IN THE MATTER	of the Resource Management Act 1991 ("RMA" or "the Act")
AND	
IN THE MATTER	of an application under section 88 of the Act to **WAIKATO REGIONAL COUNCIL** and **WAIKATIO DISTRICT COUNCIL** (ref LUC0488/22) BY **GLEESON MANAGED FILL LIMITED** to establish and operate a managed fill disposal activity at 310 Riverview Road, Huntly.

STATEMENT OF EVIDENCE OF DR. KA-CHING CHEUNG AND MATTHEW JAMES KERNOT

GEOTECHNICAL ENGINEERING

Dated 21 November 2022

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1. INTRODUCTION

1.1 My full name is Ka-Ching Cheung. I am a Geotechnical Director of GAIA Engineers Limited ("GAIA"), a specialist geotechnical consulting firm specialising in major infrastructural projects in New Zealand.

1.2 My full name is Matthew James Kernot. I am a Senior Engineering Geologist at GAIA Engineers Limited, a specialist geotechnical consulting firm specialising in major infrastructural projects in New Zealand.

1.3 This evidence is given jointly in respect of resource consent application LUC0488/22 by Gleeson Manage Fill Limited ("GMF") to Waikato Regional Council ("WRC") and ("Waikato District Council") ("WDC") to establish and operate a managed fill disposal activity at 310 Riverview Road, Huntly ("Site").

Qualifications and experience

Dr. Ka-Ching Cheung

1.4 I hold a PhD degree (1988) and MEng (1985) degree from the Civil Engineering Department of University of Canterbury. I also hold a BSc degree (1980) in Hydraulic Engineering from National Cheng Kung University, Taiwan.

1.5 I am a Chartered Professional Engineer specialised in geotechnical engineering. I am also a Chartered Member of Engineering New Zealand and a member of American Society of Civil Engineers since 1995.

1.6 I have over 35 years of geotechnical experience in major NZ infrastructure projects including the following:

(a) NZTA SH1 Huntly Bypass, Geotechnical Design Lead

(b) NZTA Cambridge Bypass, Geotechnical Design Lead

(c) Drury Quarry - Quarry Development and Thorburn Gully Managed Fill Site Development, Geotechnical Design Lead

(d) Huntly Quarry - Quarry development assessment and Managed Fill Site Development, Geotechnical Design Lead

Matthew Kernot

1.7 I hold a BSc (2012) in Geology and Geography from the University of Auckland.

1.8 I am a member of Engineering New Zealand.

1.9 I have 10 years of experience as an engineering geologist in New Zealand.

1.10 I have been responsible for the investigation, design, and construction of similarly sized managed fills underlain by similar Waikato Coal Measures geology at the Drury Quarry in Auckland. The geotechnical design philosophy utilised at the Drury Quarry Managed Fill has been proven successful in practise and these geotechnical design philosophies are similar to those proposed at the Huntly Quarry Managed Fills.

1.11 Outside of managed fill design, I have been involved with the design and construction of both temporary and permanent cut slopes and fill

embankments in similar Waikato Coal Measures geology, soft ground (peat), and historic uncontrolled fills.

1.12 I was involved in the geological assessment, modelling, construction mapping and completion reporting for the 65m high Taupiri Summit cut slope section of the SH1 Huntly Bypass section.

Involvement in the project

1.13 GAIA was engaged by GMF in May 2019 to provide geotechnical design advice for four proposed fill sites known as Fill Areas 2 to 5. Fill Area 1 was not pursued. Fill Area 5 is an overburden disposal site for Huntly Quarry operations and has previously been consented by WRC/WDC.

1.14 Fill Areas 2 to 4 have been investigated and designed as managed fill disposal sites. The initial engagement included geotechnical investigation and assessment suitable for support of a Resource Consent Application. Gaia was subsequently retained to undertake detailed Geotechnical investigation and design of Fill Area 2 and Fill Area 3.

