

Wainono Investments Limited
21 Gatland Road
Drury
Auckland 2113

21 December 2018

Our Ref: 180432-B

Attention: Mr Nick Pollard

Dear Sir

GEOTECHNICAL INVESTIGATION PROPOSED SUBDIVISION 21 GATLAND ROAD, DRURY

1.0 Introduction

The following report has been prepared by Riley Consultants Ltd (RILEY) at the request of Mr Nick Pollard on behalf of Wainono Investments Limited. It presents the results of a geotechnical investigation for a proposed residential subdivision at the above address.

The purpose of the geotechnical investigation and report is to investigate subsoil conditions, assess overall ground stability, and provide general foundation recommendations for the proposed development in support of a resource consent application to Auckland Council (Council). A separate report has been prepared by RILEY to address land contamination aspects of the development.

2.0 Site Description and Proposed Development

The site is located on the southern side of Gatland Road. It is approximately 1.21ha and is currently used for pastoral farming purposes. An existing dwelling and multiple sheds are located in the central and western portions of the site.

The site is bounded by residential properties to the west and undeveloped farmland to the east and south. Site access is via Gatland Road to the north. From the architectural drawings in the Council property file, the existing dwelling is a concrete slab-on-grade and shallow strip type foundation.

From a review of Council GIS contour data, slopes on site range from flat to gently sloping (maximum 5 degrees). A shallow 'gully' feature is present and spans the site from the north to the south. A swampy area is noted adjacent to the southern boundary of the proposed subdivision where existing surface runoff flows into.

It is proposed to subdivide the site into 20 residential lots with a road accessway. The existing dwelling on Lot 20 will remain. The proposed access for the lots are via a spine road through the centre of the subdivision, and a current unformed road adjoining from proposed Lots 12, 14, and, 16. The cut and fill earthwork plans are not available at the time of report preparation.

3.0 Geology

With reference to the 1:250,000 Geological Map 3 of Auckland, together with our experience of the surrounding area, we infer the site is underlain by alluvial sediments of the Puketoka Formation of the Tauranga Group. A preliminary review of nearby machine hole drillings available on the New Zealand Geotechnical Database (NZGD) indicates alluvial soils overlie Waitemata Group deposits at approximately 20m to 22m depth.

The Puketoka deposits generally consist of pumiceous mud, sand, and gravel with muddy peat and lignite. It also consists of rhyolite pumice including non-welded ignimbrite, tephra and alluvial pumice deposits and massive micaceous sand. These soils are often highly variable in strength and character. The presence of these materials, typically beneath a capping of volcanic material, was confirmed on-site by the subsurface investigation. This material is also found beneath recent alluvial soil, which consists of very stiff organic silt within the swamp area.

4.0 Geotechnical Site Investigation

A site walkover appraisal was carried out by a RILEY geotechnical engineer on 5 November 2018. Results from on-site observations indicated no obvious evidence of past instability, erosion, slope slippage, or soil creep affecting the proposed development and their immediate surroundings.

Fourteen hand auger boreholes (HA1 to HA14) were drilled to a maximum depth of 5m between 11 and 16 October 2018 to assess the subsurface conditions in the vicinity of the proposed lots. The approximate borehole locations are shown on the attached site plan (RILEY Dwg: 180432-1). Pilcon shear vane testing was undertaken at 0.5m intervals in the cohesive soils. These results are also shown on RILEY cross sections (RILEY Dwg: 180432-2 to -4). Scala penetrometer testing was also conducted at the base of selected boreholes to investigate for competent material.

Representative bulk samples were recovered from TP1 and TP2 for laboratory testing. Standard compaction, and CBR testing was undertaken on the samples by WSP Opus Laboratories in Auckland. Two standard compaction tests were undertaken in accordance with NZS 4402 test 4.1.1, on material immediately below the topsoil to establish appropriate compaction control criteria for the engineered fill. Two sets of California bearing ratio (CBR) tests were undertaken in accordance with NZS 4402:1986 test 6.1.1 and test 2.1 with 2% and 4% lime added. The results are outlined in Section 6.0 below.

5.0 Subsurface Investigation

Subsoil conditions encountered at the borehole locations are summarised below, and a detailed description of the soils encountered during drilling is shown on the attached borehole logs:

- Topsoil was encountered within all boreholes (except HA14) to the depths ranging from 0.1m to 0.45m depth.
- Fill was not encountered in any of the boreholes during drilling.
- Volcanic deposits of the South Auckland Volcanic Field (SAVF) were encountered beneath the topsoil to depths between 0.5m and 2m within most of the boreholes except HA7, HA11, and HA14.

The volcanic deposits typically comprised silt, with varying amounts of clay and sand. The materials encountered were generally light brownish orange with a black mottled, non to slightly plastic. Shear strengths encountered during the investigation were generally of very stiff (117kPa to 199+kPa) consistency.

- Alluvial sediments of the Puketoka Formation were identified beneath the topsoil and/or volcanic deposits within all boreholes. These sediments generally consisted of light grey with red and pink mottled silts and clays. The plasticity ranges from non to high. Measured shear strengths typically ranged from stiff to hard (60kPa to 223+kPa) consistency.

Organic material was encountered within the lower lying southern and eastern portions of the site. These deposits were encountered at 2.5m depth extending to the base of the holes (5m). The organic clay/silt had a firm to stiff consistency with measured strengths of between 34kPa to 92kPa. The locations and the approximate depths of where organic material was encountered are shown on RILEY Dwg: 180432-1.

An approximate 600mm in thickness layer of weaker silt (40kPa to 58kPa consistency) was identified at a depth of 4m within HA8 and HA10 (eastern boundary).

- Groundwater was generally encountered at depths between 2.8m to 4m across the site during drilling except HA1 (dry at the time of drilling) and HA12 to HA14, where groundwater was measured between 0.4m and 1.0m below ground level. The soils above the water table were noted to be moist to wet.
- Standard piezometers were installed in HA1 (P1) and HA11 (P2). We visited the site on three further occasions to monitor the groundwater levels. The groundwater monitoring results are shown in Table 1.

Table 1: Summary of Monitoring Results

Borehole	Piezometer Screen Depths (m)	Groundwater Depths (m)/ Dates Monitored			
		Drilling (16/10/2018)	5/11/2018	12/11/2018	22/11/2018
P1(HA1)	1.0 to 5.0	Not Encountered	3.7	3.7	3.8
P2(HA11)	1.0 to 5.0	2.8	1.5	1.5	1.4

6.0 Laboratory Test Results

The standard compaction test results from samples recovered from TP1 and TP2 indicate maximum dry densities of 1.14t/m³ and 1.27t/m³ at optimum moisture contents of 42% and 36%, respectively. The full results are attached in Appendix C.

Selected CBR values of 9% and 3% were achieved, respectively. The additional 2% lime resulted in a minor improvement in soaked CBR in TP1 soils while a significant improvement was achieved in the TP2 soils. For both samples, with 2% lime added, the laboratory soaked CBR was 11%.

7.0 Geotechnical Considerations

On the basis of the geotechnical investigation, RILEY considers the proposed development to be generally suitable for the ground conditions encountered at the borehole locations, subject to the recommendations presented in the following sections.

The majority of the proposed lots are considered suitable for future buildings, subject to further input from a suitably experienced geotechnical engineer familiar with the content of this report. Based on the existing available information, the land within the swamp area (discussed in Section 7.3) will require further investigations prior to development.

7.1 Ground Stability

The risk of slope/ground instability affecting the proposed development is considered low, given the relatively high soil strengths encountered, together with the gentle land gradients within and around the proposed development.

7.2 Settlement

Organic material was identified during the investigation. The depths where these organic materials were encountered are shown on RILEY Dwg: 180432-1. It is considered that filling will likely be required in the lower (southern and eastern) portions of the site. The swampy and organic material are considered to be susceptible to settlement under fill and dwelling foundation loads.

Once earthworks design are available, calculations should be carried out to assess the settlement magnitude induced by earthfill and the likely timeframe for settlement to attenuate. Pre-loading may be required to accelerate settlement and reduce the magnitude of post-development long-term settlement. An assessment of required pre-loading heights and placement timeframe will need to be carried out. Settlement monitoring would also be required prior to development of the lots.

Alternatively, to mitigate this risk, the soft swampy and organic materials presents the lower portion of the site could be removed and replaced with engineered fill. However, this is considered unlikely to be economic as the organic material extends close to or beyond 5m.

7.3 Swamp and Groundwater Considerations

An overland flowpath was located in the central portion of the site and discharges into the swamp area. A relatively high groundwater level between 0.4m to 1m was identified within this area at the time of investigation.

The measured groundwater tables generally range from 2.8m to 4.9m (except the swamp area). The proposed cut is unknown at this stage. The groundwater level shown on RILEY Dwg: 180432-1, represents the groundwater level at the time of drilling and following monitoring. Possible effects on the groundwater table should be included as part of a geotechnical review when the earthworks plans are available.

7.4 Foundation Requirements

The underlying, relatively stiff, natural soils (typically the upper 2.5m depth) should be suitable to enable the future light timber framed residential structures to be supported on conventional shallow-type foundations (i.e. footings, pads, or short piles) designed in accordance with NZS: 3604:2011. The soils have been assessed as Class M to H, moderately to highly expansive, with respect to AS: 2870:1996. Class M and H is defined as moderately to highly reactive clays and silts, which can experience ground movement from moisture changes. This would need to be defined with further geotechnical inputs.

