

# SITE SUITABILITY GEOTECHNICAL

Vision Project Ref: 13050 10/08/2017

#### **1 G**ENERAL

Vision Consulting Engineers Limited (VISION) was engaged to undertake geotechnical investigations, analysis and reporting to support an application to subdivide 107 Yorke Road, Haruru, being Lot 1 DP166269, to create an additional lot.

The scope of this report is given in the agreed services proposal dated 24 April 2017 and comprises a geotechnical investigation to determine the ground conditions at the site and provide recommendations regarding earthworks and foundation design.

This report is suitable to accompany an application for Resource Consent.

#### 2 SITE SETTING AND CONDITIONS

The property is located at 107 Yorke Road, Haruru and covers an area of 6,782m<sup>2</sup>. The site is bounded by Waitangi River to the north and residential lots in all other directions. The approximate location of the site is presented below on Figure 1.

The site is current occupied by an existing dwelling, shed/garage, car parking area located in the northern portion of the property and a gravel/concrete access way from Yorke Road. A gully/creek feature is present immediately to the south of the existing dwelling, which appears to be tidal. The gully appears to have been infilled to create the car parking area and access way, with a concrete culvert passing beneath. The banks of the gully appear to be over steepened and show signs of minor erosion.

The access way is gravel from Yorke Road to adjacent to the dwelling at 103 Yorke Road where it becomes a concrete surface and the gradient of the access way increases to up to approximately 14 degrees. The concrete surface continues to the north to adjacent to the dwelling of 105 Yorke Road, where it becomes gravel for the remainder of its length

The southern portion of the property (accessway) has a significant change in elevation (in the order of 19 metres) from Yorke Road sloping gently to moderately down to the alluvial flats below. Cut slopes up to approximately 1.0m in height are present where the access passes to the north of 103 Yorke Road.

The northern portion of the property is located on alluvial flats adjacent to the Waitangi River. This portion of the site is typically at an elevation of 1.8 to 2m OTP. The northern portion of the site is covered in grass, with some mature trees present near the existing dwelling, adjacent to the north-eastern boundary and adjacent to the access way in the southern portion of the site. An undulating surface profile was observed in the grassed area between 105 Yorke Road and the existing dwelling at 107 Yorke Road, where surface water is considered likely to pond and an overland flow path flowing to the north-east is present. Where the overland flow path meets the gravel access way, a plastic pipe directs flows to an open drain running along the north-eastern site boundary.

Stormwater pipes appear to have been installed in the northern portion of the site, adjacent to eastern boundary near the driveway which discharges to an open drain and along the western boundary of the site which discharges into the gully/creek.



Figure 1: Site location (not to scale, north at top of page)



#### **3 PROPOSED SUBDIVISION**

The client wishes to carry out a subdivision of the existing lot and create two new lots as shown on the attached DMS Surveyors Limited survey plan included in Appendix A. The existing lot will be subdivided approximately create Lot 1 being  $4,640m^2$  and Lot 2 being  $2,145m^2$ .

A concrete and gravel right of way providing access to both lots is located as shown on the attached subdivision plan in Appendix A.

#### 4 GEOLOGY

The 1:250,000 geological map, Geology of the Whangarei Area (Edbrooke et al 2009) indicates that the site is underlain by the Greywacke of the Waipapa Group, consisting of massive to thin bedded, lithic volcaniclastic sandstone and argillite.

Due to the proximity to the Waitangi River, the site was expected to be underlain by estuarine and alluvial deposits underlain by the Waipapa Group.

#### **5 GROUND INVESTIGATION**

The ground conditions were investigated on the 19 and 26 June 2017 and involved the drilling of four hand augured boreholes (BH1 to BH4) to a maximum depth of 1.5 metres below ground level (m bgl) and two Cone Penetrometer Tests (CPTs) (CPT1 to 2) with pore pressure measurements to up to 24.83mbgl. Measurements of the undrained shear strength were taken in cohesive materials at 200 - 600mm intervals at the auger locations using a calibrated shear vane.

The approximate location of the hand auger boreholes and penetrometers tests are shown on Figure 2 below. Field testing logs and CPT logs are included in Appendix B.





Figure 2: Geotechnical test locations



#### **6 SUBSURFACE CONDITIONS**

#### 6.1 Ground conditions

The subsurface conditions at the site were found to consist of dark brown clayey silt topsoil containing rootlets and organics to depths of between 0.2 and 0.4m bgl. Beneath the topsoil, variable alluvial deposits typically comprising silty clay, clayey silt, gravelly silt and silty gravel were encountered in the hand auger boreholes. Undrained shear strengths measured to a depth of 1.5mbgl ranged from 26 to greater than 170kPa.