1.15 We were responsible for the preparation of:

(a) *2325-12-GQ-01 (Huntly Quarry Disposal Sites – Geotechnical Assessment Rev C),* prepared by GAIA Engineers Limited, dated November 2019;

(b) *2325-23-GQ-01 (Huntly Quarry Disposal Sites – Fill Site 2-Geotechnical Design Report Rev B),* prepared by GAIA Engineers Limited, dated April 2020;

(c) *2325-74-GQ-01 (Huntly Quarry Disposal Sites – Fill Site 3 – Geotechnical Design Report Rev A),* prepared by GAIA Engineers Limited, dated July 2021; and

(d) 2325-24-GQ-01 (Huntly Quarry Disposal Sites - Fill Site 5 Geotechnical Design Report Rev 0), prepared by GAIA Engineers Ltd, dated May 2021. – Previously consented by the WRC/WDC.

1.16 We are familiar with the geological and geotechnical conditions of the subject site and wider receiving environment.

Geological and Geotechnical Investigation, Assessment and Design

1.17 GAIA have attended site for geotechnical investigations, walkover inspection, geomorphological mapping, and geotechnical site stability design for Fill Areas 2 to 5, noting that Fill Area 5 is not included in this application. Our site attendance record is as follows:

(a) June 2019 – Fill Sites 2 to 5 Walkover Inspection/Mapping and Test Pit Investigations.

(b) October to November 2019 – Fill Sites 2, 3 and 5 Additional Test Pit Investigations.

(c) March 2021 – Fill Site 3 Deep Drilling investigations.

(d) Geotechnical site stability design, July 2019 to July 2021.

Purpose of scope and evidence

1.18 The purpose of our evidence is to provide Geological and Geotechnical Engineering Opinion regarding the geotechnical suitability of the proposed fill sites. Geotechnical suitability of the proposed fill sites relates to the following:

(a) Stability of the proposed fill landforms;

(b) Stability of the existing landforms and ground improvement under the proposed fills; and

(c) Constructability of the proposed fills.

1.19 Our evidence is structured as follows:

(a) Briefly describes the site (Section 3).

(b) Briefly describes the proposal (Section 4).

(c) Sets out the key policy matters (Section 5).

(d) Addresses the relevant geotechnical issues arising (Section 6).

(e) Comments on issues raised by the Officer's Report relevant to my area of expertise (Section 7).

(f) Comments on the issues raised by Submitters relevant to my area of expertise (Section 8).

(g) Comments on the conditions (Section 9).

(h) Provides a brief conclusion (Section 10).

1.20 A summary of my evidence is contained in Section 2.

Expert Witness Code of Conduct

1.21 We have been provided a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's 2014 Practice Note. We have read and agree to comply with that Code. This evidence is within our area of expertise, except where we state that we are relying upon the specified evidence of another person. We have not omitted to consider material facts known to us that might alter or detract from the opinions that we express.

1.22 We understand and accept that it is our overriding duty to assist the Independent Commissioner in matters which are within our expertise as a geotechnical engineer and engineering geologist.

2. SUMMARY OF EVIDENCE

2.1 Gaia Engineers has undertaken geotechnical investigations and design work for the proposed managed fill project at the Huntly Quarry. This work has involved carrying out site walkovers for geomorphological mapping, test-pit investigations, and deep drilling in the case of Fill Area 3. We have prepared concept designs for proposed managed fills in Fill Areas 2 to 4 and detailed geotechnical designs for Fill Area 2 and Fill Area 3. Note that Fill Area 1 was not pursued, and Fill Area 5 is a quarry overburden fill which was previously consented by the WRC/WDC.

2.2 The proposed fill areas were found to be suitable for the purpose of placing managed fill from a geotechnical engineering perspective, subject to detailed design and construction observation by a designer site representative.

