked since 2020. I have almost 25 years experience in environmental consulting. I have worked on a number of landfill sites in a variety of roles including design of landfill elements (e.g. liners, caps, landfill gas (LFG) and leachate collection systems); environmental management and assessment of landfills; LFG risk assessments; expert support for Audits of landfill operations and design; expert witness for closed and operating landfills; groundwater, LFG and leachate assessments and more.

3 My academic qualification is Bachelor of Environmental Engineering, Royal Melbourne Institute of Technology University, 2004.

4 My professional memberships are:

(a) Member of Engineers Australia (EA).

(b) Member of the Australasian Land and Groundwater Association (ALGA).

(c) Member of the Australian Contaminated Land Consultants Association (ACLCA).

(d) Member of the Waste Management & Resource Recovery Association Australia (WMRR).

5 My professional accreditation is Construction Quality Assurance for Geosynthetic Materials and Compacted Clay Liners, Geosynthetics Certification Institute (2015).

Fields of Expertise and Experience

6 My expertise and experience in landfills relevant to the Briefs (see paragraph 10) encompasses the various stages of the landfill “life-cycle” including; design, construction and auditing of landfills; management and auditing of operating and closed landfills; capping and closure of landfill sites; investigation of leachate and landfill gas (LFG) emissions at and from operating and closed landfills; assessment of risks of harm from landfills; and management and remediation of landfills.

7 I have also undertaken training courses relevant to landfills, in particular:

(a) Landfill construction quality assurance (delivered by TRI Environmental).

(b) Ground gas assessment and management (delivered by Steve Wilson and Geoff Card who authored Wilson et al, 2007 (see paragraph 13) on behalf of Australian Contaminated Land Consultants Association (ACLCA)).

8 The following is a description of some of the landfill projects I have contributed to, with an explanation of my role, relevant to the Briefs:

(a) Independent technical reviewer for management plans provided to support the proposed extension of AB Lime Landfill, Browns, Southland, NZ. I reviewed and provided comments on the management of landfill gas, leachate and landfill operations.

(b) Design lead for landfill cap design and rehabilitation for confidential multi celled landfill in Wellington, New Zealand.

(c) Expert witness in a case about the aftercare of a closed landfill, particularly in relation to the landfill cap, landfill gas, leachate and stormwater management at a confidential former landfill in Melbourne, Vic.

(d) Expert witness in a case related to a proposed residential development adjacent to a large operating landfill at a confidential site in New South Wales, Australia.

(e) Technical expert support in relation to landfill gas for an expert witness appearing in a dispute between a landfill operator and nearby resident in relation to landfill gas migration in Melbourne, Vic.

(f) Preparation and review of landfill risk assessments and aftercare management plans for various closed landfills including Lyncadle landfill, Rosebud landfill, Cosgrove landfill and Myrtleford landfill in Victoria, Australia.

(g) Review and approval of risk management and monitoring program for Maddingly Brown Coal landfill in Maddingley, Victoria, Australia.

(h) Contribution to and technical lead for parts of the environmental management plan for the Western Soil Treatment facility in Maddingley proposed as the repository for spoil from the Westgate Tunnel construction.

(i) Design lead for a landfill gas collection and treatment system at the closed Violet Town Landfill.

(j) Design lead for a leachate riser rectification program at the operational Melbourne Regional Landfill in Ravenhall.

(k) Engineering design lead as part of design team for landfill caps including an engineered cap at the Hallam Road Landfill in Hampton Park and phytocap at the Stawell Landfill.

(l) Concept design lead for landfill management systems (i.e. liner, cap, LFG and leachate) including rehabilitation of existing cells and design of new cells to accommodate a road tunnel and associated St Peters freeway interchange at the Alexandra landfill in Sydney NSW.

(m) Assessment of landfill gas and leachate impacts from the closed Watt Street landfill Thornbury including leading the field investigations and reporting in collaboration with the project director.

(n) Auditor assistant for the Audit of landfill design and construction at the former Boral cement kiln dust landfill at Waurn Ponds.

(o) Expert support for Environment Auditors in relation to landfill operations audit and management for landfill operations audits at Hanson Landfill in Wollert, Melbourne Regional Landfill in Ravenhall and SBI Landfill in Cranbourne.

SCOPE OF EVIDENCE

9 I have prepared this report, on landfill design and management at the Green Island Landfill (GIL, the Site), located at 9 Brighton Rd, Green Island, Dunedin 9018, New Zealand, following instructions received from Otago Regional Council (ORC).

10 This report has been prepared as part of SLR's engagement by ORC to conduct a technical review of the resource consent application for the operation, expansion and closure of GIL. The content of the application includes the resource consent application and subsequent attachments, request for information (RFI) responses submitted by Dunedin City Council (the applicant, or DCC).

11 The applicant is proposing to extend the life of the site to allow acceptance of waste until sometime between December 2029 and March 2031, following which closure operations and landfill aftercare will commence.