To minimise the risk of shrink/swell movement affecting the future structures, conventional shallow foundations designed in accordance with NZS: 3604:2011, should extend a minimum 800mm into stiff natural ground. Alternatively, a specific foundation design may be undertaken in accordance with AS: 2870:1996 (i.e. waffle type slabs). Foundations may be designed assuming the following preliminary parameters:

- 300kPa Ultimate Bearing Capacity (Geotechnical Ultimate).
- 150kPa Dependable Bearing Capacity (Ultimate Limit State).
- 100kPa Allowable Bearing Capacity (Serviceability Limit State).

As mentioned previously, low-strength organic soils were encountered beyond 2.5m depth in places. This organic material is not considered suitable to support any permanent structures. Whilst earthworks are envisaged to be minimal, care should be taken during site development to avoid 'over excavation' reducing the crust of stiff material. Where those materials are present, dwellings should be subject to specific design.

All foundations, within the 45-degree zone of influence of stormwater and sanitary sewer lines, will need to be specifically designed to ensure that foundation loads are transferred to the soils below this zone.

8.0 Site Development

8.1 Earthworks

No earthworks proposals are available at this time. However, due to the gentle contour of the site, we expect only minimal earthworks will be undertaken. We anticipate that earthworks will principally involve excavations for the road pavement, service lines, and cutting down of the high elevated areas, plus fill placement over the lower lying parts of the site.

Earthworks fill compaction testing should be undertaken at, or in excess of, the frequency recommended in NZS: 4431. We envisage that earthworks control will be undertaken principally using allowable air voids and shear strength criteria.

All fill should be placed in a controlled manner in accordance with NZS: 4431. Based on laboratory compaction testing, earth fill should achieve an average shear strength of 150kPa with no single result less than 120kPa. Additionally, fill should achieve an average air voids percentage less than 8% with no single result greater than 10%.

Surficial topsoil layers should be stripped prior to fill placement and stockpiled well clear of the earthwork areas and/or used for pre-loading. This material may be reused following engineered fill placement spread over the lots to a maximum depth of 300mm.

The site earthworks proposals should be reviewed by a geotechnical engineer familiar with the contents of this report. Any exposed areas of soft or organic soils within the proposed building platform should be inspected and undercut at the discretion of an experienced geotechnical practitioner.

8.2 Retaining Walls

All cuts and fills exceeding 500mm in height should be supported by specifically designed retaining walls and reviewed by an experienced geotechnical engineer.

Retaining walls should include a drainage layer behind the wall consisting of drainage metal (e.g. TNZ F/2) with a drainage coil at the base. All collected groundwater should be diverted to an appropriated designed reticulation system of outfall.

8.3 Road Subgrade California Bearing Ratios

The laboratory test results showed varying CBR results (3% and 9%) from natural soil recovered on-site without any improvement from lime. Lime stabilisation should improve the available CBR. The test results indicate that the CBR can be increased to 11% with the addition of 2% lime in both samples. Based on the laboratory test results, we recommend that a CBR value of 7% should be used for preliminary road pavement design with the adding of 2% lime (to 300mm depth). We recommend that a program of Scala testing be undertaken during site earthworks to confirm the available CBR at road subgrade level following improvement.

8.4 Services

Stormwater runoff from roofs and paved areas should be collected and piped to a public reticulation system, or outfall, away from the development.

We anticipate that most stormwater and sanitary sewer lines will be found either within stiff natural soils or engineered fill (e.g. stiff alluvial and volcanic fill). Consideration should be given to the presence of the softer organic soils present across the site and their effect on service line performance and construction. For pipelines interbedded in the organic soils, specific bedding modifications are best recommended when the trenches are excavated and the weaker materials at the invert level are examined in detail. This could also steepen the pipe gradients or increase pipe diameter.

It is recommended that installation of stormwater and sanitary sewer lines be undertaken utilising trench shields and/or battering in soils of low plasticity, provided the shoring methodology complies with the relevant New Zealand standards and legislation. The use of sumps and pumps, will likely, be required to control groundwater inflows during service line installation.

Further geotechnical comment will be required in this regard once detailed development drawings are available.

9.0 Conclusions

RILEY considers that the proposed development is suitable subject to the following recommendations:

- The risk of slope instability affecting the proposed development is considered low, given the relatively high soil strengths encountered in the soil profile, together with the gentle land gradients surrounding the proposal.
- No earthworks proposals are available at this time. However, due to the gentle contour of the site, we expect only minimal earthworks will be undertaken. The site earthworks proposals should be reviewed by a geotechnical engineer familiar with the contents of this report prior to subdivisional development.

- Settlement of the organic soils, and as a result of surcharge filling and building loads, could be mitigated through pre-loading.
- To minimise the risk of shrink/swell movement affecting the future structures, conventional shallow foundations designed in accordance with NZS: 3604:2011, should extend a minimum 800mm into stiff natural ground. Alternatively, a specific foundation design may be undertaken in accordance with AS: 2870:1996 (i.e. waffle type slabs) using the parameters provided in this report.
- All cuts and fills exceeding 500mm in height should be supported by specifically designed retaining walls and reviewed by an experienced geotechnical engineer.
- Based on lab testing results, we recommend that a CBR value of 7% should be used for preliminary road pavement design with 2% lime stabilisation.
- Stormwater runoff from roofs and paved areas should be carefully collected and piped to a public reticulation system or outfall away from the development.

10.0 Limitation

This report has been prepared solely for the benefit of Wainono Investments Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Recommendations and opinions in this email are based on data from limited test positions. The nature and continuity of subsoil conditions away from the test positions are inferred, and it must be appreciated that actual conditions could vary considerably from the assumed model.

During excavation and construction, the site should be examined by an engineer or engineering geologist competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the email has been based. It is possible that the nature of the exposed subsoils may require further investigation and the modification of the design based upon this report.

Riley Consultants Ltd would be pleased to provide this service to Wainono Investments Limited and believes the project would benefit from such continuity. In any event, it is essential Riley Consultants Ltd is contacted if there is any variation in subsoil conditions from those described in the email as it may affect the design parameters recommended in the email.

If you have any queries, please do not hesitate to contact the undersigned.

Yours faithfully

RILEY CONSULTANTS LTD

Prepared by:



Minna Ji
Geotechnical Engineer

Reviewed by:



James Beaumont
Senior Geotechnical Engineer










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







Brett Black
Director, CPEng

Enc: Borehole Logs (HA1 to HA14)
WSP Opus Laboratories Test Results
RILEY Dwgs: 180432-1 to -4

SOIL TYPES AND SYMBOLS

	FILL		CLAY
	TOPSOIL		PEAT
	SILT		GROUNDWATER LEVEL
	SAND		SCALA PENETROMETER
	GRAVEL	10,11,10	LAST 3 NUMBER OF BLOWS PER 50mm INCREMENT

ROCK TYPES AND SYMBOLS

	SANDSTONE		BASALT
	SILTSTONE		TUFF
	MUDSTONE		IGNIMBRITE
	LIMESTONE		GREYWACKE

SOIL STRENGTH CLASSIFICATION

FINE GRAINED COHESIVE SOILS

TERM	FIELD IDENTIFICATION	UNDRAINED SHEAR STRENGTH (kPa)
Very Soft (Vs)	Exudes between fingers when squeezed.	<12
Soft (S)	Easily indented by fingers.	12 – 25
Firm (F)	Indented only by strong finger pressure.	25 – 50
Stiff (St)	Indented by thumb pressure.	50 – 100
Very Stiff (VSt)	Indented by thumbnail.	100 – 200
Hard (H)	Difficult to indent by thumbnail.	200+

SPT & SCALA PENETROMETER RESULTS

TERM	SPT VALUE No. of BLOWS/300mm	SCALA PENETROMETER No. of BLOWS/100mm
very dense	>50	17+
dense	30 – 50	7 – 17
medium dense	10 – 30	3 – 7
loose	4 – 10	1 – 3
very loose	0 – 4	0 – 2






ROCK STRENGTH CLASSIFICATION

TERM	FIELD IDENTIFICATION	UNCONFINED UNIAXIAL COMPRESSIVE STRENGTH (MPa)
Extremely weak (EW)	Indented by thumbnail.	< 1
Very weak (VW)	Crumbles under firm blows with point of geological hammer. Can be peeled with pocket knife.	1 – 5
Weak (W)	Difficult to peel with pocket knife.	5 – 20
Moderately strong (MS)	Cannot be scraped or peeled with pocket knife.	20 – 50
Strong (S)	More than one blow of geological hammer to fracture.	50 – 100
Very strong (VS)	Many blows of geological hammer to break.	100 – 250
Extremely strong (ES)	Can only be chipped with geological hammer.	250+

MOISTURE CONDITION

Dry (D)	Looks and feels dry; powdery and friable.
Moist (M)	Feels cool; darkened in colour; no free water when remoulded.
Wet (W)	Feels cool; darkened in colour; free water forms on hands.
Saturated (S)	Free water is present on sample.

