GROUND INVESTIGATION REPORT FOR

PROPOSED RELOCATABLE BUILDING

633 RANGITUKIA ROAD, TIKITIKI, GISBORNE

Project Reference: 15934
4 June 2019

1 GENERAL

LDE Ltd was engaged by Michael Russell to undertake a ground investigation for a relocatable building proposed to be located on a site at 633 Rangitukia Road, Tikitiki in accordance with the Gisborne District Council (GDC) Bearing Capacity and Geotechnical Investigation Requirements.

The purpose of the investigation was to determine the nature and strength distribution of the soils beneath the building proposed to determine the depth to "Good Ground" as defined by NZS3604 (2011) "Timber Framed Buildings". In addition, its purpose was also to determine foundation recommendations to address ground which is lower in bearing capacity, and that which includes non-engineered fill, expansive soils, or other materials which could be detrimental to the long-term integrity of the foundations.

2 SITE SETTING AND CONDITIONS

The subject property is located in a rural area approximately 6km northeast of the township of Tikitiki, and 2km northwest of the mouth of the Waiapu River. The proposed dwelling is to be located approximately 100m northwest of the intersection of Rangitukia and Beach Roads in a generally level paddock. The Maraehara River (a tributary of the Waiapu) exists some 50m to the south of the proposed building site, whilst a creek is located approximately 55m to the east of the site, adjacent to Rangitukia Road. A line of established, large trees are present approximately 15m to the north. At the time of the investigation the site was under pasture.

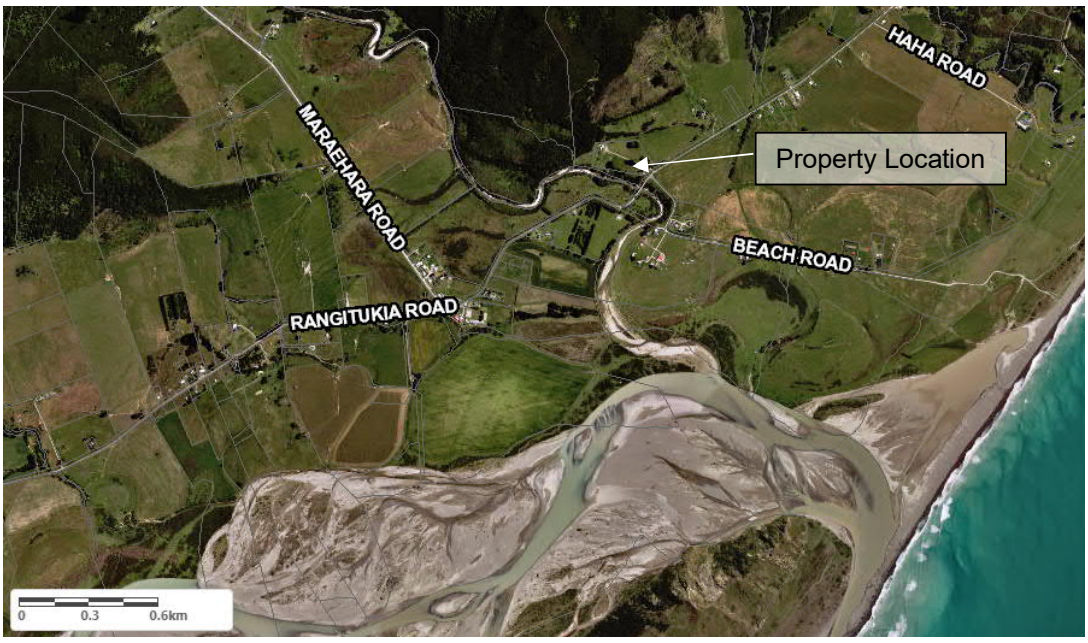


Figure 1: Property location

Figure 2: View northeast over approximate location for proposed dwelling (in red).

3 PROPOSED BUILDING

An approximately 80m^2 relocatable, single storey, light timber framed building with lightweight cladding and timber pile foundations is proposed. A deck on the east side of the building is also proposed.