2.3 The natural geology of the proposed fill area gullies is predominantly Waikato Coal Measures material. This geological unit comprises sedimentary mudstone and sandstone units with thin coal bearing beds. This material is known for having the potential to cause slope instability due to structural weaknesses along both bedding planes and along the transition between soil strength material and weak rock (transition zone). The proposed managed fills will effectively buttress the existing gully slopes and result in higher levels of stability within the gullies than currently exists.

2.4 The toe area of Fill Area 2 was found during detailed investigations to be underlain by Newcastle Group Materials, commonly known as Greywacke. This material is more competent than the overlying Waikato Coal Measure material.

2.5 Fill Area 3 already contains a significant volume of historic fill, inferred to be overburden stripping from historic neighbouring mining operations. This fill comprises generally firm to stiff inorganic clays and silts with occasional organic inclusions and coal bearing material.

2.6 It will be necessary to install under-fill drainage within the existing gullies so that shallow groundwater is not impounded by the placement of the fill and has a means of leaving the footprint of the fill area. Impounding of any surficial or near surface groundwater flows would result in reduction of stability of the completed fill. In the case of Fill Area 3, we have recommended that a network of deep trench drains (Approximately 10m deep from the existing ground level) are installed to reduce the water level within the existing mining fill present within that area.

2.7 The geotechnical design approach for the managed fills utilises structural containment bunds, constructed from fill capable of meeting the design specification. The first structural bund (referred to as the basal bund) will be keyed into the existing subgrade material at the toe of the fill in order to provide sufficient lateral earth pressure resistance. These structural bunds will form cells in which managed fill can be placed and allowed to naturally drain and consolidate under gravity.

2.8 The second geotechnical design component for the managed fills is drainage blankets. The drainage blankets will comprise specially selected gravel fill and will be placed at 10m vertical intervals. These blankets are graded to fall towards the face and the sides of the fills. The drainage blankets provide a reliable path for water (pore-water) held within the imported managed fills to exit the fill area via the surface drainage outlets and swales. Relieving of pore-water from the imported fills during construction is necessary to provide sufficient stability for the completed fill.

2.9 Stability of the fill will be monitored both throughout and after the construction period via the installation of displacement monitoring markers. Regular survey of these markers will show how the fill is responding as additional material is placed.

3. SITE DESCRIPTION AND LOCALITY

3.1 The proposed managed fill sites comprise three gully systems situated to the north of the existing Huntly Quarry main pit. The gullies have been formed via the natural incision of the underlying Waikato Coal Measure geology.

3.2 The proposed Fill Area 2 gully is a relatively unmodified gully other than the previously constructed dam and associated pond at the base of the gully.

3.3 The Fill area 3 gully has been extensively modified in the past via the deposition of fill, inferred to be overburden fill, from nearby historic mining and quarry operations. The resultant landform is the remnant broad gully head, with a plateau of historic fill material extending into the neighbouring property to the north.

3.4 The Fill Area 4 gully is mostly unmodified except for an existing earthen dam structure, larger than that in Fill Area 2, constructed towards the toe of the gully. A pond has formed behind the dam.

3.5 The geomorphology of the fill area gullies is characteristic of the underlying geology. The head of the gullies are broad where the underlying weak rock has weathered into soil, thus limiting the natural angle of repose. The gullies naturally become steeper as the existing watercourses progress downgrade, incising into less weathered and harder material, forming steeper slopes. Signs of historic and active shallow instability are visible within the existing soil slopes. However, no sign of large-scale or deep historic instability was mapped or observed within the gullies.

4. DESCRIPTION OF PROPOSAL

4.1 The proposed works include the development of three managed fills within existing gullies directly north of the existing Huntly Quarry main pit.

4.2 The fills will be between approximately 20m and 45m higher than the existing ground level at the thickest points.

4.3 The managed fills will be constructed in sub-horizontal layers with a structural containment bund being constructed at the downslope end. The managed fill will subsequently be placed in behind the bund until that layer is full.

