

7 July 2022

Otago Regional Council
Private Bag 1954
Dunedin 9054

Attention: Hilary Lenox

Dear Hilary

Technical Review: Smooth Hill Landfill - QHHRA

1 Introduction

- 1 Dunedin City Council (DCC) proposes to establish a new Class 1 landfill, to be located at Smooth Hill to the east of Dunedin Airport. DCC has applied to Otago Regional Council (ORC) for a range of resource consents required for the establishment and operation of the proposed landfill.
- 2 The application is currently the subject of a resource consent hearing, which has been adjourned to enable the provision of an 'extended water quality and quantitative human health risk assessment' (herein referred to as the **QHHRA**). The hearing Commissioners (Minute 3)¹ have requested that T+T provide a technical review of the QHHRA to confirm whether the approach and conclusions are reasonable.
- 3 Tonkin & Taylor Limited (T+T) has been engaged by ORC to undertake the technical review of QHHRA in accordance with our letter of engagement dated 12 November 2019.
- 4 The following documents have been considered as part of this technical review:
 - **QHHRA**: GHD 2022. Waste Futures Phase 2 – Work Stream 3. Extended Water Quality and Quantitative Human Health Risk Assessment. Report prepared for Dunedin City Council by GHD Limited 626860. Project number 12529451. 20 June 2022.

The following sets out technical review of the QHHRA. This has been undertaken by Dr Lyn Denison, Technical Lead Human Health Risk Assessment for T+T and based in T+T's Melbourne office. Dr Denison has more than 25 years' experience in conducting human health risk assessments in both Government and consulting. Her work has focused on the assessment of environmental pollutants and their impact on human health. Lyn has conducted a number of health risk assessments to support approvals and regulatory processes. She has presented training courses at the National Short Course in Environmental Health (Adelaide) and also conducted a course on Environmental Health Risk Assessment on behalf of the World Health Organisation for the Ministry of Health in Mozambique. She also led a review of environmental health issues in Mozambique and provided recommendations to the Ministry of Health and AusAid on the development of a National Environmental Health Strategy for Mozambique. Lyn was appointed as a member of the Long Term Hazelwood Health Study Ministerial Advisory Committee which reported to the Minister of Health. This Committee was established to oversee the epidemiological study that has been funded by the

¹ <https://www.orc.govt.nz/media/12348/minute-3-dcc-landfill-25-may-2022.pdf>

Victorian Government to assess the potential long-term impacts of a fire at the Hazelwood Coal Mine at Morwell on the health of the local community.

2 Review of Quantitative Human Health Risk Assessment

2.1 Approach to the Review

- 5 In conducting this review T+T has considered the framework that has been applied to estimating the potential risks and whether it is appropriate for use in NZ. It also considers the approach used to determine the contaminants of concern that are the focus of the HHRA and if all key contaminants have been identified and assessed. The adequacy of the input data, how it was selected and implications for the HHRA have also been considered.
- 6 The focus of the review is the human health risk assessment. T+T has not conducted a review of the extended water quality assessment or the ecological risk assessment as part of this review.

2.2 HHRA Framework

- 7 Section 2 of the HHRA states that the Guidelines that have been used to undertake the HHRA are
- EnHealth (2012a) Australian exposure factor guidance.
 - EnHealth (2012b) Environmental health risk assessment: guidelines for assessing human health risks from environmental hazards.
 - National Environmental Protection Council (NEPC, 2013) National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999, as amended 2013 (the “ASC NEPM”).
- 8 In addition, further sources of data including guidance outlined by the Ministry for the Environment (MfE 2011) have been used to select exposure assessment inputs including:
- General physical characteristics and dietary ingestion rates have been sourced from MfE (2011), enHealth (2012a; 2012b) and Food Standards Australia and New Zealand (FSANZ) (2017).
 - Dietary ingestion rates for aquatic biota have been sourced from reports prepared by the National Institute of Water and Atmospheric Research (NIWA, 2011), Ministry for Primary Industries (MPI, 2018) and Toxconsult (2013).
 - MfE (2011) behavioural and exposure duration assumptions for standard exposure scenarios for the rural residential exposure setting.
- 9 The enHealth health risk assessment guidelines (enHealth, 2012b) set out a five stage process for undertaking human health risk assessments. This approach is consistent with international risk assessment frameworks and is appropriate for use in the HHRA.
- 10 The use of specific NZ exposure and dietary data is important and its inclusion in the HHRA is supported.
- 11 The overall framework that has been used is appropriate. However there has been no consideration of Māori issues in the HHRA.

