GUMBOOTS
CONSULTING ENGINEERS

Geotechnical Appraisal Report

63 Fairlie Crescent, Opononi

For

Richard De Rosa

Ground and site feasibility for proposed minor development.
Gumboots Consulting Engineers reference 1103

◆0204486697 ◆office@gumbootsconsulting.co.nz ◆www.gumbootsconsultingengineers.co.nz
191 Onekura Road, Kerikeri, Northland 0295

Revision History

Revision Nº	Prepared By	Description	Date
A	Kelly Wright	Geotechnical Appraisal Report	07 January 2022

Reviewed/Approved

On behalf of Gumboots Consulting Engineers Ltd by:

Akira Kepu

Geotechnical-Civil Engineer

Board Member of EngNZ Northland Branch, MEngNZ

Member of NZGS & ISSMGE

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1. Executive Summary

The subsoil conditions on the subject sites (Legal description Lot 11 Deposited Plan 107852) comprise expansive soil characteristics. In accordance with AS 2870, the site (based on soil reactivity under extreme weather conditions[1]) can be classified as Class H1 (highly-reactive).

It is recommended that;

1. All structural foundation designs shall undertake specific engineering design by a Chartered Structural Engineer with due regard to the proposed development, site conditions with respect to sustaining balancing environmental effects in all aspects at post development stage.

AS 2870 can be adopted as informative guidance for foundation designs in this case

Professional opinions and recommendations within this report are based on in-situ field and lab test results, empirical relationships and local experiences.

As appropriate, this appraisal shall be read in its entirety to understand the context of the opinions and recommendations given.

2. Introduction

This report has been prepared for Richard De Rosa in accordance with the brief given to us. Where appropriate, it is in accordance with the recommendations of NZS 4404 and Auckland Council - Code of practice for Land Development and Subdivision; Section 2 - Earthworks and Geotechnical Requirements and related documents.

- Objective and Scope

  The scope of work is to assess the general site and ground bearing capacity for the proposed minor development. General objectives through our investigations were to ascertain possible construction difficulties, identify obvious hazards and applicability of land for building design in accordance with NZS 3604:2011.

Limited Liability

This report has been prepared solely for the benefit of Richard De Rosa our Client with respect to the brief and their intended use thereof. No responsible liability shall be assumed by Gumboots Consulting Engineers for any omissions or errors that may befall from inaccurate information provided by the Client or from external sources.

[1] *i.e. drought following wetter seasons and vice versa.*

Reliance or use of this report by other parties without prior review and agreement in writing by Gumboots Consulting Engineers Ltd, be at such parties sole risk.

Field data used in this report were ascertained from limited test positions. The nature and continuity of subsoils away from test locations are inferred and it must be appreciated that actual conditions could vary from those modelled within.

It is recommended that we are notified immediately if final development plans and conditions encountered onsite (nominated development location) vary from that of this report.

Accordingly, further investigations/observations shall then be undertaken as appropriate.

3. Overall Proposal Philosophy

The OPP in this case is the Minimal Impact Footprint of the proposed works in all aspects.

4. Site Description

The subject property (legal description Lot 11 Deposited Plan 107852) is an irregular shaped block (0.0914 ha). The property is moderately gentle sloping (≈6^0) westward (as depicted in figure 1 below) and is located approximately 0.49 km south of Opononi Township.

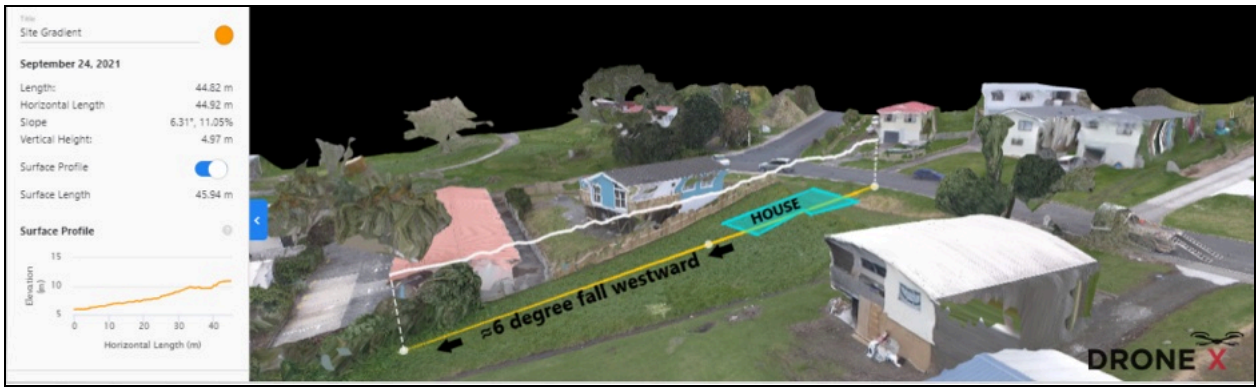


Figure 1 - Site Gradient (adapted from DroneX Aerial Survey)**.**

The property is vacant and currently grass covered as it awaits building consent. The neighbouring properties, in all aspects, comprise established residential occupation.

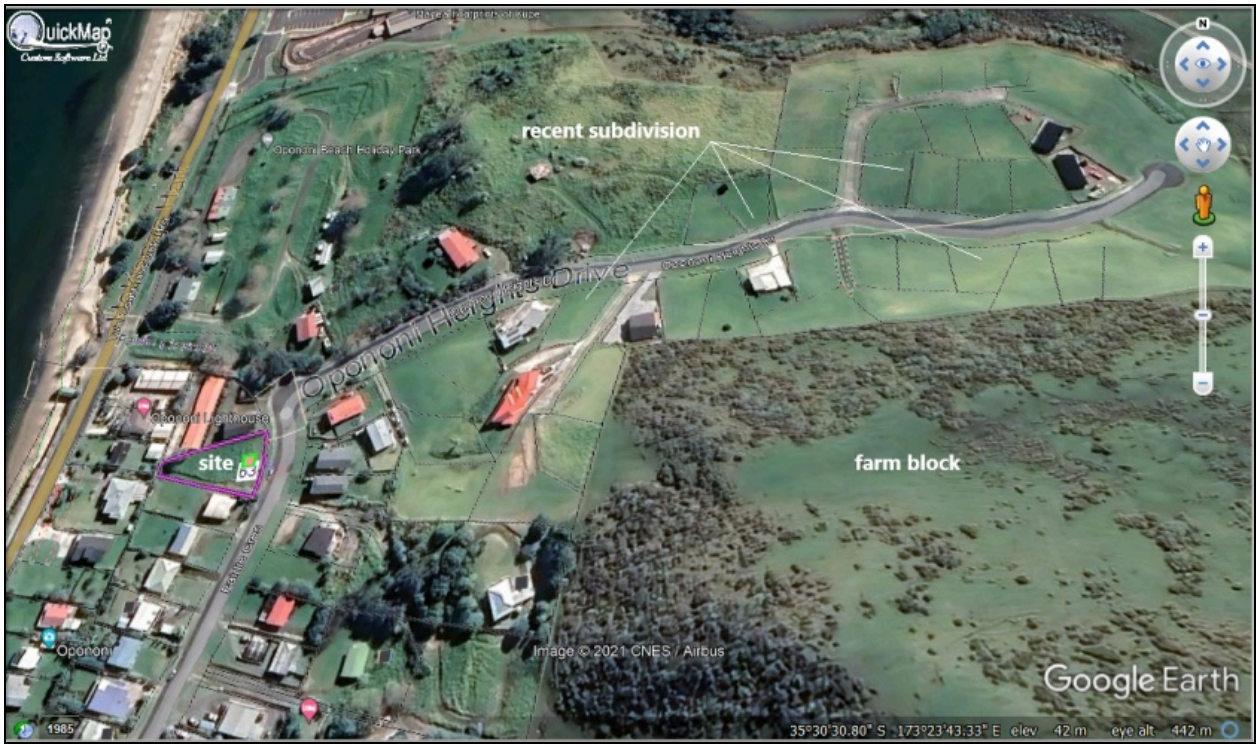


Figure 2 - Site Features (adapted from Quick Map Enterprises and Google Earth Maps)**.**

To the wider west constitutes the prominent Hokianga Harbour waters and further east along Opononi Heights Road consists of vacant properties within the relatively young coastal subdivision. South bounding beyond the former is an existing farmland occupied abundantly by native flora.

Access

Is off Fairlie Crescent bounding the lot along the eastern periphery. The road is *kerbed* which constitutes a primary flow path [PFP] that aids the water into the stormwater collection points within/underneath the road.

This readily equilibrates stormwater runoff and effective stormwater management in this instance.

5. Geomorphology

Macro Landscape

Depicts a prominent hilly country that is bisected by the Hokianga Harbour meandering inland [northeast-east].

Additionally, the higher overarching reaches of the adjoining Maungataniwha [Waima Forest] represent the overthrusting result of the Tangihua Complex (Kt) which overlie less dense sedimentary rocks of underlying thrust-bounded units.

Figure 3 - Macro Landscape (adapted from Quick Map Enterprises and Google Earth Maps)**.**

The waxing planar[2] shape [as depicted in figure four below] of the prominent hilly and east, exhibits good water shedding features. Likewise, the wider valleys are well established with native flora life form.

Moreover, the presence of native trees and vegetation within these sensitive areas encourages land resilience and balancing effects from surface water fretting of land during extreme weather events.

[2]*Technical Publication 58 - 'increasing slope angle aids run-off, but not spreading; good drainage'.*