12 In December 2022 I was engaged by Otago Regional Council (ORC) to undertake a technical review of Landfill Design and Management (LDM) aspects of the submitted application documents provided by Dunedin City Council (DCC) for the Green Island Landfill (GIL).

13 My evidence addresses the Landfill Design and Management (LDM) of the Green Island Landfill. Specifically, the following aspects:

(a) Proposed landfill cap,

(b) Leachate management,

(c) Landfill gas (LFG) management,

(d) Stormwater management, and

(e) Landfill fires.

14 This report is prepared in response to the formal instructions I have received from ORC and builds upon previous technical memorandums I have prepared as listed in paragraph 16.

Documents Reviewed and Relied Upon

15 I have reviewed a number of documents in the preparation of this report, listed as follows.

(a) Boffa Miskell Limited, Green Island Landfill Closure, Assessment of Environmental Effects, Dated March 2023. Referred to herein as the AEE.

(b) GHD Limited, Waste Futures – Green Island Landfill Closure Design Report, Dated 29 September 2023. Referred to herein as the Design Report.

(c) GHD Limited, Waste Futures – Green Island Landfill Closure Surface Water Report, Dated 7 March 2023. Referred to herein as the SW Report.

(d) Stantec New Zealand, Green Island Landfill, Development and Management Plan, Dated September 2023. Referred to herein as the LDMP.

(e) Tonkin and Taylor Limited, Landfill Gas Masterplan, Green Island Landfill, Dated September 2023. Referred to herein as the LFG Masterplan.

(f) Tonkin and Taylor Limited, Green Island Landfill, LFG Management Letter Report, Dated 21 September 2023. Referred to herein as the LFG Letter.

(g) GHD Limited, Fire Management Plan, Green Island Landfill, Dated 13 March 2023. Referred to herein as the FMP.

16 I have also prepared two technical memorandums on the matter, listed as follows.

(a) SLR Consulting New Zealand, RM23.185 - Green Island Landfill Design and Management Technical Review, dated 5 December 2023. Referred to herein as the 2023 LDM Memorandum.

(b) SLR Consulting New Zealand, RM23.185 - Green Island Landfill Design and Management Technical Review Memorandum 02, dated 24 October 2024. Referred to herein as the 2024 LDM Memorandum.

17 I have also reviewed the following responses to a Section 92 request for information, listed as follows.

(a) Boffa Miskell Limited, Green Island Landfill Closure, Assessment of Environmental Effects, March 2023 (Updated October 2024). Referred to herein as the updated AEE.

(b) Dateless and unnamed PDF document without letter head with the filename “Question 11 Response” provided to SLR by Shay McDonald of ORC on 10 October 2024. Referred to herein as Question 11 Response.

(c) Dateless and unnamed PDF document without letter head with the filename “Question 12A response” provided to SLR by Shay McDonald of ORC on 10 October 2024. Referred to herein as Question 12A Response.

(d) Dateless excel file without letter head with eleven worksheets with filename “MASTER_RM23.185 GILF RFI Jan 2024-Tranche5-6.xlsx” provided to SLR by Shay McDonald of ORC on 10 October 2024. Referred to herein as DCC Comments Response Spreadsheet.

(e) Dateless PDF document without letter head titled “Green Island Landfill Closure – Draft ORC Conditions of Consent” provided to SLR by Shay McDonald of ORC on 10 October 2024. Referred to herein as Existing Consent Conditions.

(f) Dateless and unnamed PDF document without letter head with the filename “LDMP Recommended Changes” provided to SLR by Shay McDonald of ORC on 10 October 2024.

(g) GHD Limited, Waste Futures – Green Island Landfill Closure Surface Water Report – October 2024 Update, Dated 18 July 2024. Referred to herein as the updated SW Report.

(h) Tonkin and Taylor Limited, Green Island Landfill - Landfill Gas Risk Assessment, Tonkin & Taylor Ltd, dated July 2024 (Ref: 1008787.5010 v2.0). Referred to herein as the LFGRA

18 In giving my evidence, I have primarily considered the following guideline:

(a) Waste Management Institute of New Zealand (WasteMINZ), 2023. Technical Guidelines for Disposal to Land, September 2023, WasteMINZ.

19 In addition, where additional guidance was required (e.g. in the absence of local guidance), I referred to guidance from other jurisdictions, in particular;

(a) UK EA, 2004. LFTGN 03 – Guidance on the management of landfill gas. September 2004. United Kingdom: Scottish Environment Protection Agency and Environment Agency of England and Wales.

(b) EPA Vic 2015. Best Practice Environmental Management, Siting, design, operation and rehabilitation of landfills. Publication 788.3, August 2015. EPA Victoria.

(c) EPA, 2018b. Landfill gas fugitive emissions monitoring guideline. Publication 1684, February 2018. EPA Victoria.

Assumptions

20 The following assumptions apply to the information provided herein.

(a) Discussion with respect to potential adverse human health and environmental effects associated with water and air discharges from the landfill are understood to be covered by other technical experts. Other expert reports should be read in conjunction with this expert report.