The two CPT's indicate that the upper 4.5 to 5m of the ground profile consist of variable alluvial deposits typically comprising silty clay, silty sand and sandy silts. Undrained shear strengths in the cohesive materials typically range from 10 to 70kPa and friction angles of 32 to 37 degrees in non-cohesive materials.

Beneath the upper variable alluvial layer, soft to firm silty clay is present to depths of 19 to 20m below ground level (bgl). Undrained shear strengths estimated from the CPT's using an  $N_k$  value of 15 range from 20 to 50kPa, typically increasing with depth. Below 20mbgl, the strength of the silty clay increases to being stiff, greater than 50kPa.

At a depth of 21.5 to 23.2mbgl, very stiff sandy silt and clayey silt was found to underlie the site which is inferred to be weathered Waipapa Group. Refusal of the CPT's was reached at depths of 23.68 and 24.83 on what is inferred to be bedrock.

#### 6.2 Groundwater

Groundwater was encountered in the CPT's completed at the site. Groundwater levels were measured at a depth of 0.82m bgl in CPT1 and 1.45m bgl in CPT2.

Groundwater levels at the site are likely to vary with the tidal Waitangi River level. Groundwater levels are expected to rise to near ground surface level during winter months or extended periods of heavy rainfall.

#### 6.3 Site subsoil class

The site subsoil class is considered to be Class D shallow soil site as defined by NZS 1170.5 (2004) "Structural Design Actions: Part 5: Earthquake actions – New Zealand" based on our database of deep investigation data and published geological information.

#### 6.4 Soil shrink-swell potential

The near surface soils are considered to be slightly to moderately expansive soils with a likely liquid limit above 50% based on their physical characteristics observed during testing and relevant project experience. We note that no laboratory testing of the material to confirm the liquid limit or presence of clay swelling minerals has been undertaken, however material characteristics indicate that they are potentially expansive.

#### 6.5 Liquefaction Potential

The effects of seismic induced liquefaction and lateral spreading have not been specifically assessed. GNS guidance (GNS Science Series 47) indicates that hazards associated with liquefaction should be evaluated for certain ground conditions and where sites are likely to experience peak ground accelerations (PGAs) in excess of 0.1g.

Site PGAs, calculated in accordance with NZS1170.5 (for a Class D subsoil site) are 0.04g. This PGA value is considered to be too low for seismic induced liquefaction to be a risk for the proposed development and no further assessment is considered necessary.

#### 7 ENGINEERING EVALUATION

#### 7.1 Natural Hazards

The property is mapped by the Far North District Council (FNDC) and Northland Regional Council (NRC) as being subject to the natural hazard of inundation. The FNDC and NRC hazard maps indicate that the property is affected by the 1 in 10 year and the 1 in 100 year inland flood. The NRC hazard maps also indicate that the site is affected by the predicted 50 and 100 year coastal flooding level.

Further information regarding the inundation hazard and recommended finished floor levels is presented in the VISION Flood Assessment Report, reference 13050 dated 10 August 2017.

In order to meet the minimum floor level required, bulk site filling is required.





#### 7.2 Settlement of Fill

Due to the inundation hazard present at the property, site filling is likely to be required meet the minimum floor level.

Conceptual settlement analysis for bulk filling has been carried out using CPeT-IT version 2.0.1.55. In the analysis the following assumptions have been made:

- Fill footprint is 30m by 30m
- Fill has been assumed to act as a non-rigid footing
- Fill height of 1.5m equivalent of 30kPa vertical load (fill weight 20kN/m<sup>3</sup>)

Settlement analysis of the bulk filling has considered both short term (primary consolidation) and long term (creep) settlement. The results of the conceptual settlement analysis are presented in Tables 1 and 2 below.

#### Table 1 – Short Term (primary consolidation) Settlement

CPT No	Primary
	Settlement
	(mm)
1	176
2	143

#### Table 2 – Long term (creep) Settlement

CPT No	Time Period	Creep Settlement (mm)
	(post construction)	(post construction)
1	6 months	11
	12 months	17
	18 months	22
	10 years	48
	50 years	72
2	6 months	12
	12 months	19
	18 months	24
	10 years	53
	50 years	81

The concept settlement analysis indicates that primary consolidation occurs within 6 months of placing the fill. However, creep settlements due to the placement of 1.5m of compacted hardfill (GAP65 or equivalent) result in the long term settlements (creep) occurring for the design life (50 years). Long term creep settlements are predicted to be in the order of 80mm, which is in-excess of the 25mm limit imposed by the New Zealand Building Code.

In order to reduce long term (creep) settlements to within the 25mm limit, light weight fill such as geofoam is required to reduce the imposed load on the underlying alluvial deposits. A conceptual solution is to undercut the proposed filling area by 1.3m and replace with 1.5m of geofoam, before placing 1.3m of hardfill over the geofoam to achieve a fill height of 1.5m above current ground surface level. The final design will need to consider uplift pressures on the geofoam due to flooding and is likely to require geotextile to resist uplift pressures.