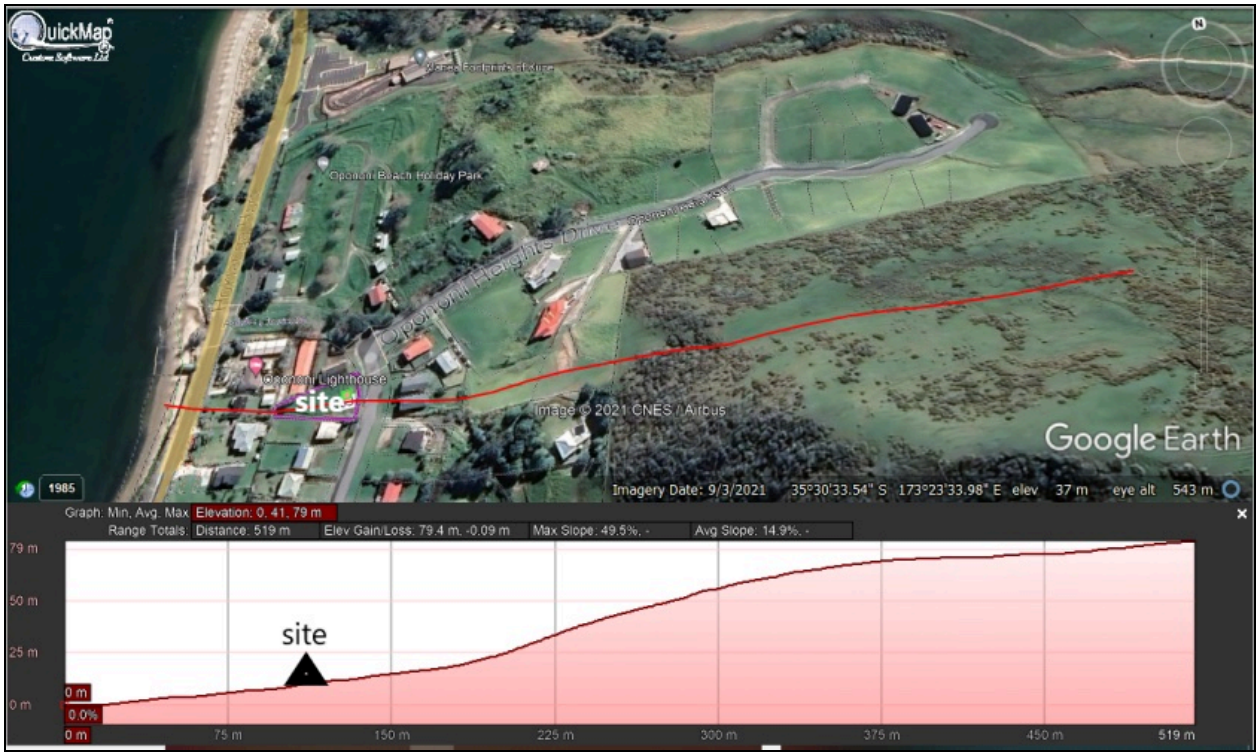


Figure 4 - Land Feature-Cross Section (maps adapted from Quick Map Enterprises and Google Earth Maps)**.**

Consequently, the landscape, resident occupants and supporting infrastructures altogether portrays a natural environment in equilibrium state.

Micro Landscape

Within and close vicinity of the property attributes good interceptive mechanisms which shall intercept surface stormwater run-off in favour of the subject Lot.

The coastal front of the area is established mostly by the locals and constitutes the township in this case. Opononi Heights Road progresses further residential occupation along the northern aspect of the dominant land feature. As shown in figure four above.

The latter designates the overarching landscape bounding the eastern aspect. The northern portion hosts the relatively recent subdivision.

Figure 5 - Micro Landscape (maps adapted from Quick Map Enterprises and Google Earth Maps)**.**

6. Cultural Landscape

In this instance, points to the direct anthropogenic effects upon the natural landscape over time.

Land Use

Is predominantly residential living. A few houses had been implemented within the locale with the majority [older] along the western aspect.

The surrounding hilly peaks within close vicinity is currently an active farm. This is understood to have been the dominant activity pre subdividing.

Infrastructures

That is; roads, wastewater and stormwater reticulation serving the community are well established and considered adequate in context of the proposed home. As depicted in figure 12.

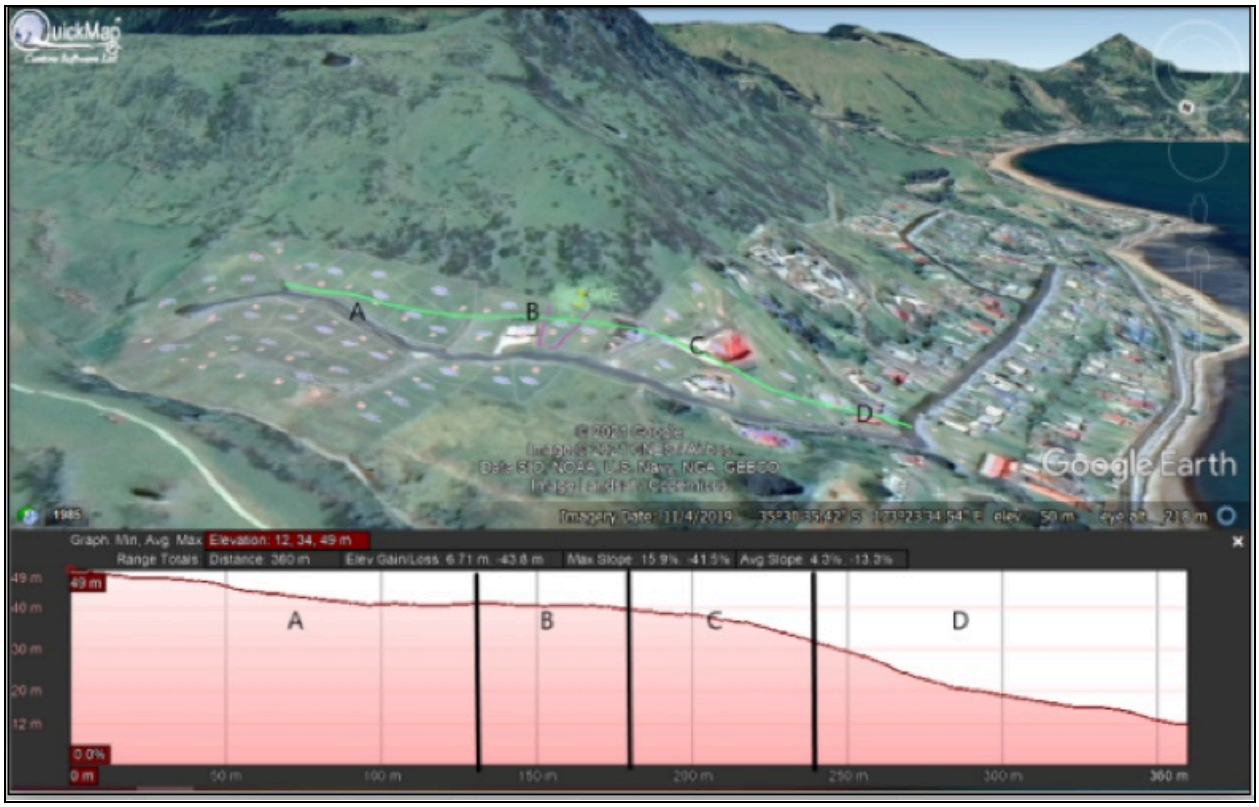


Figure 6 - Prominent Land and Settlement Feature (maps adapted from Quick Map Enterprises and Google Earth Maps)

Table 1 - Processes and Settlement Cluster.

	A	B	C	D	
	New Settlement [Recent Subdivision]			Dominant Settlement. [transition mechanism point]	Processes
Periphery					**Center**
	Predominantly vacant Lots	Scattered home developments established. [low density]		Established township [high density] Including the subject Lot	Patterns

During the first site walkover inspection, boggy and/or saturated ground was encountered. However, the second site visit revealed opposite conditions.

During intense rainfall events, it is anticipated that surface water will be absorbed in low-moderate volumes with the majority as sheetflow [west] along the natural site gradient and into the existing stormwater drains in service to the collective settlement.

7. Hydrologic Cycle

Pertaining to the immediate and associated properties presents a good water way design in complementing the infrastructures implemented for the occupancies.

The primary flow paths [PFP] are well defined and layed in a manner as to provide efficient conveyance of surface [storm] water away from the properties and eventual discharge into the Hokianga Harbour. As depicted in figure 7 below, stormwater management applications are depicted in green.

Figure 7 - PFP (map adapted from Quick Map Enterprises and Google Earth Maps)**.**

The designated PFP was observed;

- To follow closely with the natural contours of the land and incorporate Fairlie Crescent and Opononi Heights Road as the primary collection point.
- Land geometry i.e. relief, slopes and direction are in favour of the former.
- Sealed pipe network as the collecting agents.
- Designated discharge point [into Hokianga Harbour] away from downstream settlers.

The natural configuration of land surfaces, in particular the downslopes, sustains a homogenous draining manner [westward] as well as good surface water spreading characteristics.

All in all, land fretting in this aspect can be considered less than minor.

8. Development Proposal

The proposed development is to erect a 3 bedroom home on piled foundations.

Figure 8 - Site Development Proposal (adapted from Sunshine Homes & Cabins 'Floor Plan' dated 13/07/2021)

The established waters and roading infrastructures shall readily support the property and the proposal intention shall incorporate these features as vital to equilibrate the implementation [inputs-outputs] and the existing land in sustaining LIFE in all aspects.

Consequently, it is anticipated that during intense rainfall events surface water will be absorbed in moderate volumes with the majority envisioned as sheetflow north and west along the natural/landscaped site gradient and into the supporting stormwater drain/discharge points.

Enabling Earthworks

Shall designate to foundation piles and comprise site cuts [east - west] which shall create flat sections within the platform for the new home. The cuts seemed shallower to deeper respectively. The former shall be retained as appropriate.

Further discussion in this respect is undertaken within sections 17 and 18.

At the time of writing, the proposed concept plans were understood to be incomplete. As a consequence, the full extent of the site ground work was not understood fully.

Reference:

Sunshine Homes & Cabins 'Floor Plan' dated 13/07/2021

9. Geology

The geological information on hand indicates that the site is underlain by Karioitahi Group (eQa); partly consolidated sand, mud and peat of estuarine, swamp, alluvial and colluvial origins.

The geomorphology maps appended to this report gives an overview of the immediate and surrounding land and water bodies that constitutes the geological landscape.

10. Lithology

The underlain lithology is Alluvium ($A1_3$) i.e. mud,sand and gravel with minor peat forming terrace deposits up to 10m above stream or sea level; unconsolidated to very soft. Unweathered or weathered to brown stained material to depths of 2m.

Reference:
Geology of the Kaitaia Area. Institute of Geological & Nuclear Sciences; 1: 250,000 geological map 1. Lower Hutt, New Zealand.

NZMS Sheet 290 O 06/07, 1:100,000 scale map, Edition 1, 1982: "*Waipoua-Aranga"* (Rocks).

11. Subsoils

LandCare Research indicates the soils encountered here as Rendzic Melanic (ER). Comprise limestone or calcareous rock at shallow depths i.e. generally in association with lime-rich rocks or dark (basic) volcanic rocks. They cover 1% of New Zealand and are scattered throughout small areas and are normally associated with lime rich rocks or dark (basic) volcanic rocks.

Melanic Soils [E]

Have black or dark grey topsoils that are well structured (stable). The subsoils may contain lime. These soils are highly fertile and shrink and swell when hydrated/dehydrated.

Base saturation is high with high exchangeable calcium or magnesium. The clay fraction is dominantly smectite i.e. swelling clay. The soils are *imperfectly drained*.

More reference can be noted that these are soils of the Rolling and Hill lands, Arapohue clay (AU) with yellow subsoil and Hunoke stony clay loam (Hu) - i*mperfectly to very poorly drain*

All in all it can be concluded that the soils encountered here more greatly reflect the historical effects of local conditions.

Reference
Manaaki Whenua LandCare Research: New Zealand Soil Classification (NZSC) - Soil Order.
New Zealand Land Inventory - NZMS Sheet 290 O 06/07, 1:100,000 scale map, Edition 1, 1980: "*Waipoua-Aranga"* (Soils).

12. Fieldwork

Our fieldwork for this report was commenced on the 24th October 2021 and involved the drilling of three hand drilled boreholes down to a refusal depth ranging from 1.10m to 1.80m. Vane shears were taken at 0.30m lifts to full drilled depths.