(b) The entire contents of the documents listed in paragraphs 15 and 17 were not necessarily reviewed.

(c) A detailed analysis of LFG modelling, LFG pipe sizing, HELP modelling etc. was not undertaken, and models were not rerun as part of this review.

(d) The design elements considered in this review are considered to be conceptual designs at this stage and are subject to detailed design at a later date.

CODE OF CONDUCT STATEMENT

21 While this is not an Environment Court hearing, I nonetheless confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023.

22 I am satisfied that the matters which I address in my evidence are within my field of expertise. I am not aware of any material facts that I have omitted which might alter or detract from the opinions I express in my evidence.

LANDFILL ENVIRONMENTAL HAZARDS

23 This section provides some high level information about landfill environmental hazards to assist the reader to understand the LDM items discussed in this report.

24 Landfills can pose a risk to the environment via a number of environmental hazards. Of particular importance to this evidence related to LDM at GIL are the environmental hazards associated with landfill gas, leachate and landfill fires. A very high level summary of each is provided in the following to assist the reader.

25 Leachate is liquid that is generated by or has come into contact with waste. Examples of leachate include rainfall that infiltrates the waste mass and liquid generated through the breakdown of organic material in the waste mass. Leachate can be contaminated with various compounds and chemicals that can impact the environment. Hence, controls to reduce the potential for leachate migration into the environment are important elements of landfills. Controls can include things such as cell liners, leachate interception systems, active leachate extraction, landfill caps, and stormwater management systems to reduce the volume of rainfall contacting waste.

26 Landfill gas is generated by the breakdown of organic material in the waste mass, converting material into a combination of primarily carbon dioxide and methane gas. Methane and carbon dioxide can present a risk to humans and the environment, including as a greenhouse gas, if not adequately managed. Management of LFG typically includes active extraction and conversion to an energy source or destruction of methane via a flare.

27 There are two general types of fires at landfills. Deep-seated fires, which occur in the waste mass, and are typically caused by spontaneous combustion in the waste mass, ingress of oxygen into the waste mass, build up of methane and hot loads in the buried waste. The other type is surface fires which occur above ground and can be from a variety of sources (as could occur at other operational waste and industrial sites),but are becoming increasingly common due to the disposal of lithium ion batteries.

28 Landfill, fires can present a possible safety hazard, potentially produce toxic smoke and odours and can be difficult to extinguish. Inspections and management of incoming waste, waste placement and compaction, LFG management (refer paragraph 26), a fire management plan and monitoring can help to reduce the likelihood of landfill fires, both at the surface, and deep-seated fires.

29 The report herein details my assessment of the following attributes of the proposed landfill extension and rehabilitation, in relation to the three key sources of environmental hazards discussed in the preceding paragraphs, i.e. leachate, LFG and landfill fires;

(a) Landfill rehabilitation,

(b) Leachate management,

(c) Landfill gas management,

(d) Stormwater management, and

(e) Landfill fires.

BACKGROUND CONTEXT

30 The proposed / designed infrastructure and management approach is described in the LDMP, and as such are not repeated here.

31 As provided in paragraph 16, I have previously prepared two technical memorandums in relation to LDM at the site.

32 It is acknowledged that the landfill has been accepting waste since the 1950's, and pre-dates current landfill guidance including the WasteMINZ Guidelines. Some of the existing engineering controls do not conform to current guidance e.g. there is no engineered liner or leachate collection system on the landfill floor. This is a significant constraint for older landfills, including the site.

ASSESSMENT

33 The following subsections are reflective of my view in relation to the LDM at the site and my reviews detailed in the 2023 and 2024 LDM Memorandums.

Landfill Rehabilitation

34 As detailed in the 2023 and 2024 LDM Memorandums, the landfill closure concept design is generally considered appropriate, notwithstanding the following.

35 The final landfill cap grade includes areas with a grade of 2%, which is well below the minimum grade called for in WasteMINZ of 5%.

36 It is understood that this area of 2% grade covers only a portion of the landfill, estimated to be about 2.5 ha of the total 8 ha of filled area. Whilst it is only a portion of the landfill, 2.5 ha is still considered to be a significant area, and equates to over a quarter of the cap area.

37 The intent of a minimum cap grade is to promote surface water runoff, and to provide some redundancy against flat spots where water can pool in the event of localised settlement due to waste breakdown.

38 It is noted that the landfill does not include a significantly deep waste mass (relative to other landfills where a 5% minimum would be applicable also), and it is understood that the waste mass does not include a significant volume of organic material where waste breakdown and associated localised settlement would be as common relative to some other landfills.

39 To that end, I am of the view that 2% grade should be made steeper where possible, although if 5% can not be achieved this may be acceptable pending the overall area of shallower grade, and the minimum grade that is achievable.

40 It is understood that with some minor contouring, 4% grade may be possible as the minimum grade for the cap. I would support a minimum cap grade of 4% pending confirmation of exact details of landfill cap grades, including extent of areas less than 5%, and proposed ongoing management of the cap to prevent occurrence of flat spots where surface water can pool.

