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Attention: Hilary Lenox

Dear Hilary

Technical Review to Inform Notification Decision: Smooth Hill Landfill
Appendix 5 - Geotechnical Interpretative Report
Appendix 6 - Geotechnical Factual Report

Introduction

- 1 Dunedin City Council (DCC) proposes to establish a new Class 1 landfill, to be located at Smooth Hill to the south 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 Tonkin & Taylor Ltd (T+T) has been engaged by ORC to undertake a technical review of the geotechnical assessment lodged by DCC in support of its resource consent applications.
- 3 This report presents a Technical Review of the Geotechnical Interpretative Report, and also of the Geotechnical Factual Report which is essentially a supporting document giving the factual geotechnical information used for the geotechnical interpretative assessment.
- 4 The purpose of this Technical Report is to set out the findings of our technical review of DCC's geotechnical assessment, so as to inform a decision to be made by ORC regarding notification of the resource consent applications.
- 5 The following documents have been considered as part of this technical review:
 - **Appendix 5 – Geotechnical Interpretative Report:** *GHD August 2020. Waste Futures – Smooth Hill Geotechnical Interpretative Report. Report prepared by GHD Limited for Dunedin City Council.* (herein referred to as the 'Geotechnical Interpretative Report').
 - **Appendix 6 – Geotechnical Factual Report:** *GHD August 2020. Waste Futures – Smooth Hill Geotechnical Interpretative Report. Report prepared by GHD Limited for Dunedin City Council.* (herein referred to as the 'Geotechnical Factual Report').
 - **Dunedin City Council - proposed Smooth Hill Landfill: Section 92 review - requests for further information:** *Report prepared for ORC by T+T, September 2020.* (herein referred to as 'the s92 request').
 - **Revised Appendix 5 – Geotechnical Interpretative Report:** *GHD May 2021. Waste Futures – Smooth Hill Geotechnical Interpretative Report. Revised (updated) Report*

- prepared by GHD Limited for Dunedin City Council. (herein referred to as the 'Final Geotechnical Interpretative Report').*
- **Revised Appendix 6 – Geotechnical Factual Report:** *GHD May 2021. Waste Futures – Smooth Hill Geotechnical Interpretative Report. Revised (updated) Report prepared by GHD Limited for Dunedin City Council. (herein referred to as the 'Final Geotechnical Factual Report').*
 - **Smooth Hill Landfill –s92 Question Responses – Geotechnical Interpretative and Factual Reports:** *Provided to ORC, and containing responses from GHD, as part of ORC's s92 request to DCC, May 2021. (herein referred to as the 's92 response').*
 - **Dunedin City Council - proposed Smooth Hill Landfill: Section 92 review - requests for further information:** *Report prepared for ORC by T+T, June 2021. (herein referred to as 'the further s92 request').*
 - **Smooth Hill Landfill –Further s92 Question Responses – Geotechnical Interpretative and Factual Reports:** *Provided to ORC, and containing responses from GHD, as part of ORC's s92 further request to DCC, August 2021. (herein referred to as the 'further s92 response').*
 - **Smooth Hill Landfill – Geotechnical Interpretative Report – Updated Appendix A plans and Appendix B ground model sketches (cross-sections):** *Provided to ORC, and containing responses from GHD, as part of ORC's s92 further request to DCC, August 2021. (herein referred to as the 'further s92 Appendix A/B response').*
 - **Smooth Hill Landfill Draft Conditions:** *Provided by ORC as part of its further s92 response of 4 August 2021 (herein referred to as the 'draft conditions').*
- 6 On-line meetings were held between Andrew Stiles (T+T Geotechnical Consultant) and the applicant's geotechnical expert (Samantha Webb – GHD Technical Director Engineering Geology) on 7 July and 29 July 2021 to discuss the Geotechnical Interpretative and Factual Reports and s92 responses. The meetings satisfactorily clarified a number of matters.
- 7 This technical review has been undertaken by Andrew Stiles, Geotechnical Consultant at T+T. It has been prepared in accordance with T+T's letter of engagement with ORC dated 12 November 2019.

Description of the proposal

- 8 The proposed Smooth Hill municipal landfill is intended to replace the existing Green Island landfill located in Dunedin. The Smooth Hill Landfill is reduced in scale from the original application as follows:
- a) A footprint of 18.6 ha instead of the original 44.5 ha.
 - b) A gross capacity reduced from 7.9 million m³ to 3.3 million m³.
 - c) Net waste capacity of 6.2 million m³ to 2.9 million m³.
 - d) The predicted landfill life reduced from 55 years to years.
- 9 The landfill will be designed to accept municipal solid waste in accordance with acceptance criteria.
- 10 The landfill design proposes multi-bench cut slopes up to about 30 m high overall and 1V:4H or flatter, and fill slopes, formed of site-won materials, up to 10 m high at slopes of 1V:4H or flatter.