Due to non retrieved sample boring as a consequence of the shallow groundwater encountered, we were unable to advance further.

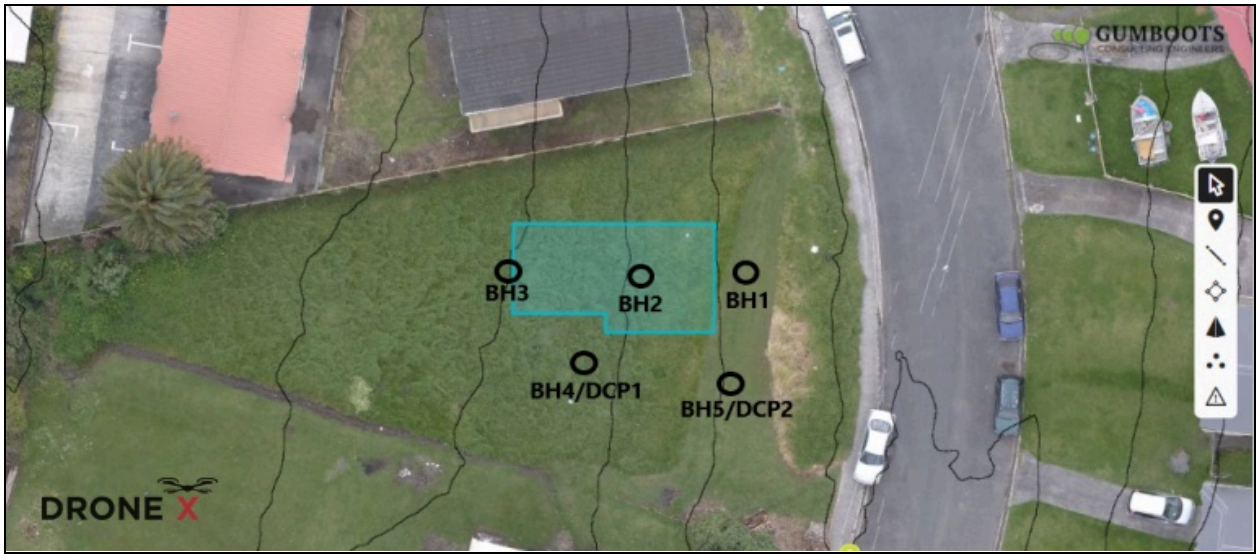


Figure 9 - Borehole Location Overview (adapted from DroneX aerial survey.)

Subsequently, the ground conditions at the time, weather season[3] and field results taken dictated that a second site visit [27th December 2021] during the dryer [summer] months in order to gauge further data [groundwater] under this context as appropriate.

Further advancement were achieved through a series of DCP[4] tests at terminated depths in the order of 2.30m to 3.10m within the designated boreholes four and five.

In addition, an aerial survey was also carried out to enable further observations of the estate.

Results of the in-situ soil tests together with detailed descriptions and depths of strata encountered during the drilling of the boreholes are appended. Soil descriptions included on the exploratory hole records are compliant with New Zealand Geotechnical Society (NZGS) publication 'Field Description of Soil and Rock', 2005.

The depths of strata and groundwater (where encountered) in the boreholes were recorded from ground levels at each exploratory hole.

13. Laboratory Testing

Two samples[5] of Linear Shrinkage and one Atterberg Limits sample were taken from the site, generally within the zone of likely influence of shallow foundations. These tests were in accordance with NZS 4402 - Sections 2.2, 2.3, 2.4 & 2.6 , "Methods of Testing Soils for Civil Engineering purposes".

[3] *wetter spring following a wet winter season.*
[4] ***D**ynamic **C**one **P**enetrometer*
[5] *one lot of samples were taken during the second site visit and are awaiting testing.*

These index tests primarily seek to give an indication of the likely subsoil behaviour, characteristics and conditions at its natural undisturbed state. Lab test results are appended.

All results are IANZ (International Accreditation New Zealand).

14. Summary of Ground Conditions

It can be viewed that the natural land layout and soils comprise sedimentary formation residual constituents through the weathering process of their parent geological unit deposited here historically. These are typical within the Northland area.

- Topsoil

  Observed as silty clay, dark and brown with minor rootlets and rootlets (approximately) 0.20 metres thick.

Natural Ground

The natural (cohesive) subsoils encountered generally comprise stiff, light orangish brown and highly plastic. At depths ≥ 1.50 meters, soils became light grey and becoming white and silty at refusal drilled depths. As depicted in Figure 9.

Figure 10 - Natural Soils Onsite (adapted from the DroneX Survey).

Filled Ground

Was not encountered within the drilled holes. However, some made ground is anticipated within the locale considering the established infrastructures therein.

Shear Vane Readings

Corrected vane shear readings recorded were in the range 57 kPa to 106 kPa [BH1 to BH3]. On the contrary, corrected vane shear readings recorded post the latter site visit fall in the range 114 kPa to 186 kPa [BH4 and BH5].

It can be considered that the wetter than normal seasons [prior ground testing], land topography within the locale and existing ground surface cover [thick kikuya] may contribute to the ground conditions.

Figure 11 - Ground Cover (adapted from DroneX aerial survey.)

All in all, shallow groundwater can be attested to less stiffer cohesive soils encountered in the former site visit in this case.

Dynamic Cone Penetrometer Readings

DCP tests indicate stiff to very stiff cohesive soils with an overall average blow count/100mm within all probes of 6 blows/100mm. The former is indicative of ***good ground*** bearing in accordance with NZS 3604.

Groundwater

Groundwater was encountered at 1.80m within boreholes two and three during drilling. However, it would be prudent to note that water levels are likely to fluctuate with the seasons/peak rainfall events.

Static groundwater levels measured [first site visit] at post augured stage were in the range of 0.20m[6] - 1.05m. The likely seasonal variation in groundwater levels can be in the order of up to 1.00m [winter] and ≥ 2.00m in summer.

15. Discussion on Sub-ground Conditions

The mapped lithology unit may consist of gravel [scoria] or marlstone are unconsolidated as a mass but comprise fragments with individual hardness up to 7. As depicted in plate 1 below.

The cohesive soils encountered at shallow drilled depths indicate development from an older sedimentary lithology interwoven with the younger sediments. That is, constituted by weakly developed soil horizons.

The likely soils mapped to the site derive from soft calcareous marl [chalk] i.e. a carbonate rich mud or marlstone which contains variable amounts of clays and silts. These soils develop in low lying areas where the water table is high.

[6] *seepage*

Moreover, huneke clay loams are volcanic derived soils mixed with sedimentary rocks.

All in all, these soils can be anticipated to comprise *'good engineering properties'.*

The bedrock was not encountered however in some cases it can generally be inferred to be in the order of ≥ 20m.

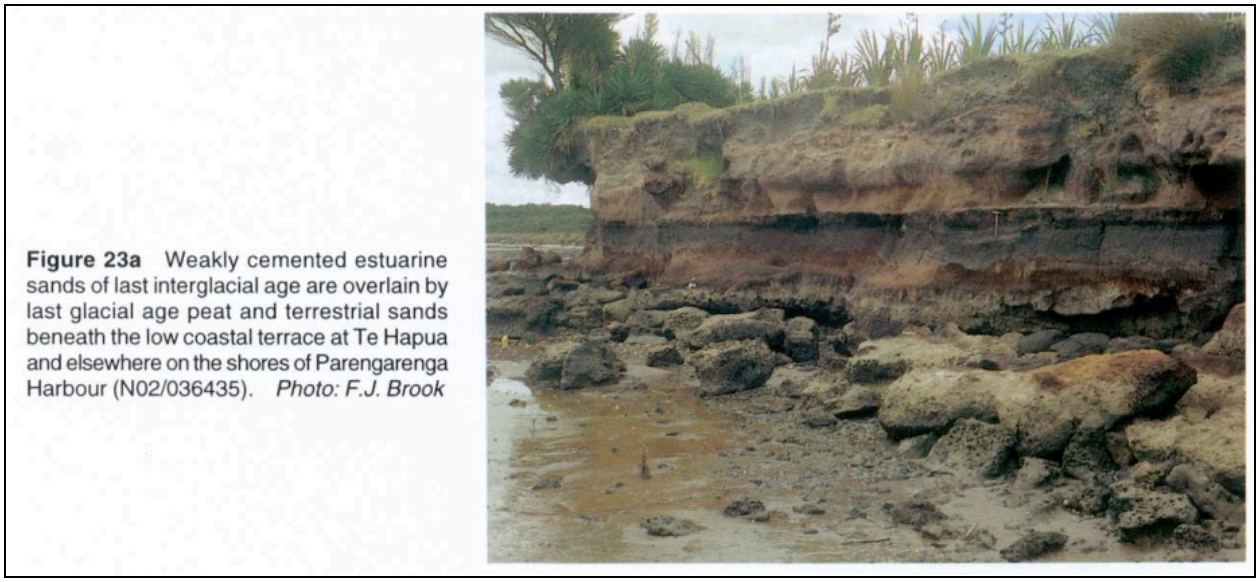


Plate 1 - Karioitahi Group.- [Geology of the Kaitaia Area. Institute of Geological & Nuclear Sciences; 1: 250,000 geological map 1. Lower Hutt, New Zealand.}.

16. Discussion on Subsoil Classification

- Expansive Soils

  Plastic soils found throughout this region have an expansive nature and tendency to shrink and swell. This phenomenon is common with these soils (where encountered) throughout the Northland region, particularly when these soils are subject to seasonal volume changes caused by wetting and drying.

  Technically, expansive soils are defined in NZS 3604 as those soils having a liquid limit of more than 50% and a linear shrinkage of more than 15%.

  Considering the local mapped geology and the laboratory test results, it is considered that the subsoils onsite exhibit *highly* expansive traits.

  On the contrary, foundations based on the proposed concept are founded within the more competent [weathered] underlying limestone. As a consequence, the site can be classified as a Class H1 site.

  Accordingly, foundation design guidance may be adopted in accordance with A.S 2870.

Soil Laboratory Characterisation

Indicates the placement of the Atterberg's Limits test result on the plasticity chart. Plate 2 below depicts the likely characteristics of the encountered soils onsite.

Soils that plot below the A-line generally have *good engineering* properties. The opposite is true for soils plotted above the A-line.