SAMPLE TYPES

	UNDISTURBED
	MACHINE AUGER DISTURBED
	HAND AUGER DISTURBED
	STANDARD PENETRATION TEST (solid cone)
	STANDARD PENETRATION TEST (hollow cone)

DRILLING METHOD

OB	OPEN BARREL
TT	TRIPLE TUBE
WB	WASH BORE
SH	UNDISTURBED SHELBY TUBE
RC	ROCK CORE
SPT	STANDARD PENETRATION TEST

FIELD TESTS

V	SHEAR VANE (corrected to BS:1377)
R	REMOULDED STRENGTH
P	POCKET PENETROMETER
CH	CLEGG HAMMER

INFORMATION BASED ON THE NZ GEOTECHNICAL SOCIETY INC. GUIDELINES FOR THE CLASSIFICATION AND DESCRIPTION OF SOIL AND ROCK FOR ENGINEERING PURPOSES



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 4 Fred Thomas Drive
 Takapuna 0622
 Tel: +649 489 7872
 Fax:

HAND AUGER LOG

Project: 21 Gattland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 16-10-18 Finish Date: 16-10-18		Ground Level (m):		HA2	
Client: Wainono Investment Ltd				Hole Depth: 5.00 m		Sheet: 1 of 1	

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests	
					50	100	150	200	3	6	9	12					15
0.25	0.25	Topsoil	TOPSOIL														
1.00	1.00	SAVF	SILT; light brown with trace black mottle. Very stiff, non plastic, micaceous [SOUTH AUCKLAND VOLCANIC FIELD].	x												✓ V= 183 R= 110	
1.50	1.50		Silty CLAY; light orange with trace grey mottles. Stiff, moderately plastic [PUKETOKA FORMATION].	x												✓ V= 90 R= 53	
1.50	1.50		1.40 m Grades to light brown with grey with orange mottles.	x												✓ V= 87 R= 43	
2.00	2.00		SILT, minor clay, whitish grey with pink and orange mottles. Slightly plastic; pumiceous.	x												✓ V= 93 R= 50	
2.80	2.80	Puketoka Formation	CLAY, minor silt; bluish grey with orange mottles. moderately to highly plastic.	x												✓ V= 133 R= 63	
3.00	3.00		3.00 m 100mm of Sandy SILT; orange, non plastic.	x												✓ V= 83 R= 60	
3.90	3.90		Organic CLAY; dark brown. Moderately plastic; amorphous.	x												✓ V= 80 R= 50	
4.10	4.10		CLAY, minor SILT; grey and orange with trace black mottles. Moderately to highly plastic.	x												✓ V= 83 R= 50	
4.90	4.90		Sandy SILT; brown grey, non plastic; sand, fine.	x												✓ V= 223+	
5.00	5.00		EOH @ 5.00 m														

RILEY\AKL\GLOB Log RILEY HA (AKL) NO MAP 180432-BOREHOLE LOGS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by GINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample Large Disturbed Sample ■ U100 Undisturbed Sample		▼ Scala Penetrometer - blows/50mm ⊕ Permeability Test ▼ Schmidt Hammer ✓ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ⚡ Water Strike (1st, 2nd ...) ↑ Water Rise (1st, 2nd ...) and ⏱ Rise Time (minutes)		GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 3.7 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth		Remarks SAVF* - South Auckland Volcanic Field	
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All dimensions in metres Scale 1:41	Shear Vane No. 4496	Logged by: AHL	Checked by: <i>aj</i>
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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 16-10-18 Finish Date: 16-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.00 m		Sheet: 1 of 1			

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12				
	0.30	SAVF* Topsoil	TOPSOIL														
	0.50		SILT; red brown with black mottle. Very stiff, non plastic (SOUTH AUCKLAND VOLCANIC FIELD).	x													✓ V= 225+
	0.80		Silty CLAY; light orange brown with grey mottles. Very stiff, moderately plastic (PUKETOKA FORMATION).	x													✓ V= 96 R= 67
	1.30		SILT, trace clay; light orange brown with grey mottles. Very stiff, moderately plastic.	x													✓ V= 120 R= 53
	1.50	Puketoka Formation	CLAY, minor silt; light grey with orange mottles. Stiff to very stiff, moderately to highly plastic.	x													✓ V= 123 R= 73
	2.00		1.50 m Grades to greyish white with orange and pink mottles. Pumiceous. 2.00 m Grades to light grey with orange mottles.	x													
	3.20		SILT, minor clay, trace sand; light brown grey with orange mottles. Stiff to very stiff, non plastic.	x													✓ V= 100 R= 50
	3.80		3.80 m Grades to minor sand, no clay. Non plastic, sand, fine.	x													✓ V= 70 R= 33
	4.50		4.50 m Grades to brown grey.	x													✓ V= 80 R= 20
	5.00		4.90 m Grades to minor clay, trace sand, fine	x													✓ V= 100 R= 33
	5.00		EOH @ 5.00 m	x													✓ V= 183 R= 60

RILEYAKL.GLB Log RILEY HA (AKL) NO MAP 180432-BOREHOLE LOGSS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations:

- Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
- Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense
- Small Disturbed Sample
- ┆ Large Disturbed Sample
- U100 Undisturbed Sample

- ▼ Scala Penetrometer - blows/50mm
- ┆ Permeability Test
- ▼ Schmidt Hammer
- ✓ Insitu Vane Shear Strength (kPa)
V=Peak, R=Residual, UTP=Unable to penetrate
- ┆ Water Strike (1st, 2nd ...)
- ┆ Water Rise (1st, 2nd ...) and Rise Time (minutes)

GROUNDWATER

None

Slow Seep (depth 3.7 m)

Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
Target Depth

Remarks
SAVF* - South Auckland Volcanic Field

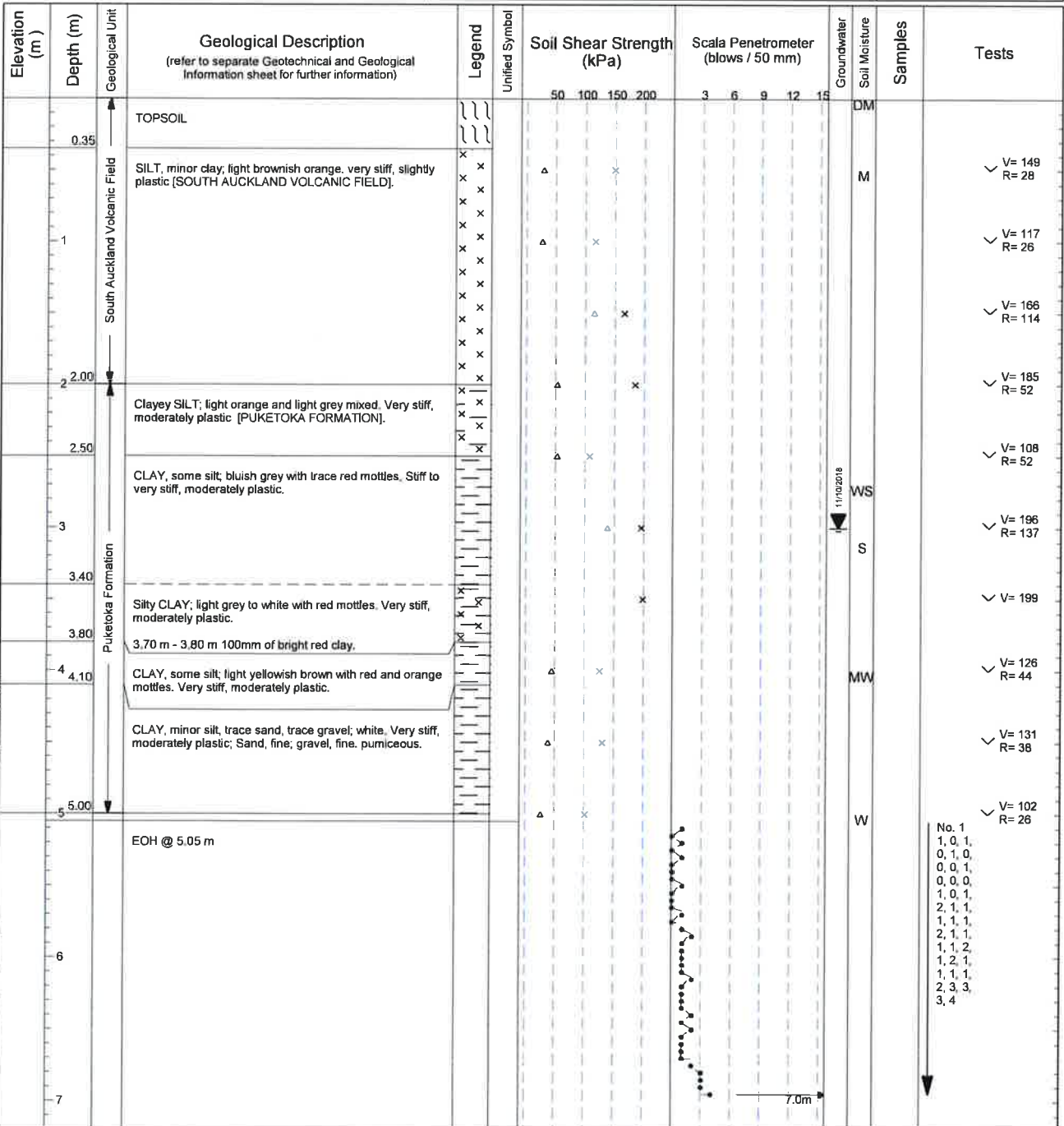
All dimensions in metres Scale 1:41	Shear Vane No. 4496	Logged by: AHL	Checked by: <i>Cef</i>
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 Takapuna 0622
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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 16-10-18 Finish Date: 16-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.05 m		Sheet: 1 of 1			