#### 8 ENGINEERING RECOMMENDATIONS

The site is considered to be suitable for the proposed subdivision scheme plan depicted on the DMS Surveyor Limited subdivision plan presented in Appendix A provided that the following engineering design considerations are adopted.

#### 8.1 Earthworks

#### 8.1.1 Unsuitable material

The topsoil present will need to be removed where any site filling is proposed. Topsoil is expected to extend approximately 0.4m bgl.

#### 8.1.2 Fill

It is recommended that all fill to be placed at the site is assessed by a chartered professional engineer experienced in geotechnical engineering as the placement of fill is likely to result in settlement at the site. Undercutting and the use of light weight fill may be required to limit settlements to tolerable levels as discussed in Section 7.2.

Where the proposed filling is to support the loads of the building it will need to be certified by a Chartered Professional Engineer in accordance with NZS4431:1989, as required by NZS3604:2011 "Timber Framed Buildings" and NZS4229 (1999) "Concrete Masonry Buildings Not Requiring Specific Engineering Design". If certification is not achieved, specific engineering design will be required to comply with the NZ Building Code.



Where filling is proposed and on removal of topsoil /unsuitable materials an inspection of the base of the excavation by the certifying Engineer or their representative is required prior to the commencement of filling. The fill should comprise suitable well graded granular material (GAP65 or similar approved) or light weight fill (as required), placed uniformly into the excavation in layers not exceeding 150mm in thickness. The fill should be placed at its optimum moisture content. The material should be inspected and approved as suitable material by the certifying Engineer or their representative. Material which is wet or saturated should not be placed into the excavation unless that is the optimum moisture content for the fill.

The fill should be compacted to achieve the minimum strengths given in the following table:

Undrained shear strength (cohesive fill)	
Average not less than	140kPa
Minimum single value	110kPa
Dynamic Cone Penetrometer (non-cohesive fill)	
Average value not less than	2 blows/50mm
Minimum single value	1.5blows/50mm

Compaction should be carried out using several passes over each lift with a steel drum roller for non-cohesive fill (sand or gravel) or a sheeps foot roller for cohesive fill (silt and clay). Compaction using a Bobcat, excavator, truck or other vehicle other than a compactor is not likely to achieve the required strength for the fill to be certified.

Provision should be made to ensure that the earth works are conducted with due respect for the weather, particularly due to the low permeability of the underlying ground. The fill should not be placed into a saturated excavation, especially if ponded water is present.

Vibration compaction should not be used if the base of the excavation is wet or if the fill is above optimum moisture content otherwise the fill strength may be significantly reduced from the resultant moisture uptake until the excess pore pressures have dissipated. The time for this to occur is variable, but is likely to take more than one day.



#### 8.1.3 Site cuts

At the time of writing this report, no site cutting is anticipated other than the stripping of topsoil and temporary cuts associated with potential undercutting of the proposed building area. It is recommended that temporary cut slopes up to 1.5m in depth are no steeper than 1H:2V.

#### 8.1.4 Ground contouring

The building areas should be graded so that water cannot pond against, beneath or around the building for the economic life of the structure. To achieve this it will be important that the soils beneath the topsoil grade away from the buildings.

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

#### 8.2 Foundations

#### 8.2.1 Slab-on grade footings founded on engineered fill

Where foundations are located on non-cohesive engineered fill greater than 1.0m in thickness, NZS3604 (2011) footings are considered to be suitable for the site. Alternatively, a waffle slab (rib-raft of similar) could be adopted.

It is recommended site specific analysis is carried out at each building area to confirm the requirements for foundation design and to assess settlement of the fill platform. Undercutting and the use of light weight fill may be required to limit settlements to tolerable levels.

#### 8.3 Stormwater & Drainage recommendations

All surface water should be collected and diverted in a controlled manner. All stormwater collected from the site not retained for domestic use should be piped to the existing swale drains and water ways. Soakage pits are not recommended.



#### 9 LIMITATIONS

This report has been completed exclusively for the Woolston Family Trust and their professional advisors with respect to the particular brief given to us for the particular purpose given above. Information, opinions and recommendations contained in this report cannot be used for any other purpose or by any other entity without our review and written consent. Vision Consulting Engineer Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

The ground conditions given in this report are based on visual methods and investigations at discrete locations. The nature and continuity of the subsurface conditions are inferred and it must be appreciated that actual conditions could vary from that described herein.

We should be contacted immediately if variations are encountered for those assumed in this report. It is possible that further investigation or modification of recommendations is required.