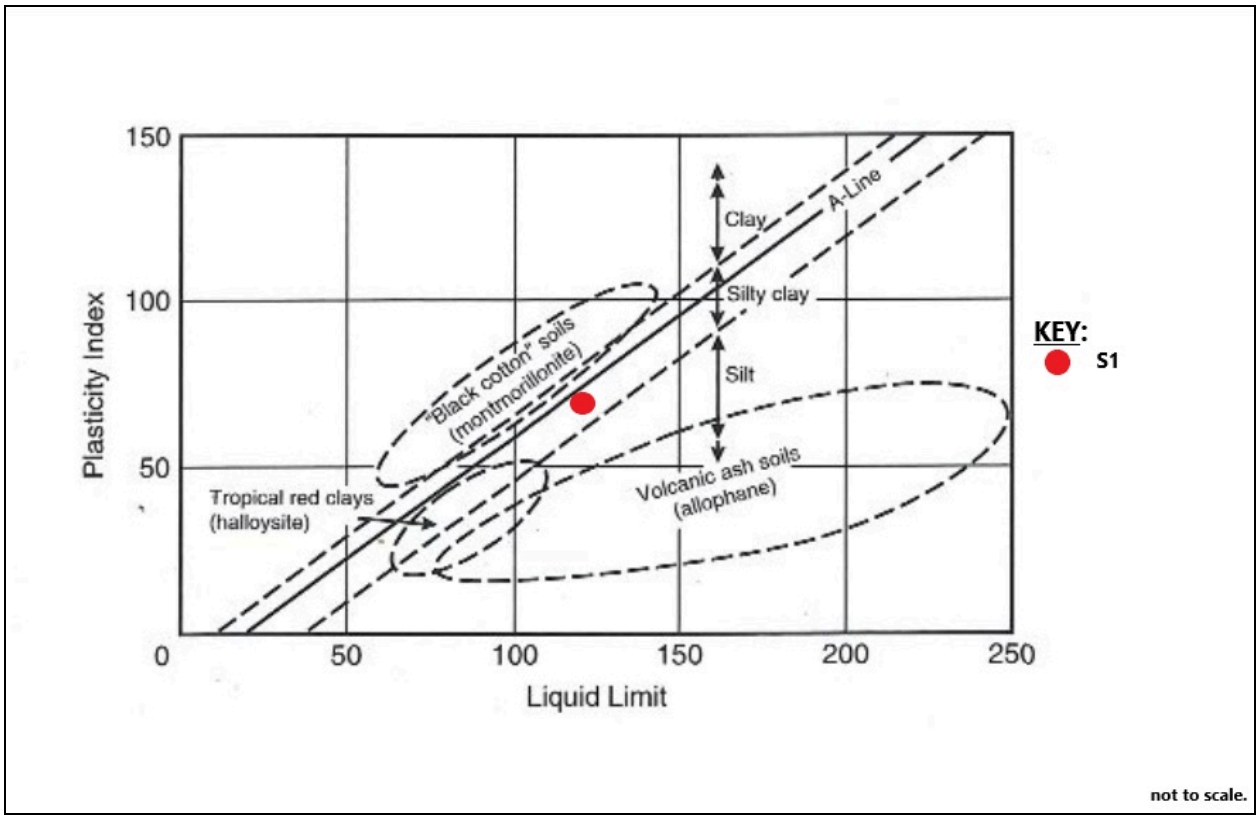


Plate 2 - Plasticity Chart.- [Cassagrande}.

Reference: A.S. 2870, "Residential Slab and Footings - Construction".

NZS 3604, "Timber Framed Buildings"

L.D. Wesley.

17. Specific Comments and Recommendations

Foundations

For this project shall undertake specific engineering design [SED] to establish appropriate depths and establish reinforcement configurations with due regard to the soil conditions onsite.

The groundwater regime encountered onsite dictates shallow depths during wet months [winter-spring] and greater than two metres in the dry months.

Consequently, the selection of foundation type i.e. driven or bored piles with associated construction methods in this case shall carefully be considered on this basis.

Table 2 below presents the bearing strengths for vertical loads (only) for foundation designs.

Table 2 - Bearing Strength Design Parameters	
Ultimate Bearing Capacity	200 kPa
Soil Classification (AS 2870)	H1

All topsoil and deleterious materials shall be cleared away from the new building platform prior commencing Works.

Subsequently, finished ground level and overland flow paths [where noted] onto the site shall be graded/maintained for the purpose of directing all surface water away from the founding ground so as to minimise adverse effects of surface water influences with respect to the former.

Geotechnical Soil Parameters

Effective stress soil parameters below are based on in-situ field results, empirical relationships and local experience:

Table 3 below presents the bearing strengths for vertical loads (only) for foundation designs.

Table 3 -Effective Stress Parameters for Structural Design			
Description	Bulk Unit Weight(ɣ) kN/m^3	Effective Cohesion(c') kPa	Effective Angle of Friction(ø')
Stiff clayey silts and silty clays	17	5	28

Foundation Design Considerations

For foundations founded on expansive soils. It is prudent for the designer to consider that one or more of the following criteria are met:

1. Sufficient dead-load pressure is exerted on the foundation.
2. Ensure adequate foundation embedment depths for positive lateral support.
3. The swelling potential of the foundation soils can be eliminated or reduced.
4. Foundation protection from surface water onto/away from the effective area.
5. Ensure appropriate sub foundation drains and surface cut off drains are considered as critical.

All limit states must be considered in design to ensure adequate safety and serviceability.

Structural Pre-Construction Foundation Check

To ensure that the founding ground is sound and the foundation system is adequately rigid, it is prudent to check the following conditions before construction i.e.

1. Ensure that bored holes are free of boring materials prior concrete pouring. Subject to bored piles being the chosen system
2. Ensure that the piles are properly restrained against lateral earth pressure.

Retaining Wall

Structural engineer to adopt the soil parameters in Table 3 for the design. Granular soil shall be used as backfill material.

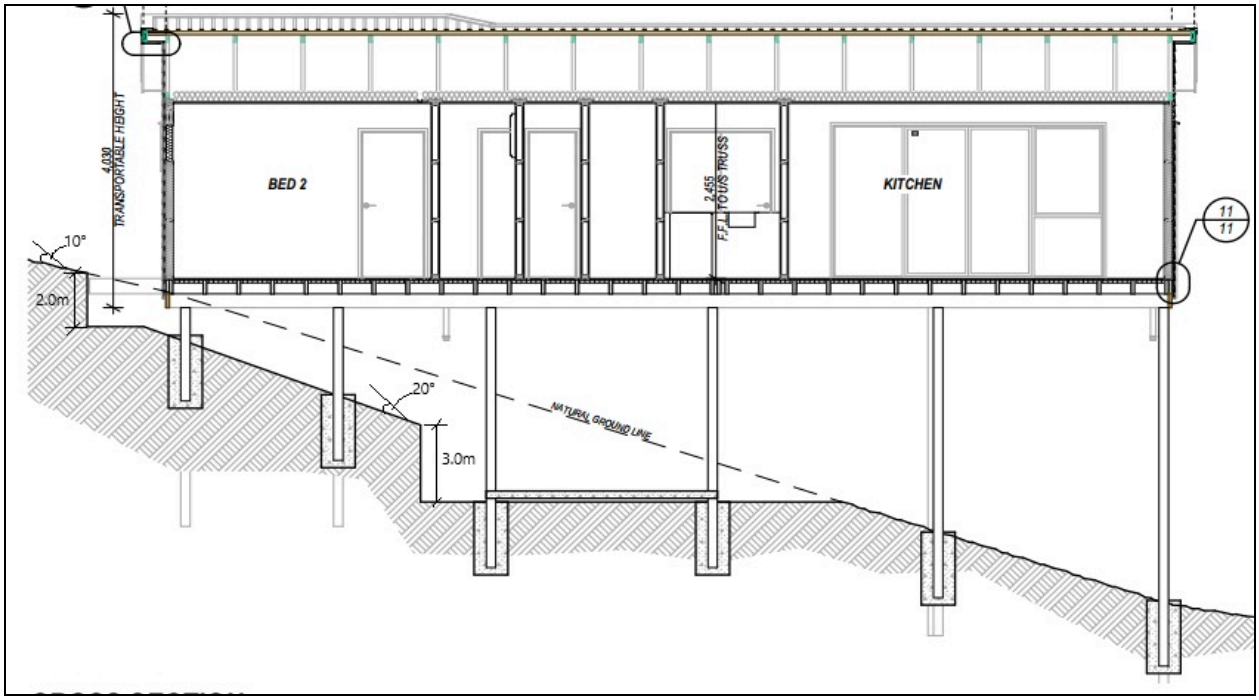


Plate 3 - Cross Section (adapted relative annotations from Sunshine Homes & Cabins 'Floor Plan' dated 13/07/2021).

Careful consideration is also advised in regards to the effects of the interaction of bearing soils and the two structures i.e. the house and retaining wall.

Pile Loading Application

Piles shall not be loaded with the dead weight of the minor dwelling until the concrete is a minimum of 24 hours old. The concrete shall not have a sump of 60 mm at the time of placing. If at any time during the 24 hours the ambient temperature drops below 10^0C, then the time before loading shall be extended to 48 hours.

Reference: NZS 3604 - "Timber Framed Buildings", Section 6.

18. Earthworks and Construction

ALL earthworks shall be undertaken in accordance with NZS 4404 - Section 2.2 and where appropriate, in conjunction with NZS 4431 and related documents.

- Site Considerations

Where encountered, all deleterious materials shall be removed completely from foundation ground where foundations Works are proposed.

Provisions for safeguard of existing foundations (foundation ground) of sustained buildings/structures during temporary excavation/construction works shall carefully be considered and executed at ALL times.

Consequently, adverse effects of the proposed works with regard to the aforementioned are kept minimal.

Planning

Earthworks shall be planned carefully and conducted in a systematic manner according to the proposed plans. That is, all effective areas of work and related areas are clearly defined before work commences.

As a consequence, permitting effective control of works.

All in all, the earthworks contractor shall submit an earthworks plan detailing the proposed work for review and approval [structural engineer] prior work commencement.

Site Clearing

Areas proposed to undergo earthworks shall be cleared of all topsoil and deleterious materials prior commencement of work. Outside the extent of earthworks, vegetation cover shall be retained and reinstated where appropriate.

Subgrade Protection

Specifically where the driveway, hardstanding and site cut areas are proposed, it is recommended to be covered with subbase-base course straight after topsoil stripping.

Subsequently, natural moisture content is sustained at an optimum state.

Site Filling

Is considered non applicable in this case. However, subject to professional engineering advice [control] as appropriate.

Erosion and Sediment Control

The earthworks contractor shall undertake full responsibility in ensuring that earthworks and all erosion and sediment control are conducted in accordance with the Far North District Council - Erosion and Sediment Control guidelines, and/or any Land Use Consent required to be obtained prior to commencing any site work.

Wastewater

Shall engage through the reticulated infrastructure in place. See Figure 12 below.

Stormwater

Shall engage directly through the reticulated stormwater infrastructure in place. See Figure 12 below.

Due care shall be of high regard to incorporate the existing stormwater [infrastructure] management application systems as primary control.

WIthin close vicinity, provisions to manage surface runoff onto and away from the property. Specifically, where foundation ground is concerned.

This shall sustain minimal impact to the overall application and property.

Runoff conveyance shall utilise sealed pipes and discharge appropriately[7] to the existing stormwater points onsite. This shall include [not limited to] retaining wall toe drainage and hard standing areas.