41 In addition to cap grade, there are some other aspects of the landfill cap that required additional consideration where the requirements and/or possible optional items detailed in WasteMINZ were not met or included.

42 This included the absence of a piggy back liner beneath future waste, and the absence of a geomembrane in the final cap. Based on my understanding of impacts to the environment, and the measures proposed for the LDM, the overall design and materials proposed are considered acceptable, as detailed in my 2024 LDM Memo. I

do not consider that a piggyback liner at the base of future waste placement, or a geomembrane in the cap are required.

43 In the 2023 LDM Memo I had raised queries about the thickness of materials in the proposed landfill cap. Based on information provided subsequent to the 2023 LDM Memo, I understand that the proposed cap profile will be (from top to bottom):

(a) 350 mm topsoil.

(b) 600 mm low permeability clay.

(c) 300 mm compacted intermediate cover soils.

(d) 200 mm soil cover.

44 I consider the capping profile above to be acceptable, and recommend that this be implemented, and design documents updated to include this detail.

Leachate Management

45 Some parts of the landfill have leachate head of 10 m or more. It is acknowledged that due to the age of the landfill, and the guidance at the time, a base liner and leachate collection system were not incorporated into the landfill design. Therefore, it is difficult to manage leachate levels in the waste mass, and to address the WasteMINZ Guidelines objective to “minimise head of leachate above the liner”.

46 It is noted that a draft condition (condition 9) of the leachate discharge license allows for a leachate head of 12 to 16 m on a geotechnical (slope stability) basis. Whilst slope stability is a priority, a leachate head derived based on the geotechnical stability may not necessarily be protective to the surrounding environment e.g. groundwater.

47 Despite being within the allowable 12 to 16 m, a 10 m leachate head is considered to be significant, and is not in line with WasteMINZ Guidelines. There is no active extraction of leachate at the site. The Design Report states that active extraction from the existing LFG wells is an option for leachate removal. It is recommended that leachate is actively pumped from the waste mass, on a trial basis as a minimum, to assess if extraction can reduce the leachate head in the cells, and in turn reduce the potential for leachate migration offsite to occur. A reduction in leachate head at the site would also be expected to improve the LFG collection rates (see section below on Landfill gas Management).

48 Any active leachate extraction, including a trial, should be based on a thorough understanding of the landfill, and take into account any effects the extraction may have

at the site, such as fate of removed leachate, potential for increased LFG generation, possible rebound of leachate after extraction etc.

49 Further to the above, the Design Report refers to extracted leachate being transferred to the perimeter leachate collection system and ultimately the Green Island Waste Water Treatment Plant (GIWWTP). It is recommended that any leachate actively extracted from the landfill is transported to the GIWWTP via enclosed drains that do not allow for potential loss of leachate to the environment.

50 The proposed horizontal leachate collection drains in the waste mass, where waste will be placed atop the existing waste mass, are considered appropriate and should be used wherever possible to help improve leachate removal and therefore reduce leachate head within the waste mass. During my inspection of the site on 5th February 2025 I observed the presence of one horizontal leachate collection drain near the south end of the landfill. This drain should remain operational for as long as possible, and additional drains added where it is reasonably practicable to do so.

51 Remedial measures to address the leachate seepage from the eastern culvert should be implemented at the earliest opportunity to reduce potential for more leachate seepage from the waste mass. It is understood that this is planned to occur in the first half of 2025.

52 The LIT (also referred to as the leachate trench or leachate collection trench) allows for mixing of leachate and groundwater within the trench. This increases the volume of leachate. The mixing of leachate with other water types, including groundwater, should be avoided, although it is noted that this is not entirely avoidable in the LIT.

53 Regardless, the LIT appears to provide a preferred flow path for leachate where it can be extracted and sent to the GIWWTP. This is expected to reduce the volume of leachate entering the water table, which would be expected to reduce the impact of leachate on the surrounding environment. Therefore, whilst the mixing of leachate and groundwater should be avoided, the use of the LIT to reduce potential impact of leachate on the surrounding environment is considered to be acceptable. This is of particular importance given the absence of a liner and leachate collection system at the base of the landfill.

54 Furthermore, the extension of the LIT as proposed in the application is considered appropriate to further reduce the potential for leachate migration offsite. Draft condition B4 requires the LIT extension to be completed within 3 years of the of the issue of the resource consent. The extension of the LIT should be subject to detailed design, in particular noting that the existing design drawings provided in the application show;

(a) A direct connection between leachate and groundwater.

(b) The materials to be placed on either side of the trench following excavation are not defined.

(c) The horizontal component of the trench extends into existing waste.

(d) The trench is founded in the natural underlying geology.

(e) The existing trench is understood to include a High-density Polyethylene (HDPE) layer, and it's unclear if this will be incorporated into the LIT extension.