4.4 The fills are designed in such a way that the downslope face of the fill is formed using Structural Fill Bunds. The uppermost layer of the fills will be formed with Managed Fill, placed at a flatter gradient.

4.5 Drainage blankets will be placed at 10m vertical intervals in order to:

(a) Allow conveyance of pore-water within the managed fill to the outside; and

(b) Avoid excess pore-pressure build up within the managed fills.

5. KEY POLICY MATTERS

5.1 Waikato Regional Plan Land and Soil Module Objective 5.1 – Accelerated Erosion

5.2 Subsection 5.1.2 Objective (c) states that: a net reduction of accelerated erosion across the region so that there is no increase in the adverse effects of flooding and land instability hazards.

5.3 The design of specific erosion and sediment management and controls is outside the scope of Gaia's geotechnical design, as is the assessment of flooding hazards.

5.4 Nevertheless, hydraulic design of the proposed surficial drainage structures within and on the fills will be required to be undertaken by a suitably qualified professional. These drains are proposed to convey both surficial stormwater and seepage water from within the imported managed fill material out of the fill landforms. The specific hydraulic design of these surface drains is necessary to mitigate erosion of the drains and the fill slope faces.

5.5 Correct implementation of the erosion and sediment controls designed by others will mitigate a potential increase in instability risk caused by erosion of the proposed fill structures.

5.6 Waikato Regional Plan Land and Soil Module Objective 5.2 – Discharges Onto or Into Land

5.7 Subsection 5.2.2 Objective (d) states that: Discharges of wastes and hazardous substances onto or into land undertaken in a manner that is not inconsistent with the objectives in Section 5.1.2

5.8 The geotechnical designs for the proposed fills have taken into consideration the types of materials included within the scope of "Managed Fill". Accordingly, subject to the correct construction, ongoing inspection, and displacement monitoring of the managed fills, as indicated in the geotechnical designs and specifications, no increase in land instability risk is anticipated.

5.9 Comment on the flooding hazard due to the proposed managed fills is outside of Gaia's scope.

5.10 Proposed Waikato District Plan (Decisions Version) Part 2: EW – Earthworks:

(a) Objective EW-01 Earthworks facilitate subdivision, use and development.

5.11 Gaia understands that the proposed managed fill works fall under the EW-01 Objectives.

(a) Policy EW-P2 (1c): Enable earthworks associated with rural or conservation activities including the importation of controlled cleanfill material to a site.

5.12 Gaia understands that some cleanfill importation may be required to construct the structural bund component of the proposed managed fills. Any imported materials intended for use within the structural containment bunds must meet the specification requirements for "Structural Fill" as provided in the relevant geotechnical design reports.

(a) Policy EW-P2 (2): Manage earthworks to ensure that: (b) The ground is geotechnically sound and remains safe and stable for the duration of the intended land use, (d) Adjoining properties and infrastructure are protected.

5.13 Geotechnical construction inspection and oversight as well as displacement monitoring during construction are specified within the relevant geotechnical design reports. The expectations and requirements for the geotechnical inspections and displacement monitoring are also specified. Should unsatisfactory performance of the managed fill be identified during geotechnical inspection or monitoring, mitigation strategies to improve the stability of the fill have also been provided.

5.14 Adjoining properties are only potentially impacted by managed fill construction with regard to geotechnical stability at Fill Area 3. Specific design has been undertaken to assess the slope stability of the proposed fill at the northern property boundary of Fill Area 3. Design slope stability factors of safety were found to be sufficient at the property boundary. Additional finite element analysis of the proposed fill also found that the risk of significant displacement at the eastern property boundary is found to be low.

5.15 The only infrastructure that Gaia is aware of being potentially impacted by managed fill construction with regard to geotechnical stability is Transpower

owned pylons near Fill Area 4. Specific design of Fill Area 4 has yet to be undertaken. It is anticipated that as the proposed fills are located downslope of the Transpower assets that stability of these assets will not be negatively affected. As noted, this assessment is subject to specific geotechnical design.