2.3 Contaminants of Concern

- 12 Section 5.3.1 outlines the contaminants of concern for the HHRA. This section identifies PFAS as the key contaminant of concern due to the potential for PFAS to biomagnify in aquatic and

terrestrial food chains and the absence of screening levels specific to these pathways. PFOS, PFHxS and PFOA are identified as the primary chemicals of potential concern (CoPC) for the HHRA.

- 13 Although T+T agree that PFAS is a key contaminant to be assessed in the HHRA, there are other contaminants in leachate that should have been considered and justification provided if they were to be excluded. These could include arsenic, lead and mercury which also bioaccumulate. Table B.4 shows that manganese exceeds the drinking water screening criteria at all points along the creek however there is no discussion as to why this was not considered further in the HHRA.
- 14 Further justification as to why the HHRA has not assessed contaminants other than PFAS should have been included. Not assessing the potential risk from other contaminants may underestimate the total risk to human health from leakage of leachate from the landfill in the case of liner failure.

2.4 Exposure pathways

- 15 Section 5.3.3 identifies the receptors used and the exposure pathways assessed. There is no justification provided for the choice of exposure pathways just a statement that these are the ones that have been assessed. All potential exposure pathways should have been considered as part of the conceptual site model (CSM) and then excluded if a complete source – receptor pathway could not be determined. This discussion has not been provided.
- 16 There is no discussion of potential exposure through drinking water. It is understood that groundwater is not currently used for drinking water in the area surrounding the Otokia Creek however given the potential for use it should have been considered in the Conceptual Site Model as a potential exposure pathway. There should have been discussion provided about potential PFAS contamination of the groundwater and the potential risk to human health assessed. This is a significant issue for the HHRA and may underestimate the total risk due to ingestion unless justification can be provided that either groundwater is not used for drinking water and/or that there is no potential contamination of that groundwater supply. Section 5.3.2 identifies migration of leachate to groundwater as the main migration pathway to surface water in Otokia Creek but does not discuss the use of the groundwater directly.
- 17 T+T agree that the inhalation and dermal exposure pathways are minor, and that the main exposure pathway is through ingestion.
- 18 The enHealth framework that has been applied to undertake the HHRA requires an assessment of the sensitivity of the potentially affected population. There is no discussion in the HHRA on the number of people who live in the potentially impacted area, the demographics of that population including age breakdown and socioeconomic status, or the baseline health status of the potentially exposed community. This information is an important part of any HHRA and should have been included to identify any factors that may make this population more vulnerable to exposure to PFAS.
- 19 It is unclear how the sensitive receptors have been chosen that have been used in the quantification of potential health risks. The assessment has been conducted for 5 points along the Creek however it is not clear how these locations have been selected and how representative they are of community exposure. Further discussion should be provided.

2.5 Toxicity data

- 20 The assessment of the toxicity data to be used in the HHRA is a critical step. It enables assessment of the health endpoints that need to be considered in the HHRA and the selection of toxicity reference values to be used in the assessment of risk.

- 21 Given the concern internationally regarding the health impacts of PFAS there is a large amount of new literature available for review including recent reviews of the scientific literature from regulatory agencies such as the US Environmental Protection Agency (US EPA), Agency for Toxic Substances and Disease Registry (ATSDR) and California EPA Office for Environmental Health Hazard Assessment (OEHHA). These reviews have been published between 2020 and 2022. Apart from the limited use of data from the ATSDR, no reference has been made to the reviews of the USEPA or OEHHA.
- 22 The HHRA has relied on studies published by FSANZ in 2017 and other reports prior to that. There has been a large amount of studies published since that time that provide additional information on potential health effects including carcinogenicity. OEHHA has classified both PFOS and PFOA as carcinogens in 2020. This should have been included as part of the hazard assessment.
- 23 T+T agree that based on the most recent health data that there is not sufficient data to allow assessment of acute health effects. The ATSDR concluded that there was not sufficient evidence to establish a chronic minimal risk level (MRL) and based their oral MRL on health effects arising from exposures between 14 days and 1 year. The HHRA has focussed on the assessment of chronic effects. A discussion of the data used in the HHRA in the context of the more recent data on the potential health effects used as the basis of the toxicity values used to quantify the risks from the Smooth Hill landfill should have been included. This would ensure that all relevant health effects had been considered.
- 24 T+T agree that a threshold approach to assessing the potential health risks is appropriate.