For and on behalf of VISION CONSULTING ENGINEERS LTD

Report prepared by:

Report reviewed and authorised by:

Dan Simmonds Senior Geotechnical Engineer **BEng (Civil)** 

Ben Perry Managing Director MIPENZ, CPEng

#### Appendices

Appendix C:

Appendix A: Appendix B: DMS Surveyors Limited Subdivision Plan. Site investigation results: Borehole logs 1 – 4 CPT logs CPT1 and CPT2 Settlement assessment results





# Appendix A

DMS Surveyors Limited Subdivision Plan





# Appendix B

Site Investigation Results



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1		10		Client: Woolston Family Trust	Project: Geotech Investigati	on	VCE Pro	oject No.:	1305	0
		3 ENGI	NEERS	Project Location: 107 Yorke Road, Haruru	Borehole Location: Refer to site plan		Hole sta Hole co	arted: mpleted:	26/0 26/0	3/2017 6/2017
				Drill method: 50m	m handauger		Drilled I	by: d by:	R.Da	ily
۹.	<b>ں</b>	÷	e				Unconce	Undraine	ed Shear S	Strength
epth (r	Sraphi	itrengt	loistur	Soil Descrip	tion	GEOLOGY & additional observations			(kPa)	
	Ŭ	0	2	Clavey SILT: Dark brown: Rootlets		TOPSOIL	0	40 8	0 120 1	60 200 240
0.0		_	•••				0.2 -			
0.2 0.3		F-St	W	Silty CLAY; Dark brown; some fine to medi	um gravel	ALLUVIUM	0.4		71	
0.4 0.5		St	Μ	Silty CLAY: Light greyish brown, light grey, trace rootlets	high plasticity		0.4		/ 1	
0.6							0.6		79	
0.7 0.8				trace orangish brown			0.8		♦ 84	
0.9 1.0		VSt	M	Clayey SILT: Light greyish brown, light grey	y, trace orange	4	1 +			◆- UTP
1.1				some fine to medium gravel	brown trace fine to coarse	-	1.2			◆ UTP
1.2		31	W	sand		soil saturated	1.4 -	•	67	
1.4 1.5			W	silty GRAVEL: Light greyish brown, fine an	gular gravel, loosely packed	-	1.0			
1.6				End of borehole at 1.6 metres			1.6			
1.7							1.8			
1.9 2.0							2			
2.1							2.2			
2.2							2.4			
2.4 2.5										
2.6							2.0			
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				Client: Woolston Family Trust	Project: Geotech Investigation	on	VCE Pr	oject No	:	13050	)	
		G ENGI	NEERS	Project Location: 107 Yorke Road, Haruru	Borehole Location: Refer to site plan		Hole st	arted:		26/06/	/2017	
				Drill method: 50mr	n handauger		Drilled	by:	-	R.Daly	y	
-		-	0				Checke	ed by:	nod Sh	D.Sim	monds	
epth (m	èraphic	trength	loisture	Soil Descrip	lion	GEOLOGY & additional observations		Unura	(kP	a)	uengu	1
ă	0	s	2	Clavey SILT: Dark brown with trace orange	trace fine gravel: rootlets	TOPSOIL	0	40	80 12	20 16	0 200	240
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0.2 0.3		St	М	Silty CLAY: Brownish orange; trace fine to	nedium gravel	ALLUVIUM	0.4					
0.4				orangish brown streaked grey			0.4 -		03			
0.6							0.6 -		◆ 70			
0.7 0.8			w	soil too wet to sample		soil too wet to sample	0.8 -		◆ 87			
0.9 1.0							1 -					
1.1			M/F	Gravelly SILT: brownish grey, fine subangu	lar gravel		1.2 -					
1.2			М	Fine to medium Silty GRAVEL: Grey with o	range streaks, subangular	-	1.4 -					
1.4 1.5			W				16					
1.6 1.7				End of borehole at 1.6 metres Groundwater encountered at 1.5m			1.0 -					
1.8							1.8 -					
1.9 2.0							2 -					
2.1 2.2							2.2 -					
2.3							2.4 -					
2.4 2.5							2.6 -					
2.6 2.7							2.0					
2.8							2.0 -					
3.0							3 -					
3.1 3.2							3.2 -					
3.3 3.4							3.4 -					
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3.6 3.7							3.8 -					
3.8 3.9							4					
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4.2							4.2 -					
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				Client: Woolston Family Trust	Project: Geotech Investigation	on	VCE P	roject No	o.:	13050		
		3 ENGI	NEERS	Project Location: 107 Yorke Road, Haruru	Borehole Location:		Hole s	started:	4.	26/06/	2017	
				Drill method: 50mr	n handauger		Drilled	d by:	J.	R.Daly	2017	
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pth (m	raphic	rength	oisture	Soil Descrip	tion	GEOLOGY & additional observations		Undra	iined S (k	near St Pa)	rengtn	
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0.0 0.1			М	CLAY: Dark brown with trace orange; some	fine/medium gravel. Rootlets	TOPSOIL	0.2					
0.2 0.3		St	М	Silty CLAY: Light brown; traces of fine/med	ium gravel	ALLUVIUM	0.2					
0.4							0.4 -		◆ 67			
0.5		St	М	Fine to medium gravelly CLAY: Light brown	with traces of orange		0.6 -		♦ 65			
0.7 0.8			W	Fine to medium silty GRAVEL: Light brown with fine to coarse sand, subangular grave	with traces of orange el, loosely packed		0.8 -					
0.9 1.0							1 -					
1.1				Orangish brown			1.2 -					
1.2 1.3							14 -					
1.4 1.5				End of borehole at 1.5 metres			- 1.6					
1.6 1.7				Groundwater not encountered			1.0 -					
1.8							1.8 -					
1.9 2.0							2 -					
2.1 2.2							2.2 -					
2.3							2.4 -					
2.4 2.5							2.6 -					
2.6 2.7							20					
2.8 2.9							2.0					
3.0							3 -					
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				Client: Woolston Family Trust	Project: Geotech Investigation	on	VCE PI	roject No.:	:	1305	0	
		G ENGIN	NEERS	Project Location: 107 Yorke Road, Haruru	Borehole Location: Refer to site plan		Hole st Hole co	tarted: ompleted:		26/06 26/06	6/2017 6/2017	
				Drill method: 50mm	handauger		Drilled	by: ed by:		R.Da D.Sir	ly nmonds	5
Jepth (m)	Graphic	Strength	Moisture	Soil Descripti	on	GEOLOGY & additional observations		Undrai	ned Sh (kP	ear S 'a)	streng	ith
0.0			М	Clayey SILT: Dark brown, some fine to medi	um gravel; rootlets	TOPSOIL	0	40	80 12	20 16	50 20	0 240
0.1 0.2							0.2 -		<b>♦</b> 84			
0.3 0.4		VSt	М	Silty CLAY: Dark brown with orange traces		ALLUVIUM	0.4			•	144	
0.5				brownish orange			0.6 -			•	144	
0.8			_		for more than the second se		0.8 -			118		
0.8 0.9			D	Cayey SILI: greyish brown with orange trac	e, nace nne gravel		1 +		63			
1.0 1.1			D M	fine to medium Gravelly SILT: greyish brown fine to coarse sand	, subangular, trace		1.2					
1.2 1.3							1.2	20				
1.4			W	Silty fine to medium GRAVEL: Brownish gre	1		1.4 -		<b>◆</b> 87			
1.5 1.6				Groundwater not encountered			1.6 -					
1.7 1.8							1.8 -		_			
1.9 2.0							2 -					
2.1							2.2 -					
2.2							2.4 -					
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5.9							6					





