BEFORE A HEARING COMMISSIONER
APPOINTED BY KĀPITI COAST DISTRICT COUNCIL

Under the	of the Resource Management Act 1991
And	
In the matter	of an application for resource consent by Gresham Trustee Limited under Section 88 of the Act, to undertake a 302-lot fee simple subdivision, the construction of 135 dwellings, and associated earthworks at 240 Kāpiti Road, Paraparaumu.

STATEMENT OF EVIDENCE OF NEIL JAMES CHARTERS (GEOTECHNICAL ENGINEER) ON BEHALF OF THE APPLICANT

Dated: 26 October 2022

INTRODUCTION

1. My name is **Neil Charters.**

2. I am a Principal Geotechnical Engineer at ENGEO.

3. I have the following qualifications and experience relevant to the evidence I shall give:

   (a) I have a Master of Engineering (Dist.), Geotechnical Engineering, from the University of Canterbury, and Bachelors in Science (Hons), Engineering Geology, University of Canterbury and University of Otago.

   (b) I am a CPEng Chartered Professional Engineer (Number 1006195) and a member of the NZGS (New Zealand Geotechnical Society).

   (c) I have more than 15 years' experience working with ENGEO and other geotechnical firms. My work has had a particular focus on:

      (i) Deep Foundations;

      (ii) Earth Retaining Structures;

      (iii) Foundation Design;

      (iv) Geologic Hazard Evaluation;

      (v) Landslide Investigations and Repairs;

      (vi) Liquefaction Analyses; and

      (vii) Slope Stability.

Code of Conduct

4. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. Unless I state otherwise, this assessment is within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Background and Role

5. I have been working on the Project since January 2022, and my input has included technical oversight and review of our geotechnical report and RFI responses, as well as meeting with contractors to discuss the methodology for the boundary retaining walls.

6. The geotechnical reports for the site are as follows:

   (a) Desktop Study Report (ref: 19667.000.001_01 issued 18/11/2021).

   (b) Site Investigation and Geohazard Assessment (ref: 19667.000.001_02 issued 28/01/2022).

   (c) Geotechnical RFI Replies (ref: 19667.000.001_03 issued 24/05/2022).

Purpose and Scope of the Evidence

7. The purpose of my evidence is to briefly summarise the key aspects of the geotechnical hazard assessment, and how it is planned to mitigate these hazards.

8. My evidence addresses:

   (a) Our geotechnical investigations and the ground conditions on site.

   (b) Geotechnical hazards affecting the site.

   (c) Mitigation Measures for these hazards.

   (d) Construction sequence for retaining walls that will be required on site boundaries.

EXECUTIVE SUMMARY

ENGEO has completed a desktop study, conducted a subsurface investigation consisting of test pits and Cone Penetrometer Tests (CPTs), and an assessment of geohazards that could affect the proposed development, including a computational liquefaction analysis.

We consider that the geohazards assessed within our reports either do not pose a significant risk to the proposed development, or where risks are identified, they can be suitably mitigated via the methods discussed within our reports.

SPECIFIC EVIDENCE

Geotechnical Investigation and Subsurface Conditions

9. ENGEO's subsurface investigation consisted of six CPT tests and 15 Test Pits across the site. A generalised summary of the subsurface conditions is provided within Table 1.

Table 1: Summary of Subsurface Conditions

Description	Depth to Top of Layer (m)	Depth to Bottom of Layer (m)	Material Consistency / Density
SAND [TOPSOIL]	0	0.3 – 0.4	Loose
SAND* [FILL]	0	0.6 – 0.7	Loose
SAND [Dune Sands]	0.3 – 0.7	Unknown	Medium Dense to Very Dense

10. Groundwater was encountered at 2 m depth.

11. Based on our previous experience in the Kāpiti Coast area, localised peat deposits with thicknesses up to 2.5 m can occur. ENGEO site investigations encountered peat deposits within one test pit in the proposed development area, however, due to the variable nature of peat deposits, it is possible peat deposits could be present on site. The project and construction teams should be aware that peat deposits may be uncovered during the construction phase.

Geohazard Assessment

(i) Liquefaction

12. We assessed the liquefaction potential in accordance with the recommendations presented within the MBIE / NZGS Earthquake Geotechnical Engineering Module 3A using the data gathered from the CPT investigation. Our methodology and a discussion of the results have been provided in Section 4.3 of our Geotechnical Investigation Report.

13. From our liquefaction analysis, we consider that the potential for seismically induced settlements at the site during SLS shaking is low and within building code tolerance. In a 1 in 100-year event, it is possible that settlements up to 80 mm could occur within the liquefiable layers. Under ULS shaking events up

to 130 mm of settlement may occur within the liquefiable layers. This is a relatively significant hazard and thus requires specifically designed mitigation measures rather than relying upon the building foundation to tolerate these displacements.