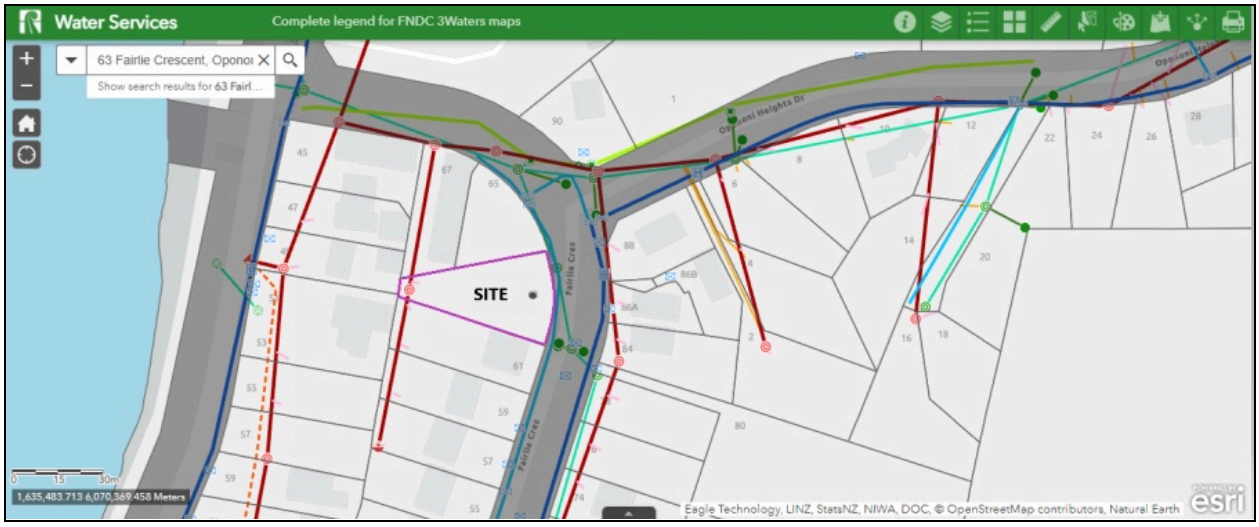


Figure 12 - 3 Waters Map - site outlined in purple (adapted from FNDC Water Services Map).

Runoff associated with resultant impermeable surfaces i.e. roof and hardstanding areas shall be managed as to the former and discharged in a manner as to induce positive effects to close by properties.

19. Natural Hazards

Flood Hazard

Upon review of the Northland Regional Council Hazards maps, it indicates the subject area as not being within a flood extent area. As depicted in Figure 13 below.

[7] *in a dispersive manner.*

Figure 13 - Natural Hazard Map - site outlined in red (map adapted from NRC Natural Hazard Maps)**.**

The site is however within a critical evacuation zone in the event of a tsunami i.e. highlighted orange. Respectively, if a 500 year return period[8] were to eventuate. As indicated within the NRC natural hazards map area above.

Stipulated within these hazard maps are safeguard precautions in which the people shall adhere if such events arise. Following discussions (phone) with the NRC Emergency Management Advisor for the Far North, communities are offered generic response plans and are encouraged to have specific community adaptation plans and response groups in place in the event of an emergency. With respect to the success and activeness of these groups it is understood that the community themselves are required to have a significant level of input.

Geological Fault Lines/Surface Ruptures

Reviewed geological maps show NO [active] fault lines through or nearby the general property. Seismic activity within the region is generally low. It was noted during our site walkover that NO signs of active shallow instability [soil creep] or relic were encountered.

Recent movement as a direct result of fault line activity within close vicinity to the subject were not observed. All in all, we consider that any risk pertaining to fault line/surface ruptures to be low at this site.

Active Land

Slides [settlement] in natural soil may be caused by such external disturbances like undercutting the foot of an existing slope or digging an excavation with unsupported sides.

Anthropogenic i.e. excavations/undercutting activities in this space[9] shall be carefully understood wholly [undermining effects] prior execution of work.

[8] *Areas likely inundated by Tsunami.*
[9] *and within close vicinity to the proposed building*

Specifically in account of resultant adverse effects of such undertakings to the subject property and allowing for safeguard provisions hereon.

Figure 14 - Critical Areas - (adapted from the DroneX Survey).

20. Conclusion

Based on our site observations, field data and the general residential developments surrounding the subject property. It is our professional opinion that the subject site (legal description Lot 11 Deposited Plan 107852) can sustain the proposed minor development.

There is less than minor,

1. Significant risk from natural hazards, and;
2. The building work is likely to NOT accelerate, worsen, or result in a natural hazard on the hosting land or any other property.
3. The work in All shall sustain the equilibrium state at present.

It is my professional opinion on behalf of Gumboots Consulting Engineers Ltd that land on the subject property (legal description Lot 11 Deposited Plan 107852) can sustain the proposed residential development SUBJECT to;

- The proposed development shall be carefully implemented with respect to the existing natural environments within the respective lot. Natural surface water flow paths shall be carefully incorporated/maintained/managed within the overall development occupation as it shall provide long term sustainability in ALL aspects to the land, development and hosting environments.
- ALL recommendations stipulated within shall carefully be considered (understood) and ADHERED to within context.
- ALL proposed Works exhaust good sound engineering practices through means of extensive and conscientiously executing field observations during and after construction.

- ALL proposed Works are in accordance with Council Approved BC Plans, FNDC Engineering Standards and Guidelines and related documents and in conjunction with NZS 4404, Land Development and Subdivision Engineering.

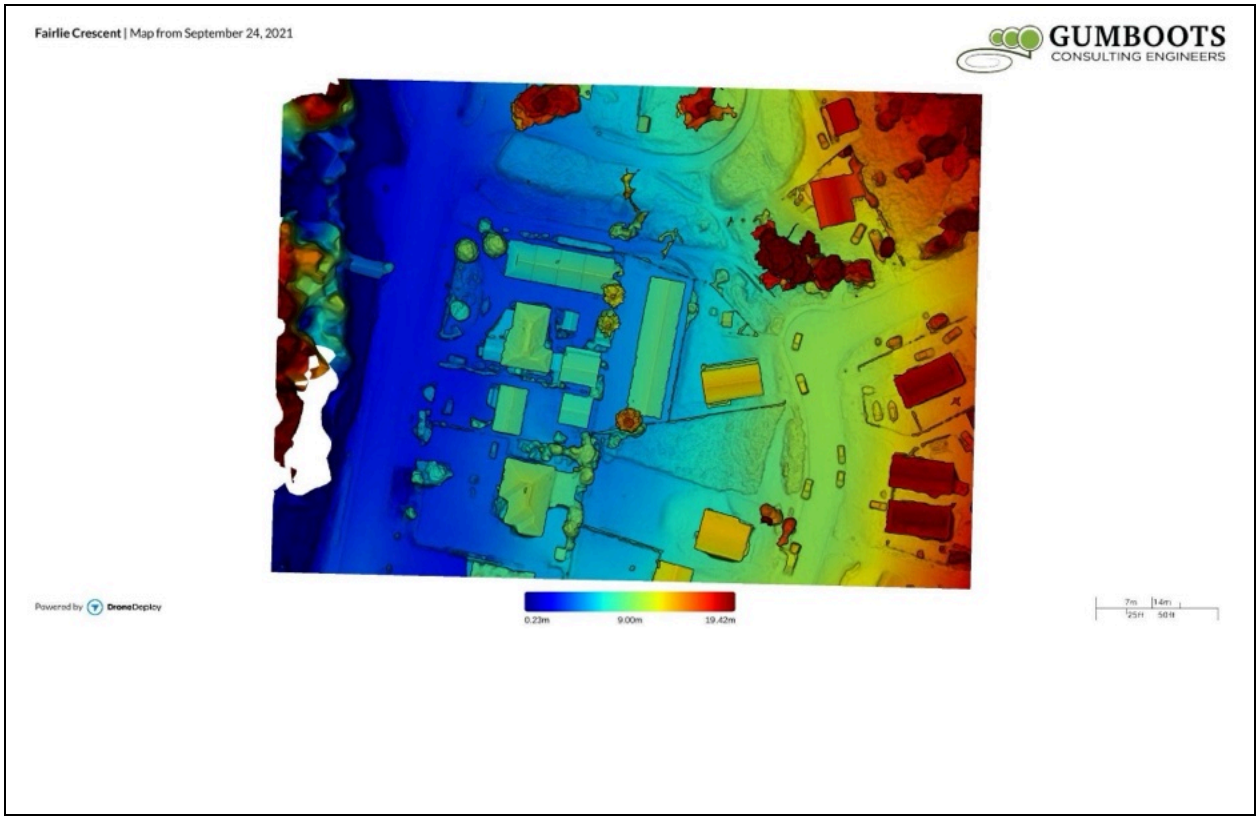
It shall be noted that, all subsequent work (which may be undertaken) pertaining to the site shall comply with the aforementioned and shall exhaust feasible consideration with regenerative/equilibrium effects to the hosting land, development and environment.

All in all, long term balancing effects of living can be of sustainable outputs in ALL aspects to the land, hosting environments and LIFE.

Appendix A

Attachments	Scale
Elevation Map	-
Annotation Report	-
Link to 3D Map	-
Geomorphology Overview Maps	NTS
Borehole Log 1	-
Borehole Log 2	-
Borehole Log 3	-
Borehole Log 4	-
Borehole Log 5	-
Dynamic Cone Penetrometer Sheet	-
Lab Test Results	-
Concept Plans - Provided by Client	-
Topography Survey	-
Photos	-