GROUND



<b>W</b> ISION	CONE PENET	RATION TEST (CPT) LOG		GROUND
E Cone Resistant	e - q <sub>t</sub> 1 - f <sub>s</sub>	Pore Pressure u <sub>2</sub> (dual scale) Friction Ratio - R Inclination - x,y		Soil Behaviour Type (SBT) Description
Deptt	-600 24 -700 28 -800 32 -900 36	- 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Assur Water   Depth 6 8	CPT classifications cannot be expected to provide accurate predictions of soil type based on grain size, but provide a guide to behaviour type.
				Clays: clay to silty clay
				Clays: clay to silty clay
				Silt mixtures: clayey silt & silty clay
Crient: Vision Consulting Engineers     Project: 107 Yorke Street	Cone Ref: MKJ208	WGS84, (deg): 174.055619,35.276156	Elevation (m): - Date of Test: 19/06/2017	
Location: Haruru Falls, Northland Engineer: Dan Simmonds	Cone Type:         Compression Plezocone           Area Ratio:         0.8	Location Method: Handheld GPS Surveyor: N/A	Depth (m): 24.83 Pre-Drill (m): N/A	Number: CP1-01
Contractor: Ground Investigation Ltd. www.g-i.co.nz	Filter Type: u2	Termination Reason: Limit of reaction force		G.I. Job Ref: 17-314