55 An updated GW Report, SW Report, and Human Health and Environmental Risk Assessment (HHERA) has been prepared.

56 Whilst detailed review of those documents is outside the scope of this report, it is understood that these assessments indicate that;

(a) There may be leachate indicators in the deeper groundwater aquifer and further monitoring/assessment of the deeper aquifer is required; and

(b) Whilst the HHERA concluded that a low risk to humans and the environment existed in relation to potential contamination of the Kaikorai Stream and underlying aquifer from landfill leachate, there were limitations to the dataset used as the basis for the HHERA.

57 Following the above, further assessment of the potential for leachate to impact groundwater and surface water should be undertaken to assess the effectiveness of the LIT in preventing impacts to the environment, and to inform if additional measures to manage leachate are required.

Landfill Gas Management

58 The leachate level in the waste mass is more than 10 m above the base of the landfill in some areas. Leachate build up within the waste mass would be inhibiting the generation of LFG and would also be expected to be reducing the effectiveness of LFG wells where leachate is present at a level above the base of the LFG well. A reduction of leachate levels would be expected to increase LFG generation rates and may improve LFG collection efficiency also.

59 It is also noted that the LFG utilisation and treatment systems (engine and flare) have significant downtime. This results in the landfill having extended periods of lower capacity for LFG utilisation/treatment. The maximum recorded LFG flow was 493 m3/hr

in January 2021, which exceeds the capacity of the flare and the engine if one was operating without the other. Furthermore, the maximum future predicted LFG collection rate is over 800 m3/hr, which exceeds the capacity of the flare and engine operating together. It is therefore surmised that;

(a) Even with the relatively low LFG collection rates, the system could potentially have extensive periods where treatment capacity is less than the LFG capture rate due to regular downtime of the flare/engine.

(b) If the capture rates improve (as predicted in the LFG Masterplan), the above issue will be exacerbated further.

(c) If LFG collection rates improve to predicted rates (i.e. 80% capture), the treatment capacity, even if both the engine and flare are operating at full capacity, will still not be sufficient.

60 The above is expected to become more critical if the LFG generation rates increase over time, which the LFG Masterplan predicts will occur. It is noted that the installation of a replacement flare has been “discussed”. It is recommended that treatment capacity is increased to ensure that all captured LFG can be treated, even during periods of downtime of the flare/engine, and that treatment capacity is sufficient for the expected increased capture rates in the future.

61 It is understood that existing wells in areas where waste is to be placed will be extended over time to the top of final waste height. This is supported, although noting that wells that are located in operating areas are at risk of damage from landfill operations (e.g. waste placement and compaction), as well as from settlement. The detailed design of such wells will need to account for this hazard.

62 Furthermore, consideration must be made to ensuring that LFG can be captured throughout the full vertical profile of placed waste i.e. where wells are extended upwards, slotted pipework should be used to ensure sections of the waste mass aren’t “cased off” from LFG collection.

63 The exact timing of installation of new LFG extraction wells is not clear. Typically, this would be done at the time that waste reaches final height. The period in which areas of waste are without LFG extraction capability should be minimised. It is recommended that more detailed timing of LFG well installation compared to waste placement in each area is provided, to provide an understanding of waste volumes that may be left untreated.

64 The LFG Masterplan considers the use of horizontal LFG wells for LFG collection. However, the LFG Masterplan recommends that horizontal LFG wells are not installed due to the “sporadic nature of filling and the varied waste depth”. Whilst it is agreed that horizontal wells may not be as effective in this type of landfill, they may still provide some collection capacity in areas where LFG may remain uncollected for a significant period of time whilst the waste mass reaches full height. During my site visit of 5th February 2025, DCC advised that horizontal LFG collection wells will be incorporated into the LFG collection system.

65 It is noted that the consent condition 24 for the draft discharge of landfill gas consent allows for 5,000 ppm as a trigger level for surface emissions through the final cap. It is noted that there is no trigger value specified in WasteMINZ or other local guidance. However, other jurisdictions have trigger levels as low as 100 ppm for final cap. It is recommended that a more conservative value, such as 1,000 ppm, be adopted as a trigger value in this instance, particularly given the potency of methane as a greenhouse gas.

66 Furthermore, where this value of 1,000 ppm is exceeded, remedial works should be undertaken to prevent emissions at the respective location, and the area re-monitored to confirm that the remedial works were successful.

67 It is noted that Advice Note below consent condition 25 of the draft discharge of landfill gas consent provides details of target weather conditions for LFG monitoring. It is recommended that monitoring of surface emissions and subsurface geology target falling or low atmospheric pressure conditions also.

68 It is noted that the consent condition 10 for the draft discharge of landfill gas consent requires LFG wells be installed within 2 yrs of waste placement ceasing in each stage. Two years, on top of the time underlying waste has already been in place could allow for a significant time period of LFG generation to occur without any active LFG capture. It is recommended that LFG wells are installed sooner than 2 years after final waste placement, and additionally, that stages are filled at the earliest opportunity, and where possible prior to moving to different stages, to ensure that large volumes of waste are not left generating gas without any active LFG extraction.

