



26 August 2024

RE: Geotechnical Investigation for Proposed Second Residence at 803 Golden Stairs Road, Mareretu (Allot 207A PSH of Mareretu).

Wiley Geotechnical Limited (WGL) was requested by Kyle Brown to provide a geotechnical investigation and guidance on foundation design for a proposed new build of a 2-bedroom dwelling. We have received and reviewed a Site Plan produced by Kyle Brown (Project No: 40, dated May 2024). We understand the dwelling is proposed to be constructed upon a concrete foundation, with timber pile foundations to support the roof of the verandah.

WGL visited the site on 19th August 2024 and made the following observations:

- The proposed house site is located on a gentle west facing slope, earthworks have taken place to create the building platform.
- A surface water cutoff drain is located upslope of the proposed building site.
- The ground falls gently to the west and it is understood the western side of the house platform is to be raised with engineered fill to create a level platform for the concrete slab foundation.
- Due to previous earthworks some non-engineered is expected.
- No obvious signs of instability were noted impacting the location of the proposed building platform, instability was noted on steeper slopes on site away from the proposed building platform.
- Two hand augers and Four Scala Penetrometer (Scala) test were undertaken within the proposed building site to a maximum depth of 1.4 m below ground level.

Geology

The GNS map for the site indicates that it is underlain by Taipa Mudstone (Motatau Complex) in Northland Allochthon Group comprising "Grey to blue-grey, calcareous mudstone, commonly with redeposited glauconitic sandstone beds".

NRC GIS Hazards Map

We have reviewed the Northland Regional Council (NRC) GIS maps in relation to the subject site. There were no hazards indicated by the maps in the vicinity to the subject site.

PO Box 401172, Mangawhai Heads, 0541

Seismic Hazards

Since there are no known active faults crossing the property, it is our opinion that ground rupture is unlikely at the subject property. Granular soils, such as sand, are susceptible to liquefaction in the event of future earthquakes. This may result in settlement or lateral deformation. Based on the regional earthquake risk (discussed further below) and depth to groundwater, it is our opinion that there is a relatively low risk of liquefaction induced settlement or lateral movement such that specific liquefaction design is not required.

We recommend that the future structures and improvements are designed to account for seismic shaking and ground motions. For seismic design at the site and in line with NZS 1170.5:2004 the corresponding design peak ground accelerations (PGA) for the site have been calculated from NZS 1170.5:2004 using the recommendations of the New Zealand Geotechnical Society as follows:

$$a_h = Z R C I_n$$

which:

Z = base PGA called "Hazard factor" and is given by Table 3.3 and Figures 3.3 and 3.4 of NZS 1170.5:2004. Z = 0.13 for areas north of Auckland.

R = "Return period factor" and is given by Table 3.5 of NZS 1170.5:2004 (R = 1.0 for 500 year return period and R = 0.25 for a 25 year return period)

C = Site response factor called "Spectral shape factor" in NZS 1170.5:2004 and is based on the seismic site classification. We consider this site to be **Class C**, based on soil depth and therefore C = 1.33.

The design PGA at the site is given as:

$$\text{ULS: } a_h = 0.13 \times 1.00 \times 1.33 = 0.17 \text{ (i.e. PGA = 0.17 g)}$$

$$\text{SLS: } a_h = 0.13 \times 0.25 \times 1.33 = 0.04 \text{ (i.e. PGA = 0.04 g)}$$

Field Exploration and Subsurface Conditions

WGL carried out a shallow subsurface investigation consisting of two hand augers with shear vane testing and four Scala Penetrometer (Scala) tests within the approximate areas shown on the site plan below.