6. GEOTECHNICAL ISSUES

6.1 The Geotechnical Engineering design of the three proposed managed fills includes the following elements:

6.2 Slope Stability:

(a) Slope stability assessments have been carried out for the three proposed managed fills (Fill Areas 2 to 4). Detailed slope stability assessments have been carried out for Fill Area 2 and Fill Area 3. These assessments concluded that the proposed designs are constructable and will exhibit sufficient stability.

(b) The historic fill under Fill Area 3 was modelled based on observations of the material made during the test-pit and borehole investigations, as well as based on input from the client and local historical knowledge. Sufficiently conservative parameters for this material were therefore adopted. The results of the stability analyses for Fill Area 3 demonstrated that the historic fill material can provide sufficient support to the proposed design.

(c) The natural Waikato Coal Measure which underlies the upper slopes of the fill area gullies is known to exhibit weakness along both bedding planes and at the soil to rock transition. The design has considered worse credible case parameters for the natural materials even though evidence of this form of instability was not observed at the subject site. It was found that the stability of the proposed fills is not adversely affected and that the proposed fill actually improve the stability of the natural slopes through buttressing effects.

6.3 Overall Fill Geometric Design:

(a) Design and analysis of the overall fill shape show that the fill layout will be sufficiently stable both during construction and at the end of construction. This includes the selection of suitable external fill batter angles.

6.4 Underfill Subsoil drainage:

(a) Design of sufficient subsoil drainage has been proposed to avoid impounding shallow groundwater tables beneath the fill which could lead to instability.

(b) The proposed drainage network has sufficient redundancy in order to mitigate potential blocking of portions of the drain.

6.5 Shear Key and Structural Bunds:

(a) Structural bunds are designed to define the external shape of the fill with sufficiently stable and resilient material. Structural bund material is specified in the geotechnical design and a construction verification specification is also provided.

(b) The Basal Structural Bund is integrated with a shear key to resist lateral movement at the toe of the fill.

(c) The structural bunds are designed to contain imported managed fill materials which are by nature highly variable in composition and strength. The structural bunds mitigate the risk of managed fill flowing in an uncontrolled manner out of the designed fill area.

6.6 Drainage Blanket – Internal Drainage Elements:

(a) Drainage blankets are designed as granular fill layers every ten vertical metres of fill to control pore-water pressure in the placed managed fill. The drainage blankets will assist with safe consolidation of the placed managed fill and stability improvements over time.

(b) Drainage blankets are designed to be sufficiently redundant that positive drainage of the managed fill is maintained under the anticipated consolidation movements within the placed managed fill.

6.7 Displacement Monitoring:

(a) Displacement monitoring is proposed as the primary stability verification method during and after construction.

(b) Displacement monitoring during construction will guide the rate of fill placement.

(c) Mitigation methods for fill placement will include: reduction of the rate of filling, installation of additional drainage, and redistribution of fill within the slope.

6.8 Construction Observation and Verification:

(a) The geotechnical properties of all construction materials proposed in the fills have been specified in the corresponding design reports. Industry standard geotechnical verification testing has also been specified.

(b) Construction observations by a suitably qualified geotechnical professional at the intervals specified in the design reports will be undertaken to verify the design intentions and assess any issues. Any monitored conditions outside of those expected shall be referred to the designer for the design of improvements.

7. ISSUES RAISED BY COUNCIL OFFICER'S REPORT

7.1 We have read the report prepared by Emma Cowan and Wade Hill, the Waikato Regional Council's and Waikato District Council's respective reporting planners.

Geotechnical Peer Review

7.2 We note that the Geotechnical Peer Reviewer, Baseline Geotechnical Ltd., engaged by the Waikato Regional Council, provided additional peer review advise in their report dated 7th June 2022. Similar advice was also provided by Baseline Geotechnical to the Waikato District Council in a report dated 29th May 2022.