Receiving Environment

- 11 Sections 1 and 2 of the Geotechnical Interpretive and Factual Reports describe the existing environmental setting for the proposed landfill, identifying that it is :

- a) Approximately 23 km south-west of Dunedin City.
 - b) About 2.7 km north-east of the coast.
 - c) In an area of rugged terrain, with elevations typically between about RL 100 m and RL 150 m, with well-defined ridges separated by stream gullies.
 - d) Currently covered by mixture of scrub, bare earth, forestry waste and replanted pine but, until recently, was covered by a pine plantation.
- 12 Within 3.5 kms of the Landfill, there are 12 No. residences and 3 No. commercial premises. Only two of these existing residences are within 1 km, with the closest being 380 m. T+T considers this is a low density of sensitive locations near to the proposed landfill.
- 13 The geotechnical aspects of the landfill development and operation are not expected to have any effects on those residences and premises.
- 14 Overall, we agree with the Geotechnical Interpretive and Factual Reports' assessment of the receiving environment.

Assessment of geological setting

- 15 The applicant's investigations have shown the proposed landfill site is likely underlain by the Upper Cretaceous Henley Breccia. This unit is typically a relatively massive interbedded siltstone, sandstone and conglomerate. Discontinuities appear relatively limited, with rare bedding planes generally shallowly dipping at between about 15° and 30°.
- 16 While Recent Loess forms the surface cover over much of the existing slopes, with alluvial soils in the stream/gully bottoms, the proposed landfill construction will remove all those materials from within the landfill footprint.

Assessment of geotechnical investigations

- 17 The geotechnical investigations discussed in the Geotechnical Interpretive and Factual Reports covered the proposed landfill area identified in the original application. However, the Reports advised that portions of the proposed landfill site, in the south-east and along the western edge, were unable to be accessed due to existing tree cover and for environmental reasons. That meant that geotechnical investigation information was not available for about 40% of the originally proposed landfill area.
- 18 The subsequent reduction in the landfill area, as discussed in the Final Geotechnical Interpretive and Factual Reports, means that the area in the south-east, which was not able to be investigated, now comprises a larger proportion, i.e., about 50%, of the overall footprint.
- 19 The lack of geotechnical investigation for much of the proposed landfill application area, and how that information 'gap' would be addressed, was identified in the s92 request, the subsequent further s92 request and in the 29 July 2021 on-line meeting.
- 20 GHD advised, on behalf of the applicant, that a further borehole was in the process of being drilled in the previously uninvestigated area. Further, it was agreed that additional investigations will be carried out at Detailed Design stage to fill in any remaining information gaps and to ensure that there is adequate geotechnical information available for the landfill's design.
- 21 T+T considers this approach acceptable and proposes that a condition of consent be included to reflect that agreement.

Assessment of seismicity

- 22 The Geotechnical Interpretive Report assumed the proposed landfill to have an Importance Level 2 (IL2) for the purposes of seismic design, i.e., its ability to resist earthquake loadings.

The s92 request noted that it is more usual to assign an IL3 rating to the immediate post-construction phase of a landfill when the completed landfill contains significant leachate which could potentially be released as a result of a seismically induced breach of the containment system.

- 23 After review, the applicant, in the s92 response and Final Geotechnical Interpretative Report revised the Importance Level rating to the more appropriate IL3.
- 24 The Geotechnical Interpretative Report was unclear as to whether the applicant proposed to carry out a Site Specific Seismic Hazard Assessment (SSSHA) and that was queried in the s92 request. The issue continued to be unclear, with T+T considering that a SSSHA should be carried out, but was resolved as part of the on-line meeting held between Andrew Stiles and the applicant's geotechnical expert (Samantha) on 29 July 2021.
- 25 In that meeting GHD advised, on behalf of the applicant, that a SSSHA would be carried out at the detailed design stage to confirm appropriate seismic design parameters are being used.
- 26 T+T considers this approach acceptable and proposes that a condition of consent be included to reflect that agreement.

Assessment of geotechnical design parameters

- 27 Geotechnical design parameters were proposed in the Geotechnical Interpretative Report and a number of queries on the proposed values, and their derivation, were raised in the s92 request.
- 28 Clarification by the applicant was provided in the s92 response and the Final Geotechnical Interpretative Report. Following a further round of queries and responses, i.e., the further s92 request and further s92 response, T+T generally agrees with the proposed geotechnical design parameters and overall approach.