RILEYAKL_GLB_Log_RILEY HA (AKL) ICG MAP 180432- BOREHOLE LOGS.GPJ 11/12/2018 16:05 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense • Small Disturbed Sample Large Disturbed Sample ■ U100 Undisturbed Sample		▾ Scala Penetrometer - blows/50mm ⊕ Permeability Test ⊖ Schmidt Hammer ∨ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ⚡ Water Strike (1st, 2nd ...) ⬆ Water Rise (1st, 2nd ...) and Rise Time (minutes)		GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 3.0 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth		Remarks 3.00 m: Water strike - Very slow seep	
All dimensions in metres Scale 1:41		Shear Vane No. 1706		Logged by: RTS		Checked by: 	



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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 16-10-18 Finish Date: 16-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.00 m		Sheet: 1 of 1			

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12				
	0.25	Topsoil	TOPSOIL														
	0.60	SAVF	SILT, minor clay; orangish brown. Very stiff, slightly plastic [SOUTH AUCKLAND VOLCANIC FIELD].	X													✓ V= 111 R= 58
	1		Silty CLAY; brownish light grey with trace orange mottles. Stiff to very stiff	X													✓ V= 105 R= 62
	1.60		SILT, minor clay; white	X													✓ V= 126 R= 77
	2.2.05		Silty CLAY; light grey with orange mottles. Very stiff, moderately plastic.	X													✓ V= 141 R= 77
	3	Puketoka Formation	2.80 m - 3.25 m Orange and light grey mixed with trace organics. Organics, amorphous.	X													✓ V= 126 R= 80
			3.20 m Grades to minor organics, amorphous	X													✓ V= 163 R= 123
	4		4.10 m Grades to trace organic, amorphous	X													✓ V= 151 R= 52
	4.15		Organic CLAY; dark brown. Stiff, moderately to highly plastic.	X													✓ V= 62 R= 31
	4.45		Clayey SILT, minor organics, trace sand; light brownish grey. Stiff, moderately plastic; sand, fine; organics, amorphous.	X													✓ V= 58 R= 22
	5.00		EOH @ 5.00 m	X													

RILEYAKL_QLB_Log_RILEY_HA(AKL)_NO_MAP_180432-BOREHOLE LOGS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations:
 Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
 Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense

- Small Disturbed Sample
- ┆ Large Disturbed Sample
- U100 Undisturbed Sample

- ▼ Scala Penetrometer - blows/50mm
- ┆ Permeability Test
- ▼ Schmidt Hammer
- ▼ Insitu Vane Shear Strength (kPa)
V=Peak, R=Residual, UTP=Unable to penetrate
- ┆ Water Strike (1st, 2nd ...)
- ┆ Water Rise (1st, 2nd ...) and Rise Time (minutes)

GROUNDWATER

None

Slow Seep (depth 4.0 m)

Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
Target Depth

Remarks

SAVF* - South Auckland Volcanic Field

All dimensions in metres Scale 1:41	Shear Vane No. 608	Logged by: GB	Checked by: <i>[Signature]</i>
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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 16-10-18 Finish Date: 16-10-18		Ground Level (m):		HA6	
Client: Wainono Investment Ltd				Hole Depth: 5.00 m		Sheet: 1 of 1	

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12				
	0.30	Topsoil	TOPSOIL														
	0.75	SAVF	SILT, trace clay; brownish orange. Very stiff, non plastic [SOUTH AUCKLAND VOLCANIC FIELD].	X	Δ									M			✓ V= 160 R= 25
	1		Clayey SILT; trace gravel; grey with trace orange mottles. Very stiff, slightly plastic	X	Δ									MW			✓ V= 166 R= 105
	1.50		SILT, minor clay, minor gravel; light greyish brown. Stiff, slightly plastic; gravel, fine; pumiceous.	X	Δ												✓ V= 111 R= 34
	1.95		Silty CLAY; light grey with minor orange mottles. Very stiff, moderately plastic.	X	Δ												✓ V= 74 R= 43
	2		2.80 m - 2.95 m Grades to greyish white with orange mottles.	X	Δ												✓ V= 123 R= 55
	3				X	Δ											✓ V= 105 R= 52
	3.50		Clayey SILT; greyish white with orange mottles. Stiff, moderately plastic.	X	Δ												✓ V= 105 R= 62
	4.00		SILT, minor to some clay; white with trace orange mottles. Very stiff, slightly to moderately plastic; sand, fine.	X	Δ									W			✓ V= 95 R= 34
	5.00		EOH @ 5.00 m	X	Δ									S			✓ V= 154 R= 28
	5			X	Δ												✓ V= 123 R= 18
	6			X	Δ												No. 1 0, 0, 1 0, 0, 1 0, 0, 0 1, 1, 0 1, 0, 1 1, 1, 1 1, 3, 2 1, 1, 2 1, 2, 2 2, 2, 3 6, 7, 3 5, 3, 4 3, 3, 3
	7			X	Δ												

RILEYAKL_GLB_Log_RILEY HA (AKL) NO MAP_180432-BOREHOLE LOGS.GPJ_11/12/2018 16:05 Produced by g|NIT Professional

Explanations:

- Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
- Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample

- ▼ Scale Penetrometer - blows/50mm
- ⊥ Permeability Test
- ▼ Schmidt Hammer
- ▼ Insitu Vane Shear Strength (kPa)
- V=Peak, R=Residual, UTP=Unable to penetrate
- ⬇ Water Strike (1st, 2nd ...)
- ⬆ Water Rise (1st, 2nd ...) and Rise Time (minutes)

GROUNDWATER

None

Slow Seep (depth 3.7 m)

Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
Target Depth

Remarks

SAVF* - South Auckland Volcanic Field

All dimensions in metres Scale 1:41	Shear Vane No. 608	Logged by: GB	Checked by: <i>CS</i>
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HAND AUGER LOG

Project: 21 Gattland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 11-10-18 Finish Date: 11-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.00 m		Sheet: 1 of 1			

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)					Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12	15				
	0.35	Topsoil	TOPSOIL, dark brown.															
	1.30		0.35 m - 0.50 m Grades to brownish orange, dry to moist. SILT, minor to some clay, light grey with trace orange mottles. Very stiff, slightly plastic, pumiceous [PUKETOKA FORMATION].															✓ V= 215+ ✓ V= 145 R= 31
	2.00		Silty CLAY; light grey with trace to minor orange mottles. Very stiff, slightly to moderately plastic, pumiceous.															✓ V= 135 R= 68
	3.50		1.90 m Grades to clayey SILT, orange with minor light grey and trace pink mottles.															✓ V= 123 R= 62
	4.60		Silty CLAY; grey with minor orange and trace pink mottles. Very stiff, moderately plastic.															✓ V= 126 R= 77
	5.00		2.10 m Grades to brownish grey with minor pink and trace orange mottles.															✓ V= 138 R= 92
			3.10 m Grades to clayey SILT, slightly to moderately plastic.															✓ V= 120 R= 62
			Clayey SILT, trace sand; light grey with trace orange mottles. Stiff, slightly to moderately plastic; sand, fine.															✓ V= 80 R= 31
			Organic SILT, minor clay; dark brown with dark specks. stiff to very stiff, slightly plastic; organics, amorphous.															✓ V= 52 R= 15
	5.00		EOH @ 5.00 m															✓ V= 123 R= 25

RILEY\AKL_GLB_Log_RILEY_HA [AKL] NO MAP_180432-BOREHOLE LOGS.GPJ <-DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample Large Disturbed Sample ■ U100 Undisturbed Sample		Scale Penetrometer - blows/50mm Permeability Test Schmidt Hammer Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate Water Strike (1st, 2nd ...) Water Rise (1st, 2nd ...) and Rise Time (minutes)		GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 3.1 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth		Remarks 	
All dimensions in metres Scale 1:41		Shear Vane No. 608		Logged by: GB		Checked by: 	



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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 11-10-18 Finish Date: 11-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.00 m		Sheet: 1 of 1			

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12				
0.10	0.10	SAVF	TOPSOIL.	x													
0.50	0.50		SILT; reddish brown with trace black mottles. Very stiff, non plastic [SOUTH AUCKLAND VOLCANIC FIELD].	x													✓ V= 223+
1.00	1.00		CLAY, some silt; grey with orange mottles. Very stiff, moderately plastic [PUKETOKA FORMATION].	x													✓ V= 183 R= 133
1.20	1.20		1.20 m Grades to trace white specks, pumiceous.	x													✓ V= 173 R= 133
1.80	1.80		1.80 m Grades to minor silt, light grey and orange mixed; moderately to highly plastic.	x													✓ V= 163 R= 110
2.20	2.20		2.20 m Grades to pink, orange and grey mixed.	x													✓ V= 127 R= 83
2.90	2.90	Puketoka Formation	Silty CLAY; pinkish grey with red mottles, stiff, slightly to moderately plastic.	x													✓ V= 117 R= 67
3.50	3.50		3.50 m Grades to light orange.	x													✓ V= 83 R= 33
4.40	4.40		SILT, trace clay; whitish grey. Firm, non to slightly plastic; pumiceous.	x													✓ V= 40 R= 17
5.00	5.00		SILT, trace gravel, grey. Very stiff to hard; non plastic; pumiceous.	x													✓ V= 223+
5.00	5.00		EOH @ 5.00 m	x													✓ V= 223+