14. A summary of the calculated vertical free-field settlements has been provided in Table 2.

Table 2: Calculated Vertical Free-field Settlement

CPT Identifier (All investigations to 15 m below ground level)	SLS (1 in 25 Year Event)	1 in 100-Year Event	ULS (1 in 500-Year Event)
	Calculated Vertical Settlement (mm)		
*CPT01	Negligible	10	30
CPT02	Negligible	40	110
CPT03	Negligible	40	130
CPT04	Negligible	60	140
CPT05	Negligible	80	140
*CPT06	Negligible	Negligible	25

(ii) Lateral Spreading

15. ENGEO considers that lateral spreading poses a plausible hazard to future development of the site under ULS conditions. In this situation, the soils above the water table could move laterally in the direction of the free face (ponds in this instance). As the ponds are to the east of the proposed houses, then soil movement would be towards the east. Generally, soils move more the closer to the ponds they are. Without mitigation, lateral spread can severely damage buildings.

16. This hazard has the potential to affect the easternmost corner of the proposed development (area closest to the pond).

Consideration of Section 106 of the Resource Management Act (1991)

17. ENGEO considered the geohazards that could affect the site and suggested mitigation options to meet the requirements of the RMA where required.

18. A summary of geotechnical hazards that could affect the site and suitable mitigation options for each hazard are outlined in Table 3 and are discussed in more detail in Section 5 of our Geotechnical Investigation Report.

Table 3: Geotechnical Hazards and Potential Mitigation Options

Hazard	Potential Mitigation Options	Comments
Ground shaking	Design to the NZ building code	-
Consolidation settlement in peat / organic soils	Foundations to be designed to mitigate against effects of static settlement. Removal and replacement of peat / organic soils, where encountered.	Organic soils only encountered in one test location; however isolated pockets could be present across the site.
Liquefaction	Placement and compaction of geogrid reinforced, engineered fill* rafts beneath the building footprints, potentially combined with Rib Raft, or waffle slabs.	-
Lateral Spreading	Building set back zones in areas where lateral spreading may pose a hazard to development; OR Placement and compaction of geogrid reinforced, engineered fill* rafts beneath the building footprints, potentially combined with Rib Raft, or waffle slabs.	-
Shallow slope failure	Regrade the site to form flatter slope angles. Creation of setback zones and / or site-specific mitigation works where flatter batters are not suitable.	At the time of writing this report it is understood that the site will be largely relevelled using cut to fill earthworks. Removal of the dune features will remove the slope failure hazard.

*It is likely that site-won sand soils will be suitable for use as engineered fill rafts, although placement and compaction of sandy soils will be challenging.

Boundary Retaining Walls – In Areas of Cut

19. The project team agreed to a construction methodology for the boundary retaining walls, subject to detailed geotechnical design at Building Consent stage. The methodology is comprised of three phases, as discussed in our RFI response. A summary of the proposed phases is provided below.

20. Phase 1 will consist of a temporary retaining structure, most likely comprised of a Continuous Flight Auger (CFA) Pile Wall, in the areas where the proposed earthworks cuts are greater than 1.5 m. In the areas where the proposed cuts are less than 1.5 m, Sheet Piles could be used. Once the temporary retaining

measures have been completed, the ground in front of the wall can be safely removed without affecting the neighbouring properties.

21. Phase 2 will consist of ground improvement works to reduce the risk of liquefaction of the soils supporting the walls. ENGEO and the project team have considered densification of the soil immediately in front of the proposed walls via Displacement Drilled Piles (DDP), or Stone Columns as possible solutions in this situation. The suitability of the DDP ground improvement method will be tested on site prior to any earthworks being undertaken. This site-specific trial is discussed in more detail in our RFI response letter.

22. Phase 3 will consist of permanent retaining solutions, to be constructed once the liquefaction risk in the soils is suitably mitigated. The permanent retaining solutions will likely be permanently retained via an L-shaped, concrete block cantilever retaining wall. This will allow the retaining structure to rely on the strength of the improved ground within the site boundary, and no longer require the support of the potentially liquefiable soils on neighbouring properties.

23. The details of this methodology will be confirmed during the detailed design phase of the project.

Boundary Retaining Walls – In Areas of Fill

24. Fill earthworks have been proposed around parts of the western and north-western boundaries. ENGEO considers that gravity of L-shaped block cantilevered walls will be suitable for retained heights in this area up to 1.4 m. Setback distances for the proposed buildings may be required at roughly a 1:1 ratio. The foundations of these retaining walls will require some form of liquefaction mitigation, such as the geogrid reinforced fill rafts that have already been proposed for the site.

RESPONSE TO SUBMISSIONS

25. Ms Bloemgarten raises liquefaction effects as a part of her submission. ENGEO has addressed these effects as part of the assessment described above and in our reports.

RESPONSE TO COUNCIL OFFICER'S SECTION 42A REPORT

26. No substantive geotechnical disagreements were identified in the s42a report.

Neil James Charters