69 Since the issue of the 2023 LDM Memo, a LFGRA has been undertaken and is documented in the LFGRA report. The LFGRA concludes that; "This assessment has identified that the risk of lateral migration impacting current adjacent site users is considered to be negligible to low risk. The main factors influencing this assessment are the low permeability of the natural materials underlying and surrounding the landfill,

and the shallow groundwater level. These features will limit the ability for the LFG to migrate beyond the site boundary."

70 The reviewer agrees that shallow groundwater and low permeability natural soil will limit the lateral migration of LFG through the subsurface. However, further information, in the form of an updated LFGRA would be needed to support the conclusion of a low to negligible risk, including, but not limited to, consideration of the following;

(a) It is acknowledged that the LFGRA is not intended to be a monitoring report, however it still needs to be informed by a robust data set. Additional data and assessment of data quality is warranted, including;

(i) Additional LFG monitoring parameters should be recorded to help inform the assessment of risk, including LFG bore flowrate, relative pressure, depth of water in the bore (this is particularly important given presence of shallow groundwater, and should be measured after LFG bore parameters have been monitored), atmospheric pressure trend and fugitive emissions. It is noted that the report states that "flow data was not typically captured", however it is unclear where and when flow data was recorded as the data set indicates no flow data was ever recorded.

(ii) Details of LFG gas bore monitoring methodology and equipment.

(iii) An assessment of the validity of the LFG monitoring data should be included, including consideration of equipment calibration, equipment operation in the field (e.g. zeroing transducers), peak and stabilised readings, details and suitability of bore construction and integrity etc.

(b) Provision of figures showing location of relevant items to this LFGRA. In particular;

(i) LFG bores and offsite receptors.

(ii) A conceptual site model figure articulating the LFG migration pathways and receptors.

(c) The report states that the risk assessment is based on CIRIA 665, however the risk matrix appears to differ from CIRIA 665. The LFGRA methodology should explain the reasoning for variation from the adopted guidance.

(d) The risk evaluation (Table 5.4 in the LFGRA) provides details of receptor groups, pathways, and assessment of risk. However, the actual hazard and potential consequence if the hazard occurred are not detailed.

(e) Notwithstanding the above, the highest consequence applied to any hazard is medium. CIRIA 665 refers to "chronic" impacts to humans equating to a medium consequence. However, impacts from the main constituents of LFG i.e. methane and carbon dioxide, are typically acute (i.e. explosion or asphyxiation). CIRIA 665 defines acute impacts as a severe consequence.

(f) The LFGRA appears to be limited to humans in buildings offsite. The report does comment that onsite receptors are not considered as ”these risks are managed through the operation of the landfill”. It is recommended that onsite receptors are still considered in any assessment of risk, particularly given the proximity to the source of LFG. Furthermore, it is unclear why other receptors were not considered, such as flora and fauna, infrastructure, the atmosphere etc.

Stormwater Management

71 Runoff from intermediate cover areas is not clearly defined in the documentation. The SW Report indicates that areas of intermediate cover are treated as leachate. However, the LDMP indicates that intermediate cover runoff can be considered as sediment laden water (which is interpreted to mean “stormwater”) that can be discharged to the environment via a sedimentation pond. The Design Report indicates that runoff from some areas of intermediate cover will be treated as leachate, and from other areas will be treated as stormwater. The classification, and fate, of runoff from intermediate cover areas should be confirmed and be made consistent across all application documents.

72 There is reference to runoff being allowed to soak into waste mass. Whilst this is acceptable for rainfall in the active tipping area, it should not apply to runoff from areas up stream of the active tipping face. Care needs to be taken to ensure that water does not pool on the landfill, where it could generate odours or become a hindrance to landfill operations. Given the significant head in the landfill, where possible, water considered to be leachate should be directed to the GIWWTP via the quickest route (that does not pose a material increase of risk to potential human health or ecological receptors), rather than be allowed to seep into the waste mass.

73 It is noted in Section 4.1.3 of the SW Report, “in prolonged high rainfall events water from this pond (northern leachate pond) will overflow to perimeter swales and discharge to Kaikorai Stream”. It is not clear what a prolonged high rainfall event is, however, leachate should not be allowed to discharge to the environment without treatment. This needs further assessment in relation to the potential frequency of leachate overflow and associated potential impacts to the surrounding environment.

74 Additionally, periodic monitoring of the northern leachate pond is recommended to be included in the existing stormwater monitoring regime for the Site, with the intent to provide an understanding of the quality of water which could be discharged to the environment. Understanding the water quality in the northern leachate pond would also help inform decisions about the proposed changes to the use of the northern leachate pond in the future (e.g. if it were to become a sedimentation pond post closure). Additionally, the water level in the northern leachate pond should be managed to reduce the likelihood of overflow, particularly when heavy and/or prolonged rainfall periods are forecast.

Landfill Fires

75 A Fire Management Plan was prepared as part of the application documents. This has been reviewed and the mitigation, monitoring, and management detailed in the FMP was generally acceptable. However, the assessment highlighted a number of questions with respect to the assessment of fire risk at the site, as follows.