RILEYAKL_GLB Log RILEY HA (AKL) NO MAP 180432- BOREHOLE LOGS.GPJ 11/11/2018 16:05 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample ○ Large Disturbed Sample ■ U100 Undisturbed Sample	▾ Scala Penetrometer - blows/50mm ▾ Permeability Test ▾ Schmidt Hammer ▾ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ▾ Water Strike (1st, 2nd ...) ▾ Water Rise (1st, 2nd ...) and Rise Time (minutes)	GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 4.0 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth	Remarks SAVF* - South Auckland Volcanic Field
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All dimensions in metres Scale 1:41	Shear Vane No. 4494	Logged by: AL	Checked by: <i>[Signature]</i>
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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 11-10-18 Finish Date: 11-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.05 m				Sheet: 1 of 1	

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)					Groundwater	Soil Moisture	Samples	Tests
					50	100	150	200	3	6	9	12	15				
	0.30	Topsoil	TOPSOIL; brown.														
	0.70	SAVF	SILT, trace sand, light brownish orange. Very stiff, non plastic; sand, fine [SOUTH AUCKLAND VOLCANIC FIELD].	x x x	Δ		x										✓ V= 155 R= 32
1	1.30		SILT, trace clay, light brown. Stiff, non plastic [PUKETOKA FORMATION].	x x x	Δ	x											✓ V= 78 R= 40
	1.90		SILT; brownish white. Stiff, non plastic; pumiceous.	x x x	Δ	x											✓ V= 57 R= 20
2	2.50		Silty CLAY; light bluish grey. Very stiff, moderately plastic.	x x x	Δ		x										✓ V= 144 R= 86
3	3.90	Puketokā Formation	CLAY, minor silt; grey with orange mottle. Very stiff, moderately to highly plastic.	x x x	Δ	x											✓ V= 201+
	4.40		3.80 m Grades to some silt, grey.	x x x	Δ		x										✓ V= 144 R= 129
4	4.40		SILT, trace clay, trace sand, grey with orange mottles. Very stiff, non plastic; sand, fine.	x x x	Δ		x										✓ V= 132 R= 89
	5.05		Pumiceous; white. Stiff, non plastic.	x x x	Δ		x										✓ V= 146 R= 63
	5.05		4.80 m Grades to minor clay, white with trace orange mottles; slightly plastic.	x x x	Δ	x											✓ V= 132 R= 52
	5.05		EOH @ 5.05 m	x x x	Δ	x											✓ V= 69 R= 43
6																	No. 1 1, 1, 1, 1, 1, 2, 1, 2, 1, 1, 1, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 4, 5, 6, 8, 8, 9, 9, 9, 9, 10, 8, 10, 10, 10
7																	

RILEYAKS_GLB_Log RILEY HA (AKL) NO MAP 180432- BOREHOLE LOGS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample Large Disturbed Sample ■ U100 Undisturbed Sample		Scale Penetrometer - blows/50mm Permeability Test Schmidt Hammer Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate Water Strike (1st, 2nd ...) Water Rise (1st, 2nd ...) and Rise Time (minutes)		GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 4.7 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth		Remarks SAVF* - South Auckland Volcanic Field	
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All dimensions in metres Scale 1:41	Shear Vane No. 1743	Logged by: AL	Checked by:
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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.: HA10
Job No.: 180432	Start Date: 11-10-18 Finish Date: 11-10-18	Ground Level (m):		Co-Ordinates ():		
Client: Wainono Investment Ltd			Hole Depth: 5.00 m			Sheet: 1 of 1

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests	
					50	100	150	200	3	6	9	12					15
	0.20	TOPSOIL															
	0.60	SAVF*	SILT, trace clay; brownish orange. Very stiff, non plastic [AUCKLAND VOLCANIC FIELD].	x x x													✓ V= 215+
1	1.40		SILT, minor clay; light orange. Very stiff, non to slightly plastic [PUKETOKA FORMATION].	x x x													✓ V= 138 R= 25
2	1.80		CLAY, some silt; orange and light grey mixed. Very stiff, moderately to highly plastic. 1.80 m Grades to minor silt; light grey with orange mottles.	x x x													✓ V= 169 R= 108
3	3.50			x x x													✓ V= 185 R= 126
4	3.80		Silty CLAY; light orange and orange mixed. Very stiff, moderately plastic.	x x x													✓ V= 154 R= 92
4	4.20		SILT, minor clay; light whitish orange. Stiff, slightly plastic; purriceous.	x x x													✓ V= 163 R= 92
4	4.20		Silty CLAY; grey. Very stiff, slightly to moderately plastic.	x x x													✓ V= 80 R= 52
5	5.00		EOH @ 5.00 m	x x x													✓ V= 58 R= 15
6				x x x													✓ V= 148 R= 68
7				x x x													✓ V= 215+

RILEYAKL.GLB_Log RILEY HA [AKL] IND MAP_180432_BOREHOLE.LOGS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense • Small Disturbed Sample Large Disturbed Sample ■ U100 Undisturbed Sample	▾ Scala Penetrometer - blows/50mm ⊕ Permeability Test ⚡ Schmidt Hammer ∨ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ⚡ Water Strike (1st, 2nd ...) ↑ Water Rise (1st, 2nd ...) and Rise Time (minutes)	GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 3.0 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth	Remarks SAVF* - South Auckland Volcanic Field

HAND AUGER LOG

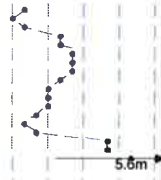
Project: 21 Gattland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 11-10-18 Finish Date: 11-10-18		Ground Level (m):		HA11/P2	
Client: Wainono Investment Ltd				Hole Depth: 4.65 m		Sheet: 1 of 1	

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)					Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12	15				
0.20		Topsoil																
0.80			SILT, minor clay, trace sand; light brownish yellow. Very stiff, non plastic (PUKETOKA FORMATION).															✓ V= 171 R= 40
1.10			SILT, minor clay, brownish light grey. Very stiff to stiff, slightly plastic.															✓ V= 57 R= 26
1.50			SILT, some clay, light grey. Stiff, slightly plastic.															✓ V= 88 R= 43
2.00			Silty CLAY, trace sand; light grey. Stiff, moderately plastic; sand, fine.															✓ V= 88 R= 43
2.50			2.00 m Grades to light yellowish grey.															✓ V= 139 R= 68
3.00			2.50 m Grades to very stiff.															✓ V= 97 R= 34
3.00			CLAY, some silt, trace to minor sand; light greyish yellow with orange mottles. Very stiff, moderately plastic; sand, fine.															✓ V= 139 R= 85
4.405			Silty CLAY, some organics; light brownish grey. Very stiff, slightly to moderately plastic; organics, amorphous.															✓ V= 117 R= 43
4.65			EOH @ 4.65 m															✓ V= 199+

RILEYAKL.GLB Log RILEY HA (AKL) NO MAP 180432-BOREHOLE LOGS.GPJ <<DrawingFiles>> 11/12/2018 16:05 Produced by GINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample ↓ Large Disturbed Sample ■ U100 Undisturbed Sample		▾ Scala Penetrometer - blows/50mm ⊕ Permeability Test ▾ Schmidt Hammer ▾ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ⚡ Water Strike (1st, 2nd...) ↑ Water Rise (1st, 2nd...) and ⏱ Rise Time (minutes)		GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 2.8, 1.5 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Refusal		Remarks Groundwater was encountered at the depth of 1.5m, dated 12/11/2018	
All dimensions in metres Scale 1:41		Shear Vane No. 1706		Logged by: RTS		Checked by: 	

No. 11
 4, 3, 4,
 7, 7, 8,
 8, 8, 7,
 6, 6, 6,
 5, 4, 5,
 11, 11,
 13





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HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 11-10-18 Finish Date: 11-10-18		Ground Level (m):		HA12	
Client: Wainono Investment Ltd				Hole Depth: 4.25 m		Sheet: 1 of 1	

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests	
					50	100	150	200	3	6	9	12					15
	0.45	Topsoil	TOPSOIL.														
	0.90	Puketoka Formation	Clayey SILT, yellowish grey. Very stiff, moderately plastic [PUKETOKA FORMATION].										WS			✓ V= 122 R= 63	
	1		Silty CLAY, trace sand; light brownish yellow with orange mottles and white specks. Very stiff, moderately plastic; sand, fine.										S			✓ V= 139 R= 14	
	2															✓ V= 139 R= 57	
	2.50															✓ V= 114 R= 43	
	3		Organic CLAY, some silt, dark grey and black mixed. Stiff, highly plastic.													✓ V= 80 R= 45	
	4		3.80 m Grades to 100mm of fine sand layer.													✓ V= 57 R= 26	
	4.25		4.10 m Grades to trace pumiceous fine gravel.													✓ V= 57 R= 23	
	5		EOH @ 4.25 m													✓ UTP	
	6																
	7																