4 INVESTIGATION

Our investigation of the site included the following work:

1) A walkover assessment of the site and surrounding area to assess its geomorphology and any features which may potentially influence the long term behaviour of the site.
2) Four 50mm hand augered boreholes put down to 2.5m depth or refusal with shear vane readings taken every 200mm; each forming a test site generally located at the corners of the proposed building.

The locations of the subsurface investigations are shown on the follwing page. Logs of the boreholes are appended.

The field work was completed in autumn 2019.

Figure 3: Site investigation plan. "TS" represents a test site where each borehole was put down.

5 SUBSURFACE CONDITIONS

5.1 Soil Profile and Strength

The appended soil profile shows an interpretation of ground conditions beneath the site.

In summary, the investigations indicate that the site is underlain by moderately organic silt (Topsoil) down to 0.2m to 0.6m depth.

Underlying this topsoil, the investigations show that moderate to high strength alluvial deposits are generally present extending down to at least 1.7m to 2.5m depth. These alluvial deposits are predominantly a moderate to highly plastic clay with varying amounts of silt and sand.

Three of the hand auger tests encountered high-density material preventing their advancement to the target depth of 2.5m. A road cutting approximately 60m to the east of the site contains gravel and cobbles within a silty and sandy matrix, as illustrated in Figure 4. The soil units observed above these materials are consistent with those encountered under the proposed building site and the sharp contact preventing advancement of three of the site tests is also consistent with encountering high density gravel/cobbles as exposed at the road cutting, at approximately the same elevation.

Being a terrace landform, depositional environments are considered likely to be the same, thus the course gravel/cobble unit is expected to pass under the proposed building site.

Figure 4: River gravels exposed in nearby cut bank.

5.2 Soil Moisture and Ground Water Levels

Groundwater was not encountered in the boreholes. Perched water (wet ground) was encountered in TS1 and TS2 between 0.8m and 1.0m depth. We expect the permanent groundwater table to be at least 5m beneath the ground surface based on the location and elevation of the site relative to the Maraehara River (50m to the south and 9m in elevation below the site).

5.3 Slope Stability

A detailed slope stability assessment for the site was outside of our work scope, however, a qualitative assessment was conducted.

Our assessment indicates the area is fundamentally stable and poses a low risk of slope instability affecting the building platform.

The nearest slope of any significance, the bank of the Maraehara River, is present over 50m to the south of the site. The bank of the river is approximately 9m high in elevation and appears to be standing relatively well, which in our opinion is likely to be a reflection of the high density materials observed in the slope exposures to the east of the site.

Given this, combined with the distance of the feature from the site, we consider that the platform is at a low risk of being affected by slope instability.

5.4 Possible Liquefaction Potential

A detailed liquefaction hazard assessment for the site was outside our work scope. The sub-surface investigation data as well as assessment of road cuttings and the river bank 50m and 55m to the south and east of the site respectively, indicates that most of the soil encountered was not liquefiable. Therefore the potential for liquefaction-induced settlement of the site due to earthquake shaking is considered to be low. Furthermore, given that the proposed building is single storey, and is to be constructed of light materials, exceedance of building performance criteria as outlined in the NZ building code up to ULS level is considered unlikely as a result of liquefaction.

5.5 Shrink-Swell Potential

Plastic soils can be subject to shrinkage and swelling due to soil moisture content variations which can result in apparent heaving and settlement of buildings, particularly between seasons.

The near surface soils appear to be low to moderately expansive soils with a liquid limit below 50% based on their physical characteristics determined during field testing. As such, the potential for vertical movement within the near surface soils due to variations in soil moisture is expected to be low.

6 ENGINEERING RECOMMENDATIONS

6.1 General

We consider that the proposed timber pile foundation system is appropriate for the site.

Recommendations for the design and construction of the foundations and other aspects of site development are given in the following sections.

6.2 Foundation Recommendations

We recommend that the pile footings be taken to a minimum 0.4m depth or through the topsoil into the underlying brown alluvium (whichever is deeper). Based on the test data, a depth range of 0.4m to 0.6m is expected.