2.6 Choice of Toxicity Reference Values (TRVs) to Assess Potential Risk

- 25 The HHRA has adopted the FSANZ tolerable daily intake (TDI) as the TRV for assessing the potential risk from the Smooth Hill landfill through ingestion of food and water (accidental). Although these are the current Australian and New Zealand standards for food, they were developed in 2017 and are based on information on the health effects of PFAS compounds prior to that time. Since then, there have been extensive studies internationally to gain a better understanding of the health effects of these contaminants.
- 26 The HHRA notes that a number of international jurisdictions have assessed the toxicity of PFOS and PFHxS and published TRVs since those published by FSANZ. The TRVs established for PFOS and PFHxS by EFSA (2020) and ATSDR (2021) are lower than the values recommended by FSANZ (2017). The primary difference between the PFOS+PFHxS TRV derived by FSANZ (2017), and the values proposed by EFSA (2020) and ATSDR (2021) is the approach used to incorporate immunotoxicity. The EFSA and ATSDR TRVs include more recent data to that used by FSANZ. GHD has chosen to use the FSANZ TRV, however, given the more recent TRVs developed by international agencies are more stringent, it would be useful to use the international TRVs as part of a sensitivity analysis to provide a complete analysis of potential risk based on recent data.
- 27 Given that the approach used to quantify risk, hazard quotient, divides the total exposure by TRV, T+T are of the view that the use of the more stringent international TRVs will result in a higher risk level than that reported in the HHRA using the FSANZ values.
- 28 The use of Ministry for the Environment exposure factors is appropriate as they have been derived for the NZ population.
- 29 The use of the hazard quotient (HQ) approach to assess potential risk is appropriate and consistent with international approaches to assess threshold contaminants. A HQ of 1 to assess 'acceptable' risk is appropriate however this should apply to total intake not just intake through potential contamination from the landfill. It appears that the results presented in Table 5.5 of the HHRA relate to the potential landfill contribution only. Results including background should also be presented. If background is included in these results, then this

should be made clear in the text. If it hasn't been included, then the results presented underestimate the total risk to the potentially exposed population.

- 30 The transfer factors used in the HHRA have been drawn from Australian Department of Defence (DoD) data from Williamstown. No review of international data and how this compares with the DoD has been undertaken. This should have been done to ensure that the most robust data is used in the HHRA. No justification has been provided on the choice of the DoD data. Further discussion on this should have been included and if they differ a sensitivity analysis conducted using the international values.
- 31 The HHRA has relied on the results of the study of Drew (2021) for transfer factors in cattle. Again, a review of the international literature should have been undertaken and justification provided on the choice of the factors used. If the international values differ significantly a sensitivity analysis should have been undertaken.

3 Submitter review

- 32 A technical review of the HHRA was undertaken by Andrew Rumsby² of EHS Support on behalf of Ōtokia Creek and Marsh Habitat Trust. The Commissioners have also requested that T+T comment *“any expert evidence provided by the ‘Bright’ submitters on the QPHRA”*.
- 33 Mr Rumsby provides the following summary of his review.
- They don't include the most up to date PFAS biomagnification model developed by SERDP and more recent advice from other government agencies such as RIVM, Health Canada and US EPA on assessing the risks from PFAS compounds.
 - The Australian Exposure Factors Guidance is different in some places from the exposure factors used within the MfE (2011) Methodology for deriving standards in soils to protect human health.
 - Studies from New Zealand Defence Forces investigation at Woodbourne and Ohakea found a higher degree of bioaccumulation of PFAS compounds in chicken at lower concentrations than is indicated in this report.
 - The GHD HHRA does not appear to reference any of the MPI advice on acceptable PFAS concentrations in fish which is published on the New Zealand Government All of Government PFAS website.
 - GHD HHRA only undertakes an assessment of 25% home-grown produce, however, the methodology for Deriving Standards for Contaminants in Soil to Protection Human Health states that “Depending on the circumstances, 10 per cent of home-grown produce may be appropriate (i.e., as for standard residential), whereas 50 per cent is expected to be towards the high end of a more self-sufficient lifestyle that some rural dwellers may adopt”.
 - In NZDF studies around Woodbourne and Ohakea Air Force Bases, there was evidence of up to 100% homegrown produce being consumed at some properties. EHS Support believes that the HHRA should also consider 50% homegrown produce and 100% homegrown eggs and meat production (and 50% produce other food items) (this type of assessment was also done for a number of Australian Defence Force sites as well where relevant (i.e. rural residential communities where present).
- 34 T+T has considered Mr Rumsby's review and agree that where available data from NZ sites should be used in the HHRA. In addition, the HHRA needs to consider the most recent data to estimate the risk to the population near the Otokia Creek. This includes the use of the most recent biomagnification model noted by Mr Rumsby.