RILEY\AKL\GLB Log RILEY HA (AKL) NO MAP 180432-BOREHOLE LOGS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense ● Small Disturbed Sample Large Disturbed Sample ■ U100 Undisturbed Sample	▾ Scala Penetrometer - blows/50mm ⊕ Permeability Test ▾ Schmidt Hammer ▾ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ▾ Water Strike (1st, 2nd ...) ▾ Water Rise (1st, 2nd ...) and ▾ Rise Time (minutes)	GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 1.0 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Refusal	Remarks

HAND AUGER LOG

Project: 21 Gatland Road		Location: Papakura		Hole position: Refer to site plan.		No.:	
Job No.: 180432		Start Date: 11-10-18 Finish Date: 11-10-18		Ground Level (m):		Co-Ordinates ():	
Client: Wainono Investment Ltd		Hole Depth: 5.05 m		Sheet: 1 of 1			

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)					Groundwater	Soil Moisture	Samples	Tests
						50	100	150	200	3	6	9	12	15				
	0.35	Topsoil	TOPSOIL; dark brown.															
	1	Puketokā Formation	Silty CLAY; light grey with minor orange mottles. Very stiff, moderately plastic [PUKETOKA FORMATION].															✓ V= 105 R= 6
	1.50		CLAY, some silt; light grey with minor orange mottles, very stiff, moderately to highly plastic.															
	2																	✓ V= 154 R= 77
	2.45																	✓ V= 141 R= 22
	3		Organic CLAY, minor silt; dark. Stiff to firm, moderately to highly plastic; organics, amorphous. 2.60 m Grades to dark grey.															✓ V= 49 R= 15
	3.80																	✓ V= 34 R= 15
	4		SILT, trace clay, trace sand; light grey. Very stiff, non plastic; sand, fine; dilatant behaviour. 4.00 m - 4.20 m Wood pieces.															✓ V= 86 R= 9
	4.50																	✓ V= 114 R= 46
	5.05		Organic SILT, minor clay; dark brown. Stiff, slightly plastic; organics, amorphous and fibrous mixed.															✓ V= 77 R= 15
	5.05		EOH @ 5.05 m															✓ V= 92 R= 18

RILEYAKL.GLB Log RILEY HA (AKL) NO MAP 180432-BOREHOLE LOGS.GPJ <<DrawingFile>> 11/12/2018 16:05 Produced by gINT Professional

Explanations:

- Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
- Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense
- Small Disturbed Sample
- ⊥ Large Disturbed Sample
- U100 Undisturbed Sample

- ▼ Scala Penetrometer - blows/50mm
- ⊥ Permeability Test
- ▼ Schmidt Hammer
- ✓ Insitu Vane Shear Strength (kPa)
V=Peak, R=Residual, UTP=Unable to penetrate
- ⊥ Water Strike (1st, 2nd ...)
- ⊥ Water Rise (1st, 2nd ...) and Rise Time (minutes)

GROUNDWATER

- None
- Slow Seep (depth 0.4 m)
- Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
Target Depth

Remarks

- No. 1
1, 1, 1,
1, 1, 1,
1, 1, 2,
2, 2, 2,
2, 3, 3,
3, 3, 3,
3, 3, 3,
3, 4, 5,
5, 6, 7,
6, 7, 8,
7, 8, 7,
7, 8, 9,
10, 9

All dimensions in metres Scale 1:41	Shear Vane No. 608	Logged by: GB	Checked by: <i>[Signature]</i>
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Riley Consultants Limited
 4 Fred Thomas Drive
 Takapuna 0622
 Tel: +649 489 7872
 Fax:

HAND AUGER LOG

Project: 21 Gattland Road		Location: Papakura		Hole position: Middle of Lot 9		No.: HA14
Job No.: 180432	Start Date: 11-10-18 Finish Date: 11-10-18	Ground Level (m):		Co-Ordinates ():		
Client: Wainono Investment Ltd			Hole Depth: 5.00 m			Sheet: 1 of 1

RILEYAKL_GLB Log RILEY_HA (AKI) NO MAP 180432-BOREHOLE LOGS.GPJ <<DrawingFile>> 13/12/2018 12:07 Produced by gINT Professional

Elevation (m)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend Unified Symbol	Soil Shear Strength (kPa)				Scala Penetrometer (blows / 50 mm)				Groundwater	Soil Moisture	Samples	Tests		
					50	100	150	200	3	6	9	12					15	
	0.70	Alluvium	SILT, minor clay; dark brown with trace dark orange mottles. stiff to very stiff, slightly plastic [ALLUVIUM].	X												✓ V= 151 R= 6		
	1.15		Organic SILT, minor clay; dark grey with trace dark orange mottles. Very stiff, non to slightly plastic.	X												✓ V= 105 R= 9		
	2	Puketoka Formation	Silty CLAY, trace sand; orange and light grey mixed. Very stiff, moderately plastic; sand, fine; pumiceous [PUKETOKA FORMATION].	X												✓ V= 120 R= 62		
	3																	✓ V= 105 R= 49
	3.50																	
	4		Organic CLAY, trace sand; dark brown. Stiff, highly plastic; sand, fine.	X												✓ V= 108 R= 62		
	4.90		4.00 m Grades to firm.	X												✓ V= 49 R= 15		
	5.00		SILT, some sand, trace organics; light grey with trace dark brown lamination. Very stiff, non plastic; sand, fine; organics, amorphous.	X												✓ V= 37 R= 22		
	6		E.O.H @ 5.00 m	X												✓ V= 77 R= 43		
	7			X												✓ V= 215+		

Explanations: Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered Relative soil Strength - very soft/very loose, soft/loose, firm/medium dense, stiff/dense, very stiff/very dense • Small Disturbed Sample ↓ Large Disturbed Sample ■ U100 Undisturbed Sample		▼ Scala Penetrometer - blows/50mm ↓ Permeability Test ▾ Schmidt Hammer ✓ Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate ↓ Water Strike (1st, 2nd ...) ↓ Water Rise (1st, 2nd ...) and ▽ Rise Time (minutes)		GROUNDWATER <input type="checkbox"/> None <input checked="" type="checkbox"/> Slow Seep (depth 0.5 m) <input type="checkbox"/> Rapid Inflow (depth) HOLE TERMINATED DUE TO: Target Depth		Remarks 		
All dimensions in metres Scale 1:41			Shear Vane No. 608		Logged by: GB		Checked by: ASD	

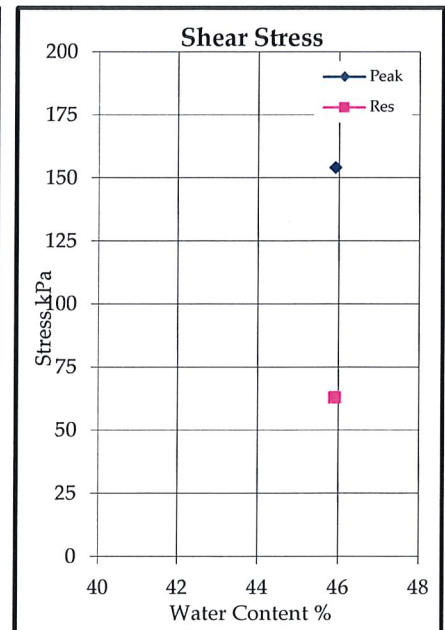
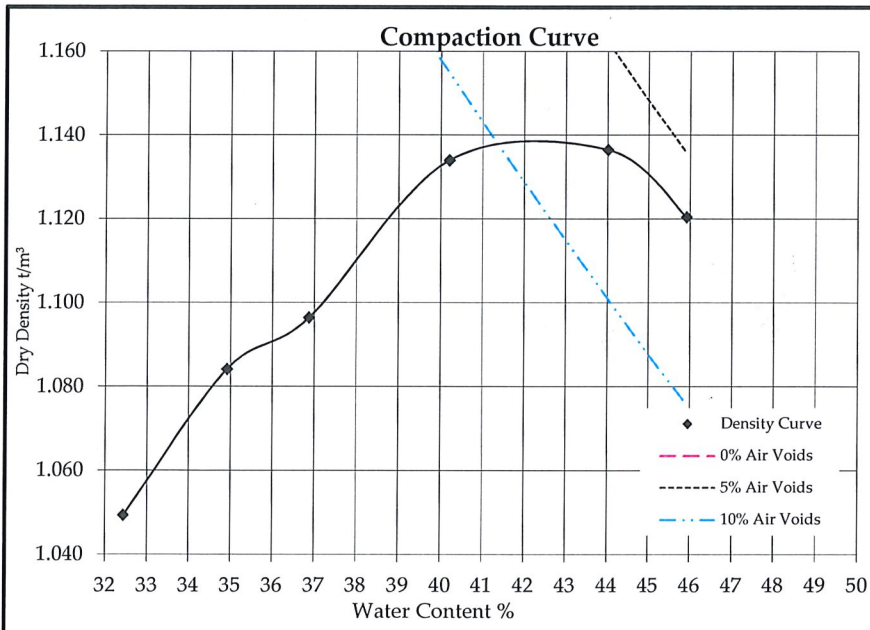
**DRY DENSITY / WATER CONTENT RELATIONSHIP
STANDARD COMPACTION**