										CO	NE P	PENET	RA	ΓΙΟΙ	ΝТ	ES <sup>-</sup>	Г (С	PT)	LO	)G						GATION
(u)				- I	C	Cone F <mark>Sleev</mark>	Resistan e Frictic	nce - q <sub>t</sub> on - f <sub>s</sub>						P u;	ore Pre 2 (dual	essure scale)		Frict Incl	ion Ra linatio	atio - R <sub>f</sub> n - x,y	ned _evel	(L)	5	SBT I <sub>c</sub>	Soil Behaviou Descr	r Type (SBT) iption
Depth		- 100 4	- 200 8	- 300 12	- 400 16	MP kPa	<b>a</b> 200 <b>a</b>	21	24	- 700 28	- 800 32	- 900 36		- 0 0 - 500 50	<b>kP</b> 0001-	<b>a</b> -1500 150	-2000 200	-4 2	degree	-12 6 -16 8 -16 8	Assur Water I	Depth	7 5	τω α 	CPT classifications cann accurate predictions of size, but provide a gu	ot be expected to provide soil type based on grain ide to behaviour type.
22 - 22																						22 $-22$ $-23$ $-24$ $-24$ $-24$ $-25$ $-26$ $-27$ $-27$ $-28$ $-27$ $-28$ $-29$ $-29$			Silt mixtures: clayey silt Silt mixtures: clayey silt Sand mixtures: silty sar	& silty clay
(	Client: Vi	ision Coi	nsulting	Enginee	ers				Opera	tor: To	mas		N	NZTM20	000 N,I	E (m): (	6095820	.8, 1696	6004.0	)6	Elev	ation (	m): -	/ / _	Client Job Ref:	
Pr Loc Eng	roject: 10 ation: Ha ineer: Da	97 Yorke aruru Fa an Simm	e Street Ills, Nor 1onds	thland					Cone I Cone Ty Area Ra	кет: МК /pe: Со ntio: 0.8	J208 mpressio	n Piezocone	•	WC Locati	on Me Surv	(deg): ethod:   vevor:	174.0556 Handhel N/A	d GPS	5.2761	156	Da I Pre	ite of Te Depth (i e-Drill (i	est: 19/ m): 24. m): N/A	06/2017 83	CPT Number:	CPT-01
Contr	actor: G	round In	vestiga	tion Ltd.		www.	.g-i.co.n		Filter Ty	/pe: u2			Te	rminati	on Re	ason:	_imit of r	eaction	force		1	(1		•	G.I. Job Ref:	17-314
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E)					-	Cor <mark>Sle</mark>	ie Res eve F	sistance riction	- q <sub>t</sub> - f <sub>s</sub>					P	Pore P ₂ (dua	ressu al scal	re e)		Frict Incl	ion Ra inatio	atio - R <sub>f</sub> n - x,y	ned -evel	(L)	SBT I <sub>c</sub>	Soil Behavio Dese	our Type (SBT) cription
Depth		- 100 4	- 200 8	- 300 12		-400 16	MPa kPa	- 500 20	- 600 24	- 700 28	- 800 32	- 900 36		- 0 0	<sup>ne</sup> k	( <b>Pa</b>	-1500 150	002 0002-	-4 2	+ % degree	-12 8 -16 8 -16 8	Assur Water I	Depth	0 4 0 8	CPT classifications can accurate predictions c size, but provide a g	not be expected to provide of soil type based on grain quide to behaviour type.
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C	lient: Vi	ision C	onsultir	ng Engir	neers				Ор	erator: m	arcelo			NZTM2	000 N	N,E (m	): 6095	5857.5	54, 169	95990	.98	Elev	vation (	m): -	Client Job Ref:	
Pr Loc	oject: 10 ation: Ha	)7 Yor aruru ∣	ke Stree Falls, No	et orthland					Con Cone	<b>type:</b> Co	KJ333 ompressio	on Piezoco	one	W Locat	GS84 ion N	l, (deç /letho	i): 174. d: Hand	05547 dheld	'1,35 GPS	5.2758	326	Da	ite of Te Depth (	est: 19/06/2017 m): 23.64	CPT	CPT-02
Eng	i <b>neer:</b> Da	an Sin	monds						Area	Ratio: 0.8	8				Su	rveyo	r: N/A					Pr	e-Drill (	<b>m):</b> N/A		
Contra	actor: G	round	Investig	ation Lt	d.	ww	w.g-	.co.nz	Filter	<b>Type:</b> u2	2		Те	rminat	ion R	Reaso	n: Dang	ger of	buckli	ng roc	ls				G.I. Job Ref:	17-314
Rem	arks:																									