Elevation Map



Annotation Report

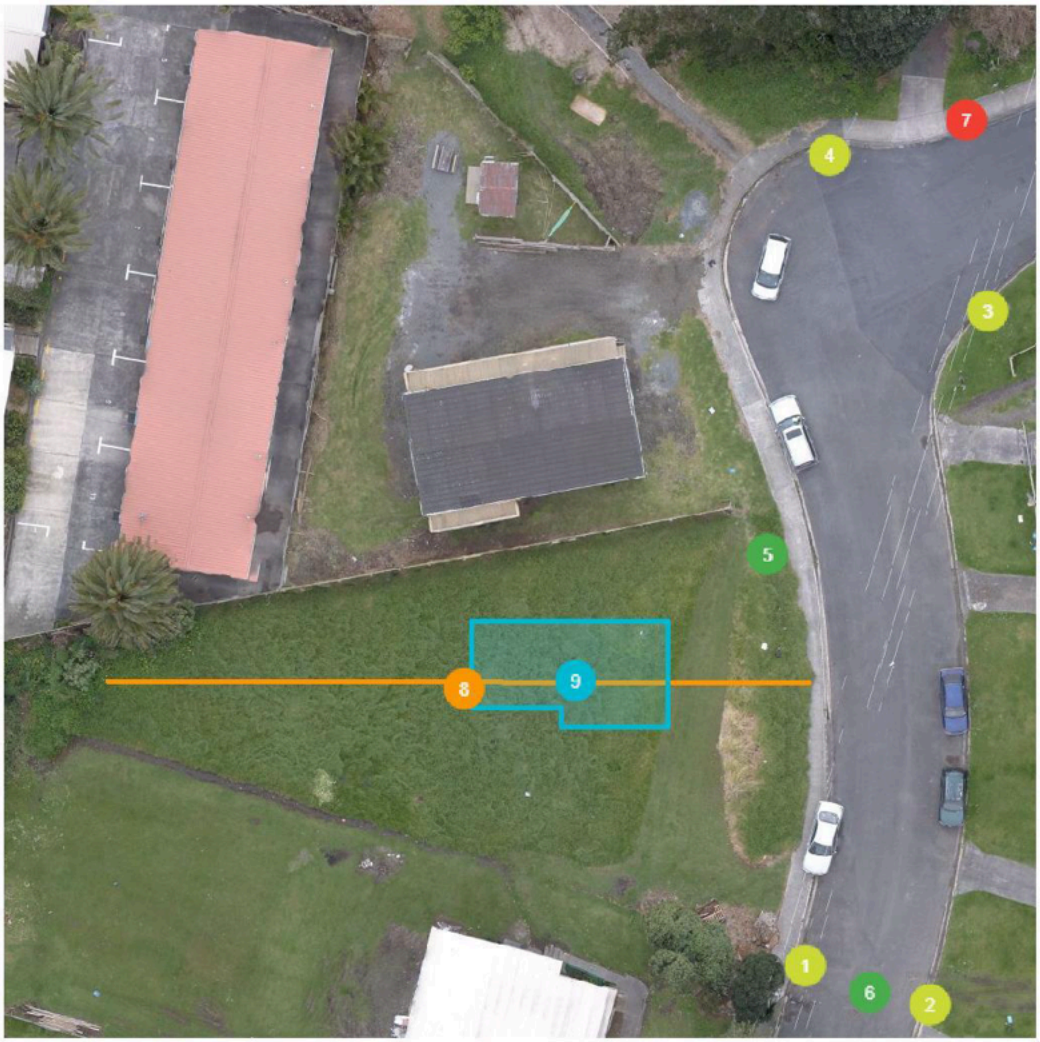
Gumboots Consulting Engineers Ltd

Fairlie Crescent Annotation Report

GUMBOOTS CONSULTING ENGINEERS

Created on January 12, 2022

Captured on September 24, 2021



Location

Label	Title	Elevation	Coordinates
1	SW Catchpit	11.20 m	-35.5097915, 173.3910422
2	SW Catchpit	11.20 m	-35.5098139, 173.3911311
3	SW Catchpit	11.39 m	-35.5094160, 173.3911713
4	SW Catchpit	11.00 m	-35.5093262, 173.3910596
5	SW Manhole	11.29 m	-35.5095556, 173.3910164
6	SW Manhole	11.39 m	-35.5098068, 173.3910880
7	WW Manhole	11.71 m	-35.5093060, 173.3911561

Distance

Label	Title	Horizontal Length	Surface Length	Slope	Vertical Height
8	Site Gradient	44.82 m	45.94 m	6.31°, 11.05%	4.97 m

Area

Label	Title	Area	Surface Area
9	House	77.90 m²	80.29 m²

Link to Aerial Survey & 3D Map

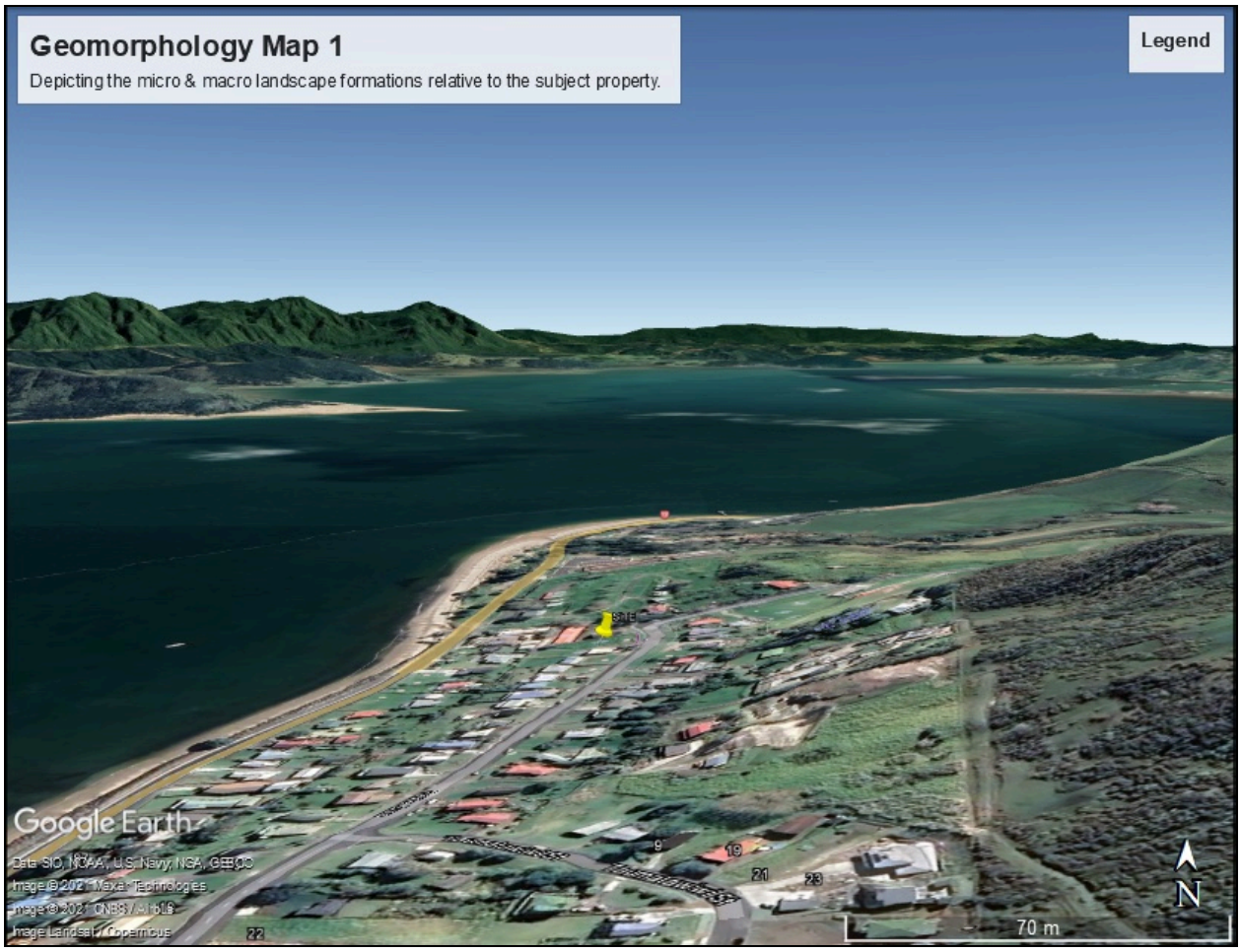
https://www.dronedeploy.com/app2/sites/614d127b95665d97428cd01e/maps/61524a904d74c604bc0d5f69?jwt_token=eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzUxMiJ9.eyJpZCI6IjYxODc0NjdhMmUwY2IxOGFjZDU5OTI1MSIsInR5cGUiOiJQdWJsaWNTaGFyZVYyIiwiYWNjZXNzX3R5cGUiOiJwbGFuIn0.IKZjpki4ZlZVQGnHZKdJDoJKHAZQqcGCk7oftmviAuh9rKuzKOwpYnQwFQ2Njz_bx5tC4crYDxyiG9zHWtPF-g

Legal Disclaimer:

The aerial survey may contain confidential information. Under no circumstance, shall this content be disclosed to third parties or used other than by the intended recipient and [their] sole purpose herein. Gumboots Consulting Engineers Ltd assumes no responsible liability for this content and use [by others] outside of this specific purpose. If you have received this link in error, please notify us and discard the link immediately.

Geomorphology Maps

(Adapted from QuickMap Enterprises and Google Maps)




Geomorphology Map 2
Depicting the micro & macro landscape formations relative to the subject property.
Legend
SITE
12
Google Earth
Image © 2021 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2021 CNES / Airbus
N
200 m


Geomorphology Map 3
Depicting the micro & macro landscape formations relative to the subject property.
Legend
SITE
12
Google Earth
Image © 2021 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2021 CNES / Airbus
Image Landsat / Copernicus
N
200 m


Geomorphology Map 4
Depicting the micro & macro landscape formations relative to the subject property.
Legend
SITE
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2021 CNES / Airbus
Image Landsat / Copernicus
200 m

191 Onekura Rd
Kerikeri
Bay of Islands
New Zealand

GUMBOOTS
CONSULTING ENGINEERS

Phone 0204 GUMMYS
022 187 9451
www.gumbootsconsultingengineers.co.nz
office@gumbootsconsulting.co.nz

BOREHOLE LOG No. 1

Hole Location: Refer to Site Plan

JOB No. 11 03

CLIENT:	Richard De Rosa	SITE:	63 Fairlie Crescent, Opononi.		
Date Started:	24/09/2021	DRILLING METHOD:	Hand Auger	LOGGED BY:	AK
Date Completed:	24/09/2021	HOLE DIAMETER (mm)	50mm	CHECKED BY:	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)
TOPSOIL, clayey silt, dark brown and damp with rootlets.	
Silty CLAY, orangish brown, moderately stiff, moist and high plasticity.	0.5
moist	
light grey mottles	
moist	1.0
perched ground water	
EOBH @ 1.10m. Non-retrieval due to ground water.	1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Graphic Log; Geology: Kariotahi Group (eQa).; Water Level: WL

Sensitivity: 1, 2, 4

Corrected Shear Vane Strength (kPa): 106 / 80; 83 / 40; 57 / 14

Dynamic Cone Penetrometer (blows/100mm drop): 0 – 1

LEGEND

TOPSOIL; CLAY; SILT; SAND; GRAVEL; FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

UTP - Unable to Penetrate
DCP- Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes - shallow depths down to 1.00m were over OMC. Downpour days prior drilling may have effectuated this.
Thick kikuyu grass cover retains a significnt amount of rainwater above grass

Average Scala Blows	0.0
Average Soil Sensitivity	2.5

191 Onekura Rd
Kerikeri
Bay of Islands
New Zealand

GUMBOOTS
CONSULTING ENGINEERS

Phone 0204 GUMMYS
022 187 9451
www.gumbootsconsultingengineers.co.nz
office@gumbootsconsulting.co.nz

BOREHOLE LOG No. 2

Hole Location: Refer to Site Plan

JOB No. 11 03

CLIENT:	Richard De Rosa	**SITE:**	63 Fairlie Crescent, Opononi.		
Date Started:	24/09/2021	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	AK
Date Completed:	24/09/2021	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)
TOPSOIL, silty clay, dark brown and damp with rootlets.	
Silty CLAY, orangish brown, moderaely stiff, moist and high plasticity.	0.5
moist	
light grey mottles	
moist	1.0
light grey	
orange greenish brown and grey streaks	
light grey mottles	1.5
moderately moist, moulded with ease.	
perched ground water	
EOBH @ 1.80m. Non-retrieval due to ground water.	2.0
	2.5
	3.0
	3.5
	4.0
	4.5
	5.0

Graphic Log: TOPSOIL; CLAY

Geology: Karioiahi Group (eQa).