Project : **21 Gatland Road**
 Location : **21 Gatland Road**
 Client : **Riley Consultants Ltd.**
 Contractor : **Riley Consultants Ltd.**
 Sampled by : **-**
 Date sampled : **15/10/18**
 Sampling method : **Not Stated**
 Sample description : **Silty CLAY; Brown; Moist, Plastic**
 Sample condition : **As Received**
 Solid density : **2.65 t/m³ (Assumed)**
 Source: **21 Gatland Road**

Project No : **1-LA014.00**
 Lab Ref No : **AL3257/1**
 Client Ref No : **180432**

Test Results							
Maximum dry density	1.14	t/m ³	Natural water content	44.0	%		
Optimum water content	42	%	Fraction tested	Whole			
Sample ID	A	B	C	D	Nat	E	
Bulk density t/m ³	1.390	1.463	1.501	1.590	1.637	1.635	
Water content %	32.4	34.9	36.9	40.2	44.0	45.9	
Dry density t/m ³	1.049	1.084	1.096	1.134	1.136	1.120	
Sample condition	Dry	Dry	Moist	Moist	Moist	Moist	
Peak stress kPa	UTP	UTP	UTP	UTP	140+	154	
Remoulded stress kPa	UTP	UTP	UTP	UTP	-	63	



Test Methods	Notes
Compaction NZS 4402 : 1986 Test 4.1.1 (Standard)	
Shear Strength using a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001	

Date tested : 08-13/11/18
 Date reported : 19/11/18

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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IANZ Approved Signatory
 Ben Richardson 
 Designation : Assistant Laboratory Manager
 Date : 20/11/18



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

**CALIFORNIA BEARING RATIO (REMOULDED)
TEST REPORT**



Project: **21 Gatland Road** Date sampled: **15/10/18**
 Location: **21 Gatland Road** Sampling method: **Not Stated**
 Client: **Riley Consultants Ltd.** Sample condition: **As Received**
 Contractor: **Riley Consultants Ltd.** Sample description: **Silty CLAY, Brown, Moist, Plastic***
 Sampled by: **Not Stated** Date sample/s received: **16/10/18**

Project No: **1-LA014.00**
 Lab Ref No: **AL3257/2-4**
 Client Ref No: **-**

Test Results															
Sample condition at test	Curing time (Days)	Soaking time (Days)	Passing 19mm (%)	Surcharge mass (kg)	Lime additive (%)	Cement additive (%)	Swell (%)	Penetration (mm)	Water content as received (%)	Water content as compacted (%)	Water content after testing (%)	Dry density (t/m ³)	CBR value (%)		
Lab Ref No. AL3257/2	Location 21 Gatland Road		Sample description Silty CLAY, Brown, Moist, Plastic												
Soaked	0	4	100	4	0	0	0.2	2.5	44.3	44.3	46.2	1.12	9		
Lab Ref No. AL3257/3	Location 21 Gatland Road		Sample description Silty CLAY, Brown, Moist, Plastic												
Soaked	3	4	100	4	2	0	0.2	2.5	44.3	43.1	46.2	1.10	11		
Lab Ref No. AL3257/4	Location 21 Gatland Road		Sample description Silty CLAY, Brown, Moist, Plastic												
Soaked	3	4	100	4	4	0	0	2.5	44.3	41.7	45.2	1.10	14		

Test Methods	Notes
CBR	NZS : 4402 : 1986 : 6.1.1
Water Content	NZS : 4402 : 1986 : 2.1
Compaction	NZS : 4402 : 1986 : 4.1.1 (Standard)
	Material Used: Passing 19mm sieve
	Rate of penetration : 1mm/min
	*Sample Description is not covered by IANZ Accreditation

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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IANZ Approved Signatory

Date tested: 12-15/11/18 Designation: *Ben Richardson*
 Date reported: 20/11/18 Date: 20/11/18



Tests indicated as not accredited are outside the scope of the laboratory's accreditation

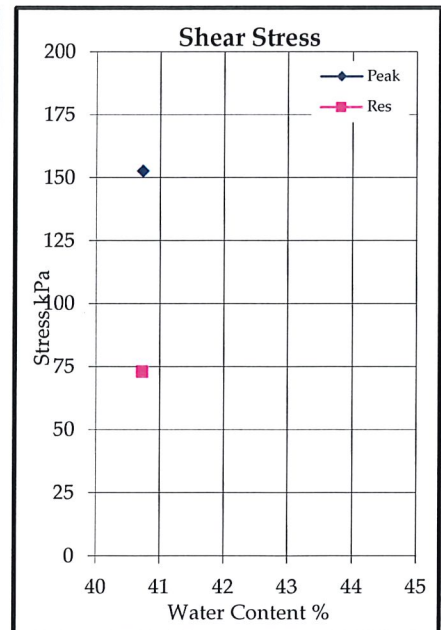
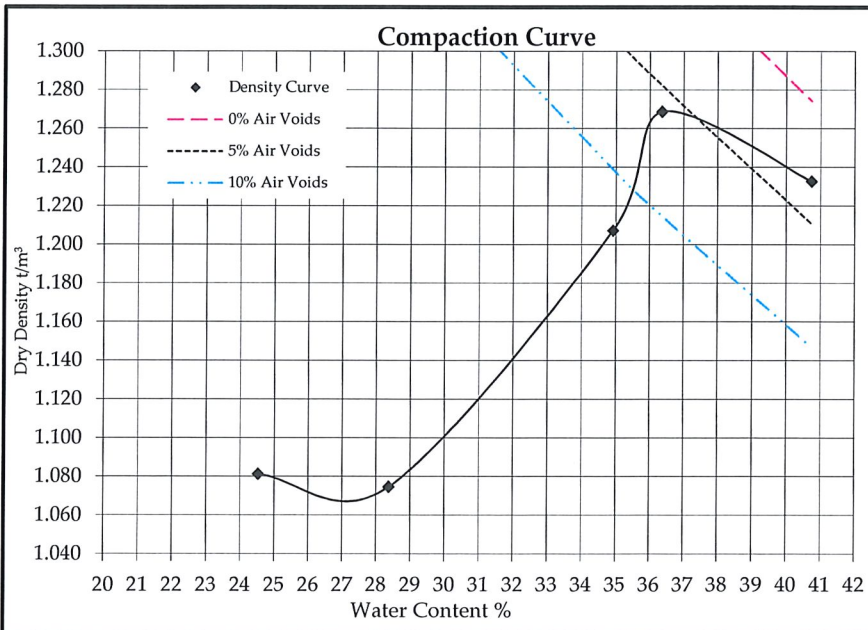
**DRY DENSITY / WATER CONTENT RELATIONSHIP
STANDARD COMPACTION**



Project : **21 Gatland Road**
 Location : **TP2**
 Client : **Riley Consultants Ltd**
 Contractor : **Riley Consultants Ltd**
 Sampled by : **Not Stated**
 Date sampled : **Not Stated**
 Sampling method : **Not Stated**
 Sample description : **Silty CLAY; Brown; Moist, Plastic**
 Sample condition : **As Received**
 Solid density : **2.65 t/m³ (Assumed)**
 Source: **21 Gatland Road**

Project No : **1-LA014.00**
 Lab Ref No : **AL3328/1**
 Client Ref No : **180432**

Test Results						
Maximum dry density	1.27	t/m ³	Natural water content	40.7	%	
Optimum water content	36	%	Fraction tested	Whole Sample		
Sample ID	A	B	C	D	Nat	
Bulk density t/m ³	1.346	1.379	1.629	1.730	1.735	
Water content %	24.5	28.4	34.9	36.3	40.7	
Dry density t/m ³	1.081	1.075	1.207	1.269	1.233	
Sample condition	Dry	Moist-Dry	Moist	Moist	Moist	
Peak stress kPa	UTP	UTP	UTP	UTP	153	
Remoulded stress kPa	UTP	UTP	UTP	UTP	73	



Test Methods	Notes
Compaction NZS 4402 : 1986 Test 4.1.1 (Standard)	%Air voids lines are not covered by IANZ accreditation due to the solid density being assumed.
Shear Strength using a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001	

Date tested : 28/11/18 - 07/12/18 Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
 Date reported : 10/12/18 This report may only be reproduced in full

IANZ Approved Signatory
 Ben Richardson 
 Designation : Assistant Laboratory Manager
 Date : 10/12/18



Tests indicated as not accredited are outside the scope of the laboratory's accreditation

CALIFORNIA BEARING RATIO (REMOULDED)

TEST REPORT



Project: **21 Gatland Road**
 Location: **TP2**
 Client: **Riley Consultants Ltd.**
 Contractor: **Riley Consultants Ltd.**
 Sampled by: **Not Stated**

Date sampled: **Not Stated**
 Sampling method: **Not Stated**
 Sample condition: **As Received**
 Sample description: **Silty CLAY; Brown; Moist, Plastic**
 Date sample/s received: **22/11/18**

Project No: **1-LA0014.00**
 Lab Ref No: **AL3328/2-4**
 Client Ref No: **180432**

Test Results														
Sample condition at test	Curing time (Days)	Soaking time (Days)	Passing 19mm (%)	Surcharge mass (kg)	Lime additive (%)	Cement additive (%)	Swell (%)	Penetration (mm)	Water content as received (%)	Water content as compacted (%)	Water content after testing (%)	Dry density (t/m³)	CBR value (%)	
Lab Ref No. AL3328/2	Location TP2		Sample description Silty CLAY; Brown; Moist, Plastic											
Soaked	0	5	100	4	0	0	0	5	41.3	41.3	41.5	1.22	3	
Lab Ref No. AL3328/3	Location TP2		Sample description Silty CLAY; Brown; Moist, Plastic											
Soaked	3	4	100	4	2	0	0	2.5	41.3	40.4	40.6	1.22	11	
Lab Ref No. AL3328/4	Location TP2		Sample description Silty CLAY; Brown; Moist, Plastic											
Soaked	3	4	100	4	4	0	0	2.5	41.3	39.0	37.2	1.22	40	