7.3 Baseline Geotechnical advised that the geotechnical designs prepared by Gaia were sufficient to demonstrate the stability of the proposed fill sites and that all previous comments and queries regarding the geotechnical design are now closed.

7.4 The officers for both the Waikato Regional and Waikato District Councils are satisfied with the geotechnical design prepared by Gaia based on the advice from the peer reviewer Baseline Geotechnical Ltd.

7.5 The Waikato District Council's officer noted submitter's concerns regarding potential negative impacts on stability, particularly at Fill Area 3. They are satisfied that the proposed designs can achieve sufficient stability based on the advice prepared by Gaia and the peer reviewer Baseline Geotechnical. Furthermore, they note the proposed consent conditions which includes a final certification of the designs by the Council prior to construction as an additional check.

8. ISSUES RAISED BY SUBMITTERS

8.1 A total of 42 submissions have been received. The topics raised in submissions that we can comment are as follows:

(a) Impacts on geology[1]

(b) Impacts on stability.[2]

8.2 Impacts on geology

8.3 The proposed fills will predominantly be placed on top of the existing ground surface.

8.4 In the case of Fill Sites 2 the primary subgrade geology includes material belonging to the Waikato Coal Measures unit and the Newcastle Group unit.

8.5 For Fill Area 3 the primary subgrade geology comprises of Waikato Coal Measures along the existing slopes, and historic mining fill at the base of the fill.

8.6 For Fill Area 4 the primary subgrade geology is currently modelled to be entirely Waikato Coal Measures, however this has not been confirmed through detailed investigation.

8.7 Placement of fill (including managed fill) upon these geological units is a common occurrence in Auckland and the Waikato region.

8.8 The only noticeable impact that placing fill upon these geologies is consolidation of the weathered soil mantles under the weight of the placed fill. Consolidation and the associated settlement at the surface is confined to the existing shallow soils within the area immediately underneath the fill and will be of a relatively low magnitude. These settlements are also expected to occur gradually with the gradual placement of the proposed fill. As such, the settlements will not be noticeable from outside of the fill area.

8.9 Impacts on Stability – Fill Area 3

8.10 Submissions #9, #16 and #26 have identified the historic placement of fill which Fill Area 3 will be partially founded on and the concern regarding the

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1 Submissions of: Norm Hill (#7)

2 Cyril & Marion Shanley (#9), Paul Vitasovich (#16) David Whyte on behalf of the Huntly Community Board(#26).

strength of this material and therefore the stability of placing additional material upon it.

8.11 The historic fill was identified independently by Gaia during the initial test pit geotechnical investigations undertaken in 2019. The 2019 investigations were unable to penetrate the full thickness of the fill at the proposed toe of the fill. A second attempt was made with a long-reach excavator which was able to dig a test pit to 12.0m depth from the existing ground level and was also not able to penetrate the fill. Two additional boreholes were thus drilled in 2021 to 24.0m and 25.95m depth near the proposed fill toe. These boreholes penetrated the fill into the natural weathered rock at 21.0m and 22.5m depth respectively. Plotting of these results on the geological cross sections (Drawing No.: 2354-74-50 and 2354-74-51, included in Appendix A of report ref.: 2325-74-GQ-01) demonstrates a reasonable geological profile that is generally in agreement with the general shape and profile of the nearby natural (unmodified) gullies. We are therefore confident that these boreholes penetrated the historic mining fill into the underlying natural ground.

8.12 Detailed stability analysis utilising both limit equilibrium and finite element modelling computerised methods were undertaken. Suitably conservative geotechnical parameters for the historic fill material were selected to reflect the variable and uncontrolled (from a geotechnical engineering perspective) nature.

8.13 Deep drainage trenches (approximately 10m deep from the existing ground level) have been designed within the historic fill to release porewater pressure in order to gradually obtain strength grain within this material.