Water Level: WL

Sensitivity	Corrected Shear Vane Strength (kPa)	Dynamic Cone Penetrometer (blows/100mm drop)
1	80 / 54	0 – 1
2	74 / 40	
2	77 / 43	
7	57 / 9	
3	80 / 26	

LEGEND

TOPSOIL · CLAY · SILT · SAND · GRAVEL · FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

UTP - Unable to Penetrate
DCP- Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes - thick kikuyu grass cover retains a significnt amount of rainwater above ground.

Average Scala Blows	0.0
Average Soil Sensitivity	3.0

191 Onekura Rd
Kerikeri
Bay of Islands
New Zealand

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CONSULTING ENGINEERS

Phone 0204 GUMMYS
022 187 9451
www.gumbootsconsultingengineers.co.nz
office@gumbootsconsulting.co.nz

BOREHOLE LOG No. 3

Hole Location: Refer to Site Plan

JOB No. 11 03

CLIENT:	Richard De Rosa	SITE:	63 Fairlie Crescent, Opononi.		
Date Started:	24/09/2021	DRILLING METHOD:	Hand Auger	LOGGED BY:	AK
Date Completed:	24/09/2021	HOLE DIAMETER (mm)	50mm	CHECKED BY:	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)
TOPSOIL, silty clay, dark brown and damp with rootlets.	
Silty CLAY, orangish brown, moderaely stiff, moist and high plasticity.	0.5
moist	
light grey mottles	
moist	1.0
light grey	
orangish brown streaks	
greenish and grey streaks	
light grey mottles	1.5
moderately moist, moulded with ease.	
perchled ground water	
EOBH @ 1.90m. Non-retrieval due to ground water.	2.0
	2.5
	3.0
	3.5
	4.0
	4.5
	5.0

Graphic Log / Geology: Katoitahi Group (e0a).

Water Level: ▽

Sensitivity	Corrected Shear Vane Strength (kPa)	Remoulded Shear Vane Strength (kPa)
2	71	31
3	71	29
7	74	10
3	71	29
2	71	31
2	64	29

Dynamic Cone Penetrometer (blows/100mm drop): 0 – 1

LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

UTP - Unable to Penetrate
DCP- Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes - shallow depths were slightly over OMC. Downpour days prior drilling may have effectuated this.
Thick kikuyu grass cover retains a significnt amount of rainwater above ground.

Average Scala Blows	0.0
Average Soil Sensitivity	3.2

191 Onekura Rd
Kerikeri
Bay of Islands
New Zealand

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CONSULTING ENGINEERS

Phone 0204 GUMMYS
022 187 9451
www.gumbootsconsultingengineers.co.nz
office@gumbootsconsulting.co.nz

BOREHOLE LOG No. 4

Hole Location: Refer to Site Plan

JOB No. 11 03

CLIENT:	Richard De Rosa	SITE:	63 Fairlie Crescent, Opononi.		
Date Started:	27/12/2021	DRILLING METHOD:	Hand Auger	LOGGED BY:	AK
Date Completed:	27/12/2021	HOLE DIAMETER (mm)	50mm	CHECKED BY:	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Graphic Log	Geology	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Dynamic Cone Penetrometer (blows/100mm drop)
TOPSOIL, silty clay, dark brown and damp with rootlets.							
Silty CLAY, greyish brown, very stiff, damp and high plasticity.	0.5		Kariotahi Group (eQa).		2 3	114 / 71 143 / 78	
EOBH @ 0.60m.	1.0 1.5 2.0						
EODCP @ 2.30m	2.5 3.0 3.5 4.0 4.5 5.0						

Dynamic Cone Penetrometer (blows/100mm drop): 0, 10, 20

LEGEND

TOPSOIL · CLAY · SILT · SAND · GRAVEL · FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

UTP - Unable to Penetrate
DCP- Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes - the purpose of this borehole was to confirm groundwater levels.

Average Scala Blows	6.9
Average Soil Sensitivity	2.3

191 Onekura Rd
Kerikeri
Bay of Islands
New Zealand

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Phone 0204 GUMMYS
022 187 9451
www.gumbootsconsultingengineers.co.nz
office@gumbootsconsulting.co.nz

BOREHOLE LOG No. 5

Hole Location: Refer to Site Plan

JOB No. 11 03

CLIENT:	Richard De Rosa	SITE:	63 Fairlie Crescent, Opononi.		
Date Started:	27/12/2021	DRILLING METHOD:	Hand Auger	LOGGED BY:	AK
Date Completed:	27/12/2021	HOLE DIAMETER (mm)	50mm	CHECKED BY:	KW

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)
TOPSOIL, silty clay, dark brown and damp with rootlets.	
Silty CLAY, orangish brown, very stiff, damp and high plasticity.	0.5
damp	
light grey mottles	1.0
damp light grey	
orangish brown streaks	1.5
EOBH @ 1.50m.	2.0
	2.5
	3.0
EODCP @ 3.10m	3.5
	4.0
	4.5
	5.0

Graphic Log: Kariotahi Group (eQa).

Water Level

Sensitivity	Corrected Shear Vane Strength (kPa)	Remoulded Shear Vane Strength (kPa)
2	114	71
2	143	78
3	128	49
3	171	55
3	186	66

Dynamic Cone Penetrometer (blows/100mm drop): 0, 20, 40

LEGEND

TOPSOIL, CLAY, SILT, SAND, GRAVEL, FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

UTP - Unable to Penetrate
DCP- Dynamic Cone Penetrometer
EOBH - End of Borehole
EODCP - End of DCP

Notes - Weak lenses as tending to groundwater. BH located @ toe of the batter onsite

Average Scala Blows	5.6
Average Soil Sensitivity	2.4

DYNAMIC CONE PENETROMETER SHEET

SITE:	63 Fairlie Crescent, Opononi.									
JOB#:	1103	**Operator**	AK	**DATE:**	27/12/2021					
Test No.	1	2								
DEPTH (m)	**DCP Blows/100mm**									
0.1										
0.2										
0.3										
0.4										
0.5										
0.6										
0.7	1									
0.8	3									
0.9	3									
1.0	3									
1.1	7									
1.2	6									
1.3	9									
1.4	8									
1.5	8									
1.6	8	1								
1.7	8	1								
1.8	7	1								
1.9	7	2								
2.0	9	3								
2.1	10	3								
2.2	10	4								
2.3	10	4								
2.4		4								
2.5		4								
2.6		5								
2.7		5								
2.8		7								
2.9		12								
3.0		14								
3.1		20								
3.2										
3.3										
3.4										
3.5										
3.6										
3.7										
3.8										
3.9										
4.0										
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4.8										
4.9										
5.0										
5.1										
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6.4										
6.5										
6.6										
6.7										
6.8										
6.9										
7.0										
7.1										
7.2										
7.3										
7.4										
7.5										
7.6										
7.7										
7.8										
7.9										
Total Depth	2.13m	3.10m								

Lab Test Results

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M: 027 656 5226
E: info@geocivil.co.nz

TEST REPORT

Lab Job No: 8496-082

Your ref.: GCE#1103

Date of Issue: 2/11/2021

Date of Re-Issue: -

Page: 1 of 3

Test Report No.
W21-1189

PROJECT: **GCE#1103 Laboratory Testing**

CLIENT: Gumboots Consulting

ATTENTION: Kelly Wright

TEST METHODS: Determination of the liquid & plastic limits, Plasticity index and water content
NZS 4402:1986 Tests 2.1,2.2,2.3,2.4
Determination of the Linear Shrinkage
NZS 4402:1986 Test 2.6

SAMPLING METHOD: Sampled by client - sampling not accredited

TEST RESULTS: As per attached sheets

Alex Millar

A. Millar
Administrator

D. Krissansen
Approved Signatory

ACCREDITED
IANZ
TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

-CPT - Aggregates Testing - Soil Testing -

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Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8496-082	**Sample No.:**	21-1078
Client:	Gumboots Consulting Engineers	**Tested By:**	R.H. / D.K.
Location:	Unknown BH3 @ 2.0m	**Date Tested:**	15/10/2021
		Checked By:	A.M
Date Received:	1/10/2021	**Date Checked:**	2/11/2021
Report No:	W21-1189	**Page:**	2 of 3
REF:	#GCE1103		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	24/09/2021		

Test Details:

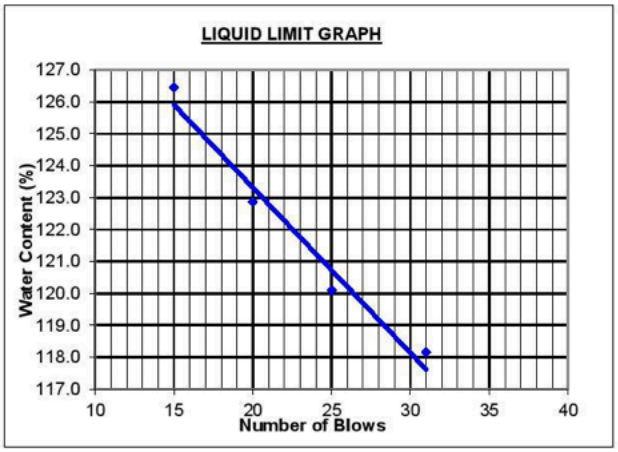
Test performed on: Fraction passing 425μm sieve

Sample history: Natural state

Description of Sample: Silty CLAY, traces of fine sands, minor organics, green grey mottled orange, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	20	25	31		
Water content (%)	126.5	122.9	120.1	118.1	33.3	33.2

NWC	64.8
Liquid Limit	121
Plastic Limit	33
Plasticity Index	88



G:\Projects\8400-\8496, Gumboots\8496-082, GCE#1103\8496-082, GCE#1103 lab testing
PI 21-1078
2/11/2021

Issue 3

D. Krissansen
Approved Signatory

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166 Bank Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz

DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8496-082	**Sample No:**	21-1078
Client:	Gumboots Consulting Engineers	**Tested By:**	R.H
Location:	Unknown	**Date:**	15/10/2021
	BH3 @ 2.0m	**Checked By:**	A.M
Date Received:	1/10/2021	**Date:**	2/11/2021
Report No:	W21-1189	**Page:**	3 of 3
REF:	#GCE1103		

Test performed on: Fraction passing 425mm sieve
History: Natural state

Description of Sample: Silty CLAY, traces of fine sands, minor organics, green grey mottled orange, moist