						CON	NE PEN	IETR	ATIO	ΝΤ	EST	CP	PT) L	OG						GATION	
(m)			C	one Resistan Sleeve Frictio	ce - q <sub>t</sub> n - f <sub>s</sub>					Pore Pres u₂ (dual s	ssure scale)		Friction Inclina	Ratio - R <sub>f</sub> tion - x,y	ned _evel	(E	SB1 Ic	Г	Soil Behaviou Descr	ır Type  (SBT) iption	
Depth	100 4	500 8	300 12 400 16	MPa <sup>ℵ</sup> kPa <sup>⊗</sup>	600 24	700 28	800 32 900 36		0 0	200 <b>kPa</b>	1500 150	2000 200	4 8 90 2 4 2	% 9 8 grees 21 9	Assur Water I	Depth	0 4 0	9 80 	CPT classifications cann accurate predictions of size, but provide a gu	ot be expected to provide soil type based on grain ide to behaviour type.	э
21 $22$ $-22$ $-23$ $-23$ $-24$													A A A A A A A A A A A A A A A A A A A			21			Silt mixtures: clayey silt Silt mixtures: clayey silt Sand mixtures: silty sar Sand mixtures: silty sar Silt mixtures: clayey silt Sand mixtures: silty sar Sand mixtures: clayey silt Silt mixtures: clayey silt	& silty clay  & silty clay  Ind to sandy silt  Ind to sandy silt  A silty clay Ind to sandy silt  A silty clay Ind to sandy silt  A silty clay  Ind Ind Ind Ind Ind Ind Ind Ind Ind In	
0	Client: Vision	Consulting Eng	gineers		Opera	ator: marc	celo		NZTM	2000 N,E	<b>(m)</b> : 6	095857.5	64, 16959	90.98	Eleva	ation (r	n): -		Client Job Ref:		_
Pr Loc Eng	r <b>oject:</b> 107 Yo <b>:ation:</b> Haruru <b>jineer:</b> Dan Sii	rke Street Falls, Northlai nmonds	nd		Cone Cone Ty Area Ra	Ref: MKJ: ype: Com atio: 0.8	333 pression Piezo	ocone	W Loca	/GS84, (/ tion Met Surve	deg): 1 <sup>°</sup> thod: H eyor: N	74.05547 andheld /A	'1,35.2 GPS	75826	Dat D Pre	e of Te Depth (r Drill (r	st: 19/06/ n): 23.64 n): N/A	/2017	CPT Number:	CPT-02	
Contr	actor: Ground	Investigation	Ltd. v	www.g-i.co.n	z Filter T	<b>ype:</b> u2			Termina	tion Rea	ason: D	anger of	buckling	rods					G.I. Job Ref:	17-314	
Ren	narks:				4																





E)	Normalised Cone Resistance, Q <sub>t</sub>	Norm. Friction Ratio, F <sub>r</sub> Pore Pressure Ratio, B <sub>a</sub>	SBT <sub>n</sub> Ic			Undra	ined Shea	r Strength	, S <sub>u</sub>			Re	elative D	ensity, <i>D</i> <sub>r</sub>		Friction	n Angle - (	Φ'	(E
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	Client: Vision Consulting Engineers	Soil Behav	viour Type (S	BTn) - Ro	obertso	n et al.	1990		Notes a	nd Limitat	tions:	been asse	ssed to pro	wide a basic	Client	t Job Re	əf:		
	Project: 107 Vorko Stroot	0 Undefined		5 \$	Sand mix	tures: silt	y sand to s	andy silt	interpre	tation in te	erms of Soil I and design p	Behaviour T	ype (SBT) using meth	and various ods published in F		·	. <u></u>		
		Sensitive fine-grained	d	6 8	Sands: cl	ean sand	s to silty sa	nds	K. Robe	ertson and technical	I K.L. Cabal Engineering,	(2010), Guid 4th Edition	de to Cone	Penetration Testi pretations are		PT	С	PT-0	1
Lo	cation: Haruru Falls, Northland	2 Clay - organic soil		7	Dense sa	and to gra	velly sand		reviewe	ed only as d by the u	s a guide for user. Ground	geotechnica d Investigation of any of the	ai use, and on Ltd doe:	snould be careful s not warrant the pical soil and day		inel:	-	1	
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Cont	tractor: Ground Investigation Ltd.	4 Silt mixtures: clayey	silt & silty clay	9 8	Stiff fine-	grained			technique this repo	ues and lin	mitations of a	any method	used to de	rive data shown ir	Tes	st Date:		19/06/20	17