Test Methods	Notes
CBR	NZS : 4402 : 1986 : 6.1.1
Water Content	NZS : 4402 : 1986 : 2.1
Compaction	NZS : 4402 : 1986 : 4.1.1 (Standard)

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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IANZ Approved Signatory

Ben Richardson
 Assistant Laboratory Manager
 Date : 10/12/18

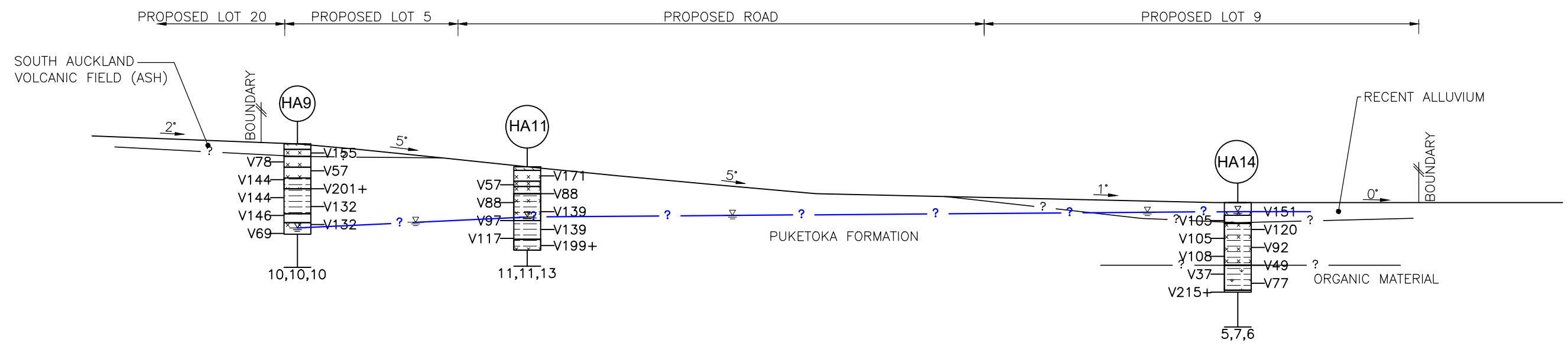
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 Date reported: 10/12/18



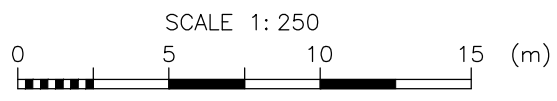
Tests indicated as not accredited are outside the scope of the laboratory's accreditation

LEGEND

- HA1 HAND AUGER LOCATION
- FILL
- CLAY
- ORGANICS
- SILT
- SAND
- v188+ INSITU UNDRAINED SHEAR STRENGTHS (kPa)
- SCALA PENETROMETER FROM BASE OF BOREHOLE (6,7,7)
- WL GROUNDWATER LEVEL (16/10/18)
- 10° EXISTING GROUND SLOPE



SECTION A
SCALE 1:250 2

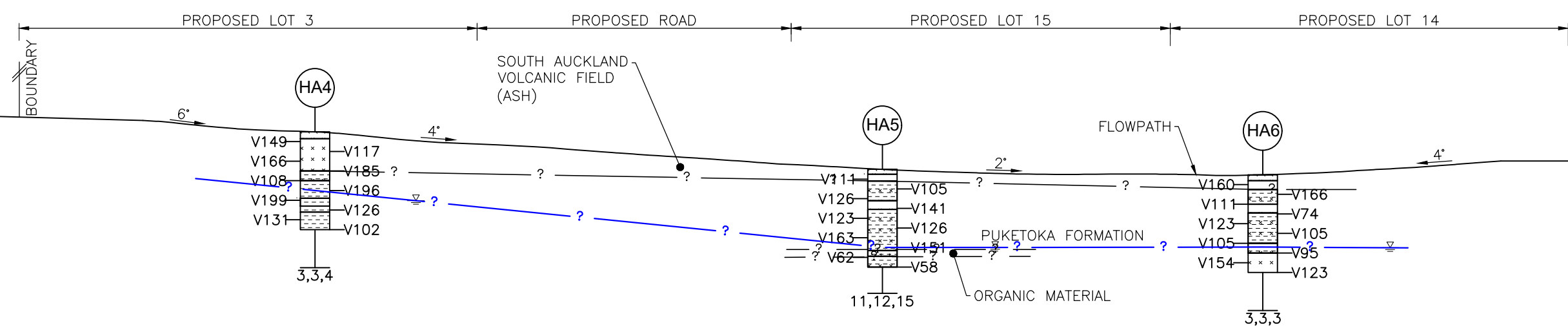


FOR RESOURCE CONSENT

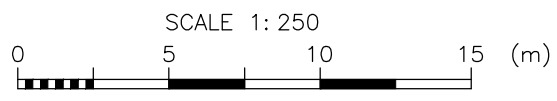
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DRAWN RTS		CHECKED JM		B BLACK			P.O. BOX 100 253 NORTH SHORE AUCKLAND 0745 TEL. 09-4897872 FAX. 09-4897873		GEOTECHNICAL INVESTIGATION CROSS SECTION A		SCALES (A3) 1:250	
1	FIRST ISSUE	WY	21.12.18	DATE DRAWN	NOV 2018	DATE:	21/12/18			DRAWING No. 180432-2		REV.
REV	DESCRIPTION	BY	DATE									1

LEGEND

- HA1 HAND AUGER LOCATION
- FILL
- CLAY
- ORGANICS
- SILT
- SAND
- v188+ INSITU UNDRAINED SHEAR STRENGTHS (kPa)
- SCALA PENETROMETER FROM BASE OF BOREHOLE (6,7,7) (blows/50mm for last 150mm)
- WL GROUNDWATER LEVEL (16/10/18)
- 10° EXISTING GROUND SLOPE



SECTION B
SCALE 1:250

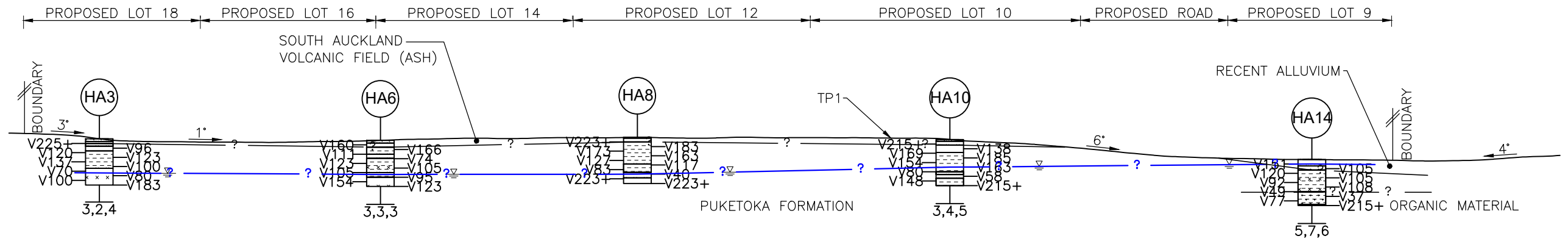


FOR RESOURCE CONSENT

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DRAWN RTS		CHECKED JM		B BLACK			P.O. BOX 100 253 NORTH SHORE AUCKLAND 0745 TEL. 09-4897872 FAX. 09-4897873		GEOTECHNICAL INVESTIGATION CROSS SECTION B		SCALES (A3) 1:250	
DATE DRAWN NOV 2018		DATE 21/12/18		DATE: 21/12/18						DRAWING No. 180432-3		REV. 1
1	FIRST ISSUE	WY	21.12.18	BY	DATE							
REV	DESCRIPTION	BY	DATE									

LEGEND

- HA1 HAND AUGER LOCATION
- FILL
- CLAY
- ORGANICS
- SILT
- SAND
- v188+ INSITU UNDRAINED SHEAR STRENGTHS (kPa)
- SCALA PENETROMETER FROM BASE OF BOREHOLE (6,7,7) (blows/50mm for last 150mm)
- WL GROUNDWATER LEVEL (16/10/18)
- 10° EXISTING GROUND SLOPE



SECTION C
SCALE 1:500



FOR RESOURCE CONSENT

DESIGN MJ DRAWN RTS DATE 21.12.18 BY DATE		CHECKED MJ CHECKED JM DATE DRAWN NOV 2018		APPROVED FOR ISSUE: B BLACK DATE: 21/12/18		P.O. BOX 100 253 NORTH SHORE AUCKLAND 0745 TEL. 09-4897872 FAX. 09-4897873		TITLE WAINONO INVESTMENT LTD 21 GATLAND ROAD, DRURY GEOTECHNICAL INVESTIGATION CROSS SECTION C		CADFILE 180432-3to4 SCALES (A3) 1:500		DRAWING No. 180432-4		REV. 1	
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