Assessment of geotechnical hazards

- 29 The Geotechnical Interpretative Report identified a number of existing slope failures across the proposed landfill site. The s92 request queried their extent, particularly depth and whether they only affected the superficial loess deposits. The s92 response and Final Geotechnical Interpretative Report identified such features to be shallow seated, within the loess, and all would therefore be removed as the loess was progressively stripped from the site during construction of the landfill.
- 30 Compressible soils within the landfill footprint were identified in the Geotechnical Interpretative Report, e.g., alluvial deposits in the base of stream gullies, historic fill, topsoil and some loess. The Geotechnical Interpretative Report noted that all such potentially compressible soil would be removed from under the proposed landfill footprint and from beneath any areas on which engineered fill is to be placed.
- 31 Groundwater seepages were identified in the Geotechnical Interpretative Report as having been noted in a number of locations around the site. There is also the potential for further such seepages to be encountered if construction excavation works intersect groundwater. This potential geotechnical hazard is discussed in T+T's Technical Review – Appendix 8 – Groundwater Report.
- 32 The Geotechnical Interpretative Report identifies that, although in theory saturated fine grained alluvium in the base of stream gullies could liquefy during a seismic event, the potential hazard will be eliminated as a result of the proposed removal of all such stream alluvium as part of the landfill development work.
- 33 T+T considers that the application has appropriately addressed the above potential geotechnical hazards.

Assessment of proposed cut and fill slopes

- 34 The Geotechnical Interpretative Report discussed the assessed stability of the cut and fill slopes necessary to form the proposed landfill subgrade geometry. The s92 request queried the appropriateness of some of the analyses, in particular whether translational failure modes in the Henley Breccia materials were more appropriate than the circular failure mechanisms analysed. The s92 request also queried why the potential for refuse (MSW) to slide over the lining system, either of temporary internal refuse slopes during construction or of the completed waste mass, had not been addressed.
- 35 Clarification by the applicant was provided in the s92 response and Final Geotechnical Interpretative Report. Following a further round of queries and responses, i.e., the further s92 request and further s92 response, T+T generally agrees with the applicant's proposed approach, and that the proposed cut and fill slope stability assessment is considered appropriate for consent application but will be reviewed, and revised as necessary, during Detailed Design.
- 36 In the 29 July 2021 on-line meeting (Andrew Stiles and Samantha Webb) T+T expressed concern that the lack of geotechnical investigation could result in unrealistic cross-sections for stability analyses. In T+T's view that was a particular reason why additional investigations were considered necessary as part of Detailed Design.
- 37 With respect to T+T's queries on the potential for refuse (MSW) to slide over the liner system, this has now been addressed in the proposed consent conditions.
- 38 Conditions of consent are included to reflect the slope stability assessment agreed approach.

Mitigation

- 39 The paucity of investigations in the revised proposed landfill area will be addressed by the further borehole currently in the process of being drilled, and the additional investigations agreed to be carried out at the Detailed Design stage.
- 40 Appropriate seismic design parameters will be confirmed by a Site Specific Seismic Hazard Assessment (SSSHA) to be carried out at the Detailed Design stage.
- 41 The proposed cut and fill slope stability assessment will be reviewed, and revised as necessary at the Detailed Design stage.

Proposed conditions

- 42 The proposed conditions include requirements to assess 'Land Stability', i.e., the stability of the proposed cut and fill slopes, and also of the potential movement of the waste mass over the landfill liner system.
- 43 To ensure seismic design issues are satisfactorily addressed, the following additional condition of consent is recommended by T+T : *A Site Specific Probabilistic Seismic Hazard Assessment (SSPSHA) shall be undertaken as part of detailed design of the landfill to ensure seismic risks are addressed so they are consistent with NZS 1170.5.2004 Structural Design Actions - Part 5 Earthquake Design Actions .*
- 44 To ensure that an adequate level of geotechnical investigation is carried out, the following additional condition of consent is recommended by T+T: *Additional geotechnical investigations shall be carried out as necessary as part of detailed design, to fill in any investigation 'gaps' and to ensure that a robust geotechnical model is able to be created.*
- 45 Other than the above, the proposed conditions of consent are considered appropriate to cover geotechnical design and construction issues for the proposed landfill.

Conclusion

- 46 We consider that the potential effects of the landfill development can be appropriately managed through the proposed conditions of consent and accordingly the potential geotechnical effects from construction and operation of the landfill have been addressed, subject to detailed design.

Applicability

- 47 This Report 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.

Tonkin & Taylor Ltd

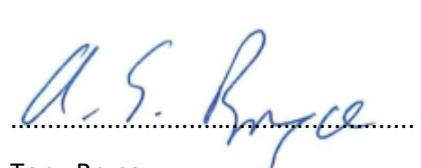
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