Image sourced from Google Earth	
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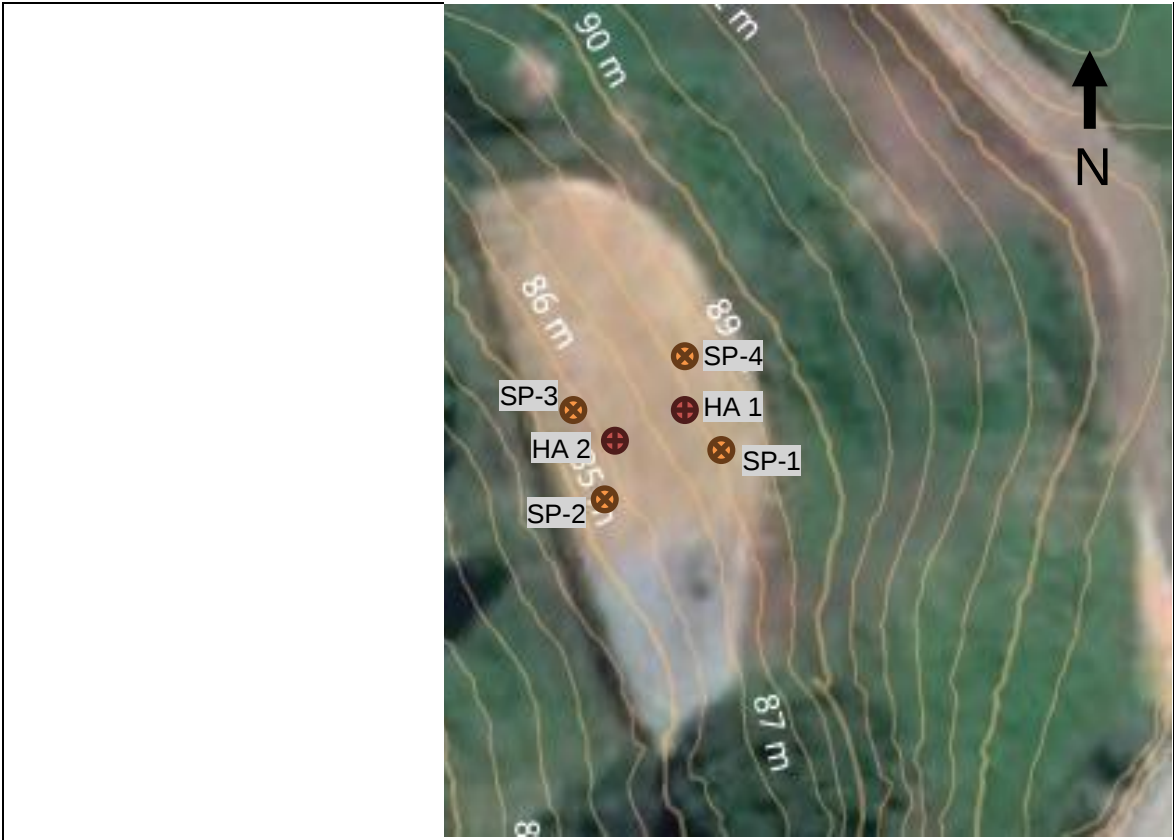


Figure 1: Approximate Subsurface Exploration Locations

The hand augers were carried out to depths of 1.0 m and 1.4 m. The subsurface material encountered in our hand auger investigation generally consisted moderately clayey silt grading into dry weathered rock at 1.0 m and 1.4 m. The measured undrained shear strengths ranged between 71 kPa and an inferred >200 kPa. The results of the individual Scala tests are shown below.

Groundwater was not encountered during our testing.

Based on this, it is our opinion that the material encountered in our subsurface investigation is broadly consistent with published geologic mapping. The bore logs are presented as an appendix to this report and are written in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005).

Scala Results

Scala blows/100mm at 803 Golden Stairs Road, Mareretu

(m)	Scala 1 (SP1)	Scala 2 (SP2)	Scala 3 (SP3)	Scala 4 (SP4)
0.1	1	0	0	1
0.2	1	1	2	2
0.3	0	1	0	2
0.4	1	0	1	1
0.5	1	1	3	1
0.6	2	3	4	2
0.7	3	2	3	2
0.8	5	2	3	2
0.9	5	2	4	2

Expansive Soils

Expansive clay and silt soils are common in the wider Northland region and have the tendency to shrink and swell, particularly with seasonal fluctuations of soil water content. This behavior has implications for foundation design and surface structures and should be incorporated during foundation design.

Based on our visual and field assessment of the soils encountered onsite, and our experience in the area, we consider that the Expansive Site Class for this site is “M - moderate” - in accordance with AS 2870. Accordingly, the minimum footing depth is 600 mm below cleared ground level.

Conclusions and Recommendations

It is our opinion that the proposed development is feasible from a geotechnical point of view, provided the recommendations presented in this report and standard development practices are incorporated in the design and construction of the project.

The soil underlying the site does **not** reach “good ground” in the upper metre as defined in NZS 3604 (2011) based on the Scala results as the requirement is 5 blows per 100 mm with a Scala Penetrometer; however, the shear vane readings indicate a suitable bearing capacity is available for the proposed house, with readings generally greater than 70 kPa.

Concrete Foundation

All topsoil and fill material must be removed before foundation construction commences.

We recommend that a minimum 300 mm layer of compacted hard fill is placed prior to applying blinding sand for any reinforced concrete slab and foundation elements have a minimum embedment depth of 0.6 m. We recommend a minimum 300 mm layer of compacted hard fill is placed for a waffle slab (i.e Rib-Raft) with the foundation being designed for expansive site class ‘M – Moderate’, as per AS 2870.

We recommend the following regarding hard fill and its placement:

- Underslab hard fill comprising GAP40/GAP65, or an equivalent approved product, should be placed across the building platform in 100 mm lifts and compacted using appropriate compaction plant (e.g. a hand held or excavator mounted vibrating compaction plate), and brought up to the finished design levels. We would recommend a high quality gravel without too many fines.
- For fills greater than 0.6 m. Every third layer of hard fill lift should be observed and tested by WGL to confirm that it has been placed to an appropriate specification. At this stage it is anticipated that compaction should be to achieve 95% of the maximum dry density (MDD) of the material, to be confirmed onsite using either a NDM (nuclear densometer) or Impact Hammer testing (Target 15 CBR).