At the recommended foundation depths, a geotechnical ultimate, factored and allowable bearing capacity of 300kPa, 150kPa, and 100kPa respectively, is expected to be available. This allows the foundation designs given in NZS3604(2011) to be used without modification, except for the expected slight deepening of the ordinary piles.

Prior to the construction of the foundations, all cuttings from the foundation excavations need to be removed to avoid the excessive foundation settlement due to the consolidation of the cuttings with loading. This is also in accordance with NZS3604 (2011) which requires all footings to be on undisturbed good ground.

6.2.1 Verification Checks Required

Verification testing of the ground by a GDC Building Inspector or Suitably Qualified Professional is recommended to ensure that the ground conditions at the base of the foundation excavations are as described in this report, and that all unsuitable and loose materials have been removed as required by NZS3604 (2011). We should be contacted immediately if these conditions vary from that described in this report. Deepening of the foundations or a modification to the recommendations or design may be required.

6.2.2 Settlement

Provided that the recommendations above are adhered to we expect static load settlements to be less than 25mm, and static differential settlements are expected to be within design tolerances.

6.3 Ground Contouring

The site should be graded so that water cannot pond against, beneath or around the building for the economic life of the structure.

Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

6.4 Trees

We consider that that gardens and trees can be established adjacent to the building, however due to the detrimental effect that these can have on the building (particularly trees) we suggest the following be taken into consideration:

- The development of the gardens should not interfere with any subfloor ventilation or the drainage system for the building.
- Care should be taken to avoid the over watering of gardens close to building footings.

To reduce the potential for heave damage associated with tree root growth or foundation settlement due to soil shrinkage due to moisture uptake by the trees, trees should be planted a minimum of 0.5 times the mature height of the tree away from the foundation.

The line of established trees 15m north of the proposed building site is considered to be low risk in which potential heave damage could be caused.

6.5 Surface Water Disposal

It is important to ensure that all surface water from roof, paved and retaining wall areas is appropriately collected and discharged to a suitable point sufficiently away from the building and areas of fill.

The stormwater system for the building should be operational as soon as the roof is in place. This is to ensure that the ground within the vicinity of the building is not compromised by the negative effects and potential consequences of soil saturation.

7 OTHER CONSIDERATIONS

This report has been prepared exclusively for Michael Russell with respect to the particular brief given to us. Information, opinions and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

This report was prepared in general accordance with current standards, codes and practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods, and subsurface investigations at discrete locations. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from that described in this report.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

Construction site safety is the responsibility of the builder/contractor. The recommendations included herein should not be construed as direction of the contractor's methods, construction sequencing or procedures. LDE Ltd can provide geotechnical recommendations during construction, upon request.

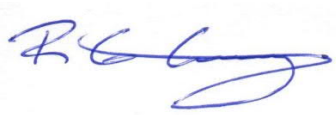
If you have any questions, please contact the engineer who prepared the report (Janelle Taplin) in the first instance.

For and on behalf of LDE Ltd

Report prepared by:

Janelle Taplin
BSc(Geology). PMEG
Engineering Geologist

Report reviewed by:



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LAND DEVELOPMENT & EXPLORATION LTD.

Michael Russell
Proposed new dwelling at 633 Rangitukia Road, Tikitiki

LDE Project No.:	15934
Investigation Date	8/05/2019
Testing by:	NJS & JMT
Checked by:	RGC

TS1

Depth (m)	Graphic	Blows/50mm	Shear strength (kPa)	Soil Description
0.00–0.15				SILT, some clay, rare rootlets, moderate plasticity, brownish black, moist (Topsoil)
0.20–0.45			131	CLAY, some silt, moderate plasticity, brown, moist (Alluvium)
0.40–0.45			123	high plasticity, rare grey patches, rare orange mottling
0.50–0.55				trace sand
0.60–0.75			89	
0.80–0.95			73	some sand, very high plasticity, no mottling, wet
1.00–1.05			75	Clayey SAND, brown, wet-saturated (Alluvium)
1.10–1.30				CLAY, some silt, high plasticity, grey, rare orange mottling, moist (Alluvium)
1.20–1.25			75	
1.30–1.35				brown, some grey patches
1.40–1.45			84	
1.50–1.75				
1.60–1.65			78	
1.80–1.95			89	highly mottled
2.00–2.15			95	
2.20–2.45			89	
			70	
2.50				End of borehole at 2.5m depth
2.55				Target depth reached
2.60				Groundwater not encountered