76 The mitigation, monitoring, and management in relation to hazards associated with fires has not been articulated. It is my view that mitigation, monitoring and management practices would best be informed via a fire risk assessment. To that end, a landfill Fire Risk Assessment (FRA) is recommended to inform, and where required revise, the mitigation, monitoring and management detailed in the Fire Management Plan (FMP).

77 Battery fires are becoming an ever increasing issue for waste collection and disposal. Vigilance at the tipping face and weighbridge are needed to detect these in incoming loads in particular. A plan for managing these is critical, including provision for such a fire to be extinguished typically by dumping in a dedicated fire safe area away from the waste mass and other infrastructure.

78 Further to the above, as the occurrence of such fires increases, so too does the need to enhance mitigation, monitoring and management requirements. Therefore, regular reviews, and potentially updates, to the FMP are warranted.

79 Section 5.6 of the FMP report details fire risk mitigation and readiness. There is reference to water sources, in section 5.6.3, including fire extinguishers. Other types of fire-fighting methods apart from water may be needed, dependant on the type of fire. For example, a chemical fire maybe inadvertently be provoked by the addition of water.

80 A key environmental impact from a subsurface landfill fire is odour. Odour should be a key part of monitoring for a landfill fire, along with other items that are proposed for monitoring including presence of smoke, increased carbon monoxide in the LFG system etc.

RESPONSE TO SUBMITTERS

81 I reviewed the contents of the four submissions received in relation to the resource consent application. There did not seem to be any submissions directly related to my area of expertise for this application (i.e. landfill design and management). However, some of the items raised in the submissions could be impacted by landfill design and management. To that end, I provide the following comments.

82 The submission by Te Runanga o Otakou raises items relating to leachate, including further investigation of the Kaikarae Stream and Estuary, and developing measures to avoid or mitigate the impacts of leachate on the environment. I have addressed leachate management elsewhere in this report and have not repeated it in this section. The need for additional monitoring is addressed by other experts.

83 The submission by Otago Fish and Game Council includes comments regarding a consent condition to lower leachate head in the landfill, undertake further assessments to assess potential leachate impacts in the surrounding environment and the effectiveness of the LIT. I have addressed leachate head and leachate management elsewhere in this report and have not repeated it in this section. The need for additional monitoring is addressed by other experts.

84 The submission by Colin Roy Venables and Carol June Venables raises concerns about odour from the landfill. I have not assessed odour at the landfill. However, landfill gas can be a regular odour source at landfills. I have provided commentary on LFG management elsewhere in this report and have therefore not repeated it here.

85 The submission by Colin L Weatherall refers to community impacts from “Leachate Control now and future, Closure of Landfill and future use”. No further information is provided and therefore I cannot provide a response to this submission. Regardless, my comments regarding landfill closure and leachate management are provided within this report.

CONSENT CONDITIONS

Landfill Rehabilitation

86 On the basis of the details provided in paragraphs 31-41, the following consent conditions are recommended, beyond those already included in the draft consent conditions provided by ORC to SLR in December 2024 in relation to the landfill rehabilitation.

(a) The applicant shall:

(i) Prepare timebound milestones for progressive capping of the landfill for provision to and approval by the consenting authority,

(ii) Revise the final cap contours to achieve a minimum cap grade of 4% across the 2.5ha region of landfill that is currently at a grade of 2% to promote runoff and reduce the potential for increased leachate infiltration.

(iii) Final capping designs maintain a minimum grade of 5% across the remainder of the proposed capping area (i.e. areas not already capped), noting that there may be some localised extension of the 4% area to accommodate tie in with the existing proposed final contours.

(iv) Provide, to the consenting authority, timebound milestones for the commissioning of the new LFG Flare, and other LFG management infrastructure including vertical LFG wells, and

(v) Implement the cap profile detailed in paragraph 42 and update relevant documents to include this detail.

(b) Draft general condition 55 in relation to the Annual Monitoring Report be updated to include the requirement to include details of any upgrades to the LFG and leachate management systems (e.g. new LFG wells) in the Annual Monitoring Report.

Leachate Management

87 On the basis of the details provided in paragraphs 42 to 54, the following consent conditions are recommended in relation to the management of leachate at the site.

(a) The applicant must:

(i) Actively reduce the leachate head within the landfill, initially in the form of a leachate pumping trial (and beyond, subject to the findings of the trial). The scope and findings of the trial and the need for ongoing extraction should be subject to review by ORC,

(ii) Implement remedial measures to address the leachate seepage from the eastern culvert as a priority,

(iii) In the event that impacts to the environment from elevated leachate levels in the waste mass are detected, then a long term target leachate head, based on a Hydrogeological Assessment or equivalent, is to be derived as a practicable target leachate head which reduces the potential impact to the environment for consideration by ORC.

(b) Detailed design of the LIT be prepared by suitably qualified and experienced engineers and be approved by ORC prior to its construction.

Landfill Gas Management

88 On the basis of the details provided in paragraphs 55 to 66 the following consent conditions are recommended in relation to the management of landfill gas at the site.