A geotechnical ultimate bearing capacity of 200 kPa may be used in the design of a reinforced concrete slab or a waffle slab (i.e. Rib Raft). The ultimate bearing capacity should be available provided that the hard fill has been placed and certified according to the construction specification. We recommend WGL, or a qualified geotechnical engineer, inspect any excavations prior to the placing of any fill or foundation elements.

Pile Foundation – Verandah Roof

It is our opinion that wooden piles designed in accordance with NZS3604 (2011) will provide a suitable foundation for the proposed development. We recommend all piles are H5 treated and have a minimum 125 x 125 mm dimensions. Pile holes should be bored with a minimum diameter of 400 mm. We recommend that all piles are embedded to a minimum depth of 1.0 m. Final pile embedment and dimensions should be verified by a structural engineer/designer taking into account the wind loading and structural load requirements.

The piles should meet NZS3640 Class H5, and cut surfaces should be retreated with a protective coating in accordance with the manufacturer's recommendations. Piles should not be spliced.

All bored holes should be inspected by WGL, or a qualified geotechnical engineer, prior to continuing with foundation construction

A geotechnical ultimate bearing capacity of 300 kPa should be available.

Earthworks

For the development scheme provided we anticipate the majority of the earthworks will be limited to site clearing and construction of the building platform for the proposed dwelling. We recommend that any site concept plans be discussed with WGL or suitably qualified Geotechnical Engineer familiar with the site and the contents of this report.

In addition, we suggest the following:

- All cut surfaces should be inspected by WGL (or suitably qualified Geotechnical Engineer) prior to placing any fill to ensure founding conditions are as anticipated;
- All excavated soil to be removed from site or placed in an engineered stockpile that is strategically placed such that it would not trigger slope instability. If there is any soil to be placed permanently on site, we suggest contacting WGL for further guidance;
- In areas of tree removal where planned structures or roadways are located, the full root ball should be removed;

- Any proposed earthworks and drainage plans should be approved by a suitably qualified Geotechnical Engineer familiar with both the site and the recommendations within this report for review and comment;
- Fill placement, should be placed in accordance NZS 4431 – Code of practice for Earth Fills for Residential development. Fill should be placed on a suitably stripped and prepared subgrade including the removal of any non-engineered fill;
- Additional design-level earthwork recommendations are required if cut and fills are greater than 600mm; and
- All proposed batter slopes should be restricted to gradients no steeper than 1v:3h.

Drainage

We recommend that the existing cut-off drain upslope of the proposed house site is cleared out to help catch stormwater run-off from the upslope areas. The drain should have a minimum width of 500 mm and depth of 300 mm, and discharge downslope clear of the proposed dwelling. The outlet should have a 3 m section of rock rip rap to protect against any scour. The rip-rap apron should have a minimum width of 1 m and depth of 0.3 m, and be filled with 150-300 mm clean rock.

Counterfort/subsoil drains are recommended to intercept groundwater from effecting the building site and help improve the overall stability. The final location shall be confirmed by the geotechnical engineer on site; however, we envisage the locations being offset to the northern and southern ends of the building including verandah. We recommend the trenches be a minimum depth of 1.0 m to 1.5 m down to the weathered rock, and 500 mm wide with a 110 mm punched PVC pile (Novoflow or similar) at the base backfilled with suitable drainage metal. The base and sides of the trench should have a layer of geotextile cloth (Bidim A29, Cirtex AS410 or a similar approved product). The outlets will be near the western boundary.

LIMITATIONS

- (i) This report has been prepared for the use of our client, Kyle Brown and their professional advisers and the relevant Regional Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- (ii) Assessments made in this report are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this report based on accepted normal methods of site investigations. Variations in ground conditions may exist between test locations and therefore have not been taken into account in the report. If variations are found during excavation or at foundation preparation stage WGL should be notified immediately so we can amend our recommendations.
- (iii) This Limitation should be read in conjunction with the ENZ/ACENZ Standard Terms of Engagement.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned at richard@wileygeotechnical.co.nz or matt@wileygeotechnical.co.nz if you require any further information.



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Attachments:

- *Bore Logs*

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
Motatau Complex in Northland Allocthon	SILT light grey with orange brown staining, moderately clayey, moderately plastic moist to wet		1				44 71 60 97 24 74 37 97	
	light brown, friable, dry grading into weathered rock							
	E.O.B: 1.4 m						200	15
			2					
			3					
			4					
			5					

NOTES Groundwater was not encountered.

Hand auger encountered practical refusal at 1.4 m upon weathered rock material

LOGGED BY: MD & CS

DATE DRILLED: 19-Aug-24



WILEY GEOTECHNICAL LTD

BOREHOLE No. 2

SITE: 803 Golden Stairs Road, Mareretu

REF: 24079

Sheet 1 of 1

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
Motatau Complex in Northland Allochthon	SILT light grey with orange brown staining, moderately clayey, moderately plastic							
	light brown, friable, dry grading into weathered rock		1				50 84 200	
	E.O.B: 1.0 m							15
			2					
			3					
			4					
			5					

NOTES Groundwater was not encountered.

Hand auger encountered practical refusal at 1.0 m upon weathered rock material

LOGGED BY: MD & CS

DATE DRILLED: 19-Aug-24