TS2

Depth (m)	Graphic	Blows/50mm	Shear strength (kPa)	Soil Description
0.00–0.15				SILT, trace clay, some rootlets, low plasticity, brownish black, moist (Topsoil)
0.20–0.45			89	trace charcoal, some mixing with brown material
0.40–0.45			98	
0.50–0.55				some gravel
0.60–0.75			114	CLAY, some silt, trace sand, moderate plasticity, brown, moist (Alluvium)
0.80–0.95			64	Clayey SAND, brown, wet (Alluvium)
1.00–1.05			128	CLAY, some silt, trace sand, moderate plasticity, brown, some grey patches, rare orange mottling, moist (Alluvium)
1.10–1.15				
1.20–1.25			126	
1.30–1.35				
1.40–1.45			126	
1.50–1.55				some orange mottling
1.60–1.65			128	
1.70–1.75				
1.80–1.85			126	
1.90–1.95				
2.00–2.15			70	
2.20				End of borehole at 2.2m depth
2.25				Target depth not reached - UTP
2.30				Suspected river gravels causing refusal
2.35				Groundwater not encountered

TS3

Depth (m)	Graphic	Blows/50mm	Shear strength (kPa)	Soil Description
0.00–0.35			78	SILT, some rootlets, trace charcoal, brownish black, moist (Topsoil)
0.40–0.45			74	SILT, some clay, greyish brown, moderate plasticity, moist. (Alluvium)
0.50–0.55				
0.60–0.65			86	
0.70–0.75				CLAY, some silt, trace sand, yellowish brown, some grey patches, moist, high plasticity.
0.80–0.85			107	
0.90–0.95				
1.00–1.05			102	some orange mottling
1.10–1.15				
1.20–1.25			112	
1.30–1.35				
1.40–1.45			84	
1.50–1.55				
1.60–1.65			84	
1.70–1.75				
1.80–1.85			84	
1.90				End of borehole at 1.9m depth
1.95				Target depth not reached - UTP
2.00				Suspected river gravels causing refusal
2.05				Groundwater not encountered

TS4

Depth (m)	Graphic	Blows/50mm	Shear strength (kPa)	Soil Description
0.00–0.15				SILT, some sand, some rootlets, brownish black, moist. (Topsoil)
0.20–0.45			91	SILT, trace clay, medium brown, moist, low plasticity (Alluvium)
0.30				orange mottling
0.50–0.55				
0.60–0.75			81	
0.80–0.95			112	CLAY, some silt, some sand, yellowish brown with orange mottling, some grey patches, moist, moderate plasticity.
1.00–1.05			114	Sandy CLAY, trace silt, yellowish brown with orange mottling, moist, moderate plasticity.
1.10–1.15				
1.20–1.25			77	CLAY, some silt, trace sand, yellowish brown, moist, moderate to high plasticity.
1.30–1.35				
1.40–1.45			91	high plasticity
1.50–1.55				
1.60–1.65			UTP	
1.70				End of borehole at 1.7m depth
1.75				Target depth not reached - UTP
1.80				Suspected river gravels causing refusal
1.85				Groundwater not encountered

TS5

Depth (m)	Graphic	Blows/50mm	Shear strength (kPa)	Soil Description
0.00–2.95				

TS6

Depth (m)	Graphic	Blows/50mm	Shear strength (kPa)	Soil Description
0.00–2.95				

Notes
1 Refer to plan for test site locations
2 Information is taken from point locations. Ground conditions may vary from that shown away from test site.
3 Soil colours indicative only
4 UTP: Shear vane unable to penetrate in-situ soil