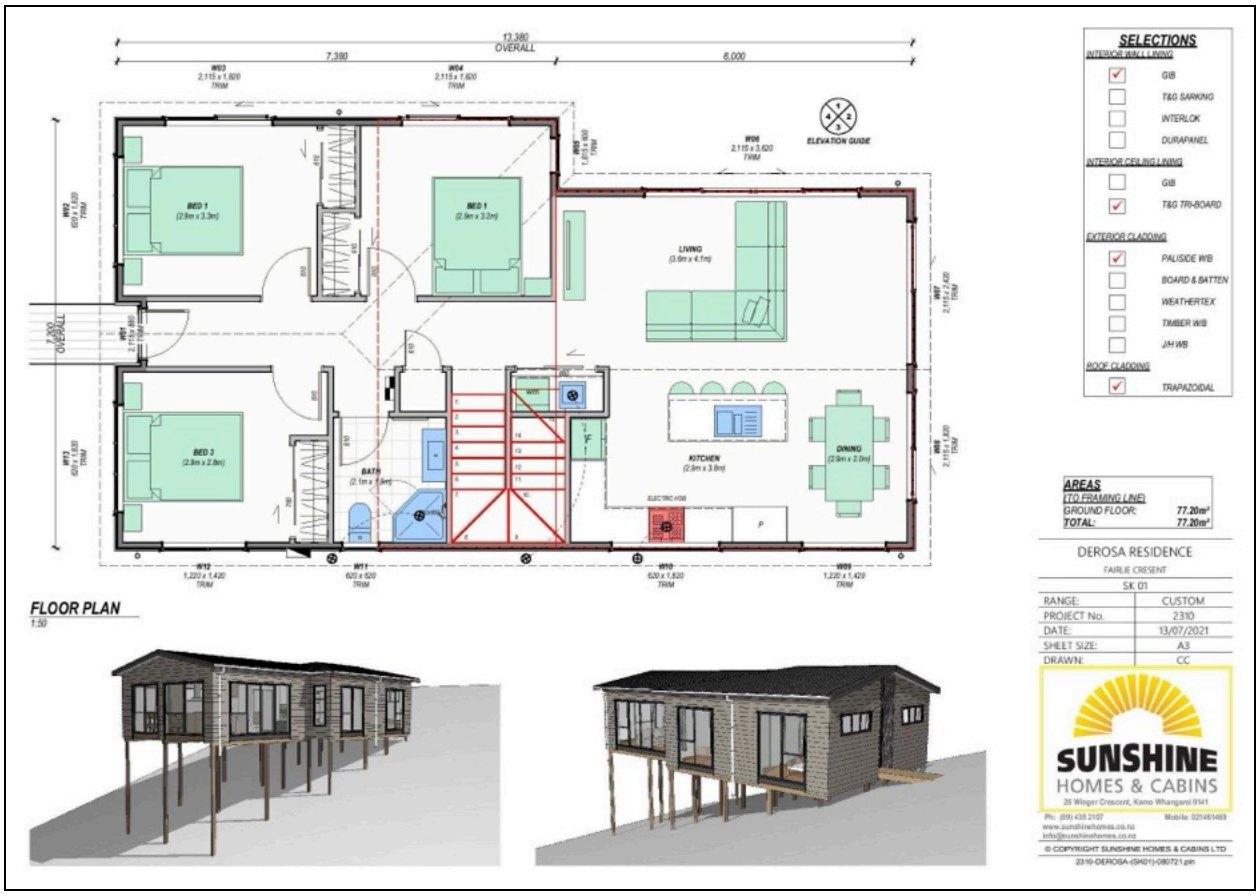
Linear shrinkage	**24**

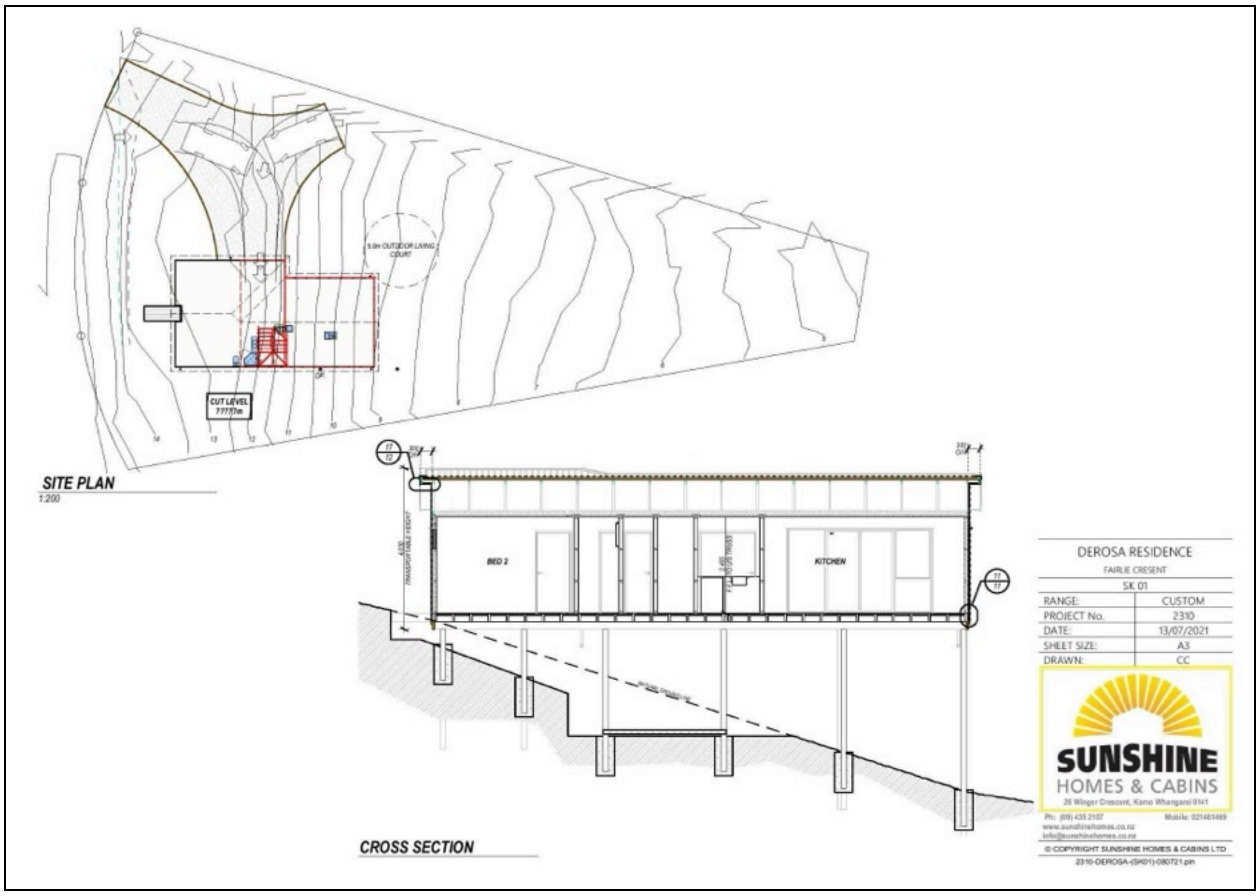
G:\Projects\8400-\8496, Gumboots\8496-082, GCE#1103\8496-082, GCE#1103 lab testing
LS 21-1078
2/11/2021

Issue 3

D. Krissansen
Approved Signatory

Concept Plans




SITE PLAN
1:200
5.0m OUTDOOR LIVING COURT
CUT LEVEL
BED 2
KITCHEN
CROSS SECTION
DEROSA RESIDENCE
FAIRLIE CRESENT
SK 01
RANGE: CUSTOM
PROJECT No. 2310
DATE: 13/07/2021
SHEET SIZE: A3
DRAWN: CC
SUNSHINE
HOMES & CABINS
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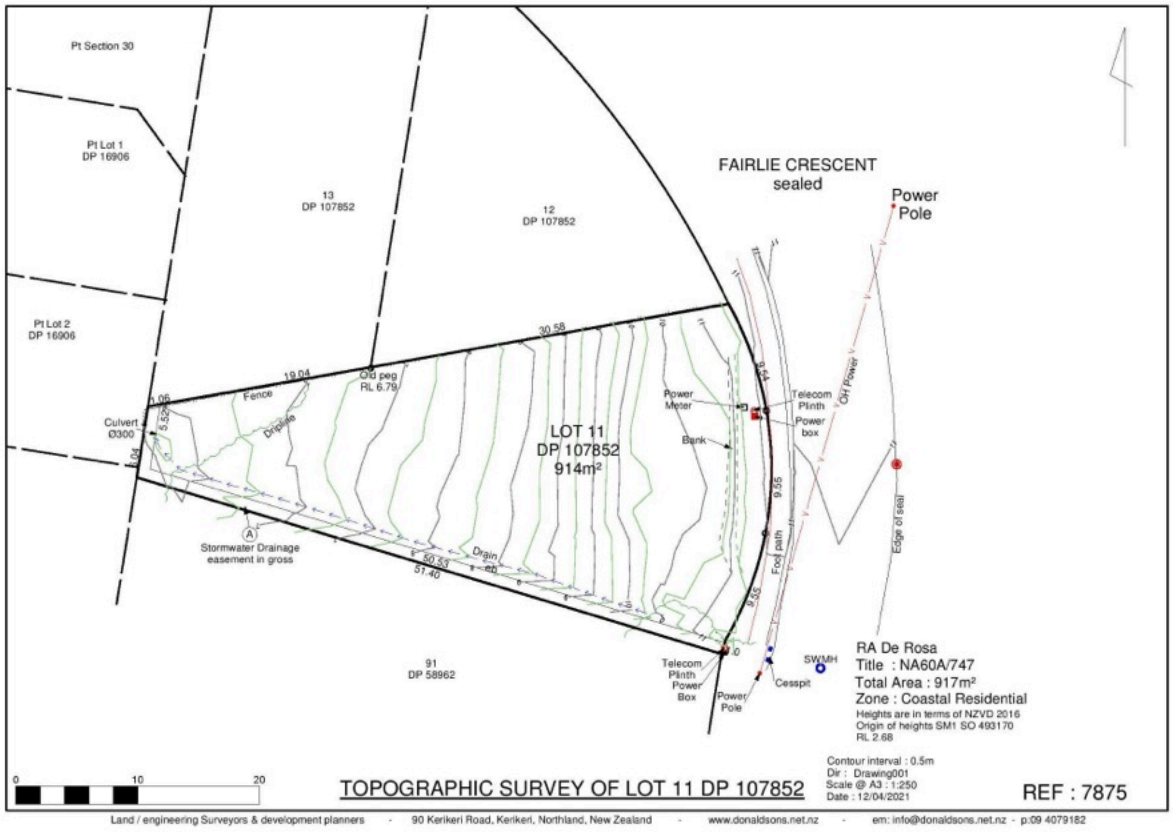
2310-DEROSA-(SK01)-080721.pln

Topography Survey



Photos

Photo 1 - South facing over subject property. Hokianga Harbour beyond.

Photo 2 - Panning left, neighbouring property to the south.

Photo 3 - West facing along southern boundary.

Photo 4 - Facing east along southern boundary.

Photo 5 - Facing east from western boundary toward Fairlie Crescent.

Photo 6 - Panning left toward northern boundary.

Photo 7 - As above, panning left.

Photo 8 - Facing west along northern boundary.

Photo 9 - Panoramic of Fairlie Crescent, facing west.