(a) The applicant must:

(i) Prepare an update of the LFGRA with a more robust data set, conceptual site model, and assessment of risk, including recommendations for ongoing LFG monitoring requirements. The updated LFGRA should be reviewed by ORC.

(ii) Treatment capacity must be improved to ensure that all captured LFG can be treated, even during periods of downtime of the flare/engine, and that treatment capacity is sufficient for the expected increased capture rates in the future.

(iii) Expand the LFG collection network in accordance with the LFG Masterplan.

(iv) Provide (to the consenting authority) detailed timing of expansion works relating to the LFG collection network compared to waste placement in each area.

(v) Ensure that as the LFG collection network is expanded (laterally and vertically), the design of expansion infrastructure ensures that LFG is collected throughout the full vertical profile of placed waste (e.g. through slotted or perforated vertical pipework) and laterally with horizontal pipework...

(vi) Ensure that where practical and appropriate, horizontal LFG collection wells are incorporated into the LFG collection system to

enable capture of LFG at the earliest opportunity. Particularly where vertical LFG collection wells are not considered practical or where there is a lag time between waste placement and installation of vertical wells.

(vii) LFG extraction pipework should be connected to the LFG extraction system as soon as is practicable, noting that care must be taken not to introduce oxygen into the waste mass.

(viii) Provide (to the consenting authority) as-built construction reports and surveys demonstrating the location, extent, and nature of upgrades to the LFG collection network as they are implemented. This could be done in the Annual Monitoring reporting.

89 Further, a revision of current draft conditions are recommended as follows.

(a) Consent condition 24 for the draft discharge of landfill gas consent should be revised to specify a more conservative trigger level for LFG surface emissions through the final cap. It is suggested that this is made to be 1,000 ppm or less.

(b) Furthermore, where this trigger level of 1,000 ppm is exceeded, remedial works should be undertaken to prevent emissions at the respective location, and the area re-monitored to confirm that the remedial works were successful.

(c) The advice note below consent condition 25 for the draft discharge of landfill gas consent should be updated to require that monitoring of surface emissions and subsurface geology target falling or low atmospheric pressure conditions also.

(d) Consent condition 10 for the draft discharge of landfill gas consent should be revised to specify a shorter timeframe than 2 years for the installation of LFG collection wells following the placement of waste. It is recommended that 6 months be adopted.

Stormwater Management

90 On the basis of the details provided in paragraphs 67-70 the following consent conditions are recommended in relation to the management of stormwater at the site.

(a) The applicant must:

(i) Ensure that runoff from intermediate cover areas is be treated as “leachate” and directed to the leachate collection system, and landfill documents, including the LDMP, should be updated as required to reflect this.

(ii) Ensure that to the extent practical, the different types of runoff as defined in the AEE (i.e. clean stormwater, sediment laden stormwater, and leachate) are kept separate, to reduce the potential for contamination of runoff, and to reduce the volume of leachate and sediment laden runoff.

(iii) Undertake periodic monitoring of the northern leachate pond to understand the quality of water which may be discharged to the environment during prolonged rainfall events.

(iv) Ensure the water level in the northern leachate pond is managed to reduce the likelihood of overflow events.

Landfill Fires

91 On the basis of the details provided in paragraphs 71-76 the following consent conditions are recommended in relation to landfill fires at the site.

(a) A landfill Fire Risk Assessment (FRA) be prepared that includes consideration of the potential for subsurface fires to occur.

(b) The Fire Management Plan (FMP) be updated to include the management of battery-related fires, including a provision for such a fire to be extinguished typically by dumping in a dedicated fire safe area away from the waste mass and other infrastructure.

(c) The results obtained / monitoring records relating to the thermal monitoring of the active tip face (i.e., from the fixed mount thermal imaging camera) are compiled and provided alongside regular compliance reporting (e.g., within the Annual Monitoring Report).

(d) Include a monitoring requirement in the sites odour management plan for the detection of odours that may be indicative of subsurface landfill fires.

CONCLUSIONS

92 The landfill has been operating for almost 30 years, and pre-dates current landfill guidance including the WasteMINZ Guidelines. Some of the existing engineering controls do not conform to current guidance e.g. there is no engineered liner or leachate collection system on the landfill floor. This is a significant constraint for older landfills, including the site.

93 The landfill includes a significant leachate head, understood to be as much as 10 m vertically. This is a significant volume of leachate within the landfill, and efforts should be made to reduce this head, via active extraction of existing infrastructure (e.g. LFG wells) to assess if ongoing extraction is a reasonably practicable option. I have made recommendations in relation to reduction of leachate head.

94 I have also made other recommendations relating to leachate management.

95 I have made recommendations relating to management of LFG, assessment of risk of LFG, assessment of fire risk, and stormwater management also. Details are provided in the body of this report.

96 Additional measures in relation to landfill design and management may be required in the future, pending results of further and ongoing assessment of potential impacts to the environment from leachate and landfill gas, and subject to implementation of the existing landfilled sign and management items and associated compliance with relevant consent conditions.

James Colin Elliott

21 February 2025