² Andrew Rumsby 2022. Review of GHD Quantitative Health Risk Assessment for the Propsoed Smooth Hil Landfill. Memorandum prepared by EHS Support for Ōtokia Creek and Marsh Habitat Trust, 28 June 2022.

- 35 If there is evidence from NZ studies that the consumption of homegrown produce is higher than that used by GHD in rural areas, then it is important that this data be used in the HHRA. If the ingestion rates are higher than those used by GHD, then the risk posed from this source will also increase. Use of the lower estimates for consumption of homegrown produce will lead to an underestimate of the risk from this source.

4 Key findings

- 36 T+T has undertaken a review of the Quantitative Human Health Risk Assessment (HHRA) undertaken to assess potential risk to human health from PFAS from the proposed Smooth Hill Landfill. The key findings of the review are:

- The overall approach to the HHRA is appropriate and consistent with national and international approaches to human health risk assessments
- Although the inclusion of PFAS compounds as contaminants of concern for the HHRA is supported, it is unclear why other contaminants have been excluded. Their exclusion may underestimate the risk to the health of the potentially exposed population from leachate from the landfill. Justification for their exclusion should be provided or the scope of the HHRA expanded to include additional contaminants.
- There is no assessment of potential risk through use of groundwater as a source of drinking water or why this exposure pathway has been excluded, although it is understood that there groundwater is not used for this purpose at present. If groundwater is used as a source of drinking water, then excluding it from assessment will underestimate the potential risk.
- The focus on ingestion as the main exposure pathway is appropriate.
- Given the international focus on the potential health effects of PFAS, there is a significant body of recent literature on the health effects and regulatory guidelines. The hazard and toxicity assessment that has been conducted as part of the HHRA are limited and do not include a lot of the recent evidence on the potential health effects. This should have been included to ensure that the toxicity reference values selected to assess the potential risk reflect the current international state of knowledge in this area.
- Although FSANZ TRV is the current Australian and New Zealand guideline, a sensitivity analysis should have been conducted using more recent international regulatory guidelines. As these are more stringent than the FSANZ TRVs, using the international values would provide an upper estimate of risk based on the current science.
- The use of NZ exposure factors and dietary intake values is appropriate. Mr Rumsby's review identifies that there is NZ specific data that indicates that the value used by GHD for consumption of home grown produce is lower than that reported for studies in NZ. This would lead to an underestimate of risk from this source. A sensitivity analysis using the NZ estimates should be undertaken.
- The selection of transfer factors for PFAS to fruit and vegetables and cattle are based on Australian studies undertaken for DoD. No review of international data has been undertaken. This should have been done to determine how the values used sit within the international data. This would also allow a sensitivity analysis to be undertaken.
- The HHRA identifies that the choice of TRVs is one source of uncertainty in the assessment. T+T agree with this as discussed in paragraphs 25 to 27 of this review. If the international values, which are more stringent, had been used this would result in higher risk predictions.
- Although GHD state that there are a number of conservative assumptions used in the HHRA that lead to an overestimate of risk, there are also a number of inputs that are not conservative. These include for example, the use of the FSANZ TRV and lower dietary intake

values for home grown produce consumption as discussed above. This lowers the level of conservatism claimed by GHD in the results.

- A sensitivity analysis has been undertaken but does not include the issues raised above.
- Overall, the HHRA concludes that there is a low risk to health from PFAS arising from failure of the liner of the landfill. If more recent TRVs from international sources had been used the estimated risks would be higher as the TRVs are at least an order of magnitude below the corresponding FSANZ 2017 values.
- There has been no consideration of Māori in the HHRA.

5 Applicability

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

We understand and agree that this report will be used by the Otago Regional Council in undertaking its regulatory functions in connection with the resource consent applications by Dunedin City Council for the proposed Smooth Hill Landfill.

Tonkin & Taylor Ltd

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PP



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7-Jul-22

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