E)		Nor	malis	ed Co	one F	Resis	tanc	e, Q <sub>t</sub>		Norn Pore	n. Fri Pres	ction sure F	Ratio, F, Ratio, B <sub>q</sub>	r	SBT <sub>n</sub>			Un	drain	ed She	ear Stre	ength,	Su				Rel	ative	Dens	ity, D	r		Fricti	ion A	ngle - (	Φ'	E)
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C	lient:	: Visi	ion C	onsu	ulting	Eng	inee	ers	1			S	oil Beha	avio	ur Type (S	BTn) - F	oberts	on et	al. 19	990		Notes and Limitations: Data shown on this report has been assessed to provide a basic Unterproteing in terms of Sell Pohaviour Tune (CPT) and various							Job	Ref:							
Dr	oiect	• 107	' Yor	(a \$t	troot					0	Uno	defined	ł			5	Sand m	ixtures	: silty s	sand to	sandy	Ity silt interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.															
	0,001.	. 107	101							1	Ser	nsitive	fine-grair	ned		6	Sands:	clean s	ands	to silty :	sands		K. Rob for Geo	ertson a otechnic	and K.L. ( cal Engine	Cabal (201 eering, 4th	0), Guide Edition.	to Co The ir	ne Pen nterpret	etration ations a	Testing re	CI	2 <b>7</b>		С	PT-(	01
Loca	ation:	: Har	uru F	alls,	Nor	thlar	ld			2	Cla	y - org	anic soil			7	Dense s	sand to	grave	elly sand	ł	presented only as a guide for geotechnical use, and should be carefully reviewed by the user. Ground Investigation Ltd does not warrant the															
Engi	ineer:	: Dar	n Sim	mon	ıds					3	Cla	ys: cla	y to silty	clay		8	Stiff sar	nd to cla	ayey s	and		correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the G.I. Job Ref: 17-314								14							
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(E)		Nor	malis	ed Co	one R	esista	ance	, <b>Q</b> <sub>t</sub>		Norm Pore	n. Fr Pres	iction ssure	Rat Rati	io, F <sub>r</sub> o, B <sub>q</sub>		SBT, Ic	1				U	ndrair	ned S	hear	Stren	gth, \$	Su				Rela	tive De	ensity	1, <b>D</b> r		F	Frictio	on An	gle -	Φ'	(E)
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P	rojec	<b>t:</b> 107	7 Yorl	ke St	reet					1	Se	nsitive	e fine	-graine	ed			6	s s	and m	clean	s. siity	to silt	v san	ds	٠	geotech K. Robe	hnical ertson	soil and desig and K.L. Cab	n parame al (2010)	ters usir Guide t	ig metho cone	ods put Penetra	olished i ation Te	in P. esting	СР	т		~	пт	04
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E)		Nor	malis	ed Co	one R	esist	ance	e, Q <sub>t</sub>		Norm Pore	n. Fri Pres	ction ssure	Ratio Ratio	o, F <sub>r</sub> o, B <sub>q</sub>		SBT <sub>n</sub>	1				Undr	ained	Shea	r Stre	ngth,	Su				Rel	lative	Dens	sity, D <sub>r</sub>			Frict	ion A	ngle - (	Φ'	E)
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VISIO	N			CPT ZE	ROS AND	DRIFT				
Client Ref: 17-31	4			10	07 Yorke Street				G.I. Ref: 17-3	14
			Tip Resistance			Local Friction			Pore Pressure	
Cone Reference	CPT Name	Initial (MPa)	Final (MPa)	Difference (%)	Initial (MPa)	Final (MPa)	Difference (%)	Initial (MPa)	Final (MPa)	Difference (%)
MKJ208	CPT-01	9.470	9.480	-0.02	0.132	0.132	-0.04	1.407	1.406	0.04
MKJ333	CPT-02	10.177	10.151	0.05	0.140	0.140	-0.02	0.960	0.960	0.02

Client: Vision Consulting Engineers	Location: Haruru Falls, Northland	NOTE: Percentage Zero Difference calculated following ASTM D5778-12. Green indicates a
Project: 107 Yorke Street	Engineer: Dan Simmonds	below -2% or over 2%

# Appendix C

Settlement Assessment Results





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CPT: CPT-01 Total depth: 24.83 m, Date: 7/07/2017 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00

Cone Type: Uknown

Cone Operator: Uknown

Project: 107 Yorke Street Location: Haruru

#### Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

\* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \boldsymbol{C}_a \cdot \Delta \boldsymbol{z} \cdot \log(t)$$

Footing type: Rectangular Footing width: 30.00 (m) L/B: 1.0 Footing pressure: 30.00 (kPa) Embedment depth: 0.00 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: Yes Calculate secondary settlements: Yes Time period for primary consolidation: 6 months Time period for second. settlements: 606 months



62 Kerikeri Road, Kerikeri

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CPT: CPT-02

Total depth: 23.64 m, Date: 7/07/2017 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Uknown Cone Operator: Uknown

Project: 107 Yorke Street Location: Haruru

#### Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

\* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \boldsymbol{C}_a \cdot \Delta \boldsymbol{z} \cdot \log(t)$$

Footing type: Rectangular Footing width: 30.00 (m) L/B: 1.0 Footing pressure: 30.00 (kPa) Embedment depth: 0.00 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: Yes Calculate secondary settlements: Yes Time period for primary consolidation: 6 months Time period for second. settlements: 606 months