8.14 It was calculated that the stability of the historic mining fill remains sufficiently stable under the proposed weight of the completed managed fill. It was also demonstrated that the existing stability of the historic mining fill at the historic fill toe in the neighbouring property is not quantifiably reduced by the presence of managed fill at Fill Area 3 due to the relative distance being large. Finite element models which enable the computation of displacements both within the proposed fill and the underlying existing fill demonstrated that even under suitably conservative conditions, movement within the founding historic fill does not meaningfully extend beyond approximately 40m from the proposed fill toe.

8.15 Regardless of the numerical modelling that has been completed, displacement monitoring of the fill during construction will be a necessary condition. This monitoring will serve as verification of the design and the

numerical models. Mitigations for excessive displacement will include reduction in the rate of filling, additional drainage and relocation of managed fill.

9. COMMENTS ON CONDITIONS

9.1 Fill Stability – Conditions 6, FA3 to Property Boundary

(a) The area between the Fill Area 3 footprint and the neighbouring property boundary has been assessed using 2D finite element modelling methods to evaluate displacement under the loading of the proposed fill. The actual distance between the toe of the fill and the property boundary may be shorter than that initially calculated and reported on due to the uncertain property boundary position at the time of reporting. Nevertheless, the majority of the calculated displacements are conservatively contained within the first 30m horizontal from the toe of the fill and these displacements are of a relatively small magnitude. Displacements will be monitored during construction as per the monitoring plan shown on drawing no.: 2325-74-103 included in Appendix A of the 2325-74-GQ-01 design report. Mitigation measures will be required if excessive displacements are noted on the existing ground between the fill toe and the boundary.

(b) It is noted that the owner of the property located at the northern boundary of Fill Area 3, Mr Mike O'Reilly, has provide written approval to the proposed managed fill site.

9.2 Fill Stability – Condition 7, Annual Geotechnical Reporting

(a) Annual reporting of the geotechnical conditions and performance of the managed is a good practice.

9.3 Fill Stability – Condition 8, Fill Placement Stability

(a) Due to the variable nature of managed fill, good earthwork practices must be followed when spreading and placing it. This includes, but is not limited to, avoiding end-tipping at the upper slope, and placing material that is too wet to be trafficked by construction machinery without conditioning.

9.4 Fill Stability – Condition 9, Geotechnical Best Practise

(a) The referenced earthworks specification outlines the minimum requirements in terms of geotechnical supervision and expectations.

The managed fill operator will be required to engage with the supervising geotechnical engineer and adhere to these requirements.

9.5 Fill Stability – Condition 10, Testing and Monitoring

(a) Observation of the fill material is a critical component of the geotechnical design for the managed fills. Accordingly, it will be imperative that the testing requirements and displacement monitoring are adhered to both during and after construction.

10. CONCLUSIONS

10.1 Based on the geotechnical investigations and designs undertaken by Gaia for the proposed managed fills at Huntly Quarry, we are of the opinion that the proposed fills are constructable and will exhibit sufficient geotechnical performance and meeting acceptable geotechnical design guideline requirements.

10.2 The geotechnical design has been based on a selection of parameters with a sufficient level of conservatism relative to the level of investigation and uncertainty in the ground models. This uncertainty is particularly applicable to the historic fill which has been placed in Fill Area 3.

10.3 The proposed managed fills can be constructed without decreasing the stability of the existing slopes as demonstrated through slope stability analyses.

10.4 Performance of the proposed fill and existing historic fill can be verified during construction through on-going displacement monitoring. Sufficient mitigation strategies are available should excessive displacements be observed. These mitigation strategies can be implemented before significant instability is trigged.

10.5 The geotechnical peer reviewer engaged by the Waikato District and Regional Councils, Baseline Geotechnical Ltd., has indicated that the designs by Gaia have been prepared in using geotechnical best practices. All geotechnical peer reviewer comments have been closed/resolved at the time of submission.

Ka-Ching Cheung
Matthew James Kernot
GAIA Engineering Limited
21 November 2022